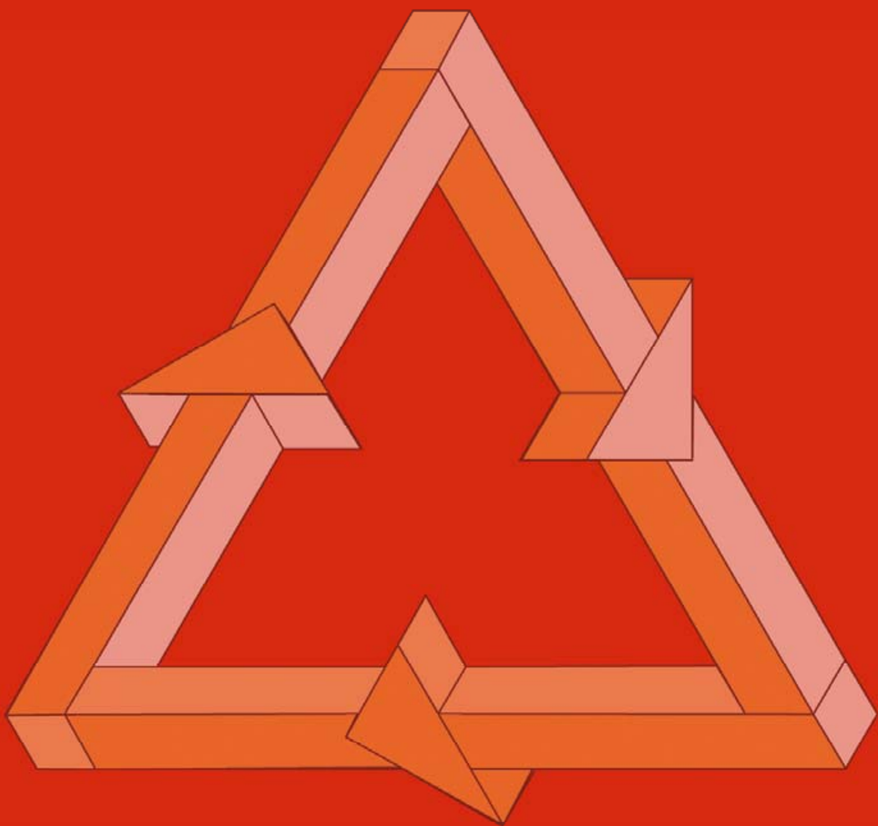
Reuse of Learning Objects in Context
Human and Technical Aspects



Allard Strijker

Reuse of Learning Objects in Context: Human and Technical Aspects

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REUSE OF LEARNING OBJECTS IN CONTEXT: HUMAN AND TECHNICAL ASPECTS

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door

Albertus Strijker

geboren op 21 Augustus 1971
te Hoogeveen

Het proefschrift is goedgekeurd door
Prof. dr. B.A. Collis, Promotor

Table of Contents

List of Tables

List of Figures

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Allard Strijker

Enschede, augustus 2004

1 The Learning Object in Context: Introduction to the Research

In the context of this research, learning objects are defined as digital entities, available for use or reuse in different learning settings. The objects themselves may or may not have been originally created as learning objects; it is their use for learning purposes that makes them learning objects. An entity may be as technically and conceptually simple as a single paragraph of text or a single image, or as complex as a pdf file of a book or manual, or a multimedia resource including embedded video, audio, and hypertext elements. In this chapter, the focuses of this research on learning objects are introduced (Section 1.1), followed by a review of the motivations for the research (Section 1.2). Section 1.3 turns to a first step in the analysis of learning objects themselves, with a consideration of six key points or aspects in their lifecycles. In Section 1.4 the lifecycle aspects are seen in the context of two main dimensions, one relating to technical considerations and the other to human factors. These two dimensions form the framework of the research. The dimensions map onto the research questions, given in Section 1.5. Section 1.6 describes the methodology used in the dissertation and the chapter closes with an overview of the structure of the dissertation (Section 1.7).

1.1 Focuses of the Research

The reuse of digital learning material has been an issue for more than two decades (Section 1.2 provides a review, see also Collis, 1995). In the 1980s a number of initiatives occurred with the aim of promoting the reuse of educational software outside of its original market. These initiatives came to little success for a number of reasons. One certainly was the technology of the time, with incompatibilities in operating systems and storage media forming major barriers. In addition, there were problems in awareness and access. Potential users had little opportunity to be aware of what was available or to see or try it out. Clearinghouses and databases of information about software products began to be established. The most substantial problems however were related to the local context and culture of the end users (Ely, 1989). The reusability of an electronic learning resource depends on its fit with the language, culture, curriculum, computer-use practices, and pedagogical approaches of the potential learners and their instructors. Making this fit has proven to be very difficult. For example, recently as 1998, Draper analysed the many digital learning materials emerging from the TLTP Initiative in higher education in the United Kingdom and found that most of the products produced did not get used beyond the niche for which they were first developed (Draper, 1998). In this section, solutions for reuse will be considered in terms of reuse situations (Section 1.1.1), technical focuses (Section 1.1.2), human-aspect focuses (Section 1.1.3), and focuses related to standards and metadata (Section 1.1.4). Section 1.1.5 concludes the section with a first statement of key propositions of the research.

1.1.1 Reuse situations[1]

The reusability problem can be addressed from a number of perspectives. Technology barriers and awareness barriers are less-severe problems than they were in the 1980s given

1 Portions of Sections 1.1.1 to 1.1.3 were originally published as Collis, B., & Strijker, A. (2003). Re-usable learning objects in context. International Journal on E-Learning, 2(4), 5-16.

the World Wide Web and Web technologies. However, fit with the language and situation of the local user remains an issue as does fit with the instructional practices of the instructor. Fit has to do with the size and scope of a digital learning object. The more-extensive the size and scope of the object, the more likely that some aspect of it will be inappropriate for the particular local learning situation. Solutions often relate to reducing the size and scope of a potentially reusable object--perhaps a whole course cannot be reused, but a module or some learning materials within it could be useful in a broader context? This relates to the granularity of the object. Another solution is to provide the instructor with tools to adapt objects to his or her own setting. However, there has been little success with bringing instructors too close to an actual authoring process: instructors do not have the time, interest, or skills (Moonen, 1989). Responses to this are on one hand, to increase the ease-of-use of tools for the instructor, and on the other hand, to remove the instructor from the process altogether. Reuse situations and the associated technologies related to granularity and the role of the instructor can be represented as shown in Table 1.

Table 1 Reuse situations and associated technologies, related to granularity and instructor dimensions. (From Collis & Strijker, 2003)

	Granularity: Small learning objects	Granularity: Course-level objects
No instructor	1. E-learning; Technologies: Learning management systems (LMS), learning content management systems (LCMS)	2. E-learning; Technologies: Portals to WBT (Web-based training) or CBT (computer-based training)
Instructor	3. Blended learning; Technologies: Course-Management Systems (CMS)	4. Collaborative projects among institutions; Technologies: Web or CD-ROM access to original courses

There is currently much attention in the business world focused on the re-use of learning objects (Chapman, 2003) Frequently this occurs in the context of the introduction of "e-learning" as an alternative to "classroom courses". E-learning is typically seen as being instructor-free or instructor-neutral, in order to capitalize on an "any time, anywhere" motivation and thus relates to Cells 1 and 2 in Table 1. Complex systems, called learning management systems (LMSs) and learning content management systems (LCMSs), are proliferating, generally based on the underlying assumption that the system itself will select and deliver the learning experience, based on some level of user modelling. LMSs are defined as systems "to manage learners, keeping track of their progress and performance across all types of learning activities" while LCMSs manage content or learning objects to "serve up to the right learner at the right time" (Chapman & Hall, 2001, p. 11). The metaphor underlying LCMSs is that of "beads on a string" (Stephenson, 2000); small learning objects can be chosen from many different origins and combined together to form a "necklace" appropriate to the individual. LCMSs typically include content-development tools to produce these "beads", intended generally for professional developers rather than a classroom instructor. "Content assembly" and "publish learning" into different "output formats" are key tasks of LCMSs (Chapman & Hall, p. 16).

The granularity of the objects can range from single-topic e-modules to entire courses. WBT, or Web-based training, is a term sometimes used when network delivery of courses is involved. However, courses can also be available via non-Web technology, disseminated via CD-ROM or local-area networks. In these cases, the more-traditional term CBT (computer-based training) is applicable. Portals (Cell 2 of Table 1) may be integrated with an underlying LMS or LCMS or may make use of their own object-management technology. Via a portal, a large number of services and selections are typically offered to user-clients (Barron, 2000). In universities, portals typically involve integration with student-administration systems and libraries as well as other services such as counselling. In companies, portals run as in-house intranets often linked to knowledge-management systems based on competency profiles. Access to entire courses via the portal can sometimes directly occur. The courses may be objects in a local database or the access may be via links to external systems. In both Cells 1 and 2 of Table 1, the use of standards-based metadata is critical, "…the linchpin that enables interoperability" (Singh, 2000).

Meanwhile at the same time as commercial LCMSs and LMSs are being taken up for "e-learning" in company training settings, the use of Web-based course-management systems, also called online educational delivery systems (see http://www.edutools.info/course/index.jsp) continues to grow in importance in universities particularly in support of instructor-led courses with or without a classroom component (Cell 3 of Table 1). Course-management systems (CMSs, not to be confused with content-management systems, also sometimes called CMSs) integrate content delivery, communication, learner activities, collaborative work support, feedback, testing, portfolio development, groupware tools, and administrative tools for the instructor. Selection and management of content objects is only part of the use of an online educational delivery system, and in some cases a minor or non-existent part.

Cell 4 from Table 1 situations occur when an instructor elects to make use of an entire set of electronic course materials produced elsewhere. The role of the instructor then may be organizing the local support and assessment practices to accompany the use of the externally produced course. In the school context, models based on this approach are beginning to emerge, based on the idea that speciality subjects may be beyond the range of local teachers but instead could be offered by expert teachers via the Web, but with the local teachers continuing to play an important role in terms of providing on-site motivation and monitoring (see http://www.fhs.net). In the company context, such a model usually involves outsourcing, where the local trainer may be involved in various ways with the delivery of the out-sourced course.

In all four of the cells of Table 1, the institution needs to make a substantial investment in the underlying technology and in sustaining the relationships needed for portal access to external courses or out-sourcing. Within Cell 3, however, there is an interesting opportunity for the instructor to make individual decisions about the use and re-use of individual learning objects, as resources within an institutionally supported CMS. The instructor can remain in control of the tailoring of his or her course to local conditions, and within this choose to reuse a learning object, as an example, as a supplement, or as a complement to other aspects of instruction. However, because this possibility exists does not mean that instructors are taking advantage of it. In The Netherlands, where all universities are supporting the use of course-management systems, a recent study has shown that few instructors integrate re-used objects within them, preferring to use the course environments supported by these systems primarily for dissemination of information about courses (Lubberman & Klein, 2001). Clearly technology and human aspects are intermingled when learning objects and their use and reuse are the focus. Differences in organisational settings are also key in this reuse process. For this reason the research focuses on three different types of organisations and reuse processes. The three different types of organisations, corporate, military and university, are compared to each other. The three contexts can be compared because the architecture shown in Figure 1 can be applied to the three different organisations. Figure 1 shows the architecture that is researched in this dissertation. This architecture will be introduced in Chapter 4 and further developed in the three contexts that occur in Chapters 5, 6, and 7.

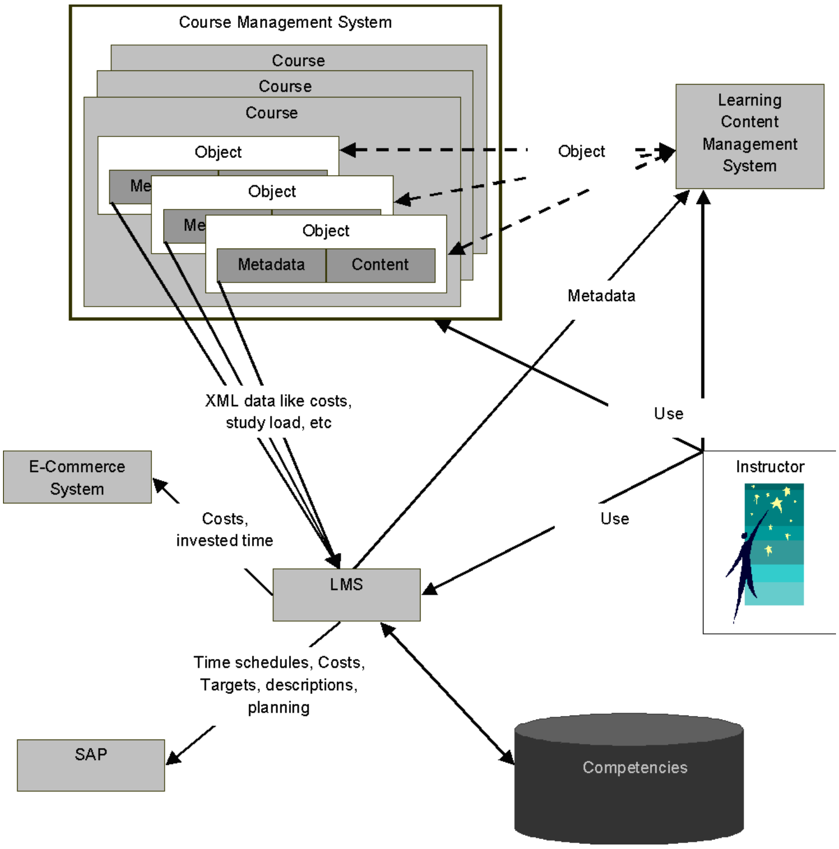

Figure 1 Integrated architecture

1.1.2 Technology focuses

The technology involving learning objects can be considered at four levels: the technology of the objects themselves, including the reference model used for labelling, or metatagging, of the object; technology related to the repository in which the objects are collected, including database technology and/or learning content management technology (Chapman & Hall, 2001); technology for services related to the use of the repositories, such as search, browse, preview, and download tools; and technology to support the sharing or interoperability of learning objects between systems and repositories. All of these focuses are discussed in more detail in Chapter 2. All of these technology components are increasing in complexity due to the continued integration of systems on the market, for example the now-familiar course management systems with systems such as learning management systems (LMSs) and LCMSs (Chapman, 2003).

1.1.3 Human focuses

As complex as the technical focuses of the research are, human factors involved with the use and re-use of learning objects are even less easy to deal with than technical issues. One major barrier has been the instructor's perception that material created elsewhere does not fit well enough with the situation in his own instructional setting (Collis & Pals, 2000). While this human factor directly relates to Cells 3 and 4 of Table 1, it also indirectly affects Cells 1 and 2; the learning objects made available must be seen by the learner and those responsible for the quality control of learning as appropriate to the particular organisational context. It has also been shown that some discipline settings are more successful than others in terms of reusability; factors to do with the subject area and instructional approach and the instructional style of the instructor are among the major variables that can make a difference in reuse potential (Collis, 1995). Hershfield, as early as 1987, identified the impact of culture on the use of learning objects. This impact is still the subject of research (Marcus & Gould, 2001; Ogunbase, 2003; Seufert, 2002). A way to deal with the lack-of-fit problem is to reduce the granularity of the potential reuse object, and also to make it instructionally neutral, so that the instructor can embed it as he likes in his own learning setting (Schatz, 2000). Such issues relate to pedagogy, which will be one of the human focuses in this research and further described in Chapter 2. ADL SCORM™

There are other human aspects that influence the (re)usability of learning objects: Not only must they be available and findable, but in situations relating to Cell 3 and Cell 4 of Table 1 the instructor must be motivated to look for them, supported in making decisions about how to not only find them but more importantly integrate them into the rest of his course and instructional planning, and then must have easy-to-use tools that help him make this integration. Instructors will vary in terms of how much support and guidance they will need. Based on their own levels of experience and also on key pedagogical dimensions relating to their courses, different forms of support and guidance will be needed. Appropriate tools will need to be available to the instructor to allow him to do this embedding and tailoring with as low a threshold as possible in terms of his time and effort investments. If the instructor does not perceive the return for his time and effort investment investments, he will not bother. If an instructor is not involved (Cells 1 and 2 of Table 1), someone--the learner himself or a training manager--must be motivated to turn to the learning objects and make use of them. These likelihood-of-use issues are human factors and involve the integration of many different issues relating to the person or persons making a choice about using electronic learning objects or not.

A conceptual model to express this integration is the 4-E Model (Collis & Pals, 2000; Collis, Peters, & Pals, 2001; Collis & Moonen, 2001). This model predicts the likelihood of an individual's use of a technical innovation in his instructional practice as the interaction among four sets of variables: Educational effectiveness, Ease of Use, Personal Engagement, and Environment Conditions. In the 4-E Model, vectors represent the first three of these sets of variables whose sum has a certain height. The Environment vector in turn has the function of determining the height of a "likelihood of use" threshold. According to the 4-E Model, if the vector sum of Effectiveness, Ease of Use, and Engagement reaches the level of the threshold determined by the Environment vector, then uptake of the innovation is likely to occur. If the sum is not high enough, then voluntary use is not likely to occur. Figure 2 shows the 4-E Model with two different environment vectors. In the first case, uptake is likely to occur, in the second case, not. It is a basic premise of this research that the (re)use of learning objects should not to be assumed as automatic if technical issues such as standards and metadata aspects are solved. The decision maker, designer, instructor or learner needs to feel that the balance the many factors involved must be "positive enough" to justify the efforts.

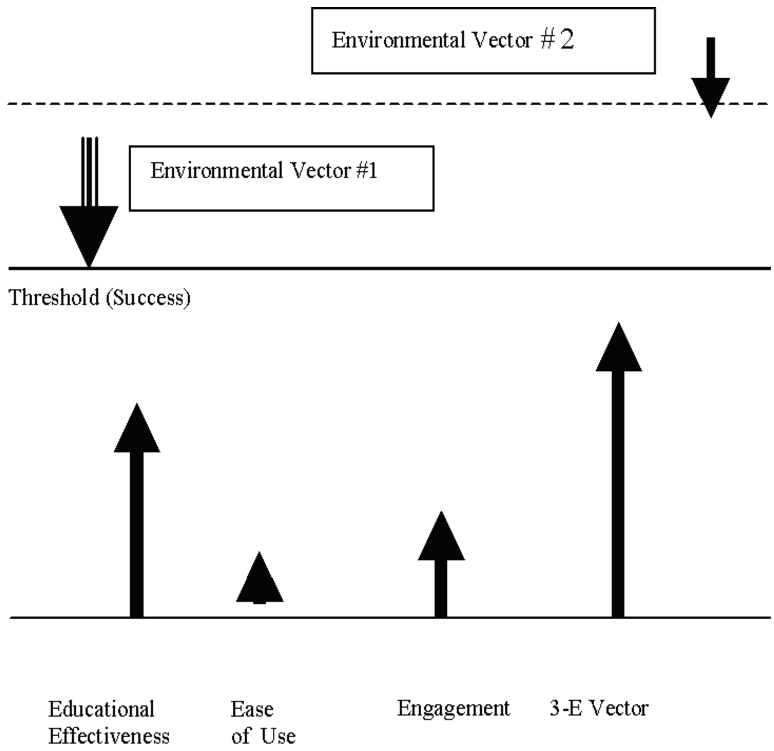

Figure 2 The 4E-Model, indicating factors that influence the uptake of a technical innovation in a learning setting (Collis & Moonen, 2001)

In Figure 2, two different threshold lines are shown. The one lower to the baseline represents a context where use of learning objects is positively supported; the individual does not need as strong a combination of the more-personal Es--effectiveness, ease of use, and engagement--to reach the likelihood of use level as is the case for the higher threshold line, representing a less-favourable organisational context. In this research, the differences in three major contexts for use of learning objects--universities, corporate-learning contexts, and military training--will be a major focus.

Within the life cycle of learning objects (see Section 1.3) human and technical focuses are intertwined. In this dissertation, they will be introduced separately, in Chapters 2 and 3 respectively, but in the contexts in Chapters 5, 6, and 7, they will be shown to be interacting. As an example of their close relation, Table 2 shows an analysis of the user requirements and technological requirements needed to support a scenario of learning where the learner or his mentor can pick and choose from a variety of learning objects and opportunities.

Table 2 Relationships and user requirements, tools and functionalities for a future university scenario involving user choice in the selection of learning objects (Collis & Moonen, 2001, p. 209; Collis & Strijker, 2001-2002, pp. 154-155)

User actions and requirements	Technology requirements
Access & privileges: A professional community shares access to a common database or interconnected distributed databases and evolves a procedure for certain categories of resources into the database for communal use.	Privileges for distributed users, allowing differentiated read and write access
Entry & labeling of objects: When entering a resource into the shared database, a simple to use check-list process allows the addition of metadata tags to the resource. The least number of tags for use in practice is the goal as instructors will not take the time to make more than a few key indications.	Granularity will be expressed in terms of what can be entered as a single file or linked to from a single-view overview. Tools for users to easily add or adapt metadata tags and add new ones if necessary must be available. Views of the objects in the database selected around any given set of tags or other key categories can be called up in which the associated objects can be listed in terms of frequency of access. Rules can move objects to an archival status after a designated period of non-access.
Instructor support: To create a course environment, tools are present in the system leading the instructor through the steps in setting up a course environment, in terms of general organisational features, communication features, a device such as a CMS roster which presents an integrated overview of study materials and activity instructions and support, groupware features, resource-management features, and special features such as quiz tools.	The course-management system should be integrated with an instructor-support tool to lead the instructor through options associated with the organisation of his course. The tool should directly generate a new course environment associated with the underlying database.
Re-use tools: The instructor should be able to sort and choose from resources from the associated database (the general database and other databases created in relation to this) and copy whatever resources (s)he wishes to the new site and also move the objects from a completed version of the course that (s)he wants to re-use in other settings back to the main database.	A sort and copy tool relating to all databases to which the user has access is needed to facilitate the copying of resources. Copying allows new privileges to be assigned to the resources, privileges that may be different in different data bases.
Learner-contribution tools: Learners studying with the new course environment not only use the selected resources provided by the instructor (both from other courses or from non-course related sources) but also enter new resources into the course database. The instructor can indicate with a simple click which of these learner-contributed resources are candidates for re-use and thus transfer them to the master database or to a new copy of the course database adapted for a different learner population.	The system must handle student submissions as ordinary objects, and should provide a tool for the instructor to easily designate which student submissions should be copied for possible re-use.
View options: Different views of the database can identify different categories of objects, different patterns and dates of access, and different authors, among other possibilities. Members of the community can also attach comments and rating codes to objects.	The system should allow user-tailored views and the adding of notes or additional codes to objects. Tools such as concept-mapping tools can show different clusters and categories.
Ownership: The knowledge community itself decides on procedures for maintenance of the database, for updating categories, and assigning read and write privileges.	Tools in the shared workspace should support these activities.

This sort of integration will be illustrated in the project descriptions in Chapters 5, 6, and 7 and discussed further in Chapter 9.

1.1.4 Metadata focuses

In terms of the learning objects themselves, there are a number of links between technical and human factors. The originator of the object must have a way to make the object available to others. It must be described in such a way that others can find it and this description (called metadata) has to be available to potential users as well as linked to the object itself. In turn, there must be a mechanism to assign the metadata. Metadata use requires decisions about standards and standardization. For reuse beyond the local setting, standards for these descriptions are increasingly being seen as critical in order to facilitate an economy of scale for reuse (Schatz, 2000). There is not yet an international consensus on which set of standards to use, although it is an area of intense research, debate, and commercial interest (Singh, 2000). Standards, particularly the ADL SCORM™ standard, and metadata based on that standard are another major focus of this research. They involve both technical and human factors, but will be introduced from a technical perspective in Chapter 3.

1.1.5 The focuses combined in the research

Through the combination of technological and human considerations, a number of the barriers limiting the potential reuse of digital resources can be addressed, particularly those that relate to fit with the local context. The research positions a study of metadata requirements and standards within a broader context. This broader context relates to the situation in which potential learning-object use occurs. One of the focuses of the research will be the identification of key factors whose variation leads to a set of different generic re-use situations related to the type of organisational setting. It is proposed that different generic re-use situations will yield different requirements for metadata and standards as will reuse strategies to support reuse. Validating this proposition will be one of the key tasks of the research.

A second proposition of the research is that those responsible for course development and other stages in the lifecycle of learning objects (see Section 1.3) within a re-use setting will benefit from support tools that guide and stimulate their decision processes when considering the use of pre-existing units of learning material in their own course settings and also that serve as templates to facilitate the embedding of re-used objects within a larger Web-based course environment. Thus another focus of this research will be to evolve support tools and templates for each user context and test them in practice. A series of projects over three years provide the validation setting for both the re-use scenarios and a set of features for each re-use situation. These features will include key factors that will influence re-use in the setting, user and task modeling of different groups involved with learning objects within the setting, requirements for metadata and standards for the setting, and support tools to stimulate and facilitate re-use within the setting.

1.2 Motivations for the Research

The focuses identified in Section 1.1 have been important for a number of decades although they are receiving new impulses due to several lines of current developments. Section 1.2.1 reviews these focuses over time in the field of educational software portability as a forerunner to current focuses on digital learning objects, Section 1.2.2 indicates some of the current motivations for the research, and Section 1.2.3 reviews lines of research concerning these focuses in the research group and contexts in which the current project has taken place.

1.2.1 Motivations over time[2]

The reuse of electronic learning material has been a goal and a problem for more than two decades in the educational sector (Bork, 1976; Ely, 1989). Reasons that reuse is seen as desirable are educational, economic, and social (Collis & De Diana, 1990). From an educational perspective, the desire to disseminate useful digital materials beyond their developers is partly to do with the difficulty of producing such materials from both technical and conceptual perspectives. Once something of quality has been achieved there is a desire on the parts of both the developer and potential users to see the product dispersed. Economic motivations have also stimulated many large-scale initiatives for digital learning materials reuse (for a review, see Collis, 1995). Those who fund the development of such materials naturally look for a return on investment, which means use outside of the development context. Finally, social motivations have stimulated many initiatives for digital learning material reuse, especially in the 1980s between those who had the resources and those in developing countries who feared being excluded from important new developments (Griffiths, Heppell, Millwood, & Mladenova, 1994).

Although reuse is valuable, it has also been long established that reuse most often does not occur to any meaningful extent. For example as noted in Section 1.1 as recently as 1998, Draper analysed the many digital learning materials emerging from the TLTP Initiative in higher education in the UK and found that most of the products produced did not get used beyond the niche for which they were produced.

Historically, there have been many analyses of factors that influence educational-software reusability. These factors include (Collis, 1995; Collis & De Diana, 1990):

Technical factors: mechanisms for human-computer interactions, program architecture, authoring tools and environments, operating system factors, hardware characteristics, network and interconnectivity aspects

Educational factors: Educational need and relevance, curriculum fit, instructional approach, tone and style of educational interactions, classroom context in which the software will be used, teacher-related considerations

Social/cultural factors: Language for interaction with the software, tone and style of communication, issues related to cultural identity, political sensitivities, cultural perception of the roles of teacher and student, local references and assumptions

Organisational issues: Institutional decision-making procedures, copyright and ownership, cost-related issues, marketing and distribution issues, maintenance, and management of the development and distribution processes (Collis, 1995, pp. 80-81).

Some of the factors that were most critical in the 1980s and early 1990s are much less of a problem in the early 2000s. These are factors that relate to hardware and operating system incompatibilities and the ability to find out about materials that could be appropriate to one's own setting. The rapid development of the World Wide Web and of search engines for the Web have much reduced the first of these problem areas and made a major step forward with respect to the second. However, the third area of transferability remains a particular problem

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[2] Section 1.2.1 is taken from Collis, B., & Strijker, A. (2001b). *Generic re-usability situations for Web-supported learning: Metadata requirements and user-support tools.* Internal research proposal, Faculty of Educational Science and Technology, University of Twente, Enschede, NL.

(Seufert, 2002). An important issue for developers of computer-based learning materials is the one of transferability to other locations beyond the setting in which the initial material was developed. Much discussion goes on about this problem, informally and in the literature, but much of this discussion appears to be based on very simplistic solutions which do not examine the full range of problems associated with transferability. This was noted by Bork nearly three decades ago (1976, p.1) and appears to still be the case, as will be seen in the literature reviewed for this research in Chapters 2 and 3.

1.2.2 Current impulses

There are many current impulses for a study of learning objects. Several are introduced in this section.

A new role has been identified in the educational software (and learning object) market: the broker of learning material. The role of LCMS developers is closely related to this sort of brokerage initiatives because the brokers depend on the tools developed for interoperability and exchangeability.

Different initiatives have started to make it possible to provide LCMS tools or trading places to share and exchange learning materials. Within the Netherlands the Digital University [Digitale Universiteit] and Kennisnet are initiatives involved in the development and exchange of digital content. The Digital University is a consortium of ten higher-education institutions in The Netherlands. It focuses on the development and application of digital educational products and knowledge for higher education (Digitale Universiteit, 2002). The consortium involves six technical colleges (hogescholen) and four universities. The projects of the Digital University can be divided in five programs:

- Digital testing, assessments and digital portfolio
- Digital educational tools: tasks and resources
- Learning and coaching from a distance: dual, virtual and international
- Building up and disseminating expertise
- Electronic learning environments (standardization and interoperability)

The sharing of learning objects is particularly important in the last program but has a role in the others (Digitale Universiteit, 2002).

“Kennisnet” is a project for primary and secondary schools and contains besides the exchange of learning material a platform to make this possible as well as support for network facilities and funding for purchase of personal computers.

The wide implementation of course management systems (CMS) makes it possible for many users to create resources that can be shared through networks (Hall, 2001). These involve the use of intranets on a limited scale, extranets on a larger scale and the Internet on a very large scale. Creating resources is mostly the second step of integrating the use of computers in education. The resources become more and more available through the Web because the accessibility of the Web is larger, bandwidth is larger, and the tools are becoming easier and more dedicated for the Web. Tools used like Word, PowerPoint, Flash, Macromedia, all have functionalities built in to produce Web content in a very easy manner. If a course management system is provided for publishing the content and bringing it to the students many resources can become available. An example of an country-wide implementation is the Kennisnet in Dutch vocational education which has resulted in the situation that most teachers are somehow involved in using learning objects. Using the Web within the actual higher education setting is more and more becoming the actual manner of providing resources for courses. Strong search engines like Google give the ability to search for useful material stored on the Web. The results that these search engine show depend on the keywords specified and the content of the relevant pages. Also the popularity of pages and keywords used are used in the algorithms for searching.

The choice of the different CMSs that are offered to manage, create and publish learning material is difficult. The difference between the systems is difficult to determine although several studies try to give in-depth information about the possibilities of the available systems. The WCET Edusort online initiative (http://www.edutools.info/course/index.jsp) and the "teleleerplatforms" analyses of Droste (1999, 2000) give summaries of the existing systems based on functionalities and types of use and indicate the surge of interest and use that is occurring for learning objects as elements within a CMS.

Finally, different international initiatives like IMS, Dublin Core, ADL, IEEE and Ariadne are all focusing on the reusability and exchangeability of learning material between the different systems. Interoperability and describing content with metadata is key in these initiatives. They will be discussed in Chapter 3.

1.2.3 Motivations within the research team and research contexts

The research took place within four different settings, each of which had its own motivations, which are discussed in Sections 1.2.3.1- 1.2.3.4.

1.2.3.1 TO

The former Faculty Toegepaste Onderwijskunde (TO, Educational Science and Technology) was for most of the time of the research one of the ten faculties of the University of Twente. One of the main focuses of the faculty was research about new learning technologies and their integration in the curriculum to make education more flexible and adaptive. The faculty was divided in five departments; (a) Instrumentation technologies, focusing on educational support in terms of software and computers; (b) Curriculum technologies, emphasizing on educational programmes and related issues including management implications; (c) Organisation and Management; (d) Instruction technologies, creating support for task-based instruction, and (e) Methodology, working on the process of data gathering and statistical analysis. In 1997 the TeleTOP® project was initiated that stands for Telelearning Toegepaste Onderwijskunde Project. The project was initiated because different departments requested the development of computer-supported environments using the Internet. The requests were based on past experiences because the faculty was one of the early adapters of course management systems. The requests for the different projects were combined to one faculty-wide project. The project focused also on the decreasing number of students and was intended to be a support system for a growing target group, the part-time students. Part-time students could use the course management system to do assignments and get course information at a distance. After a reorganisation in 2003 the Faculty TO merged into the Faculty of Behavioural Science and Educational Science and Technology became one of three educational programs, together with Psychology and Applied Communication Sciences (Toegepaste Communicatie Wetenschappen). The program Toegepaste Onderwijskunde changed in 2003 its name to Educational Design, Media and Management (EDMM). Within the dissertation the former name Toegepaste Onderwijskunde (TO) and its English equivalent Faculty of Educational Science and Technology will be used to place the organisational context in the perspective that was correct when the studies were being carried out.

1.2.3.2 Department ISM

The (former) Department of Instrumentation Technology (ISM)[3] of the (former) Faculty of Educational Science and Technology (TO)[4] at the University of Twente has a strong basis for carrying out the research described in this dissertation. Since the 1980s researchers in the department have been involved in a series of research and practical projects involving the reuse of electronic learning materials in settings outside those in which they were created (for example, Collis, 1995; Collis & De Diana, 1990; Moonen, 1989; Stanchev, 1990). A multi-part research project focused on this topic was carried out in the department between 1989-1995, which resulted in two dissertations (Zhu, 1996, and Zhang, 1996) in partnership with the East China Normal University in Shanghai as well as a series of other associated studies (for example, Collis, Zhang, Stanchev, & Dong, 1994). From all of this research several major points were consistent findings: There are first-level problems that affect reusability (usually to do with technology access and costs) which present a barrier that must be crossed, but after this, a series of second-level problems are more difficult to overcome (Collis, 1995). These second-level problems include the personal, instructional, and institutional factors that have a major influence on an instructor's decision making about the use of any technology-related innovation.

Research into these generic problems that limit use in practice has also been a long-standing focus in the department, resulting in the 4-E Model (Collis & De Vries, 1994; Collis & Pals, 2000; Collis & Moonen, 2001; Collis, Peters, & Pals, 2001; Moonen & Kommers, 1995). These lines of research fed directly into research in terms of identifying the complexity of the re-use context: re-use will depend ultimately on many more features than those involved with standards and metadata and conversely, metadata and standards requirements will be influenced by the re-use context.

There is another line of research in the department that is also directly relevant to the research. This is the line, since 1997, investigating features that influence the adoption and use in practice of Web-based course-management systems (De Boer, 2004; Gervedink Nijhuis, 2004; Tielemans & Collis, 1999; Van der Veen, De Boer, & Collis, 2000). This line of research accompanied the development of the TeleTOP® system, now in use throughout the University of Twente as well as in other institutions (see Chapters 4, 5, 6, and 7). Within the framework of research related to TeleTOP®, one line of focus has been on decision support tools (De Boer, 2004; Collis & De Boer, 1999), yielding several tools that are integrated into the TeleTOP® system itself and assist the instructor to make personal decisions about the learning environment he sets up for his learners. Other lines of research relate to the design of new templates for the TeleTOP® system, including those oriented toward reuse (Collis & Strijker, 2001a, 2001-2002; Strijker, 2000a, b; 2001).

In addition to use and re-use focuses, another line of research in the Department ISM that influences this research is the methodological line. In the Department there has been much attention given to appropriate methodologies for design and research with innovative technologies. This research involves design. The 3-Space Design strategy (Moonen, 2000, 2002) emphasizes the relation between structured and associative design. Structured design is what is frequently involved in the design of technologies for learning objects, while associate design is what is frequently involved in dealing with human factors. The 3-Space Design

[3] Now the department of Psychomomics and Human Performance Technology (PHPT)

[4] Now the Faculty of Behavioural Sciences.

Strategy describes in a global way how design and development activities unfold in practice, emphasizing three kinds of activities or activity spaces, each to be executed in a different phase of a project: (a) a Consensus Space focused on negotiating temporary agreements, (b) a Task Space focused on prototyping, and (c) an Implementation Space focused on end-user tailoring. Within each space the activities combine structured and associative design approaches. Figure 3 visualizes the 3-Space Design Strategy, which is also used in this research.

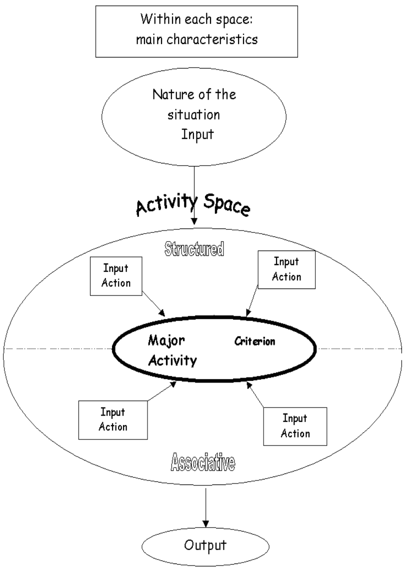


Figure 3 The 3-Space Design Strategy, integrating structural and associative aspects of design (Moonen, 2000, 2002)

The research did not only take place in the Department ISM, but also in the three contexts of the projects that will be reported in Chapters 5, 6, and 7. Each of these contexts had its own motivations for supporting the research. One context was that of military training (Section 1.2.3.4, TNO); one of a university context, the Faculty of Educational Science and Technology (Section 1.2.3.1, TO); and one of the corporate-learning context, Shell EP Learning Centre (Section 1.2.3.3).

1.2.3.3 Shell EP Learning Centre

Shell Exploration and Production (EP) is one of the five core businesses of The Royal Dutch/Shell Group of Companies and focuses on finding and producing oil and gas. In an effort to continually improve performance among its staff of approximately 30,000, Shell EP has to ensure that these employees acquire, share, and use new skills and knowledge. To champion this effort, the Shell Open University (SOU) was established in December 2000 to deliver world-class learning products to its employees, located in over 45 countries, through the use of technologies. These learning products are designed and delivered by the Shell (EP) Learning Centre (SLC). The Shell EP Learning Centre (SLC) uses the new learning technologies to incorporate a new way of knowledge dissemination and of restructuring education and learning around a competence framework.

In 2001, a research partnership between the University of Twente and the Shell EP Learning Centre was formed, leading to the establishment of a Shell Chair of Networked Learning at the university, the appointment of prof. dr. B. Collis as chair holder, and the support of three associated PhD research projects. The aims of the collaborative project (2001-2006) involving the University of Twente and the Shell EP Learning Centre are to develop, share, and apply state-of-the-art knowledge and experience relating to new forms of learning in the organisation and how these new forms are supported by technology. On-going research is also occurring to monitor and benchmark the impact of the new approaches on the business. One of the three PhD research projects is the basis for this dissertation.

Learning objects have a number of roles in the approach to blended learning now in place at the SLC. Potential learning objects can be acquired via contracts with software developers (these objects are called e-modules) but they also can be acquired via exchange and sharing of digitized resources that are entered by designers, course facilitators, and course participants into the database of the TeleTOP® system used as the CMS (course management system) for SLC "blended learning" courses (Bianco, Collis, Cooke, & Margaryan, 2002). Furthermore, learning objects can be objects originating in the various knowledge-management systems serving Shell EP. Choosing a common standard for sharing learning objects is of particular importance. The project descriptions in Chapter 6 will focus on the Shell EP Learning Centre as a corporate-learning context for learning objects. In 2003 the group working in the Shell EP Learning Centre was reorganized and renamed to Shell EP Learning and Development. An important part of the reorganisation was the bringing together of the knowledge and learning and development groups.

1.2.3.4 TNO

TNO Physics and Electronics Laboratory (TNO-FEL) is one of the institutes of the Netherlands Organisation for Applied Scientific Research (TNO). TNO participates in (international) defense research and has a long tradition of developing and applying new techniques for defense purposes as well for civil research programmes. TNO served as project leader in many research projects related to the Royal Air Force and Royal Army. Research of TNO-FEL is concentrated in four divisions: (a) Operations Research and Business Management, (b) Command & Control and Simulation, (c) Smart Sensor Solutions and (d) Observation Systems. Within Command & Control and Simulation division the research group Training and Instruction focuses on the application of information technologies in training, Kuiper for example, in 1995 researched the development of authoring systems. The authoring system was developed for trainers to design different, tailored, training materials for people in the Royal Army learning about a new anti-aircraft tank weapon system using a life-size simulator. The tanks needed three types of people within: a commander, a gunner, and a driver. For the army research related to ADL SCORM™ was enforced based on the fact that US defence is working hard on this E-learning specification. The Dutch army tries to follow the specification to cooperate in the future with other countries and make exchange of learning material possible, for example the exchange of Course Based Training (CBT) related to aircrafts that are also used in Norway. The development of CBT is expensive. Exchange and sharing this kind of material can lead to cost reduction and a more efficient approach of creating content. In Chapter 7 a more extensive overview will be given about the military as an organisation and its reuse context for reusing objects

1.2.4 Current challenges

From the historic and current settings for the research, a number of questions and challenges can be identified which can form the background for the research questions of this study. The use of learning objects can relate to questions about what is reused, also pointing to granularity and aggregation level: How material is reused, focusing on copying, linking, combining and editing material. There are also questions for different actors that are involved regarding to who is reusing what. Where material is reused deals with issues of exchanging material between people, organisations, and systems but also differences in learning scenarios. The lifecycle of content development determines when material is ready for reuse. The questions all can be considered from a more-structured and a more-associative perspective. Table 3 shows how common questions relating to learning objects can be seen from their structured and associative aspects using them as perspectives (Moonen, 2000, 2002).

Table 3 Common questions relating to learning objects, from associative and structured perspectives

Perspective	Perspective question	Description
Associative	Why?	What is the reason for reuse? Why should humans invest time and effort during the different stages of the learning-object lifecycle?
	Who?	Who are involved in the reuse process? What roles can be identified in the different stages of a learning-object lifecycle?
Structured	What?	What material is reused? What is the granularity and type of the reused material?
	How?	How the material is actual reused in terms of tools? What kind of technical support is possible and in place in the different stages of the learning-object lifecycle?
	Where?	Where takes reuse place in terms of systems? What systems are available to support reuse and what services are offered by the systems during the different stages of the learning-object lifecycle?

Each of these and other common questions, from the two perspectives, will arise in different ways in the projects. All of these sorts of common questions deal with learning objects at various moments in the lifecycle of the objects.

1.3 The Lifecycle of Learning Objects

A learning object can be seen as going through six distinct stages in its particular lifecycle. For each of these stages, the Why What? How? Who? Where? questions from the two perspectives indicated in Table 3 can be asked. In Sections 1.3.1 - 1.3.6 the stages in the lifecycle of a learning object will be introduced. These stages will reappear as organizers throughout the research.

1.3.1 Obtaining

Obtaining learning objects can be done by different methods. Individuals like teachers or groups can develop learning objects. These development teams can contain subject-matter experts, multimedia specialists, graphical designers, educational designers and writers. The size of the groups and the development path require different approaches for development. Therefore LCMS systems offer workflow facilities to control and guide the development of material. These workflows are based on the development of learning material used by publishers including reviews and several development stages.

1.3.2 Labelling

When the learning objects are created, they can be described or labelled. Labelling can be seen as adding metadata. Material can be described on several levels for different purposes. The most important reason to label material is to retrieve it; the more logically material is labelled, the greater the chance that the material can be retrieved. It can be done for individuals like teachers who want to find their own material after they have created it. Giving a Word document a logical name and storing it in a folder structure is a simple example. The name is the description of the document, putting it on the hard drive in a certain folder can be seen as cataloguing or putting material in a taxonomy. Using this sort of personal labelling strategy makes it difficult for a larger user group to find material. Using a structured set of metadata makes it possible to exchange material easily among a larger user group but also for systems that can interpret a structured set of data.

1.3.3 Offering

LCMS vendors sell their products with the idea that a large set of learning objects is available. They can only be offered if someone has created them. The LCMSs try to offer a set of learning objects to be used for different goals. The goals depend on the needs of the course developers. How the material is offered should fit the search strategy of the course developer. The material can be offered based on different conditions. It can be used freely or with the idea of sharing material. A more-commercial model is based on paying for useful learning objects.

1.3.4 Selecting

The selection of the learning objects is closely related to the to-be created course material. The selected material should fit the needs of the course developer. The needs can consist of the course learning objectives, the type of course created, the instructional model used by the course developer, the subject of the course, and the level of knowledge to be presented. The offered material can only be selected if it labelled according to these needs.

1.3.5 Using

When a learning object actually is selected, it can be used in the course. If the material fulfils the exact need of the course developer, it can be used as it is. The material can also be a close fit. The course developer can choose to use the material as it is or change the material to fulfil the needs in the course. This is only possible if the learning object is editable and if the conditions under which the material is offered give this opportunity.

1.3.6 Retaining

After a learning object is used, the choice can be made to reuse the object in the future as it is, to revise the existing object, or to remove the object from the repositories because it is for example outdated. The owner of the object should make this decision carefully because it also means that the material should be maintained

1.4 Research Framework: Relating Lifecycle Stages to Technical and Human Perspectives

The lifecycle stages described in Section 1.3 can be represented as shown in Figure 4 as a simple horizontal row:

Obtaining	Labelling	Offering	Selecting	Using	Retaining

Figure 4 Stages in the lifecycle of a learning object

These can be integrated into a framework with two dimensions, one relating to the human perspective and technical perspective and the other to the lifecycle stages. The Why? and Who? questions refer to the human perspective: Why is reuse applied, and who is involved. The technical perspective of tools and techniques refer to What?, How?, and Where?: What is reused in terms of learning objects, How does reuse take place in terms of tools and support?, and Where is reuse established, or what systems are used? Questions can then be considered per lifecycle stage, and in terms of different human and technical perspectives, as shown in Figure 5.

Perspectives	Perspective questions	Obtaining	Labelling	Offering	Selecting	Using	Retaining
Human	Why?						
	Who?						
Technical	What?						
	How?						
	Where?						

Figure 5 Combining human perspective and technical perspective in relation to the lifecycle of a learning object: A framework for the research

This framework presented in Figure 5 serves as an organizer for the research questions of this study.

1.5 Research Questions

The overall research questions for this study relate to different user contexts as described in Section 1.2.3 and the influences those have on tools and technologies within the lifecycle of a learning object. For each of the research questions, the framework from Figure 5 will be used to illustrate which aspects of the lifecycle are particularly involved in the question, and which dimension, human or technology aspects. In each project, in Chapter 8, the results of the contexts will be used to review the selection of darker and lighter cells presented here, as well as indicate more specifically what issues and solutions pertain to the cells. In addition, differences in the tables and cells for the three different contexts--university, corporate learning, and military learning--will be compared and analysed.

Three research questions can be identified: (a) Human perspective, (b) Technical perspective, and (c) Combining the Human and Technical perspectives:

> *RQ1: Human perspective – What human aspects are important to support the different stages of the lifecycle of a learning object?*

Key cells and secondary cells for this question are shown in Figure 6. The Why? and Who? rows are darker-coloured because the focus from the human perspective will be relatively more on what sorts of material will be selected, used, or retained, and how this reuse should occur in terms of edited or original material.

Perspectives	Perspective questions	Obtaining	Labelling	Offering	Selecting	Using	Retaining
Human	Why?						
	Who?						
Technical	What?						
	How?						
	Where?						

Figure 6 General Reuse: Key cells for the human perspective

> *RQ2: Technical perspective - What tools and technologies are important to support the different stages of the lifecycle of a learning object?*

Key cells and secondary cells for this question are shown in Figure 7. Here the Labelling and Selecting columns are darker-coloured because the focus will be on tagging tools and how material can be selected using appropriate tools.

Perspectives	Perspective questions	Obtaining	Labelling	Offering	Selecting	Using	Retaining
Human	Why?						
	Who?						
Technical	What?						
	How?						
	Where?						

Figure 7 General reuse: Key cells for the technical perspective

RQ3. Combining human and technical perspectives - What are key dimensions to guide the selection of tools, technologies, and human procedures to support the different stages of the lifecycle of a learning object for users in different usage contexts, particularly university, corporate learning, and military training?

Key cells and secondary cells for this question are shown in Figure 8 This question combines both perspectives. As a starting point, all cells appear highly important and those are all given in gray. In each of the projects, the particular cells which become dominant and the questions and issues related to those cells will be identified.

Perspectives	Perspective questions	Obtaining	Labelling	Offering	Selecting	Using	Retaining
Human	Why?						
	Who?						
Technical	What?						
	How?						
	Where?						

Figure 8 General Reuse: Key cells for the human and technical perspectives combined

Based on the results of the investigations in the projects, Figure 8 will be refined and used to organize the summary of the research in Chapter 8. Chapter 8 will also present an analysis of which of the cells are most critical, and compare this within each of the three contexts: university, corporate learning, and military training, addressing questions such as: What are the successes in the contexts?, What are the strengths?, What are the weaknesses, What is the likelihood of success in other contexts?, and What does this mean in practice?.

These questions will not be addressed in isolation, but in the realistic context of three organisational contexts. Following the projects, a synthesis of the different experiences as well as advances from the literature will serve as the basis for answering the three main research questions. The investigations will identify which cells in which contexts are most important.

1.6 Methodology

The research focuses on the application of learning-technology standards for learning objects and the differences in reuse in university, corporate, and military contexts. Within the three contexts the human and technical perspectives will be key elements for the responses to the research questions. In each context a set of research projects will be initiated to see how learning-technology standards can be implemented and what roles human and technical perspectives emphasize during the implementation. Figure 9 shows the three contexts and the related research projects.

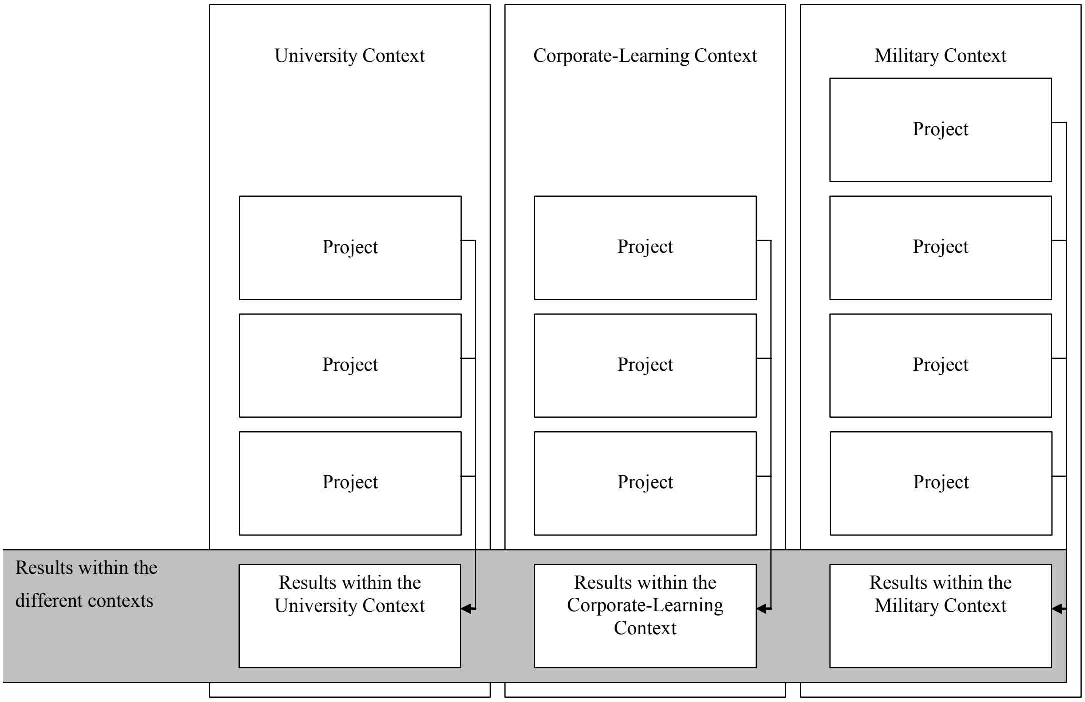


Figure 9 Contexts and related research projects

The researcher fulfilled different roles in these various projects such as designer, developer, designer analyst, and, interviewer within the projects to gather insight information about the motivations, issues, and possibilities within the various contexts. The use of a structured interview in the different projects made it possible to gather a set of data for research purposes. Besides the structured interview, data were gathered during informal meetings and discussions about the implementation of the standards for learning technology. More about the methodology can be found in Chapter 4.

1.7 Overview of the Dissertation

The dissertation gives in Chapter 2 and 3 a conceptual overview, analysis, and literature review focused on the human aspects and technical aspects. Chapter 4 gives a methodological overview including a description of the tools such as TeleTOP® used in the investigations. The three contexts: a) university, b) corporate and, c) military, are described in Chapters 5, 6, and 7. Chapter 8 gives the synthesis with answers to the research questions based on the framework used within the three contexts. Chapter 9 offers a new framework and includes reflections and implications. Figure 10 shows how the chapters are structured and related to each other.

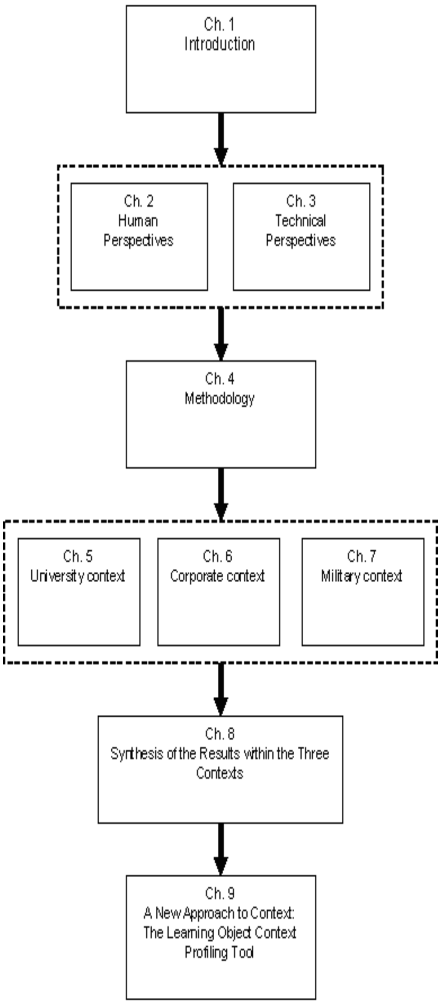


Figure 10 Overview of the chapters in the dissertation

As Figure 10 shows, the following chapter will elaborate on the human perspective.

2 Learning Objects from a Human Perspective

In the Three-Space Design Strategy, Section 1.2.3.2 the associative approach was defined as being heavily sensitive to the context, with "fuzzy situations and uncertainty" (Moonen, 2000, p. 168), and with the strong influence of the actors involved with emergence of what evolves. Thus learning objects from a human perspective is the focus of this chapter. Figure 11, repeated from Chapter 1, has grey cells to show this focus.

Perspectives	Perspective questions	Obtaining	Labelling	Offering	Selecting	Using	Retaining
Human	Why?						
	Who?						
Technical	What?						
	How?						
	Where?						

Figure 11 General Reuse: Key cells for the human perspectives

Section 2.1 introduces key elements related to learning objects in a human perspective and Section 2.2 describes the lifecycle of a learning object, also from this perspective. In Section 2.3 metadata is the focus, from the perspective of aspects relating to the user's ways of thinking and working. Section 2.4 then introduces four key sets of issues relating to the human perspective using the 4-E Model (Collis, Peters, & Pals, 2001) as the reference model. From this, the chapter concludes in Section 2.5 with a set of secondary research questions relating to the human perspective.

2.1 Key Elements of the Human Perspective

From the human-aspects perspective, key elements include the definition of learning objects (Section 2.1.1), the organisational contexts in which the humans function (Section 2.1.2), the actors and their roles (Section 2.1.3), pedagogy (Section 2.1.4), and usability (Section 2.1.5). Each of these is introduced in this section.

2.1.1 Learning objects from a user's perspective

There is no single definition of the term learning object from a human perspective. Although most instructors probably do not use the term learning object as part of their day-to-day vocabulary, most would be likely to understand the term as something that is used for learning. If that something is digital or not may not be clear, nor is its size. Is it a whole Web site or one image in the site? While many university instructors may find a broad definition such as "digital entities that can be delivered over the Internet" understandable (Wiley, 2000a), and some university instructors may relate to a definition such as "elements of a new type of computer-based instruction grounded in the object-oriented paradigm of computer science" (Wiley, 2000a), it is not likely that course designers in corporate or military contexts will respond to such definitions.

In the corporate context, learning objects are generally defined in the terminology of the vendor supplying a LMS or LCMS. Chapman and Hall (2001), note that in this context that there is no consistent definition of a learning object; "…each of the companies using the learning object metaphor has their own defined relationship and characteristics for what constitutes a learning object" (p. 9). In their review of LCMSs, they identify definitions as varying as "a structured, reusable learning event" (p. 52) and "a single page or a group of pages, typically they should not exceed about 20-25 pages" (p. 81). Although "typically they should be five to 15 minutes in length (seat time)" (p. 9), they may also be objects such as a single image. Mortimer (2001) shares this impression of confusion within the corporate setting:

> *"Learning object. Reusable learning object. Reusable information object. Shareable content object. Modular building block. Chunk. Nugget. Lego. Whatever. The list goes on…no single learning object definition exists...there seem to be as many definitions as there are people to ask."*

Chapman and Hall conclude their review by saying "We hope to see better definitions and common standards for learning objects in the future" (p. 9).

In the university world differences in definitions also occur. In the CANDLE Project, a distinction was made between c-atoms, c-content, and c-courses, emphasizing the idea that learning objects can be combined to form composite learning objects (Scott & Van Helvert, 2001). Oliver and McLoughlin (2002) discuss a type of learning object called a "framework" which "might take the form of a Web-based database that a teacher could use to create a setting for a particular subject context [for example] a role-playing learning activity" (pp. 96-97). In this sense a learning object can be a template as well as associated resources that together can be used to "create an overall learning setting for a learning activity" which could then be delivered to students via a course-management system.

Others also see learning objects in terms of different sorts of functions involved with a course, such as: knowledge objects, tool objects, monitor objects, test objects, and resource-organisation objects (Koper, 2003, pp. 47-48); or: instructional objects, individual-activity objects, companion-activity objects, collaborative-activity objects, technical-activity objects, narrative objects, and assignment objects (Weller, Pegler, & Mason, 2003a, b). These terms may be more familiar to instructional practice than terms such as c-atoms, although they will still need some definitions before they can be immediately recognized. (For example, technical-activity objects are defined as objects giving instructions for activities that "require students to explore appropriate technologies, for example instant messaging, blogging, collaborative tools, etc.").

Even more important in these lists of types of objects is the idea that the learning objects are seen to get their meaning from their larger context, including services (Koper, 2003) and "the course as a whole and the dynamic environment created through dialogue [between instructor and learners and discussions among learners] and the assessment structure" (Weller, Pegler, & Mason, 2003b, pp. 4-5). This broader context was also reflected in Oliver and McLoughlin's framework idea, where the framework object was used to create a resource for an activity that was then integrated within a broader course environment and carried out by groups of learners in face-to-face interaction. While the broader course context is also expressed by the sequencing feature in ADL SCORM™ Version 1.3 (see Section 3.3.2.4), the major issue is if the broader context in the ADL SCORM™ sense (and also the EML sense, Section 2.1.4.1) also includes elements other than digital learning objects, such as the instructors, and the students who are doing activities using the instructions in the "activity object" that was offered to them via their course-management system (Oliver & McLoughlin, 2002).

Thus key variations in the definitions that are relevant to human creators and users of learning objects include:

- Should a learning object be explicitly created for learning puposes or just be any digital entity which can have a learning function in a broader learning context outside of the learning objects themselves?
- If a learning object is explicitly created as such, should it be done within a structured framework, perhaps using a template for consistency with other learning objects and for thoroughness?
- Do size and scope matter? Is it sensible to treat a zipped Website with perhaps hundreds of components or a pdf file of a lengthy book or manual in the same way as a single digital image?

2.1.2 Organisational contexts[5]

In this section, three main organisational contexts in which the lifecycle of learning objects may occur are described and contrasted. In each, key aspects relating to the nature of learning, typical sorts of learning settings, ownership, and access to learning are discussed in order to show some of the variations that occur when the "fuzzy", associative settings of human organisations are considered. Aspects introduced in this section will be examined in detail in Chapters 5, 6 and 7. Section 2.1.2.1 gives an overview of key features affecting the use of learning objects in a university context; Section 2.1.2.2 in a corporate-learning context, and Section 2.1.2.3 in a military-training context. These three contexts are currently the major settings for the use and reuse of electronic learning resources. They are briefly compared in Section 2.1.2.4.

[5] Portions of Section 2.1.2 are taken from Collis & Strijker, 2004

2.1.2.1 University context

The university is structured around a set of domain-specific faculties whose tasks are research, teaching, and supervision of graduate students. These faculties provide programs based on a curriculum that leads to degrees. Faculty boards that are led by a dean define the curriculum. The curriculum consists of a set of coherent courses that can be provided by instructors who are subject-matter experts and who are gathered in the subject-specific departments of a faculty. The courses are based on the objectives defined globally in the curriculum and developed more specifically by the instructors for their courses.

The instructors are all part of the academic staff and their freedom within course development is large. The instructor's professional identity is predominately based on his research. "In the university model, the long-term work is research, assembly, investigation, exposition, criticism, publication, and integration of knowledge….What is most persistent in this university model is the process of knowledge production…The overall development of knowledge requires long term, commitments" (Roschelle, Henderson, Spohrer, & Lilly, 1997, p. 27). Within this research orientation, instructors also design, develop, and deliver courses, frequently bringing in their research into the course materials.

The instructor can choose how to structure the course in terms of organisation, course material, and assessment. The instructor can also narrow the objectives and focus on particular issues and integrate aspects of his current research and projects into courses. This means that research-specific and sometimes instructor-specific knowledge is used for the courses. Because of the research aspects, many courses are revised every year and upgraded with new articles and relevant material. The types of course materials most used are PowerPoint presentations, word-processed documents created primarily by the instructor, textbooks, copies of scientific articles, and increasingly, digital resources available via the World Wide Web (DeBoer, 2004). There is very little use of educational software of a tutorial nature (see for example, Draper, 1998, who discusses the lack of use of educational software in higher education beyond its developers).

The knowledge provided to students is often not directly created for learning (Roschelle, Henderson, Spohrer, & Lilly, 1997) but often is of a more-abstract nature. Throughout higher education, there is an on-going, sometimes explicit, emphasis on the development of metacognitive skills, on critical thinking and reflection, and on gradual apprenticeship into a community of scholars (Sfard, 1998) rather than on content transfer in itself. Most instructors have no training themselves in pedagogy or instructional design. Most have little experience with using computer-based tools and systems for instruction-related tasks, although all are regular users of general tools such as Web browsers, word processors, and presentational software and increasingly of the CMS (course-management system) provided by the institution (DeBoer, 2004).

2.1.2.2 Corporate context

The curriculum in corporate-learning situations is based on the different domains identified in the organisation. The courses offered in the corporate context are based on demand where the demand partly comes from changes in the field and partly comes from needs identified within the organisation such as through competence-gap analyses or profiling done by the human-resources division. The participants in the courses generally are employees of the organisation and may or may not be required to take certain courses in terms of internal human-resource development policies. The supervisor of the participant approves the participant's involvement and if costs are involved is typically the one responsible for deciding on participation. Typically, attending a course means going to a classroom-based setting away from work for a period of days although other combinations involving computer-based (e-)learning can occur with the employee still in his own workplace. A recent surge of interest in anytime, anyplace e-learning has been fuelled by the rapid development of the market for LMS (learning management systems, see Section 2.1.6.4) and LCMSs (learning content management systems, see Section 2.1.6.2). However, classroom sessions with no use of networked technology are still the majority form (Sloman & Rolph, 2003).

A team of subject-matter experts typically use the corporation's competence framework to select the subject matter for and develop the courses. The competence framework describes the competences identified as needed to fulfil the business needs. Experts available in the organisation develop the competence framework to reflect the full scope of tasks involved in keeping the organisation running and making it profitable (Mulder, 1999). The courses are under constant revision because of new developments in the workplace.

The trainers or instructors who teach or facilitate the courses with the participants may or may not have been members of the specialist team that developed the course. Typically they are employed as trainers or instructors and do not have other duties within the organisation. Instructional designers and other types of support personal may be part of the development team and may also be involved in support during the execution of the course. Courses are task-oriented, focused on improving both individual and corporate performance (Kessels, 1993). Courses and learning objects involving generic knowledge are frequently outsourced; courses and materials with domain-specific and corporate-specific knowledge are generally created in house (Armour, 2003). An industry exists for producing courses and learning resources and the technologies needed for creating and managing electronic learning objects when resources and courses are not produced in house (Chapman & Hall, 2001). LMSs and LCMSs are primarily marketed to the corporate-learning context. In-house course resources are corporate property and individual ownership is not usually claimed; sharing and reusing resources within a discipline group or a learning centre is common.

Two distinct types of learning occur in corporate contexts: courses or formal learning, and informal learning that can involve knowledge-management tools and systems: Blending aspects of these in one learning event is an emerging idea (Chapman & Hall, 2001, p. 10; Collis & Margaryan, 2003). Informal learning frequently involves the use of knowledge-management systems, either for codification of information or personalization (Kankanhalli, Tanudidjaja, Sutanto, & Tan, 2003). A codification approach emphasizes efficient access to information while a personalization approach emphasizes knowledge sharing and facilitating contacts with others. Traditional classroom-based courses in corporate contexts may include both approaches but "e-learning" via learning objects typically typically reflects characteristics of a codification approach rather than an approach that emphasizes human contacts.

2.1.2.3 Military context

The military context for the use of learning objects is a setting that changes slowly. The organisation is strict and has a command structure that is hierarchical. This means that all procedures are well defined and that uncertainty is minimized to exclude errors in orders and commands. This command structure is based on the fact that misinterpretation of definitions can result in casualties. The training that occurs and course materials that are developed are based on this strict form of communication and use the same predefined definitions to make terminology as consistent as possible. Courses and learning resources are highly specialized and localized. Course materials include text materials such as handbooks and manuals and also multimedia materials, particularly visual materials (videos and images) (Verwijs, 1998). Simulators and hands-on experiences are often used. Courses and course materials are made by in-house teams that include subject-matter specialists, instructional designers, and multimedia designers and developers (Visscher, 2002). The trainers who run the courses with the participants are generally not part of the development teams. Trainers are not generally involved in other work besides training. Training is highly task-focused. Participants have a prescribed series of courses based on their specialisms and levels although their supervisors can also request additional courses to fit particular needs (Visscher, 2002). External companies produce tools and systems such as simulations and development tools and are beginning to supply LMSs and LCMSs to military training settings.

2.1.2.4 Comparing the organisational contexts

Although many points of comparison will be made among the three organisational contexts throughout this dissertation, three particular aspects are of key importance.

- The first relates to the nature of the course and of reuse of learning objects within it. In the university context, the course is very much influenced by the instructor who in turn is relatively autonomous in his choice of instructional approach and learning resources. The instructor is professionally defined by the originality and productivity of his research. He has little or no help from others in terms of developing or delivering his course. Reuse usually relates to reuse of his own materials in different courses. In the corporate context, courses and learning objects are based on business needs and competence analyses. Courses are client-oriented and course developers must respond quickly to new requirements and requests. This limits the freedom of developers and of those who eventually teach the course. Suppliers of courses, learning objects, and learning-object technologies from outside the corporation stimulate the reuse context: "aiming at what they perceive to be a much bigger market: content aggregation 'on the fly' by individual learners or training providers" (Rehak & Mason, 2003, p. 22). While "universities in the forefront of learning object development are designing templates and others systems to support academics in the preparation of learning material geared to reuse…[training company providers are creating systems] where learners indicate their personal parameters, needs, background knowledge, etc and courses are created automatically from a database of learning objects" (Rehak & Mason, 2003, p. 22). As Rehak and Mason point out, "a number of significant implications about the nature of learning objects arise from these scenarios" (p. 22). In the military context, courses and content are highly structured, and slow to change or adapt. Instructors have little or no say in the selection of the content of the courses they facilitate or of the learning objects involved. Reusable objects, such as repositories of photographs, are managed in a systematic way using database technology as well as other systems.

- The second point of comparison relates to course delivery and technology: In universities, instructor-delivered courses with lectures remain the norm but Web-based course-management systems are routinely used to support the courses throughout their cycles (De Boer, 2004). In corporate contexts, there are typically two parallel but different delivery forms: classroom with instructor, or e-learning without instructor. However, as will be discussed in Section 2.1.3, a mixture of these, "blended learning", is appearing, but unlike the university context, a course-management system is not typically used but rather an LMS to deliver the e-learning component and the classroom-portion of the blend generally does not make use of electronic learning objects or delivery systems such as CMSs (Rossett, Douglis, & Frazee, 2003). In the military context, there are classroom (or practical) settings or CBT (computer-based training) but typically no combination of the two in a single course.
- The third point of comparison relates to ownership and access to learning objects: In the university context, the creator of a learning object sees the object as his intellectual property. Many times the object will include specific aspects of the creator's own research and writing. As the creator is generally also the instructor, his willingness to share his work with others is bounded by the wish and need to retain acknowledgement of his intellectual property. In the corporate context, in-house learning objects are company property, there to be used when needed, but concerns are high that the company-specific material and knowledge remain inside the corporation and not be used to the advantage of other corporations. In the military, the need to protect state secrets also limits access to in-house learning objects and objects are well copyrighted. However, reuse within the military training context is seen as desirable.

As will be seen in Chapters 5, 6 and 7, these differences lead to substantial differences in the roles, nature, and use of learning objects and also have strong influences on the choice of standards and the use of metadata.

2.1.2.5 Cultures within the context

The organisational cultures of the contexts can be seen as different worlds where different values and attitudes can be applied. These worlds are of a different nature than sectors in organisational contexts. Boltanski and Thevénot (1991) define a set of six worlds, each with their own culture and characteristics. The worlds can be compared with different cultures identified in the various settings and offer another view of how cultures can be described. Table 4 shows the characteristics of the different worlds in terms of verbs, value features, and attitudes.

Table 4 Characteristics of the worlds (adapted from Boltanski and Thevénot, 1991)

	Verbs	**Value features**	**Attitudes**
The World of Inspiration	To create, to discover, to research, to share, to imagine, to dream, to explode, to be amazed, to perceive, to harness.	Singularity, difference, innovation, originality, irrationality, imaginary, spirituality, unconscious, chance	Spontaneous, passionate, risk taking, open-minded, independent, intuitive
The Domestic World	To behave, to give, receive and give back; to respect; to keep the convenient distance; to be polite (with both inferiors & superiors); to interact.	Confidence, responsibility, merit, respectability, convention, dignity, tradition, hierarchy, rank; parents, children, generation; rules and confidence, principles; harmony; the "natural"; the duty	Honest, decent, respectful, common sense, savoir-vivre, repetitive, reproductive, cautious, reliable
The World of Opinion	To influence, to convince, to persuade, to seduce, to promote, to advertise, to orientate, to catch the attention, to compare.	Image, reputation, fame, success, honour, acknowledgement, visibility, audience, credibility, Identification.	Being an actor, contributive, communicative, participative, personality, celebrity
The Civic World	To debate, to voice, to mobilise, to gather, to adhere, to exclude, to inform, to codify, to delegate, to represent and to be represented, to show solidarity, to share.	The general will, the common interest, generosity, self-abnegation, sacrifice, pride, the group, collective action, collective entities (ideas, values, symbols and institutions).	Concerned with the general will, altruism, giving collective interest a higher rank than personnel Interests.
The Merchant World	To desire, to possess, to bet, to win and to loose, to gamble and to play, to buy, to sell, to negotiate, to deal, to pay, to rival, to conclude, to accumulate, to keep one's distance.	Wealth, money, luxury; business, fair deals, good deals, bargain; interest, attentions to others; contract; competition, rivalry, opportunism, freedom,	Attractive, appealing, respectfulness to the customers, open-minded, obliging, willing to help, thoughtful, careful, reactive, opportunist
The Industrial World	To master, to integrate, to organise, to control, to stabilise, to foresee, to implement, to detect, to adapt, to analyse, to measure, to formalise, to standardise, to solve, to optimise, to schedule, to sequence, to anticipate.	Progress, future, functionality, efficiency, optimality, performance, productivity, professionality, reliability, far-sightedness, system	Competences, responsibility, professional qualifications, effort, discipline, obedience, seriousness, energy, dedication

To relate the table to the research an example can be found in an organisation such as Shell EP that can be compared with an Industrial World where formalizing and optimizing are key verbs and values such as efficiency and productivity are important. Responsibility, professional behaviour, and dedication can be seen as required attitudes within a corporate context.

Using Worlds as reflections of cultures in various contexts can also help to anticipate problems that might occur when different Worlds want to work together. Boltanski and Thevénot (1991) provided in Table 5 a set of critics from each World to each other World.

Table 5 Critics from each World to each other (adapted from Boltanski and Thevénot, 1991)

Criticism	Criticism to the World of Inspiration	Criticism to the Domestic World	Criticism to the World of Opinion	Criticism to the Civic World	Criticism to the Merchant World	Criticism to the Industrial World
From the world of Inspiration		Habits, inherited social norms and principles, fossilized institutions form a break to creativity and initiatives.	Vanity of appearance, personal rivalry, the higher attention paid to the image of the self, inhibit imagination.	Cold institutional frameworks freeze human to human warmth and affective relationships	Self-interested people and dependence on "money' hijack invention and innovation to reroute them for business	Rigidity of routines, impersonality, methods and know how to hinder spontaneity and creative spring.
From the Domestic world	Disorder, carelessness, disorganized behaviour. Too much attention given to the emotional component		Good manners require discretion and caution. Exhibitionism is incompatible with common decency	The collective reinforce the anonymity and obstruct to individual responsibility	You can't buy everything. Self-interest corrupts social bounds.	Productivism brings low quality. Technical expertise sweeps away common sense and realism.
From the world of Opinion	Esoteric. False depth and elitism. Selfishness.	Domestic secrets, paternalism. Opacity. Lack of daring. Refusal to be compared and to be assessed.			The commercial focus of communication and information through interested advertising.	The esoterism of specialists
From the Civic World	Individualistic approach, irresponsibility, spontaneism, adventurism.	Paternalism, family secrets (corruption, etc.), to free from authoritarianism, pollution of authentic human relations.	Public opinion are manipulated in their expression they do not refiect aggregation of interests.		Egoism of the wealthy and individualism in a merchant world put democracy at risk.	Technocracy, attention paid to individual promotion more than to collective enrichment.
From the Merchant World	Lack of emotional distance and control of emotions, business needs to keep one's self-control	Personal relations, traditions, prejudices, and routines hold back competition and opportunistic merchant relationships.	Deviousness, mass culture, snobbery, ravages of mimetic speculation	Collective processes inhibit action.		Rigidity of tools and methods, heaviness of organisations, mentality of engineers confiict with commercial principles.
From the Industrial World	The waste of improvisation, uncertainty, unreliability	Tradition is not adapted to present times, the old is outmoded.		Inefficiency of administrative procedures. Costs of social policies. Hindrance of reactivity.	Useless luxury goods, unjustified prices, market impulsive drives	

Next to differences in cultures, there are different actors involved with learning objects in each of their stages. This is described in the next section.

2.1.3 Actors and their roles

The people related to learning objects can be generically grouped in five sets of roles: (a) content specialists involved in creating or assembling objects and courses; (b) instructors or facilitators who lead learners through a course; (c) support staff assisting course creators, instructors, or learners; (d) managers, and (e) learners and those associated with them. There can be other categorizations. For example, in the CANDLE Project, focusing on collaboration among various institutions for the sharing of learning objects relating to telematics instruction, 12 actor roles were defined, which can be mapped into the above categories (Scott & Van Helvert, 2001). The CanCORE Project (CanCore, 2003) also defines a set of actors and roles which can be mapped more or less onto the five named above. Russo, Borelli, Castaldo, Graziano, Sarpa, and Vecchio (2002) define categories such as author, cataloguer, and technician, which map onto (a) and (c). Each of the five groups given at the start of this paragraph will be briefly described in Sections 2.1.3.1 - 2.1.3.5, with a comparison of actors and roles in the university, corporate, and military contexts summarized in Section 2.1.3.6.

2.1.3.1 Content specialists involved in creation or assembly

In the university context, the content specialist is typically the instructor although in distance-education universities, course-design teams that include content specialists are the norm. In the corporate context, content specialists are usually persons within the corporation with sufficient experience to be designated as a SME (subject-matter expert) although they may also be contracted in as externals. Among commercial providers of courses and learning objects, content specialists may be available in-house but typically are contracted in, sometimes from the corporate context in which the courses and learning objects will be directly used. In the military context, content specialists are also persons from within the military with appropriate field experience. Content specialists are not usually trained in instructional design. They may or may not also be involved in the subsequent running of the course.

In all three contexts, the assembly of learning objects into a course can be done with the help of tools and systems, particularly learning content management systems, if content specialists have been involved in the metatagging of the objects that will be selected by the system for the particular learner. The term "bricoleur" has been used to describe the situation where a content specialist uses such a repository of metatagged learning objects to assemble a course according to a particular pedagogical framework (Jarret, Mendes, & Prnjat, 2003).

2.1.3.2 Instructors

In the university context, instructors (called tutors in distance-education universities) are those who lead learners through the course, monitor and give feedback, and assess and grade the learning performance of the participants. Instructors in traditional university contexts generally give lectures and meet face to face with the learners, communicating in a variety of ways. Others may fulfill some of the roles of instructors in universities, for example, tutorial leaders, seminar leaders, practicum leaders, and other sorts of mentors. In corporate contexts, instructors may function as the university instructors, but often different permutations occur. A course may consist of a series of specialists from inside or outside the company who come, one after the other, to deliver a portion of the course. In these cases, someone with a title such as course director or programme manager will be overall responsible for the running of the course but may not interact directly with the participants and may or may not be a subject-matter expert in the topics of the course. In the military context, the situation is more like that of the traditional university, with a single instructor teaching in the classroom setting; however such an instructor typically was not also involved in course development.

2.1.3.3 Support staff

There are many different types of support staff. These can include instructional designers who are involved in the design and development (or assembly) of courses or learning objects. Technical support staff are another category. The latter can include multimedia and authoring specialists who create electronic materials, and technicians who produce the final objects in formats suitable for different delivery channels (including digital). Another group of supporters include those who select and produce the metadata for learning objects, called by Russo and his colleagues (2003) "cataloguers…who produce the metadata and are expected to have a sufficient understanding of the domain to which the object belongs, an understanding of the purpose of the object itself, and also a deep understanding of the relevant metadata syntax, vocabularies, and descriptive facilities" (Russo, et al, 2003, p. 329). The term "librarian" is a more-general term for the support staff who maintains resources, but unless they are subject-matter experts they will not be also selecting metatags.

Other categories of support staff are those who work with repositories and associated repository services, building, maintaining, and offering support in various ways. Gray, Allan, and McLean (2000) for example, describe different services provided by those maintaining the "digital media asset management system" at the University of Melbourne. Cardinaels and his colleagues (1998) describe different responsibilities of the team involved with the ARIADNE KPS (Knowledge Pool System). An important task is the granting of access privileges in local areas.

Yet another type of support role is that of staff development relative to the (re)use of electronic learning objects. Much has been written about staff development in universities for the eventual use of technology and course-management systems (see a review in De Boer, 2004). Littlejohn (2003) however is one of the first to focus on staff development aimed at stimulating instructors in a university to share their resources by developing skills in resource discovery, customisation, and integration within course design. Bianco, Collis, Cooke, and Margaryan (2002) discuss a similar initiative for course-design teams in the corporate context. In this initiative, systematic consideration for reuse also occurs.

A final category of support staff are all those involved in supporting the technology and tools involved with learning objects. In the corporate context, this includes personnel working with the LMSs and LCMSs. In the military, it includes multi-media specialists.

2.1.3.4 Managers

Managers include the policy makers in an organisation who must make the decisions about reuse procedures, policies, technical infrastructure, and support staff. These decisions involve financing and personnel aspects. Managers are also involved in institutional decisions about intellectual property, copyrights, access, and privileges. Critically, managers may be in the position to see that the use of learning objects is embedded in the strategy and operating procedures of the organisation, and to provide incentives and rewards for those who support the strategy.

In terms of services such as repositories, it may be a government officer who makes the policy decision to establish the service, such as in The Netherlands where the Minister of Education, Culture, and Science took the decision to initiate the Kennisnet and Digitale Universiteit organisations (see Section 1.2.2). In the corporate-learning context, the manager must see how corporate strategy can be advanced via an investment in learning objects and their technologies and then must allocate adequate funding and support for all that is needed to make learning objects part of the delivery context of the organisation. In the military, high-level decisions are taken by the Minister of Defence and in his name, the civil servants involved in defence policy.

Managers at a level below the senior policy maker also have an influence. In particular, managers of the teams or units responsible for the implementation of learning objects will be making decisions that are critically related to the issues impacting on learning objects from the human perspective, such as costs for access, details of metatagging, procedures for metatagging, and procedures for version control (see Section 2.4). For all of these, staff and incentives need to be in place, embedded in organisational policy.

2.1.3.5 Learners

Learners are the eventual targets of the learning objects. In higher education, learners typically search for learning resources in addition to what is selected for them in a course. The library is familiar to learners but now the World Wide Web and the use of search engines has brought a new dimension into higher education in terms of learners finding their own supplementary learning resources. A major issue for learners making use of the Web is quality appraisal; learners must develop skills in identifying quality and relevance as, in general, a Web search gives no direct indicators. An associated issue is that of standards and procedures for reuse of objects found via the Web: What and how much can be reused, with or without referencing, without asking the permission of the site owner? In general, the use of the Web by students in higher education is probably the major situation of reuse of electronic resources for learning, although much of what is found was not developed specifically for learning purposes and search engines rely not on metadata but on other search procedures such as examining the number of links pointing to a page. The search engine Google, for example "examines the number of links pointing at a page (and the number of links pointing at each linker)..to derive statistics about the number of Web-authors who believe that that page is important enough to link to" (Doctorow, 2002), which in turn means that the learners are increasingly becoming responsible themselves for identifying what is relevant for them in that they must decide for themselves what to do with such linking data. There is generally the assumption that learners in higher education have the time and Internet access needed for searching for supplementary learning resources via the Web.

In the corporate and military sectors, learners in general do not browse the Web and do not expect to be selecting their own learning resources. Studying is done at the cost of being out of the workplace, and thus must be as efficient as possible. Quality control is guaranteed by the course developers and the training institution; the possibility of incorrect or inappropriate resources is not tolerated. Learners may sometimes be required to complete a series of initial training courses but after that, the choice is between informal learning (via e-learning, best-practice databases, corporate discussion forums, or in-house meetings) or occasional attendance in a formal course.

A new possibility for learning objects is emerging in universities, and in at least one case, in a corporate context (see Collis & Margaryan, 2003; and Collis & Moonen, 2001) and this is the idea of learners finding or creating electronic products that they submit to the course environment of a course-management system and that are then used by other learners as learning objects. This requires a pedagogical approach that incorporates and manages this sort of process (Collis & Moonen, 2001; see Section 2.1.4.2). When submissions by learners are reused with subsequent groups of learners, as model answers or examples, the new users need to be aware of the context and background of the objects. Issues relating to obtaining permission from learners for the reuse of their work require institutional policies.

2.1.3.6 Summary of actors and their roles

As with the key context elements discussed in Section 2.1.2, there are many variations among the ways that key actors work and are organized that will have a direct impact on the nature and use of learning objects. The major distinctions relate to quality issues and the structure of learning objects.

Quality issues - With regard to quality, who is responsible for the quality of a learning object? How is a quality assessment made and communicated? Can lack of quality in the sense of being inappropriate or even incorrect be tolerated? Who monitors this? These are key issues that separate the higher-education sector from the corporate and military sectors. In higher education, the individual instructor and even the learner are expected to make the decisions about quality. Learning can occur from studying objects that contain errors, as long as the learner is aware of the errors, although the responsibility for this rests heavily on the learner in terms of objects found via the World Wide Web. In the corporate and military contexts, all actors expect that the course team (and the training institution) guarantee the relevance and quality of the learning objects, digital or non-digital, that are selected and presented to the learners. This places heavier demands on the selection of items as learning objects and the selection of appropriate metatags.

Structure vs. learner control - With regard to structure, a major distinction can be made between informal and formal learning. In informal learning, the desire may be to locate a single learning object that just-in-time serves a specific learning need. Here the focus is on the search process and on the adequacy of the repository of objects being searched. In more-structured learning, a sequence of learning objects must be developed in which the relationship between objects becomes of critical importance. If it is technology in the form of a LCMS or LMS or there is a human bricoleur who selects the objects and organizes them into an instructional sequence, new issues relate to appropriateness and consistency of language and presentation, of adaptability to individual learning needs, and of a cohesive pedagogy and assessment approach. These requirements lead to many more demands on the design of learning objects as well as for their metatagging.

In this section, the influence of pedagogy on the role of learning objects was noted. In the next section this influence is discussed in more detail.

2.1.4 Pedagogy

Different approaches regarding to pedagogy can be identified. Section 2.1.4.1 will look at pedagogy at a general level, in terms of basic organisational and delivery forms for learning. Section 2.1.4.2 discusses the implications of different philosophical approaches to learning and pedagogy. Section 2.1.4.3 discusses the levels of learning objects in different learning scenarios.

2.1.4.1 Delivery and instructional approaches

When learning is structured by the institution, a number of different basic delivery combinations can be chosen, and within each of these, learning objects can have different roles. In traditional higher education, courses often involve lectures by the instructor, supported by objects such as PowerPoint presentations or self-made lecture notes. These can serve as reusable learning objects for self-study outside of the lecture setting. Often however it is assumed that the lecture is needed for interpretation of the object. The lecture and the textbook are often the "core" media in higher education, while other learning resources as complements, adding something extra that may or may not be necessary for successful performance in the course (Collis & Moonen, 2001). In this context, digital learning resources are not often used to replace the instructor or the textbook but to complement them in some way.

Sometimes reuse of a learning object is not assumed to occur directly but rather a template is reused that can be subsequently filled in by the instructor for the particular course. This was the approach used by Oliver and McLoughlan (2002) for their activity templates discussed in Section 2.1.1. Chaloupa and Koppi (1998) use a similar approach when they talk about templates for learning activities by using the term vignette. A vignette is a template for a single-issue activity, for example, relating to a discovery activity, which identifies the necessary components of the activity in a generic sense (topic, preparation, steps of the activity) but which can be filled in across a variety of disciplines. They see these sorts of learning objects as appropriate for higher education. "Learning materials themselves cannot be the sole teaching and learning strategy. Each is a small piece in the overall strategy of deliverable learning activities, reference, support and assessment…where the teacher's locus of control is as important as learner heuristics" (p. 49).

In distance-education institutions, the traditional approach to course development involves the design and production of paper-based, carefully sequenced, and consistently presented learning resources. Technology is more often used to add a communication and human-interaction aspect to the course than to present additional learning objects although this is beginning to change at some of the larger distance-education institutions in western countries (Strijker, 2002a). Another exception is the Open University in The Netherlands which has developed the EML (Educational Modelling Language) for course building with a pedagogical, or learning design, focus in which objects of different sorts (knowledge objects, tool objects, monitor objects, test objects, and resource organisation objects) are used and reused (Koper, 2003; see also http://eml.ou.nl).

In contrast, in corporations and the military, when electronic learning objects are used this is generally in the context of e-learning defined as self-study or anytime, anyplace learning. The presumption is that no instructor or classmates are involved, although there may be access to tutors or human coaches available, and thus the learning objects in combination must carry out the instructional role. When face-to-face sessions occur, electronic learning objects are not often involved. Rossett, Douglis, and Frazee (2003) suggest this in their overview of learning resources related to degree of social interaction involved in their use. "Web modules" appear to be the opportunities for digital learning objects in this overview, but these are categorized as for individual study as shown in Figure 12.

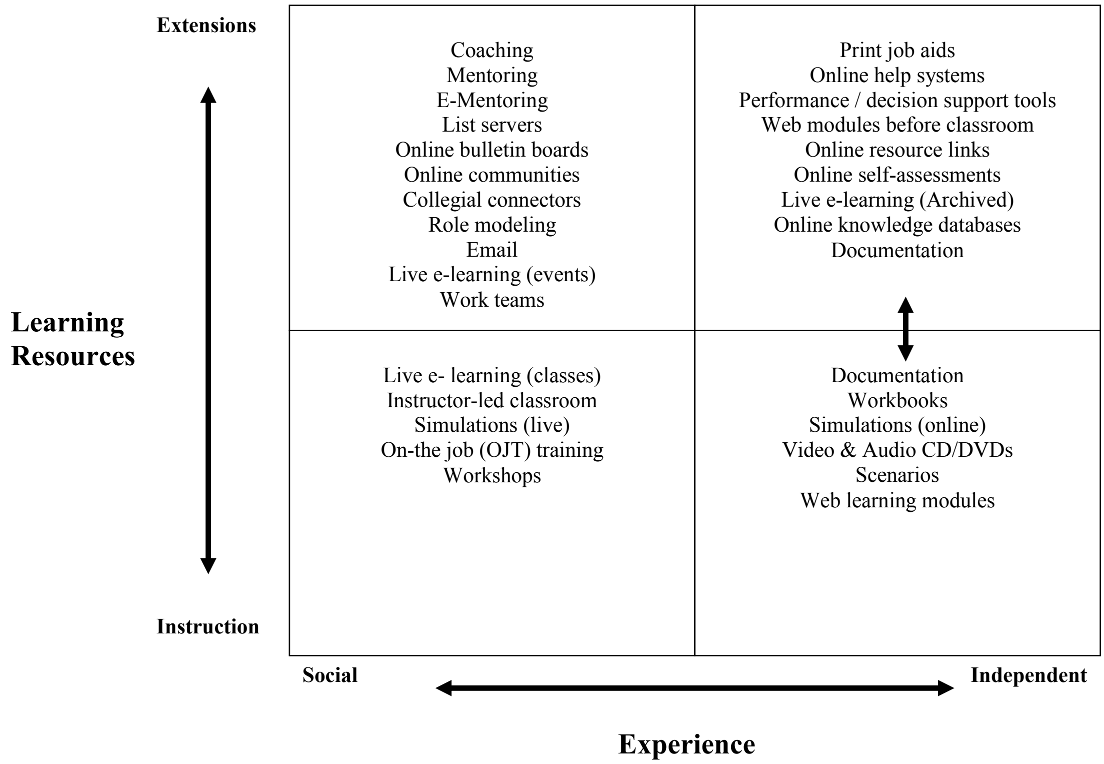


Figure 12 Learning resources relating to social or individual learning (Rossett, Douglis, & Frazee, 2003)

Within the corporate context, some examples can be found of integrating learning objects with other instructional forms. The blended-learning approach at Shell EP (Margaryan, Collis, & Cooke, 2002) is one example. Learning objects in this approach to blended learning can be of a variety of types, including those designed as self-contained "15-minute tutorials", but also resources from the company and objects created and submitted by participants. It is the activities that make use of the learning objects that give them their learning value, not the objects in themselves. The activities are defined outside of the learning objects, for example, in terms of work-based problem solving (Collis & Margaryan, 2003). Oliver and Herrington, 2001, discuss a similar approach in the university context.

The critical difference in instructional and delivery settings that affects learning objects is the place that the objects have in relation to other elements of instruction, including an instructor. If learning objects are resources to be used to support activities or stimulate debate or discussion or help learners develop their capacity to find and evaluate and synthesis knowledge from a variety of sources, all under the steering of an instructor, there are substantially different requirements for the objects than if they are meant to carry the full load of instruction. Many of the discussions of pedagogies in terms of learning objects assume, implicitly or explicitly, that the latter is the case. Chapman and Hall (2001) in their review of LCMSs identify the company's "learning object philosophy" per LCMS but in no case does their description imply the learning objects are expected to be used as part of an instructor-led course where other elements will be also part of the instructional mix and where the learning objects may be more like the library resources used by students in higher education to help carry out an activity. However, exceptions do occur. Bannan-Ritland, Dabbagh, and Murphy (2000) suggest a focus on learning objects as part of a constructivist learning environment, where the emphasis is on learners generating their own meanings, and even their own learning objects. For them, a learning-objects system must be able to "support learner-generated artefacts by incorporating learner contributions, …by allowing for learner designed and created artefacts that could become learning objects if posted to the system, and permit multiple versions of objects to be incorporated into the system" (p. 40). Such an approach relates to an underlying learning philosophy that is different from that underlying the LMSs and LCMSs.

2.1.4.2 Learning philosophy

Underlying the differences in the instructional and delivery approach that were discussed in the last section, is a major difference in philosophy of learning. Sfard (1998) describes these as the knowledge-acquisition approach and the participation approach. Collis and Moonen (2001) extend the participation approach to include an emphasis on learners contributing to the overall learning experience, and thus speak of the distinction between knowledge acquisition and contribution as underlying models of learning. The participation or contribution approaches both focus on active, constructive, intentional, authentic, and collaborative activities (Jonassen, Peck, & Wilson, 1999) where these activities take place in the real world as much as possible and not within a learning object. Table 6 contrasts four different approaches within a participation/contribution/action learning approach.

Table 6 Learning approaches emphasizing activities (from Collis & Moonen, 2001, p. 88)

"Participation-oriented" (Sfard, 1998)	"Action Learning" (Dopper & Dijkman, 1997)	"Engagement Theory" (Kearsley & Shneiderman, 1998)	"The Contributing Student" (Collis & Moonen, 2001)
Key definition of learning: Learning as participation, the process of becoming a member of a community, "the ability to communicate in the language of this community and act according to its norms" (p. 6); "the permanence of *having* gives way to the constant flux of *doing*" (p. 6) *Key words*: Apprenticeship, situatedness, contextuality, communication, social constructivism, cooperative learning; Belonging, participating, communicating *Stress on* : ""The evolving bonds between the individual and others" (p. 6); "The whole and the parts affect and inform each other" (p. 6) *Role of the instructor*: Facilitator, mentor, expert participant	Key characteristics: Practical problems are central: Learning is based on working on problems from one's own work situation When there are contacts among learners, these are focused on stimulating self-reflection and learning from others Instead of "lectures" learners use contact times for activities *Role of the instructor*: Leader, motivator, and guide of the learning processes; giving feedback on evolving phases of the problem-oriented project, and evaluator of the final submission. Must ensure that learner contact is more that the sharing of experiences but also that experiences are related to theory *Stress on* : Learning to learn, to collaborate, to self-regulate	*Key idea*: "students must be meaningfully engaged in learning activities through interaction with others and worthwhile tasks" (p. 20) *Key characteristics*: Learning activities that "occur in a group context (i.e., collaborative teams) are project-based, and have an outside (authentic focus)" (i.e., are meaningful to someone outside the classroom) *Role of instructor*: Supporting and screening the initial definition of projects and formulation of teams, provide guidance in working in teams, provision of criteria to evaluate projects *Role of technology*: "To facilitate all aspects of the engagement " (p. 23)	*Key ideas*: Learners contribute to the learning materials via contributions made available to others in a WWW-based system. The others may be others in the same group or others at other times. Key characteristics: the WWW site is largely empty at the start of the learning experience; the learners and the instructor will fill it via the process of many activities during the course Learners learn from realistic materials as well as peer-created materials as much as or more than professionally developed materials Learning materials contributed by students are re-used in other learning settings *Role of instructor*: Designer of activities and of feedback and monitoring strategies for activities. *Role of technology*: To facilitate all aspects of the activities

In all of the approaches described in Table 6, digital learning objects can serve important roles as resources, examples, discussion focuses, or the products of learning, but do not serve as the core of the learning. "Collaborative construction, reconstruction and negotiation of information…are powerful constructivist and generative principles that provide an alternative view of the capabilities of learning object systems for learning" (Bannan-Ritland, Dabbagh, & Murphy, 2000, p. 37). Technologies are taken away from designers and handed over to learners to use as tools for generatively representing and expressing what they know. "Learners themselves function as designers using technologies as tools for analysing the world, accessing information, interpreting and organizing their personal knowledge and representing what they know to others" (Jonassen & Reeves, 1996, p. 694).

This educational philosophy is very different from that underlying most of not all LCMSs or LMSs that see a combination of digital learning objects as adequate in itself for learning. The latter can fit with what Euler (2003) and Issling (2003) note as the least-complex form of learning. Issling notes that learning can be related to behaviourist, cognitive, and constructive theories; the exclusive use of learning objects can fit with a behaviourist or possibly a cognitive approach, while a constructive approach relates to problem solving in which learning objects would play only a supportive role. Euler takes a different approach to his definition of three levels of pedagogy, seeing knowledge acquisition as the least complex; followed by individually oriented constructivist approaches where the goal is self-regulated learning; but with a third level relating to collaborative learning, participation in a community, and knowledge creation and sharing. Euler's three levels can be mapped onto typical pedagogical scenarios in the university, corporate, and military contexts as shown in Figure 13

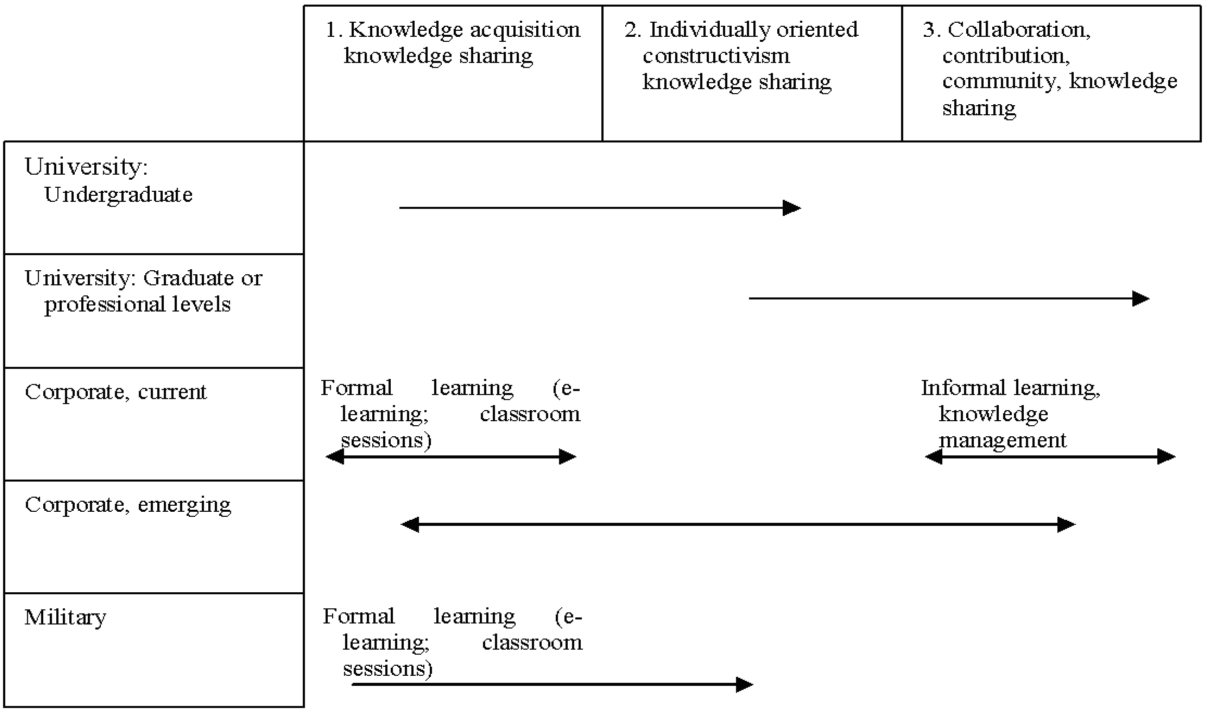


Figure 13 Pedagogies related to organisational setting

The "corporate, emerging" row can be seen in new models of blended learning in corporations where the integration of formal and informal learning through work-based activities can involve all of Euler's levels (Collis & Margaryn 2003). It, and the second row, relating to university courses at the graduate or professional level, represent the difference between learning as acquiring content, and learning…

> *"as a human experience laden as it is with emotive colouring, and nested in an intricate, ever-changing web of relationships…All learning has context, and it has historicity. In both dimensions, [it] is imbued with meaning and emotion far beyond its informational content, and it is netted in a social understanding of the world. ..It has a past and a future. It means different things to different people….The snapshots and freeze frames of knowledge objects…are not to be mistaken for the processes of learning and knowing themselves" (Lambe, 2002, pp. 3, 5-6.)*

2.1.4.3 Levels of learning objectives

The learning objectives or competences related to the tasks are provided using different learning scenarios. These different learning scenarios can be related to differences in required learning objectives and the required cognitive skills for these objectives. To describe the dimensions in terms of cognitive skills the taxonomy of Bloom (1956) is used showing several competence levels within the cognitive domain. The cognitive domain involves knowledge and the development of intellectual skills. This includes the recall or recognition of specific facts, procedural patterns, and concepts that serve in the development of intellectual abilities and skills. There are six major categories, which are listed in order below, starting from the simplest behaviour to the most complex. The categories can be seen as degrees of difficulties; Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation.

Table 7 Taxonomy of educational objectives (Adapted from Bloom, 1956)

Competence	Skills Demonstrated	Question Cues
Knowledge	- observation and recall of information - knowledge of dates, events, places - knowledge of major ideas - mastery of subject matter	list, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
Comprehension	- understanding information - grasp meaning - translate knowledge into new context - interpret facts, compare, contrast - order, group, infer causes - predict consequences	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
Application	- use information - use methods, concepts, theories in new situations - solve problems using required skills or knowledge	apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover
Analysis	- seeing patterns - organisation of parts - recognition of hidden meanings - identification of components	analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer
Synthesis	- use old ideas to create new ones - generalize from given facts - relate knowledge from several areas - predict, draw conclusions	combine, integrate, modify, rearrange, substitute, plan, create, design, invent, what if?, compose, formulate, prepare, generalize, rewrite
Evaluation	- compare and discriminate between ideas - assess value of theories, presentations - make choices based on reasoned argument - verify value of evidence - recognize subjectivity	assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize

The use of cognitive levels such as identified by Bloom can be used for the definition of learning objectives for different learning scenarios. Besides the learning objectives and the related learning scenarios, usability close related to learning from a human perspective as described in the following section.

2.1.5 Usability

A final key element of learning objects from the human perspective relates to usability characteristics. Usability in terms of computer software is defined as learnability, efficiency, memorability, errors, and subjective satisfaction:

- Learnability; the system should be easy to easy to learn so that the user can rapidly start getting some work done with the system,
- Efficiency; the system should be easy efficient to use so that once the user has learned the system, a high level of productivity is possible,

- Memorability; the system should be easy to remember, so that the casual user is able to use the system again some time later without re-learning everything,
- Errors; the system should have a low error rate. If an error occurs, the user should be able to recover from it easily,
- Satisfaction; the system should be pleasant to use (Nielsen, 1994).

Key features of usability relate to consistency, learnability, friendliness in terms of helping the user to avoid errors or in responding to errors, ease of remembering how to use the object once it has been used before, and attractiveness. Attractiveness involves presentation style, appropriate language, appropriate tone and style of communication, as well as visual engagement.

Many factors influence what is appropriate tone and style of presentation and communication for different learners, for example, from different cultures (Collis, 1999; Griffiths, Heppell, Millwood, & Mladenova, 1994). A considerable amount of research is occurring to focus on how to build adaptability into learning objects so that they will adapt appropriately to the needs and characteristics of individual learners, in ways that include preferences for types of approach, forms of communication, and presentation styles (for example Albert, Hockemeyer, Conlan, & Wade, 2001). "Users would like to be able to tailor the resources found…to provide a consistent look and feel…the latter is not a problem in many cases especially in humanistic courses where a course includes a collection of resources for the students to read which come from different authors and are traditionally heterogeneous in format and style" (Russo, Borelli, Castaldo, Graziano, Scarpa, & Vecchio, 2002). However, in corporate contexts, such a mixture would not be considered usable without reformatting into a consistent house style.

In terms of the 4-E Model of factors influencing the likelihood of use of a technological tool, resource, or system, ease of use is one of the key elements (Collis, Peters, & Pals, 2001; Section 1.1.3). Ease of use involves the features of usability identified by Nielsen (1994), but also involves the larger context of use. For learning objects to be used on a large scale in an institution, many things in the culture and context must make this sort of use acceptable. Gray, Allan, and McLean (2000) discuss the importance of winning institutional acceptance for "digital media asset management" at the University of Melbourne and note the need for buy in from "stakeholders in every faculty, as well as the library, the media production service, the IT services, and the university press" (p. 641) as well as management before a critical mass of acceptance could develop. A system and standards for managing learning objects is needed before a critical mass of use will develop, but such a system and standards need acceptance from many stakeholders before being implemented. "The combined approach integrating resource providers, educational evaluators and developers, and academic instructors, is generally acknowledged as necessary for the community [of users of learning objects]. However, in many cases the organisational and cultural mechanisms to achieve this are not yet sufficiently in place" for a critical mass to develop (Calverly & Shepherd, 2003).

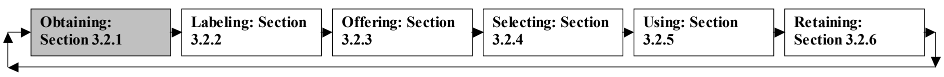
Ease of use also relates to the fit of a technology with ones' own views and practices. For an instructor oriented toward a contribution philosophy of learning (Section 2.1.3) the use of an LCMS and LMS on its own has no fit. For an instructor, such as those in classroom courses in corporate contexts and the military, where no use of a computer usually occurs, the use of digital objects just will not fit with standard practice or the instructor's comfort level.

This section presented a variety of elements involved with learning objects from a human perspective. In the next section the lifecycle of a learning object will be related to the human context.

2.2 The Lifecycle of a Learning Object from a Human Perspective

Section 2.1 presented a variety of elements involved with learning objects from a human perspective. In this section, these elements will reappear but seen from a different perspective in order to relate the lifecycle of a learning object to the human context. The focus in Section 2.2.1 is on obtaining an object, Section 2.2.2 describes how objects are labelled, and Section 2.2.3 how objects are offered. The selection process is described in Section 2.2.4 where Section 2.2.5 looks at the use aspects. How learning objects are retained is described in Section 2.2.6.

2.2.1 Obtaining



How learning objects are created depends on the developer. Choices are to be made by the developer about the sort of learning objects to be created. The pedagogical approach, learning goals, the available resources in time and money, available tools and skills or support for these tools all reflect the eventual result. The organisational context, curriculum or IT staff may set some of these variables. But the freedom within these settings is, how well defined they may seem, very large.

For the "Why?" aspect of obtaining or creating learning objects, these aspects differ among the contexts:

- University: The instructor wishes to supplement the textbook, support a variety of different types of class processes and activities, and bring in new developments and research.
- Corporate: The organisation is concerned with the quality and attractiveness of learning objects, sees cost-effectiveness in replacing the instructor and classroom with learning objects, values the efficiency of reusable learning objects particularly if managed by an LMS. Criteria are that an externally produced object is editable, costs are acceptable, compatible with existing technical systems, and is uniform in terms of house style and branding.
- Military: The organisation chooses CBT and within it, learning objects, for the efficiences and standardization of self-managed learning (costs are not much of an issue as internal consistency and localization).

A key shared issue in "Why?" is whether to make your own or obtain and reuse existing objects (your own, in-house not your own, external).

For the "Who?" aspects:

- University: Decision maker (with respect to support of a technical system and policy), instructor;
- Corporate context: Decision maker, subject-matter expert (SME), multimedia team, course-team (including instructional designers), bricoleur;
- Military: Management, course-development team.

In all three contexts, those obtaining or creating learning objects must know what is available, and decide if they have to make their own or not. If yes, the higher-education instructor is limited by time and skill, while in the corporate and military contexts with a course-development team, the limitation relates to time and funds and personnel available. If an existing learning object is obtained in any setting then privileges, access, and costs must be considered.

From whom learning objects are obtained varies per context:

- University: One's own resources, also from colleagues, projects, conferences, the Web/Internet, consortium resources, and discipline-specific portals or other forms of collections usually of research papers
- Corporate: Consortia supported by the company (see for example, PetroSkills, http://www.petroskills.com/, a consortium of companies in the oil business); or in knowledge-management (KM) systems within the company;
- Military: Nothing obtained from the Internet, everything is self-made, manuals often used as learning resources so the reuse of actual manuals is typically the starting point for learning objects.

Summarizing these points, Figure 14 shows the human aspects of obtaining objects.

Perspective questions	**University**	**Corporate**	**Military**
Why?	Ease of use, professional behaviour, distribution of one's research and ideas	Professional presentation, consistent and efficient distribution	Ease of use, adaptability, efficiency
Who?	Course developers, Student assistants, Educational support staff, consortia, EU projects; Sometimes, a development team.	Course developers, media-support team, knowledge-management personnel	Course-developer teams, media-support team, collaborative projects

Figure 14 Human aspects of obtaining learning objects

2.2.2 Labelling

Providing the appropriate descriptions is a task that should lead to retrievable learning objects. For specific domains only a small group of subject-matter experts is able to recognize a learning object and assign the right metadata. This is in contrast with the idea of a more centralized approach where a librarian labels learning material.

Why labelling? Per context:

- University: To find a previously made resource, aid the instructor's memory as to where the object can be found, to organize material (i.e, folders on the hard drive);
- Corporate: Label to relate to the competency framework, (objects are justified and findable relative to their fit with the competency framework), to anticipate accreditation, maintenance, quality control,
- Military: Label to archive and reproduce (time and shutter on photo) of images, to make subsequent steps of producing images easier, more effective, and more effective; the military has so much expensive media resources, photos or films, that it could not or would not want to make again labelling is necessary to find what is already there.

Who?

- University, instructor or support team; if there is a course-developer group then learning objects are obtained with the advise of the instructor;
- Corporate: Subject-matter experts (SMEs), support-time persons with the advice of the SME;
- Military: With photos, multimedia team because they have the assignment to make photos of a certain physical object, so they can label it; also the course-developer team

Figure 15 shows the human aspects of labelling objects.

Perspective questions	University	Corporate	Military
Why?	Efficiency in finding what has already been created or used	Relate to competence framework and employee profiling	Saving money by labelling costly media objects so that they can be found or reproduced as efficiently as possible
Who?	Individual instructors, professional groups with shared expertise area; librarian familiar with a discipline	Commercial vendors market systems with tagging tools	Commercial vendors, Internal development groups

Figure 15 Human aspects of labelling learning objects

2.2.3 Offering

Once a collection of learning objects has been tagged it can be offered to its public. The "Why?" reasons are similar to those shown for Obtaining or Creating, with the addition that object-service providers must include offering objects to their customers as a key aspect of their business approach. In addition, the instructor in higher education may want to offer his objects for his own professional prestige.

"Who offers?" by context:

- University: Instructors; also when there is a repository service, the business perspective of the service requires offering objects, for example, a university (for prestige and recognition), the Digital University in The Netherlands or other service providers, European Union consortia, domain publishers, owners of discipline-specific portals; conference organizers
- Corporate: Vendors, publishers, whoever maintains the LCMS (publishers offer material through the LCMS); in-house electronic forums, announcements; brochures, marketers using (regular) mail, vendors at trade shows
- Military: All training is done internally so course developers are just offering their objects to each other, a more efficient way of sharing than having to ask each other for certain resources. Some efforts are made to offer learning objects to NATO-country partners.

Figure 16 shows the human aspects of offering learning objects.

Perspective questions	University	Corporate	Military
Why?	Prestige, showing one's knowledge, professional commitment	On a commercial basis	Efficiency
Who?	Joint ventures, service groups or organisations, groups with shared interest, communities of practice	Commercial vendors	Commercial vendors, Internal development groups

Figure 16 Human aspects of offering learning objects

So far, the first three steps relate to those who will be providing learning objects to others. For the next steps, those who use those objects are the focus. Figure 17 shows this crossover, with the ovals on the left relating to the first three stages of the life cycle and the ovals on the right relating to the second set of stages.

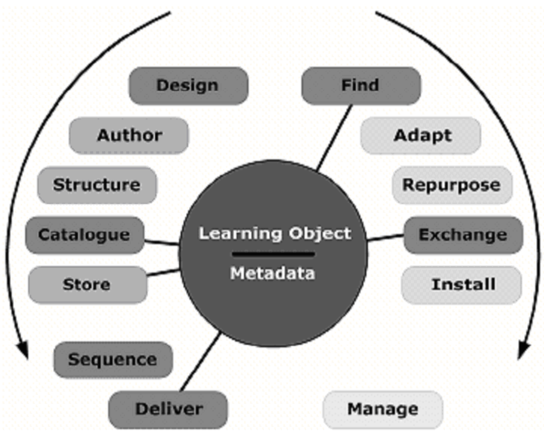
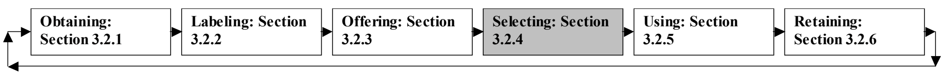


Figure 17 Activities with learning objects (Rehak & Mason, 2003, p. 33)

2.2.4 Selecting



The potential user of a learning object that he or she has not directly produced has to find and select the object from a collection. All of the reasons ("Why?") involved in "Obtaining" and "Offering" are also relevant in the "Why?" of "Selecting".

"Selecting" goes a step further in terms of deciding what of what is offered is potentially usable. The influence of colleagues or advertising or trade exhibits also have a role in decisions about selections. Issues related to mismatches in content, tone and style of communication, presentation, and granularity as well as costs and ownership all influence the selecting process (Calverly & Shepherd, 2003).

"Who"? does the selecting varies in the different contexts:

- University: The instructor;
- Corporate: A subject-matter expert, or the course-design team with a subject-matter expert providing advice, maybe a multimedia team/support staff; or a decision maker (selecting on a broad scale, such as all the products of a consortium or vendor), based on endorsement of colleagues or convinced by a vendor;

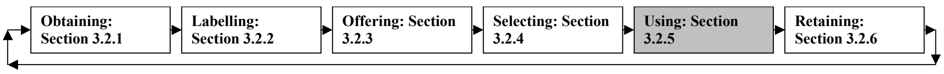
- Military: Course-development team and multimedia team if given steering by the course developers.

Figure 18 shows the human aspects of selecting learning objects.

Perspective questions	University	Corporate	Military
Why?	Fits in curriculum, status, up to date	Needed for training, needed to reduce costs,	Needed for course development
Who?	Instructors	SME, Course-development team with advice of , Support team; Decision maker in terms of a relationship with a ventor or consortium	Course developers

Figure 18 Human aspects of selecting learning objects

2.2.5 Using



Major aspects involves with using a learning object relate to whether it is used in a self-contained manner, as provided by a LMS, or if it is chosen by an instructor or design team to be used in combination with other learning elements (including an instructor).

Why using?: In all three contexts material is used for the development of course material. Using existing material can be efficient and time saving.

Who?:

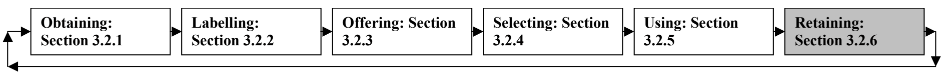
- University: The instructor or learners directly;
- Corporate and Military: Course design and development team, bricoleurs, support persons, SMEs

Figure 19 shows the human aspects of using learning objects.

Perspective questions	University	Corporate	Military
Why?	Extends existing elements (instructor-lectures, textbooks), used as resource for activities	Individualized, anytime, anyplace provision with quality control and tracking	Self-paced, efficient, consistent training
Who?	Instructors	SMEs, course development team, bricoleur	Course development team

Figure 19 Human aspects of using learning objects

2.2.6 Retaining



Retaining is the stage of the learning-object lifecycle where the decision is made if materials are candidates for reuse for the next cycle. If material is still useful it is used again, otherwise the material is deleted or archived.

The Why?s are similar for all contexts: To prevent aging of learning material, to keep up to date, to select best versions, to get errors out. However, for higher education (and now in some corporate contexts) to serve as examples later (reusing participants' submissions)

Who?:

- University: Instructor (maybe supported by a repository team)
- Corporate: Subject-matter expert,
- Military: Subject-matter expert, Multimedia specialist, (in terms of decisions about the aging of photos, quality of media)

Figure 20 shows the human aspects of retaining learning objects.

Perspective questions	University	Corporate	Military
Why?	To keep information up to date, bring in new research	Control quality, bring in new developments	Control quality, bring in new developments
Who?	Course developers, Special interest groups (SIGs)	Course developers, Subject-matter experts, specialist groups	Course developers, Subject-matter experts, specialist groups

Figure 20 Human aspects of retaining learning objects

2.2.7 Modelling the lifecycle

Modelling the lifecycle from both technical and human perspectives will be a focus of this research and will be demonstrated in Chapters 5, 6 and 7.

Others such as Koper (2003) present an approach illustrated as a flow sequence involving both learning objects and services relating to those objects, such as shown in Figure 21.

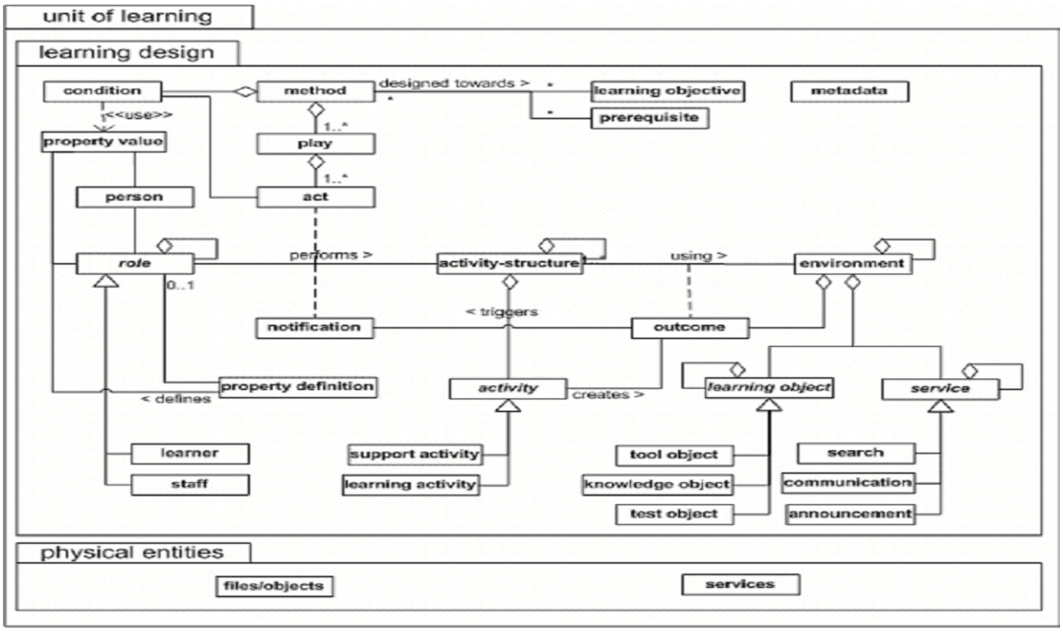


Figure 21 A framework for a unit of learning, containing objects and services (Koper, 2003, p. 55)

Seuffert, Lechner, and Stanoevska (2002) combine four "views" in a reference model for online learning communities that could also be applied in a reference model of the lifecycle of learning objects from a human perspective. These four views are Community view, (a "community is defined as a ensemble of agents sharing a language and a world with values and pursuing common interests, connected via a medium on which they act in roles"); an Implementation view, as the mapping of processes and services into interaction design; a Service view for information exchange, contracting, and other support; and an Infrastructure view for technology that integrates the processes and services. However, while such a reference model implicitly involves the human perspective, its language and approach does not map onto the typical ways that humans refer to their actions and interests.

2.3 Metadata from a Human Perspective

Metadata is a major topic when learning objects are considered from a rational, technical perspective. From the human perspective, metadata have different meanings within each context context. In the university context, metadata are likely to be related to the individual instructor's own way of managing files. In the corporate sector, metadata are likely to be focused on the organisation's competence framework. In the military context, metadata often relate to the technical features of images and specifics relative to the place of an object in a handbook or manual. The discussion of taxonomies for metadata needs to be considered within these differences. In Section 2.3.1 some general issues related to taxonomies and ontologies for metadata are discussed. In Section 2.3.2, some services related to metadata for a particular context are described.

2.3.1 Taxonomies and ontologies

All of the standard bodies are developing taxonomies. While these taxonomies may seem appropriate from a rationale perspective, in (associative) practice they may not reflect the way human users think about learning objects if they go to find them, or have to label them. There are two major issues: Can a taxonomy be generalized across all potential users? How much detail is necessary and how much detail is feasible to collect?

In terms of the first question, a number of groups have tried to define taxonomies for metadata based on pedagogical analyses of potential end users. In the CANDLE Project (2000-2003) considerable effort was put into the modelling of different user groups in order to provide input for the set of metadata to be used (Scott & Van Helvert, 2001). The set of metadata that was decided upon was based on a pedagogical approach to thinking about learning objects (Stevenson & Wetterling, 2003). Figure 22 shows the metadata categories associated with the task modelling shown in Section 2.2.7.

CANDLE Pedagogical Model **-Step 1. Setting Up an Activity** -Date -Author -Title -Domain Focus -Level -Place -Aims -Outcomes -Knowledge -Understanding -Skills -Assessment **-Step 2. Choosing an Activity Structure** -Mode -Tools -Activity Structure **-Step 3. Providing Background Information** -Prior Knowledge -Understanding -Skills **-Step 4. Evaluating the Activity** -Did the activity achieve its outcomes? -Should the activity be changed and/or improved?

Figure 22 Metadata categories based on a pedagogical approach from the CANDLE Project (Stevenson & Wetterling, 2003)

To help users in the CANDLE Project assign these metadata to a potential learning object, a software Wizard was created to guide assigners through each of the metadata categories (Liu, 2003). As much as possible, pull-down menus were available in the Wizard, and for each metadata category. However, even with this detail, the use of the Wizard by an instructor intending to use an eventual object as a potential resource, particularly for a generative or contribution-type activity, is problematic (Brostoff & Kent, 2003). One reason is that with a generative or collaborative approach, the activity is not inherent in the learning object itself, but in what the learner does with the learning object. It may be useful, for example, that a broad selection of learning objects be available, so that the learner can make the decision of which are most useful for his task. In this case, the metadata in Steps 2 and 4, relating to the activity, are in fact outside of the object itself.

Another problem is the selection of a taxonomy. While the fields in the CANDLE metadata appear generally appropriate for a university, they lack many elements that would be necessary in a corporate context or a military context. And even in a university context, it is doubtful if instructors would set up their own folder structure for archiving of documents based on the CANDLE taxonomy. In a corporate context, objects are likely to be labelled in terms of their relation to a competence framework (Mulder, 1999) where personal authorship is of little importance. Adaptations would have to be made to the CANDLE metadata for this orientation. Many of the categories in the CANDLE set would not be particularly relevant to a corporate or military context. In addition, the distinction between understanding, knowledge, and skills is not easy to apply in practice in any context.

More fundamentally, there is considerable debate about the possibility of developing taxonomies that involve the same ontologies for different groups of users. Kraan (2003) notes that objects are "best described by using multiple vocabularies. There is no way to determine which vocabulary will be relevant to either an author or user of a given object…What may be a learning object to you, is a news article, archive context or a use case for somebody else. An object's meaning, in other words, depends on its context of use".

User-tailored descriptions for metadata are a form of peer-to-peer collaboration already being studied in a number of locations. Recker, Walker, and Wiley (2000) describe an approach similar to that used on the Web in public sites such as Amazon Books in which patterns of choices and responses of users are used to identify which objects might be of interest to which persons. Called "collaborative filtering", the approach involves "developing and evaluating a collaborative filtering system, which enables users to share ratings, opinions, and recommendations about resources". They note that "systems built on a collaborative information filtering approach (also called recommender systems) have been demonstrated in a variety of domains, including filtering and recommending books, movies, research reports, and Usenet news articles". In the system developed by Recker, Walker, and Wiley, users enter their opinions about the quality of learning objects using a template related to the metadata fields chosen for the approach. Table 8 shows the template used.

Table 8 Metadata and rating scale, collaborative filtering system of Recker, Walker, & Wiley, 2000

Name	Description	Format
Web site title	The title of the site	Text box
Internet address	The URL of the site	Text box
Keywords	Keywords to classify resource	Multiple selection list
Added by	User name	Automatically generated
ADA Accessibility	Meets Disabilities Act design criteria	5-point Likert scale
Usability	How usable is the resource	5-point Likert scale
Authoritativeness	Authority base of document author	5-point Likert scale
Educational relevance	Educational relevance of the resource	5-point Likert scale
Description	Simple description of resource	Text box
Quality	The subjective quality of the resource	5-point Likert scale
Overall rating	Overall opinion	5-point Likert scale

Recker and her colleagues report results from a group of 15 graduate students contributing ratings using the approach, however with mixed results as most resources only received one review; if such a system would be taken up in widespread practice throughout an organisation is not clear. An incentive for content specialists to take the time to add comments about a particular object is likely to be lacking. (Recker, Walker, & Wiley, 2000).

With regard to incentives for the labelling of learning objects with metadata, a major issue is the amount of metadata that is feasible to expect, given the time constraints of those who enter metadata and given the interests of those who make use of the metadata for the selection of objects. Bois (2002) says that "all" that is needed is that learned societies develop domain ontologies, authors use the new tag editing application to complete their texts with tags, and retrievers use the new browsers that allow the selection of documents by specifying tag contents and relations. However, she acknowledges that while "this is simple it doesn't mean that there is no effort" (p. 343). The effort involved needs organisational embedding and incentives in order to occur.

If learning objects are created by instructors (as is the case in higher education) or by learners themselves, the need for user-tailored categories is large. Tools are needed to help the creators assign the metadata as easily as possible and using categories that are relevant in their own situations. If metadata are to be applied by multimedia specialists, as is often the case with the labelling of images in the military, the majority of the fields will be likely to focus on technical details of the images and on context-specific labels (relating to the content of the images) rather than any of the fields in the CANDLE metadata set.

Taxonomies and ontologies can be used to structure material and to describe relationships between different objects. The potential of using these relationships for searching and selecting learning objects is expected to be high. The development and maintenance of taxonomies and ontologies is problematic for complex domains and automatic generation requires advanced technology that is also still in development.

2.3.2 Services based on objects and metadata

Given all the difficulties in expecting user groups to apply metadata or make use of it, many services have been established, particularly at the university level, to help different groups of users make use of learning objects. Sometimes these are services managed by groups also involved in standards, such as ARIADNE (2002; also Cardinaels, et al, 1998), CanCORE (2003), and AICC (2002) (See Section 3.3). Other times they are services organized partially for the promotion of computer-supported learning such as PROMETEUS (2003), or by particular user groups such as CANDLE (for telematics instructors) or the Digital University (for higher education in The Netherlands). In other cases the services relate more to a particular university context, such as the DSPACE Initiative (http://www.dspace.org) at the Massachusetts Institute of Technology, and the digital media assist system at the University of Melbourne (Gray, Allan, & McLean, 2000). The emphases of these services clearly differ. Some are more oriented toward supply to particular user groups, others toward support of the demands and needs of potential user groups including support for user communities.

In the corporate context, these kinds of services are less frequent. When they do occur, they are likely to be supplied by vendors who in some way are involved in the supply of learning objects, learning-object technologies, or consulting services related to these. This is because corporate-setting users of learning objects are not likely to be searching for such objects from general collections of resources but instead are more likely to first form a relationship with a service provider or within a consortium (such as Petroskills in the oil industry) and then acquire objects within this relationship.

2.4 Issues Related to a Human Perspective

From the discussions in Sections 2.1 to 2.3, many potential issues relating to learning objects from a human perspective have been identified, but within the contexts of other discussion points, such as the lifecycle of a learning object or metadata. Another way to approach learning objects from a human perspective is to ask the question: Will they use them? The "they" refers to those who have a choice about the use of learning objects, with or without metadata, in instructional settings. In Section 1.1.3 the 4E Model (Collis, Peters, & Pals, 2001) was introduced as a tool for predicting the likelihood of an individual's uptake of a technological innovation in his or her own working situation. According to the 4-E Model, this likelihood is related to four clusters of variables: ease of use, perception of effectiveness, personal engagement, and environment. These clusters can be used to discuss issues related to learning objects from a human perspective (Sections 2.4.1-2.4.4).

2.4.1 Ease of use

Ease of use has at least three main dimensions:

- *Usability issues*

  Tools have to be easy to use because of the risk of cognitive overload. Another issue is the computer skills of those involved with learning objects particularly the use of developer tools when there is not sufficient experience with computer-related tasks. Tools have to be easy to use.

- *Need for integrated support*

  Tools have to be presented just in time and seamless integrated in the tools. It should be intuitive to use tools. The primary process is creating course material, not managing content. The use of templates and human support can be essential

- *Time and effort investments*

  The effort invested for providing metadata for reuse should be as little as possible because the payoff is not directly visible. Rewarding the invested effort should be discussed within the organisation.

2.4.2 Effectiveness

Similarly, effectiveness can be seen in three ways, relating to direct learning impact but also short-term and long-term payoff (Collis, Peters, & Pals, 2001). With regard to learning objects these can be expressed as:

- *Pedagogical aspects*

  The opinions of those involved about the potential value of learning objects can vary strongly, particularly in different organisational contexts. Is the use of learning objects pedagogically seen as leading to more effective learning, or is education getting poorer by reuse and recombinations of objects? Is the use of submitted work a solution for gathering more learning objects for reuse or will the lack of quality control and consistency of structure make such objects inappropriate for a learning-object respository? This will depend on the educational philosophy implicit or explicit in the context.

- *Savings in time and effort*

  Is reuse saving time or is the adaptation of learning objects taking too much time? Is the searching for the right content and adapting it if it is found taking as much time as creating it for yourself?

2.4.3 Engagement

Two major aspects of personal engagement are pertinent to the learning-object context:

- *Intrinsic motivation*

  Why should creators want to share their material? What drives them to create learning objects for reuse, by themselve, their colleagues, or others? Showing one's knowledge, getting fame and status within the organisation or the larger professional community can appeal to some but not to others. This difference in intrinsic motivation can be seen in the practice of putting one's articles and books on the World Wide Web; some do it extensively, others never. Spontaneous sharing on the public World Wide Web rarely occurs in the corporate or military sectors, although in corporate knowledge-management systems the use of forums or networks to support communities of practice provides a setting from those intrinsically motivated to share.

- *Willingness*

  Are the developers of learning objects willing to share their knowledge or is it a protected domain of knowledge? Are there organisational policies that limit sharing, even if there were willingness? For researchers, when will sharing interfere with intellectual property and with the uniqueness of one's research? For academics, publishing in academic journals is still a major criterion of worth and journals routinely require signing one's rights over the journal before an article can be published. The copyright policies of publishers of academic journals are major barriers to the willingness of academics to make their quality work available to others for sharing in a digital repository (other than the ones maintained by the publishers and only accessible at a subscription cost). Koppi and Lavitt (2003) note that "for most instructors simple use of technology is as far as they can go, or wish to go, under the circumstances of a research-intensive university…the creation of metadata recurs of their own teaching materials is often perceived as not providing a return on investment, at least not in the short term".

2.4.4 Environment (context)

Within the context or organisational setting, at least four different types of issues affect the likelihood of use of learning objects:

- *Support services*

  How are developers supported in terms of educational, technical, and management? What are the resources available for this support and how are they offered in terms of capacity? How are they available? What is the level of support and what does it include if it is about reuse? Do others or the developers themselves self tag material? All of these questions relate to organisational policy and involve a financial commitment.

- *Organisational incentives*

  What is the reason to implement a reuse strategy in the organisation: status, professional approach, fame? Or efficiency? Under what conditions will acquire learning objects from third-party sources be cost-effective compared to in-house production or to learning approaches that do not make use of digital learning objects at all? How can a organisation provide incentives for sharing and reuse? What are the prerequisites in terms of procedures and facilities if such incentives are in place? Koppi and Lavitt (2003) note that this lack of incentives was a key problem for a learning-objects initiative in their university setting.

- *Access and privileges*

  Who can, or cannot, have access to learning objects? Is material accessible in terms of general embargoed countries or is it secret, classified, commercial secret? In the university context, can students see the work of other students? Does this lead to plagiarism or to lack of control over assessment?

- *Ownership and copyright*

  Who owns material, the creator, the development group, the subject matter expert, the publisher, internet provider, hosting organisation, or the organisation? (Rowe, Webb, and Hartwell-Hunnicutt, 1998, identify this as a critical issue related to learning objects in the university). What is the essence of what is owned? The idea, the actual content, its representation conceptually, or its representation in terms of digital presentation? If adaptations are made to an object, does the owner or copyright holder have to give explicit permission? If so, how is this managed and how is version control maintained?

Thus the 4-E Model provides a reference for identifying a wide range of issues from the human perspective that affect the likelihood of use of learning objects in practice within an organisation. Masie (2003) suggests that what is needed is not a CMS (or LMS or LCMS) but a *context-management* system to take into account the different combinations of the above issues that are relevant in a particular setting.

Based on the preceding sections that were related to learning objects from a human perspective the Research Framework as presented in Chapter 1 can be refined with secondary research questions. This is described in the next section.

2.5 Refining the Framework

This chapter has identified a number of issues that relate to learning objects from a human perspective that expand on the general research questions presented in Chapter 1. In this section, six secondary research questions from the human perspective are identified in Section 2.5.1 and related to the learning-object lifecycle in terms of the pedagogical approaches noted in Section 2.1.4 in which pedagogies were related to organisational context. The secondary research questions from the human perspective underpin all of the three overall research questions presented in Chapter 1.

2.5.1 Secondary research questions, Human perspective

A first major question relates to the likelihood of learning objects having a role at all in an organisational context. If there is no organisational incentive for the support of learning objects, particularly in the corporate and military contexts, then individuals on their own are not likely to even have access to them or have a way to make use of them. In the university setting, reuse will not be systematic, beyond what the individual faculty member does with his own bookmarks and archival and search strategies. Euler (2003) notes that the use of learning objects or any form of electronic-supported learning must be embedded in organisational strategy in order to become mainstreamed. Thus the first secondary research question from the human perspective is:

> *HQ1. Organisational context - Is the use of learning objects embedded in an organisational strategy? If yes, how and why? If not, what then is the meaning of reusable learning objects for the individuals in the organisation?*

This question relates to the Environment vector of the 4-Es in terms of organisational incentives, the Engagement vector in terms of willingness and the Effectiveness vector in terms of organisational pay-off.

Assuming that there is an organisational strategy, then the next major question relates to pedagogy. Identified different pedagogical approaches related to the university, corporate, and military contexts. This leads to the second secondary research question from a human perspective:

> *HQ2. Learning scenarios - What are the implications of different learning scenarios or pedagogical approaches, particularly the contrast between knowledge acquisition and collaborative problem solving and knowledge creation, for the use of learning objects, for their structural requirements, for their quality control, and for their metadata?*

This question relates to the Effectiveness vector of the 4-Es, “pedagogical aspects”.

The third secondary question relates to the source of learning objects, and follows from the answers to the first and second questions:

> *HQ3. Object creation - Who creates the learning objects in a repository or otherwise available for sharing? And what is it that they create: A pedagogically neutral or pedagogical specified resource? Does the object have to be created specifically for learning? What about the quality control of what is created; who affirms this? The creator or the user?*

This question relates to all four of the 4-E vectors.

Assuming that the first three sets of questions have been answered in a way that there still is a place for learning objects in organisational practice, then the fourth secondary question relates to how to support those involved in the lifecycle of a learning object at each of its phases (see Section 2.3).

> *HQ4. User support - What training, support, incentives, tools, and services are needed, for whom, for each of the stages in the lifecycle of learning objects? Who designs these? Who provides these?*

This question relates to the Environment vector of the 4-Es, support services, and to the Ease of use vector, integrated support.

One of the general research questions relates to technology, tools and metadata. This question can also be revised in the human-organisational context of the previous four sets of questions:

> *HQ5. Metadata - Is there a need or wish for assigning metadata to learning objects within the organisation? Assuming its application, who decides what terms and relationships to express? Are these decided from a logical or a user-generated approach? Who applies the metadata, what will motivate them to do this, and how much time will they be willing to spend on the process?*

As with HQ3, HQ5 involves all four 4-E vectors.

2.5.2 Preliminary answers

Given the key secondary questions related to the associative (human) perspective on learning objects and their use in practice, the implications of these for the different organisational-pedagogical settings will be illustrated in Figure 23 to Figure 27 in a way that is embedded in the lifecycle framework.

First, for the university context typical for undergraduates Figure 23 shows the major aspects of the first five sets of secondary research questions from Section 2.5.1:

<table>
<tr><th>Perspective questions</th><th>Obtaining</th><th>Labelling</th><th>Offering</th><th>Selecting</th><th>Using</th><th>Revising</th></tr>
<tr><td>Why?
HQ1, 2, 3, 5</td><td>H3. To keep course up to date related to (own) research</td><td>H5. For personal convenience</td><td></td><td colspan="3" rowspan="2">H2. Instructor, knowledge-acquisition pedagogy, spreading his own research</td></tr>
<tr><td>Who?
HQ1,3,4,5</td><td colspan="2">H3 and H5. Instructor</td><td></td></tr>
</table>

Figure 23 University context, knowledge-acquisition

Figure 23 does not indicate an answer to HQ1, because there usually is not any organisational strategy relating to the use of learning objects. What occurs is typically at the instructor's own initiative. Figure 23 also does not include an answer relating to HQ4, as generally no specific tools or support will be available to the individual instructor.

For the second row in Figure 23 relating to the university context but for more-senior students such as graduate students or professional-development courses, the framework remains similar to that shown in Figure 23, but may be extended in two major ways: Learners themselves will be more active in obtaining learning objects because of a different pedagogical philosophy (professional community, sharing, collaborating, problem solving); and the larger professional community may be involved in the determination of metadata. Also, the larger professional community may provide forms of support. Figure 24 shows this distinction:

<table>
<tr><th>Perspective questions</th><th>Obtaining</th><th>Labelling</th><th>Offering</th><th>Selecting</th><th>Using</th><th>Revising</th></tr>
<tr><td>Why?
HQ1, 2, 3, 5</td><td colspan="3">H3 and H5. Increase professional awareness and identity</td><td colspan="3" rowspan="2">H2. Instructor, for pedagogical or professional reasons</td></tr>
<tr><td rowspan="2">Who?
HQ1,3,4,5</td><td>H3. Instructor and learners</td><td>H5. Instructor, larger professional community</td><td></td></tr>
<tr><td colspan="6">H4. Larger professional community may provide support</td></tr>
</table>

Figure 24 University context, participation/contribution pedagogy

There is still no indication related to HQ1 because there is usually no institutional strategy or embedding. It is still up to the individual instructor to choose a strategy.

In the corporate setting, as seen in Figure 25, there can be two different framework representations, one related to the typical use of learning objects as e-learning reflecting a knowledge-acquisition philosophy, and the second representing the use of learning objects in informal learning based on a community-of-practice, knowledge-sharing educational philosophy. Figure 25 shows the first of these:

<table>
<tr><th>Perspective questions</th><th>Obtaining</th><th>Labelling</th><th>Offering</th><th>Selecting</th><th>Using</th><th>Retaining</th></tr>
<tr><td>Why?
HQ1,2,3,5</td><td colspan="2">H3 and H5. To match competence framework</td><td></td><td></td><td>H2. Acquisition philosophy</td><td></td></tr>
<tr><td rowspan="2">Who?
HQ1,3,4,5</td><td colspan="2">H3 and H5. Provided by LCMS, LMS, specialist staff</td><td></td><td></td><td>H1.Learning manager, efficiency reasons</td><td></td></tr>
<tr><td colspan="6">H4. Specialist staff working with LCMS, LMS,</td></tr>
</table>

Figure 25 Corporate context, knowledge-acquisition use of learning objects

It is in the view shown in Figure 25 that the typical orientation of LMSs and LCMSs applies. Figure 26 in contrast shows the typical orientation of those involved with knowledge-management systems for informal learning within corporations.

Perspective questions	Obtaining	Labelling	Offering	Selecting	Using	Retaining
Why? HQ1,2,3,5	H1. HR policy reasons H2. Pedagogy of community of practice					
Who? HQ1,3,4,5	H3 and H5. KM professionals, competence specialists			H4. Support via forum moderators, discussion groups for knowledge sharing		

Figure 26 Corporate context, knowledge sharing and community of practice orientation

The major distinctions between Figure 25 and Figure 26 are that Figure 25 is based in the learning director's domain of responsibility while Figure 26 is based in the knowledge-management domain. Typically these domains do not intersect in the corporate context.

Finally, for the military context, the same general view of the framework applies as for the knowledge-acquisition corporate setting (Figure 26), but with the addition that media specialists will be involved in the obtaining and labelling of learning objects (HQ3 and HQ5) and without the emphasis on the use of LMSs and LCMSs as sources of objects and of support. Figure 27 shows this view:

Perspective questions	Obtaining	Labelling	Offering	Selecting	Using	Retaining
Why? HQ1,2,3,5	H1. Efficiency reasons H2. Acquisition pedagogy					
Who? HQ1,3,4,5					H1. Policy maker	
	H3 and H5: In-house development team, media specialists					

Figure 27 Military context

Thus, as Figure 23 to Figure 27 show, the context creates different views of the key issues and players related to the lifecycle of learning objects, at least according to the literature. It is clear that there is no single or simple answer to questions relating to learning objects from a human perspective. However, the five different views of the lifecycle framework shown in Figure 23 to Figure 27 suggest that within a view, progress can be made to at least better understand the dynamics (Secondary Questions 1 and 2) and to provide better tools and support (Secondary Question 4) for obtaining, labelling, and using learning objects (Secondary Questions 3, 5, and 2). In this way an integration of the rationale and associative perspectives (Moonen, 2002) might be more likely to occur. These figures and the preliminary answers to the secondary research questions shown within them are based primarily on the literature. They will be verified in field works settings in Chapters 5, 6, and 7.

As this chapter has examined the human perspective, the following chapter moves to the technical perspective.

3 Learning Objects from a Technical Perspective

In Chapter 1, Section 1.4, the research was expressed in terms of two main dimensions: One related to the human-aspects context of learning objects, and the other related to the objects and their associated tools and techniques from a technical perspective. Also in Chapter 1, the interaction between structured and associative aspects of design was introduced in Section 1.2.3.1 (Moonen, 2000, 2002). The technical perspective relates to structured design. In the structured approach, there is a "strong assumption that the problem is well defined" (Moonen, 2000, p. 167) and that the problem can be logically decomposed into sub-problems (Simon, 1969). In this chapter, the structured, technical perspective on learning objects will be emphasized. Figure 28 repeated from Figure 5 in Chapter 1 and related to the second set of research questions shows this focus.

Perspectives	Perspective questions	Obtaining	Labelling	Offering	Selecting	Using	Retaining
Human	***Why?***						
	Who?						
Technical	***What?***						
	How?						
	Where?						

Figure 28 Key cells for the technical aspects

Section 3.1 introduces key definitions related to learning objects in a technical perspective and Section 3.2 extends the definition of the lifecycle of a learning object, that was given in Section 1.3, from a technical perspective. In Section 3.3 metadata is the focus, including some key initiatives for the formalization of specifications and standards related to metadata. Section 3.4 then introduces five key sets of issues relating to the technical perspective. From this, the chapter concludes with a revision of the research framework in Section 3.5, based on critical aspects and secondary research questions relating to the technical perspective.

3.1 Key Elements of the Technical Perspective

This section will define the most important terms used in this research related to the technical perspective. The terms Learning Object will be defined in Section 3.1.1, Granularity in Section 3.1.2, Metadata in Section 3.1.3, Standards in Section 3.1.4, and Tools and technologies in Section 3.1.5.

3.1.1 Learning objects

Hodgins (2002) introduced the term “learning object” in 1992, based on experiences with his children playing with Lego™ building blocks, Hodgins realized that his learning-design efforts might benefit from plug-and-play interoperable pieces of learning content that could be assembled and reassembled as needed. The term “learning object” has since been defined in many articles and in various projects. This section gives a short overview of the history of learning objects and definitions used. The section ends with the definition used for the research. Learning objects are commonly viewed as the smallest element of stand-alone information required for an individual to achieve an enabling performance objective or outcome. Learning-object uses include, but are not limited to, online instruction or performance support. Grounded in the object-oriented paradigm from computer science, learning objects are central to instructional theories offered by Merrill, Li, and Jones (1989). These theories support breaking down content to constituent parts, then reassembling that content to meet specific learning goals (Jones, Li, & Merrill, 1990). In the period from 1992 to 1998 the Learning Object Metadata Group from the National Institute of Science and Technology and the Computer Education Management Association (CedMA, 1991) began to address learning-object issues such as modularity, database centricity, and metadata. The Aviation Industry Computer-Based Training Committee (AICC, 2002); the International Electrical and Electronics Engineers (IEEE, 2003); Learning-technology standards Committee (LTSC, 2002); the Instructional Management Systems (IMS); Global Consortium (IMS,2002), and the Alliance of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE, 2002) started their work in the learning-object arena, paying particular attention to the development of standards. Around this same time, Oracle introduced the Oracle Learning Architecture (OLA), an early attempt at an authoring environment using learning objects (Wagner, 2002). (Oracle later stopped the development of OLA because of the fast changes in specifications in the Microsoft Windows platforms.) The definition used for learning objects by Oracle was the following:

> *A Learning Object can be defined as a distinct, stand-alone piece of education. It can be taken in isolation or as part of a larger course. This is exactly the same principle behind Programming Objects, where stand-alone components are reused in different ways for different applications. When Learning Objects are fully implemented, it is possible for every user to define their own unique educational experience (Ellwood, 1997).*

Barritt who worked on the development of OLA continued these efforts for Cisco Systems (Barritt, Lewis, & Wieseler, 1999) and this resulted in a release of Cisco's white paper on Reusable Learning Objects in 1998. In this white paper Cisco defines two sorts of learning objects, RIOs and RLOs. At its core is the RIO, a learning nugget that contains content, practice, and assessment components. Each RIO is defined as a concept, fact, process, principle, or procedure, and tagged appropriately. Several RIOs, as few as five and as many as nine, are combined together to create a Reusable Learning Object (RLO). If a RIO can be equated with an individual component of a learning objective, an RLO is the sum of RIOs needed to fulfill that objective. Each RLO, which also includes introduction, summary, and assessment items, is designed to meet a learning objective derived from a specific job task (Barritt, Lewis & Wieseler, 1999). A more holistic definition comes from Wiley (2000b) who worked closely with Merrill and defined learning objects as:

> *Any digital resource that can be reused to support learning.*

Working together does not mean that definitions used are the same. This broad definition of Wiley somewhat contradicts the strict definition of knowledge objects used by Merrill (2000):

> *A knowledge object consists of a set of fields (containers) for the components of knowledge required to implement a variety of instructional strategies. These components include: the name, information about, and the portrayal for some entity; the name, information about, and the portrayal for parts of the entity; the name, information about, values, and corresponding portrayals for properties of the entity; the name, and information about activities associated with the entity; and the name and information about processes associated with the entity.*

Knowledge objects can also been seen as learning objects in terms of reusability and also can be compared with the definition of Barritt, Lewis, and Wieseler, (1999) who identified: Educational learning objects, Content objects, Training components, Nuggets, and Chunks as terms used in the industry. This broader set of industrial terms includes even a broader pool of definitions. For example from Robson (2001):

> *The Learning objects are the core concept in an approach to learning content in which content is broken down into "bite size" chunks. These chunks can be reused, independently created, and maintained, and pulled apart and stuck together like so many legos.*

The definition used in this research will be adapted from that of the IEEE Standardisation Body (2003) which in turn was adapted from the Learning Object Metadata (LOM) (LTSC, 2002) definition that defines an object as:

> *A learning object is any entity, digital or non-digital, that may be used for learning, education or training.*

This definition of IEEE/LOM will be used for this research but with the important difference that the "non-digital" kind of material will not be included in the research. The definition is used because it has been formulated and supported by a large community and can be applied for a large range of learning objects. The members of the community come from academia, higher education, corporate, and military organisations.

3.1.2 Aggregation levels and granularity

The definition of learning objects in Section 3.1.1 does not prescribe the size of learning objects, Robson (2001) notes that:

> *There is no standard for the size (or granularity) of a learning object. Larger learning objects are typically harder to reuse, and smaller learner objects save less work for those who are reuse them. Per the literature of pedagogy, the happy medium has been estimated as between five and fifteen minutes of learning material.*

Also Hodgins (2000b) suggests that:

> *There is no set absolute size to a learning object, since the size of the object will be relative to the needs of learners and the requirements.*

This corresponds with the white paper of Cisco (Barritt, 2001) that starts with a comment about the size of an object:

> *The size and shape of an "object" is open to each organisation to define. This decision is based upon the needs, tools, processes, and business goals of the organisation.*

To deal with the different approaches of defining the size of learning objects and granularity within the research there is no size or content structure of objects defined according to the definition of learning objects in Section 3.1.1. However to deal with granularity aspects, within the LOM vocabulary (LTSC, 2002) four levels of granularity are defined. These four levels are used within the research to identify the level of aggregation:

1. The smallest level of aggregation, such as raw media data or fragments (pictures, plain text, Word document, PowerPoint files, attachments in a course-management system)
2. A collection of atoms, such as an HTML document with some embedded pictures or a lesson (a webpage, a archive item in a course management system)
3. A collection of Level 2 learning resources, such as a web of HTML documents with an index page that links the pages together or a course (a course within a course-management system)
4. The largest level of granularity, such as a set of courses that lead to a certificate (a set of competences that lead to a profile set of courses).

As another example of granularity within learning objects, Wiley (2000a) identified five types of learning object types that vary in: number of elements, type of objects contained, reusable component objects, common function, extra-object dependence, type of login contained in the object, potential for inter-contextual reuse, and potential for intra-contextual reuse. The different types of learning objects vary in behaviour, complexity, content, and functionality. This means that also the technology has to cover the differences in the types of learning objects. Authoring tools should provide the support to deal with different types of learning objects and variances in granularity.

3.1.3 Metadata

Two definitions of metadata are given that are used for the research. The definitions relate directly to the learning objects in Section 3.1.1 because the metadata are used for describing and finding these learning objects for reuse.

> *1. Metadata is information about an object, be it physical or digital. As the number of objects grows exponentially and our needs for learning expand equally dramatically, the lack of information or metadata about objects places a critical and fundamental constraint on our ability to discover, manage and use objects (LTSC, 2002).*
>
> *2. The purpose of metadata (data about data) is to provide a common nomenclature enabling learning resources to be described in a common way. Metadata can be collected in catalogues, as well as directly packaged with the learning resource it describes. Learning resources that are described with metadata can be systematically searched for and retrieved for use and reuse (Dodds, 2001b).*

Hodgins (2000b) in contrast identifies two different sorts of metadata: “Objective and subjective”:

> *Objective metadata is factual information, most of which can be generated automatically, things such as physical attributes, date, author, operational requirements, costs, identification numbers, and ownership. Subjective metadata is the more varied and valuable attributes of an information object determined by the person or group who creates the metadata. The labels on the cans are objective metadata; your opinion of the product, or whether it worked as well as a fresh ingredient in your favourite spaghetti sauce, is subjective metadata. With new technology that can extract and recognize these attributes, it is possible to find, combine, and use not only text-based information but also a person’s face, a sound, a smell, a shape, or “things like _____”.*

The difference between objective and subjective data is important because the objective data can be gathered using tools and technology. Most objective data can be provided automatically. Subjective data are difficult to handle in terms of tools and technology because human values (see Chapter 2) are involved. Tools can support a person adding this kind of subjective data, but can never assign it automatically,

The definitions of ADL SCORM™ and LTSC are similar in terms of the focus on retrievability and supplementary in terms of the use of metadata. ADL SCORM™ defines where the metadata should be kept or stored, while LTSC emphasises the need for metadata in situations where the number of objects is growing and management is impossible without tools. Both definitions are relevant for the research. See Section 3.3 for detailed descriptions of the standards.

3.1.4 Standards

Standards can be developed in two ways: (a) Development by an official standardisation body, like the International Standardization Organisation (ISO, 2002) or Institute of Electrical and Electronics Engineers, Inc (IEEE, 2003); or (b) Development of the standard without the help of a standardization body. The success of the standard can be measured by how many people use the standard. If a standard is used by the industry but not officially approved (yet) then it is called a “de facto” standard. A standardisation body has several committees working on creating different specifications for standards in all kinds of fields. The standardization bodies use several stages of adaptation before a standard reaches an official “de jure” status. “De jure” literally means ‘legally’ and is used for standards that are recognised by official standards bodies such as ISO and IEEE. For example, the IEEE uses the stages shown in Figure 29 for developing a new standard. PAR stands for Project Authorization Request:

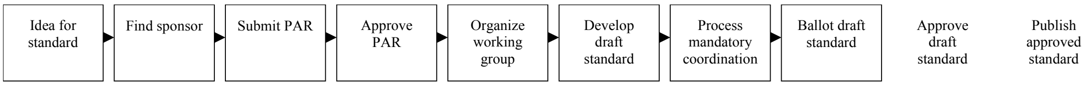


Figure 29 The standards development process (IEEE, 2003)

3.1.5 Tools and technologies

This section describes tools and technologies used to create and edit learning objects, add, and use metadata, and reuse learning objects according to the applied standards.

Four different sorts of technologies in terms of systems and tools can be identified to create, edit, manage, maintain, and use learning objects in different organisational settings.

- Authoring tools
- Learning Content Management Systems
- Course Management Systems
- Learning Management Systems

To obtain or create learning objects (a) authoring tools (Section 3.1.5.1) are used. These authoring tools vary in complexity, features, and the skills needed to use. Once the learning objects are created they can be stored in the (b) Learning Content Management System (LCMS) (Section 3.1.5.2). A LCMS can be compared with a repository that holds a large set of learning objects that are structured in such a way that users should be able to retrieve every learning object based on metadata. A (c) Course Management System (CMS) (Section 3.1.5.3) can be used to structure and organize so that the learning objects have a logical order, sequence, and consistent behaviour in a course, lesson, or module. The learning objects used can be selected from the LCMS or taken directly from an authoring tool. The interaction between learning objects that can be part of a course and users is regulated and managed by the (d) Learning Management System (LMS) (Section 3.1.5.4).

Figure 30 shows the relation between authoring tools; LCMSs, CMSs, and LMSs and the stages in the learning-object lifecycle. (The learning-objects lifecycle was introduced in Section 1.3 and will be further expressed in Section 3.2.)

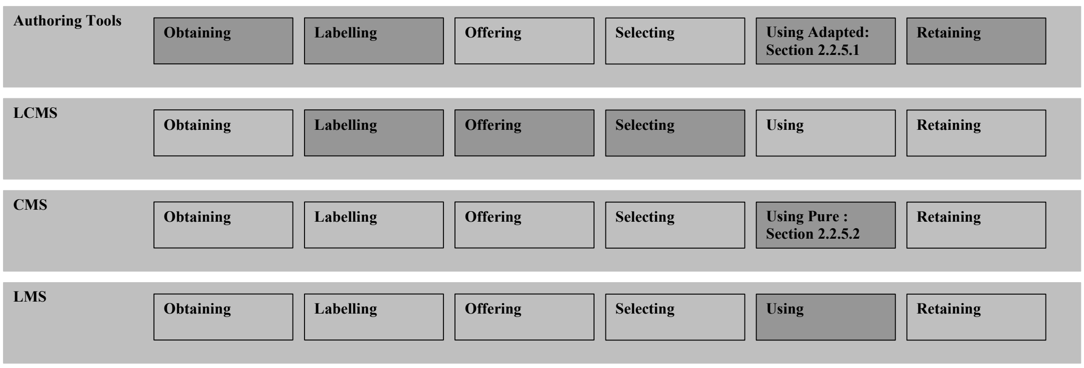


Figure 30 Relation between authoring tools, CMS, LMS, and LCMS and stages in the learning object s lifecycle

3.1.5.1 Authoring tools

Figure 30 shows where authoring tools are used in the learning-object life cycle. Authoring tools can be available as separate software programs like Lectora, Webmentor, Course generator, or SCO-generator, but can also be part of a CMS or LCMS. Figure 31 shows a screen dump of the SCO-generator as example of an authoring tool.

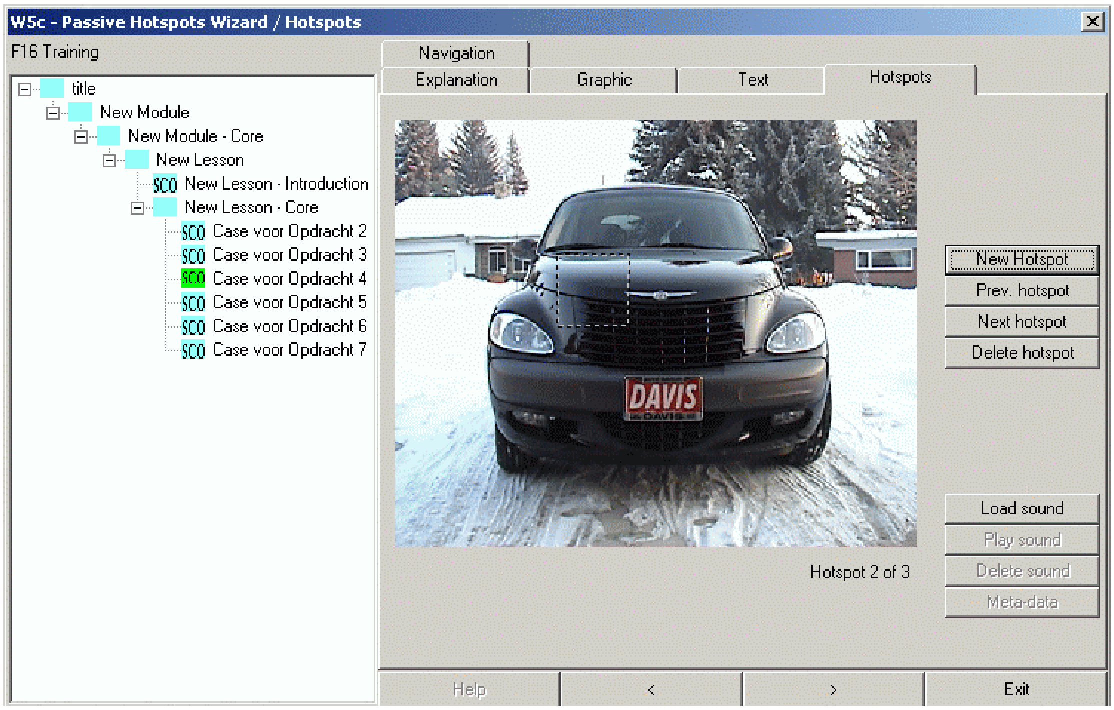


Figure 31 Screendump of the SCO-generator (Boot, Bots, & van Schaik, 2003)

The main tasks of authoring tools are obtaining, creating, or editing learning objects. Authoring tools can also be used to structure or combine learning objects into modules, lessons, or courses. The more sophisticated the tools are the more options they offer in terms of pedagogical guidance and templates based on instructional principles. Some tools also offer meta-tagging tools and functionalities for packaging and distribution. Macromedia offers authoring tools like Toolbook, Authorware, Flash, and Director. The current latest version (http://web.macromedia) includes integrated direct hosting services for the course material built with the tools. Figure 32 shows in grey the stages in the learning-object lifecycle where authoring tools are used.

Figure 32 Authoring tools and stages in the learning-object lifecycle

Although most authoring tools pretend to be free from pedagogical principles, see for example the analysis of tools done by Chapman and Hall (2001), some authoring tools provide templates to create learning objects in the form of lessons or courses based on instructional models. The templates give guidance in what steps are needed in the instructional process. As an example the SCO-generator, developed by TNO (Boot, Bots, & Van Schaik, 2003) provides this sort of support. These tools can for example provide basic support according to the events of instruction described by Gagné (1985). Another example is the set of templates built at the University of Wollongong (Lukasiak, Burnett, Drury, & Goodes, 2003) The Dutch Open University extends the pedagogy used in course development by defining Educational Modelling Language (EML, 2003) for authoring.

3.1.5.2 Learning content management systems

Chapman and Hall compared in 2001 a set of 29 LCMS products. To determine if a product could be used as a LCMS the system should offer reusability of learning content and be generally constructed using an learning-object model. The following definition was used for the comparison:

> *A LCMS is a multi-developer environment where developers can create, store, reuse, manage, and deliver learning content from a central object repository (Chapman & Hall, 2001).*

When learning objects are stored in the repository, they are labelled according to their specific contents and properties. The learning objects are then offered for selection. The selection process can be supported by the following services (Pushpagiri & Rahman, 2002).

- Search services, keywords, such as the advanced and browse levels of Yahoo; Task of the LCMS, or the repository or the search engine
- Browse services, based on taxonomy (like competences); Task of the LCMS, or the repository or the search engine
- Preview services, to see what material looks like (can be done in actual authoring systems); Task of the LCMS, or the repository or the search engine or system that holds the material
- Download services, for exchanging or reusing material with other system; Task of the system that holds the material

Also the brokerage service of learning objects discussed by Anido, Fernández, Caeiro, Santos, Rodríguez, & Llamas (2001) can be seen as an important part of a LCMS. Within the brokerage service four different roles can be identified: Customer, broker, supplier and, helper (Blinov, 1998). Customers access the LCMS to search and locate information and products. The LCMS offers several tools to assist the customer in the searching process. Brokers serve as interfaces between customers and suppliers. They provide information about price, delivery conditions, and other practical matters. Suppliers provide information to customers through brokers. They describe their products and services to their brokers to make them available to customers. Helpers provide additional services and support, like authentication, payment management, or transaction security.

For brokerage the system has to perform four actions, Search, locate, order, and deliver (Anido, Fernández, Caeiro, Santos, Rodríguez, & Llamas, 2001; Blinov, 1998):

- Search occurs when a customer asks a broker to find some products or services. The result of this action is a list of unique identifiers for the products or services satisfying the needs of the customer.
- Location takes place when the customer asks the broker to provide the coordinates of a product or service. For this the customer produces the unique identifier for the desired resource, and obtains, as a result, a list of unique identifiers for resource location, together with information about practical matters such as delivery conditions, or price.
- The order action is triggered when a customer asks for a resource, after it has been located. This action evolves through two different phases: negotiation and purchase.
- The process ends with a deliver action. Through this action, the broker delivers the acquired product.

The actions and roles are summarized in Figure 33. The helpers that provide these facilities to complete and secure the brokerage process manage all the authentication, security, and payment. In order to verify the identity of one actor to another, an authentication exchange may need to take place. This may occur during any of the actions. It may be necessary for payment to take place during a transaction. In this situation, one actor pays one or more other actors. As part of any action, it may be necessary to carry out some security operations, such as encryption of data, verification of source and content integrity of product, or digital signature of some data entity or entities (Blinov, 1998).

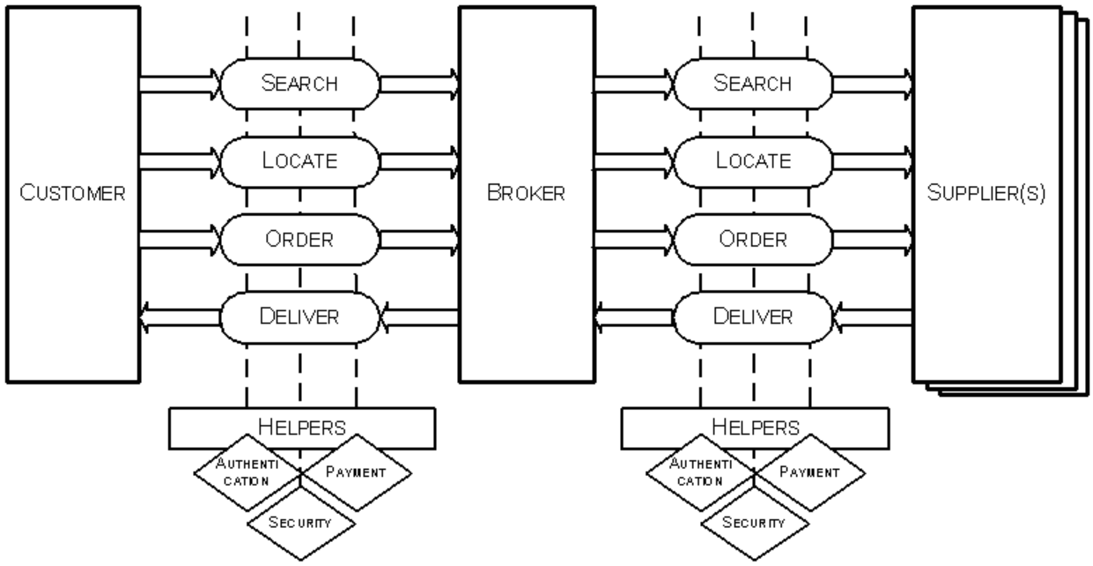


Figure 33 Brokerage roles and actions (adopted from Blinov, 1998, pp. 13)

Figure 34 shows the functionalities offered by a LCMS in relation with the learning-object life cycle, indicated with grey parts of the figure.

LCMS	**Obtaining**	**Labeling**	**Offering**	**Selecting**	**Using**	**Retaining**

Figure 34 LCMSs and stages in the learning-object lifecycle

Besides their role for the management of learning objects, LCMSs are also used as knowledge-management systems to store "pieces of knowledge", as example in the form of presentations, and discussion topics to integrate the knowledge of experts in the process of learning.

3.1.5.3 Course management systems

Course Management Systems (CMSs) are basically used for providing learning objects in a course or lesson structure. CMSs provide tools to combine learning objects selected from the LCMS or create learning objects using integrated authoring tools. Most CMSs also contain LMS functionalities regarding to accessibility, authentication, tracking, and tracing. Landon (1997) provided an online-decision tool to compare different CMSs according to their functionalities.

Figure 35 shows the place for the use of CMSs in the learning-object lifecycle via a grey area.

CMS	Obtaining	Labeling	Offering	Selecting	Using	Retaining

Figure 35 CMSs and stages in the learning-object lifecycle

3.1.5.4 Learning management systems

The LMS controls access to learning objects based on course structure and permissions given by system administrators. The LMS can hold information pertaining to users, but also about the actions carried out by the users in terms of accessing learning objects. A large set of variables, taken from the AICC (2002), is specified within the ADL SCORM™ (Dodds, 2001a,c; ADL SCORM™, 2003) to indicate what information can be stored and retrieved by a learning object from the LMS. This includes for example: scores on tests, duration of access, number of attempts, and object accessed. Figure 36 shows the functions of the LMS in relation to authoring systems like Dreamweaver and content suppliers like Smart Force, Netg, and Skillsoft and the delivery of courses to different users including tracking the activities of the users.

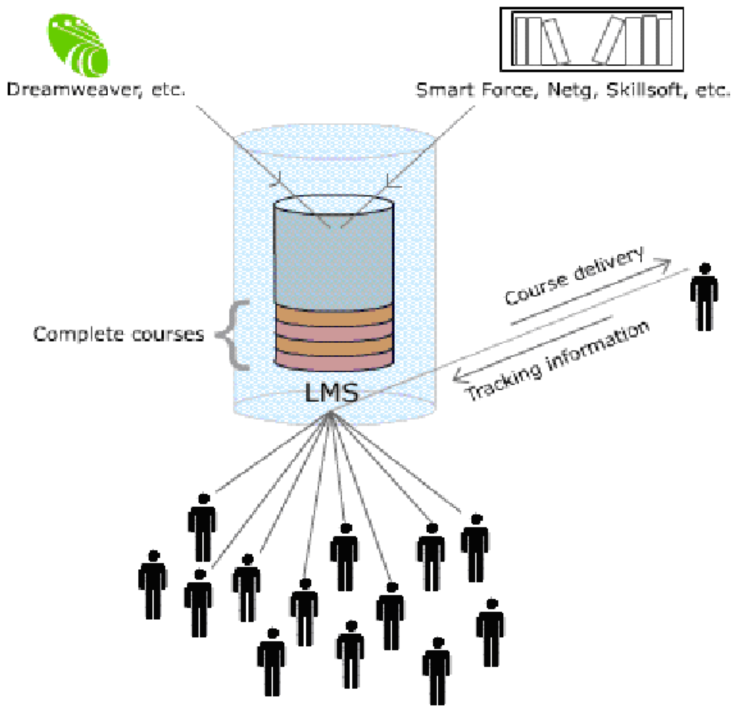


Figure 36 LMS (adapted from Nichani, 2001)

The grey area in Figure 37 shows the stage in which functionalities are involved related to LMSs in the learning-object lifecycle.

LMS	Obtaining	Labeling	Offering	Selecting	Using	Retaining

Figure 37 LMSs and stages in the learning-object lifecycle

3.2 The Lifecycle of a Learning Object from a Technical Perspective

Figures 5-10 mentioned six stages of the lifecycle of a learning object. In this section the different stages of the lifecycle of a learning object are described in more detail from a technical perspective. The focus therefore will be on the How?, What?, and Where? questions of the research framework (Figure 7, Chapter 1), that cover most of the technical aspects discussed so far in Chapter 0. The Why? and Who? questions related to the learning-object lifecycle are emphasized in Chapter 2, covering the human aspects. The How? and Where? question can directly be related to the tools and systems described in Sections 3.1.5.1 to 3.1.5.4.

Section 3.2.1 will focus on the technical aspects of obtaining or creating learning objects; Section 3.2.2 describes how learning objects are labelled, Section 3.2.3 how learning objects are offered to users, Section 3.2.4 how the learning objects can be selected, Section 3.2.5 focuses on the use of learning objects and Section 3.2.6 describes how learning objects can be retained. Section 3.2.7 offers a procedure for how modelling the lifecycle from a technical point of view can be organized. Figure 38 is repeated in the Sections 3.2.1-3.2.6 to show which stage in the lifecycle is described. The dark-coloured cell in the sections refers to the stage in the lifecycle.

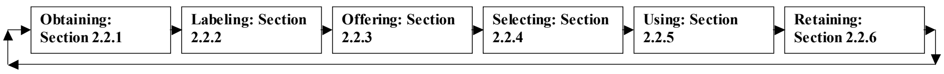
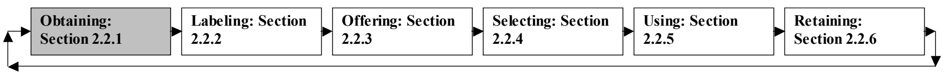


Figure 38 Stages within the learning-object lifecycle

The first stage of the Learning-Object Lifecycle is “Obtaining” and is described in the next section.

3.2.1 Obtaining



The first stage of the lifecycle is obtaining or creating a learning object. All the following stages depend on this first one. Material is obtained in a digital form for easy distribution and adaptability. Also the desire for quality in terms of professional behaviour and consistency in presentation play a role. In different organisations various kinds of templates are available for example, to create PowerPoint presentations, documents, and proposals. The use of templates provides structure and can help users to create consistent pieces of material. Templates are therefore an important tool for obtaining a new object. Consistency can be found in how courses are built, but also in how face-to-face sessions are organized when templates are used.

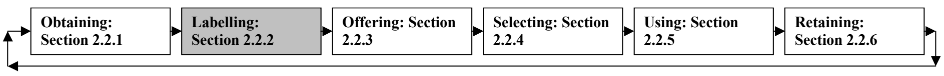
Within the university different types of materials are developed. Development is done for several reasons, for example to explain difficult topics and provide an additive simulation such as Min (1995) describes in the case of the tool JavaTHESIS. Collaboration with other universities can also result in the development of learning objects, for example the ZAP (Zeer Actieve Psychologie [Very Active Psychology]) project that delivers a set of learning objects that can be used in several CMSs in higher education (Eysink, Hulshof, & Loyens, 2002). In the corporate setting, specialist course developers often develop pieces of material, for example the Open University in the UK that provides business-oriented learning objects for the Shell EP Learning Centre. Within the military, external partners that work closely with the aircraft developers to build large aircraft simulations. Figure 39 shows different aspects related to organisational settings with regard to obtaining learning objects and the technical perspectives (the Human perspective questions Why? and Who? were discussed in Chapter 2).

Perspective questions	University	Corporate	Military
What?	Presentations, assignments, course descriptions, guidelines, animations, development tools,	Course material, presentations, E-modules, simulations	CBT, pictures, movies, photos, animations, simulations.
How?	Templates	Templates	Templates
Where?	Authoring tools, scanner, office tools (Word, PowerPoint), hard disk	Authoring tools, scanner, digital camera, software programs, 3rd-party commercial development, office tools (Word, PowerPoint)	Authoring tools, scanner, digital camera, software programs, 3rd-party commercial development tools

Figure 39 Technical aspects of obtaining learning objects

Creating learning objects is from a technical point of view a combination of technical skills and tools. Even a simple learning object that consists only of a set of HTML pages requires a certain basis of knowledge of tools that can create these pages, or programming skills. Tools or applications that can create learning objects differ in complexity. Applications like Microsoft Word and Powerpoint already have the capabilities to create webpages. More advanced tools like Lectora and Webmentor add more possibilities for interaction and have implemented the standards further in terms of adding metadata (See Section 3.2.2) and packaging (See Section 3.2.3).

3.2.2 Labelling



After a learning object is obtained, the second stage of the lifecycle is labelling the object. The most-arbitrary form of labelling is providing a filename or subject for the learning object. Tagging tools can facilitate and support adding metadata to the objects. Text processors like Microsoft Word (Figure 40) also have metadata-tagging tools for documents

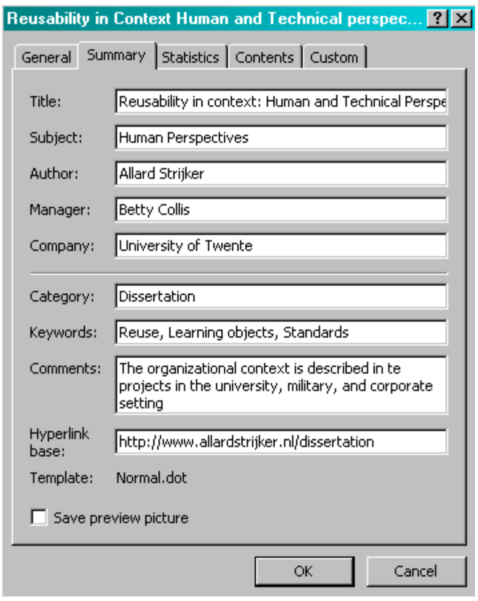


Figure 40 Microsoft Word template for metadata

The use of database-oriented developers' tools makes it possible to gather metadata from different locations and resources for a learning object. Also the use of profiles can make labelling of material easier. Profiles can be seen as predefined sets of data that are filled in automatically as initial values when a learning object is tagged. Inheriting metadata from a learning object to a similar learning object can reduce the time that is needed to be invested in labelling a new object. Inheritance can play a important role because the needed set of metadata for learning objects can be identical for certain settings. Examples of profiles can be found in the current versions of Internet Explorer that provides for fill-in forms and an "Auto-complete" function. Google provides a dialog box with set of previously used terms that can be chosen as values (Figure 41).

Figure 41 Auto-complete function Google (http://www.google.com)

A tool that is part of the Google-toolbar (Google, 2003) extends this "Auto-fill" idea. After filling in the profile, it recognizes form fields in web pages and offers to fill them in according to the provided profile data. By clicking one button, recognized fields are filled in automatically. Figure 42 shows the profile, a web page that contains fields that are recognized by the tool, and a web page filled with data from the profile after using the tool.

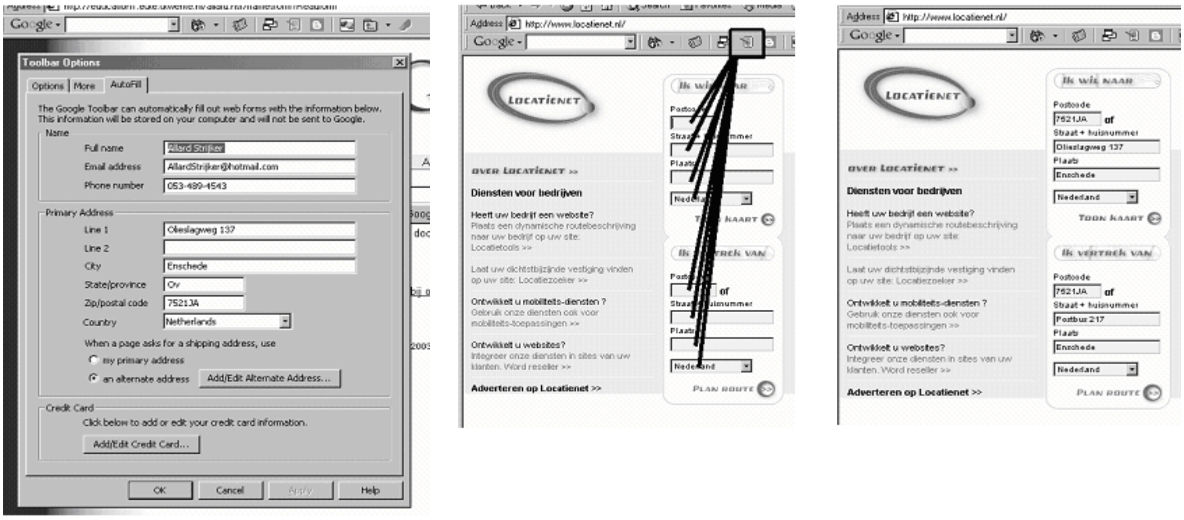


Figure 42 Google auto-fill tool for web-pages

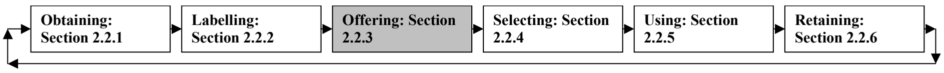
This sort of tool, like the Microsoft Internet Explorer “auto-complete tool” and the Google toolbar “auto-fill tool”, look simple but can be extended and used in future tagging tools. Another set of examples of interesting tools for analysing meta-tagging comes from DONOR (1998) and IMAT (Barnard, Kabel, Riemersma, Desmoulins, & Grandbastien, 2000). DONOR analyzes online web pages and extracts metadata based on the web-page content. The result is a Dublin Core metadata set (DCMI, 2002) that can be included in a web page so that search engines can index pages more accurately. The IMAT system includes a metadata tagging tool originally designed to split up technical manuals into objects that can be tagged with metadata based on the manual structure, indexes, and headings used. Meta-tagging in IMAT is also based on a set of predefined ontologies (Kabel, Riemersma, & Wielinga, (2001).

Another form of support for tagging can be found in the use of vocabularies (LTSC, 2002). A vocabulary is a recommended list of appropriate values for metadata. Other values, not present in the list, may be used as well. However, metadata that rely on the recommended values will have the highest degree of semantic interoperability, i.e. the likelihood that such metadata will be understood by other end users is highest. Vocabularies are developed based on experiences and good practices in various initiatives (ARIADNE, 2002; IMS, 2002). Figure 43 shows the technical aspects related to labelling in the different contexts.

Perspective questions	University	Corporate	Military
What?	Course material	CBT, short courses, multimedia, animations, simulations	CBT, pictures, photos, animations
How?	Using profiles, databases, back-office systems, content-analysing tools	Using profiles, databases, back-office systems	Using profiles, databases, back-office systems, content analysing tools, ontology-based agents
Where?	Authoring tools, LCMS, dedicated labelling tools	Authoring tools, LCMSs, dedicated labelling tools	Authoring tools, LCMSs, dedicated labelling tools

Figure 43 Technical aspects of labelling learning objects

3.2.3 Offering



When a learning object is obtained and labelled it can be offered for selection and eventual use. Different people or organisations can offer learning objects, for example course developers and trainers but also 3rd-party vendors specialized in creating course material. Software vendors like Davilex (2003) or Petroskills (2003) for example offer a wide of variety of learning objects on a commercial basis. The materials are offered at conferences, but also via the Web and through catalogues. Figure 44 summarises some technical aspects of offering learning objects.

Perspective questions	University	Corporate	Military
What?	Course material	E-modules, CBT, short courses, multimedia, animations, simulations	CBT, pictures, photos, animations
How?	Software packages, CDs, DVD	Software packages, CDs, DVD	Software packages, CDs, DVD
Where?	LCMSs, web	LCMSs, web	LCMSs, web

Figure 44 Technical aspects of offering learning objects

3.2.4 *Selecting*

Obtaining: Section 2.2.1 → Labelling: Section 2.2.2 → Offering: Section 2.2.3 → **Selecting: Section 2.2.4** → Using: Section 2.2.5 → Retaining: Section 2.2.6

The selection process is the fourth stage in the learning-object lifecycle. Tools can support course developers or course takers in selecting material from from repositories that contain learning objects.

For instance Petroskills, (2003) offers a "Competency Assessment Tool" that identifies the competence gap between current and needed competences so that a course can be provided to fill the gap. In that case, the selection process is based on the competence gap of a particular learner. The selection process can also be based on the curriculum, course development, or needs of a course developer. Several support tools have been developed to select material based on the criteria. Another example is the Candle Authoring Tool (CAT), developed within the CANDLE project (http://web.candle.eu.org/), and offers a wide variety of selection criteria including combinations of ontologies, semantic relations, and keywords within the categories: General, classification, life cycle, pedagogical, and technical. Figure 45 shows some aspects of the CAT selection tool.

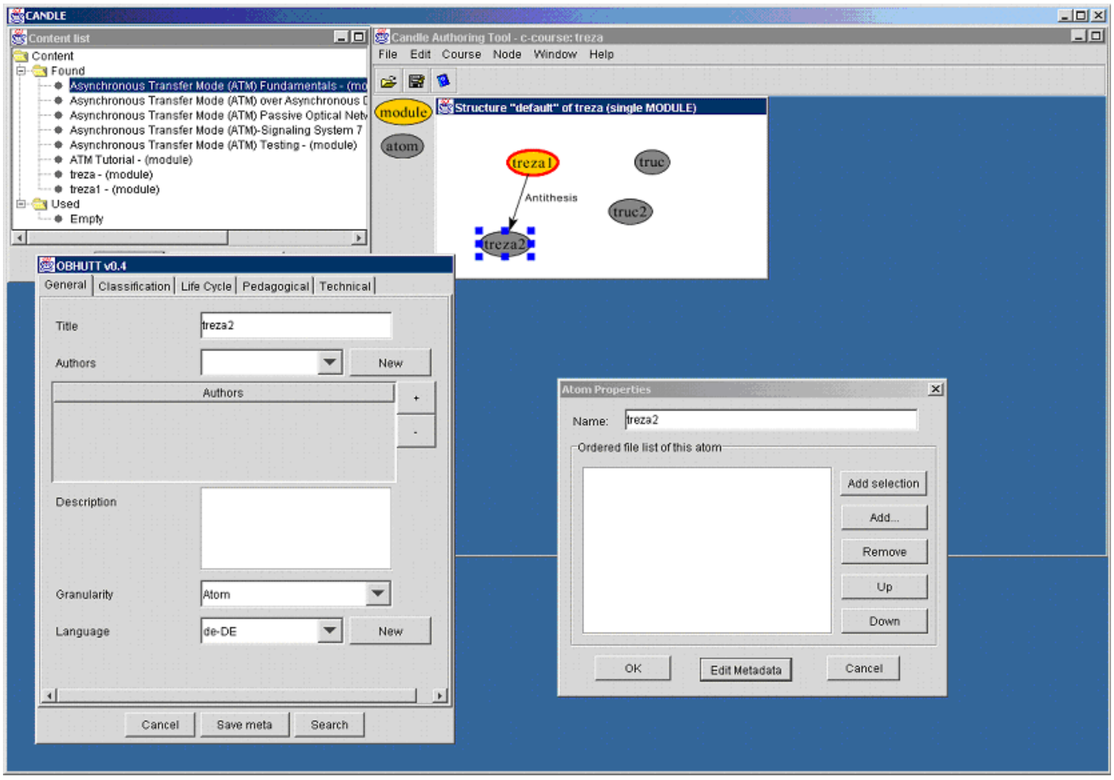


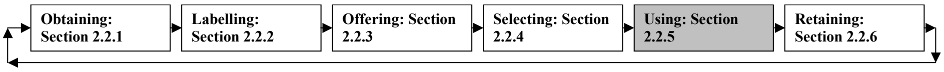
Figure 45 CAT selection tool (adapted from Ragnard, 2003)

Figure 46 shows what technical aspects are involved during the selection process of learning objects.

Perspective questions	University	Corporate	Military
What?	Own material	Training modules	Media objects
How?	Dedicated selection tools, Search engines, browsing tools	Competency assessment tool, search engines, competence gap analysis, browsing tools	Search engines, browsing tools
Where?	From own courses, LCMSs	LCMSs	Catalogues, LCMSs, WEB

Figure 46 Technical aspects of selecting learning objects

3.2.5 Using



Material can be used in two different ways'. Direct use of the object, the so-called "pure" use of the object, and the "adapted" form. "Adapted" means that the object after selection is edited or adapted for the new environment. Section 3.2.5.1 describes the "pure" use of learning objects, and Section 3.2.5.2 emphasizes the "adapted" learning objects. The use of adapted or pure learning objects involves also the method of access, like linking or copying, and where the objects are stored. Linking is described in Section 3.2.5.3 and copying in Section 3.2.5.4.

3.2.5.1 Pure use of learning objects

With pure use, the learning objects can be used without modifications after selection. This can be the case if learning objects perfectly match the needs of the course developers. Pure use of learning objects is, compared to adapted use of learning objects (Section 3.2.5.2), easier because the modification of learning objects requires specific tools and skills that may not be available to the developer. Within the university as an example, courses related to basic computer skills are offered as complete COTS (Commercial Off The Shelf) products or modules. In all three contexts most multimedia assets like movies and pictures are also used without any modifications. Figure 47 shows aspects of using pure learning objects in different settings.

Perspective questions	**University**	**Corporate**	**Military**
What?	Multimedia assets, animations, courses	E-modules, multimedia assets	Multimedia assets
How?	Courses	Courses, E-modules	E-modules
Where?	CMSs, LMS	CMSs, LMS	CMSs, LMS

Figure 47 Technical aspects of using pure learning objects

3.2.5.2 Adapted use of learning objects

The adapted use of learning objects is involved when the selected object does not completely fit the needs of the course developer. Learning objects are edited to match these needs in terms of intended course objectives or preferences of the course developer. The adaptation or editing of learning objects implies that the course developer does have full access to the objects and no restrictions regarding to access. The developer needs also the authoring tools and the original learning object to make the needed adjustments. Therefore the packaging of learning objects (Section 3.3.2.3) is an essential method for distributing learning objects between systems. Distribution of packages includes the copying (Section 3.2.5.4) of learning objects instead of linking (Section 3.2.5.3) By editing the learning object, it results automatically in a new instance or version of the learning object. Figure 48 shows aspects regarding to the adapted use of learning objects.

Perspective questions	**University**	**Corporate**	**Military**
What?	Modules, courses, learning objects	Modules, courses, learning objects	Modules, courses, learning objects
How?	Courses	Courses, E-modules	E-modules
Where?	Authoring tools, CMSs	Authoring tools, CMSs	Authoring tools, CMSs

Figure 48 Technical aspects of using adapted learning objects

3.2.5.3 Linking

Linking material is seen as an appropriate manner to reuse material more than once. Only one copy of material is available and is maintained and revised when needed. The “one” master-copy idea is from a technical point of view an ideal solution for reusing learning objects. There are some advantages and some disadvantages regarding to linking to one single resource. Advantages compared to copying learning objects are:

- Maintenance is only needed at one place
- Version control is only needed at one place
- Storage of data is only needed once
- Total control over objects

Disadvantages are:

- Workflow processes and development of learning objects can be time consuming
- Learning objects need strict maintenance because of external use
- Learning objects always need to be online
- It is difficult to administrate if learning objects are still in use, what is the end of the lifecycle?

Sometimes linking is the only option for reuse if learning objects are too large to copy. This can be the case when data repositories contain research data, for example in the field of geosciences.

3.2.5.4 Copying

Copying material can be very useful for several reasons. Advantages for using copies instead of links of learning objects can be:

- When material needs adaptation or editing for a new context.
- The adapted material does not influence earlier use and can be maintained by the new user.
- New users can store material on private networks; maintenance, and storage can be controlled independently
- Access can be guaranteed for learners offering enough bandwidth and access.
- Learning objects can be removed when necessary.

Disadvantages are:

- Version control is difficult
- Different versions need maintenance
- Copies consume more storage space then linked learning objects.

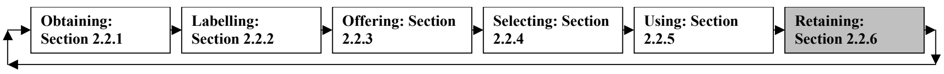
Content Packaging is a very effective method to exchange copies of learning objects, see Section 3.3.2.3 for an elaborated example.

3.2.5.5 Accessibility

A prerequisite to using learning objects is that they should be accessible to the involved users. Different sorts of accessibility can be identified related to hardware and software. Hardware includes network facilities in terms of connections, bandwidth, modems, and computers. Software accessibility includes the use of restricted access to resources in terms of read, write, edit, and remove actions on a system level. To achieve these sorts of access rights users are authenticated when they access a system by providing a username and password. Based on this authentication users are granted permissions to permitted resources. When using material from outside the organisation, these access rights should be in place for every user involved for every learning object. ADL SCORM™ does not provide standards or guidelines to deal with accessibility and authentication between systems. The packaging standard that makes it possible to exchange the whole learning object and store it within the organisation so that local permission procedures can be applied also covers accessibility. When material is free from rights and available on the web, accessibility plays no role.

3.2.6 Retaining

The last stage in the lifecycle for the learning object is the decision on how to retain the object.



After or during the actual use of the learning object the object can become outdated and should therefore deleted or revised. Decisions about retaining an object are influenced by new insights, experiences, or research from the developer or user of the object. New instances or versions may be created to revise the original object. Authoring tools are used to revise the original learning object. The quality control of the learning objects can be measured by tracking the use of learning objects. Also rating tools can provide information about the useability and quality of learning objects. Figure 49 shows technical aspects regarding to retaining learning objects.

Perspective questions	**University**	**Corporate**	**Military**
What?	Modules, courses, learning objects	Modules, courses, learning objects	Modules, courses, learning objects
How?	Tracking and tracing learning objects, editing learning objects	Tracking and tracing learning objects, editing learning objects	Tracking and tracing learning objects, editing learning objects
Where?	Authoring tools	Authoring tools	Authoring tools

Figure 49 Technical aspects of retaining learning objects

3.2.7 Modelling the lifecycle

The stages within the lifecycle (Figure 50) can be seen as a workflow from the first creation to the last decision about retaining the learning object.

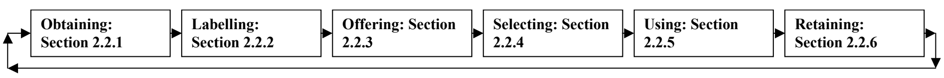


Figure 50 Modelling the lifecycle

This workflow approach has been adapted by the developers of LCMS systems and is for example used in the systems of Learn eXact (http://www.giunti.it) and Hive (http://www.hive.com), large LCMS vendors, where it is taken as the structure to develop learning materials. Figure 51 gives an overview of the system architecture used within

DLNET (Pushpagiri & Rahman, 2002). The architecture used within the DLNET project can be used as overview for the learning-object lifecycle because it includes the different stages as services and engines. Obtaining learning objects is seen as contributions from knowledge developers. Reviewers can tag the learning objects with metadata so that they can be offered in the system. Selection can take place by searching and browsing within and outside the repository. An Open Archives Initiative (OAI) interface provides access to digital libraries outside the repository. Using the material can take place by downloading the learning object. Maintenance of the repository includes retaining the learning objects.

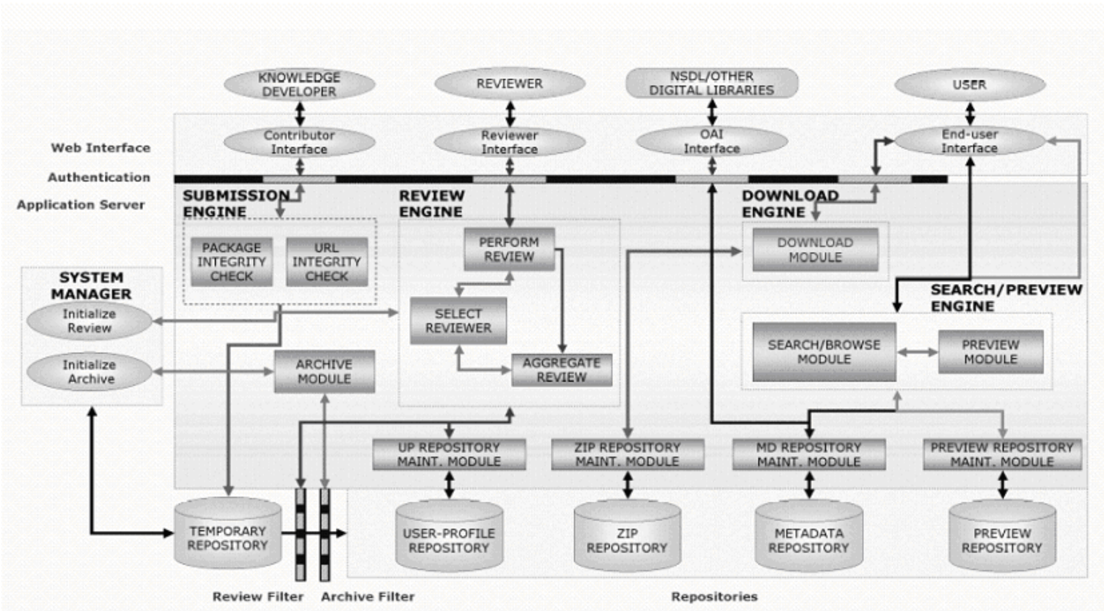


Figure 51 DLNET – system architecture (adapted from Pushpagiri & Rahman, 2002, p. 4)

3.3 Standards and Metadata from a Technical Perspective

In this section standards and metadata in relation to learning are discussed. Section 3.3.1 gives an overview of standards and metadata developments followed by Section 3.3.2 with a focus on the ADL SCORM™. The ADL SCORM™ can be seen as a combination of specifications and standards that are closely related. A more-extensive list can be found in Appendix A: “The ADL SCORM™ 2003 application profile”.

3.3.1 Overview of standards and metadata developments

Standards are developed for exchangeability and interoperability between platforms. Different organisations work on the development of these standards related to learning technologies. Learning technologies are defined as a set of technologies related to learning that includes the development of learning objects standards (LTSC, 2002). Many organisations that focus on learning technologies are working together in some form. Two main standard-setting bodies are the Institute of Electrical and Electronics Engineers (IEEE, 2003) working group called the Learning-technology standards Committee (LTSC), and the Advanced Distributed Learning group developing ADL SCORM™ – the Sharable Content Object Reference Model. These and other closely related and leading initiatives are described in Sections 3.3.1.1 to 3.3.1.9.

3.3.1.1 Learning-technology standards Committee

In 1996, the Learning-technology standards Committee (LTSC, http://ltsc.ieee.org/wg12) was established within the Institute of Electrical and Electronics Engineers (IEEE). The purpose of the LTSC is to "develop accredited technical standards, recommended practices and guides for learning technology" (LTSC, 2002). Within the LTSC different groups have been formed to work on standards. Workgroup 12.1 (WG12) focuses on the development of a metadata specification. The result of the workgroup is the 1484.12.1-2002, the IEEE LTSC LOM Standard, where LOM stands for Learning Object Metadata. The standard is the result of collaboration between LTSC, ARIADNE, and IMS. This standard is important as Wiley (2000a) pointed out with reference to LOM:

“Without such standards, universities, corporations, and other organisations around the world would have no way of assuring the interoperability of their instructional technologies, specifically their learning objects” (Wiley, 2000a).

The full version of the LOM metadata set can be found in Appendix B: “The LOM metadata set”.

3.3.1.2 ADL - Advanced Distributed Learning Initiative

The Advanced Distributed Learning Initiative (ADL, http://web.adlnet.org/) was established in 1997 by the US Department of Defence (DOD) to promote the sharing of learning materials between government, industry, and education/academia. "The Advanced Distributed Learning (ADL) Initiative is a collaborative effort between government, industry, and academia to establish a new distributed learning environment that permits the interoperability of learning tools and course content on a global scale. ADL's vision is to provide access to the highest quality education and training, tailored to individual needs, delivered cost-effectively anywhere, and anytime" (ADL, 2002).

Expanding the above, the goals of ADL are:

- Develop guidelines for development and implementation of efficient, cost-effective distributed learning on a large scale
- Identify and promote business models and economic incentives for consumers, and vendors of distributed learning content, tools, and systems
- Establish a rapidly growing network community of education and training consumers
- Stimulate large-scale collaborative developments by organisations that share learning requirements
- Identify technical challenges that exceed the current state-of-the-art and initiate collaborative research and development (R&D) programs to meet those challenges.
- Ensure access to high-quality education, training, and decision-aiding (“mentoring”) materials that can be tailored to individual learner needs and made available whenever and wherever they are required (ADL, 2002).

ADL has worked to create ADL SCORM™ - Sharable Content Object Reference Model. "The Sharable Content Object Reference Model (ADL SCORM™) defines a Web-based learning "Content Aggregation Model" and "Run-Time Environment" for learning objects. “The ADL SCORM™ (See Section 3.3.2) is a collection of specifications adapted from multiple sources to provide a comprehensive suite of e-learning capabilities that enable interoperability, accessibility, and reusability of Web-based learning content" (ADL, 2002). ADL has coordinated and built upon the work of groups like IEEE/LTSC, ARIADNE, and IMS in attempts to create a unified set of standards, specifications, and guidelines for learning objects.

This initiative is designed to accelerate large-scale development of dynamic and cost-effective learning software and to stimulate a vigorous market for these products in order to meet the education and training needs of defence and industry in the 21st century. ADL is developing a common technical framework for computer and Web-based learning that will foster the creation of reusable learning content as "instructional objects." The ADL initiative has defined high-level requirements ("-*ilities*") for learning content, such as content reusability, accessibility, durability, and interoperability to leverage existing practices, promote the use of technology-based learning, and provide a sound economic basis for investment (ADL, 2002).

Key aspects for ADL include:

- Reusability: the flexibility to use instructional developed components in several applications in different contexts;
- Durability: The possibility to edit and update material easily without the need of redesign, reconfiguration or reprogramming;
- Interoperability: The possibility to use developed instructional material in different places using different systems or different platforms;
- Accessibility: The possibility to access and use material place and time independent

3.3.1.3 ARIADNE - Alliance of Remote Instructional Authoring and Distribution Networks for Europe

The ARIADNE (http://web.ariadne-eu.org/) Foundation is involved with the standardization efforts of the IEEE LTSC, and is working with the Educause IMS Project (Section 3.3.1.4) to assist in developing metadata standards (the LOM - learning objects metadata). ARIADNE is described as “A European association open to the world, for knowledge sharing and reuse, e-learning for all, international cooperation in teaching, serving the learning citizen” (ARIADNE, 2002). The ARIADNE Foundation is also working with the ADL Initiative (Section 3.3.1.2), and the ADL SCORM™ standards group.

3.3.1.4 IMS - Instructional Management Systems Project

IMS (http://web.imsproject.org/)was established in 1997 within the National Learning Infrastructure Initiative of Educause. IMS has two main goals: (a) Defining the technical specifications for interoperability of applications and services in distributed learning, and (b) supporting the incorporation of the IMS specifications into products and services worldwide. “IMS endeavours to promote the widespread adoption of specifications that will allow distributed learning environments and content from multiple authors to work together (in technical parlance, interoperate"). The scope for IMS specifications, broadly defined as "distributed learning," includes both online and off-line settings, taking place synchronously (real-time) or asynchronously. This means that the learning contexts benefiting from IMS specifications include Internet-specific environments (such as web-based course management systems) as well as learning situations that involve off-line electronic resources (such as a learner accessing learning resources on a CD-ROM). The learners may be in a traditional educational environment (school classroom, university), in a corporate or government training setting, or at home. The IMS Project is currently collaborating with a number of groups such as IEEE/LTSC, ADL, ARIADNE, and others to ensure that their standards are applicable across other instantiations.

3.3.1.5 CanCore - Canadian Core Learning Resource Metadata Application Profile

The following section is taken from the CanCore website (http://web.cancore.ca/indexen.html):

> *"The CanCore Profile is intended to facilitate the interchange of records describing educational resources and the discovery of these resources both in Canada and beyond its borders. CanCore is based on and fully compatible with the IEEE Learning Object Metadata standard and the IMS Learning Resource Metadata specification" (CanCore, 2003).*

CanCore attempts to simplify the metadata process. If learning-object designers are to properly support their objects with metadata tags, they must provide information for almost eighty different categories of meta information. "CanCore addresses some of these issues by recommending simplifications and interpretations of the LOM standard. CanCore provides best practice recommendations for the implementation of the LOM standard to maximize the opportunity for interoperability between projects" (CanCore, 2003). CanCore is an instantiation of the LOM standard. As such, it "occupies the middle ground" between this standard and the work needed to create an interoperable body of metadata records. CanCore is not intended to compete with or be used in place of the LOM. As an indication of these facts, the IMS consortium has included two CanCore records on its Website as exemplary instances of the use of its own metadata specification.

3.3.1.6 DCMI - Dublin Core Metadata Initiative

"The Dublin Core Metadata Initiative is an open forum engaged in the development of interoperable online metadata standards that support a broad range of purposes and business models. DCMI's activities include consensus-driven working groups, global workshops, conferences, standards liaison, and educational efforts to promote widespread acceptance of metadata standards and practices" (DCMI, 2002). The mission of the DCMI is to make it easier to find resources using the Internet through the following activities: (a) Developing metadata standards for discovery across domains, (b) Defining frameworks for the interoperation of metadata sets, and, (c) Facilitating the development of community- or disciplinary-specific metadata sets that are consistent with Items a and b. A full description of the Dublin Core metadata set can be found in Appendix C: "The Dublin Core metadata set".

3.3.1.7 AICC - Aviation Industry CBT (Computer-Based Training) Committee

AICC (http://web.aicc.org/) is an international association of technology-based training professionals. The AICC develops guidelines for the aviation industry in the development, delivery, and evaluation of CBT and related training technologies. The objectives of the AICC include development of guidelines to enable interoperability (AICC, 2002).

> *"AICC recommendations are fairly general to most types of computer based training and, for this reason, are widely used outside of the aviation training industry. The group focuses on reuse and interoperability of online learning. The AICC actively coordinates its efforts with broader learning-technology standards organisations like IMS, ADL, and IEEE/LTSC"*

(AICC, 2002). AICC specifications regarding to tracking and tracing are heavily used in the ADL SCORM™ run-time environment (Section 3.3.2.5).

3.3.1.8 CANDLE - Collaborative and Network Distributed Learning Environment

The objective of the CANDLE project (http://web.candle.eu.org/, 1999 - 2003) was to use the Internet to improve the quality and reduce the cost of ICT teaching in Europe by using web and multimedia technology, and to enable co-operation between universities and industry in creating and reusing learning material and improving the quality of delivery.

The CANDLE system was not designed to constrain the freedom of academics and trainers to develop their own courseware. This flexibility is ensured through the use of component architectures, toolkits, and pedagogical frameworks that allow individual teacher to combine course objects to create their own courses designed to meet their learners particular needs. The results of the project have been made available under the "open courseware" license.

The project also addressed the question of usability and acceptability of its proposed solution. A further key objective was therefore to evaluate the impact of the system on individual learners, their organisations (both corporates and SMEs), and on more-general socio-economic factors (e.g. improved competitiveness)(CANDLE, 2003). The final evaluation showed these results were well met in the pilot stage (Brostoff & Kent, 2003).

3.3.1.9 EML – Educational Modelling Language

The educational modelling language (http://eml.ou.nl/eml-ou-nl.htm) has been developed by the Open University (OU) in the Netherlands as an addition to the LOM metadata and IMS packaging specifications. EML provides a pedagogical framework in terms of descriptions of roles, relations, activities, pedagogy, classification, and structure within the learning process. According to Koper (2001) the basic ideas of EML can be summarized as:

- Classify, or type, the learning objects in a semantic network, derived from a pedagogical meta-model,
- Build a containing framework expressing the relationship between the typed learning objects and,
- Define the structure for the content and behaviour of the different learning objects.

The metadata set defined by EML to describe the pedagogical framework can be used in addition to the LOM. Using EML includes the use of the dedicated “EDUbox” player that can interpret EML. EML formed the basis for the new developments regarding to learning design in the IMS Learning Design 1.0, which was approved as an IMS Final Specification on February the 10th 2003.

In the previous sections different projects and initiatives were described related to reuse of learning material and involved learning technologies. The number of initiatives and their specific application in different research areas show the interests of various groups but also the differences in application of such learning-technology specifications. The ADL SCORM™ product described in the following section tries to use outcomes of the various described research projects for one combined set of specifications for reuse of learning material.

3.3.2 The ADL SCORM™ product

The Sharable Content Object Reference Model (ADL SCORM™) defines a Web-based learning “Content Aggregation Model” and “Run-time environment” for learning objects. The current 2004 version is the ADL SCORM™ 1.3 Application Profile Working draft. This version contains specifications regarding to the “Content Aggregation Model” covering the

Content model (Section 3.3.2.1), Metadata (Section 3.3.2.2), Content Packaging (Section 3.3.2.3), and Sequencing (3.3.2.4). Section 3.3.2.5 contains the “Run-time environment” specifications. The Version described here, ADL SCORM™ 1.3, does not completely match the Versions 1.1 and 1.2 used in the research described in Chapters 5, 6, and 7 although the most basic features did not change. Due to constant development of the ADL SCORM™ parts are extended or removed when necessary. Changes in the new version that have influence on the research are discussed in the corresponding sections.

3.3.2.1 Content model

The ADL SCORM™ Version 1.3 Application Profile introduces the following components:

- Assets
- Sharable Content Assets (SCA)
- Sharable Content Objects (SCO)
- Content Aggregations.

An asset is the simplest learning resource that can be identified. Figure 52 shows a set of assets and what type of material an asset can consist of.

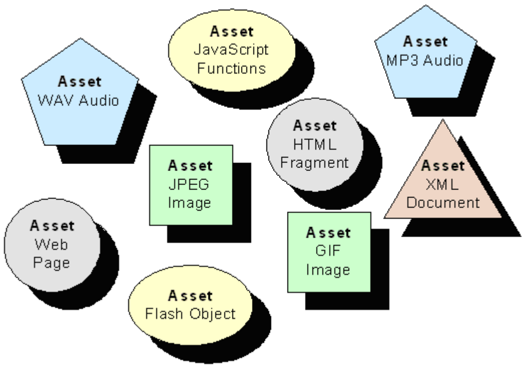


Figure 52 Assets (adapted from ADL SCORM™, 2003 pp. 2-4)

A Sharable Content Asset (SCA) is defined as a collection of one or more Assets packaged as a single launchable learning resource (ADL SCORM™, 2003). A SCA does not communicate with a Learning Management System. A SCA can be packaged as seen in Figure 53.

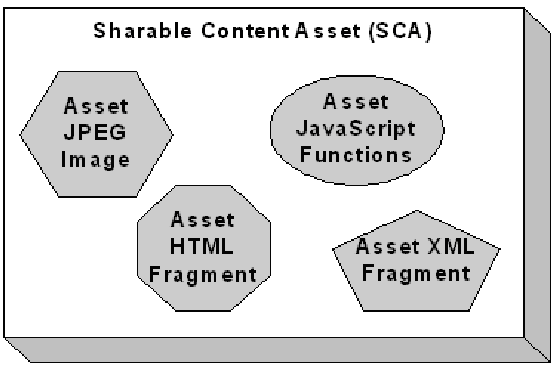


Figure 53 SCAs (from ADL SCORM™, 2003, p. 2-5)

A Sharable Content Object (SCO) is a collection of one or more Assets that represent a single launch-able learning resource that utilizes the ADL SCORM™ Run-Time Environment to communicate with Learning Management Systems (LMSs) (ADL SCORM™, 2003). Figure 54 shows how a SCO should communicate with a LMS.

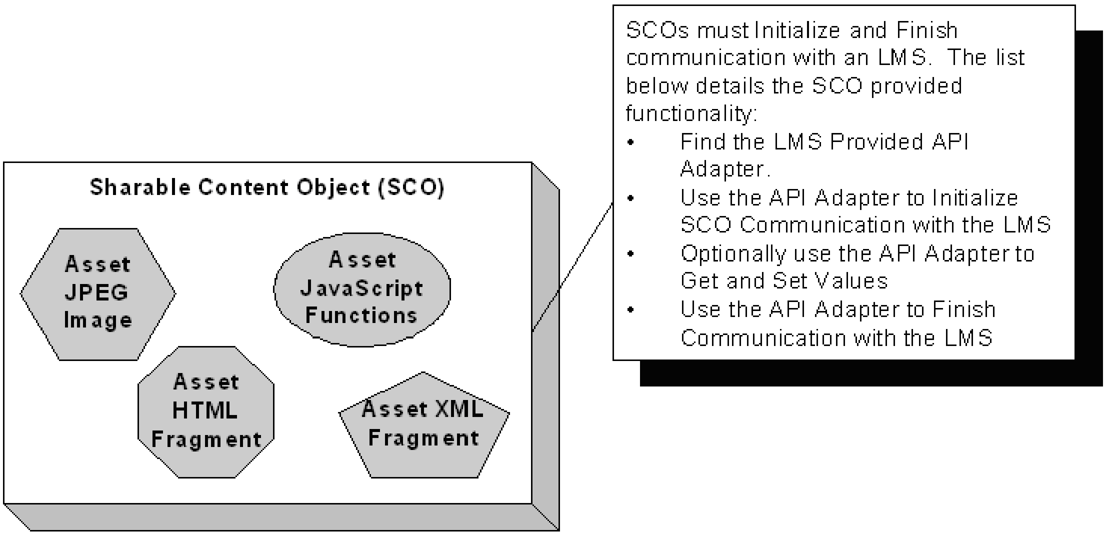


Figure 54 SCO (from ADL SCORM™, 2003, p. 2-6)

A Content Aggregation is a map (content structure) that describes cohesive units of instruction (Activities), relates Activities to one another, and may associate learning taxonomies to the Activities (e.g., course, chapter, or module). Figure 55 shows an example of a Content Aggregation.

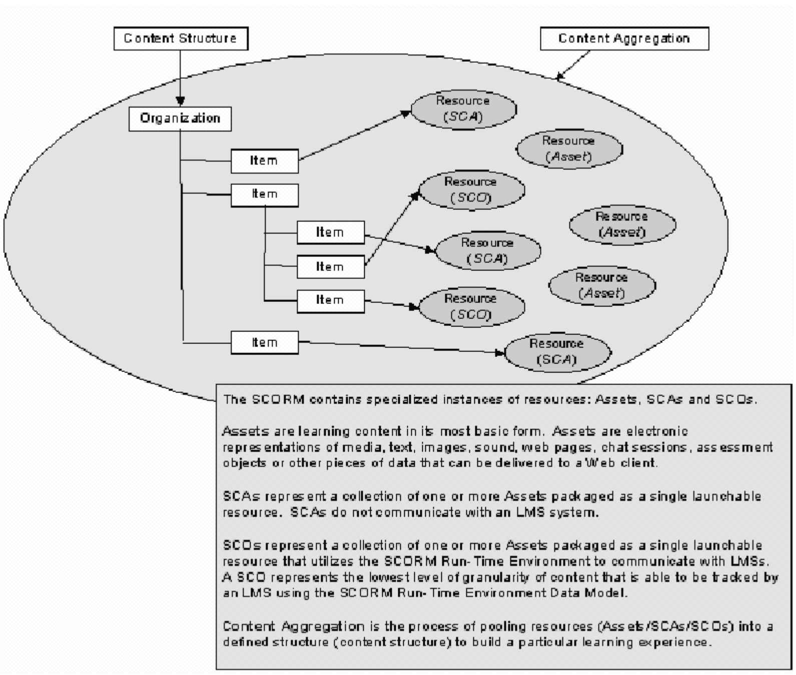


Figure 55 Content Aggregation (ADL SCORM™, 2003, p. 2-7)

Figure 55 describes and presents the components of the ADL SCORM™ Content Aggregation Model. The model describes searching, finding, and assembling pieces of content ("assets") needed for a lesson part, structured lesson, or course. The model is bound to the following restrictions regarding to learning material:

- It should be pedagogically neutral;
- It should be specific;
- It should be usable for a variation of user groups (stakeholders);
- It should also be applicable in relation to personal preferences for a specific approach of Instructional System Design. Also for blended learning, a combination of traditional and advanced learning methods.

3.3.2.2 ADL SCORM™ metadata

The ADL SCORM™ metadata set references fully the IEEE LTSC Learning Object Metadata (LOM) standard. The full metadata set available in the LOM contains roughly 64 elements and can be found in Appendix B: "The LOM metadata set". The metadata elements are divided in nine categories (LOM, 2002):

1. The *General* category groups the general information that describes the resource as a whole.
2. The *Lifecycle* category groups the features related to the history and current state of this resource and those who have affected this resource during its evolution.
3. The *Meta-metadata* category groups information about the metadata record itself (rather than the resource that the record describes)
4. The *Technical* category groups the technical requirements and characteristics of the resource.
5. The *Educational* category groups the educational and pedagogic characteristics of the resource.
6. The *Rights* category groups the intellectual property rights and conditions of use for the resource.
7. The *Relation* category groups features that define the relationship between this resource and other targeted resources.
8. The *Annotation* category provides comments on the educational use of the resource and information on when and by whom the comments were created.
9. The *Classification* category describes where this resource falls within a particular classification system.

Appendix D: "All LOM elements related to actors and sources" shows the nine categories of LOM elements related to actors, source and content-aggregation level, as well as possible initial values.

ADL SCORM™ defines also different types of learning objects to which metadata can be applied. For every type a mandatory subset of metadata is identified that is applicable. The number of elements is therefore reduced to a smaller set than the original 64 elements. The number of mandatory elements is listed for every type of learning object is given in Table 9.

Table 9 Mandatory metadata elements in ADL SCORM™ (2003)

Name	**Package**	**Content Aggregation**	**Activity**	**SCO**	**SCA**	**Asset**
Number of mandatory elements	0	17	17	17	17	10

Appendix A: "The ADL SCORM™ 2003 application profile" shows what elements are optional and mandatory in the ADL SCORM™ metadata set 2003, which are also grouped in the nine LOM categories

From the technical perspective, the means to describe and identify learning content is key to enabling reuse. Metadata (data about data), when clearly defined for a particular domain, provide critical insight into the nature, purpose, and qualities of privately authored material. This information can form the basis of learning-content libraries (repositories) and can provide content developers the ability to search and retrieve pre-existing material appropriate to the instructional task at hand (Dodds, 2001a). Standards are developed to create metadata for learning content in a uniform format.

3.3.2.3 Content packaging

The Content Packaging specifications in the ADL SCORM™ are taken from the IMS-packaging specifications. According to Dodds (2001b) the purpose of Content Packaging is to provide a standardized way to exchange digital learning resources between different systems or tools. Content Packaging also can define the structure (or organisation) and the intended behaviour of a collection of learning resources.

Content Packaging defines, among other things (ADL SCORM™, 2003) a manifest file describing the package itself and which contains:

- Metadata about the package
- An optional Organisation section that defines content structure and behaviour
- A list of references to the resources in the package
- Specifications for creating an XML-based Manifest
- Directions for packaging the Manifest and all related physical files into a zip file or on a CD-ROM, or other storage media.

Content packages are expected to be used to move digital learning resources or collections of learning resources between Learning Management Systems (LMS), development tools, and content repositories. The Content Packaging specification provides a common "input/output" format that any system can support. A Content package can be seen in Figure 56. The package itself can be a single wrapper file like a zipfile that contains a manifest file in XML format that describes the content of the zip file in terms of how the files are structured (Pushpagiri & Rahman, 2002). Besides the file structure also a course structure can be described in terms of learning objects that should be followed in a certain order. Also metadata should be included to identify the content of the course. The content of the course can consist of different sorts of files varying from actual resources to support files.

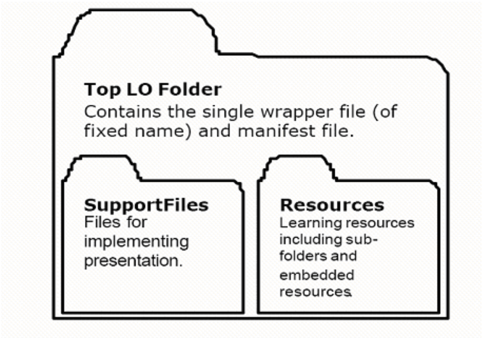


Figure 56 Content package (adapted from Pushpagiri & Rahman, 2002, p. 3)

3.3.2.4 Sequencing

Sequencing is a feature introduced in ADL SCORM™ Version 1.3 because it was identified as the most critical missing feature at the ADL SCORM™ Plugfest 4 in 2001 (Rehak, 2003). To fill this gap in the ADL SCORM™ specifications, the IMS Simple-Sequencing specification (IMS SS) was included (IMS, 2002). This simple-sequencing specification relies on the concept of learning activities. A learning activity may be a loosely described meaningful unit of instruction. A learning activity may use a learning resource, or it may consist of several sub-activities (ADL SCORM™, 2003). Figure 57 illustrates the "take lesson" activity that includes the sub-activities "take a pre-test", attend a lecture", and "pass a final test". This implies a hierarchical structure in which a learner cannot do the sub-activity "take a pre-test" without accessing the "take lesson" activity.

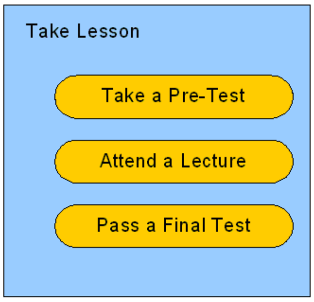


Figure 57 Activity illustration (adapted from ADL SCORM™, 2003 pp. 33)

The sequencing specification provides a set of rules in terms of if-then statements to make it possible to give the "sequencer" control over all interactions and navigation between the activities and the learner (Rehak, 2003). "*If*" statements can include: satisfied, completed, progress known, score greater than, score less than, attempt limit exceeded, time limit exceeded, and outside available time range. "*Then*" statements can mean: skip, disable, hide from choice, stop forward traversal, exit parent, exit all, retry, continue, previous, and exit (ADL SCORM™, 2003). Sequencing of learning activities can be described by layering control on top of learning objects and is expressed as a set of patterns of behaviours. Sequencing patterns can be described independent and separate from actual learning objects (Rehak, 2003). Templates can be used to capture frequently used patterns to provide support to sequencers creating navigation structures. Figure 58 gives an example of a content activity tree and how a learner can navigate through the tree based on a predefined sequence and the interactions that occurred. Starting on the top the sequencer built in if-then criteria that have to be fulfilled before the learner can access the activities lower in the hierarchy.

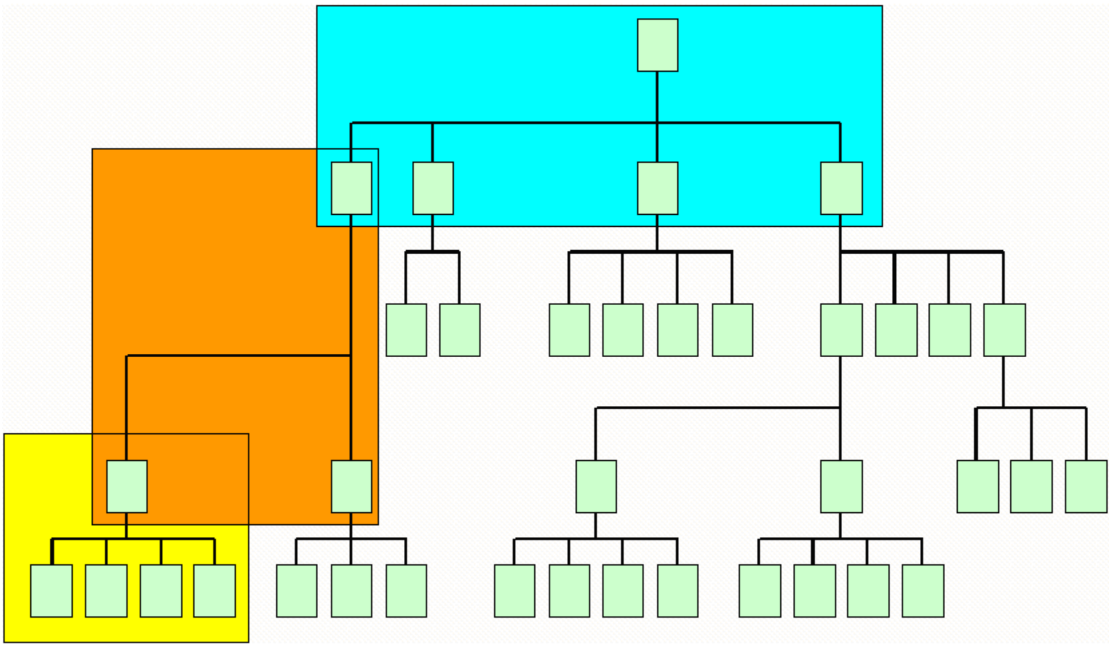


Figure 58 Content activity tree (adapted from Rehak, 2003)

Course material can be made more adaptive in terms of flexibility to fit a large variety of learners if sequencing is used to tailor different routes for reaching educational objectives. Benkiranm, Ajhoun, and Belqasmi (2000) discuss adaptability for this reason, and couple adaptability to user profiles. The ADL SCORM™ does not use a user profile in such a way but builds upon a sequence of interactions of the user that eventually can be part of a user profile.

3.3.2.5 Run-time environment

The ADL SCORM™ run-time environment implies the use of an LMS that launches SCOs, SCAs, or assets. These SCOs, SCAs, and assets can all have been seen as learning objects themselves although only a SCO has the ability to communicate with an LMS. A LMS can launch a learning object based on the needs of the learner. Learning objects can be part of a course that is delivered through the LMS. The ADL SCORM™ run-time environment is based on a client-server structure and communication between the client and the server. The server can be seen as the LMS, the client as a browser showing learning objects. The LMS manages the learning objects in terms of launching and data based on the communication between the learning objects and the LMS. A SCO can make use of different assets that are also launched by the LMS. During the launch a SCO can send and retrieve data from the LMS. ADL SCORM™ has, based on the AICC, specified what types of data can be exchanged and what commands should be used. An API (Application Programming Interface) is used to establish a data link between to the LMS and SCO. The main aspects of the ADL SCORM™ run-time environment are shown in Figure 59.

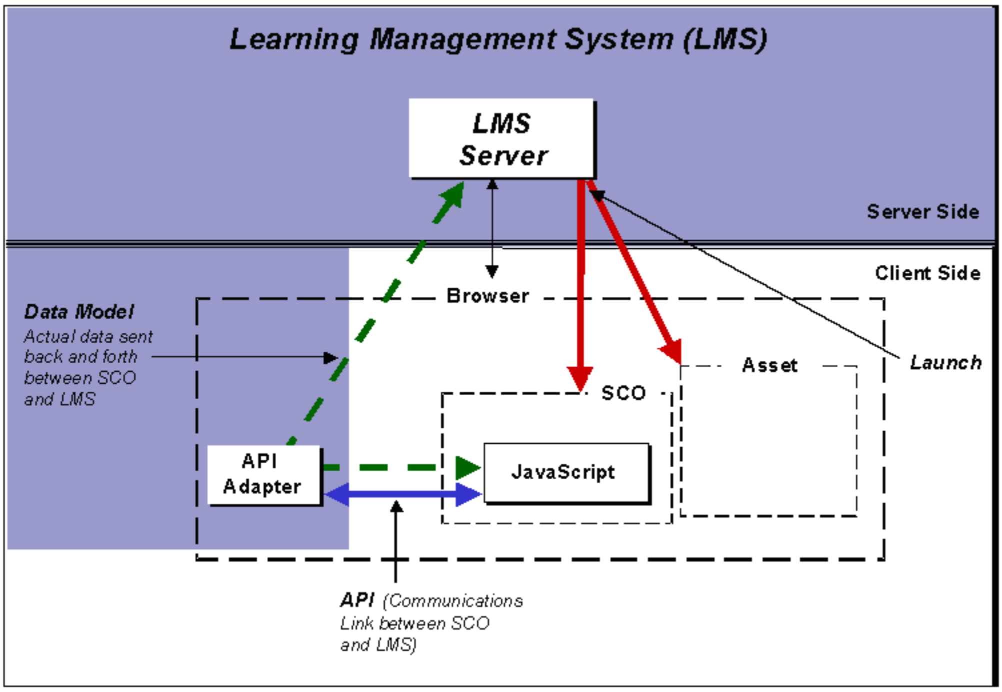


Figure 59 Launch, API, and Data Model as they apply to the ADL SCORM™ Run-Time Environment (adapted from Dodds, 2001c, p. 11)

Figure 60 shows what different stadia a SCO can have after the launch from a LMS. The figure shows also the two mandatory calls, LMSInitialize and LMSFinish, that a SCO should perform to communicate with an LMS. When a SCO is launched it should be initialised. This means that the SCO sends a message to a LMS that is already started and that is ready to interact with users. The LMS can record this message including the identifier of the user that accessed it, the time started, and the SCO-identifier. When the SCO is initialised it can send data to the LMS like assessment scores and bookmarks. It can also retrieve data from the LMS like the name of the user, earlier attempts, and scores from assessments. When the user ends the SCO or finishes the SCO, a message to the LMS is sent that the SCO is ended. The LMS can record the time of finishing and the results of the available assessments. Based on the results and the course structure or sequence another SCO can be launched.

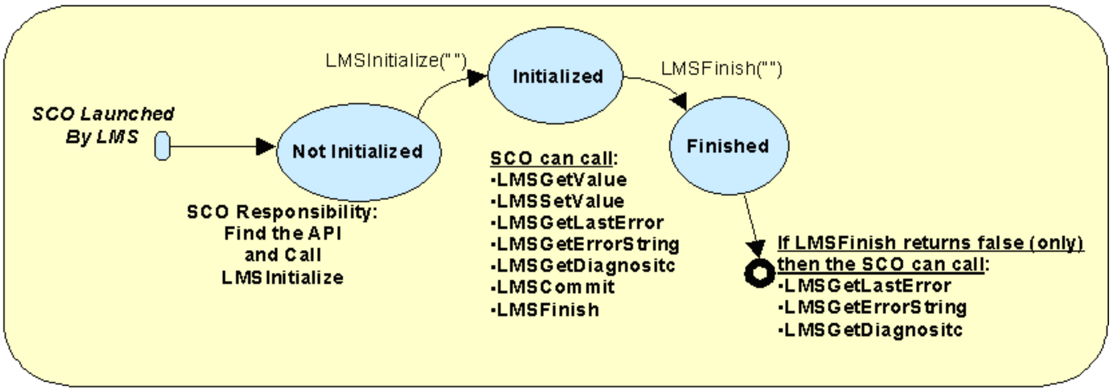


Figure 60 API Adapter State Transitions (adapted from Dodds, 2001c, p. 21)

3.3.2.6 ADL SCORM™ Technical architecture overview

Figure 61 gives an overview of relations within ADL SCORM™ in terms of the LMS services discussed in the previous sections. The LMS provides the course administration in terms of user accessibility and authentication based on learner profiles. The content is delivered based on the sequencing and the interaction with the testing and assessment services. This content can come from different repositories that can be local or remote. All interaction and access is tracked using the API that serves as communication bridge between LMS and browser.

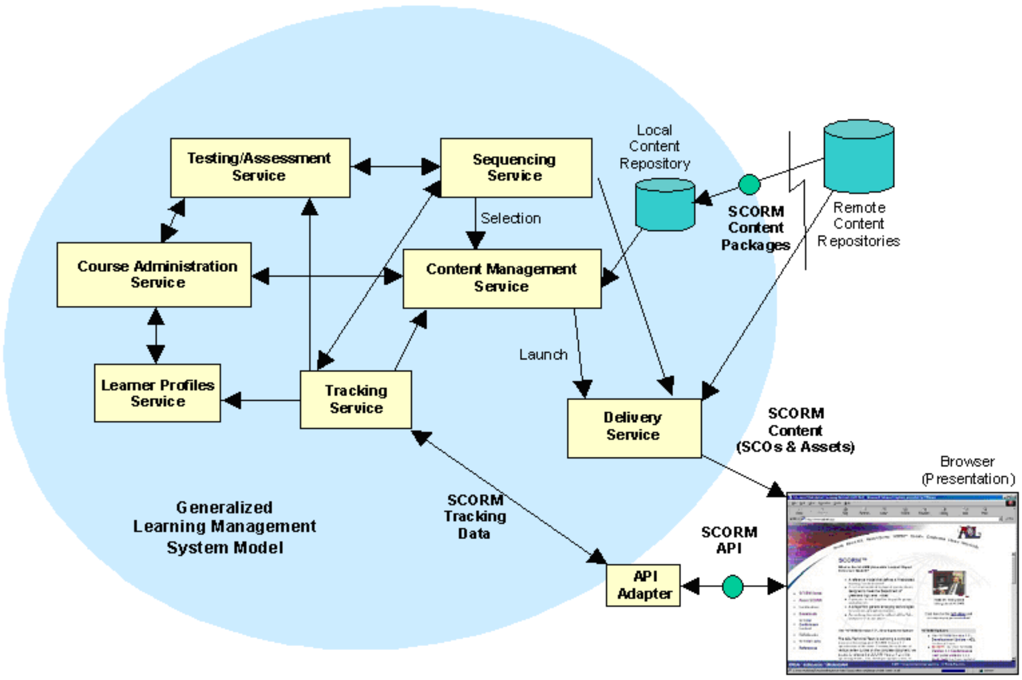


Figure 61 ADL SCORM™ technical architecture LMS (adapted from Dodds, 2001a, p. 39)

3.4 Issues Related to a Technical Perspective

The issues related to the technical perspective relate to Sections 3.1 to 3.3 where potential issues were identified. The key issues are identified as: specifications and standards, granularity, reuse, metadata tagging, and access and privileges. These issues relate to the ADL SCORM™ standards as a whole and are elaborated in Sections 3.4.1 - 3.4.5.

3.4.1 Specifications and standards

The specifications are evolving quickly and are rather technical. The implementation of the standards, development of content, and development of tools is therefore difficult:

- *Constant evolutions of specifications*

  Because of their constant evolution it is difficult to implement the standards in tools or in the content-generation process. Although the general intentions of the standards stay the same, the actual application can differ from version to version. For example the use of a Course Structure Format in ADL SCORM™ Version 1.1 changed to Organisational structure in the package manifest in ADL SCORM™ Version 1.2 and then again to the current Simple Sequencing specification in ADL SCORM™ Version 1.3. The fact that there is no backward compatability in the different versions results in content that may be useless in future versions.

- *Development of content may require support of unavailable specialists*

  Specifications and standards like ADL SCORM™ are technical documents written for vendors and toolmakers (Rehak, 2003). This means that content developers need the assistance of technical persons for the actual use of standards. Being involved in technical issues and having to depend on others can be a problem for developers.

- *Constant new developments of tools is required*

  Although the specifications are written for vendors and toolmakers (Rehak, 2003), the constantly evolving specifications need constant attention from the developers and need research for actual use. But research is expensive and this can be a reason to stop actual development. Tools also need to be tailored to the new specifications to create content according the new standards.

3.4.2 Granularity

The granularity of material plays a role during the exchange of material and the size of the objects. Authoring tools are used to obtain or maintain learning objects. Key issues are:

- *Different authoring tools may be needed*

  The specifications can deal with the different types, sorts, and sizes of objects. While this is not so much a technical problem, it becomes a problem for humans who will require different tools and skills for dealing with objects at different levels of granularity. This can be on course, module, lesson, or object level. For the different levels technology in terms of tools and support is required.

- *Size restrictions may be necessary*

  Also the size of the actual objects is an issue because it relates to the hardware needed such as: Capacity of server speed, server storage capacity, bandwidth, connections and clients.

3.4.3 Reuse

Technical issues involving reuse can be related with interoperability between systems, but also the services to handle the exchange between systems in terms of copyrights and restrictions of use.

- *Interoperability problems when application profiles do not match*

  The specifications and standards are developed to enhance exchange between systems. The standardised packaging of learning objects can provide solutions to make exchange easier, but does not solve all problems if systems use different application profiles for constructing packages of learning objects. Application profiles are sets of rules for how to use the standards. If the application profiles do not match, systems still will have problems to use the packages. For example the CMS

BlackBoard has integrated the complete IMS packaging specification but Blackboard-exported packages cannot be used in any other CMS other than BlackBoard itself.

- *Brokerage services require digital rights management*

  The exchange of material in terms of paying for use, hosting, and restrictions for use can be handled within the brokerage service that can be part of the LCMS. Within a LCMS the term "Billing" is often used for the service that is responsible for calculating the use of learning objects and relating costs. Using brokerage services requires policy that can be handled by a system in terms of rules that can be applied to learning objects, costs, and involved users. The copyrights, costs, and terms of use need to be described before brokerage and billing can take place. The use of Digital Rights Management (DRM) can help to solve issues related to the copyrights. DRM can only help to solve issues, also DRM needs policy requirements before it can be actual used.

3.4.4 Meta tagging

Metadata tagging is essential for reuse, tools to support metadata tagging are therefore important for actual use. Two sorts of metadata where identified: Objective metadata and subjective metadata (Hodgins, 2000b).

- *Objective metadata not available*

  Objective metadata can be obtained from different sources like backend repositories and database functionalities. Examples can be found in the automatic registration and calculation of file size, file type, user, creation time, and creation date. Also tools that can access or use different resources, templates, profiles, and analysing functionalities can supply most metadata automatically. The issue still is that most tools do not use databases for creating content and that also the objective metadata is not available.

- *Subjective metadata not available or not consistent*

  A more difficult sort of metadata is subjective metadata. This kind of metadata depends on the metadata provider who may not have the skills to assign the correct data or uses criteria that do does not fit other settings. Solutions may be found in ontologies and semantic webs but the tools to use these ontologies and semantic webs are needed (Section 9.11).

3.4.5 Access and privileges

The biggest issues from a technical perspective are those related to access and the privileges needed to use material. Hardware and software issues can be identified related to access and privileges.

- *Hardware barriers to access*

  Although the web is the primary starting point, in practice material is often not accessed via the web but is only available on private networks, physically not attached to the web. Also lack of hardware connections with the Internet can be issues in geographic regions or locations when learners try to access the Internet. Content packaging and using alternative media storage can play an important role

- *Security restrictions*

  Confidential material, classified material, commercially competitive material, copyright-protected material, embargos, terrorism, hacker attacks, network security, lack of software, and private networks are issues that interfere with exchange of learning objects.

Based on the preceding sections that were related to learning objects from a technical perspective the Research Framework as presented in Chapter 1 can be refined with secondary research questions. This is described in the next section.

3.5 Refining the Framework

The tools and techniques available for the reuse of learning objects vary in the organisation contexts. Also the use of standards and their applications in the contexts differ. Questions relate to the learning-object lifecycle and the questions: The kind of learning objects (What?), the tools (How?), and the type of systems (Where?). The What?, How?, and Where? questions directly relate to the availability to operate with specifications and standards regarding to reuse and metadata requirements. Secondary research questions related to the technical aspects are identified in Section 3.5.1. These secondary research questions are related to the previous sections in this chapter.

3.5.1 Secondary research questions, Technical perspective

The secondary research questions are derived from the original research questions which were described in Chapter 1, Section 1.5:

> *RQ2: Technical perspective - What tools and technologies are important to support the different stages of the lifecycle of a learning object?*

> *RQ3. Combining human and technical perspectives - What are key dimensions to guide the selection of tools, technologies, and human procedures to support the different stages of the lifecycle of a learning object for users in different usage contexts, particularly university, corporate learning centres, and military training?*

From these two general questions related to the technical perspective, three secondary research questions that underlie all of the original questions can be specified. The first of the secondary research questions for the technical perspective focuses on the granularity of the learning objects and if reuse is applicable in the different stages of the lifecycle. Different types of material can be identified such as courses, multimedia assets, modules, software programs, CBT, and course modules. Seen from the LOM (IMS, 2002), all these different types can be seen as learning objects with varying aggregation levels. According to the ADL SCORM™ specification there can also be a distinction between packages, content aggregations, activities, SCOs, SCAs, and assets. The first question therefore relates to the aggregation level of learning objects in the different organisation contexts.

> *TQ1. Granularity and standards - What granularity level of learning objects can be identified in the different organisational contexts and how can these learning objects be mapped against existing standards?*

The second question relates to the tools used to obtain, label, offer, select, use, and retain the learning objects and how the are used in the different organisational settings.

> *TQ2. Tools - How do tools in the varying organisational contexts support the different stages within the learning-object lifecycle?*

The systems where the learning objects are stored are also important for their actual reuse. This can differ among authoring systems, LMSs, LCMSs and CMSs. Within the different organisations all these sorts of systems are available. The third secondary research question focuses on the actual use of the systems.

> *TQ3. Systems - What systems are in use with the actual reuse of learning objects in the different organisational context, and how do they vary?*

These questions will be used to refine the research framework in the following section.

3.5.2 Preliminary Answers

To give an idea about the direction of this research, Figure 62 shows preliminary answers to the secondary research questions for the university context.

<table>
<tr><th>Perspective questions</th><th>Obtaining</th><th>Labelling</th><th>Offering</th><th>Selecting</th><th>Using Pure</th><th>Using Adapted</th><th>Retaining</th></tr>
<tr><td>What?
(granularity standards)
TQ1</td><td colspan="4">Presentations, assignments, course descriptions, guidelines, animations, development tools, web</td><td>Multimedia assets, animations</td><td colspan="2">Modules, learning objects</td></tr>
<tr><td rowspan="2">How? (tools)
TQ2</td><td colspan="2">Templates</td><td colspan="5"></td></tr>
<tr><td>Scanner, office tools (Word, PowerPoint), hard disk</td><td>Using profiles, databases, back-office systems, content-analysing tools, dedicated labelling</td><td>Software packages, CDs, DVD</td><td>Dedicated selection tools, Search engines, browsing tools</td><td colspan="2">Browser, dedicated clients</td><td>Tracking and tracing learning objects, editing learning objects</td></tr>
<tr><td rowspan="2">Where?
(systems)
TQ3</td><td colspan="2">Authoring tools</td><td colspan="2"></td><td>LMSs</td><td colspan="2">Authoring tools</td></tr>
<tr><td></td><td colspan="3">LCMSs</td><td colspan="2">CMSs</td><td></td></tr>
</table>

Figure 62 University context, answers to the secondary technical research questions

Figure 63 shows preliminary answers to the secondary research questions for the corporate context.

Perspective questions	Obtaining	Labelling	Offering	Selecting	Using pure	Using Adapted	Retaining
What? (granularity standards) TQ1	E-modules						
	Packages, content aggregations, activities, SCAs, assets.						
How? (tools) TQ2	Templates						
	Office tools (Word, PowerPoint) Scanner, digital camera, software programs, 3rd-party commercial development	Using profiles, databases, back-office systems, dedicated labelling tools	Software packages, CDs, DVD	Competency assessment tool, search engines, competence gap analysis, browsing tools	Browser, dedicated clients	Tracking and tracing learning objects, editing learning objects	
Where? (systems) TQ3	Authoring tools				Authoring tools		
		LCMSs		CMSs			
			Web	LMS			

Figure 63 Corporate context, answers to the secondary technical research questions

For the military context the use the actual systems are only CBT maintained and created by authoring tools. Reuse is not automated by systems. Figure 64 shows this.

Perspective questions	Obtaining	Labelling	Offering	Selecting	Using Pure	Using Adapted	Revising
What? (granularity standards) TQ1	Packages, content aggregations, activities, SCAs, assets.						
How? (tools) TQ2	Templates						
	Scanner, digital camera, software programs, 3rd-party commercial development tools	Ontology-based agents dedicated labelling tools	Software packages, CDs, DVD	Search engines, browsing tools	E-modules	Tracking and tracing learning objects, editing learning objects	
Where? (systems) TQ3	Authoring tools		Catalogues, Web		Authoring tools		

Figure 64 Military context, answers to the secondary technical research questions

The main and the secondary research questions will be further analysed in Chapters 5, 6, and 7.

In the next chapter, the methodology that will be used for further investigations of the frameworks shown in Figure 62 to Figure 64, supplemented with the parallel frameworks from Section 2.5, will be described.

4 Methodology

The previous chapters identified the problem domain for the research: the issues and secondary research questions that apply to the life cycle of a learning object in different contexts. This chapter makes a bridge between the conceptual descriptions in Chapters 2 and 3 and the eventual application of the research to the goal of successful use and reuse of learning objects in different learning settings. The bridge involves the methodology for the remainder of the research. Section 4.1 combines the results of Chapters 2 and 3 to express the investigative focus of the research and the methodology used to carry out the tasks of the research. The chosen methodology (Action Research) is described in Section 4.2. Section 4.3 describes the way data will be collected in the specific contexts and projects for the research and Section 4.4 gives a description of the TeleTOP® system as the major research tool in the projects.

4.1 Focus of the research and choice for the methodology

Chapters 2 and 3 have described the investigative focus conceptually, using the approach of considering the life cycle of a learning object from two major perspectives—technical and human—and within each of these, in terms of three different contexts. In Section 4.1.1 the variables used in the research are consolidated. Following this, in Section 4.1.2 three main tasks for the research are identified. Section 4.1.3 describes a general approach to the methodology and the choice for Action Research as the methodology that was used for this research.

4.1.1 Consolidating questions and perspectives

The research focuses on differences and similarities related to reuse within three different contexts: University, corporate learning, and military training. The learning-object lifecycle is used to identify different stages of learning objects within the three contexts. Section 1.3 described the following stages of the learning-object lifecycle:

- Obtaining
- Labelling
- Offering
- Selecting
- Using
- Retaining

and discussed the stages within each use context. This formed one organizer for the research. Another organizer related these contexts and stages to questions and issues as well as to the human and technical perspectives. To describe how the stages of the learning-object lifecycle play a role within the three contexts, questions, perspectives and issues from Chapters 1, 2, and 3 were identified:

- Main research questions
- Perspectives
- Human-perspective questions

- Technical-perspective questions
- Secondary research questions
- Issues

These questions and variables form the structure within the description of a series of projects carried out to give insights about the relevance and need of the learning-object lifecycle for reuse within different contexts.

The two key perspectives, technical and human, were first identified in Chapter 1. The human perspective was then described in Chapter 2, and the technical perspective in Chapter 3. Also the questions Why?, Who?, What?, How?, and Where?, the secondary research questions, and the issues were formulated in the Chapters 2 and 3. The questions and perspectives of the research are consolidated in Table 10.

Table 10 Consolidation of the questions, perspectives, and issues of the research

Main research question		Perspectives	Perspective questions	Secondary research questions	Issues
RQ3. Combining human and technical aspects - What are key dimensions to guide the selection of tools, technologies and human procedures to support the different stages of the lifecycle of a learning object for users in different usage contexst, particularly university, corporate learning centre, and military training?	***RQ1: Human aspects – What human aspects are important to support the different stages of the lifecycle of a learning object?***	Human	Why?	HQ1. Organisational context - Is the use of learning objects embedded in an organisational strategy? If yes, how and why? If not, what then is the meaning of reusable learning objects for the individuals in the organisation? HQ2. Learning scenarios - What are the implications of different learning scenarios or approaches, particularly the contrast between knowledge acquisition and collaborative problem solving and knowledge creation, for the use of learning objects, for their structural requirements, for their quality control, and for their metadata? HQ5. Metadata - Is there a need or wish for assigning metadata to learning objects within the organisation? Assuming its application, who decides what terms and relationships to express? Are these decided from a logical or a user-generated approach? Who applies the metadata, what will motivate them to do this, and how much time will they be willing to spend on the process?	HI2. Effectiveness HI4. Environment
			Who?	HQ3. Object creation - Who creates the learning objects in a repository or otherwise available for sharing? And what is it that they create: A pedagogically neutral or pedagogical specified resource? Does the object have to be created specifically for learning? What about the quality control of what is created; who affirms this? The creator or the user? HQ4. User support - What training, support, incentives, tools, and services are needed, for whom, for each of the stages in the lifecycle of learning objects? Who designs these? Who provides these?	HI1. Ease of use HI3. Engagement
	RQ2: Tools and techniques - What tools and technologies are important to support the different stages of the lifecycle of a learning object?	Technical	What?	TQ1. Granularity and standards - What granularity level of learning objects can be identified in the different organisational contexts and how can these learning objects be mapped against existing standards?	TI1. Specifications and standards TI2. Granularity
			How?	TQ2. Tools - How do tools in the varying organisational contexts support the different stages within the learning-object lifecycle?	TI3. Reuse TI4. Meta-tagging
			Where?	TQ3. Systems - What systems are in use with the actual reuse of learning objects in the different organisational context, and how do they vary?	TI5. Access and privileges

4.1.2 Tasks for the research

The questions and issues listed in Section 4.1.1 all have been based on the literature. They lead to three major tasks of the research.

The first task for the research is **descriptive**: to see if the descriptions of the problem domain as described in Section 2.5 and Section 3.5 [the summaries of Chapter 2 and Chapter 3] can be confirmed in practice. This is primarily a validation task with the goal of confirming the descriptive views, or altering them if needed.

A second for the task is **explanatory**: Why do events relating to the use or non-use of learning objects in real practice occur as they do? The analysis of the secondary research questions can help in structuring such explanations so that the research has applications in practice beyond description and models.

Together these two tasks lead to the major task of the research: A **prescriptive** task of identifying procedures and requirements for optimising the chance of the learning-object lifecycle operating successfully in different contexts. The prescriptive task involves all of the elements of the research listed in Section 4.1.1. By "successfully" is meant that (a) tools are in place, (b) rules are understood and followed, (c) roles related to the learning objects are identified, and (d) organisational embedding has occurred leading to learning objects (e) being used and reused by a critical mass of users within an organisation in (f) ways that are appropriate and (g) valuable to the organisation. A "Learning Object Context Profiling Model" and instrument will be presented in Chapter 9 as a tool for improving the chance of such success in a specific context.

A methodological approach needs to be chosen that will support these main tasks: to validate the views from the literature in practice, to explain experiences from practice, and to test prescriptions for procedures and requirements that will lead to successful use of learning objects in different contexts. A general methodological approach for these tasks is described in the next section.

4.1.3 Choosing the research methodology

Christie, Rowe, Perry, and Chamard (2000) identified a methodology that gives three straightforward methodological stages that can lead to a set of research outcomes for research in complex problem domains:

- The first stage includes a literature review and pilot studies. This stage raises research questions, issues, variables, a conceptual framework, and is the base for the interview questions to be used in subsequent projects.
- The second stage focuses on the case studies based on projects and the evaluation of the projects. The projects are analysed individually, but also cross-project analyses and aggregate analysis are used for evaluation. Also the conceptional framework is confirmed and peer evaluation by international experts occurs, such as during conferences and presentations.
- The third stage is used for issue clarification. This means that predictions can take place and prescriptions based on the research findings can be made. Such

prescriptions, or guidelines, can be also part of the results of the research in the third stage.

Figure 65 gives an overview of the three stages in Christie, Rowe, Perry, and Chamard's general approach to research methodology and the tasks and outcomes in every stage.

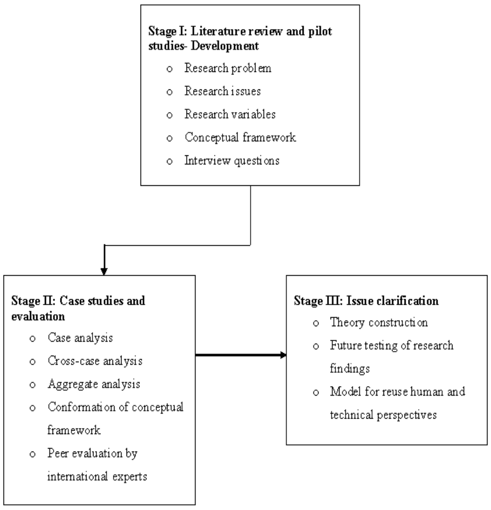


Figure 65 Research methodology for complex problem domains (adapted from Christie, Rowe, Perry, & Chamard, 2000, p. 13)

The model shown in Figure 65 will be used for the overall research methodology for the learning-objects research. Figure 65 can be directly related to the different chapters of this dissertation and the three research tasks identified in Section 4.1.2. The first stage in the model of Christie and his colleagues can be found in the first three chapters of the dissertation that define a conceptual framework and raise the research problem, variables, and questions to be further studied. This stage can be seen as a descriptive task within the methodology. The second stage will mainly focus on a set of studies of investigations and the analysis of these. Chapters 5 - 7 describe the ten different investigations. The second stage of the methodology can be seen as primarily relating to the explanatory task in the research, as well as the validation of the descriptive results from the first stage. The third stage relates to the prescriptive task. Chapters 8 and 9 are used to synthesize the results from the ten projects and to construct a model that supports such a set of prescriptive recommendations for reuse strategies in different contexts.

This way of carrying out research closely relates to case-study research within an Action Research paradigm. In this research Action Research as a methodology is therefore chosen. This choice is further explained in the next section.

4.2 Action-Research Methodology

According to O'Brien (1998) Action Research is known by many names, including participatory research, collaborative inquiry, emancipatory research, action learning, and contextual action research, but all are variations on a theme. Action Research (AR) belongs to the case-study family of methodologies, but they are intentionally treated as separate forms (Benbasat, Goldstein, & Mead, 1987): Action-Research studies likely include cases, but a case study can certainly avoid using an action-research approach (Davison, 1998). An overview of the Action Research methodology is given in Section 4.2.1 and Section 4.2.2 further investigates some of the principles that underlie AR. Section 4.2.3 describes the role of the researcher in AR. In Section 4.2.4 the scope and generality of AR is expanded. Section 4.2.5 describes the validity of AR in this research, while Section 4.2.6 describes the limitations of the AR approach. To conclude, Section 4.2.7 describes the specific methodologies for data collection in the projects of this research.

4.2.1 Overview of the Action-Research Methodology

A simple description of Action Research is “learning by doing” - a group of people identifies a problem, tries to resolve it, sees how successful their efforts were, and, if not satisfied, tries again. While this is the essence of the approach, there are other key attributes of Action Research that differentiate it from common problem-solving activities. These are described in this section.

A more-specific definition of AR is:

> *"Action research...aims to contribute both to the practical concerns of people in an immediate problematic situation and to further the goals of social science simultaneously. Thus, there is a dual commitment in action research to study a system and concurrently to collaborate with members of the system in changing it in what is together regarded as a desirable direction. Accomplishing this twin goal requires the active collaboration of researcher and client, and thus it stresses the importance of co-learning as a primary aspect of the research process." (O’Brien, 1998)*

Action Research is described by Kock, McQueen, and Scott (1997) by contrasting AR with three other major research approaches to describe AR as an appropriate approach for information-systems research. A brief description of these categories highlighting major contrasting characteristics is given:

Experimental research - In experimental research the researcher has a strong control over the environment being observed. This research approach has its roots in the scientific practice of biologists and physicians, where variables are manipulated over time, associated numeric data are collected, and causal or correlational models are tested through statistical analysis.

Survey research - This research approach has its roots in the work of economists and sociologists. In survey research the researcher typically has a considerable sample to be analysed, which suggests the use of questionnaires with questions that are easy to be answered and that permit quantitative evaluation "a posteriori". Survey research is typically applied to validate models or hypotheses.

Case research - This research approach has its root in business studies. Cases are analysed either to build up or validate models or theories, typically through collection of textual data through interviews. Typical instances are on-site case research situations.

Action research - The origins of this research approach rest in socio-psychological studies of social and worklife issues. AR is often uniquely identified by its dual goal of both improving the organisation participating in the research project, usually referred to as client organisation, and at the same time generating knowledge. Although it is typical that control on the environment being studied is almost impossible, the AR practitioner is expected to be involved in interventions in this environment.

From the comparison by Kock, McQueen, and Scott (1997) they conclude that of these four major research approaches one main characteristic, and strength, of AR becomes clear: it suggests intervention carried out in a way that may be beneficial to the organisation that is participating in the research study. AR involves aspects of naturalistic inquiry and recognises that even casual observation affects a system and therefore takes this effect inside its scope (Lincoln, & Guba, 1985). According to Kock, McQueen, and Scott (1997) the other three approaches are based on detached observation and analysis, disregarding the possibility of positive intervention from the researcher.

Previous work suggests that the distinctive characteristic of AR with regard to interventions leads to the development of a stronger linkage between organisations and research centres and to organisational development and improvement (Ledford & Susan, 1993; Sommer, 1987). Nevertheless, AR has been the target of criticism from positivists, who typically view experimental and survey research as the only "valid" modes of scientific inquiry, because they view knowledge in terms of the principles and laws which regulate the existence of the processes and the relationships of the social and physical world (Kuwaum, 2004; Davison, 1998; Levin, 1988) (See also Section 4.2.6 about the limitations of AR).

Susman and Evered (1978) identified five stages within a general AR project, which occur in a cyclical process: Diagnosing, action planning, action taking, evaluating, and specifying learning:

- The diagnosing stage involves the identification and definition of an improvement opportunity or a general problem to be solved in the client organisation.
- The action planning stage involves the consideration of alternative courses of action to attain the improvement or solve the problem identified.
- The action taking stage involves the selection and realisation of one of the courses of action considered in the previous stage.
- The evaluating stage involves the study of the outcomes of the selected course of action.
- The specifying learning stage involves the study of the outcomes of the evaluating stage and, based on this study, knowledge building in the form of a model describing the situation under study (Susman & Evered, 1978).

A single AR situation is expected to be limited in its generality, since the deep involvement of the researcher with the environment being studied leads, due to time constraints, to the study of a small number of instances of particular events. However, as the number of AR studies carried out on a similar topic grows, their resulting descriptive analyses can then be integrated into more general and predictive models, and can even eventually lead to "grand theories" (Strauss & Corbin, 1990).

The classical approach to AR usually prescribes that all stages (except the specifying learning stage) can be carried out in cooperation with the client organisation (see Figure 66). More contemporary approaches to AR, such as participatory AR, strive for the full involvement of the client organisation in the specifying learning stage as well (Elden & Chisholm, 1993).

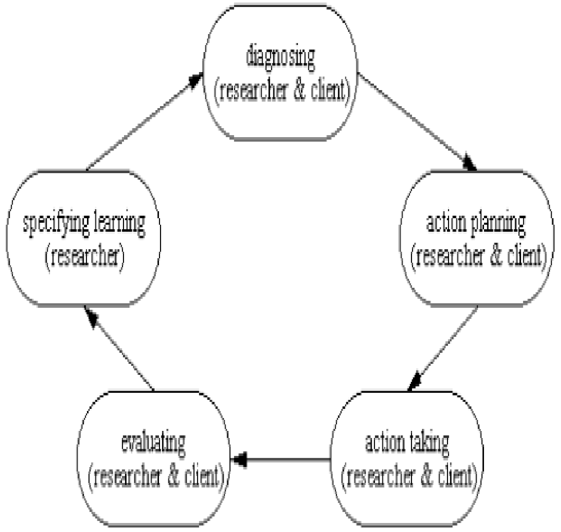


Figure 66 The AR cycle (Kock, McQueen, & Scott , 1997)

Next to a general overview of the AR approach as given above several principles underlying AR are important for this research. These are described in the next section.

4.2.2 Principles of Action Research

Winter (1989) provides an overview of several principles that give Action Research its unique flavour and are pertinent to the research carried out and described here. Among these principles is the principle of "reflexive critique", in which people involved in the research reflect on issues and processes and make explicit the interpretations, biases, assumptions and concerns upon which judgments are made. In this way, practical accounts can give rise to theoretical considerations. Another principle is that of "collaborative resources": it is argued that participants in an action research project are co-researchers and assumes that each person's ideas are equally significant as potential resources for the analysis. The nature of AR research embodies a combination of views, commentaries and critiques According to Winter this leads to multiple possible actions and interpretations and is the principle of "plural structure". The outcomes of AR, for instance a report, will act as a support for ongoing discussion among collaborators, rather than a final conclusion. Winter concludes his overview of AR principles by stating that theory informs practice, practice refines theory, in a continuous transformation (Winter, 1989). He argues that in any setting, people's actions are based on implicitly held assumptions, theories and hypotheses, and with every observed result, theoretical knowledge is enhanced. "It is up to the researchers to make the theoretical justifications for the actions explicit, and to question the bases of those justifications. The resulting practical applications that follow are subjected to further analysis, in a transformative cycle that continuously alternates emphasis between theory and practice".

From the above it can be concluded that Action Research is used in real situations, rather than in contrived, experimental studies, since its primary focus is on solving real problems. It can, however, be used by social scientists for preliminary or pilot research, especially when the situation is too ambiguous to frame a precise research question AR is also chosen when circumstances require flexibility or there is an involvement of the organisation in the research (O'Brien, 1998). It is often the case that those who apply the AR approach are academics who have been invited into an organisation (or other domain) by decision-makers aware of a problem requiring (action) research, but lacking the requisite methodological knowledge to deal with the problem (O'Brien, 1998). This is also the case in the research described in this dissertation. The role of the researcher in AR is described in the next section.

4.2.3 Role of the Action Researcher

According to O'Brien (1998), the researcher's role is to "implement the AR method in such a manner as to produce a mutually agreeable outcome for all participants, with the process being maintained by them afterwards". To accomplish this, AR may necessitate the adoption of many different roles for the researcher at various stages of the process, including those of planner, leader, catalyzer, facilitator, teacher, designer, listener, observer, synthesizer and reporter (O'Brien, 1998).

O'Brien notes further that the main role of the researcher is to "nurture local leaders to the point where they can take responsibility for the process". This point is reached according to O'Brien if the local leaders understand the methods and are able to carry on when the initiating researcher leaves. O'Brien also argues that in many Action Research situations, the hired researcher's role is primarily to take the time to facilitate dialogue and foster reflective analysis among the participants, provide them with periodic reports, and write a final report with recommendations when the researcher's involvement has ended.

Within this research the researcher fulfilled the roles of developer, designer, analyst, and interviewer. This is further elaborated in the descriptions of the specific projects in the different contexts in Section 4.3.

4.2.4 Expanding the scope and generality of Action Research across iterations

AR is seen as preferably carried out in cycles (Ketchum & Trist, 1992). One of the reasons for this is the opportunity that this allows for strengthening research findings by building on evidence gathered from previous iterations in the AR cycle. Ketchum and Trist see the frequency needed of the iterations in the AR cycle as likely to decrease as the match improves between the researcher's conception of the socio-technical system, expressed in the model comprising research findings, and that found as a result of the learning in each cycle. "This can be obtained by expanding the research scope, e.g. the areas of the client organisation involved in the research, and building up the generality of the results through the identification of invariable patterns".

This point is illustrated in Figure 67, which depicts the relationship between research scope and the generality of the model describing research findings. The rectangles in the cycles represent each of the AR cycle stages, where: "di" represents diagnosis, "ap" represents action planning, "at" represents action taking, "ev" represents evaluating, and "sl" represents specifying learning. The iterations are named Cycle 1, Cycle 2, ...to Cycle "n", where "n" is the total number of iterations in the AR project.

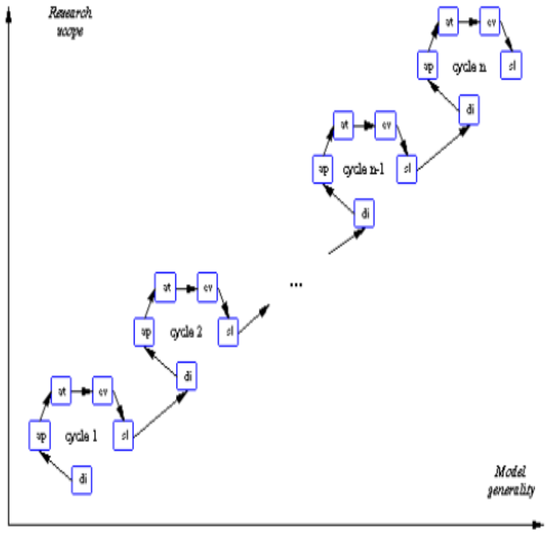


Figure 67 Relationship between research scope and model generality (Kock, McQueen, & Scott , 1997)

Strengthening the validity of AR findings through multiple iterations of the AR cycle can occur through a series of different projects as cycles within the AR. Within the research the different projects can be seen as cycles where the outcomes of each project are used for the next project.

4.2.5 Validity of Action Research

Internal validity is a measure of the internal consistency of the research findings and is not necessarily linked to external validity, which is a measure of the generality of the findings to situations other than the one studied. A high internal consistency of the findings is not always likely to increase their generalisability. The threats to external validity in AR are often seen as caused by the focus of AR on in-depth study of a small number of socio-technical systems, perhaps only one to three organisations. Iterative cycles of projects or cases can increase the validity of results in AR.

4.2.6 Limitations of Action Research

Three main possible AR weaknesses emerge from the discussion by Orlikowski and Baroudi (1991) about the clash between positivist and non-positivist assumptions, and therefore seem to require particular attention in the development of methodological tools for improving AR from a positivist perspective. The main weaknesses are related to:

- *Contingency of the research findings.*

  While important links between variables can be shown in AR that might not be identified by the use of other approaches such as survey research, AR is often seen as inappropriate to produce models with high external validity, i.e. that are valid outside the context of the AR project (Cook & Campbell, 1976; Berkowitz & Donnerstein, 1982). This is because most AR projects involve a small number of client organisations in in-depth and often longitudinal studies (Galliers, 1992), and very seldom do assessments occur across a number of organisations or industries.

- *Low control of the environment.*

  This lack of control is, according to Jonsonn (1991), one of the main reasons for AR being seen as inappropriate to test or produce strong theories, or build up research models based on solid evidence. The influence of a particular variable might take too long to be isolated in AR studies (Jonsonn, 1991).

- *Personal over-involvement.*

  The personal (over)-involvement of the researchers with their client organisations in AR projects may hinder good research by introducing personal biases in the conclusions (Francis, 1991). This is particularly true in situations involving a conflict of interests. With respect to this Galliers (1992) points out that AR "... places a considerable responsibility on the researcher when objectives are at odds with other groupings" (p. 152).

- *Unplanned and informal structure.*

  Rapoport (1970) mentions AR's typical unplanned and informal structure: “The ad-hoc approach of AR, where most of the study is done in cycles with temporary reports, methodologies and frameworks, may be considered as lacking scientific discipline and consequently regarded of low academic interest”.

- *Interference with the research environment.*

  While potentially beneficial to the client organisation, AR’s interference with the research environment may bias research findings in ways that are difficult to be identified, and make them difficult to be replicated by other researchers in different settings (Rapoport, 1970).

- *Time required.*

  A final alleged weakness mentioned here is the lengthy time required to conduct quality AR projects, which may not be acceptable to the research's sponsor or client. Two principles, usually followed in case research to avoid this are to perform a careful preliminary preparation of the research, and seek guidance from a structured methodology (Yin, 1994). These two principles, however, are still not commonly practised in AR.

All of these are potential problems in the current research. Yin’s two principles plus the fact of carrying out ten different AR cycles in different settings will be used to deal with the limitations.

4.2.7 Methodologies for data collection

According to O’Brien (1998) Action Research is more of a holistic approach to problem-solving rather than a single method for collecting and analyzing data. Thus, it allows for several different research tools to be used as the project is conducted. This section starts with a short overview of possible methods for data collection in Section 4.2.7.1, followed by a description of the different methodologies that will be used for data collection in the projects for this research (Section 4.2.7.2). Section 4.2.7.3 gives an elaboration of the most important instrument in this research: a questionnaire, used across the projects to collect structured data.

4.2.7.1 Overview of possible methods for data collection

AR allows for several different research tools to be used as the project is conducted (O'Brien, 1998). These various methods, which are generally common to the qualitative research paradigm, include keeping a research journal, document collection and analysis, participant observation recordings, questionnaire surveys, structured and unstructured interviews, and case studies.

Even though AR is not completely the same as case-study research, the methodologies used in case-study research are to some extent applicable to AR. This also implies that as with case-study research AR can be classified as qualitative analysis (Miles & Huberman, 1994) but offers the possibility to combine qualitative with quantitative analysis (Winter, 2000).

Different types of data can be gathered in the case study. Stake (1995), and Yin (1994) identified at least six sources of evidence in case studies:

- Documents
- Archival records
- Interviews and questionnaires
- Direct observation
- Participant comments and reactions
- Physical artefacts

Documents could be reports, project descriptions, or any other document relevant to the research. The documents can assist in confirming the evidence from other sources. Archival documents can be log files, or out-of-date course material. Interviews are one of the most important sources of case-study information (Tellis, 1997). Several forms of interviews are possible: open-ended, focused, and structured or survey. In an open-ended interview, key respondents are asked to comment about certain events (Swanborn, 1994). The researcher must avoid becoming dependent on a single informant, and seek the same data from other sources to verify its authenticity. This process of verifying data from different sources is called triangulation (Swanborn, 1994; Stake, 1995). The focused interview is used in a situation where the respondent is interviewed for a short period of time, usually answering a pre-set questions. This technique is often used to confirm data collected from another source. The structured interview is similar to a survey in which the questions are detailed and developed in advance (Meerling, 1989). Direct observation occurs when a field visit is conducted during the case study and participant observations can also make use of other forms of participant reaction. In addition to this, physical artefacts (tools, instruments, other forms of records) can be collected during the study as part of a field visit. As Yin points out, it is important to keep in mind that not all sources are relevant for all case studies (Yin, 1994).

4.2.7.2 Data collection for the research

Based on the possible methodologies in AR specific data-collection methodologies for this particular research can be chosen. In this research questionnaires combined with a structured interview were used. Information was also gathered using unstructured interviews during the projects via talking to specialists from libraries, software developers, program managers, educational managers, line managers, IT- staff, support staff, helpdesk staff, and subject-matter experts. Research documents such as project proposals, ADL SCORM™ documents, manuals, existing course material, discussion groups, and articles were used to gather information for the projects and the research. Direct observation was a natural process during the case studies. Collecting physical artefacts occurred primarily by collecting course material available for reuse in digital form. Next to this an on-going literature review was carried out and log files were analysed. Summarizing the methodologies gives the following list:

- *Literature study.*

  Literature studies were used to provide a theoretical background for the research area and construct descriptive and explanatory models to be tested in the cases. For this research the literature study was mainly focused on technical and human perspectives and issues within the learning-object lifecycle (Chapter 2 and 3).

- *Structured interview with questionnaire.*

  Two versions of a structured interview were used. The initial version was used in the Alfa Beta (university) project to find preliminary conclusions relating to the reuse of material. The second version of the interview was more focused on different settings and the related issues. This was because it was found that the first version did not provide enough detailed information about these aspects (this will be discussed in Chapter 5). The questionnaire which served as the basis for the structured interviews in three of the projects will be described in Section 4.2.7.3.

- *Unstructured interview.*

  The interviews with subject-matter experts (SMEs) and instructors were of great value for understanding the original pedagogical ideas and "translating" them in new structures that make reuse possible. Discussions about an actual "rationale" of a course were used for guidelines for creating courses but also made clear current problems with implementing standards and of sharing and reusing learning objects in practice. In addition to the interviews with the SMEs and instructors, interviews were carried out with other persons involved in (the support of) course development.

- *Log-file analysis.*

  To get data from actual users and their behaviour relating to reuse, log files were analysed to find frequencies of reuse and methods for retrieving objects.

- *Course material analysis.*

  Within many of the projects, the number of reused objects was analysed. These analyses indicated how many objects were reused and where the objects were coming from. Also the type of reused material was clarified.

As is the case in most AR the projects differed from each other. In this case the projects differed in sort of projects, in the role of the researcher within the projects, and in the outcomes of the different projects. Therefore the different projects required different combinations of methods for data collection. This will be described in Section 4.3 after the projects are introduced.

As mentioned the most important method for data collection in all three contexts is the questionnaire and the structured interview. This is described in the next section.

4.2.7.3 Questionnaire for structured interviews

One or more of the projects in the university context, corporate-learning context, and military context included the same structured interview. Four parts can be identified in the questionnaire which was the basis for the interviews. In the corporate context the questionnaire was extended with an extra section because of a specific local condition. The common four parts are:

- Characteristics of the user including: context, roles within the organisation, and experiences with electronic learning environments.
- Experiences with reuse: Availability of material, need for reuse, ownership, control of material, after reuse, efficiency aspects, lifecycle of material, and what kind of material is reused already.
- Labelling material: ADL SCORM™, terminologies used for describing material, and time involvement.
- Selecting material: search strategies, used taxonomies, and need of use.

In the corporate project blended learning and the related reuse aspects were also part of the questionnaire.

The first four questions of the questionnaire were used to identify the characteristics of the user in terms of organisational context and role(s) within the organisation, and the experience with CMSs. The email address was used as unique identifier for the users. Figure 68 shows the first four questions.

01 Email Adress

02 Context — Higher Education / Commercial / Military

03 Role (Check as many as apply) — Course Material Assembler / Subject Matter Expert / Course Director / Part of CD Team / Instructor / Participant / Part of Multimedia Team / External Course Provider / Part of Development Team / Line Manager

04 How many years have you worked with a Course Management Sytem (for example Teletop)? — 1 / 2 / 3-4 / 5-6 / 7-more / Never

Figure 68 Questionnaire, characteristics of the user

Questions 5 to 14 were used to make an inventory of the need for reuse, tools, and sources that were available. These questions included items relating to control over the material after reuse and the copyrights that may be involved. The questions also focused on problems that may arise when reuse is supported by a CMS. Figure 69 shows this set of questions.

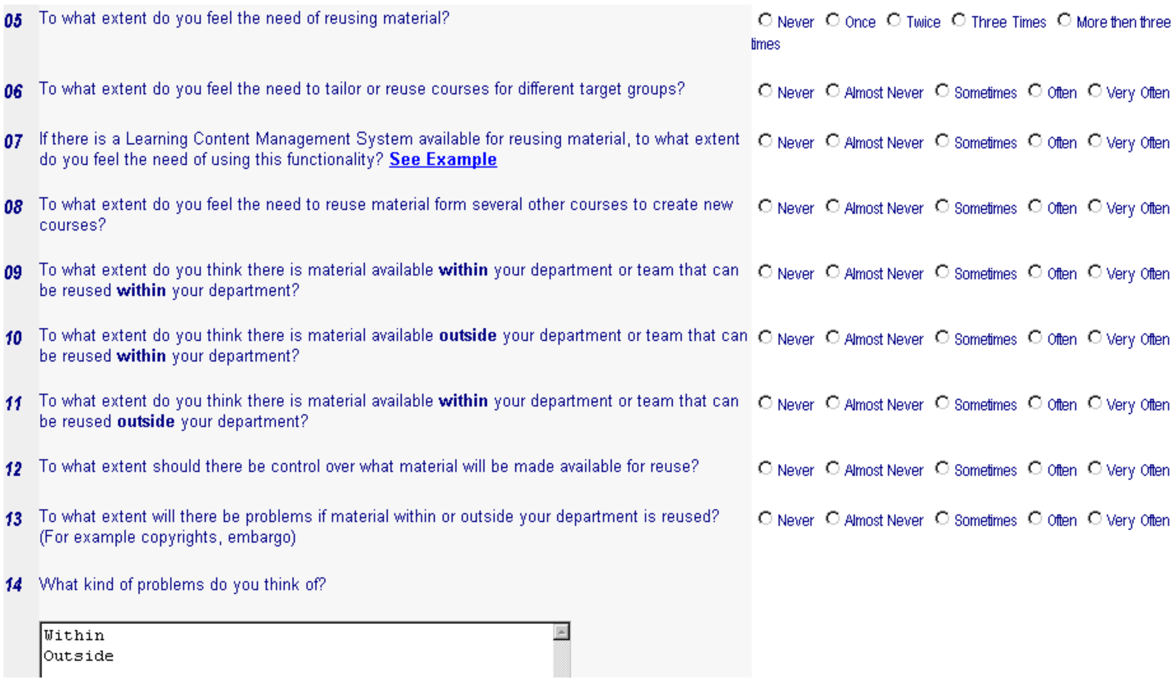


Figure 69 Questionnaire, experiences with reuse

During the interview, examples were shown to visualize the functionalities and tools related to the questions. Question 7 was related to such an example, as shown in Figure 70.

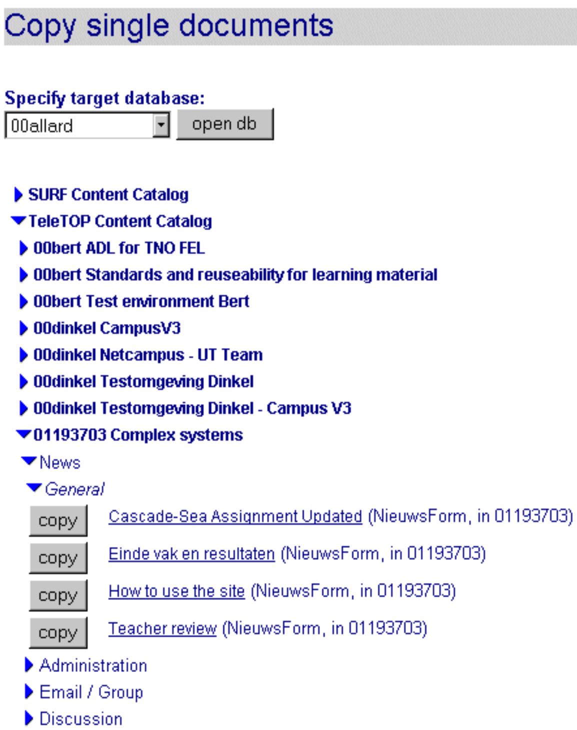


Figure 70 Questionnaire, example of tools for reuse

Because the questionnaire was built upon closed questions, there was a chance that a question may not exactly fit the specific situation. Open questions (15 and 35) were added so that users could comment on certain answers or questions. Figure 71 shows a field for an open question.

15	Do you have any remarks about the previous section?

Figure 71 Questionnaire, remarks and comments

Questions 16 to 31 (Figure 72) were used to record what types of material were found to be interesting for reuse. The first items were fixed types of material; the last four could be filled in if specific types of material were used in a certain context.

	How often do you expect will the following types of material be reused:	
16	• *Animations*	Never / Almost Never / Sometimes / Often / Very Often
17	• *Presentations*	Never / Almost Never / Sometimes / Often / Very Often
18	• *Movies*	Never / Almost Never / Sometimes / Often / Very Often
19	• *Pictures*	Never / Almost Never / Sometimes / Often / Very Often
20	• *Courses*	Never / Almost Never / Sometimes / Often / Very Often
21	• *Modules*	Never / Almost Never / Sometimes / Often / Very Often
22	• *Lessons*	Never / Almost Never / Sometimes / Often / Very Often
23	• *E-Modules*	Never / Almost Never / Sometimes / Often / Very Often
24	• *PDF, Doc as attachments*	Never / Almost Never / Sometimes / Often / Very Often
25	• *commercial off-the-shelf (COTS) CBT*	Never / Almost Never / Sometimes / Often / Very Often
26	• *Web links*	Never / Almost Never / Sometimes / Often / Very Often
27	• *Test Items (Quizzes)*	Never / Almost Never / Sometimes / Often / Very Often
28	•	Never / Almost Never / Sometimes / Often / Very Often

Figure 72 Questionnaire, type of material reused

To get a clear indication of the life-time of a learning object for reuse and what metadata requirements for selection were present, Questions 32 and 33 were used. Efficiency in terms of time investment was asked about in Question 34. Figure 73 shows this set of questions including Question 35 used for remarks.

32	How long do you think is coursematerial reusable, what is the lifecycle of material (in years)	Less then 1 / 1-2 / 3-5 / 6-10 / more then 10
33	If, material could only be selected based on subject and type **See Example**. Is this information sufficient?	Not At All / Not Much / No Opinion / Usually / Always
34	Do you think that reuse saves time?	Not At All / Not Much / No Opinion / Sometimes / Definitely
35	Do you have any remarks about the previous section?	

Figure 73 Questionnaire, lifecycle, selection of material, and efficiency

The example used in Question 33 is shown in Figure 74. The screen dumps only can give an indication of what is shown. The actual demonstration showed much more than just one picture.

Figure 74 Questionnaire, example of selecting material based on subject

The use of a LCMS and assigning metadata to material is new for most users. Question 37 (Figure 75) focused on the new terminology used for assigning metadata and on the users' understand of these new terms.

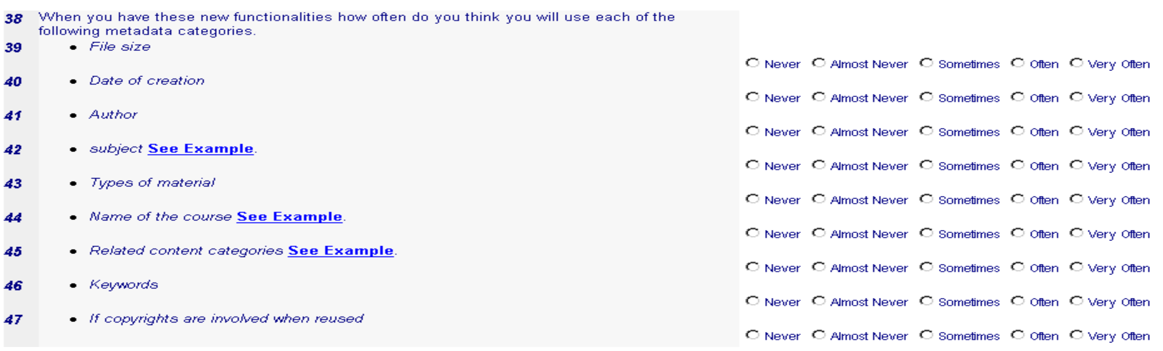


Figure 75 Questionnaire, metadata

The example used to support Question 37 about the terminology used is shown in Figure 76.

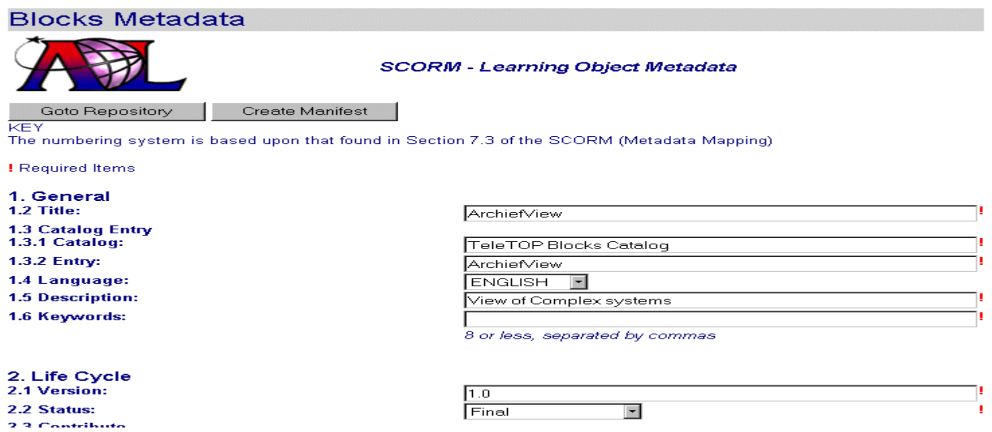
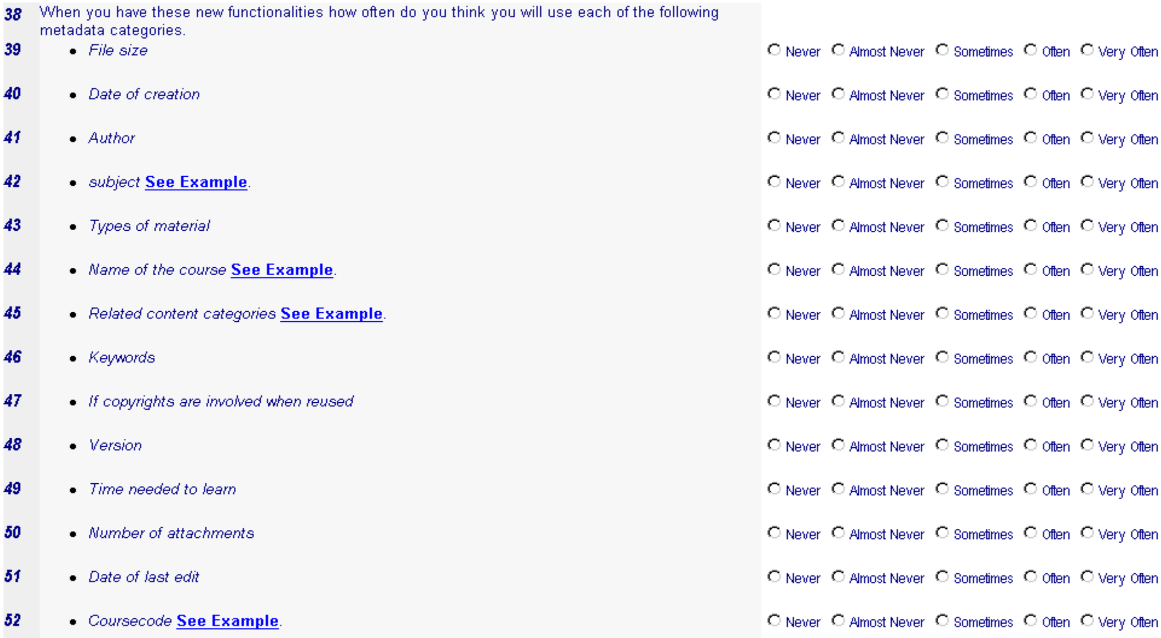


Figure 76 Questionnaire, example adding metadata

The search strategies of users are interesting because metadata are closely related to these search strategies. Questions 39 to 52 (Figure 77) focused on what metadata were found interesting to use to select material.



38	When you have these new functionalities how often do you think you will use each of the following metadata categories.	
39	• *File size*	Never / Almost Never / Sometimes / Often / Very Often
40	• *Date of creation*	Never / Almost Never / Sometimes / Often / Very Often
41	• *Author*	Never / Almost Never / Sometimes / Often / Very Often
42	• *subject* **See Example**.	Never / Almost Never / Sometimes / Often / Very Often
43	• *Types of material*	Never / Almost Never / Sometimes / Often / Very Often
44	• *Name of the course* **See Example**.	Never / Almost Never / Sometimes / Often / Very Often
45	• *Related content categories* **See Example**.	Never / Almost Never / Sometimes / Often / Very Often
46	• *Keywords*	Never / Almost Never / Sometimes / Often / Very Often
47	• *If copyrights are involved when reused*	Never / Almost Never / Sometimes / Often / Very Often
48	• *Version*	Never / Almost Never / Sometimes / Often / Very Often
49	• *Time needed to learn*	Never / Almost Never / Sometimes / Often / Very Often
50	• *Number of attachments*	Never / Almost Never / Sometimes / Often / Very Often
51	• *Date of last edit*	Never / Almost Never / Sometimes / Often / Very Often
52	• *Coursecode* **See Example**.	Never / Almost Never / Sometimes / Often / Very Often

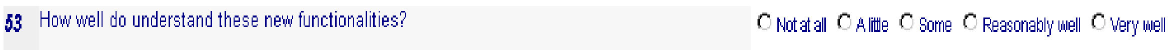
Figure 77 Questionnaire, selecting material based on metadata

One of the examples used in Question 42 is shown in Figure 78. The example shows the subjects of the learning material as a selection criteria.

copy Checklist for Assignment 2 (ArchiefForm, in 01193703)
copy Checklist for assignment 3 (ArchiefForm, in 02193703)
copy Docenten handleiding TeleTOP (NL) (ArchiefForm, in 01193703)
copy Example for shell (ArchiefForm, in 01193703)
copy Features/Tools and Tech Info for TeleTOP (ArchiefForm, in 01193703)
copy general feedback assignment 2 (ArchiefForm, in 00allard)
copy hands on sessie slides (ArchiefForm, in 01193703)
copy How to start: de Wizard handleiding: (ArchiefForm, in 01193703)
copy How to Zip (ArchiefForm, in 01193703)
copy INVA Checklist (ArchiefForm, in 00allard)

Figure 78 Questionnaire, example selecting material based on metadata

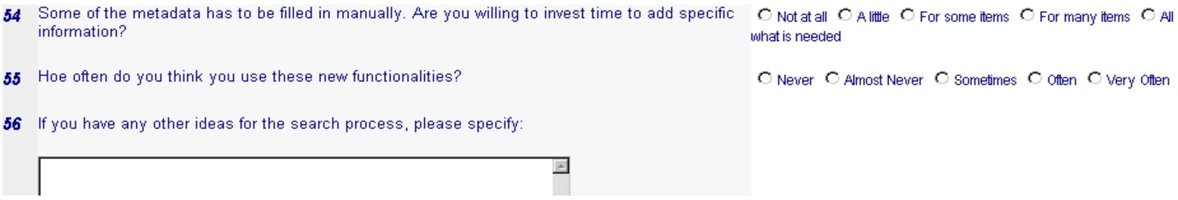
Because of the abstraction level and the fact that all functionalities were new in the CMS system involved in the projects, the user was asked how well the demonstration and functionalities were understood. Question 53 (Figure 79) shows this.



53 How well do understand these new functionalities? Not at all / A little / Some / Reasonably well / Very well

Figure 79 Questionnaire, understanding functionalities

The last questions of the questionnaire focused on the use of the tools in the future. Questions 54 and 55 asked what time investment is reasonable according to the user and if the new functionalities have potential use possibilities. The last question (56) asked the user to describe a search process and what is important to have in this process. Figure 80 shows the questions.


54 Some of the metadata has to be filled in manually. Are you willing to invest time to add specific information? ○ Not at all ○ A little ○ For some items ○ For many items ○ All what is needed

55 Hoe often do you think you use these new functionalities? ○ Never ○ Almost Never ○ Sometimes ○ Often ○ Very Often

56 If you have any other ideas for the search process, please specify:

Figure 80 Questionnaire, potential future use and time investment

For the corporate-learning context an extra set of questions was developed because reuse was incorporated in a blended-learning approach. These extra questions were specific for this context and were not repeated in the other (university and military) contexts. A reflection part, shown in Figure 81, asked the instructors how the blended-learning approach was useful in their specific courses. Also the time investment, for reusing material and obtaining reusable material was taken in account.


How satisfied are you with the blend or face-to-face and workplace learning that you chose for your course? ○ Not At All ○ Not Much ○ No Opinion ○ Satisfied ○ Very Satisfied

To what extent do you think there is a need for professionally made e-modules as resources within your course? ○ Not At All ○ Not Much ○ No Opinion ○ Perhaps ○ Definitely

Compared to the time you spent on this cycle, how much faster do you think you will be able to set up your TeleTOP site for the next cycle of this course? ○ Much Longer ○ Somewhat Longer ○ About The Same ○ Faster ○ Much Faster

Approximately how much time did you spend on entering feedback into TeleTOP for participant submissions? ○ None ○ Less Than 30 Minutes ○ Less Than An Hour ○ Between 1 And 5 Hrs ○ More Than 5 Hours

Approximately how much time did you spend on other forms of communication (other than feedback to submissions) within TeleTOP? ○ Less Than 30 Minutes ○ Less Than An Hour ○ Between 1 And 5 Hrs ○ More Than 5 Hours

How successful did you find each of the following aspects of your course?

- *Your personal contact with participants?* ○ Very Poor ○ Poor ○ OK ○ Good ○ Very Good
- *The study materials?* ○ Very Poor ○ Poor ○ OK ○ Good ○ Very Good
- *The activities done by participants?* ○ Very Poor ○ Poor ○ OK ○ Good ○ Very Good
- *The ways the participants learned from each other?* ○ Very Poor ○ Poor ○ OK ○ Good ○ Very Good
- *Commitment of the supervisors?* ○ Very Poor ○ Poor ○ OK ○ Good ○ Very Good
- *Other successful aspects:*

Figure 81 Questionnaire, reflection on reuse in a corporate learning

The questionnaires were filled in during a face-to-face interview schema. The accompanying structured interview was planned to take for each respondent around 45 minutes, but in most cases the interview took over 90 minutes because of the demonstrations involved. The five-point-Likert scale used forced the users to express their meaning about the different subjects. In many cases this was a difficult task that formed a starting point for the users to discuss the issues involved with the researcher.

The questionnaire was accompanied by a demonstration of the reuse functionalities in the TeleTOP® CMS as described in the project SURF Alpha Beta (see Section 4.3.1). During the structured interview, the different functionalities were shown when relevant. The TeleTOP® CMS and reuse support tools were used to give the users an idea of what was meant with the concepts such as learning objects, reuse, labelling, and learning material. Also the use of taxonomies, searching, and LOM were addressed with the demonstration as the purpose of the demonstration was to show some practical examples and to make the users aware of their own reuse possibilities. Besides the possibilities also problems and issues were addressed with the demonstration. The demonstration of the functionalities were also done to help prevent the respondents giving socially desirable answers (Meerling, 1989; Swanborn, 1981). The users were asked to give individual answers only tailored to their own situation and not to think in terms of others. This was emphasized more than once during the interview.

The questionnaire was used for the first time in the university context in the Alpha Beta project (described in the next section) where seven instructors were interviewed. First-time use of the interview in the Alfa Beta project made it clear that additional questions were needed to get a clearer idea of the difference between organisations.

The new structured interview which was based on the Alpha Beta questionnaire was repeated in the corporate, military, and university contexts. Within the university context another group of seven people were interviewed, in the corporate-learning context all 21 available course directors in one of the projects were interviewed, and in the military context three different groups of instructors were used to validate different user groups. Eight instructors from the Royal Army, four instructors from the air force, and ten instructors from the KIM (naval training college) were used to gather information using the interviews. The users were not randomly selected as all available instructors at the moment were interviewed, larger samples were thus not possible.

The results of the questionnaires are grouped around themes that were seen as important issues. Every theme was mapped against a set of questions used in the questionnaire. Table 11 shows the themes and the used questions from the questionnaire.

Table 11 Questionnaire themes and related questions

Themes	# - Question
Procedure and respondents	02 - Context 03 - Role 04 - How many years have you worked with a Course Management System (for example TeleTOP®)?
Reuse experiences	05- To what extent do you feel the need of reusing material? 06- To what extent do you feel the need to tailor or reuse courses for different target groups? 07 - If there is a Learning Content Management System available for reusing material, to what extent do you feel the need of using 34 - Do you think that reuse saves time? 53 - How well do understand these new functionalities? 55 - How often do you think you use these new functionalities?
Reuse what?	08 - To what extent do you feel the need to reuse material form several other courses to create new courses? 16 - Animations / News items 17 - Presentations / Course info items 18 - Movies / Roster items 19 - Pictures / Submitted work items 20 - Courses / Group items 21 - Modules / Discussion items 22 - Lessons / Question and answer items 23 - E-Modules / Workspace Items 24 - PDF, Doc as attachments / Presentation Items 25 - Commercial off-the-shelf (COTS) CBT / Glossary Items 26 - Web links / Web links Items 27 - Test Items (Quizzes) / Archive Items 28 - Open / Publications Items 29 - Open / Page Items 30 - Open / Poll Items 31 - Open / Category items
Metadata	33 - If, material could only be selected based on subject and type (See Example), is this information sufficient? 37 - Approximately what percentage of the terminology do you understand? (See Example) (%) 54 - Some of the metadata has to be filled in manually. Are you willing to invest time to add specific information?
Giving the opportunity for reuse	09 - To what extent do you think there is material available within your department or team that can be reused within your department?
Controlling reuse	12 - To what extent should there be control over what material will be made available for reuse?
Structuring material	56 - If you have any other ideas for the search process, please specify:
Selecting material for reuse	39 - File size 40 - Date of creation 41 - Author 42 - Subject 43 - Types of material 44 - Name of the course 45 - Related content categories 46 - Keywords 47 - If copyrights are involved when reused 48 - Version 49 - Time needed to learn 50 - Number of attachments 51 - Date of last edit 52 - Course code
Reuse of one's own materials by others	11 - To what extent do you think there is material available within your department or team that can be reused outside your department? 13 - To what extent will there be problems if material within or outside your department is reused? (For example copyrights, embargo) 14 - What kind of problems do you think of?
Reuse of materials made by others	10 - To what extent do you think there is material available outside your department or team that can be reused within your department?

4.3 Data Collection in Specific Contexts and Projects

Within the research the university context (Section 4.3.1), corporate-learning context (Section 4.3.2), and military context (Section 4.3.3) are investigated. Within each of these, three or four iterative projects took place in which the researcher followed an AR methodology. Figure 82 gives an overview of the investigations in the contexts.

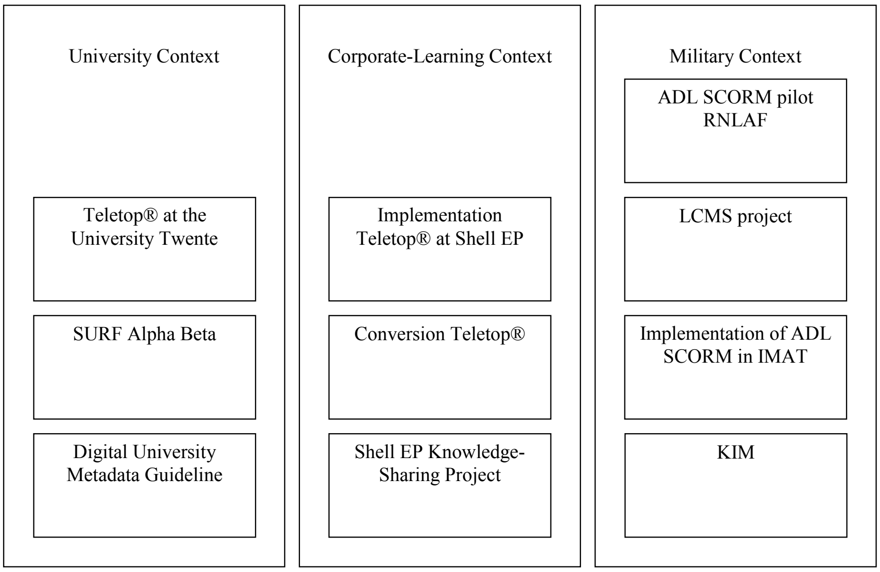


Figure 82 Overview of the investigations in the organisational contexts

In Sections 4.3.1 - 4.3.3 each context and related investigations are described.

4.3.1 University context and projects

Two of the projects in the university context involve the TeleTOP® course-management system developed at the Faculty of Educational Science and Technology of the University of Twente in The Netherlands. These two projects involve the use of templates for learning objects, version handling, the decision to use standards, user rights, data exchange, metadata requirements, and aggregation levels. The TeleTOP®-university projects also focus on the application of a standard in the existing TeleTOP® system, as well as the reasons to implement the standard in the environment, and the use of specially designed and constructed support tools based on the standard. The University of Twente was used for most of the experiences in two of the projects in the university context because the implemented TeleTOP® course-management system (CMS) made research possible on a large scale. The second project, the SURF Foundation Alfa-Beta Project, was used to study the TeleTOP® CMS experiences in other university settings. The other settings were the Faculty of Law, University of Leiden, and the Digital University [Digitale Universiteit]. The three projects are:

- *TeleTOP® at the University of Twente*

  TeleTOP® is a course-management developed at the Faculty of Educational Science and Technology to support blended-learning courses. A faculty-wide and then university-wide implementation provided a course-management system for all courses to make it possible for part-time students to participate in an active manner. The development of the TeleTOP® system was based on several developments deployed in earlier years (for a summary, see Collis & Moonen, 2001). The general ideas and experiences of earlier "tele-learning" or "e-learning" were used to build a database-driven course-management system. The researcher was the main designer and developer of the system between 1997-2001. From the start reuse of material was a key issue in development. The use of databases made it possible to make this reuse aspect simple and useful for course developers. Course developers were mainly instructors supported with student assistants and the TeleTOP® support team. The support team created desired functionalities and provided help with moving face-to-face learning to a more-blended mixture of self-study and managing courses at a distance. The purpose of this research was to facilitate within the Faculty of Educational Science and Technology a change in educational delivery in response to the decision to include working students along with "regular" students in its regular programs. Along with the design and development of a technical system to support this change, the TeleTOP® system, the project also focused on new didactics and instructor support, and on the change process in the organisation.

The researcher was designer, developer, and programmer of the TeleTOP® CMS.

- *SURF Alpha Beta*

  The SURF Foundation is the higher education and research partnership organisation for network services and information and communications technology (ICT) in the Netherlands. The mission of SURF is to exploit and improve a common advanced ICT infrastructure that will enable higher-education institutes to better realise their own ambitions and improve the quality of learning, teaching, and research (http://www.surf.nl). The method of SURF can be summarized as follows: Providing vision in four-year Strategic Plans initiated by the Scientific Technical Council (WTR), ensuring the commitment of the institutions for higher education, executing the Strategic Plan by stimulating collaboration, and co-funding innovative national development programs. The SURF activities are funded both by the participating institutions as well as by the Dutch government. The participating institutions pay the costs for the operation of the SURF office. In addition to this, SURF receives grants from the Ministry of Education, Culture, and Science and from the Ministry of Economic Affairs. These grants may only be used for strategic innovations.

  The Alfa Beta Project focused on the reuse and exchangeability aspects between course-management systems. A metadata-tagging tool based on ADL SCORM™ / LOM was developed for the TeleTOP® system and a Learning Content Management System was set up to get user experiences and results. Also structured interviews were carried out to find out how instructors reuse material and the related issues. The main role of the researcher during the SURF Alpha Beta project was designer and developer of functionalities for reuse in the TeleTOP® CMS. For evaluation purposes the researcher was also the interviewer of the intended users of the developed functionalities.

- *Digital University Metadata Guideline*

  The Digital University is a consortium of ten higher-education organisations in The Netherlands. The University of Twente is one of the members. All organisations contribute in the form of a yearly fee and therefore projects can be proposed that are funded by the Digital Universiteit. The intention of the projects is cooperation with other higher-education organisations and sharing knowledge and products between the members of the consortium. A set of project lines has been identified to streamline the research and focus on useful products for the consortium. The Digital Universiteit focuses on interoperability and the use of standards for exchanging created products within the consortium and between other involved organisations such as publishers. This project is about the development of a metadata-application profile for projects created within the DU. This profile describes the minimal metadata set and vocabulary used within the consortium. The role of the researcher was that of analyst.

4.3.2 Corporate-learning context and projects

The three projects in the corporate setting took place at Shell International (Exploration and Production BV) and focused on the definition of learning objects, and their relation to a company-wide integration based on competencies. They also stressed the workflow issues related to the reuse of material and the life cycle and version control of learning objects. The projects are:

- *Implementation of TeleTOP® at Shell EP*

  The purpose of this research was to develop and validate tools for applying international standards for metadata and re-use (initially, ADL SCORM™) to the TeleTOP® system and to study the use of the standards in practice within blended-learning courses. Work packages within the project were: Definition of specifications for courses with regard to metadata and reusability, developing procedures for dissemination of knowledge about standards regarding reuse, developing tools for actual reuse within courses, lifecycles of courses, reuse procedures, using the Shell EP competence structure as a classification structure, and the implementation of the structure in LOM. The roles of the researcher were designer and interviewer.

- *Conversion of TeleTOP®*

  The University of Twente, via the Dinkel Institute (now ITBE), had the task of rebuilding TeleTOP® into a commercial version, with Shell EP as one of the first clients. The TeleTOP® system was rebuilt for commercial purposes after it had been used for five years in an academic setting in a combined prototype and production setting. The system was back-engineered and bugs and problems were solved. Back engineering was needed to provide user assistance for use and reuse of learning objects in the future. Moving to the new commercial version included a conversion to reuse old material in the new version. The issues related to the conversion are described in this investigation. The role of the researcher was developer and consultant.

- *Shell EP Knowledge-Sharing project*

  An inventory of procedures and taxonomies for reusing and sharing knowledge objects was made in different locations within the Shell EP organisation. Because of the decentralization of Shell EP, knowledge and expertise is scattered over locations around the world. Inventories were made at the NAM in Assen, Shell Rijswijk, and the Shell EP Learning Centre in Noordwijk. NAM is a centre of excellence for document management, in Rijswijk a group is working on knowledge management and the new ways of working involved, while the Shell EP Learning Centre includes a group of LDLs (Learning and Development Leaders, i.e. instructors or course leaders and designers) involved in training and learning within courses. Experts involved in knowledge sharing, information and communication technology, document management, and building taxonomies were interviewed and existing systems analysed. The main role of the researcher was analyzing the systems and procedures that could support reuse.

4.3.3 Military context and projects

Four different projects were carried out for the Royal Netherlands Air Force (RNLAF), the Royal Netherlands Army (RNLA), and the Royal Netherlands Naval College (KIM). The ADL SCORM™ Pilot RNLAF focused on the runtime aspects of ADL SCORM™ and the implementation of ADL SCORM™ in existing Computer-Based Training (CBT) courses. Also the use of the ADL SCORM™ metadata set for a Learning Content Management system was one of the key research points. One of the projects presented the application of the standard in the existing IMAT system and related issues that occur. The projects are:

- *ADL SCORM™ Pilot RNLAF*

  This was a project that consisted of three work packages and focused on the ADL SCORM™ implementation in several training programs of the Royal Dutch Air Force. Package 1 focused on the experiences with a LMS: Installation, requirements, possibilities, behaviour, and actual courses. Package 2 related to the restructuring of content to make reuse possible. The courses “Ranks” and “Aircraft Recognition” were used to see how this restructuring could be applied in practice. Package 3 involved the implementation of the runtime ADL SCORM™ specifications. This means that based on AICC, interaction between LMS and courseware was established to exchange user data and course-specific information. The roles of the researcher could be characterized as analyst, designer, and developer

- *LCMS project*

  A Learning Content Management System (LCMS) was built for research purposes for TNO (Section 1.2.3.4). Instructors used the LCMS to search for material to create courses. After creating courses, material was stored in the LCMS for reuse purposes. The research project had two main focuses: (a) Results from the research were used for the Dutch Royal Army to see if instructors could actually find material and use a LCMS. How the metadata were used, how instructors searched for material, and if descriptions were useful were studied; and (b) on the other hand the research also focused on the classification aspect that was to be implemented in ADL SCORM™ in the military context in terms of its use for the competence/classification structure for the Shell context. The roles of the researcher could be characterized as developer and designer of the LCMS and interviewer of users.

- *Implementation of ADL SCORM™ in IMAT*

  The IMAT system was developed to create metadata for segments of technical manuals to use for future e-learning purposes. Based on indices, headings, a predefined taxonomy, and other characteristics of the content, materials were divided into reusable objects and metadata was added. This project focused on the implementation of ADL SCORM™ in the existing metadata schema. The existing IMAT metadata set was analysed and mapped against the LOM. The main role of the researcher was that of analyst.

- *KIM*

  The KIM (Koninklijk Instituut voor de Marine, Royal Netherlands Naval College) investigation focused on the instructor interviews to gather data about the possibilities for reuse and the need for tools. Also questions about the differences in learning scenarios, organisational strategies, and type of learning material were part of the interview. The role of the researcher was interviewer of respondents within the KIM context.

4.3.4 *The role of the researcher in the projects*

As described in Section 4.2.3 the researcher can have different roles in the different projects. This was also the case in the projects in the different contexts as described above. Figure 83 shows the relation between the roles, contexts, and projects.

University Context	Corporate-Learning Context	Military Context
		ADL SCORM pilot RNLAF: analyst, designer, and developer
Teletop® at the University Twente: designer, developer, and programmer	Implementation Teletop® at Shell EP: designer and interviewer	LCMS project: developer, designer, and interviewer
SURF Alpha Beta: designer, developer, and interviewer	Conversion Teletop®: developer and consultant	Implementation of ADL SCORM in IMAT: analyst
Digital University Metadata Guideline: analyst	Shell EP Knowledge-Sharing Project: analyst	KIM: interviewer

Figure 83 Roles within the contexts and projects

Figure 84 presents the relation between the projects and data-collection methodologies

	University context			**Corporate -learning context**			**Military context**			
	TeleTOP® development	**The SURF Alpha beta**	**Digital University**	**TeleTOP® at Shell EP**	**Conversion TeleTOP®**	**Knowledge sharing**	**ADL concepts: LMS content runtime**	**IMAT**	**LCMS**	**KIM TeleTOP®**
Literature study	√		√				√	√	√	
Structured interview	√	√		√					√	√
Unstructured interviews	√		√	√	√	√	√	√		√
Log-file analysis	√	√					√		√	
Course-material analysis	√	√			√		√	√		
Action Research	√	√	√	√	√	√	√	√	√	√

Figure 84 Relation between projects and data-collection methodology

4.4 The TeleTOP® CMS as a Research Tool

For five of the cases the TeleTOP® course-management system (CMS) was taken as the basis for the research tools. TeleTOP® was used because of its flexibility and scale of use. TeleTOP® was used for all three contexts in different variants. In the following sections the underlying system is described and how its functionalities were used for the research. Section 4.4.1 describes the foundation of TeleTOP®, Section 4.4.2 the choice for Domino as the database technology for TeleTOP®, Section 4.4.3 the development of TeleTOP®, and Section 4.4.4 the development of TeleTOP® related to projects. The researcher was designer and the main developer of TeleTOP®.

4.4.1 The foundation of TeleTOP®

The faculty-wide implementation of a course-management system at the University of Twente in 1997 was an initiative of the dean based on the requests of several departments to provide courses with Web-supported learning. Also the decreasing number of full-time students and the focus on part-time students was a motivation to implement a course-management system in that more flexibility in course participation could be offered. The "**Tele-**learning **T**oegepaste **O**nderwijskunde **P**roject", TeleTOP®, was responsible for the faculty-wide implementation. A major part of this project involved the development of a course-management system.

4.4.2 Database technology for TeleTOP®

After an inventory of available CMSs in 1997 a product to serve as the basis for the course-management system was initially chosen, one that built on Oracle databases. The initially chosen product, Oracle Learning Architecture (OLA), was created as an "open, online Education application for delivering interactive; multimedia education in any subject over networks" (Ellwood, 1997). OLA focused on the use of learning objects and assembling these objects together. "The bulk of the content on OLA today has been converted from existing CBT (Computer Based Training) courses. Once content is developed explicitly for this medium, Learning Objects can be stored in an Oracle database and the OLA application can assist the user in assembling these objects together".

OLA was meant to be tailored for the needs of the Faculty of Educational Science and Technology and was also to serve as a collaboration and group tool. Unfortunately, OLA was no longer supported by Oracle as of 1997 because of continuing changes in operating system requirements from Microsoft. Thus, another database had to be chosen. The choice for using the Web-based database Lotus Notes Domino came from the experiences in the "Webnet" project (van Beek, 1997; Strijker, 1997) where a Web-based educational environment was developed for Dutch middle-vocational schools. The TeleTOP® system was initially based on these experiences.

An inventory of available Web-based support functionalities was made during the first months of development of TeleTOP®. Because various tools and functionalities were possible a choice was made with the instructors of what to use. To provide instructors with a set of good examples for the set of functions that would be offered, a Decision Support Tool (Collis & De Boer, 1999; De Boer, 2004) was developed. This resulted in a prototype of the course environment that was used for the first three courses in early 1998. The use of the Domino platform gave the ability to rapidly develop database-driven Web applications and database-driven Web-based templates to support education. A clear difference could be made between the operating system, database engine, Web server, and the front-end TeleTOP®

templates. Figure 85 shows this schematically. The benefit of this approach is that developments only needed to focus on educational aspects and not on the technical implications.

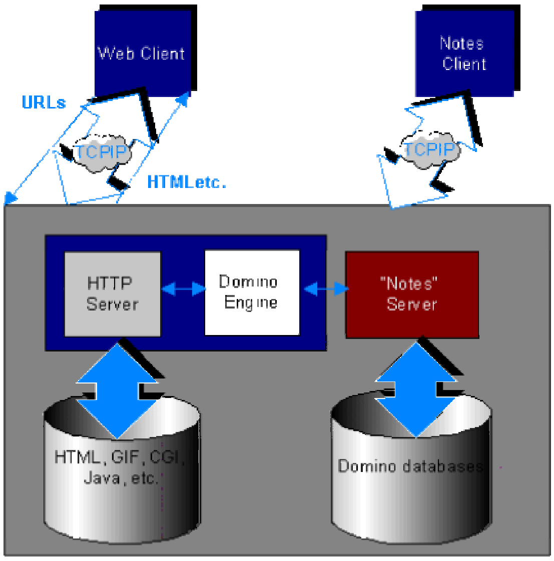


Figure 85 The Domino platform

Most of the technical solutions were offered in the form of functions. Development and maintenance of database functionalities like user right management, storage, retrieval options, search functionalities, and user administration were totally covered by Lotus Domino. This included APIs to JavaScript, Java, C++, d-COM, and Lotus script. This meant that most popular scripting languages could be used to program functionalities. This development capability was only offered to the developers of the TeleTOP® system.

4.4.3 Development of TeleTOP®

The course-management system TeleTOP® has been used within the Faculty of Educational Science and Technology at the University of Twente since 1997. In this section, its general requirements are summarized (Section 4.4.2.1), followed by an overview of terminology (Section 4.4.2.2), a further comment about the underlying Lotus Notes Domino system (Section 4.4.2.3), the use of templates (Section 4.4.2.4) and the database structure (Section 4.4.2.5).

4.4.3.1 Requirements

Development of the TeleTOP® CMS was focused on making the work of the instructor as simple as possible and trying to support the primary process of creating course material. These focuses included giving as much functionality as possible to the instructor while not changing the educational objectives of the courses or forcing instructors to work in ways they would not find comfortable. During introduction sessions instructors were urged to experiment with the system and use the environment as it fit their needs. The development was focused from the start on a Web-based environment. The system was developed to be as simple as possible and to make the interventions of instructors independent from time and place (for a summary of initial requirements see also Collis & Moonen, 2001; Tielemans & Collis, 1999).

4.4.3.2 Terminology

For the use of databases specific terminologies are involved. A short description of the most-used terms in the TeleTOP® CMS is given here

Element: Within the Lotus Notes Domino database records are called fields. An element or field is a container that can contain data. The type of data is in most cases well defined. Types of data can be for example: text, date, integer, or lists. For an example of a see Figure 86.

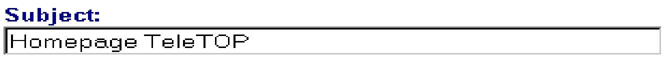


Figure 86 Example of an element

Data: Data can consist of pure text, but can also include dates, HTML code, or binary pieces. For example “Homepage TeleTOP®”

Record: Within the Lotus Notes Domino database records are called documents. A record is a set of related data. The data are stored as element-data pairs. For example in Figure 87 the dataset is Category-“TeleTOP®”, Subject – “Homepage TeleTOP®”, Description – “General information about TeleTOP®”, Content – Text, Web link – http://www.TeleTOP®.nl.

Template: A template is predefined structure of elements. Templates can be used to structure forms or views

Form: A form is used to assign data to elements. For example; when a form within a Web page is filled in, data are assigned to elements. Figure 87 gives an example how this can be displayed.

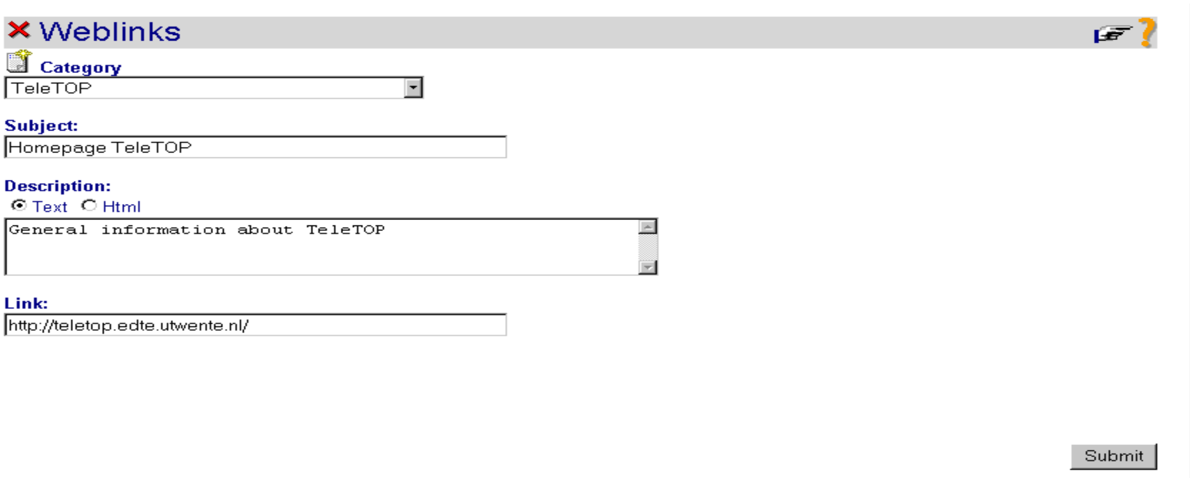


Figure 87 Example of a form in edit mode showing element-data pairs

Forms can be used to assign data to elements, but also to present data. Figure 88 shows this.

Figure 88 Example of a form in read mode

View: A view can show a selection of records. Within the records selections can be made of what elements are shown. Views can also provide sorting mechanisms. Different views can be created for the same records. Figure 89 shows a set of records associated with "Homepage TeleTOP®".

Figure 89 Example of a view sorted on subject

Figure 90 is another view where the data are displayed a little differently, but also contain the record "Homepage TeleTOP®".

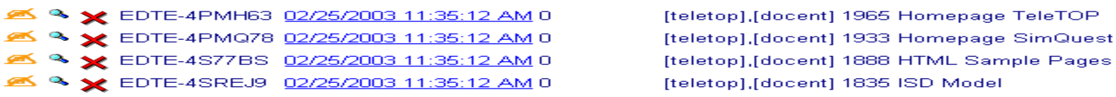


Figure 90 Example of a view sorted on unique identifier

Figure 89 and Figure 90 show that the same data can be displayed and offered in completely different ways and that the data depend on what is needed in a certain situation.

Attachments: Attachments are seen from a database perspective as a set of data. Attachments are stored in the database and are accessible by links that are maintained by the database.

4.4.3.3 The use of templates

The design of TeleTOP® is based on the use of templates. Figure 87 is an example of the use of templates at the user level. Users can only fill in the templates and can only use a predefined type of data. These forms are templates, but they are self-based on a higher level of templates. The system design in itself is a template. This means that the maintenance of the whole system can take place at one place and that changes in the template are inherited to all instances of the template. The forms and views used can differ in the varying contexts of use. The data however remain the same in the different databases. Figure 91 shows the design of the forms and views in the template and how they are inherited in a course database where documents are created with these forms. Views are used to show the documents.

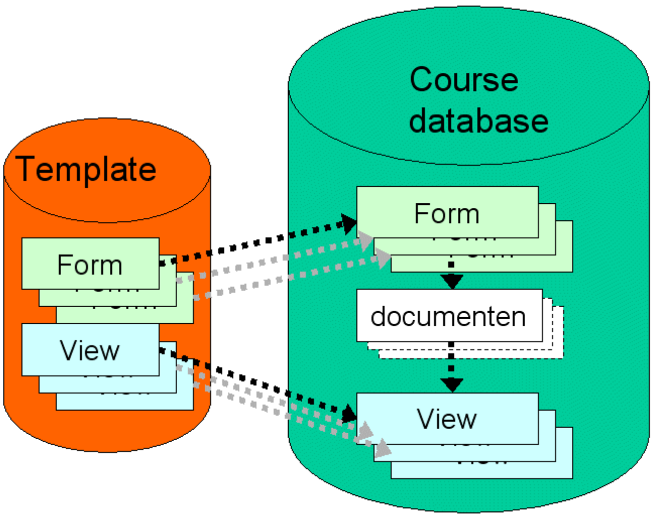


Figure 91 Templates in TeleTOP® (Strijker, 1999)

4.4.3.4 Database structure

The database structure is the key for the development of the system. Before the database structure was defined, an inventory was made of existing standards in the field for learning technologies. At the start of the development, only the Dublin Core (DCMI, 2002) specification was available for use and the initial definition of the database structure included all the data elements that could be mapped against the Dublin Core. Besides these Dublin Core elements a large set of data was included to deal with future reuse solutions. For all records created in the database the same data structure is used.

The basic data structure used for every record is shown in Figure 92. A distinction can be made between the design of the TeleTOP® CMS and the system design of the Lotus Notes Domino database. The first set of elements is specific for the TeleTOP® CMS and can have the state mandatory (M) or optional (O). Mandatory means that the data are available on every record created in the database, optional means that the data are only available when the TeleTOP® CMS functionality requests this. Different sources can be identified that assign data to the elements: The database (DB), the TeleTOP® CMS, and the user. The data can be assigned automatically (A) by the database or TeleTOP® CMS, or manually (M) by the user who maintains a course. The user is supported for most elements with vocabularies. The vocabularies are predefined by the TeleTOP® CMS, course curriculum, or user. The Lotus Notes Domino database automatically assigns the second set of elements to every record to manage the records on the system level and provide security.

Figure 92 Basic data structure for the TeleTOP® CMS

Design	Element	State (m=monitoring, o=optional)	Source	Assigning (a=automated, m=manual)	Description
TeleTOP® CMS	Unique Record number	M	DB	A	Contains a worldwide unique record number
	Related Unique Record number	O	DB	A	Contains the unique record number where the record is related to
	Page name	M	User based on CMS predefined vocabulary	M	Contains the name of the functionality within the CMS
	Title	M	User	M	Contains the title of the content
	Description	O	User	M	Contains the actual content
	Web link	O	User	M	Contains a related web link
	Category	O	User based on own predefined vocabulary	M	Contains a content category
	Reader rights	M	CMS	A	Contains a group, groups, or user that may read the content
	Author	M	DB	A	Contains the initial author username, this can also be anonymous
	Author rights	M	CMS	A	Contains a group, groups, or user that may edit the content
	Content	M	User	M	Contains type of material. This can be text, or html
	Course name	M	User based on Curriculum predefined vocabulary		Contains the name of the course
	Attachment	O	User		Contains related attachments
	Sequence	O	User or CMS		Contains the sequence number or character of how the material is sorted
Lotus Notes Domino Database	Updated by	M	DB	A	Contains the usernames of the editors of the content.
	Revisions	M	DB	A	Contains the number of revisions and dates and times of the revisions
	Template	M	DB	A	Contains the name of the template used for displaying the record
	Creation date	M	DB	A	Contains the initial date and time of creation
	Last modified	M	DB	A	Contains the date and time of last modification
	Last read or edited	M	DB	A	Contains the date and time of last access
	Size	M	DB	A	Contains the number of bytes of the record including attachments
	Attachment names	M	DB	A	Contains the names of the attachments
	Attachment length	M	DB	A	Contains the number of bytes for every attachment
	Attachments	M	DB	A	Contains the attachments
	Unique database location	M	DB	A	Contains a worldwide unique record number
	Author	M	DB	A	Contains username of the last editor

4.4.4 Development of TeleTOP® related to the projects

During the existence of TeleTOP® several stages and changes in the system can be identified. This is because of revisions of the system resulting in different versions of the system. The developers managed version control of the system, and users were often not aware of the changes because the interface design did not change dramatically. New versions of the system were developed during the academic year starting in August. A prototype of each new version was tested in May, using two courses as test-beds for the new functionalities. In the period between May and July revisions were made to produce a stable version that was used for the next cycle of courses starting in August. Only small errors were found in new versions, and small corrections were made directly in the production version. Because of the use of templates, corrections could be made in all courses within 24 hours. In emergency cases, corrections could be applied in minutes. The versions developed over the years differ in consistency and advanced functions. However, material produced in earlier versions could also be used in the following versions. This was possible because the underlying data structure did not change, only the way material was displayed and ordered. Only the commercial version of TeleTOP® did not use the original data structure, Section 6.3 describes the involved problems and issues in the project Conversion TeleTOP® in the corporate-learning context. Table 12 shows the timeline and the projects to indicate how different developments in TeleTOP® followed each other and how different functionalities in the various projects were added.

Table 12 Timeline related to projects

Year		University			Corporate learning			Military			
		TeleTOP® at the university	SURF Alpha beta	Digital University metadata guideline	TeleTOP® Shell EP	Conversion TeleTOP®	Shell EP Knowledge sharing	ADL SCORM™ pilot RNLAF	LCMS	ADL SCORM™ in IMAT	KIM TeleTOP®
1997	Q1										
	Q2										
	Q3										
	Q4	√									
1998	Q1	√									
	Q2	√									
	Q3	√									
	Q4	√									
1999	Q1	√									
	Q2	√	√								
	Q3	√	√								
	Q4	√	√								
2000	Q1	√	√								
	Q2	√	√								
	Q3	√	√					√			
	Q4	√	√					√			
2001	Q1	√	√					√	√	√	√
	Q2	√	√					√	√	√	√
	Q3	√	√						√	√	
	Q4	√	√						√	√	
2002	Q1	√			√				√		
	Q2	√			√				√		
	Q3	√			√	√			√		
	Q4				√	√			√		
2003	Q1				√				√		
	Q2				√				√		
	Q3			√	√		√		√		√
	Q4			√	√		√		√		
2004	Q1				√		√		√		
	Q2				√		√				
	Q3				√		√				
	Q4				√		√				

The TeleTOP® system as a whole is not only a course-management system but includes also authoring tools and content-management facilities which will be described in more detail in the following chapters. The current chapter describes only the basic CMS, technical background, underlying system, and authoring tools available in the CMS. The projects describe specific functionalities developed for the projects.

The new functionalities implemented were in some projects, like University Alpha Beta and the Military LCMS, initiated within the case studies. In Chapters 5, 6, and 7 it will be separately described how the new functionalities are related to the projects. Table 13 shows a timeline with the most important changes and developments in the TeleTOP® CMS system design. Although some projects had a short project time, the value of each project for the research was very high.

Table 13 Development of TeleTOP® related to use and based on timeline

Year	Version	Users	Functionalities
1997	0 Prototype	Faculty of Educational Science and Technology, phase 1	Roster, glossary, email, links, presentations
1998	1	1998 First prototype and use within three courses 1999 Use of revised version TeleTOP® for first phase of the faculty	Participants, video integrated streaming video
1999	2	Use in first and second phase, New roster, use of TeleTOP® in other faculties like Telematics, BSK, Electronics at the University of Twente, and Law in Leiden. Also the KIM and The SURF foundation Alpha Beta projects	Line-based roster
2000	3	Use in the first three phases within the faculty	Reuse, groups,
2001	3	2001 New version of TeleTOP®, Use in all phases within the faculty, Use within Shell Open University, University-wide implementation	Portfolio, metadata, ADL SCORM™
2002	4	Use in all phases within the faculty, Use within Shell Open University, University-wide implementation, various secondary education institutes	LCMS functionalities, Possibilities for uploading and using IMS packages in the CMS Packages upload
2003	5	Use in all phases within the faculty, Use within Shell Open University, University-wide implementation, various secondary education institutes.	Commercial version, rebuild research version Multi language functionalities
2004	6	Use within Shell Open University, University-wide implementation, KIM, various secondary education institutes.	Integration of various metadata application profiles, creation of IMS packages

The following chapters describe the projects within their particular contexts. The chapters describe the context based on the perspective-related questions What, When, Where, How, and Who. Based on the learning-object lifecycle the different perspectives are structured around the different stages of the lifecycle. Each chapter ends with a reflection based on the secondary research questions and issues.

5 University Context

This chapter describes aspects of a university context for learning objects. The focus in two of the projects is on the University of Twente where several projects were initiated and carried out related to reuse and exchange of material. Section 5.1 describes the University of Twente as an organisation, Section 5.2 the project relating to the development and implementation of TeleTOP® within this context, and Section 5.3 describes the project in which the University of Twente was involved with another university in the SURF Foundation Alpha Beta project. Section 5.4 focuses on the project related to the development of a guideline relating to metadata for the Digitale Universiteit. Section 5.5 summarizes the results of the different projects. Figure 93 shows the structure of this chapter.

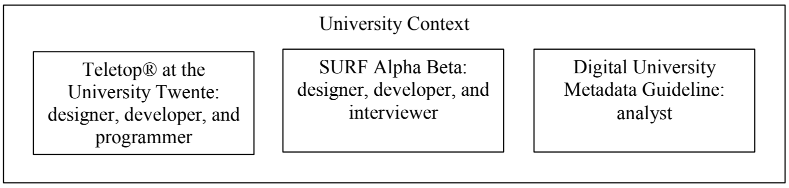


Figure 93 Overview of Chapter 5, university context

5.1 General Description of the University of Twente Context

According to the website of the University of Twente (http://www.utwente.nl), the UT is an internationally-oriented institute of scientific education and research. Spread over five faculties and 23 educational programmes 6,594 students were enrolled in the academic year 2002-2003 (1,547 of which were first-year students); in addition there were 574 PhD students. In 2002 the UT had 2,705 employees, 190 of which were professors, granted 122 PhDs, and had a total budget in 2002 of 204 million euro.

The University of Twente is an entrepreneurial research university. It has stressed the interconnectedness of technical and social sciences since its foundation in 1961, and as an innovative university it is also active in new fields for example medical technology. The UT aims for knowledge transfer to society and has a part of its mission to make a contribution to technological and societal innovation, in close co-operation with public and private parties in society. In the Netherlands the UT is at the forefront of innovations in terms of ICT, infrastructure, and research and is a member of the Digitale Universiteit (Dutch Digital University). Internationally it also participates in strategic alliances, among them the European Consortium of Innovative Universities (ECIU).

The UT is the only university in the Netherlands with a campus: studying, working, living, enterprise and relaxation are mostly concentrated in one location; this campus is also used as an instrument in the individual and academic development of students, and for the promotion of the spirit of enterprise, particularly with the close proximity to a business park.

Compared to the other nine universities in the Netherlands, the UT is classified as one of the three technical universities and is ranked the last years as one of the best according to a survey from Elsevier/NIPO (University of Twente, 2004). In the top 12 universities of the European Union in terms of research the University of Twente takes a sixth place (see Table 14). These results come from the “Third European Report on Science & Technology Indicators 2003” and concern publications from the period 1993-1999 (University of Twente, 2002).

Table 14 European top 12, universities and their citation impact scores

Rank	University	Citation Impact score
1.	University of Cambridge	1.55
2.	University of Oxford	1.48
3.	Technische Universiteit Eindhoven	1.40
	Technische Universität München	1.40
5.	University of Edinburgh	1.35
6.	Universiteit Twente	1.34
	Universität Freiburg	1.34
	Universität Karlsruhe	1.34
9.	Erasmus Universiteit Rotterdam	1.32
	Universität Heidelberg	1.32
	Université Strasbourg 1	1.32
12.	Université Catholique de Louvain	1.30

Thus the University of Twente is a relatively small research-oriented university with an emphasis on technical studies and with a high-quality ICT infrastructure. Therefore, the generability of the results of the projects may be somewhat limited with respect to other universities.

5.2 Project TeleTOP® at the University

Section 5.2.1 gives a general description of the project. The subsequent sections are described around the questions Why are standards used? (Section 5.2.2), Who are involved? (Section 5.2.3), What is reused? (Section 5.2.4), How is reuse supported? (Section 5.2.5), and Where does reuse place in terms of systems? (Section 5.2.6). Section 5.2.7 describes how reuse in practice took place, Section 5.2.8 summarizes the learning-object life-cycle in the project, in Section 5.2.9 preliminary answers to the secondary research questions are given, and Section 5.2.10 describes the key observations of the researcher for the project

5.2.1 General description and role of the researcher

The TeleTOP® at the University project describes how tools for reuse within the TeleTOP® CMS were developed. The use of metadata and ADL SCORM™ specifications was part of the TeleTOP® development. The project describes also the implementation of the TeleTOP® CMS in the University of Twente and how reuse within this context was organized. Nearly all (over 95%) of the courses at the UT are supported by the TeleTOP® course-management system, which has been in widespread use since 1998. This section describes what tools regarding to reuse were developed and used, what standards were involved, and why certain reuse methods were used. It describes also the development of the tools and how the users used these tools.

The main roles of the researcher could be identified as designer, developer, and programmer of the TeleTOP® CMS.

5.2.2 Why standards for reuse?

Course material has always been reused in universities. Only the type and sort of material has changed. In the last years for example, books, articles, and presentations have typically been used more than once and revised when necessary. Digital material is reused, revised, distributed, and copied much easier than hardcopy materials. Within the university setting revisions are made every year. When a course is given twice a year, revisions must be made even quicker to tailor the material to the different target groups. Reuse saves time because instructors can use similar course outlines and do not have to start from scratch for gathering material for a new cohort of students.

Material is also reused or copied because the courses need to be available for three years after they were last provided. The courses need to be kept in their original state according to the Dutch regulations relating to higher education. This means that courses cannot be edited for a next year. Every year a new course must be created that can reuse content from previous years.

Using the university academic-year cycles as a reuse life cycle forces the instructors to make content choices every year. It also gives them the ability to tailor material for a specific year group. This rises issues for reuse because the more material is created for a specific purpose or is tailored for a specific context or time scale, the more difficult it is to reuse. Experiences with obtaining and reusing material made instructors aware of this context dependency and they thus developed material trying to avoid absolute dates or specific names. When material is tailored for a specific context, the material is still reused but the integrated authoring tools are used to change the material to a new context.

From the faculty-management point of view the TeleTOP® project was a risk with unclear long-term results. The costs for in-house development were high, taken in account that from 1997 to 2000 a team of five people worked fulltime on development and implementation of the product. The uncertainty of the e-learning market regarding to new products and tools were also key in the implementation of standards for reuse. The faculty board has the responsibility to offer continuity in its educational programs. The shift to standardized material should it make possible to use the learning material in other systems than TeleTOP®.

Also the expected involvement of publishers was a reason for standardization. The learning material available by publishers was seen as an important resource that could be used in courses. The implementation of standards should make exchange between publishers and the university possible without the interference of technical issues.

However the main reason for implementing standards was not reuse but exchangeability and interoperability chances. The standards were seen as a possibility to reuse material within other systems.

The growth of the quantity of learning objects was also a reason for the standardization of metadata. In 1998 14 courses were running with a total of approximately 76 objects. In 1999 the number of courses was already 78. Table 15 shows the number of courses using TeleTOP® within the Faculty of Educational Science and Technology from 1998 to 2003 (NB: Since 2003 the Faculty of Educational Science and Technology is part of the Faculty of Behavioural sciences). The rows reflect different groups in the faculty.

Table 15 Number of courses using the TeleTOP® CMS in the Faculty of Educational Science and Technology

Educational Programs	1997	1998	1999	2000	2001	2002	2003	Total
TO	2	13	54	107	114	117	108	515
Masters Program		1	9	41	44	62		157
Other				55	70	29		154
TCW			6	10	1	1	70	88
ULO/ELAN			5	33	33	6	18	95
Not Categorized			4	0	5	4		13
GW							44	44
PSY							33	33
WTM							23	23
WWTS							20	20
Total	2	14	78	246	267	219	316	1066

As can be seen from Table 15 the number of courses in TeleTOP® has grown rapidly. The management of these materials is organized on several levels. The expectation is that the use can be more effective and efficient by reusing and exchanging material. A structured university-wide repository for all material can support users finding material for courses or as reference material.

Also changes of curriculum created a demand for reuse solutions. The shift of courses from the previous Dutch doctorandus program with a separate Masters program for international students to a bachelor-master curriculum (occurring in 2004) and the need for more integrated modules or splitting up pieces from courses makes it useful to search for material on a finer degree of granularity than only by course.

Requests from other organisations using TeleTOP®, like Shell EP and the Royal Netherlands Air Force (see Chapters 6 and 7), for ADL SCORM™ compliancy were also important motivations. Adopting the ADL SCORM™ standard offered possibilities to cooperate with other organisations, but also to make the TeleTOP® product commercial to get return from the investments in its development. The use of these standards provides also for such large organisations the possibility to switch from a particular platform or to work in collaboration with other organisations. For the Air Force, collaboration was found in other countries that also used the same sort of aircrafts and equipment and thus the same manuals and course material. For Shell EP the cooperation with the University of Twente for sharing knowledge about reuse and the learning materials from the Open University in the UK were opportunities. The projects described as cases in Chapter 6 and Chapter 7 are a direct result of these interests and the further development of the TeleTOP® CMS in the direction of ADL SCORM™ implementation.

5.2.3 Who is involved?

Within the university context the instructor gives input to a course. This means that the instructor provides the knowledge and structure but also assembles the material within the course. The courses are mostly related to the domain of research in which the instructor is involved. The instructor is the subject-matter expert (SME) who provides knowledge to the students. This does not mean that an instructor always acts as an individual. Currently in the Faculty of Behavioural Science more and more courses contain material based on several subject-matter domains and created by groups of instructors. During the first implementation phase of TeleTOP® project (1997-2000) the roles associated with TeleTOP® were different compared with the second phase (2000-2004) when the system was fully embedded in the faculty. During the first phase a project team was installed to support the implementation of the course-management system; this team was no longer supported by the faculty after the initiation phase although support could be obtained from the central group that managed TeleTOP® use for the university. These two phases can be identified:

- *First phase (1997-2000)*

  A support group was established and available for instructors to help them with pedagogical and technical issues (Collis & Moonen, 2001; De Boer, 2004). Members of the support group could carry out administration tasks, system development, instructor support, authorization issues, multimedia aspects like streaming video, and decision support for the choice of functionalities. The support team was able to make changes in the system design and could use tools to develop new functionalities. The implementation of the TeleTOP® CMS was the most important task and supporting the instructors was key in this approach. The researcher was member of the support group.

- *Second phase (2000-2004)*

  In the year 2000 the decision was made to implement TeleTOP® as a university-wide CMS. In this year developments were still carried out by the Faculty of Educational Science and Technology but mid-2001 the development of the system was taken over by the ITBE. ITBE is the unit within the university that offers all faculties support in terms of information technology, infrastructure, library, and educational support. Within the Faculty of Educational Science and Technology the project group that developed TeleTOP® was disbanded and the remaining tasks in terms of support for creating courses and user accounts, were moved to the previously existing central support groups such as the central educational office and helpdesk.

5.2.4 *What is reused?*

The material reused within TeleTOP® varies from very small objects, like keywords, to very large objects such as whole courses. Because of the underlying database and the use of attachments the learning objects can be as simple as ASCII text-oriented pieces of material, but can also include pieces of video, animations, or presentations. The size of the material is not limited by the system but by network connections, download time, and disk space. Instructors use the TeleTOP® system as a replacement for their hard drives because the structure provided by the CMS offers the instructors a place to store all material related to a course. Because of the functions available within the system, instructors have the tools to create rosters for managing courses. The rosters can contain material for lectures, workshops, or can be subject oriented. The initial organisation within a roster is generally based on time, with sessions scheduled linearly in time. Figure 94 shows the different aggregation levels in TeleTOP®. Material can be selected on Levels 1 and 2.

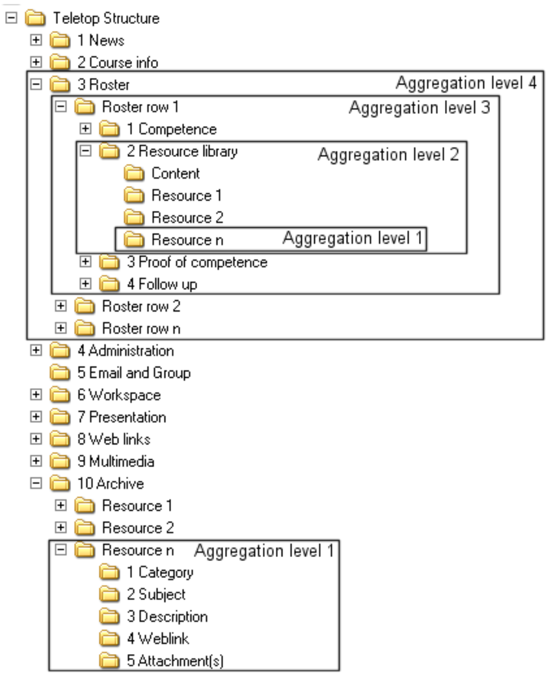


Figure 94 Aggregation levels in the TeleTOP® CMS

5.2.5 *How is reuse supported?*

During the development of TeleTOP® support tools for reuse were developed. A set of support tools was developed to provide assistance to the users. Within the TeleTOP® environment different support tools relating to reuse can be identified:

- DST (decision support tools)
- Tools for creating profiles
- Copy tools
- Tools for creating resources
- Tools for creating combined resources
- Tools for adding metadata
- Tools for reusing material

The support tools are Web-based and part of the TeleTOP® CMS. The first three tools and their relations with reuse are described separately in Sections 5.2.5.1-5.2.5.3. The remaining will be described in Section 5.3.5.

5.2.5.1 Decision support tool

Several versions of Decision Support Tool (DST) were developed to support instructors in the choice of functions in the TeleTOP® environment (Collis & De Boer, 1999; De Boer, 2004). The choices depend on the characteristics of the course material and the pedagogical decisions of the instructor. Every chosen functionality is related to a type of material created in the course. The functionalities in the course environment provide support tools to create learning objects. The initial choices made and also the information provided, like course name and course code, are used as the classification structure for the metadata. Figure 95 shows a screen dump of one of the DSTs. Based on questions and examples, instructors are able to choose functionalities in the TeleTOP® CMS.

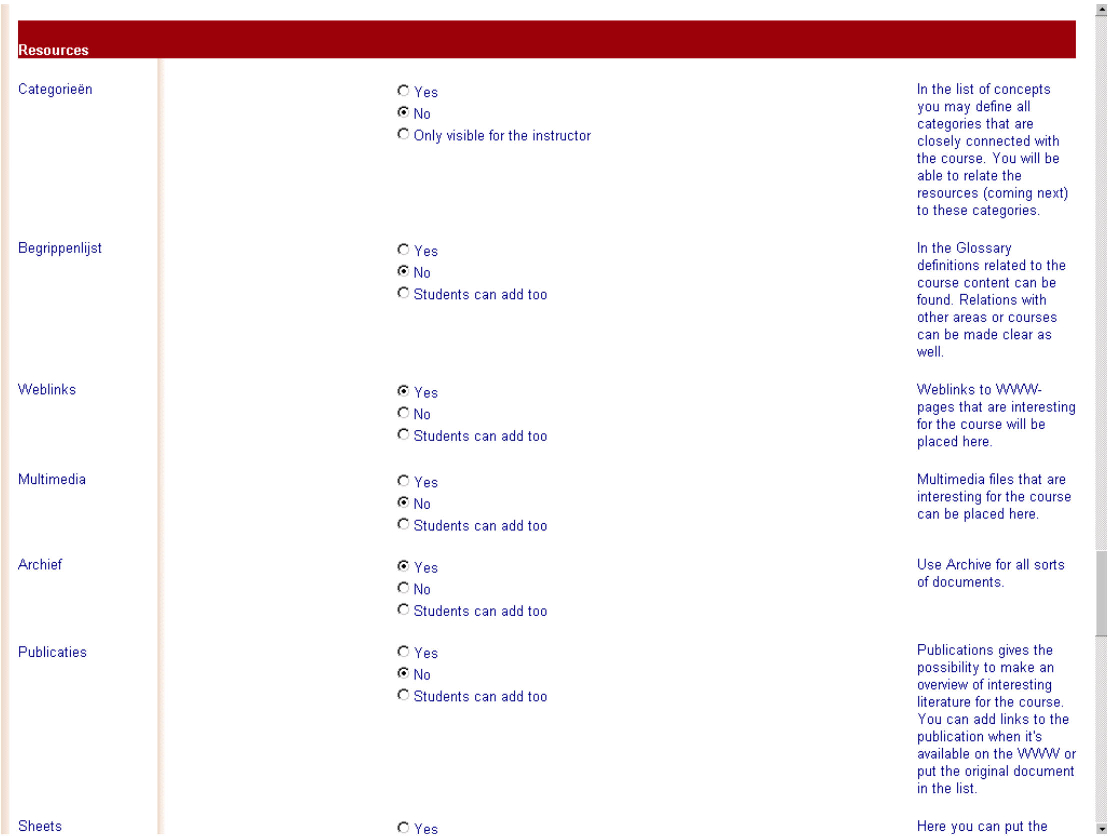


Figure 95 Screen dump of the DST

5.2.5.2 Tools for creating profiles

Different profiles are created to gather information about the users, the courses, the course material, and the students. All this information is directly mapped to the metadata when needed. The information about the users in the system provides some personal data like interests, hobbies, current involvement in projects, jobs, and contact information. It can also contain the domain of interest, faculty, division, department, group, or research line. These data can be used to provide initial vocabularies, when metadata are assigned to material. Figure 96 shows such a profile used in the TeleTOP® system.

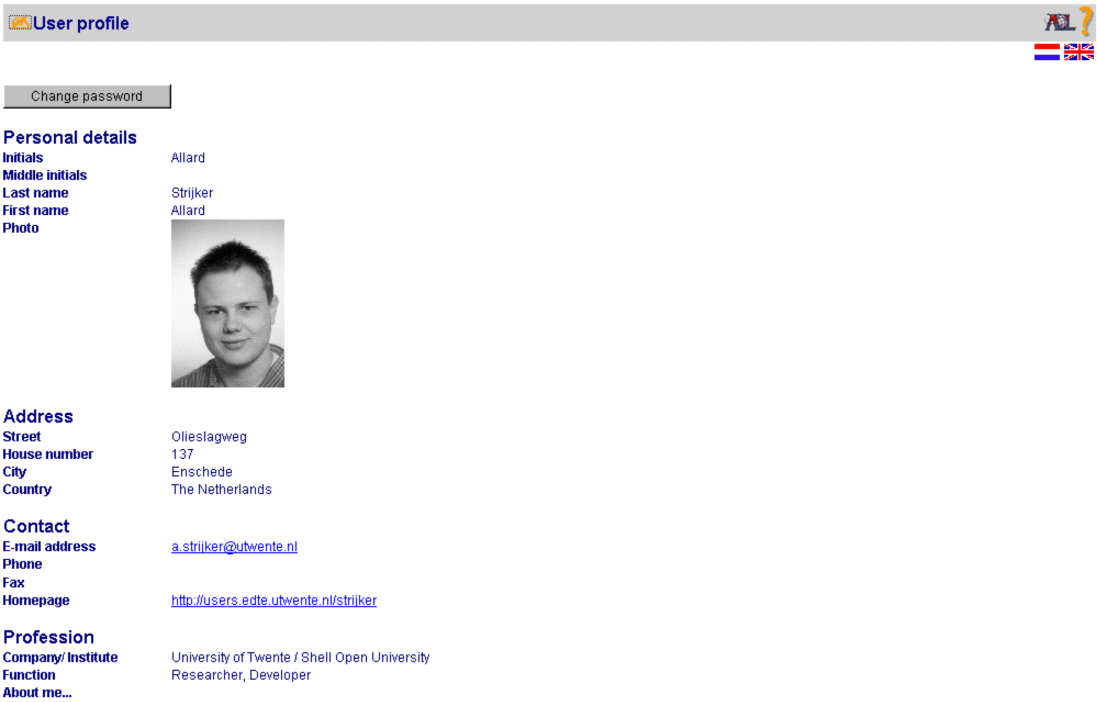


Figure 96 User profile within TeleTOP®

When profiles of courses are created, information is provided about the place of the course in the curriculum that can be identified based on the course code, the phase in the program, and the time investment needed defined by study points (a study point during the period up until 2003 corresponded with 40 hours of study investment). The course profile also holds the name(s) of the instructors that can be linked to information about the copyright and intellectual property holders of the content. These instructors are also responsible for the validity and quality of the material made available in the course. Within the system there are also profiles available for the actual course material. Figure 97 shows how this profile was implemented for a particular course in the TeleTOP® system. A Dutch version is used because an English version was not implemented for this functionality.

Figure 97 Course profile within TeleTOP®

Another profile is used to provide initial metadata in terms of keywords for the course material. Based on the ADL SCORM™ 1.2 aggregation model, three types of metadata are identified that could mapped against the design of the TeleTOP® CMS: Course metadata, blocks metadata, and content metadata. Blocks metadata are described in the ADL SCORM™ version 1.1 and imply a set of material grouped together as a whole. The profile gives the possibility to provide initial values for each of the types of metadata. Figure 98 shows how this is made available in the TeleTOP® CMS.

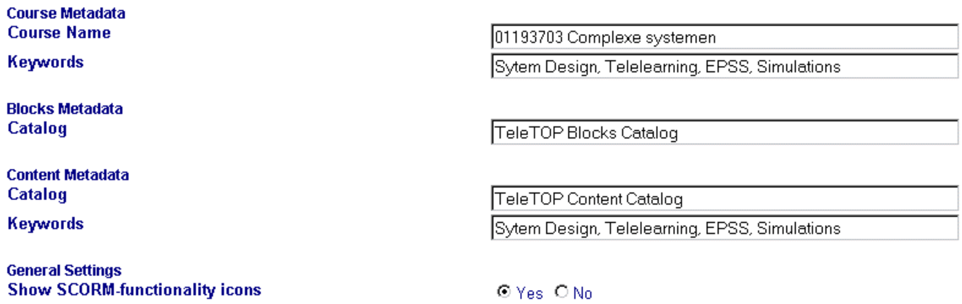


Figure 98 Content profile within TeleTOP®

These tools were developed in the first two years of the TeleTOP® project. After these initial two years other projects like The SURF foundation Alpha Beta were used for new developments relating to standards. Additional tools to support reuse were built into the Alpha Beta project and will be discussed in Section 5.3.5.

5.2.5.3 Copy tool

Because no copy tools were available in the first years of TeleTOP® for the users, the system administrator made reuse of courses possible by copying the whole course content to a new version of the course. The administrators used the Lotus Notes client to copy records from one database to another. In a later stage a Web-based functionality was developed that made it possible for the instructors to select and reuse parts of the course. Figure 99 shows how material can be copied from one course to another. The instructor can choose to copy all material at once to a (new) course by clicking one link, or make a selection on a lower aggregation level as seen in Figure 94.

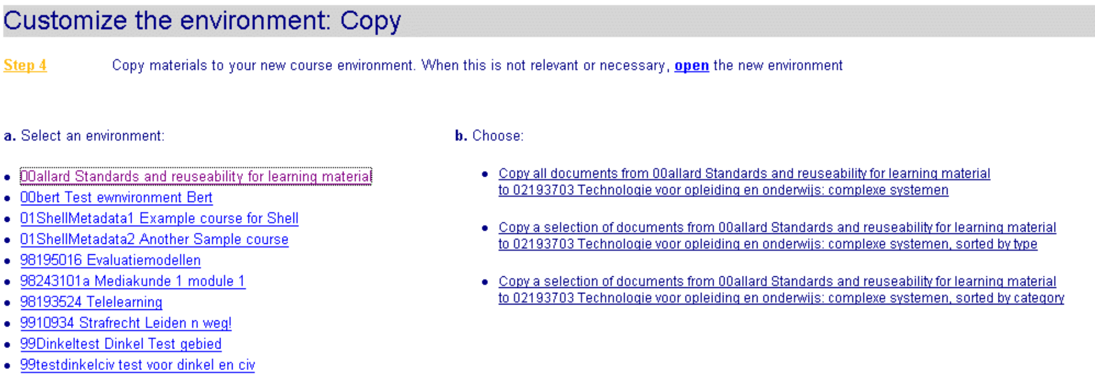


Figure 99 Tool for copying learning material between courses

Figure 100 shows how material already within courses can be selected based on a minimal set of metadata. The minimal set of metadata are appropriate because instructors only see material they created themselves. The metadata is based on the titles and descriptions that were given to the material by the instructors.

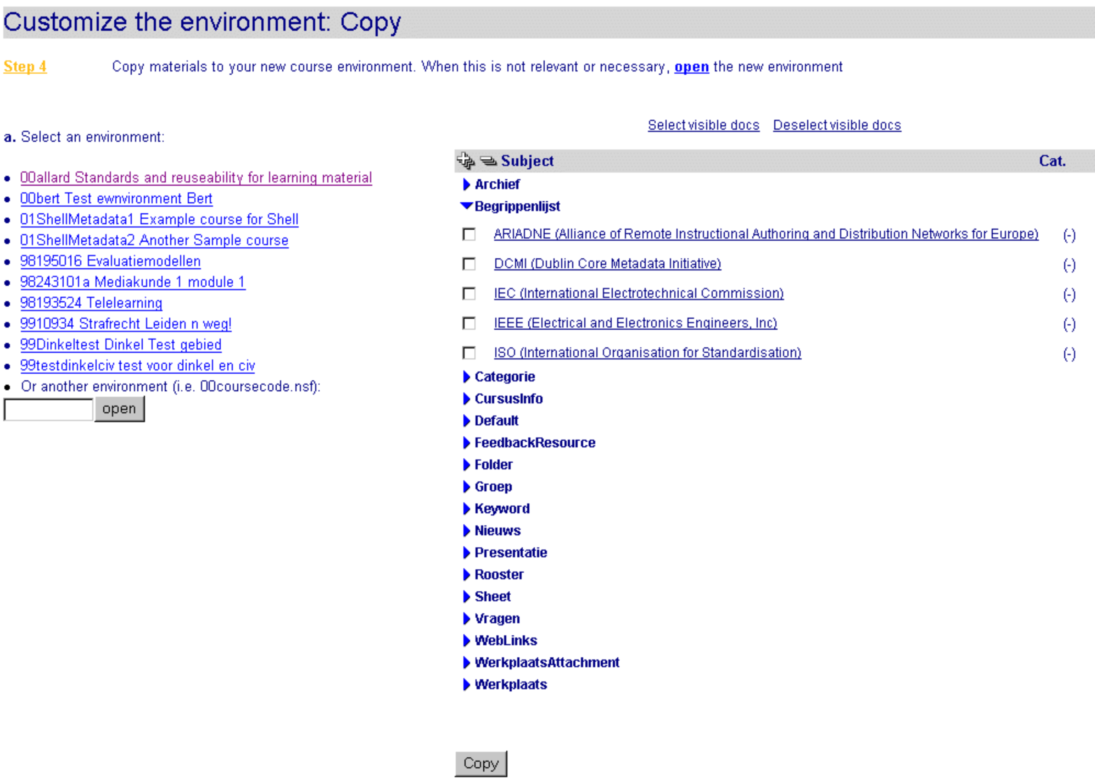


Figure 100 Selection of material based on own metadata

The classification used is based on the functionality used within the TeleTOP® CMS. Because the instructors only select material from their own courses, only a small classification structure is used.

5.2.6 Where does reuse take place in terms of systems?

The TeleTOP® CMS handles the different actions needed to make reuse available. Because the TeleTOP® system can be used to create, offer, use, and change learning objects when needed, instructors use the system as an overall tool to structure their course material. Besides the authoring tools within the CMS, MS Office software applications are used like Microsoft PowerPoint and Word to create presentations and documents. To provide video to support distance students, video-capturing programs are used to obtain the video files.

5.2.7 Use in practice

The use of the TeleTOP® CMS in the university context from 2000 to 2003 is shown in Table 16. The table shows the number of courses created within the university.

Table 16 Overview of TeleTOP® course environments produced for courses and other projects at the University of Twente, 2000-2003, by study phase (De Boer, 2004)

Phase	Frequency	Percent of total
First-year courses	616	22%
Second-year courses	536	19%
Third-year courses	225	8%
Fourth-year courses	755	27%
Masters programme courses	136	5%
Others (projects & miscellaneous)	498	18%
Total	2766	100%

Besides the number of courses also the number of learning objects (documents) in each course was inventoried. Table 17 shows the number of objects grouped and the number of courses that reflects a certain interval of number of objects.

Table 17 Documents placed in TeleTOP® by an instructor, courses with active use of TeleTOP®, 2000-2003, University of Twente (De Boer, 2004)

# of TT documents	Frequency	Percent	Cumulative Percent
1 - 25	194	13.6	13.6
25 - 50	280	19.7	33.3
50 - 100	469	33.0	66.3
100 - 200	310	21.8	88.1
200 - 500	149	10.5	98.5
> 500	21	1.5	99.7
Total	1423	100.0	

The tables show how the number of objects and the use of course environments grew every year. The numbers show also the potential value of material gathered by instructors that can be made available for reuse.

5.2.8 The learning-object lifecycle: Summary for the TeleTOP® project

Within the university context the lifecycle stages are in most cases integrated in the academic-year cycle. Almost every course is reused and revised every year. The six stages in terms of the TeleTOP® project are summarized as follows:

Obtain - The material is obtained using templates in the TeleTOP® CMS. Also other tools are used to create files which are stored in the system as attachments. When a course already exists, almost all material is selected for reuse and edited in the new course. When a new course appears in the curriculum, selections from different courses are made to create a new set of material that forms a new course.

Label - Labelling of material is done by the TeleTOP® CMS. The material is labelled according to the structure of the environment with complementary database values. The descriptions filled in by the users for the content and the categories used for structuring the material are used as metadata values. This means that instructors use their own descriptions for the content when this is automatically generated by the system.

Offer - The material is only offered to the students and other instructors of the same course. The moment a piece of material is submitted, it is offered to the users of the course. As courses are being built, students do not have access, it is given to them when the course starts. This does not mean that all content is available to them then. Instructors can choose to offer material in a later portion of the course. Other instructors of the course can see the material directly after it has been submitted. The normal procedure is that students keep access to the course environment as a reference after the course is finished. Instructors can choose to close courses when needed.

Select - Material is selected for reuse based on the descriptions provided by the user. The structure of the course helps the instructor to find the desired material. The use of categories as an extra set of keywords provides another way of searching and selecting material

Use - The material is used as course material beginning at the moment of submission. Also the students use the material for their study, but can also reuse material in their own workplace settings. This is especially valuable for part-time students who already have jobs and can use reports or examples from their courses in practice.

Retain - Retaining the material is only done at the start of every new course. Material is not updated when courses were closed. During the time a course is running, material is retained based on the control of the instructor(s), but also on the reactions of students when material is outdated or not in place. The instructor has the control over the content and has to manage the quality of the course material.

5.2.9 Answers to the secondary research questions for the TeleTOP® project

Based on the human and technical perspectives related to the learning-object lifecycle a set of preliminary answers to the secondary research questions can be constructed.

TQ1. Granularity and standards - According to the learning object metadata (LOM) specifications, all granularity levels can be identified, but tools are only available to support exchange on Level 1 and Level 2.

TQ2. Tools - Within the university context mainly office tools like PowerPoint and Word are used to obtain material. The TeleTOP® system itself is the major tool.

TQ3. Systems - Within this project in the university context the TeleTOP® course-management system is used. This system provides exchange of learning material between courses.

HQ1. Organisational context - The use of learning objects is provided by the CMS used, but there is no organisational strategy focused on these possibilities. Initiatives were started to make reuse possible but there is no awareness of cost reduction or the value of created and available material. There is no organisational policy about copyrights.

HQ2. Learning scenarios - Within the university setting the different learning scenarios depend on the instructor. Reusing material makes it easier to create courses for different target groups and tailor the courses to the new developments. Courses can be seen as knowledge stores for the instructors that are shared with the participants. In most cases the instructor makes material available to participants. The process of obtaining material from the participants only occurs when assignments are written in such ways that reflect this pedagogy. Most instructors do not construct such assignments (De Boer, 2004).

HQ3. Object creation - Because the instructor is the manager of the course, the quality is controlled by this instructor who is in most cases also the subject-matter expert. The objects are most often created especially for courses but instructors regularly make use of articles and resources such as PowerPoint presentation that were not originally for learning.

HQ4. User support – In the university setting, instructors want to reuse their own material and need tools to make this process as easy as possible. Materials outside their own departments are not seen as serious candidates because their own expertise area is seen as too unique to find other resources from elsewhere within the university

HQ5. Metadata - Reuse of material in the university context is in most cases use of one's own material. Assigning metadata does not have to be very advanced if this is the case. One's material is easily recognized when it is shown. Meta tagging at the course and type of document levels can be done automatically.

5.2.10 Key observations of the researcher for the TeleTOP® project

The TeleTOP® project showed that reuse is an important strategy for instructors to create courses each year using material from previous years. It shows also that instructors can decide what to reuse based on a basic metadata set if the material involved has been obtained by them originally. It also shows that most tools related to the learning-object lifecycle can be integrated in one system that can support the instructor in different ways.

5.3 Project SURF Alpha Beta

The SURF project Alpha Beta describes how reuse within a university setting can be initiated using an existing CMS and how the users are involved. The project describes the results of the initial research and covers the first reactions of the instructors. Sections 5.3.2 to 5.3.6 describe the project with an example from the Faculty of Educational Science and Technology from a human and technical perspective using the Why?, Who?, What?, How?, and Where? questions. The results of the structured questionnaire and structured interview used for university instructors can be found in Section 5.3.7, in Section 5.3.8 a summary is made in terms of the learning-object lifecycle, in Section 5.3.9 preliminary answers to the secondary research questions are given, and in Section 5.3.10 the key observations of the researcher are described.

5.3.1 General description and role of the researcher

The Alpha Beta project was initiated from the University of Leiden, Faculty of Law, and funded by The SURF foundation. The SURF foundation is a Dutch organisation that regulates government funding for higher education related to information technology (NIWI, 2004). The project started in September 1999 and finished in August 2001. The project focused on reuse and implementation of learning-technology standards and was carried out in the context of the Faculty of Educational Science and Technology because the development of the TeleTOP® CMS took place there. The developed functionalities were also tested in this context. The role of the researcher focused on the development of reuse support tools and the implementation of standards. The project mission was twofold. The first was the test if the TeleTOP® course-management system developed for a particular faculty in a technical university also could be used in a social-sciences university like Leiden in the Faculty of Law. The University of Leiden focused mainly on the implementation and first experiences of the TeleTOP® system in a social-science setting and is thus not described in the project here. The second part of the project focused on reusability of course material within course-management systems based on standards. Different tools were developed for the TeleTOP® system during the project that could support reusability of learning objects using standards. The support system built for the Alpha Beta project was based on the ADL SCORM™ 1.1 specifications. Although the implementation of the specifications was a success, no actual reuse with other systems took place because no other "ADL SCORM™ compliant" systems were available to test reusability possibilities.

The main role of the researcher during the SURF Alpha Beta project was developer of functionalities for reuse in the TeleTOP® CMS. For evaluation purposes the researcher was also the interviewer of the intended users of the developed functionalities.

5.3.2 Why standards for reuse?

The issues related to standardization implementation were initiated from different groups for different reasons. The TeleTOP® development team, the University of Twente faculty board, the Alpha Beta project team, and third parties such as those with interest from the Royal Air Force all had different focuses with respect to standardization. Within the Alpha Beta Project two important motivations could be identified for using standards:

Motivations from the TeleTOP® development team - The TeleTOP® development team had been focusing on the standardization of learning material from the first start of TeleTOP®. Because developments were premature regarding learning technologies in 1997-1998, only the Dublin Core was discussed as a standard. The specifications were too difficult to implement at that moment because of their development stage and thus no standards were incorporated in the first versions of TeleTOP® although from the very first start reusability and the structure of learning materials were keys in the course-management system's development. Also ease of use, total Web accessibility and user independence were keys during development. These features made possible the massive growth of learning materials because all subject-matter experts were able to make their material available in a course structure on the Web anyplace, anytime, anywhere. The use of databases and fill-in forms for data and the structured storage of material were used as the basis for the Alpha Beta project to manage large numbers of objects between different universities.

Motivations of instructors - In terms of what would motivate the instructors to consider reuse, the major stimulus was not so much pedagogical but rather their need to adapt existing courses to changes in the curriculum. The changes were resulting in a redefinition of courses and a restructuring of learning material for use in different courses or new versions of existing courses. The issue of restructuring courses made the need of reusing material and the need for ease of use clear for the instructors. Also the start of new educational programs such as part-time and master courses resulted in the need for reusing learning material.

5.3.3 Who is involved?

The development of tools focused on support tools for instructors. These instructors were users of the TeleTOP® CMS and the support tools were intended to make reuse possible between different organisations. The project also focused on the developers to build the tools needed. Developers were involved to create the working prototypes. The researcher was the main developer in the Alpha Beta Project.

5.3.4 What is reused?

The material that was reused came from different faculties. The Faculty of Law used the TeleTOP® CMS for supporting courses. The content there could be identified as cases and law-related regulations and rules. Because of the use of the TeleTOP® system also organisational content was used like the roster, and course information. All these sorts of material were candidates for reuse. Within the Faculty of Educational Science and Technology, the same material was being reused as was described in Section 5.2.4.

The project focused on the different types of faculties, and also how the different types of material and learning strategies could be supported in terms of learning. The development of educational models and their implementation in such a kind of CMS was key.

5.3.5 How is reuse supported?

Different tools were developed to add metadata to the existing content using standards. The following tools were developed to support the users:

- A repository to store and retrieve metadata
- Metadata creation on the course level
- Metadata creation on the blocks level, for coherent pieces of content
- Metadata creation on the content level
- Generation of sharable content objects (SCOs)
- Use of search engines based on provided metadata
- Implementing XML for interoperability
- Course-structure format creation (CSF)
- Use of taxonomies for finding material

The tools and their applications in the Alpha Beta Project are described separately in Sections 5.3.5.1 - 5.3.5.9. The ADL SCORM™ 1.1 version was used to build the different tools and functionalities. According to the metadata set three aggregation levels --course, blocks, and content-- were used and applied to the TeleTOP® CMS. These are discussed in the next sub-sections.

5.3.5.1 Repository for metadata

An important part of the project was the seamless creation of metadata in the TeleTOP® CMS and subsequent storage in a repository, Figure 101 shows how this process occurred. For each submission based on the content a metadata record was created and placed in the repository.

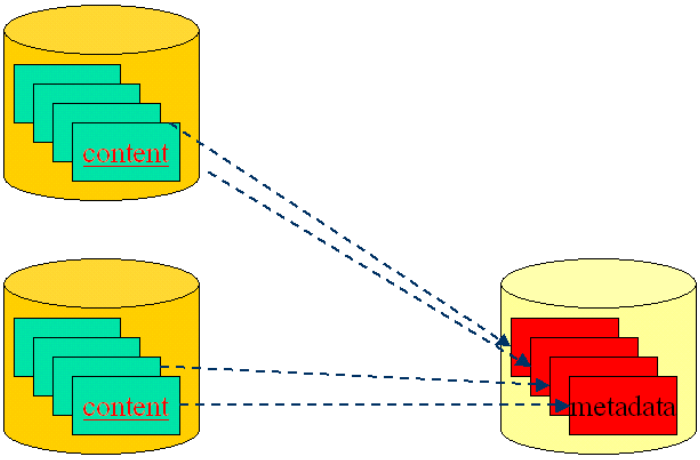


Figure 101 Metadata creation and storage in a repository

The actual metadata stored was based on the LOM specifications that were referenced by ADL SCORM™. Figure 102 shows a representation of the metadata as used in the TeleTOP® CMS. The exclamation marks in the right side of the screen show when an element was mandatory according to ADL SCORM™.

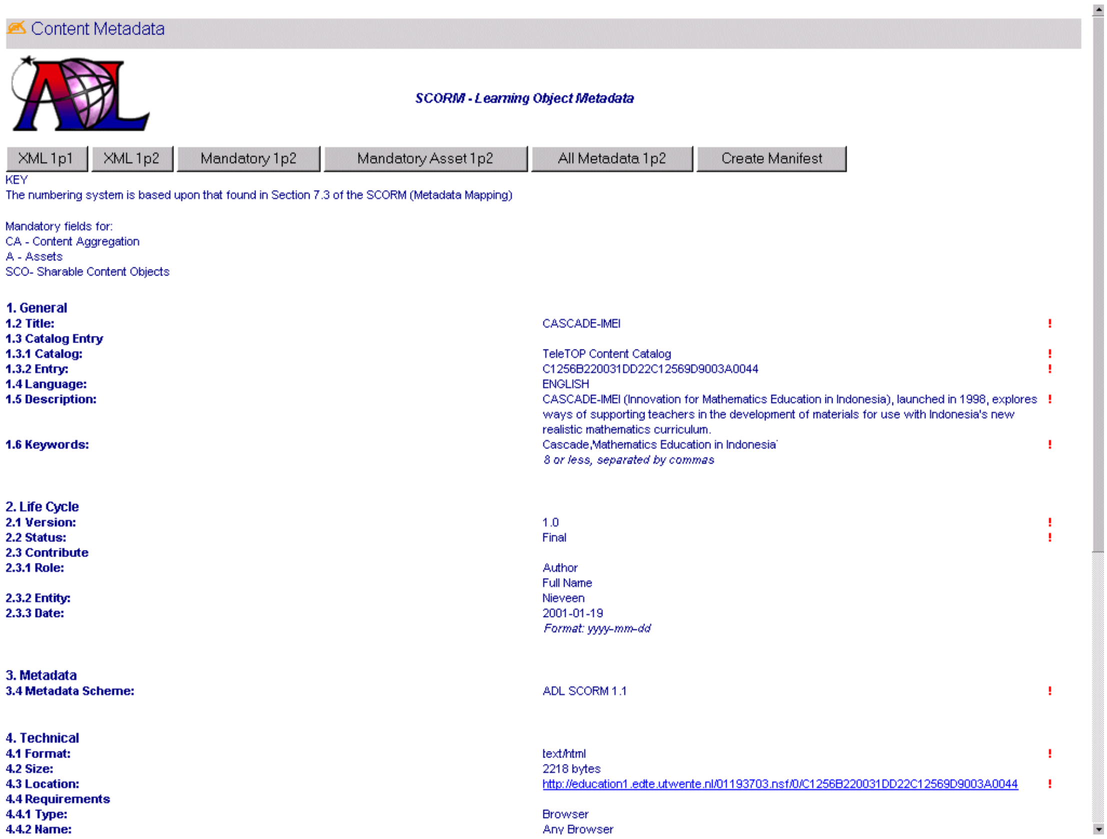


Figure 102 Metadata representation in TeleTOP® CMS

The repository was a database that contained all the metadata of the material that was offered for reuse. The repository offered functionalities to retrieve and offer the content and metadata in several standard formats. The repository in combination with the resources and functionalities acted like a learning-content management system (LCMS). When the metadata were stored, the material could be selected based on the metadata using search engines or the taxonomies provided. Figure 103 shows how the procedure was structured. Based on the metadata, the material was located (the dotted arrows), and when it is useful it could be reused for the new purpose (the thick arrows show this).

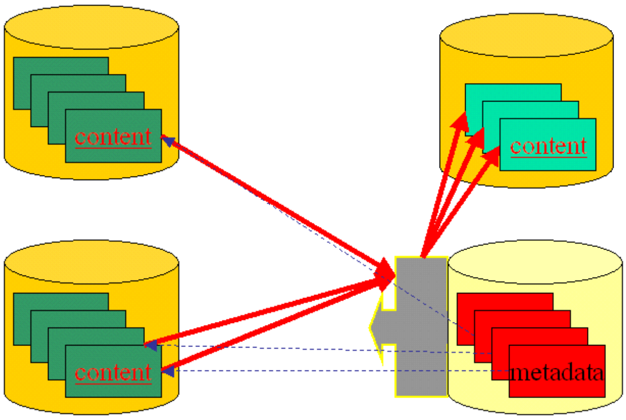


Figure 103 LCMS functionality in the TeleTOP® CMS based on repository

5.3.5.2 Metadata creation on the course level

Metadata creation on the course level can be seen as tagging material according to Aggregation Level 4 in Figure 94. The metadata used to describe the material on the course level were extracted from the initial course information provided by the course instructor when using the course environment for the first time. The description of the TeleTOP® CMS in Section 5.2.5 identified the data used as source to create this metadata. In the current ADL SCORM™ 1.3 version these course metadata are mapped against items that can be a content aggregation. Figure 104 shows how the course metadata were extracted from the course profile.

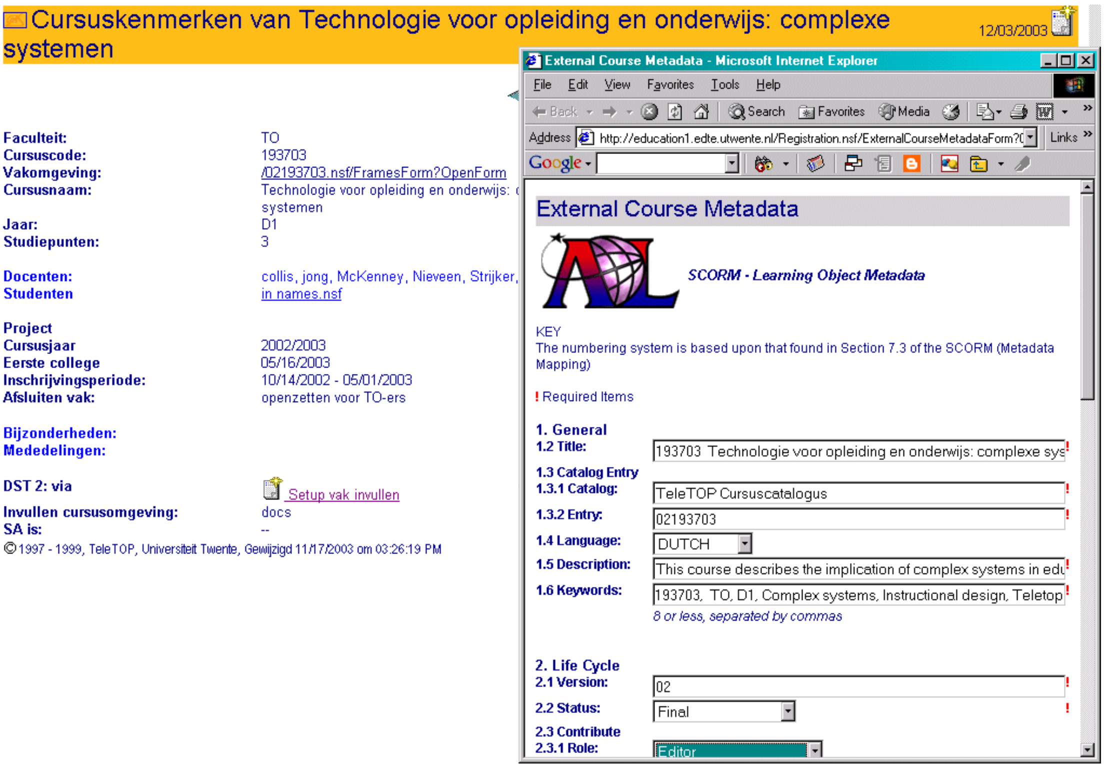


Figure 104 Creating course metadata

A course can be built based on blocks or groups of material. Every group or block can be described separately.

5.3.5.3 Metadata creation on the blocks level

Metadata creation on the blocks level can be seen as tagging material according to Aggregation Levels 2 and 3 in Figure 94. Within the TeleTOP® CMS several blocks or groups of material could be identified. Blocks were created based on interrelated content such as roster rows, but also if material could be marked as similar kinds of content such as Web-links, archive documents, or course information. In the current ADL SCORM™ 1.3 version these block metadata are mapped against items that consist of SCAs or SCOs. Using the properties of the views in the database as the initial metadata set, the blocks metadata could be filled. Figure 105 shows this.

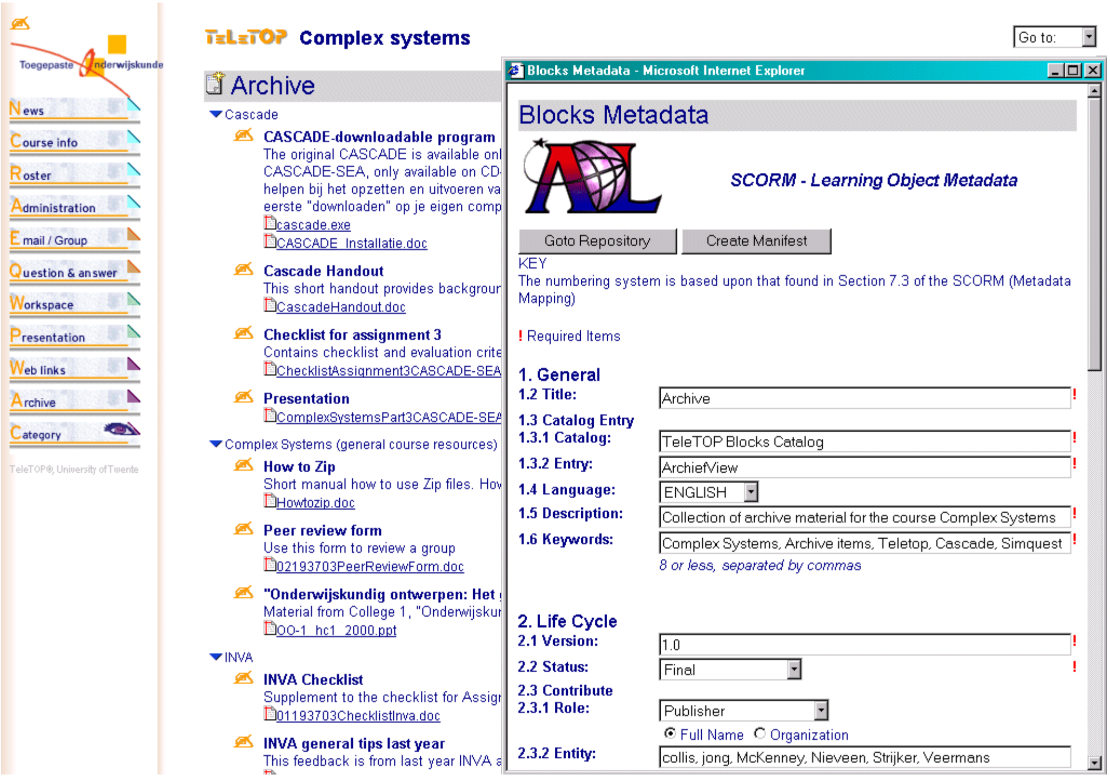


Figure 105 Creating block metadata

Within each block the objects were stored in terms of content items. Every piece of material could be described independently.

5.3.5.4 Metadata creation on the content level

Metadata creation on the content level can be seen as tagging material according to Aggregation Level 1 in Figure 94. The lowest reusable level of objects in the TeleTOP® CMS were tagged as content. Every piece of material stored in the database could be assigned with metadata on the content level. Within the CMS assets like pictures or movies were stored, but because the assets were uploaded in the database and shown as a web page that consisted of a set of files, the assets became more or less a SCA containing descriptions and other metadata. The TeleTOP® CMS could only store the assets if this kind of information was provided. When the material was offered through the CMS, the actual asset was offered as is, but the place within the course and the relation(s) with the other material made it a SCA. Therefore the metadata on the content level in the current ADL SCORM™ 1.3 version were also mapped against items that can be SCAs or SCOs like the blocks metadata. Figure 106 shows how the content metadata were extracted from the actual content, using in the background the content profiles when no categories in the content were available.

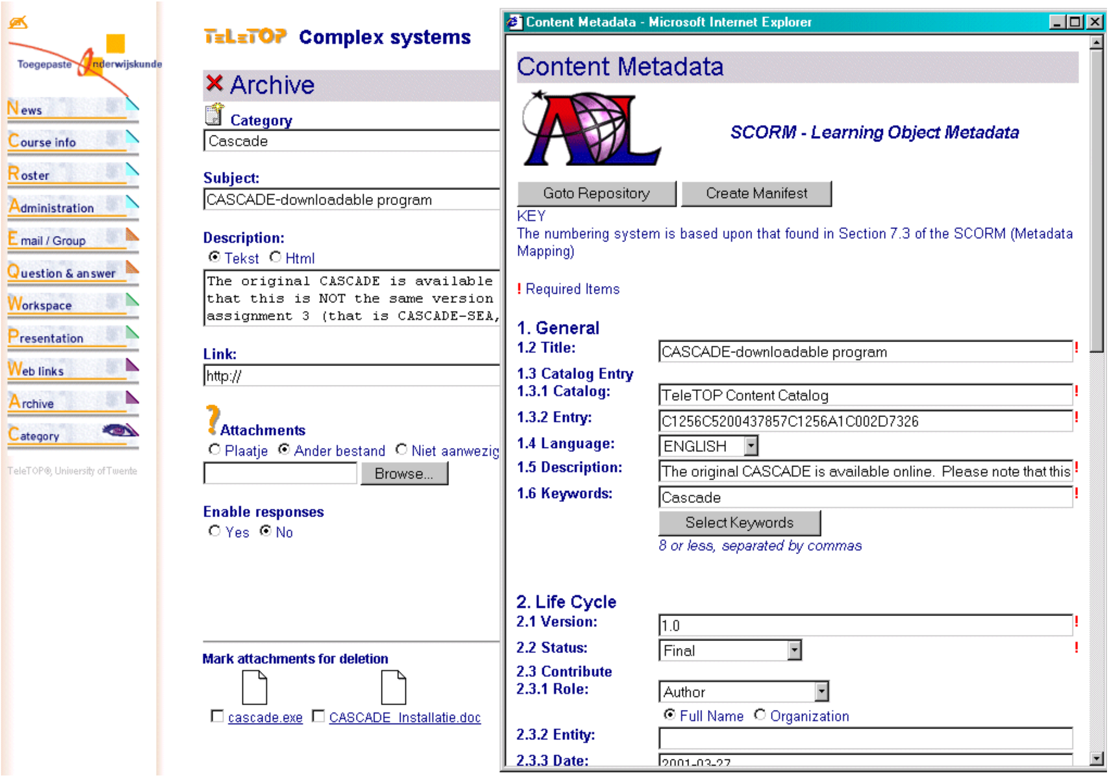


Figure 106 Creating content metadata

Within the TeleTOP® CMS the different aggregation levels of content could be offered to a learning-management system (LMS) with the behaviour of a SCO.

5.3.5.5 Generating sharable content objects (SCOs)

ADL SCORM™ Version 1.1 focused on the use of sharable content objects (SCOs). Chapter 3 describes SCOs and their function in ADL SCORM™. SCOs were seen as how learning material should be developed in the future. An important part of the development of SCOs involved the LMS-interaction possibilities. These interaction possibilities provided the exchange of user data between the SCO and the LMS. Transforming learning material into SCOs was a problem because the ADL SCORM™ explanation about the involved runtime was very poor and even for technical staff like programmers hard to understand. Also the lack of an LMS in the institutions participating in the Alpha Beta project that could be used to test the SCOs was a serious problem. Based on the documentation and examples provided by ADL, minimal requirements for SCOs were implemented. Section 3.3.2 described the relation of ADL and ADL SCORM™. When the actual requirements regarding the SCOs were clear, the actual implementation in the TeleTOP® CMS was simple. A new template was developed that could display the actual content, and three extra lines of JavaScript code were added to each learning object to provide the interaction. These three lines of JavaScript code made it possible to establish a connection to the LMS for data communication. The three lines corresponded to the initialization, start, and finish of the SCO. Figure 107 shows the coding of a SCO used in the TeleTOP® CMS for this project. The dark shaded lines are a minimal implementation. The page includes two JavaScript files offered by ADL. These files, APIWrapper.js and SCOFunctions.js, made it possible to use simple commands in the coding to interact with the LMS. The “LoadPage()” command initialised and started the SCO, the “return unloadPage()” command told the LMS that the SCO was completed. Additional buttons were offered to give more interaction possibilities in the environment where “doBack()” resulted in showing the previous SCO, “doQuit()” ended the SCO, and “doContinue(‘completed’)” told the LMS that the SCO was completed by the user and was ready for the next SCO.

```
<HTML>
<HEAD>

<SCRIPT LANGUAGE="JavaScript" SRC="../APIWrapper.js"></SCRIPT>
<SCRIPT LANGUAGE="JavaScript" SRC="../SCOFunctions.js"></SCRIPT>

</HEAD>

<BODY TEXT="000000" BGCOLOR="FFFFFF" onLoad="loadPage();" onUnload="return unloadPage();">

Content

<INPUT TYPE="button" VALUE="Back" onClick="doBack();">
<INPUT TYPE="button" VALUE="Quit" onClick="doQuit();">
<INPUT TYPE="button" VALUE="Continue" onClick="doContinue('completed');">

</BODY>
</HTML>
```

Figure 107 SCO program code

Figure 108 shows a TeleTOP® SCO during the Project Alpha Beta.

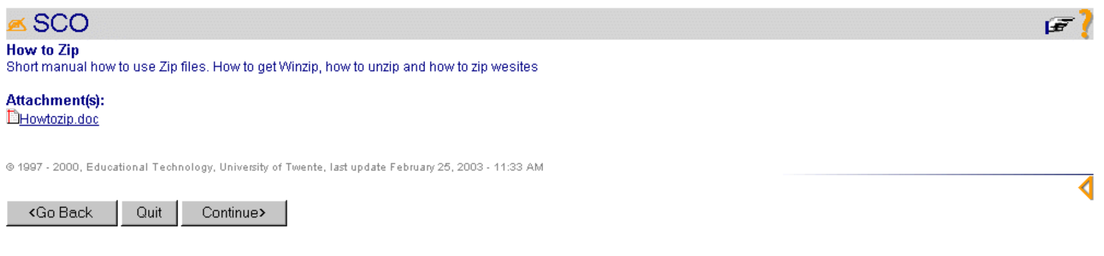


Figure 108 A learning object presented as SCO in the TeleTOP® CMS

5.3.5.6 Search engines based on provided metadata

Based on the metadata, the search engine of the database was used to retrieve course material. These full-text indexes were created to make searching based on the provided keywords and descriptions possible. Also operators like wildcards (*, ?) and Booleans can be used to narrow searches. Figure 109 shows the search option used in the TeleTOP® CMS to search for metadata tags in the repository.

Figure 109 Search option within the TeleTOP® CMS

The search results were based on the metadata provided. The results were ordered in relevance. Relevance was based on the number of times the keyword was found in the document. Figure 110 shows the results of a search.

- 05/16/2003 02:17:44 PM CASCADE-downloadable program
- 10/15/2002 03:40:44 PM CASCADE Line of Inquiry
- 10/15/2002 03:40:45 PM CASCADE-IMEI
- 10/15/2002 03:40:45 PM CASCADE-MUCH
- 10/15/2002 03:40:45 PM CASCADE-SEA
- 06/26/2003 10:50:33 AM Cascade Handout
- 10/15/2002 03:41:10 PM CASCADE (original)
- 10/15/2002 03:40:46 PM EPSS & PCD
- 06/23/2003 02:22:48 PM Checklist for assignment 3
- 10/15/2002 03:41:15 PM Cascade-Sea Assignment Updated
- 10/15/2002 03:41:27 PM Cascade
- 10/15/2002 03:34:50 PM opdracht 3 - Cascade
- 11/06/2002 03:08:23 PM Beoordeling

Figure 110 Search results of the query

The hits led to the metadata descriptions of the actual content. The descriptions included a URL where the actual material was stored. The metadata used by the search engine is shown the right column in Figure 102. The left column shows the element names described in LOM.

5.3.5.7 Interoperability and XML

The data that were shown in Figure 102 are presented using a HTML Web page. This page is developed for the TeleTOP® CMS and the metadata available on the page cannot be read by any other system with a standardized method. Therefore an XML binding was used that was also part of the ADL SCORM™ specification. The XML binding was adopted from the IMS specifications. A XML binding means that for every element a strict set of tags is defined in XML, including data types, that makes it possible to exchange the metadata between different systems. The XML format makes the metadata readable by machines. The data types and descriptions of values are defined in a data-type definition (DTD). Each system can use the DTD to make interpreters that can read the XML files and handle the information as necessary. System developers can also use the DTDs to generate XML files so that they can be used in other systems. Figure 111 shows such a XML file that is generated from a ADL SCORM™ metadata set and shows how data fields can be converted in XML code.

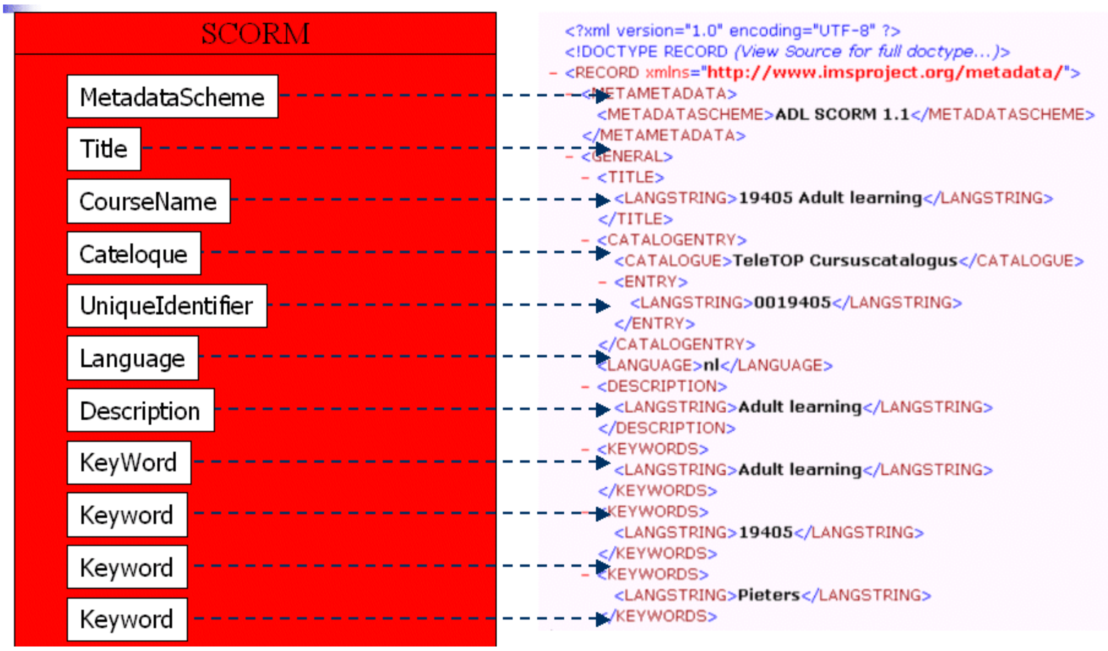
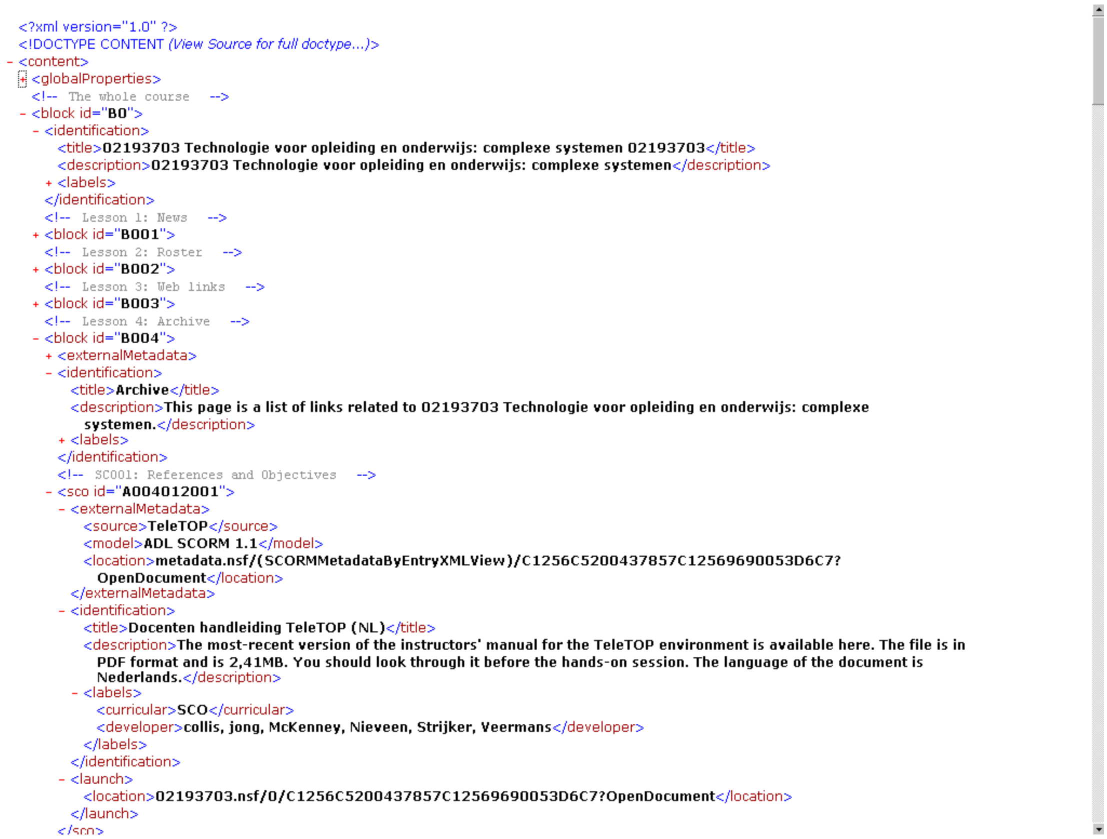


Figure 111 Metadata presented in XML format for machine interoperability

5.3.5.8 Course structure format creation (CSF)

Besides the description of the content of the course, also the structure of the course was described with metadata. The organisation of the course material in ADL SCORM™ 1.1 was described in the course structure format. The organisation of the course described the sequence of the content and conditions for how to proceed through the content. The structure of TeleTOP® was earlier shown in Figure 94 in Section 5.2.4. The CSF was a direct adaptation of this structure used in the TeleTOP® CMS. Figure 112 shows how this structure is mapped against the functionalities used in the CMS. The TeleTOP® CSF does not have a content sequence but provides a “tree structure” that can be browsed as a Web page. There are also no restrictions in how the content needs to be accessed. Only within the quizzes is a fixed sequence set, but within the CSF a quiz is seen as one object. The sequence is set within the object, and so it does not reflect the CSF.



```
<?xml version="1.0" ?>
<!DOCTYPE CONTENT (View Source for full doctype...)>
- <content>
  + <globalProperties>
    <!-- The whole course -->
  - <block id="B0">
    - <identification>
        <title>02193703 Technologie voor opleiding en onderwijs: complexe systemen 02193703</title>
        <description>02193703 Technologie voor opleiding en onderwijs: complexe systemen</description>
      + <labels>
      </identification>
      <!-- Lesson 1: News -->
    + <block id="B001">
      <!-- Lesson 2: Roster -->
    + <block id="B002">
      <!-- Lesson 3: Web links -->
    + <block id="B003">
      <!-- Lesson 4: Archive -->
    - <block id="B004">
      + <externalMetadata>
      - <identification>
          <title>Archive</title>
          <description>This page is a list of links related to 02193703 Technologie voor opleiding en onderwijs: complexe
            systemen.</description>
        + <labels>
        </identification>
        <!-- SC001: References and Objectives -->
      - <sco id="A004012001">
        - <externalMetadata>
            <source>TeleTOP</source>
            <model>ADL SCORM 1.1</model>
            <location>metadata.nsf/(SCORMMetadataByEntryXMLView)/C1256C5200437857C12569690053D6C7?
              OpenDocument</location>
          </externalMetadata>
        - <identification>
            <title>Docenten handleiding TeleTOP (NL)</title>
            <description>The most-recent version of the instructors' manual for the TeleTOP environment is available here. The file is in
              PDF format and is 2,41MB. You should look through it before the hands-on session. The language of the document is
              Nederlands.</description>
          - <labels>
              <curricular>SCO</curricular>
              <developer>collis, jong, McKenney, Nieveen, Strijker, Veermans</developer>
            </labels>
          </identification>
        - <launch>
            <location>02193703.nsf/0/C1256C5200437857C12569690053D6C7?OpenDocument</location>
          </launch>
        </sco>
```


Figure 112 CSF generated from a TeleTOP® course

5.3.5.9 Taxonomies based on the curriculum and course material

Different taxonomies were developed to provide the instructors with tools to retrieve learning material. The complexity and depth varied in the taxonomies based on the expected use and uniqueness of nodes. The different taxonomies could be chosen from a menu so that instructors could decide how to search for material. Figure 113 shows a taxonomy based on the curriculum structure, the courses, type of material, categories used, and description of the material.

Figure 113 Taxonomies based on the curriculum and course material

Another way of structuring the data is from a keyword or category point of view. The categories used in the courses were used as keys to access the material. The description and the course where the material is used were also shown to give some more information about the objects. This shallow presentation of material gives quick access to the material but can only be used when the number of documents is limited. Figure 114 shows this.

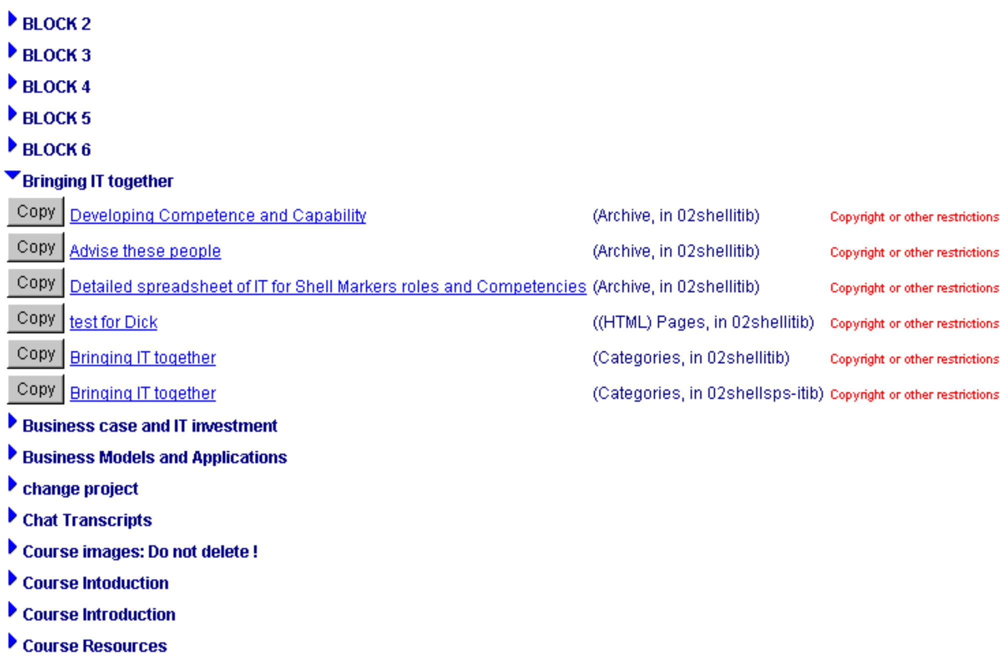


Figure 114 Classification based on categories used

Using the structure of the CMS as a functional classification of material could occur because the users were all aware of the material they could expect selecting the different keys. Using the classification also gave insight about the use of objects. For example the "Heartbeat" object in Figure 115 was used in several courses. This information could also be used to make a selection.

Figure 115 Classification based on CMS functionality

The tools developed in the Alpha Beta project focused on most aspects of ADL SCORM™ and provided functionalities to make exchange of learning material, metadata, and use of taxonomies possible.

5.3.6 Where does reuse take place in terms of systems?

The initial goal of the project focused on the development of tools for reuse within the TeleTOP® CMS, but also on the exchange of material with other CMSs using an e-learning standard. The reason to focus on standards and not on a native CMS connection was to provide general conclusions for connections between systems compared to tailor-made solutions. However although the system was set up to exchange material with other systems, these were not available at that moment. So reuse was only tested within the TeleTOP® CMS.

5.3.7 The results of the structured interview in the Alpha Beta project

Based on the tools described in the Surf Alpha Beta project and tested in the Faculty of Educational Science (Section 5.3.5.1 - 5.3.5.9) a research plan was written to discover the need for reuse within the faculties and between faculties. For this research a critical mass of learning objects was needed to make the search tools and exchangeability useful. The initial research plan focused on the involvement of all instructors using the TeleTOP® CMS in the faculty. A request was made to the director of education if all material could be made available for reuse within the faculty. The response of the director of education was that all individual instructors had to sign up for making material available for reuse. From the 53 instructors only seven responded to an individual request to make material available for reuse. Research on reuse and metadata was being carried out in the context of the Faculty of Educational Science and Technology where all instructors had been making use of the TeleTOP® CMS (Collis & Strijker, 2002). To study the instructors' reactions to these tools, the seven instructors who had agreed to make material available for reuse and many course instructors who had already shown themselves to be advanced users of the TeleTOP® course-management system were invited to participate in the Alpha-Beta project research. Section 5.3.7.1 indicates the procedure and respondents while Section 5.3.7.2 gives the results.

5.3.7.1 Procedure and respondents

Seven course instructors agreed to participate and were questioned within the structured interview about their opinions relating to the possibilities of reuse. The instructors had long experience with creating Web-supported courses, both before and during the faculty's adoption of a course-management system. The content they currently used was created with the CMS TeleTOP®. The course instructors had experiences with this CMS for approximately four years. The number of Web-based course environments developed by these instructors in this period ranged from 9 to 33 (environments can be created to support project teams and other group initiatives as well as courses). During the interviews the functionalities that were developed for the local course-management system to facilitate the reuse of learning material were demonstrated. The interviews lasted approximately an hour each.

5.3.7.2 Results

Because the responses of the instructors were in general similar to each other (for a full report, see Strijker, 2001) and Appendix E: ”Results of the structured interviews”, their responses are discussed here collectively. This material is summarized from Collis and Strijker, 2002, in the following groups: Reuse experiences, reuse what?, metadata, giving the opportunity for reuse, controlling reuse, structuring material, selecting material for reuse, reuse of one’s own materials by others, and reuse of materials made by others.

- *Reuse experiences*

  During the interviews, the instructors were asked to describe their usual practices with reuse of course materials. During the proceeding years, these instructors for their upcoming courses had reused much course material in the following year. A frequently used method was the cut-and-paste procedure. This approach was however seen as time consuming and student assistants carried out the work most of the time because no special educational skill was needed after the instructor had made the initial decision of what to cut and where to paste it. Another method for reuse that had been used by these instructors was that of "whole-course copy". In this approach, all outdated material such as announcements was removed or changed if needed before the course environment was reused. The selection of material for reuse was not a problem because the instructors had created the material themselves and knew what material would be relevant and should be selected for reuse. The selection of material for reuse was made after the course was finished. There was no formal selection criteria used before material was placed in a course, only the instructor's own experience.

- *Reuse what?*

  The materials reused within the CMS differed for each of the instructors. Several remarks were made that most of the time an information component within the course is convenient for reuse but also submitted work, assignments, lecture slides, and plug-ins where applicable are useful reuse candidates. The news items that were most of the time temporary objects were also seen as reusable. The reusable news items are most of the time course-introduction messages. Also the submitted work from students for assignments was seen as very valuable and reusable. By labelling extraordinarily good work in a course environment when it is assessed, it can be identified immediately as reusable material. After using a CMS for several years the instructors had come to see the course environment as an organisational unit that makes it possible to structure, capture, and manage their learning materials in one central place. The fixed structure gives the instructors the ability to deal in a more-procedural manner with reuse. The reasons were that the material is all in one place and that the instructor is forced to organize material for the students. When the instructor wants to retrieve material for reuse (s)he tends to pay more attention to the structure in the material in the first place. The instructors found that they had become more time efficient over the years through their reuse of their own materials. The instructors were pleased that in the near future a function would be available within the faculty's course environment that will make it possible and easy to mark material as relevant for reuse.

- *Metadata*

The instructors saw adding metadata to learning material as doing “work for others”. The added value for themselves was not seen because the instructors have the idea that they already know what they have created themselves and where to find it. The time investment is too large and the profit is too small for them to want to bother adding metadata to objects. The argument that metadata can be useful for archiving one's own material was also not a reason that was convincing to the instructors because problems were seen in the continuity of terms that would be used. Keeping up with the provided information and who is going to carry out the tasks associated with metadata provision were seen by the instructors as barriers to the practice of adding metadata. Also the complexity of filling in metadata tags played a role in their scepticism. The concepts used by ADL SCORM™ were not clear enough or multiple interpretations were possible. The instructors believed that they would have problems filling in the ADL SCORM™ fields by themselves in a proper manner. They felt that a specialist who focuses on building thesauruses and related concept schemas should carry out this task. Developing a collectively agreed-upon base of concepts seems to be essential. The instructors doubted however that this would occur in the faculty.

Giving the opportunity for reuse

The instructors reacted very positively to actually being able to reuse material. They immediately however came up with a set of restrictions. The idea is good but only if there has been care taken with dealing with copyrights, rewarding reuse activities, and notification of reuse. Reusing one's own material is something that all the instructors want to do. The instructors were worried about the complexities of a system to handle copy and reuse functionalities. The invested effort should be minimal. The instructors were also afraid of the lack of an overview of available materials. There should be an immediate link between the material to be reused and the place where the material will be reused. A description of material given in metadata was not expected to be enough to make a selection. The actual material needs to be inspected before it can be considered for reuse. The instructors could not identify a manner in which they thought metadata would be useful, as the instructors could not identify what others would feel to be informative. More experience is needed before instructors can tell what kind of metadata they will use.

- *Controlling reuse*

During the interviews the instructors made it clear that they would want to have control of their created material if they make it available for reuse. A difference of opinion was expressed about the situation in which instructors could control on a very detailed level what is going to be reused and the situation in which instructors would be willing to share everything as long as they are notified afterwards that the material is being reused. All the instructors felt that if they would make material available for reuse they would appreciate a notification of when and how it was being used by others.

- *Structuring material*

  The instructors saw important characteristics of material as different if they are sorting their own material or sorting materials made by others. One's own material is organized by course names, years, and the age of the material. Remarks were made that it would be useful to be able to easily mark material that can be reused in one's own courses. Searching for material made by others is based on keywords, authors, and information about where the material has earlier been used.

- *Selecting material for reuse*

  The instructors did not feel that they were having problems with finding material for reuse. A selection based on material type or based on instructor-created categories was felt to be sufficient or not needed at all. Reusing all the material through copying an entire course and then deleting things that the instructor did not want to use again seemed to be an option that was so useful that other methods for reuse were most of the times not being used. Terms associated with reuse such as “documents” and “material type” were not understood by the instructors. To help the instructors have a better overview of available selections, they felt the material should be organized around an already existing list of terms meaningful for the individual instructor, for example the structure in the menu of the course environment. The menu reflects a structure that can be used by the instructor to make more deliberate decisions for what to reuse.

- *Reuse of one's own materials by others*

  The instructors did not see the reuse of one’s own material by others as very desirable. Having a faculty-wide procedure and a fixed set of rules for how reuse by others would be carried out was seen as an important. The time invested and personal characteristics of a piece of content that the instructor has made him or herself were major disincentives in offering this material for use by others. Examples were feedback on submitted work or video recordings of lectures. The large investment of time to create the material compared to the ease someone else would have in reusing the material was a sensitive point. The instructors wanted to be rewarded for their invested effort in creating content. Rewards could consist of released time or money. Copyrights and intellectual-ownership issues would have to be taken care of by the faculty. References to the creator of the object would have to be clear. On the other hand the instructors noted that reuse could also be seen as a complement from their peers that they had produced good work. The instructors made a distinction between reuse by colleagues in their own faculty and reuse by people from the “outside”. If a procedure was set up for how to deal with reuse, then this would not be a problem for the instructors within a faculty setting. Actual reuse within the faculty was not considered very likely however because the chance would be reasonable that material would be provided twice to the same students. Reuse was expected to result in a mixed-up set of learning material that could be confusing for the learners because course boundaries would become vague. Possible objects for reuse could include manuals, examples, or suggestions of how to use applications. Own-made content could be partly useful to others if seen as additional or supportive resources. These could be used within and outside the faculty.

- *Reuse of materials made by others*

  The instructors were also asked about their experiences with the use of materials made by others. Only three of the seven instructors thought that within the faculty or university material was available from other instructors that could be used in their own courses. The following reservations about this external material were made by the seven interviewees:

  - The relevant material was estimated to be limited because material that can be reused is already available in printed books.
  - Besides that, the material used in the current CMS is expected to be too specific for reuse. Instructors expected that material needs to be specifically created for a certain type of educational approach such as project-based, problem-based, and case-based methods. The focus was expected to be so specific that externally produced material will be not useful for reuse in terms of audience, educational level, or type of instructional approach.
  - Also the instructors believed that the reuse of material will be a problem in terms of copyrights and intellectual property.
  - The comment was made that a high rate of reuse would lead to "impoverished" education. By too much reuse of existing “old” material new educational developments regarding to content may be less likely to be made produced for the course. The reuse of material from others could also imply that the new user is not up to date him or herself.
  - The instructors felt that reusing of material made by others would lead to the instructors themselves not really mastering the content or being able to explain the material themselves, a situation that they saw as not desirable. An instructor who reuses the material might not be able to give appropriate support to the learners.
  - Also, the reuser would have to be familiar with the intentions of the creator. Using content in situations where it was not intended to be used was identified as an issue because misinterpretations could be the result if an instructor does not have the knowledge to use the material in a proper manner. Material is most of the time too context specific and thus not reusable for others. Also the instructor's own personal manner and favoured operating procedures were stated as other reasons that made these instructors sceptical that externally produced material would be of much value to them.
  - And even if material is somewhere available that could be useful, the instructors felt that the effort of searching for it would take too much time.

During the structured interview a few terms were constantly used by instructors that indicate instructors may need some clarification, such as the terms “other” and “own” material. "Own material" was the content of courses that were created by the instructors themselves or created within a course by participants of the course. For example submitted work of students is seen as "own" material by the instructors. "Other material" was described as content that was created by other course instructors or found on the Web (none of the instructors considered making use of commercially made content). Differentiating these types of material resulted also in the distinction of reusing material for one's own purposes and making reuse possible for others. The computer skills of most users are not very high. The ease of use therefore is very important.

Another similar group of seven instructors was asked to fill in the questionnaire in the 2002 during a workshop at the University of Twente. The instructors were asked to participate in a workshop about reuse and standards and were given a demonstration of all reuse functionalities of the TeleTOP® CMS. The results of the questionnaire are used in the overall results in Chapter 8.

Including the results of the interviews the results of the Alpha-Beta project within the university context can be described in the next section.

5.3.8 The learning object-lifecycle: Summary from the Alpha-Beta project

This section summarizes the stages within the learning-object lifecycle for this project.

Obtain – The Alpha-Beta project does not focus on how material is obtained. The material available in the TeleTOP® system is used for reuse.

Label – The material is labeled with the developed tools. The tools use the content descriptions and the classification given by the instructor as values for the metadata. Additional metadata can be provided as needed or desired.

Offer – The TeleTOP® CMS created for the project offers all material in form of metadata documents. These metadata documents are used to search for material. Only content that is assigned with metadata and stored in the new developed LCMS is available for reuse. Material that is not seen as candidate for reuse is not assigned with metadata and not stored in the repository. Each TeleTOP® system contains such a repository that is accessible to all users that have access to the system and the material can be used by all users.

Select – The material can be selected using different taxonomies based on the metadata. Users can also use a keyword search to find the desired material. When useful material is selected, the new developed LCMS exchanges the material to the user’s desired place.

Use – The use of the selected material differs because instructors can have different reasons for using the material. The material can be edited before use or used as it is. Because the exchange of the material takes place within the TeleTOP® environment, instructors have the possibility to tailor material for their own needs. When instructors make material available for reuse they are able to specify under what conditions reuse takes place. When the material is made available for reuse, a remark is added that the material can only be reused after permission of the creator. An email address is used to contact the copyright holder or creator.

Retain - Within the university context, the course lifecycle is fixed because the academic year runs from September to August every year. Material is retained for the next year when it is reused in a next version of the course.

5.3.9 Answers to the secondary research questions for the Alpha Beta project

Based on the learning-object lifecycle learning-object lifecycle and findings in the human and technical perspectives the secondary research questions can be given preliminary answers.

TQ1. Granularity and standards - The granularity of the material is based on the database structure. This means that database records and their content are taken as the unit for reuse. Only the roster row is an exception because a roster row consists of five records; the row itself and the four related pages linked to the cells in the row. The database records and sets of records for the roster rows can be mapped against the first and second levels of aggregation specified in the LOM.

TQ2. Tools - In the Alpha Beta case tools were developed to exchange material between instructors using LOM. The tools are based on the ADL SCORM™ specifications implemented in the TeleTOP® CMS.

TQ3. Systems - The TeleTOP® CMS was used for all stages of the learning-object lifecycle. The different functions within the CMS make this possible.

HQ1. Organisational context - The intended large-scale reuse research was not possible because of the missing organisational strategy. The organisations did not developed rules, procedures, or regulations for reuse. No policy was available for how to deal with copyrights, intellectual property, and sharing each other's materials. Reuse depends on individual users that see the importance of such development and search for facilities.

HQ2. Learning scenarios - The TeleTOP® project started in 1997 and one of the main conditions was the continuity of the curriculum and avoiding changes in the running courses. The intention of the faculty board was not to develop a complete new curriculum because the number of changes in the last years and related invested time and effort of the instructors was already a burden. The TeleTOP® CMS was developed to support existing learning programs and not intended to develop new learning scenarios. Although it was not the intention, the new educational ideas for mentoring, coaching, and participants being more responsible for their own learning and knowledge acquisition began to emerge (Collis & Moonen, 2001). The TeleTOP® CMS is more and more used as a repository of reference material that can be used for learning. The yearly revisions of the courses improve the material constantly and the instructors as subject-matter experts control quality.

HQ3. Object creation - The material created in the university context is created by the instructors. The material used in the roster is in most cases pedagogically specific and not reusable in other contexts. Reuse is mainly focussed on one's material used in the next cycle of the course. The resources created in the Web links, archive, presentations, and multimedia functions are most of the time pedagogically neutral and do not include pedagogical directions. Material is most of the time gathered from the local resources like the hard drive of an instructor, but in other cases found in websites and with a short description used for learning.

HQ4. User support - For the university context the instructor obtains the material and should be supported with appropriate tools. The TeleTOP® CMS offers functionality for the stages in the life-cycle but instructors still need other tools such as Office to create small pieces of content for example presentations, pictures, figures, movies, tables, animations, and simulations.

HQ5. Metadata - The main person who reuses material is the creator of material. This means that most people recognize their material based on a few self-defined terms. Metatagging therefore is not seen as needed or desired in the organisation. The provided metatagging tools assign metadata automatically to the material and the vocabulary is based on the CMS and curriculum structure.

5.3.10 Key observations of the researcher for the SURF Alpha Beta project

The project showed that implementing specifications such as ADL SCORM™ is not difficult if a CMS is database driven. Although the ADL SCORM™ specifications are written for the development of CBT can they also easily applied within database-driven web-based CMSs. The project shows also an implementation problem and the related lack of use when there is no incentive for reuse from the organisational side. Reuse is then mainly focused on individual needs. The level of reuse within the faculty did not change over time because the already existing tools for reuse (the copy tools in TeleTOP®) were appropriate enough for the instructors to reuse whole courses for the next year.

5.4 Project Digital University Metadata Guideline

The project Digital University Metadata Guideline focused mainly on the third stage of the learning-object lifecycle. Section 5.4.1 gives an project overview description and the role of the researcher in the project. Sections 5.4.2 to 5.4.6 describe the project from a human and technical perspective using the Why?, Who?, What?, How?, and Where? questions. In Section 5.4.7 a summary is made in terms of the learning-object lifecycle, in Section 5.4.8 preliminary answers to the secondary research questions are given, and Section 5.4.9 describes the key observations of the researcher for the project.

5.4.1 General description and role of the researcher

The Digitale Universiteit (DU) of the Netherlands (http://www.digiuni.nl) initiated a project in the 2nd quarter of 2003 which ended in the 1st quarter of 2004 to define a metadata guideline for their consortium members. A guideline of how metadata can be used in a certain setting is also called an application profile. The term application profile is used as a more-general term in various systems and contains sets of vocabularies to be used for meta-tagging learning objects. For several metadata fields a set of predefined values is given. The project focuses thus mainly on the third stage of the learning-object lifecycle. The project delivered a manual explaining how to metatag learning material using the vocabularies.

The researcher participated in the project to define the guideline and associated vocabularies for the DU projects. The main role of the researcher could be characterized as analyst. The guideline was intended to be a manual for content developers in different projects and was developed to support these content developers in creating consistent and interoperable metadata.

5.4.2 Why does reuse take place?

A main goal of the DU is the exchange of knowledge within higher education. The outcomes of the projects are screened on (re)usability for different consortium members. This means that a number of consortium members needed a certain solution before a project could be carried out. This procedure also was meant to exclude very specific products that were only useful in one particular organisation. The selection of project proposals included the requirements for reuse. The metadata guideline should support the process of creating reusable products and make it easier to find material by providing taxonomies and a clear description of how material needs to be described. Using such a metadata-guideline should give the consortium members the possibility to reuse product outcomes in a structured way.

5.4.3 Who is involved?

Different groups of users were identified as potential users of the metadata applications profile such as:

- Project members that decide within a project what metadata to use.
- Authors or developers of content that assign metadata.
- Document managers that add metadata for library purposes.
- Users of digital material that can add remarks about reuse of material in practice.

All these people were involved when it came to the actual content of the eventual product, and the descriptions that accompanied the content. In the different stages of the project, metadata may have been provided to describe the eventual product(s), especially when larger projects were involved and different deliverables are presented. Each deliverable may also have been described with its own set of metadata according to the metadata profile. Also the program managers should have been involved to add descriptions that relate with other program lines and can be interesting for other programs.

5.4.4 What was reused?

Within the DU consortium many different projects are carried out. The project outcomes in the form of deliverables can be course material, guidelines, workshops, manuals, or curriculum. Course material developed in the DU projects are meant to be reused by consortia partners as well as others in higher-education institutions in The Netherlands. An educational service provider (ESP) is used to exchange this obtained material.

5.4.5 How is reuse supported?

Reuse is supported through the organisational strategies that stimulate the different members of the consortium to reuse obtained course material. Conferences were organized and product catalogues were published to make members aware of the material available. Also the requirement that different organisations work together in project groups stimulated the reuse of material within projects. Using communities of practice and project environments for collaboration through the Web stimulated the project groups to share and reuse material. The metadata guideline was also a tool that was intended to support reuse on different levels. For the development of the metadata guideline the following steps were taken:

- Inventory of metadata guidelines available
- Selection of what elements to use from the specification

- Inventory of available vocabularies
- Selection of vocabularies and methods to assign metadata to elements.

One of the requirements from the DU was to be compliant to the current available standards such as LOM and ADL SCORM™. An inventory was made to find metadata guidelines available that could be used or serve as examples. Interesting examples were found in the CanCore (http://www.cancore.ca) specification. The selection of elements was mainly based on the ADL SCORM™ mandatory fields for SCAs. An example based on an existing DU-object in Table 18 gives an impression of a “metadata record”, this is the set of metadata elements that need to be assigned for one learning object The metadata elements that can have a value in Table 18 have a white background. The gray elements are organizers of the elements and cannot contain a value. The choice was made to use a Dutch translation for the LOM for the ease of use. A Dutch translation of the LOM was initiated by the Dutch standardization institute (NEN, http://www.nen.nl). Although a Dutch translation is used for the words, the element number (LOM nr.) is kept identical to the original. The example shows that some elements appear more then once. In this example the element “Bijdrage” can have more then one value. Table 18 shows the mandatory elements for the metadata profile. An exception is made for the Element 6.3 “Omschrijving”. The table is split up in two parts, a part for the author (auteur), and a part for the library expert (documentalist). An English version of the LOM can be found in Appendix B: “The LOM metadata set”.

Table 18 Example (in Dutch) of selected elements for the metadata guideline (Adapted from Benneker, Delchot, Ham, Pannenkeet, Schoonenboom, & Strijker, 2004).

LOM nr.	Naam	Invulling
		Ingevuld door auteur
1	Algemeen	
1.2	Titel	(nl, Exploitatiehandboek Virtueel Milieuadviesbureau)
1.4	Omschrijving	(nl, 'In Company Milieuadvies' is een operationeel virtueel bedrijf. Dit handboek bundelt de werkzaamheden en instrumenten waar studenten en docenten in 'InCompany Milieuadvies' mee te maken krijgen.)
1.5	Sleutelwoord	Handboek
1.5	Sleutelwoord	Virtueel Milieuadviesbureau
2	Levenscyclus	
2.1	Versie	1.0
2.2	Status	definitieve versie
2.3	Bijdrage	
2.3.1	Rol	Auteur
2.3.2	Persoon of organisatie	BEGIN:VCARD FN:Darco Jansen EMAIL;TYPE=INTERNET:darco.jansen@digitaleuniversiteit.nl END:VCARD
2.3.3	Datum	2003-03-01
2.3.1	Rol	Auteur
2.3.2	Persoon of organisatie	BEGIN:VCARD FN:Angelique Lansu EMAIL;TYPE=INTERNET:Angelique.lansu@digitaleuniversiteit.nl END:VCARD
2.3.3	Datum	2003-03-01
2.3.1	Rol	Auteur
2.3.2	Persoon of organisatie	BEGIN:VCARD FN:Wilfried Ivens EMAIL;TYPE=INTERNET:wilfried.ivens@digitaleuniversiteit.nl END:VCARD
2.3.3	Datum	2003-03-01
		Ingevuld door documentalist
1	Algemeen	
1.1	Identificatie	
1.1.1	Schemanaam	DUCat
1.1.2	Identificatiecodes	DI.PROD.HANDB.VMAB.1
1.3	Taal	Nl
2.3	Bijdrage	
2.3.1	Rol	Uitgever
2.3.2	Persoon of organisatie	BEGIN:VCARD FN:Stichting Digitale Universiteit EMAIL;TYPE=INTERNET:buro@digiuni.nl END:VCARD
2.3.3	Datum	2003-03-01

Table 18, continues…

Table 18 (continued)

3	Metametadata	
3.2	Bijdrage	
3.2.1	Rol	Maker
3.2.2	Persoon of organisatie	BEGIN:VCARD FN:Kees Pannekeet EMAIL;TYPE=INTERNET:kees.pannekeet@digitaleuniversiteit.nl END:VCARD
3.2.3	Datum	2004-01-04
3.2.1	Rol	Documentalist
3.2.2	Persoon of organisatie	BEGIN:VCARD FN:Judith Schoonenboom EMAIL;TYPE=INTERNET:judith.schoonenboom@digitaleuniversiteit.nl END:VCARD
3.2.3	Datum	2004-01-05
3.3	Metadataschema	DULOMnlv1.0
3.4	Taal	Nl
4	Technisch	
4.1	Bestandsformaat	application/msword
4.3	Locatie	http://www.digiuni.nl/digiuni//download/temp/07_VMBA.pdf?CFID=125695&CFTOKEN=58152576
6	Rechten	
6.1	Kosten	Nee
6.2	Auteursrechten en andere beperkingen	Ja
6.3	Omschrijving	Deze uitgave is binnen het consortium van de Digitale Universiteit vrijelijk te gebruiken, mits voorzien van adequate bronvermelding. Niets uit deze uitgave mag buiten het consortium openbaar worden gemaakt, verspreid en/of verveelvoudigd door middel van internet, druk, fotokopie, microfilm of op welke andere wijze dan ook zonder voorafgaande schriftelijke toestemming van het bureau van de Digitale Universiteit.

The metadata used in the guideline are based on several other standards available. The reason for this is that already provided standards do not need to be developed again and exchange of material outside the DU is easier if the same standards are used. The DU guideline is mainly based on the values defined for the elements used within LOM. When needed changes are made to the DU context such as the possible values for Element 5.6 “Context” (In Appendix F: “Werken met metadata in DU-projecten“) that may contain “master” and “bachelor” to indicate the year of study (Benneker, Delchot, Ham, Pannenkeet, Schoonenboom, & Strijker, 2004).

The specific DU context needed besides the mandatory ADL SCORM™ elements another set of elements from the LOM. These are mainly elements related to author(s) information and person(s) who assign metadata to the objects. Within the DU context it can be necessary to contact the creators, obtainers, or authors of the objects for example when the user wants to give reactions about the use of material or when it is noticed that an object is not well described. Besides the author, also the publisher or owner should be able to be contacted. This is default in the DU and in particular important when material is used outside the DU. Last is the language of the objects to be assigned. The default language is Dutch based on the Dutch translation used of the LOM (Benneker, Delchot, Ham, Pannenkeet, Schoonenboom, & Strijker, 2004). The classification category that is mandatory in the ADL SCORM™ is optional in the DU-metadata guideline. Although there is a DU-classification schema available, this was not developed for use as metatagging. The application of the DU-classification in practice is not clear for all DU projects. This is the reason that the classification category in the DU classification scheme is not mandatory.

If project groups want to be compliant with ADL SCORM™ they need to develop their own classification schema to fill the classification category where purpose (doel), descriptions (beschrijving) and keyword (sleutelwoord) are mandatory. Table 19 shows the differences between the DU-guideline and ADL SCORM™ where "Verplicht" means mandatory.

Table 19 Differences between the DU guideline and ADL SCORM™

LOM nr.	Naam	Evt. vaste waarde	DU-richtlijn metadata	ADL SCORM ™
1	Algemeen			
1.3	Taal		verplicht	Optioneel
2	Levenscyclus			
2.3	Bijdrage			
2.3.1	Rol	auteur	Verplicht	Optioneel
2.3.2	Persoon of organisatie	-	Verplicht	Optioneel
2.3.3	Datum	-	Verplicht	Optioneel
2.3.1	Rol	uitgever	Verplicht	Optioneel
2.3.2	Persoon of organisatie	BEGIN:VCARD FN:Stichting Digitale Universiteit EMAIL;TYPE=INTERNET:buro@digiuni.nl END:VCARD	Verplicht	Optioneel
2.3.3	Datum	-	Verplicht	Optioneel
3	Metametadata			
3.2	Bijdrage			
3.2.1	Rol	maker	Verplicht	Optioneel
3.2.2	Persoon of organisatie	-	Verplicht	Optioneel
3.2.3	Datum	-	Verplicht	Optioneel
3.2.1	Rol	documentalist	Verplicht	Optioneel
3.2.2	Persoon of organisatie	-	Verplicht	Optioneel
3.2.3	Datum	-	Verplicht	Optioneel
3.4	Taal	-	Verplicht	Optioneel
9	Classificatie			
9.1	Doel	-	Optioneel	Verplicht
9.3	Omschrijving	-	Optioneel	Verplicht
9.4	Sleutelwoord	-	Optioneel	Verplicht

Five stages can be identified when metadata are assigned in the DU context:

1. *Definition of the metadata profile:* Choosing the metadata that will be used to describe the material developed in the project. In most cases, different project members will make this choice.
2. *Assigning initial metadata:* Those involved with development of course material are the authors and add initial metadata.
3. *Assigning final metadata:* The metadata assigned by the author are checked by the library expert
4. *Revision:* During the development or use of the material revisions may be needed. Revisions can have more ore less impact on the metadata descriptions
5. *Adding annotations:* During the use of the material users can add annotations to the material. These annotations are not relevant for the metadata guideline manual but can be used in the future to get more clear view on the use of material.

Figure 116 shows how the different stages relate to the roles involved in assigning metadata.

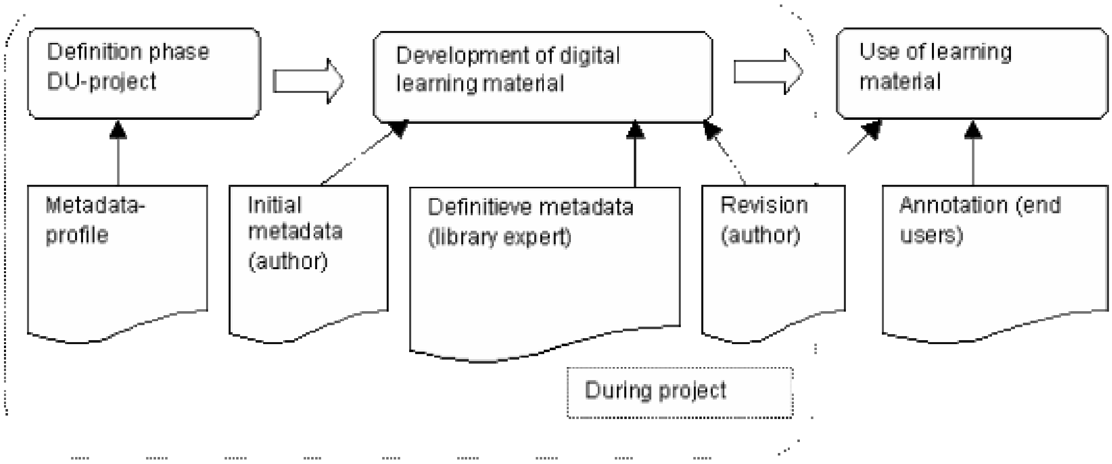


Figure 116 The different stages of assigning metadata and roles in the DU context ((Benneker, Delchot, Ham, Pannenkeet, Schoonenboom, & Strijker, 2004)

For each metadata element the guideline describes the initial values and what vocabularies can be used. These are based on the original LOM and extended by the DU-vocabulary (DULOMnlv1.0). Appendix F: "Werken met metadata in DU-projecten" contains the full guideline.

5.4.6 Where does reuse take place in terms of systems?

The Website of the Digital University (http://www.digiuni.nl) offers an entry point for the project outcomes. Deliverables are directly accessible through the Website which offers resources that can be reused by whoever is interested. The material is available to everyone, also organisations that are not part of the consortium. Besides of the public access of the actual project outcomes, there are also restricted areas that are only accessible for consortium members. Only registered users can access these parts, and accessibility differed according to the project in which someone is a part.

The material currently available through the TeleTOP® Websites can also be seen as resources for the LCMS functionalities in the future. The metadata guideline can be seen as part of the procedure of how the material can be made available in the upcoming LCMS functionalities. An inventory of LCMSs has been made by the Digital University (2002) with the intention to offer such kinds of functionalities for all consortium members. The metadata guideline prescribes what data are needed for every piece of material stored in a LCMS.

The DU metadata guideline is used in several ways to make effective implementation possible. The guideline was presented during a workshop to project leaders so that they are aware of the guideline and expected to work with it. The guideline is expected to be used during the development of course material in de DU context. The guideline is also being used as one of the example application profiles for the further development of the TeleTOP® CMS. The vocabularies used in the guideline are used as bases for new developments in the TeleTOP® CMS for tagging and packaging tools.

5.4.7 The learning-object lifecycle: Summary of the Digital University project

The metadata guideline focuses on the labelling aspects of the material. The other stages in the learning-object lifecycle were not discussed within the DU project because the guideline was seen as a prerequisite for the other stages. For each of the other stages a short description can also be given how of the metadata guideline supports the stage:

Obtain - Material are obtained through the projects carried out for the DU. During the project initiation the metadata guideline can support the writers of the proposal with keywords and taxonomies to assign the project to the available project lines. The project proposals themselves can also be reused in other projects, or for further project-management decisions. The outcomes of the projects in terms of deliverables are the intended products for reuse. The deliverables can be manuals, guidelines, but also software applications, or software-based support tools.

Label - When the deliverables are ready, the metadata guideline can be used for labelling the products. This labelling may be directly adapted from the project proposals, but if the project proposal labels were too broad or did not cover the actual deliverable, a more-specific metadata set could be assigned using the metadata guideline. This could be the case if a deliverable is part of a greater whole or is not foreseen in the proposal, but could be a good resource for reuse.

Offer - The metadata guideline did not cover a procedure or strategy to offer the material. This procedure was already partly covered because the deliverables that were part of the project outcome were owned by the DU. The strategy for knowledge dissemination was that all the deliverables are offered through the Website to everyone who is interested. The assumption is that in the near future project leaders or program managers would be offering the material through an LCMS.

Select - Because of the use of vocabularies in the metadata guideline, taxonomies need to be built to support searching for material. Based on the metadata guideline different search strategies can offer support to users in the selection of learning objects.

Use - The use of the material is partly covered within the metadata guideline; the assumption is that useful material is being offered and can be used in different situations and systems, and that by using the LOM standard interoperability is guaranteed. This means that different CMSs like TeleTOP®, N@tSchool, and BlackBoard are able to read the metadata descriptions. Besides the CMSs, there are also different LCMSs and search engines that should be able to handle the metadata descriptions.

Retain - When projects are finished and the deliverables are submitted, they are available for reuse. This also means that there is no structural procedure to retain the material. Once deliverables are ready, maintenance stops unless the deliverables are used in a following project. Program managers can decide that material is out of date or not relevant anymore for a certain project line.

5.4.8 Answers to the secondary research questions for the Digitale Universiteit project

Based on the learning-object lifecycle and findings from the human and technical perspectives the secondary research questions can be be further answered:

TQ1. Granularity and standards - In the Digital University context granularity is not predefined and is based on the sort of content delivered in the project. The granularity level according to the standards is mapped on the moment of tagging. The size of the objects is not described beforehand.

TQ2. Tools - The guideline can be seen as the requirement for the tools to be chosen and that the tools must support the metadata specifications. The tools used in the different stages of the lifecycle should support the requirements from the guideline.

TQ3. Systems - The set of systems that can be used for reuse is restricted by the guideline because the systems selected should be able to use the defined data structure in the guideline. These prerequisites restrict the participating consortium members in their choices, but offer future interoperability.

HQ1. Organisational context - A guideline can be used as a basis for development and exchange of material in an organisational strategy. It specifies how exchange on a technical level can be provided. The guideline does not support strategy makers in making policy for reuse.

HQ2. Learning scenarios - The guideline does not specify learning scenarios or approaches.

HQ3. Object creation - Different roles are specified in the process of assigning metadata to ensure the quality of metadata. From the moment of initial project proposal until the deliverable presentation different stages and roles are specified for assigning metadata on the expert level for ensuring the quality of metadata.

HQ4. User support - In projects material are obtained as part of deliverables. The guideline is a form of support to assist developers and designers in creating these deliverables. Besides this project managers are supported with training where reuse of material and tagging of material is part of the training program.

HQ5. Metadata - Exchanging deliverables is a main goal of the Digital University because knowledge is disseminated in this form. Assigning metadata is seen as key for retrieving material. The motivation is the fact that it is part of the project proposal and that it is mandatory to assign metadata. The DU pays for this activity.

5.4.9 Key observations of the researcher for the DU metadata guideline

The development of the DU metadata guideline was more difficult than expected. The DU is planning to use the guideline for all involved consortium members and future projects. This means that the material should also be tagged in different ways. One of the main interesting things was that the DU did not provide a mandatory taxonomy to assign material to. In contradiction to the ADL SCORM™ application profile, the classification element is optional in the DU application profile.

Another interesting observation is that once such a profile is created it is immediately taken as an example on which new tools are based. The profile forms the basis for further CMS developments.

The three projects as described above in Sections 5.2, 5.3 and 5.4 have been carried out with the involvement of the researcher. In the next section the results of the projects are summarized.

5.5 Results, within the University Context

In Section 5.5.1 the results are described in terms of the secondary research questions, the key observations of the researcher are described in Section 5.5.2, Section 5.5.3 describes the Perspective-Lifecycle figures based on Section 2.5.2 and Section 3.5.2. Section 5.5.4 identifies key success and fail factors as criteria of success for learning objects in the university context as part of the explanatory task of the research, and Section 5.5.5 concludes the chapter with a preliminary set of guidelines for the university context, relating to the prescriptive task of the research.

5.5.1 Secondary research questions for the university context

For the three projects together preliminary conclusions are drawn and summarized here.

TQ1. Granularity and standards - The granularity of objects is defined by the systems used. Learning objects are not defined in terms of time and content. The material placed in the CMS can have any size and format. The users determine what material is stored and the size of the material is limited to bandwidth, hard-disk space, or administrator settings that restrict upload time, download time, or disk-space quantity.

TQ2. Tools - In the university context the tools are part of the CMS used. In addition office tools are used to create documents, presentations, or similar types of materials.

TQ3. Systems - Within the university context for the projects the TeleTOP® course-management system is used. This system provides exchange of learning material between courses. The TeleTOP® CMS is used for all stages of the learning-object lifecycle. The different functions within the CMS make this possible. The set of systems that can be used for reuse is restricted by the metadata guideline because the systems used should be able to use the defined data structure in the guideline.

HQ1. Organisational context – The university context is based on the expertise of the instructors. This means that instructors mainly behave independently in terms of creating course material and deciding the content of a course. Reuse of material is not part of the organisational strategy. The organisational context focuses on strategies for curriculum plans such as the implementation of the Major Minor and Bachelor Master but less on the educational support in terms of systems, and strategies for reuse. Steering is only given on high-level curriculum plans, faculty members such as instructors and the management board have to provide the actual content. No actual support is given in terms of the specific tools that are provided. The CMS can be used to develop new courses, but it is a general tool not developed and equipped with tools to do this in an easy way. Tools to really integrate course material from different programs, reuse, and exchange between faculties to support the Bachelor-Master plans have not been developed from an organisational level. Individual users mainly try to exchange and reuse material using various work arounds including cutting and pasting to deal with the CMS resulting in various problems of different sorts such as lack of consistency.

HQ2. Learning scenarios – The learning scenarios depend mostly on the instructor. New upcoming scenarios in terms of curriculum changes are important for reuse. The changes in the curriculum mean that different student groups need to be addressed and that learning material can be reused in the different courses.

HQ3. Object creation – Material in the university is obtained by the instructors using mainly the tools available. The provided CMS is mainly used to structure the course and add material obtained with Office tools such as Word and PowerPoint. Instructors create material alone or in groups in projects. Projects to create content can be carried out for consortia such as the Digitale Universiteit or The SURF foundation. Material also is gathered from the Internet or created by a multimedia support group.

HQ4. User support – The support of users in terms of systems is important and comes mainly from the TeleTOP® CMS. Another very important form of user support was established in the faculty in the implementation phase of the TeleTOP® CMS when instructors were supported by the TeleTOP® project team when they had educational and technical problems using the system. On a university level this kind of human and technical support is still provided.

HQ5. Metadata – The need of tagging material becomes urgent when large amounts of material are available that need to be shared among a large group of users (See Table 16 and Table 17 for usage data). In the current university setting where reuse focuses on the individual user, tagging of material is not an organisationally driven task. Individuals tag material for their own reuse purposes, mostly unaware of doing so because the system takes care of this based on the titles and descriptions of the material.

5.5.2 Key observations of the researcher for the university context

- Within the university context the main observation is that reuse is organized individually.
- Copyrights and intellectual property are key issues related to reuse
- The use of a database driven CMS is essential for implementation of learning-technology standards. Educational content stored in databases can be easily transformed in any required technical format (such as learning objects according to ADL SCORM™ Specifications).
- Within the university context there is no real drive to implement specifications and standards, although consortia like the Digital University and SURF focus on interoperability and exchangeability to make exchange between higher education and publishers possible. The extent to which individual faculty members of universities in these consortia make use of these services is unknown but likely to be low.
- Reuse of material in the university setting plays an important role in the development of courses. Exchange of material with other colleagues is for most instructors not important, but providing a new version of their courses every year is an important issue.
- Even if reuse becomes a university-wide strategy, defining vocabularies and tools to use will be very difficult because instructors are all independent and working on very specific expertise areas.

- The reuse of their own materials seems to be a daily routine for these instructors. The use of metadata however seemed to be difficult to imagine for the course instructors even after showing them the actual functionalities used for automatically attaching metadata that are available within the TeleTOP® CMS.
- The definitions used within ADL SCORM™ for metadata are difficult to understand and interpret. For several fields more than one interpretation is possible. For filling in the metadata, specialized personnel should be available (Strijker, 2001).

Based on the secondary research questions and main observations of the researcher for the different projects the descriptive view for the university context can be validated.

The university projects show how much the instructor's research and the instructor's personal knowledge management is incorporated in learning and also the use of group assignments and the coaching role of the instructor match the participation and contribution pedagogy as shown in Section 2.1.4.2. The issues related to reuse have to be controlled. Because of the independence of the instructors this seems a difficult task, but on the other hand a policy can be rather simple. The fact that reuse and exchange is not part of the university's organisational strategy is because of the lack of policy. Besides providing education, the research aspect is very important in the university context and exchanging knowledge is seen as important. The knowledge-management aspect takes place in projects like The SURF foundation Alpha Beta but is integrated in the courses. When instructors create new course material, results from the projects are immediately integrated. The knowledge management is part of the process of obtaining course material.

Through the combination of technologies and pedagogies, and in the implementation context of a course as an activity and contribution-oriented setting, a number of the barriers limiting the potential reuse of digital resources can be addressed, particularly those that relate to fit with the local context. In terms of the distinctions made in Section 2.1.4.2, it is doubtful that technology itself can take over the decision making about a learning context, and thus there is a move (back) from instructor-neutral e-learning or Web-based training toward (again) a blend of pedagogy, good teaching, and social interaction, but with an emphasis on learner contributions and re-use of those contributions (Weller, Pegler & Mason, 2003b). All of this requires a strong technology-support system, not to take over but to support the learning process. In theory, the reuse of one's own material can be natural here, particularly example materials contributed by students. However, the instructor interviews show some issues about the likelihood of instructors being convinced about sharing their materials with others, making use of materials made by others, or seeing the need for detailed specification of their own materials. Reuse of one's own materials is already well established, but beyond simple tools for copying from one course environment to another, instructors may not be likely to see the value of metadata or other schemes beyond their own directory structures. Reuse is a personal practice that can fit well with a contribution-oriented pedagogy. Unfortunately this personal view does not fit with concerns about sharing and the goal of building a critical mass of commonly available material even within a faculty.

5.5.3 Validating the descriptive view for the university context, perspective by lifecycle

Figure 117 shows the integration of perspectives, life cycle, and brief answers to the secondary research questions in a university context. The distinction in theory of two contexts within the university based on pedagogical orientation is not supported in the projects.

	Learning objects	Obtaining	Labelling	Offering	Selecting	Using Pure	Using Adapted	Retaining
Human persp	Why?	HQ5. For personal convenience, HQ2. development of individual learning scenarios.						
	Who?	HQ3 and HQ5. Instructor						
Technical perspect	What?	TQ1. Course material						
	How?	TQ2. Office tools (Word, PowerPoint)				TQ2. CMS functionalities		
	Where	TQ3. CMSs, hard disk						

Figure 117 University context revised

The perspective by lifecycle can be simplified because reuse is much more an individual process than expected. The tasks related to the stages within the learning-object lifecycle are carried out in by individual users and overlap. The CMS used provides support in the different stages of the development of course material.

5.5.4 Explanatory task: Key success (and fail) factors for learning objects in the university context

Table 20 shows the key success factors from Section 4.1.2 for learning objects in a university context. Each factor is given a value for success based on applying to the projects a five-point scale where five indicates the researcher's opinion for a success factor for the context, based on discussion at the end of each project

Table 20 Success in the university context

Coding	Success factor	Value for success (1= least success, 5= most success)
SF1	The tools are in place	5
SF2	Rules are understood and followed	1
SF3	Roles related to the learning objects are identified	3
SF4	Organisational embedding has occurred leading to learning objects	2
SF5	Learning objects are being used and reused being used and reused by a critical mass of users within an organisation in	4
SF6	Learning objects are being used and reused in appropriate ways	3
SF7	The use and reuse of learning objects is valuable to the organisation	1

One of the key success factors can be related to the organisational embedding and the value for the organisation. Policy about reuse, how time investment is rewarded, and the status of obtained material should be official, but currently no rules are available. In contrast to the current practice that instructors only create material for their own use, instructors should be urged to create resources that can be reused in different settings and thus by different instructors. The lack of official regulations for these new ways of content development and the lack of vision in this field from the university board make it difficult for instructors to reach over the wall that is built from unawareness. The technical infrastructure is available but the tools to exchange learning objects are not in place, and decision makers do not see the urgent need for these tools for the development and exchange of learning objects, and for collaboration between different subject-matter experts.

The first stage of the learning-object life cycle was a success in the TeleTOP® and Alpha-Beta projects because of the university-wide implementation of a course-management system and the huge amounts of learning objects obtained in the system. Providing all instructors with tools to create content in an easy way is a success level that most universities have not reached yet.

In the university setting an important failure factor is that the university does not see the value of the material already created. The material available in the TeleTOP® CMS can be exploited in different ways only if policy is made clear for reuse and if tools are developed to exchange material with other systems. Everything is there, but the possibilities are just not used. Decision makers are afraid to make decisions about “technical stuff” because they cannot see the actual outcomes in terms of money, effort, and efficiency. The invested effort is not clear to the management and the “vague” concepts, the technical aspects that are needed for reuse, are skipped in decision processes and banned to IT staff. The IT staff on the other hand cannot proceed in the technical-reuse area because of the lack of policy in the reuse area. The lack of knowledge in this area and the difficult issues involved make reuse every time an interesting discussion.

5.5.5 Prescriptive task: Recommendations for the university context

The prescriptive task for the university context focuses on guidelines in the form of recommendations that can be used for implementing a reuse strategy.

- *University Guideline 1: Develop a policy for reuse*

  A policy for reuse needs to be developed so that exchange of material is part of the course-development task. Because the use of a CMS is centrally controlled by the university board, faculties are not in the situation to decide how to proceed in reuse procedures. Faculty members cannot choose for a system that makes reuse actually work. They depend on the functionalities offered by the centrally chosen system. The policy that is needed for reuse can only come from the university or faculty board, with the decision to use a system that offers the possibilities for reuse. If departments cannot choose a system on their own, the choice for instructors is even smaller. Instructors will just create material for their own use, in such a way that the learning objects are created in a time-independent form and are reusable every year again in the same or different courses taught by the individual instructor. Exchange on the faculty level will not desirable or if attempted, not be very efficient. The material used in courses is too specific to be tailored for different educational visions. Using the immense resources available for reuse created by the university instructors is only one of the advantages that can come from a successful learning-objects approach. Another benefit can be the exchange of material with other organisations and the sharing of the knowledge that is available in different places.

- *University guideline 2: Reward instructors*

  Instructors need to be rewarded for the development of course material and their willingness to share material. The need is not high enough to actually do so. Most instructors do not experience the ease of use for reuse for learning material and the benefits and expectations for finding reusable materials are low. The drive to reach a critical mass of reusable material can partly come from the instructors, but only when there is some kind of satisfaction for the teacher in terms of rewards.

- *University guideline 3: Relate costs to reuse*

  Making instructors aware of the costs for course development can be a way to stimulate reuse. The development of courses is an expensive and time-consuming task in the university. Most instructors are not aware of what the costs are when developing new material. Courses can be seen as projects that have a certain budget and a certain set of costs. The financial model of the university has typically been based on the number of students completing a course per year. Because of changes in the financial model, instructors are not aware of the budget they have actually available for creating a course. It is also often not within the control of the instructors how to use this course budget. Gaining this awareness could make it more attractive to buy available course material, but also to sell self-created course material. Setting up courses as individual projects and seeing also the course material as potential valuable outcomes that can be used for trading can help to get a higher engagement of instructors creating courses and exchanging material.

This concludes the description of the results of the university context. In the next chapter the corporate context is described.

6 Corporate-Learning Context

The study of the corporate-learning context is based on a set of three projects for the Shell EP Learning Center in Noordwijkerhout in the Netherlands. Section 6.1 gives a general description of this specific corporate-learning context and Shell EP as an organisation. A project related to the implementation of TeleTOP® is described in Section 6.2. Section 6.3 focuses on the TeleTOP® conversion project that dealt with interoperability between CMSs and the role of learning-technology standards. Section 6.4 describes the Knowledge-Sharing project, and Section 6.5 summarizes the three projects. Figure 118 shows the structure of this chapter.

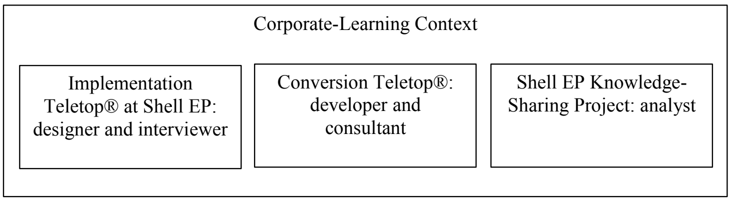


Figure 118 Overview of Chapter 6, corporate-learning context, roles of the researcher

6.1 General Description of the Shell EP Corporate-Learning Context

In Section 6.1.1 an overview is given of the Shell EP organisation and the changes within the Shell EP organisation in the last years in terms of moving to a world-wide IT infrastructure. Section 6.1.2 describes how learning scenarios within Shell EP are structured and supported within the organisation, particularly via the Shell Open University and blended learning. Section 6.1.3 gives an overview of the collaboration between Shell EP and the University of Twente for research relating to new forms of learning supported by technology.

6.1.1 Shell EP organisation

The Shell EP International Exploration and Production (Shell EP) Learning Centre in Noordwijkerhout (the Netherlands) is used as the primary focus for the study of the corporate-learning context. Shell EP as a context for the research is used because the business strategy of Shell EP includes new ways of learning involving courses or portions of courses participated in while remaining in the workplace. These new ways of learning will be discussed in Section 6.1.2. First, the Shell EP organisation is summarized with a focus on the evolution of its technical infrastructure.

The general information about the Shell organisation that follows is primarily based on the information available on the Shell EP external Website (http://www.annualreport.Shell EP.com/).

Shell is a worldwide organisation with more than 115,000 employees in more than 145 countries and territories around the world, companies that together form the Royal Shell group. They focus upon hydrocarbon-related exploration and production (EP), gas and electricity, oil products, chemistry, sustainable energy, and other activities. The Royal Dutch/Shell Group commonly referred to as “Shell”, is an Anglo-Dutch company. The company is an arrangement between two companies, which are the Royal Dutch Petroleum Company in the Netherlands and The “Shell” Transport and Trading Company, p.l.c. in the United Kingdom. Shell is commonly thought of as an oil company but it considers itself a global energy company operating in over 145 countries and employing more than 115,000 people. The businesses within Shell are united by common goals with an aim to meet the energy needs of society in ways that are economically, socially, and environmentally viable (Shell Open University, 2002). Figure 119 shows how the Royal Dutch/Shell Group is structured.

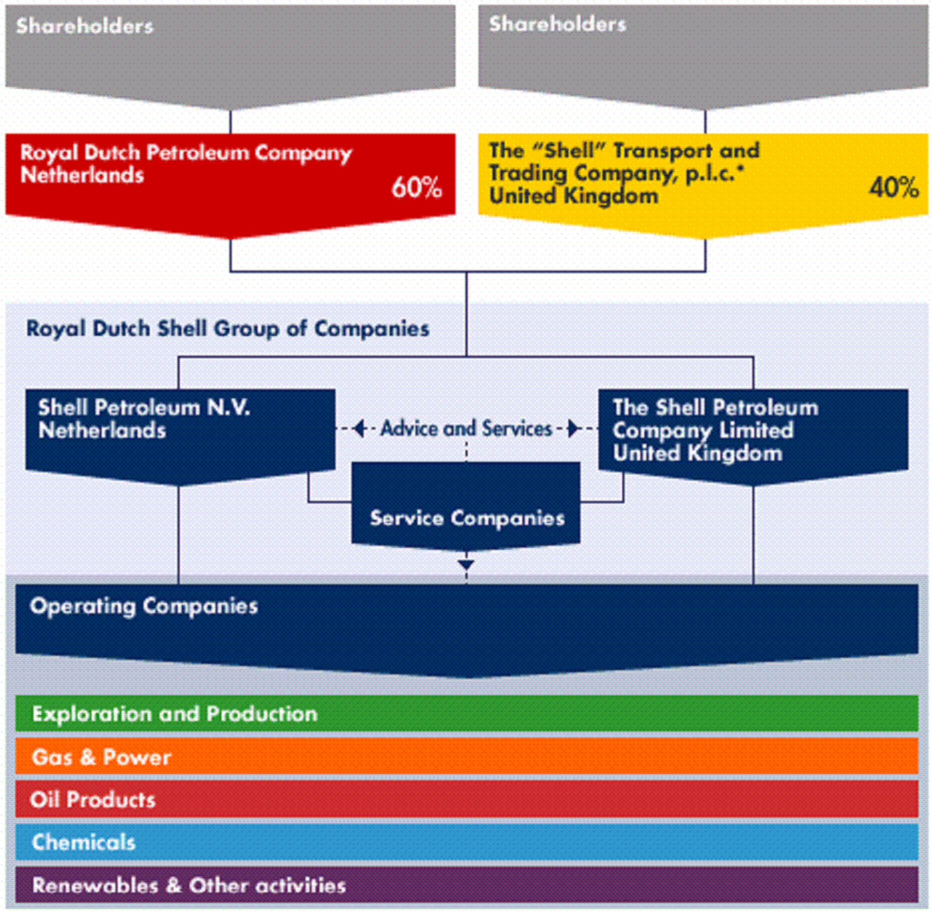


Figure 119 Structure of the Royal Dutch/Shell Group

Shell International Exploration and Production (SIEP, or Shell EP) finds and produces oil and gas through innovation and application of new technologies.

Shell has gone through different stages of structure within the organisation that relate directly to changes in its IT infrastructure. A short overview will be given from the 1960s when the first computers were used that has influenced the current state of information technology within Shell. The history is described from this perspective because it is directly related to the current IT infrastructure and the projects relating to reuse described in this chapter.

In the 1960s the structure can be seen as given in Figure 120. The business leadership was centralized and the operational units were led by the central organisation. The operational units were initiated by the central organisation or taken over when they were needed to achieve current business goals. The central organisation offered many kinds of facilities in terms of learning, courses, personal, hardware, software, and IT solutions. The operational units paid the central organisation for these facilities.

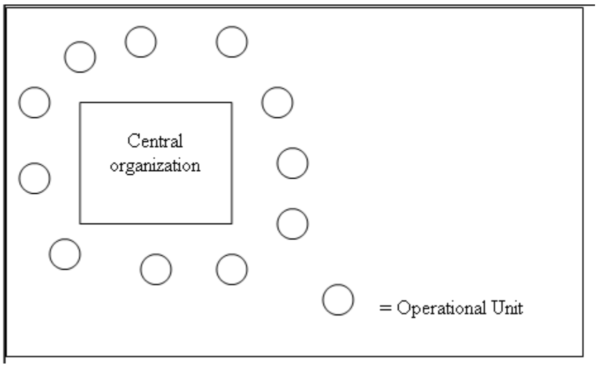


Figure 120 Schematic view of the Shell EP organisational structure 1960s

In the 1980s the organisational structure changed to a more-decentralized approach. Every operational unit became an independent department that could choose to find solutions that fit its own needs. This led to a widespread variety of software and hardware solutions being used in the different operational units. The central organisation was not longer the centre of the initiated activities. The operational units could negotiate about the payments to the central organisations, for example for learning and courses. Figure 121 shows how the central organisation became smaller and the operational units bigger because of the autonomous solutions and the support needed for these.

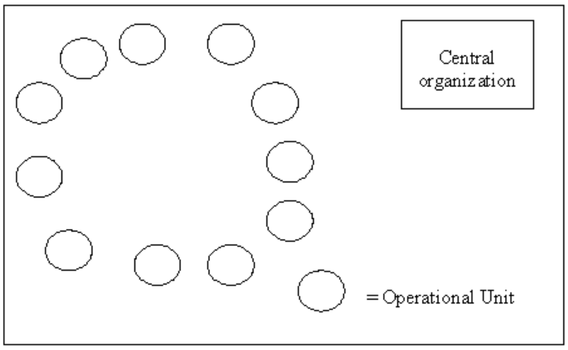


Figure 121 Schematic view of the Shell EP organisational structure 1980's

Beginning in 2003 the organisation has focused on a global approach, moving away from a decentralized approach for operational units and toward trying to find solutions to be applied to a large group of operational users at the same time. These global solutions are initiated and structured by the central organisation. This approach is based on the assumption that all operational units can benefit from using similar tools. The operational units are grouped in regional entities that are facilitated by the central organisation. Figure 122 shows how the operational units are now smaller and grouped in regional entities. The central organisation has grown to support the global activities.

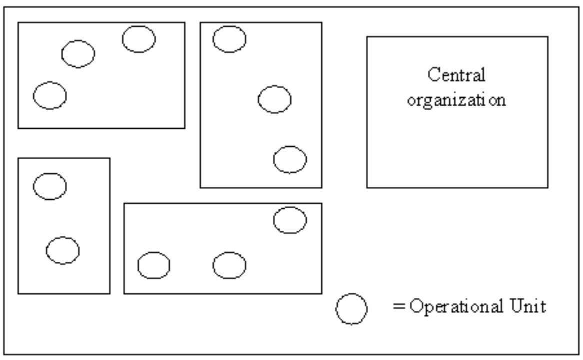


Figure 122 Schematic view of the Shell EP organisational structure beginning in 2003

The organisational changes in the past have resulted in different IT systems and solutions. In the new organisational structure these systems and solutions need to be organized in such a manner that everyone gets the benefits of the solutions worldwide. The worldwide IT infrastructure is seen as the most important enabler of this globalization process. Standardization of systems, procedures, and processes is seen as part of the IT infrastructure.

Shell EP's plans for the future focus on applying very specialized exploration and production methods to get more benefits than competitors. Also outsourcing is a strategy using third-party solutions for learning and specialist needs. A trend related to these plans in the near future is the fact that a large group of specialists will be reaching the age of retirement and will leave the company, taking all their specialist knowledge with them. Years of experience will be wasted if there are no actions taken to capture this knowledge and experience. The globalization process and sharing this knowledge using the global IT infrastructure are seen as part of the solution for these emerging problems (Lomas, 2004).

There has been a specialized group serving the learning-related needs of Shell EP in terms of course delivery for years. This group was formed at the Shell EP Learning Centre in Noordwijkerhout in the Netherlands. The current group formed by mergers in 2003 is Shell Exploration and Production Learning, Leadership and Development (Shell EP LLD or SIEP LLD) which serves the learning needs of technical professionals such as petroleum engineers, petrophysicists, geologists, and well engineers who work not only in a multinational and multicultural company but also in a field whose requirements are rapidly changing. The LLD group involves the merger of groups relating to knowledge management, new ways of working, virtual team working, course design and delivery, competence development, leadership development, learning-value assurance, change management, IT, and research, within the Shell EP context. New technologies as well as new challenges characterize the various EP workplaces, which will differ throughout the world in their specific issues but share a common need to meet the standards for technical and operational excellence set by specialists in the company. Figure 123 shows the structure of the SIEP LLD.

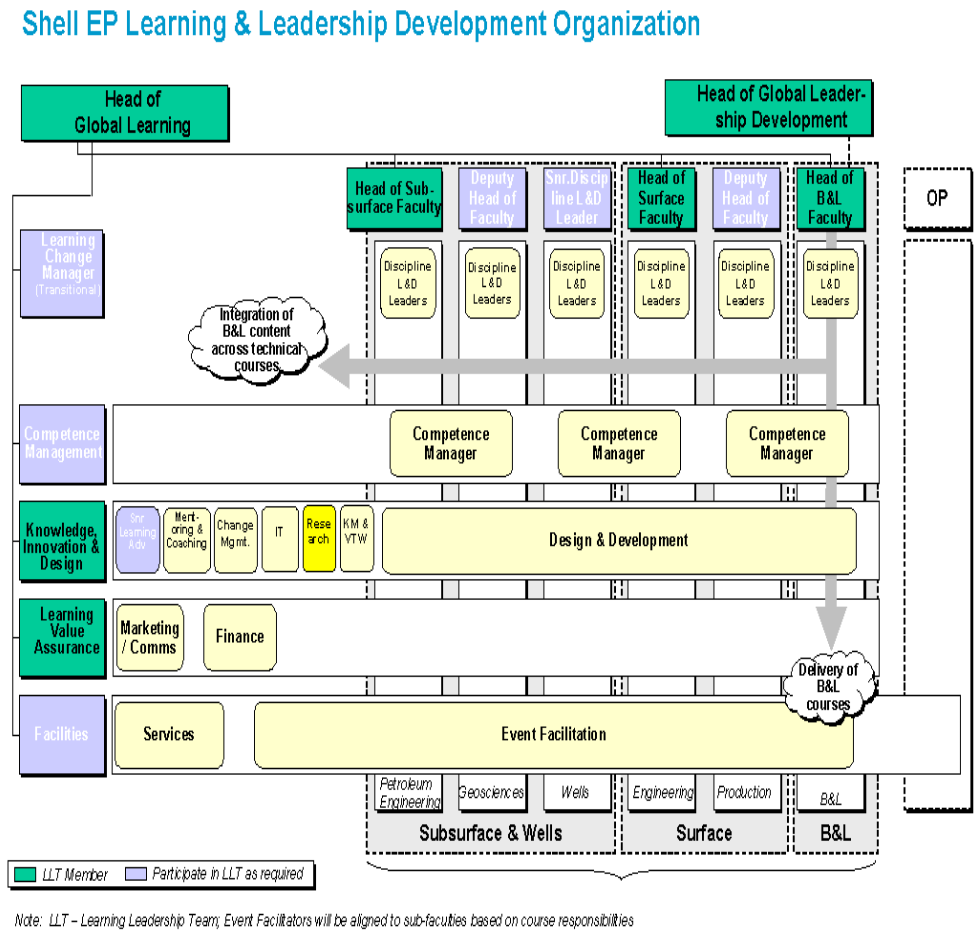


Figure 123 Structure of the SIEP LLD

The researcher is member of the Research Team.

6.1.2 Shell Open University, e-modules, and blended learning

In 2000, a wave of change in the delivery of learning occurred when the Shell EP Learning Center began offering a range of services to meet learning needs "at the speed of business", through a combination of employee profiling in terms of the Shell EP Competence Framework and provision of both time- and place-independent e-modules in addition to classroom training both anchored in the competence gaps of the learner. While both methods of delivery have their strengths (and more than 20,000 persons have registered online with the Shell EP Learning Centre since December 2000), an analysis of business needs and strategies has led to the development of a new phase of learning with a unique combination of aspects. While this phase has been called "blended learning" is it something much more than the typical combination of a period of e-modules and a period of classroom (Collis, 2003).

Blended learning at Shell EP is a learning philosophy and method based on three coherent pieces (summarized from Collis, 2003):

- A carefully selected blend of formal and informal learning, where the best features of formal learning the discipline and tempo of structured sessions, the opportunity to learn with and from classmates with a wide range of backgrounds and current experiences, assessment and accreditation, and being stretched beyond the boundaries of one's own workplace and daily problems. Blended learning is managed by excellent and motivating course instructors, as of 2003 called Learning Development Leaders (LDLs) and before that Course Directors (CDs). The Shell EP approach strives to integrate the best features of informal learning (learning directly applied to real workplace needs and business problems, learning with peers both in the workplace and throughout the organisation, learning acknowledged by one's supervisor because of the payoff in workplace productivity, learning that teaches one how to learn further in a self-reliant way) with the strongest features of structured learning, integrated within a course. The strategy for making this happen is to maintain the course structure but build the course around work-based activities, carried out in the workplace, but guided by the Course Director via technology use and collaborative learning experiences.

- A philosophy of capturing, sharing, and building upon the tacit knowledge in the company, so that a major source of learning becomes resources contributed by the learners based on their own analyses of and solutions for workplace problems. While the Shell EP Global Networks provide one powerful medium for sharing of experiences throughout the company, specific learning methods in the blended-learning courses also lead the participants to the regular and systematic contribution of submissions discovered by them in business resources or developed by them as illustrations of how critical business principles can be applied in the complexity of the workplace. This approach leads to systematic capturing of experience for reuse as learning objects. Depending on the technology used, blending a course-management system with a powerful database and using metadata related to the Shell EP Competence Framework so that the reuse can be throughout the company, the submissions can be available for both informal and formal learning. Learning becomes more productive, in two ways: productive for the individual participant because the course is focused on authentic work-based activities, and productive for the company in that valuable experience is captured for reuse. Figure 124 represents this educational philosophy, particularly important in a company where a "big crew change" based on a wave of retirements among senior professionals will soon occur.

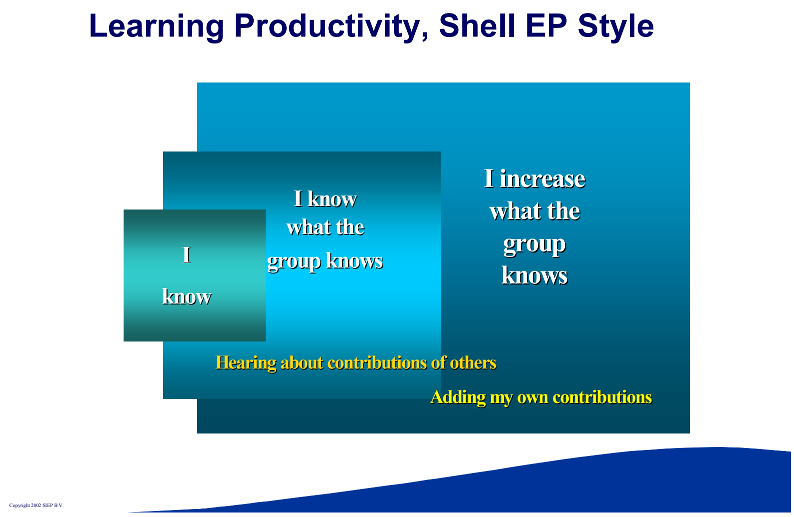


Figure 124 From individual learning to increasing company productivity through knowledge sharing within courses with work-based activities (Collis, 2003)

- A strategy focused on stimulating the supervisor of the participant to facilitate and recognize the contribution of work-based activities as part of a blended-learning course and also more deeply, to become a "learning and performance partner " (Bianco, 2004). To reach this aim, tools and interventions are being developed and monitored whose aim is to motivate and coach the supervisor in how to be engaged in work-based activities.

6.1.3 Collaboration between Shell EP and the University of Twente

In 2001 research projects were initiated with the University of Twente related to the new learning initiatives described in Section 1.1.2. A set of research lines was initiated in the form of projects. The researcher was a project member in several of the projects related to standards and reuse-related issues. The University of Twente was chosen for collaboration based on the successful experiences of Collis (for example, Collis & De Boer, 1999) with tele-learning and the implementation of the TeleTOP® system in the university context (see Section 5.2). The research lines are based on the specific corporate-learning setting for Shell EP and are closely related to the implementation of Web-supported learning. The implementation of Web-supported tools is part of the "blended-learning" approach that was initiated in 2001 within the Shell EP context, where a focus is on re-use of learning objects. The TeleTOP® system is used as the tool to support this blended-learning approach. The developments of the TeleTOP® system are closely related to the blended-learning approach and the projects described in relation to the corporate-learning context focus on the developments of the system. The reuse of learning objects in this context is important because of capturing knowledge for the future and for efficiency reasons. Using standards for learning objects can make it possible to outsource course development but also exchanging learning material within the organisation.

To research one of the solutions that could be applicable for the Shell EP learning context the TeleTOP® system was implemented in April 2001 within the overall research plan initiated in 2001 between Shell EP and the University of Twente established in 2001 (Collis, 2001a). The following are the terms of reference for the research as stated in 2001:

- "Shell EP - University of Twente Collaborative Project" - (2001-2006) Funded: Shell EP International Exploration and Production (SIEP) Learning and Development. The purpose of this research is to identify an appropriate and innovative model of e-learning for Shell EP, to study the technology requirements for support of the model in the unique Shell EP situation, and to test the model and technology requirements via the use of the TeleTOP® Web-based course-management system. The research involves impact-measurement studies as well as work with standards and re-use and with the implementation of blended learning. Role of B. Collis: Researcher and Project leader. "

Within the Shell EP Project, there are three associated long-term research projects, each leading to a dissertation for the PhD candidate involved. These are (as described in the 2001 agreement):

- "Generic Re-usability Situations for Web-Supported Learning: Metadata requirements and user support tools" - (2001-2004). Funded by TNO-FEL (2001-2002) and Shell EP. The purpose of this research is to develop and validate tools for applying international standards for metadata and re-use (initially, ADL SCORM™) to the TeleTOP® system and to study the use of the standards in practice. PhD work is associated with this research.
- "Learning for technical professionals in the multinational company: Strategies, issues and technology" - (2002-2005). This research focuses on the strategies related to learning and change within the multinational organisation and the role of technology in those processes. PhD work is associated with the research (Bianco, expected in 2005).
- "Optimizing learning for technical professionals: A blend of pedagogy and technology" - (2001-2005). This research focuses on the development and implementation of blended learning for the Shell EP context and the role of technology in these processes. PhD work is associated with the research (Margaryan, expected in 2005).

The setting described in Section 6.1 is the context of the three projects in the corporate-learning context for this research. The first project is the implementation of TeleTOP® at Shell EP (Section 6.2), the second project is the TeleTOP® conversion project, (Section 6.3), and the third project is the Knowledge-Sharing project (Section 6.4).

6.2 Implementation TeleTOP® at Shell EP Project

Section 6.2.1 gives a general overview of the project Implementation TeleTOP® at Shell EP. Sections 6.2.2 to 6.2.6 describe the project from a technical and human perspective using the Why?, Who?, What?, How?, and Where? questions. Section 6.2.7 describes the responses of the structured interview of the persons involved in the project, Section 6.2.8 a summary is made in terms of the learning-object lifecycle, and in Section 6.2.9 preliminary answers to the secondary research questions are given. Section 6.2.10 gives an overview of the observations of the researcher for the project.

6.2.1 General description and role of the researcher

The TeleTOP® system is used as tool for this project. This project involves the use of the TeleTOP® system and how the reuse of learning material within this system influences the strategies used for learning. How the implementation of the TeleTOP® CMS took place and the possibilities offered for creating learning material were questions addressed in this project. The need for reuse, the tools offered, and how the curriculum is structured all had an impact on reuse aspects. The tools and reuse possibilities are mainly developed to support the Course Directors. This name is used for the subject-matter experts that work as instructors at the Shell EP Learning Centre. It was the named used until late 2003, when the current term, LDL (Learning & Development Leader), was introduced. However, as the term Course Director (CD) was that used during this project and also the other projects described in this chapter, it will be used here.

The main role of the researcher was the designer of new features of the TeleTOP® CMS and its reuse functionalities. The design aspects focused on the needs of the course developers during the implementation of TeleTOP® for blended learning. This included also the redesign of several TeleTOP® functionalities for the corporate-learning context. For the use of e-learning modules specifications for external course-material developers were defined. A second role of the researcher was that of interviewer. Based on the experiences with the system all available course designers and CDs were interviewed by the researcher.

6.2.2 Why does reuse take place?

The initial initiative for standardization came from the Head of the (then) Virtual Learning Team of the Shell EP Learning Centre in 2000 in the context of the launch of the Shell Open University in 2000. Corresponding to this the development plans of TeleTOP® at the University of Twente to work on standards (see Section 5.2) were a motivation to do a pilot with the TeleTOP® system in the Shell EP Centre. The motivation to focus on standards also came from the drive at Shell EP to be involved in new initiatives and developments to support learning “at the speed of business”. Also the definition of e-modules as nuggets and the development of specifications for the “nuggets[6]” were reasons to look at standards. In order that the e-modules being developed would be appropriate for reuse, an inventory was made of benefits which could occur from joining existing standardization bodies (Strijker, 2001) so that a potential influence could be brought to the development of the standards. Meetings of the IEEE were attended by the researcher and an ADL SCORM™ “Co-laboratory” was visited to see the possibilities of collaboration, and how Shell EP could benefit from collaboration. However, the costs for joining these groups was seen to be high, and the expected return on investment seemed to be low because the developments were already in a definitive stage and thus the impact of collaboration could be expected to be minimal for the Shell EP organisation. The definitive stage of the standards development that had already been reached was a reason not to join the standardization bodies, but just to use the delivered standards. The benefits for the Shell EP Learning Centre of using the standards could be found in an easier procedure for outsourcing needed learning material and exchanging material with other organisations. Also cooperation with the Open University in the United Kingdom was based on the use of standards. Finally, the specifications provide a clear technical and structured framework for content developers.

6.2.3 Who is involved?

Within Shell EP different roles can be identified for course development involving learning objects and for running courses. In some cases one person can have multiple roles:

- Course Directors (as of late 2003, called Learning and Development Leaders-LDLs) - instructors responsible for courses from the content perspective)

[6] “Nuggets” were defined in 2000 as e-modules consisting of approximately 15 minutes of learning.

- Subject-matter experts - SMEs, with appropriate expertise
- Course designers - support staff for Course Directors for designing courses
- IT support – support staff for the technical systems
- Event facilitators – support staff for organizing event locations and registrations of participants
- External e-module providers – developers of pieces of course-based training, when included in the course design
- The LLD Management team – leaders of the Course Directors and of other support groups
- The KID team (Knowledge, Innovation, & Design, the support group within LLD that includes the Design and Research Teams)
- Participants – the learners

The Course Directors are subject-matter experts in a certain expertise area and are responsible for the content in the courses. The Course Directors manage the courses with different support groups. Support groups such as the course designers help the Course Directors in building a course. Course Directors are also supported with technical problems that are related with the Internet tools, but also with digitizing and obtaining material for the courses. The course designers can also support the Course Directors with instructional ideas or by structuring the content in the courses. Because most Course Directors do not have didactical experience this support is needed. The Course Directors' experiences with software programs vary from person to person.

User management of the TeleTOP® CMS is provided by the IT support staff. For every course the participants, Course Directors, and support staff are given the proper user accounts for the requested courses. Before access is given, participants need clearance from their line managers for doing a course. The Course Directors responsible for the courses control access to courses and check if participants have permission to participate. External CBT providers are sometimes used to develop materials (e-modules) for certain courses. The Course Directors decide if such material is needed and ask for financial sponsoring from the LLD-management team. When the request is rewarded, the course designers support the communication between the Course Director and the external e-module developer. The event facilitators support the Course Directors by organizing the classrooms and providing on-site facilities for the participants when courses have a classroom component, and by managing the registrations to the TeleTOP® ® environment when the courses are blended and use TeleTOP®.

Thirty-one Course Directors were involved in the development of 81 course cycles of 51 unique courses during the period 2002-2003. Table 21 shows what courses were developed. Nine different course designers helped the Course Directors to develop new courses making use of TeleTOP® and blended learning.

Table 21 Number of blended-learning courses developed within the Shell EP corporate-learning context

Course/learning events		**Courses under construction, 2004**		**Courses available/running, 2004**	**Course cycles completed**	
Product team	Total	Phase 1	Phase 2	Phase 3	Phase 4	
B & l	10	0	3	4	4	
Surface	21	4	6	4	4	
Subsurface	12	3	2	0	7	
Other	8	4	1	1	4	
Total redesign	51	11	12	9	19	51 unique courses
Total, including cycles of courses		11	13	14	43	81 total runs

6.2.4 What is reused?

The learning material within Shell EP comes from a mixture of material including resources used for face-to-face sessions, existing computer-based training material, and instructors' own resources. For the blended-learning courses, the material is brought together in the TeleTOP® CMS. Four different levels of granularity can be identified for the materials used relating to courses within the Learning Centre. These four levels map onto the granularity levels for the TeleTOP® CMS learning-object metadata described in Section 5.2 and can contain materials such as:

- Level 1- Actual objects that can contain content like discussions, assignments, submitted work, movies, animations, project documents, manuals, and PowerPoint presentations
- Level 2- "Nuggets" or e-modules, sets of material about a certain topic and discussion threads that cover a particular subject based on several objects
- Level 3- Courses or threads that focus on a particular competence within a certain domain within the competence framework
- Level 4- Domain descriptions, based on the competence framework and related to competence-based development.

The Archive function in the TeleTOP® system is mostly used in the courses for storing the pieces of material and primarily contains material representing the Level-1 granularity level. The roster in TeleTOP® is used to organize the material for the participants. A roster row can be seen as a combination of material, like e-modules and learning objects that cover a certain topic (Level 2).

The Course Director or members of the design-team place the material in the course environment. Based on the specifications of the Course Director material may also be created by multimedia companies. This commercially made material is used in the courses as individual stand-alone pieces of study material. These pieces are small Web-based materials that are built in HTML, or Flash®. They are mostly used to attract new participants and provide a limited amount of learning material. Because TeleTOP® was developed as a course-management system, it lacks good functionalities to store complete self-study e-learning Web modules. Figure 125 shows a screen dump of an e-learning object used in a course. Most material developed by external content providers for these kinds of e-learning Web modules are in the form of "interactive page turners" that potentially can contain high-quality learning material, but initially were not supported by the TeleTOP® system because the system was not developed to store large amounts of actual learning content structured according to the proprietary methods of external software providers (i.e., involving nested folders, special players, and a lack of a simple upload capacity). The availability of such digital material and the difficulties of using it easily in the TeleTOP® system were large problems during the start of the blended-learning implementation. This changed during the use of the system because of the fact that Course Directors came to use TeleTOP® as an activity-based course-management system and were less inclined to use e-modules as part of their learning material.

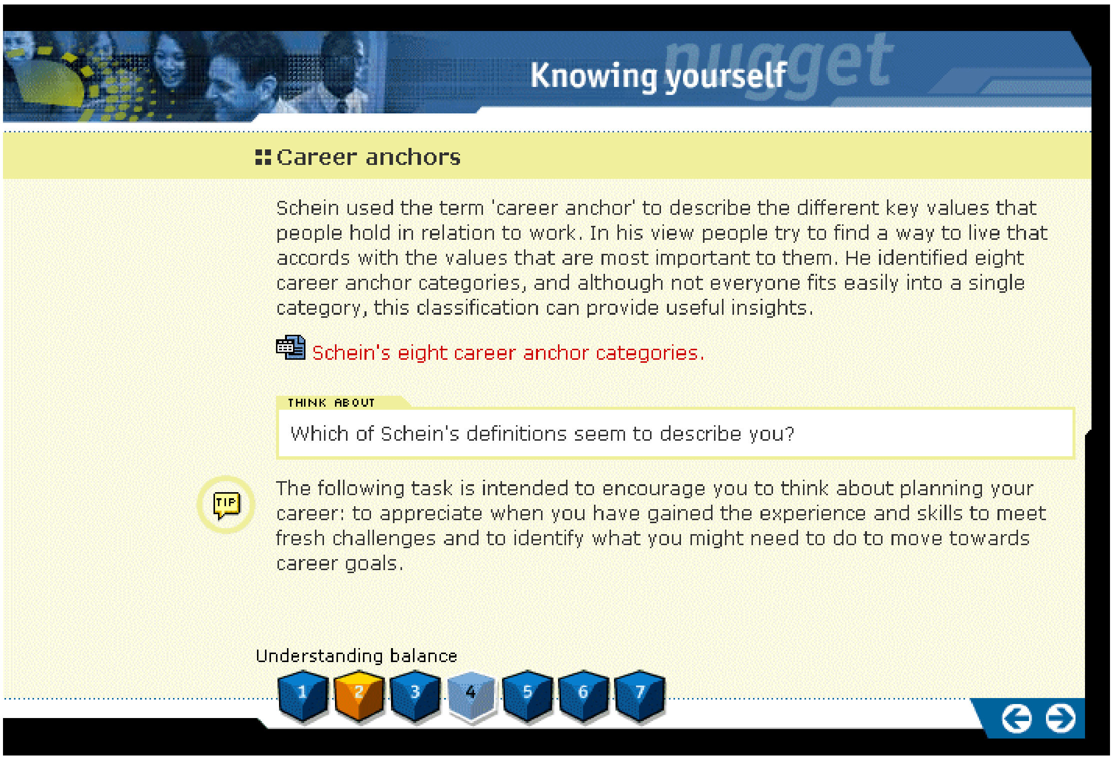


Figure 125 One of seven frames of a Shell EP learning "nugget"

The use and development of different sorts of e-learning Web modules required a definition so that new material could be based on clear specifications. The earliest specifications for the development of nuggets were based on the AICC standards (See Section 3.3.1.7). These specifications were in line with the Docent Learning Management System (LMS) that was (and is) used as portal for the distribution of already existing e-learning Web modules. The term "nugget" came to be used in a different way than it had previously been used, once e-learning Web modules were developed to use within TeleTOP® and with reuse characteristics. Defining nuggets as reusable learning objects within the Shell EP Learning Center is still an important objective for having a standard piece of material that can be recognized in the organisation by different people and groups. The aim of common packaging and labelling is to make clear what is needed for such nuggets and what the characteristics are needed when developed. Within TeleTOP® a roster row can be also be seen as a nugget. A roster row gives the possibility to combine a set of learning materials. This combination of learning materials should be related to the competence framework that Shell EP has developed that is used within the company worldwide. The competence framework is a taxonomy that can be used to label or identify material available in the company.

6.2.5 How is reuse supported?

The TeleTOP® system offers the functionalities that are needed for reuse. The functionality described in the University Alpha Beta Project (Section 5.3) can also be used to reuse material within the TeleTOP® system. Material copied from previous courses was originally done by hand supported by the course designers. Most material is in HTML format and was originally copied by taking or copying the code of the original files.

The competence framework also supports the development of course material and the structure of the curriculum (Strijker, 2003). The structuring of content is closely related to the domains, disciplines, and skill groups used in the competence framework. In the Shell EP Learning Centre courses the competence framework is the basis for content. All content is related to a competence element that is described in the competence framework. This close relation guarantees that courses only map onto the qualifications described in the course catalogue. Courses can be selected based on these competences and are part of the requirements for particular job levels. A certain job requires a certain set of competences, and the competences are covered by certain courses. The mapping between courses and competences is therefore the basis of the course content. Reuse of material is possible when courses share some of the same competence elements. The competence elements can be used as identifiers for the content in the courses. They support the users in finding and selecting material. Also when material is obtained, the competence elements can be used for the content development and as keys for defining objectives.

Following from the research done in 2001 (Strijker, 2001), the metadata fields in the TeleTOP® templates are based on ADL SCORM™. For the Shell EP-specific context choices were made related to the granularity and the classification of the objects. These choices are closely related to the competence framework used within Shell EP. The competence framework consists of three parts:

- Expertise areas
- Building blocks
- Elements

Table 22 gives an idea of how the competences are structured and related to expertise areas and building blocks. The elements are the lowest aggregation level defined in the competence framework. When metadata are added to material, every level within the competence framework can be assigned. More then 800 elements are identified and described in the competence framework.

Table 22 Structure of competences (Sample)

Expertise Area	Building Block	Element
Production Subsurface Expertise	Well Modelling & Performance	Model inflow performance
		Model outflow performance
		Improve inflow performance
		Select and improve artificial lift methods
	Develop Conceptual Completion Design	Select completion type
		Design well/reservoir interface
		Select and improve sand control measures
		Prepare a proposal for well completion equipment
		Determine well operating envelope
Fluids Expertise	Provide Laboratory Services	Establish analysis requirements and select analysis/sampling methods/equipment
		Develop and control sample management process
		Perform analysis
		Evaluate and interpret results
	Provide Production Chemistry Solutions	Develop drilling cement and completion fluids solutions
		Develop well stimulation chemical selection solutions
		Develop chemical solutions for production operations
		Provide chemical and waste management solutions

The elements are the most-specific parts and can be used to structure course material around the objects and expertise areas.

6.2.6 Where does reuse take place in terms of systems?

The different software programs used in the global Shell EP organisation contain many different sorts of material for several reasons. Most IT systems are connected to the Shell EP Worldwide Web (SWW). The SWW is configured as a private network that uses the Internet as a medium. This means that the network outside the Shell EP buildings is only accessible with dedicated Virtual Private Network (VPN) clients. This in turn means that the actual data retrieval and processing is done on the SWW (in Figure 126 shown as “Private network client”) and that only results are shown in the virtual private network client. No data can be directly derived from the network via these clients. The client offers a window to the data, but no downloads are possible to the client computer outside the buildings. All data are encrypted when the Internet is used as connection between a local client and SWW. Formally spoken all Shell EP employees have access to the SWW, although due to poor Internet connections in some regions such as the Middle East and Africa the availability is sometimes a problem. Besides the access to the SWW all employees have access to the World Wide Web (WWW). The TeleTOP® system within Shell EP is configured to be accessible through the WWW. This means that the TeleTOP® system is available without the dedicated private-network client. If links are made in the TeleTOP® system to material available on the SWW, these links are not accessible outside the SWW, and outside the Shell system the virtual private network client has to be used. Material actually stored in the TeleTOP® system is therefore seen as “public” material that is not classified. Although the material is not really classified, Course Directors and participants can only access the material when they have a valid user name and password. Figure 126 shows the SWW and systems connected to it. The SWW and connected systems are accessible through the Internet with a private network client. The TeleTOP® system is directly connected to the Internet.

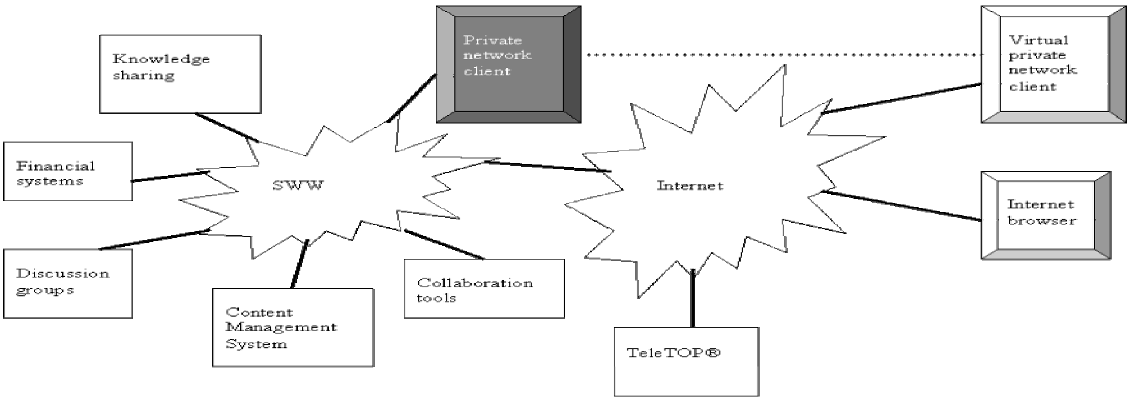


Figure 126 SWW, Internet, and clients

6.2.7 Results of the structured interview in the corporate-learning context

To get more depth information about experiences and possibilities of reuse within the Shell EP blended-learning courses, an inventory was made within the Shell EP Learning Centre (SLC) in 2003. Section 6.2.7.1 describes the procedure and how the respondents were addressed, and Section 6.2.7.2 gives the results of the structured interviews.

6.2.7.1 Procedure and respondents

For the inventory the structured interview (see Section 4.2.4.1) was used with 21 members of the SLC in 2003. All the respondents were involved in the development of course material (See Table 23). Different roles such as one line manager, four members of the Design Team, and 16 Course Directors could be identified. Respondents were part of a course-development team (11) or part of a Course Director team (6).

Table 23 Question 03 - Role (more than one can be indicated), n = 21

Course Material Assembler	Subject Matter Expert	Course Director	Part of a CD team	Instructor	Participant	Part of a Multimedia team	External Course Provider	Part of a Development Team	Line Manager
10	10	11	6	10	1	4	0	11	1

Apparently at least one of the Course Directors did not identify himself as an Instructor.

Eighteen respondents had one or two years' experience with the TeleTOP® CMS, three respondents had more than five years' experience. Figure 9 shows the experience range.

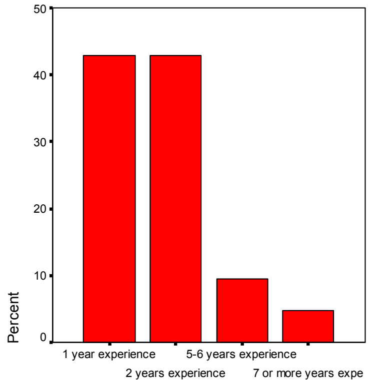


Figure 127 Question 04 - How many years have you worked with a Course Management System (for example TeleTOP®)?

All 21 respondents had developed one or more courses with the TeleTOP® CMS (Figure 128). When more than course had been developed it is expected that material has been reused from previous TeleTOP® courses and that there is experience with reuse.

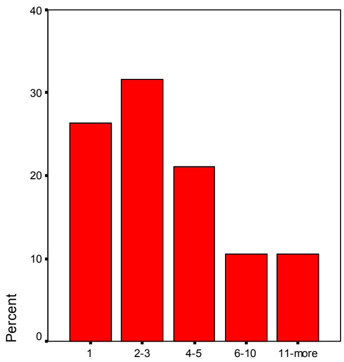


Figure 128 Question 92 - How many blended courses have you provided?

6.2.7.2 Results

Appendix E: "Results of the structured interviews" gives the full results of the structured interviews. In this section, the results are grouped around themes that were seen as important issues by the respondents and also identified in the previous chapters: Reuse experiences, reuse what?, metadata, giving the opportunity for reuse, controlling reuse, structuring material, selecting material for reuse, reuse of one's own materials by others, and reuse of materials made by others.

- *Reuse experiences*

Reuse was seen by all respondents as necessary (Figure 129). The need differed from "sometimes" to "very often" depending on the type of course developed.

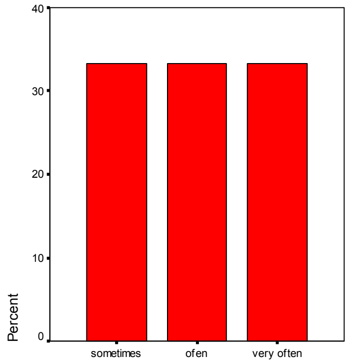


Figure 129 Question 05 - To what extent do you feel the need of reusing material?

Material was reused by 11 respondents to tailor courses once (4) or often (7) for different target groups (Figure 130).

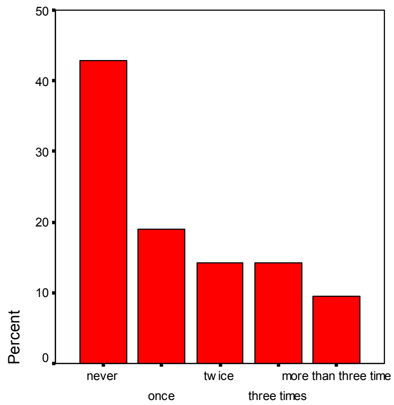


Figure 130 Question 06 - To what extent do you feel the need to tailor or reuse courses for different target groups?

According to 11 respondents LCMS functionalities, if available, would be never or almost never used. Nine respondents in contrast think that LCMS functionalities would be sometimes (3), often (2), or very often (4) needed (Figure 131).

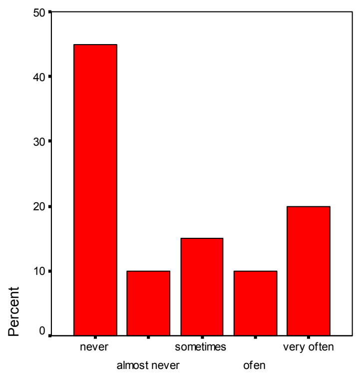


Figure 131 Question 07 - If there is a Learning Content Management System available for reusing material, to what extent do you think you would feel the need of using it?

Most (16) respondents think that reuse definitely saves time, while two respondents think that reuse only sometimes is time saving (Figure 132). One respondent thinks that reuse does not save time because material always needs adaptation to a new situation and searching for existing material is more time consuming than creating new material.

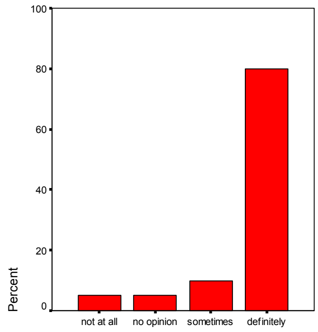


Figure 132 Question 34 - Do you think that reuse saves time?

The new functionalities in TeleTOP® related to reuse were reasonably well understood by 12 respondents, three understood some of the new functionalities, two a little, and one did not understand anything about the functionalities (Figure 133).

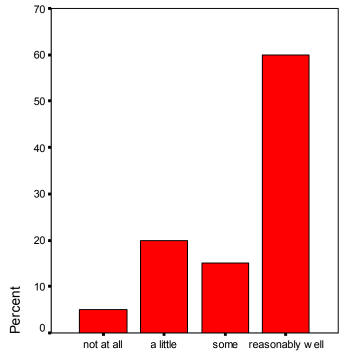


Figure 133 Question 53 - How well do understand these new functionalities?

Out of 20 respondents giving a comment to Question 55 relating to the intention to make use of the reuse tools in TeleTOP® (see Figure 134), 12 understood the new functionalities reasonably well, three somewhat and four only a little. Only one respondent did not understand the new functionalities in TeleTOP®. The fact that the respondents did not really work with setting up the system themselves but left this primarily to the course designers made it difficult for them how the functionalities work in practice.

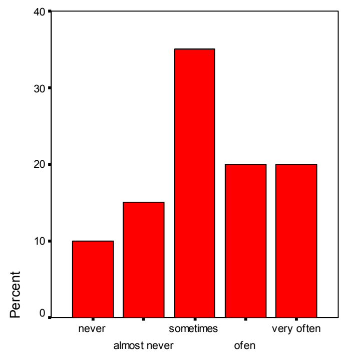


Figure 134 Question 55 - How often do you think you use these new functionalities?

- *Reuse what?*

The material available for reuse came from previous TeleTOP® CMS courses but also from already existing e-modules (Figure 135). The reuse of material from other courses was never (9) or almost never (2) possible according to 11 respondents but 9 respondents thought that there was sometimes (4), often (1), or very often (4) material available for reuse.

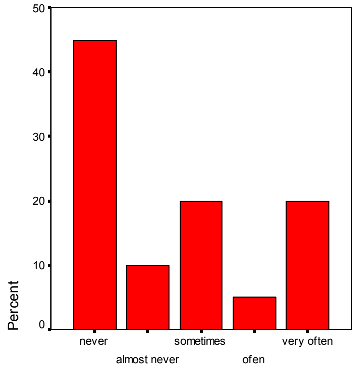


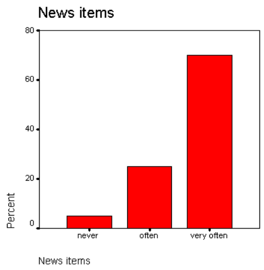
Figure 135 Question 08 - To what extent do you feel the need to reuse material form several other courses to create new courses?

Because of the use of the TeleTOP® CMS, the Course Directors were asked what types of functionalities were used often and which functionality contained material that can be reused. Table 24 shows how different types of material are reused within the corporate context.

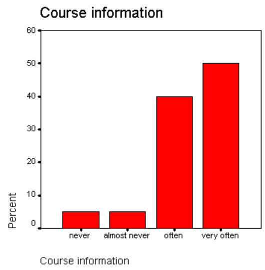
Table 24 Type of material reused within the corporate-learning context

Type of material	N	Minimum	Maximum	Mean	Std. Deviation
News items	20	1	5	4,55	0,945
Course information	20	1	5	4,25	1,070
Archive items	20	1	5	3,95	1,317
Feedback items	20	1	5	3,90	1,252
Category items	19	1	5	3,37	1,461
Question and answer items	20	1	5	3,15	1,424
Roster items	20	1	5	2,85	0,875
Submitted work items	20	1	5	2,85	0,875
Web links items	20	1	5	2,65	1,387
Poll items	19	1	5	2,42	1,387
Discussion items	20	1	5	2,40	1,046
Presentation items	20	1	5	1,90	1,334
Group items	20	1	4	1,85	0,933
Page items	19	1	4	1,74	1,098
Glossary items	20	1	5	1,70	1,174
Workspace items	20	1	3	1,55	0,686
Publications items	19	1	4	1,53	0,905

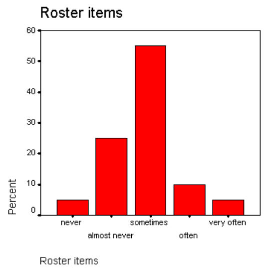
The News items, Course Information, Archive items, Feedback items, and Question and, Category Answer items were seen as very reusable. Publications, Workspace items, Glossary items, Page items, Group items, and Presentation items where seen as less reusable. Figure 136 shows the respondents' opinions about the reusability of items from each of the frequently used area in TeleTOP®. (During the setup of the courses, the Course Directors had been advised by the local design team not to use the Glossary, Publications, and Presentation, or Workspace templates and thus had little or no understanding of their reuse possibilities).



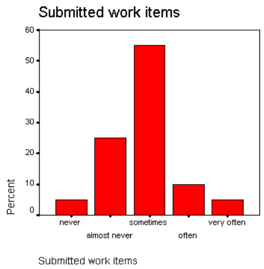
Question 16 - News items



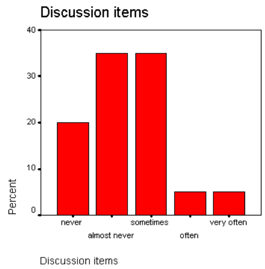
Question 17 - Course info items



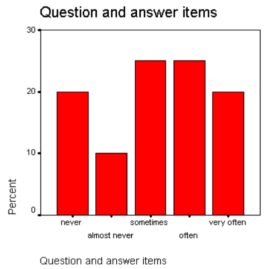
Question 18 - Roster items



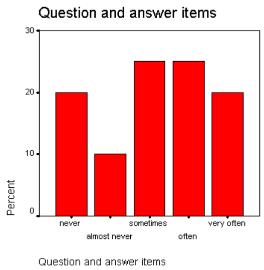
Question 19 - Submitted work items



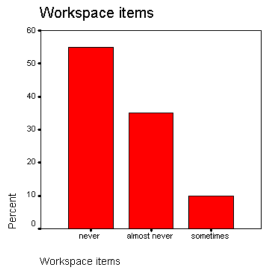
Question 20 - Group items



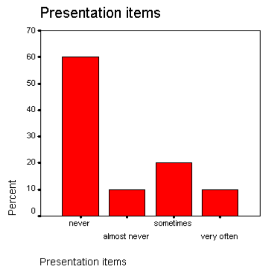
Question 21 - Discussion items



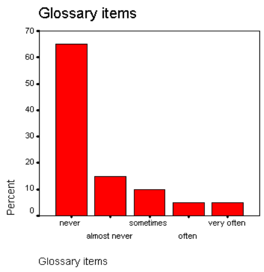
Question 22 - Question and answer items



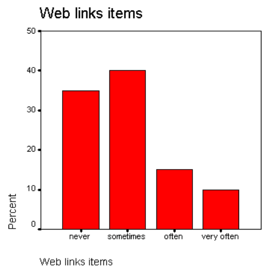
Question 23 - Workspace items



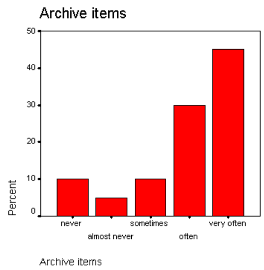
Question 24 – Presentation items



Question 25 - Glossary items



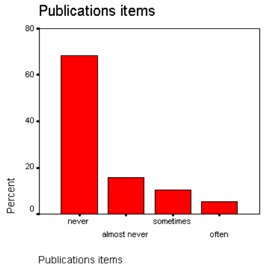
Question 26 - Web links items



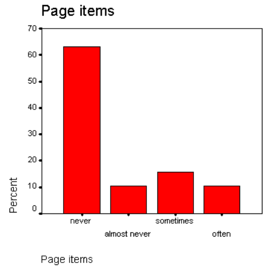
Question 27 - Archive items

Figure 136 continues…

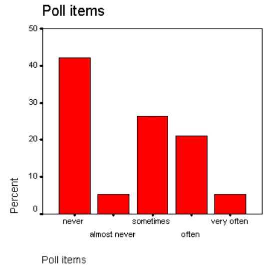
Figure 136 (continued)



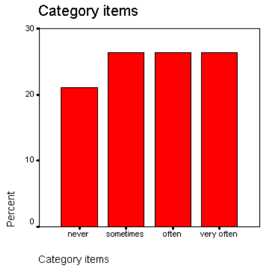
Question 28 - Publications items



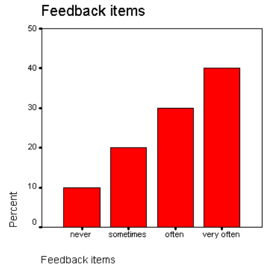
Question 29 - Page items



Question 30 - Poll item



Question 31 - Category items



Question 32 – Feedback items

Figure 136 Questions 16-32, Types of material reused within the corporate-learning context

- *Metadata*

  The metadata used in the TeleTOP® CMS courses based on the functionality, category, and subject were found to be enough when the set of objects that were candidates for reuse only contained self-created material (Figure 137). Material created by others needed more metadata.

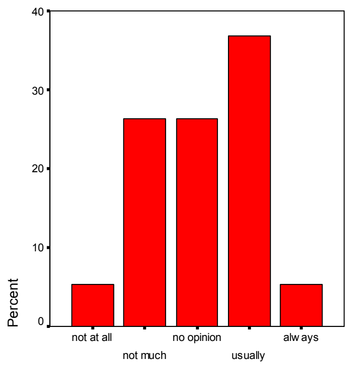


Figure 137 Question 33 - If, material could only be selected based on subject and type. Is this information sufficient?

The LOM metadata set was used in the TeleTOP® CMS to describe the materials. The terminology used for the metadata elements was understood for about 25% by seven respondents, four respondents understood 50% of it, six respondents 75%, and one did not have a problem understanding the provided set of metadata elements (Figure 138).

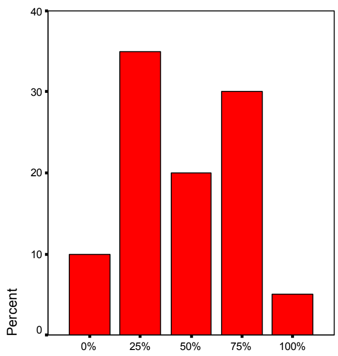


Figure 138 Question 37 - Approximately what percentage of the terminology do you understand?

The willingness to provide the metadata differed (Figure 139). Six respondents did not want to provide any metadata, nine were willing to provide metadata for some items, three for many items, and one was willing to provide all what was needed.

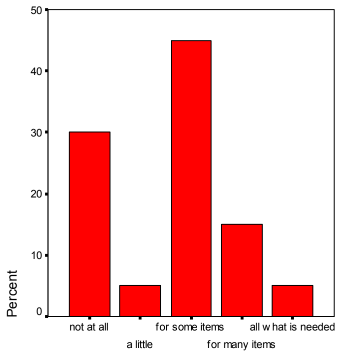


Figure 139 Question 54 - Some of the metadata has to be filled in manually. Are you willing to invest time to add specific information?

- *Giving the opportunity for reuse*

Respondents of the SLC are willing to share and reuse material and do think that there is also material available within the department that are candidates for reuse (Figure 140). Eighteen respondents think that material within the organisation can be reused sometimes (12), often (3), or very often (3). Two respondents think material will never, or almost never be reused in the organisation.

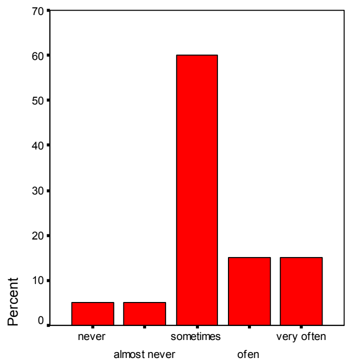


Figure 140 Question 09 - To what extent do you think there is material available within your department or team that can be reused within your department?

- *Controlling reuse*

Nine respondents from the SLC do not want to have control over the shared material, but 13 want to have control over the reused material (Figure 141). This control can be always or sometimes and in the form of notifications of reuse or explicitly giving clearance for reuse in a particular setting. Control is also desired because Course Directors are afraid that material may be misused in situations where the re-user is not aware of the actual application of the content.

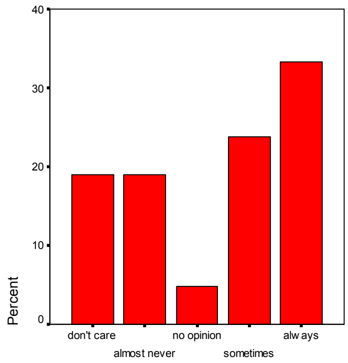


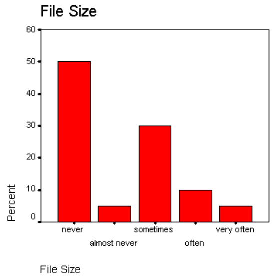
Figure 141 Question 12 - To what extent should there be control over what material will be made available for reuse?

- *Structuring material*

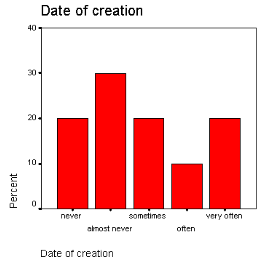
  How the material should be structured was asked by the open-ended question # 56: “If you have any other ideas for the search process, please specify” Different suggestions were made for structuring the material. Six respondents felt that using the Expertise areas, Blocks, and Elements from the competence framework should be a key structuring mechanism. Another approach is seen via using the Awareness, Knowledge, Skills, and Mastery (AKSM) levels. Also the concept of an encyclopaedia is used to express the structure that could be used. The use of material in previous courses and how it was mentioned should also be part of the structure.

- *Selecting material for reuse*

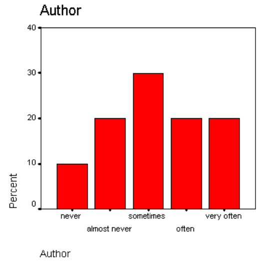
  In the remarks about selecting material for reuse (Question 35) five respondents noticed that the easiest way to select material is using a search engine such as Google (http://www.google.com). The name of the course, the subject of the material, the course code, and keywords are seen as important identifiers of the material. The file size, number of attachments, date of creation, and copyrights were seen as less important as metadata identifiers. Figure 142 show the respondents ideas relating to the value of using a series of different identifiers as metadata categories to aid in the selection of materials for reuse.



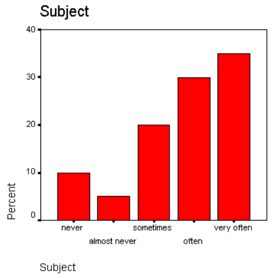
Question 39 - File size



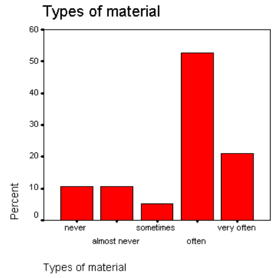
Question 40 - Date of creation



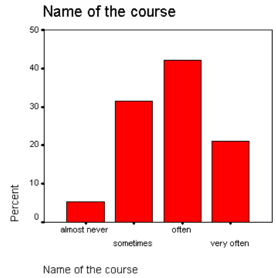
Question 41 - Author



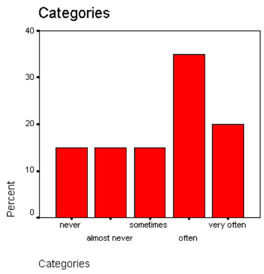
Question 42 – Subject



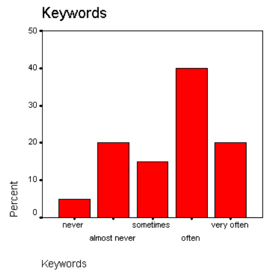
Question 43 - Types of material



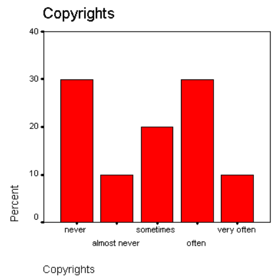
Question 44 - Name of the course



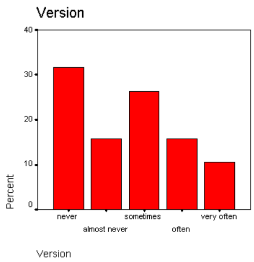
Question 45 - Related content categories



Question 46 - Keywords

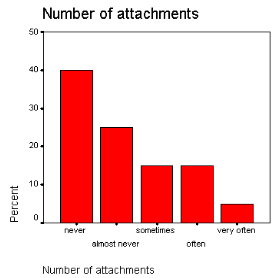


Question 47 - If copyrights are involved when reused



Question 48 - Version

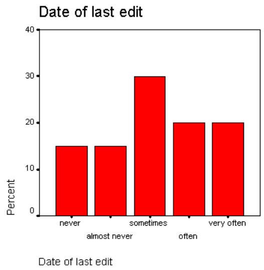
Question 49 - Time needed to learn



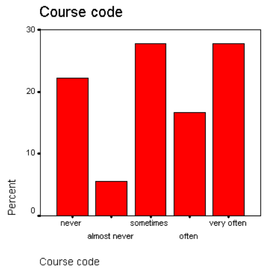
Question 50 - Number of attachments

Figure 142 continues…

Figure 142 (continued)



Question 51 - Date of last edit



Question 52 - Course code

Figure 142 Questions 39– 52, Selecting material for reuse in the corporate-learning context

Although some items are more positive than others, no real consensus can be found as to what items are important for all users.

- *Reuse of one's own materials by others*

Reusing one’s own material by others outside the company is according to 14 respondents never or almost never possible, seven respondents think that is possible sometimes (1), often (5), or very often (1). Figure 143 shows these responses.

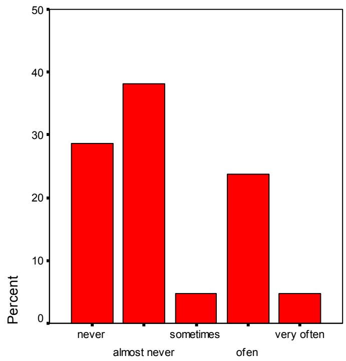


Figure 143 Question 11 - To what extent do you think there is material available within your department or team that can be reused outside your department?

The fact that material is classified and the restrictions of export regulations are important issues that make reuse outside the company very difficult (Figure 144).

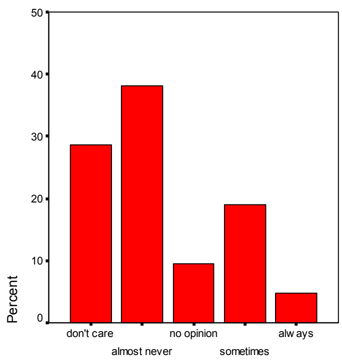


Figure 144 Question 13 - To what extent will there be problems if material within or outside your department is reused?

- *Reuse of materials made by others*

Any available material in the form of digital content is used when possible. The respondents decide themselves if material has the needed quality, based on their own skills and experiences (Figure 145). Thirteen respondents think that material is sometimes available; five respondents think that material is often or very often available. Only two respondents think that material is never or almost never available.

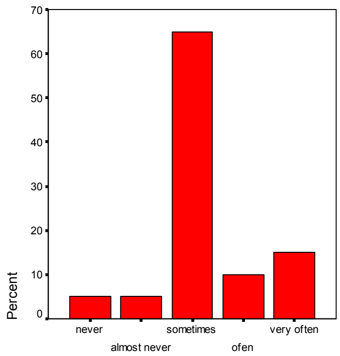


Figure 145 Question 10 - To what extent do you think there is material available outside your department or team that can be reused within your department?

In Chapter 8 the responses to the structured interviewed summarized in this section from the corporate context will be compared to those from the university and military contexts.

6.2.8 The Learning-Object Lifecycle: Summary of the TeleTOP® at Shell EP project

Obtain - The material is obtained in different ways. The Course Directors create most of the material based on their work experiences and literature. Another resource is the submitted work of course participants. These course participants are most of the time professionals in their own expertise areas bringing in interesting cases themselves. The courses developed in the Shell EP Learning Center are Shell-EP specific and designed for the Shell-EP context. Material that is seen as basic knowledge is outsourced. The company Petroskills is seen as an important partner that provides complete courses for basic skills in areas such as geo-science and drilling. Also the Open University in the UK provides pieces of course material. These pieces are used within the TeleTOP® courses, for example within EP leadership courses. The materials are based on original content of the UK Open University and offered according to specifications based on LOM. This means that the parts are tagged and that the modules can be used separately. Content obtained for the Shell EP context is often reformatted related to the house style.

Label - Labelling of material within the courses is not done because reuse is mainly focused on the Course Director's own material. When material is reused the Course Director knows what kind of material is used. Tagging is provided by the TeleTOP® system. Third-party vendors like the UK Open University are asked to provide metadata for each delivered e-module. The existing courses are tagged for future reuse within Shell EP. The labelling is done according to the LOM and a vocabulary is used.

Offer - The material is offered to follow Course Directors during informal discussions about courses. Course Directors in a certain expertise area share their course material by showing colleagues the material and offering the material for reuse in other courses. The courses are only offered to paying customers. These customers do not have to be Shell EP employees. Other oil companies can also request courses. Existing courses are in that case modified and Shell EP-specific material is removed. An important issue in offering material are the export restrictions on knowledge also known as the Global Export Controls

(GEC). More information can be found on the Website http://www.gec.info/ that gives a summary of regulations related to these global export controls. “Almost all countries impose restrictions of some sort on the export of goods, technology and services. These national restrictions can also impact (re-) exports from other countries. In addition to these national controls are international organisations that impact the export controls environment. The European Union, the United Nations and multilateral arrangements are examples of organisations that shape the restrictions that are in place in individual countries. All these export controls together compose what Filter Control Technologies calls the Global Export Controls (GEC, http://www.gec.info/).” Shell EP is very strict in the procedures related to these GEC regulations because the organisation is in risk when the US GEC regulations are violated. The US government has already brought organisations to court because of such violations, and the penalties were so heavy that these organisations no longer exist. Because some regulations are related to the export of US knowledge to certain countries, sometimes US citizens are prohibited from participating in projects because the project results cannot be used in countries where Shell EP is working. Offering content that is not screened for these GEC regulations to countries with export controls can be a potential risk.

Select - The selection of material takes place when a new course is developed or a new cycle is offered. New courses are developed for new target groups. New target groups can come from new course cycles planned in the curriculum or when requested. This means that some courses have a fixed starting date and a fixed number of sessions. Material is selected from several sources. Old courses are most often used as resources, but also the Course Director’s own material from previous job experiences are also used. The material is selected for the courses based on competences that need to be covered and the specific target group served.

Use - When using material, the Shell EP style is very important for presentation purposes. When material is obtained, the look and feel in Shell EP style is a key negotiation point. One of the first requests during the implementation of the TeleTOP® system was the change of its interface into the current Shell EP colours. When obtaining material clear agreements have to be made if material actually can be offered in a different style and how this can be achieved. As long as a course exists and the material is used, the Course Director is responsible. The Course Director is the only one who can manage the material. This means that as long as a course contains participants and is being used, the Course Director should also manage the material that is provided by the participants. A Course Director therefore should decide how long participants might access a course. When a course is created the Course Director should have immediate access. This is needed to add content and structure the new course. Adding material is possible through reusing material from old courses or adding new content. The Course Director’s access to a course is needed as long as a course contains material that is needed for reuse. Submitted work from participants can be very useful for reuse. When asking for submitted work, participants should be made aware of this reusing strategy. Participants should be informed or asked if material can be reused in future courses. This can be done when a course starts. This information can be provided through the "Course Information" section in the course. If the decision is made to reuse submitted work the course participants can be contacted by email. Reusing material does not always mean that the old material fits in new courses. Time-sensitive items might need to be changed and parts of the material might be outdated. Material should be checked for dependencies and relations with other materials. The reuse within TeleTOP® is a process that has been made as easy as possible and the system provides functionalities that can help Course Directors to create courses in a short time. But some aspects have to deal with content that cannot be handled by a course-management system. Research continues to be needed to see how Course Directors can be supported. The process of reusing material therefore should be evaluated. A pilot of this evaluation was done in 2003 through the structured interviews reported in this section. The evaluation process is part of the reuse procedure so that in the near future reuse can be carried out in a more-sophisticated way and be supported in a broader context. The Course Directors as users are the most important source of information because they have to develop new courses.

Retain - Differences in the cycles for re-offering courses result in varying retention procedures. Course Directors are not all bound to a certain time slot. Some courses are given when requested and do not have an end date. Participants can start when they are ready and finish when they have fulfilled the assignments. The lifecycle of material in these on-going courses differs from the lifecycle of the course. Every piece of material is retained individually in these courses. Within the courses the participants are coached individually and in some cases the assignments are tailored to the individual context.

6.2.9 Answers to the secondary research questions for the TeleTOP® at Shell EP project

Based on the learning-object lifecycle and findings for the human and technical perspective questions the secondary research questions can be given preliminary answers:

TQ1. Granularity and standards - The granularity level of material is an issue because during the development of learning material in the years 2000 and 2001 the learning objects were already defined in terms of "nuggets". These nuggets were bound to time constraints (a nugget was defined as 15 minutes long) and included non-flexible instructional approaches. In the TeleTOP® CMS these sorts of definitions are not used. The use of a TeleTOP® roster row as a nugget that includes a set of pedagogical directives as well as content objects can be seen as a solution for the granularity definition of learning objects (Strijker, Masseling, & Collis, 2003).

TQ2. Tools - To obtain material, different tools are used. In the Shell EP Learning Centre tools such as Flash are used by a few experienced Course Directors to create animations, simulations, and the development of CBT modules. Course designers however provide a large part of this kind of support using several tools for obtaining material, but also for structuring course material.

TQ3. Systems - The TeleTOP® CMS is used as key system to deliver courses. Besides this CMS a LMS (Docent) is also used to offer a portal for learning. The integration of knowledge management in the learning process involves systems for discussion. These discussion areas are supported with a content-management system that contains reusable resources that can be used for learning.

HQ1. Organisational context - The organisational strategy is based on sustainable development. This means that projects are initiated with long-term results in mind. Reusability of learning material and sharing knowledge are part of this strategy. Reusability is seen as a long-term investment that makes it possible to capture knowledge now for reuse in the future when experts may not be available anymore but their expertise is still present in the learning objects.

HQ2. Learning scenarios - The learning strategies began to change when Course Directors started using the TeleTOP® CMSs for delivering courses. Courses are more focused on work-based activities and bringing learning into practice (Margayan, Collis, & Cooke, 2003). The learning approaches try to facilitate the learners in their daily activities and support them with coaching. Course Directors guide learners through the material and offer expertise when needed. The Course Directors offer expertise in the form of course material that is selected for their expertise area.

HQ3. Object creation - Course Directors, course designers, or external resources obtain material. The material obtained from third-party vendors is mainly fixed in terms of content and instructional approach. The flexibility of material used in the TeleTOP® CMS depends on its location in the system. Resources such as Web links and Archive items are most pedagogically independent while the roster is not. The quality of the material depends on the expertise of the Course Director.

HQ4. User support - Because reuse is part of the organisational strategy, training and support for reuse are part of the research that is being done in this area. The researcher provides the services needed but also works on developments of the TeleTOP® system to provide tools for the different stages of the lifecycle.

HQ5. Metadata - Because of the size of the organisation and the huge amounts of material produced, the organisation needs to tag all material for future retrieval. From a knowledge-management point of view, the material can be seen as learning objects that can be re-used for learning in other contexts. Metadata are assigned by professionals in libraries, authors of material, Course Directors, or automatically by software agents within TeleTOP®.

6.2.10 Key observations of the researcher for the TeleTOP® at Shell EP project

The interest for learning-technology standards is closely related to policy and strategy, in particular for group leaders. For sustainable development within the Shell EP context this is a problem because of the constant change in group leaders and differences in the interest of the staff members in passing on experience and previous learning. The use of standards and reuse of material and the closely related knowledge-management aspects are all long-term developments that need constant awareness and attention from the management. Within a large company such as Shell EP the overview of related systems is difficult for a constantly changing staff and the benefits of the use of standards may not always be clear when there is no constant interest. Another issue is the constant involvement of different stakeholders in the various related systems. The difficulty of the subject, the technical aspects, and the lack of knowledge are other issues.

6.3 TeleTOP® Conversion Project

In Section 6.3.1 a general description is given of the project Conversion TeleTOP®. Sections 6.3.2 to 6.3.6 describe the project from human and technical perspectives using the Why?, Who?, What?, How?, and Where? questions. In Section 6.3.7 a summary is made in terms of the learning-object lifecycle, and in Section 6.3.8 preliminary answers to the secondary research questions are given.

6.3.1 General description and role of the researcher

The project Conversion TeleTOP® is based on the project to move the TeleTOP® CMS from a university-based version to a commercial version for use at the Shell EP Learning Centre. The role of the researcher in this project was to support the Shell EP Learning Centre IT staff for the development of conversion scripts because of the researcher's experiences with the original TeleTOP® version (see Section 4.4.3). This project started in December 2002 and finished in July 2003. The development of the (commercial) Version 5 of TeleTOP® started in January 2002 and was initiated by the Dinkel Institute of the University of Twente (now called ITBE). The TeleTOP® CMS used until then at Shell EP was developed according to a rapid-prototyping design approach with relatively little time available for documentation. Because of the interest of several third-party organisations such as Shell EP, Philips, Heineken, other higher-education institutes, and the university's wide-scale implementation, a new version of TeleTOP® was built to make it possible to give professional IT support based on documentation. Another reason for rebuilding the system was to solve inconsistencies and small interface problems that were raised during the prototype-design phase of the TeleTOP® system. The new version was reprogrammed from scratch using the functional design from the original system. An inventory of the functionalities of the existing system was made including interface aspects relating to the layout of the screens. Because the whole system was reprogrammed, also the data model changed from the first four TeleTOP® versions which were all based on the same data model. The differences in data models made the conversion a difficult task because all fields had to be mapped from the old design to the new design. An important role for exchange based on standards was found to be the key in this process. Another problem was the fact that some courses had to be migrated while they were active because no timeslot was available for the conversion when all courses were finished.

The developer's main role in the project was that of developer. The development of the project focused on scripts for the conversion of course material from one system to another system using a data model based on learning-technology standards such as ADL SCORM™. The researcher was involved in the development of the conversion scripts and consulted programmers with information about the data structures of the original TeleTOP® CMS and the importance of metadata and content needed for the new CMS.

6.3.2 Why did reuse take place?

The shift from a university version to a commercial version was not expected to be a reuse step. The initial idea was to just go on with a new version of the system and not make any selections, choices, and edits to the original material. The fact that the university version and the commercial version did not match in their data models forced the users of the system to make selections of the material to be reused. These selections were based on the value of material, quality of material, invested effort for obtaining material from Course Directors, need for course management, and the need for grading participants. The selection of reused material was not based on the actual content, but on types of content and their relevance for upcoming or running courses.

6.3.3 Who is involved?

The Shell EP Learning Center support staff managed reuse. Management was needed because different groups were involved in the conversion process:

- Application Service Provider (ASP) – To manage hardware and the Lotus Notes database management system.
- Dinkel – As license holder of the TeleTOP® CMS.
- TeleTOP® developer (the researcher)– To develop scripts for the conversion.
- Lotus Notes programmer. – To write scripts for the conversion.
- Shell EP TeleTOP® support group – Primarily members of the Design Team, to check and handle problems in converted courses.
- Course Directors – To be informed about the conversion and to participate in discussions about what was needed to convert in their courses

Beforehand decisions were made about contact persons and responsibilities for the procedures. This resulted in a plan strongly focused on the Course Directors and the consequences for the Shell EP TeleTOP® support group. During the project the responsibilities became less clear because new tasks that arose were not inventoried and not well described. The main unclear tasks were related to technical aspects. Expectations from the Shell EP users did not seem to be addressed by the technical group because the expectations were inventoried on a general level and "translated" to technical specifications. The Shell EP users were not aware of the specific data that were required for the conversion and the technical group developed conversion scripts based on the incomplete available requirements. After the conversion the Shell EP users could not provide information about what was missing because no tools were available to inventory data about use, numbers of documents, and size of course environments. The use of an ASP gave problems because different groups interacted with each other on different levels about similar problems. The lack of technical knowledge about the systems and not-addressed points in the SLA resulted in problems about responsibilities.

6.3.4 What is reused?

Much of the course material created partly in the years 2001 and 2002 in the TeleTOP® CMS was seen as usable in the new commercial version of TeleTOP®. This included material developed in the Shell EP Learning Center or obtained by the Course Directors, course designers, and research group. In total there were 76 courses seen as candidates for conversion, varying from 10 megabytes to 1.3 gigabytes in size. The number of objects in each course differed from 75 to 1400. A total of 763 registered users were accessing these courses. Within the Shell-EP context a specific set of functionalities were used, in particular the Roster, Course info, and Archive were used to store material needed for the courses. The archive contained resources such as pictures, drawings, movies, PowerPoint files, animations, HTML files, Word documents, and PDFs. The sizes of the objects differed from smaller than one kilobyte for HTML files to over 60 megabytes for movies. Functionalities such as Web links and Presentation were used less, possibly because they were not familiar to the Course Directors. The quizzes were heavily used in some courses and contained large sets of questions. Data related to users were also exchanged. Profiles of users and also submitted work were migrated to the new version of the system. The conversion was carried out in two phases because after the first conversion too much information seemed to be missing to use the new version of the system. Based on a first intensive inventory the following materials were exchanged in the first phase:

- News
- Roster
- Course information
- Web links
- Archive
- Participants
- Presentations
- Submitted assignments
- Categories

It was expected that material obtained by the Course Directors contained the most necessary reusable material. Because the functionalities in the TeleTOP® CMS were based on a consistent data model, only one conversion script needed to be written for all material. Material that was not covered by the conversion script was planned to be converted manually using the Windows copy/paste functionality. The conversion script focused on the actual content and mandatory metadata fields according to ADL SCORM™. It was expected that this data set was enough because this set is also expected to be enough for exchange between completely different course-management systems. The selected functionalities were developed in such a way that this mandatory metadata was available for ADL SCORM™ exchange. The development of these conversion scripts based on ADL SCORM™ specifications was done in a few days and made it possible to move material from the TeleTOP® university version to the TeleTOP® commercial version. Appendix G: “TeleTOP® corporate-learning context conversion mapping” shows the conversion mapping done by the researcher. However, the following problems were encountered:

- The use of hard-coded links – Within the Shell EP learning environment lay-out aspects are key and much time is invested in the format of the pages. In most cases HTML is used in combination with hard-coded links to pictures stored in the TeleTOP® CMS. Because of the conversion, pictures and material did not keep their same locations and the links to the hard-coded content could not be updated. This resulted in pages that needed to be updated manually.
- The use of HTML – In relation to the use of hard-coded links the use of HTML also gave problems in terms of layout. Figure 146 shows how the layout was changed to a more-interactive site using extra icons, bullets, font types with HTML coding. The use of HTML in places where it was not intended to be used disturbed the intended way of presenting information. Places that needed to contain only text such as titles and headings could not be interpreted by the scripts and resulted in presentation errors when viewing course material.

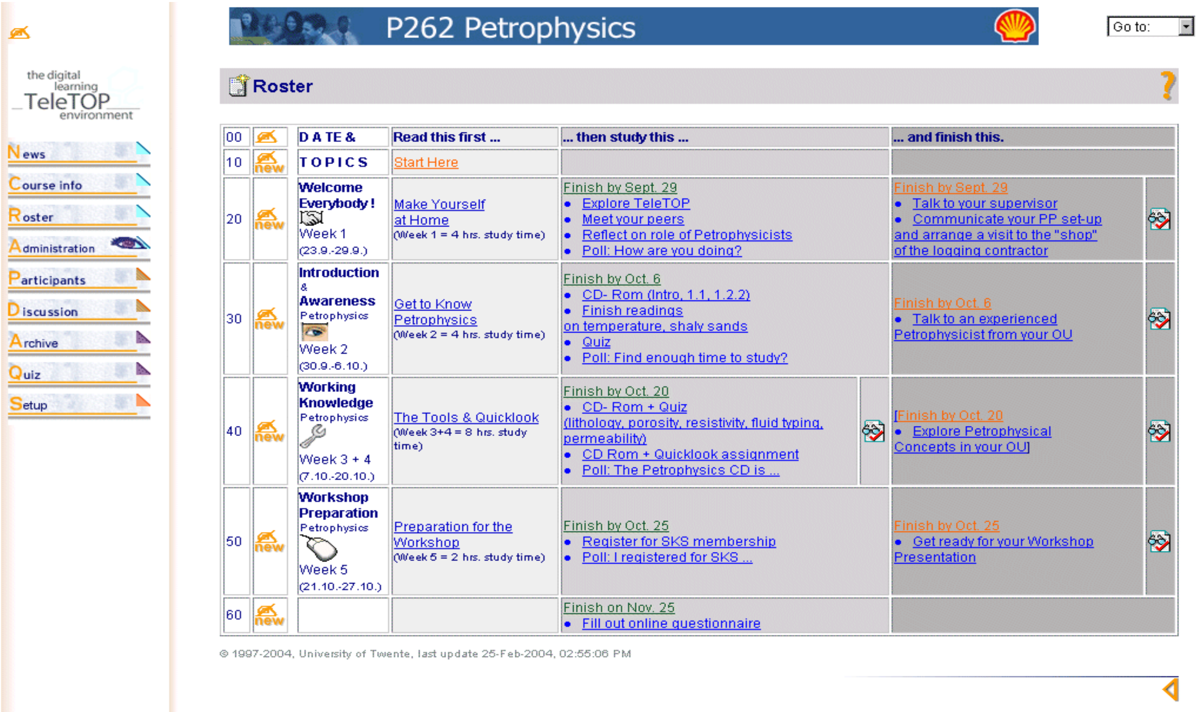


Figure 146 Example of the results of the use of HTML for lay-out in the roster (images, different size fonts, different colours in the fonts)

- Missing information – Because there was no moment that all courses were finished, a set of courses was still running during the conversion. For these courses also all participant information was needed concerning submissions, grading, and feedback. This had to be manually converted.
- Missing content - Not all material was converted because a few items were not built using the TeleTOP® data model. The functionality for creating quizzes in the research version of TeleTOP® was developed not using any specifications, because those available in the period 1997-2000 did not fit the users requirements, and also specifications (IMS, 2002) for Question & Test Interoperability (QTI) were not ready for implementation.
- Size of attachments – The size of material used in the environments was in some cases very large because of the use of video fragments. Two of the environments that needed to be converted were over 1.2 gigabytes. It was not expected that such large files were going to be used and that they would take so much server space.
- Number of documents – The number of objects available in the environments was also underestimated. Some courses contained more than 3000 objects. Appendix H: "Conversion results Shell EP TeleTOP®" shows the number of documents for each course, the number of converted files, and documents that were not converted. Not-converted files included the help documents (37) and empty pages such as not-filled roster pages. These automatically generated pages were not converted.
- Usernames – Because of the inconsistencies in naming conventions used by the Course Directors, for example switching a participants first name and last name, there were also problems in grading the assignments. The result of this was that in the new courses submissions were found with sometimes the participants' first

name appearing first and in other occasions the last name first. Because the submissions were sorted on the first characters, the participants' submissions could be found on two places.

Because of these issues a second conversion was planned to overcome these large problems. This conversion focused mainly on the quiz functionality and providing more data for the participant's submissions. Also the workspaces were converted because they contained more relevant material than had been expected. The development of these conversion scripts took twice the time than the first selection because of their specific nature. Each type of document needed to be mapped to the new system, needing also user information.

6.3.5 How is reuse supported?

In this project the exchange of needed material between the different versions of the system is seen as reuse. Different tools were developed to make the conversion as easy as possible. The main parts of the tools were scripts that could convert a complete course. Courses were converted individually and checked on consistency and content after conversion. The support group checked hard-coded links, the use of HTML, and if all information was available in the new courses. Every available course was checked for its relevance and its reason of existence and an inventory was made of the priority of conversion. Running courses were identified as highly important and dates for the conversion were based on the activities in these courses.

6.3.6 Where did reuse take place in terms of systems?

For the conversion an Application Service Provider (ASP) was contracted to host the new version. The tasks of an ASP depend on the Service Level Agreement (SLA) that is stated in the contract. For the Shell EP contract it meant that the ASP takes care of server maintenance, Internet connections, and controls Lotus Notes for maintenance. Also the ASP does backups and disk space. A billing model was used based on the number of users accessing the system. The number of courses, bandwidth, and used disk space were not part of extra costs. Dealing with eventual problems with the Lotus Notes software were also part of the SLA. This resulted in some unclear situations because the borders between the TeleTOP® CMS and the Lotus Notes database-management system were vague. Problems raised at Shell EP during the conversion were presented to the ASP and also to the Dinkel Institute, the holder of the TeleTOP® CMS license.

6.3.7 The learning-object lifecycle: Summary of the Conversion TeleTOP® project

Obtain - The material reused in the conversion TeleTOP® CMS project was already obtained during the development of the courses. No new material was obtained.

Label - Material was labelled based on the categories, titles, and descriptions provided by the Course Directors. The type of material such as Course information, Archive, Web links, Roster, and Multimedia was also used as metadata tags based on the TeleTOP® CMS functionalities. Other metadata such as course name, course code, authors, and editing dates were also used for tagging.

Offer – The material was not offered to other users in the conversion project.

Select – The selection of the candidate material for reuse was made by different groups and based on different grounds. Selection was based on type of material and the ease of conversion of that type of material. Also types of material used occasionally were converted because adding the types to the scripts for such material involved little effort. Other material was selected because it was needed for the running courses such as grades and submitted work. Another set of material such as the quizzes was selected because the invested time and effort was much too high to recreate material manually. Another selection was based on course level. Courses that were not relevant for the future or were not to be maintained any further were skipped and not converted.

Use – The use of the converted material was sometimes problematic because of the use of static HTML and linking to resources not longer available because of the conversion. Some material needed to be edited manually to use in the new system. This material had not been developed to be reused in other settings.

Retain – The selection of material was also a choice of what courses were relevant in the future and what material was to be retained. Material not converted to the new system cannot be used for reuse purposes. Courses not converted contained in most cases trial versions of material or were used as project environments and reusable material was already copied to versions that were converted. The process was also used to check what responsibilities for the courses were still valid and to get rid of material that was no longer maintained. Course Directors were informed about the courses that were not to be converted to give them the chance to retain valuable material.

6.3.8 *Answers to the secondary research questions for the Conversion TeleTOP® project*

TQ1. Granularity and standards – The granularity in the TeleTOP® CMS project was completely based on database records. Only the types of material converted related to an educational use of the learning objects. No actual standards were used to exchange the material between the two different versions of the systems. The use of the underlying ADL SCORM™ model worked for most content but was not satisfying because some material was not structured based on the underlying data model and other system functionalities needed more system data to proceed in running courses. This was not surprising because a metadata schema is not intended to be used as a basis for a content exchange.

TQ2. Tools – The developed tools for exchanging material are only to be used in the Lotus Notes system. The development of the tools and the conversion of such amounts of material give information about the ability of a course-management system based on standards and what data needs to be exchanged when running courses are converted. The experiences with tools provide a general mapping of the content of learning objects relevant for the TeleTOP® CMS but can be used as guidelines for how to exchange material to other CMSs.

TQ3. Systems – The TeleTOP® CMS is a database-driven environment and most key CMS vendors use a similar data model to store and manage learning objects. The representation and functionalities vary slightly. Conversions of prior versions of the CMS Blackboard also resulted in various problems such as loss of discussions, invalid translation of foreign characters, missing courses and content (ICTO, 2004; VU, 2004; Zandee, 2004). Inventories of available material and technical possibilities do not always match the desired needs and result in data loss. In some cases the conversion is not reversible. In the TeleTOP® CMS project a second conversion was started to retrieve missing data.

HQ1. Organisational context – The choice to use a new commercial version of the TeleTOP® CMS was made by the Shell EP Learning Center management team to overcome problems in terms of support in the university version of the TeleTOP® CMS. The conversion of the course material was not intended to be such a large and time-consuming project. Making reuse material as much as possible available in the new CMS was strongly supported by the organisation. The need of the Course Directors for the missing data resulted in a second conversion cycle. The technical possibilities were utilized to support the Course Directors in the use of the system.

HQ2. Learning scenarios – The learning scenarios were important for the conversion because these were the reason that data were missing as this was related to participant submissions. The grades of the participants for submitted work are the result of the blended-learning approach.

HQ3. Object creation – The originally created material was created in the TeleTOP® CMS and was created to be used in courses. The Course Directors and course-support team created the material.

HQ4. User support – The conversion was supported by a large project team mainly focused on the support of the Course Directors, and from a technical perspective using conversion scripts. The user-support team solved problems related to the use of HTML and static links.

HQ5. Metadata – The exchange of material was mainly focused on the metadata definition used in the TeleTOP® CMS. Although metadata is the description of the content and not the content itself, the mandatory ADL SCORM™ fields were used as a data model for the actual content. In the TeleTOP® CMS metadata are mainly based on the content. Data such as category, title, and description are used as initial metadata values for the learning objects. Using the mandatory metadata fields substituted with additional content elements such as links and attachments was expected to be enough to exchange data between different systems.

6.3.9 Key observations of the researcher for the TeleTOP® conversion project

A conversion of courses is closely related to the reuse of material because the aspects for reusability are identical such as problems in lay-out and hard-coded links. The conversion project showed that there is a big difference in reusing material from a repository and exporting active courses. Reusing one’s own material from previous courses can be seen as using material from a repository because the reused material is no longer related to the old course. Within the conversion project also active courses were converted. The conversion showed that there is a large set of extra data needed besides “normal” learning objects such as on-going records on participants’ submissions. These data may not be relevant when material is reused in other situations, but for running courses they are essential. This data depends on the system used and is too specific to transfer with standards. The projects showed also that there will always be victims in a migration. The use of a new system may offer needed new functionalities, but is also includes the frustration of users that are confronted with another system that may not work the way they were used to.

6.4 Shell EP Knowledge-Sharing Project

In Section 6.4.1 a general description is given of the Shell EP Knowledge-Sharing Project. Sections 6.4.2 to 6.4.6 describe the project from a human and technical perspective using the Why?, Who?, What?, How?, and Where? questions. In Section 6.4.7 a summary is made in terms of the learning-object lifecycle, and in Section 6.4.8 preliminary answers to the secondary research questions are given.

6.4.1 General description and role of the researcher

This project focuses on a broader scope than the TeleTOP® implementation. The TeleTOP® implementation and related issues discussed in the previous two projects were specific for courses in the Shell EP Learning Centre context. This third project in contrast is much more related to a greater context where different locations such as NAM in Assen, Rijswijk, as well as the Shell EP Learning Centre in Noordwijkerhout are involved. This project describes the Knowledge-Sharing Project and focuses on the integration of knowledge management and learning that occurred at the creation of the LLD unit in October 2003 and will be intensified in practice when the Shell EP Learning Center moves to a new location in Rijswijk in early 2005. This integration started with merging the learning and knowledge-management departments in the new LLD organisation and the Knowledge-Sharing project was a direct result of this merger.

For the integration of knowledge management with course-based learning, reuse of material is a key aspect. Material from real practice needs to be digitised and is seen as highly valuable and reusable in the near future for learning activities. The material used in the different knowledge-management activities has the same high potential value for learning and are also candidates for reuse purposes. The project focuses on strategies to make reuse possible between different current systems using standards. An inventory in the organisation was made to see if tools for knowledge sharing among systems can be used and if material from different repositories can be reused, and what is needed to achieve this reuse. The project as described in this dissertation deals only with the inventory of available systems, procedures, and taxonomies that can be used for the development of organisational reuse policy and strategy; there were other aspects involved in the overall Knowledge-Sharing project with the LLD not reported here.

The main role of the researcher was analyzing the systems and procedures that could support reuse. The inventory of these systems and procedures can be used for the support of organisational reuse strategies.

6.4.2 Why does reuse take place?

The following reasons were identified why reuse takes place via the knowledge-management systems of Shell EP: Globalization, project management, demographic changes, scale, and knowledge management. These reasons are discussed here briefly:

- Globalization - NAM is a joint venture of Shell EP/Exxon and is also a Shell EP operating unit. Information management and information technology are seen as enablers for globalization. Information management with information technology (IM/IT) systems are the first step to organisational globalization. IM/IT systems are not part of the Subsurface or the Surface portfolio, but are part of the common portfolio for Shell EP.

- Project management - The urge for a management system comes from different directions. Before grants are given from governments for drilling new wells, all documents need to be in place for all different aspects of the well or rig. A set of 60.000 different documents for a single project is not an unusual number that has to be managed and controlled. The expected number of documents managed will in the next years be over 50.000.000.
- Demographic changes - The loss of knowledge when employees retire results in gaps in the corporate memory. Knowledge management is important for the future when older employees retire and the knowledge of these people cannot longer be used in daily practice.
- Number of documents - The globalization of the organisation and the number of documents and resources that have to be managed are enormous. Regarding the systems discussed in this project, there is a difference in the implementation scope within the Shell EP organisation. Some applications may be only used locally; others may have a global function but are tailored for local needs. Examples are the developments within NAM and the AHA database. This database is maintained and developed within NAM, but is also used as the basis for different applications in Rijswijk.
- Knowledge management - Because of the strategic goals within the organisation regarding to knowledge management, all employees are involved. Employees are obligated to take knowledge management into account. However, although this is part of the strategic goals of Shell EP, there are no rewards or punishment if the knowledge-management goals are not achieved.

6.4.3 Who is involved?

Within the document-management systems a distinction is made between producing and consuming. The producer or creator does the producing of material. This is most of the time a subject-matter expert who is also the one who should tag the material with initial metadata. After the creation of material it is handed over from the subject-matter experts to the document-control staff. In the past material was lost by inappropriate tagging because tagging was done based on the document's title. In practice the Course Directors are the main focus when they develop new course material. When Shell EP employees use the global networks to share knowledge all employees are involved and are potential developers of new resources that can be used in several ways. Each respondent who can post questions or solutions can support learning through reuse. The Shell EP Global Networks can be compared with the broader term used for communities of practice.

6.4.4 What is reused?

The material in the Shell EP organisation is very diverse and varies in the locations used. The Shell EP library in Rijswijk made an inventory of the sort of material available in the library. The inventory was made to have an indication if material was needed to be scanned:

> *"The documents involved in this scanning process consist of mainly A4 pages, and are a mix of black/white and colour pages. They could be loose pages, but could also be bound as a book or stapled together. There can be pages in the documents or in the attachments to the documents, which are of a different size than A4, e.g. A3, A2.*
>
> *The documents can vary from 20 to more than 100 pages. The quality of the documents can vary as well, because they have been produced from 1900 onwards."*

The material gathered by the Course Directors is expected to be in the same variety of formats. This is because the private collections of the Course Directors can be seen as small libraries, only less organized for a large audience. An inventory at NAM in Assen in The Netherlands came up with a set of more than 2700 different document-defined natures based on an analysis of the tasks and task results during the business process. The documents come from different sources. Some examples are:

- NAM, including all information about the fields in Slochteren, Ameland, and Schoonebeek.
- Rijswijk, the library containing non-digital material and video material
- Aberdeen, A library containing huge amounts of non-digital material
- Noordwijkerhout, the personal collections of the Course Directors and other subject-matter experts

For the last group the Knowledge-Sharing Project is key because the LLD requires knowledge access and sharing for learning as broad as possible.

In 2003 organisational changes with Shell EP such as the global IT solutions (see Section 6.2.1), the widespread use of different applications related to knowledge-management systems, competence-based development, the use of a course-management system, a learning-management system, and global system integration led to the need for a solution to exchange and use material within these systems. Figure 147 gives an overview of main systems related to the Shell EP Learning Centre. It also shows the different types of data that the different systems contain.

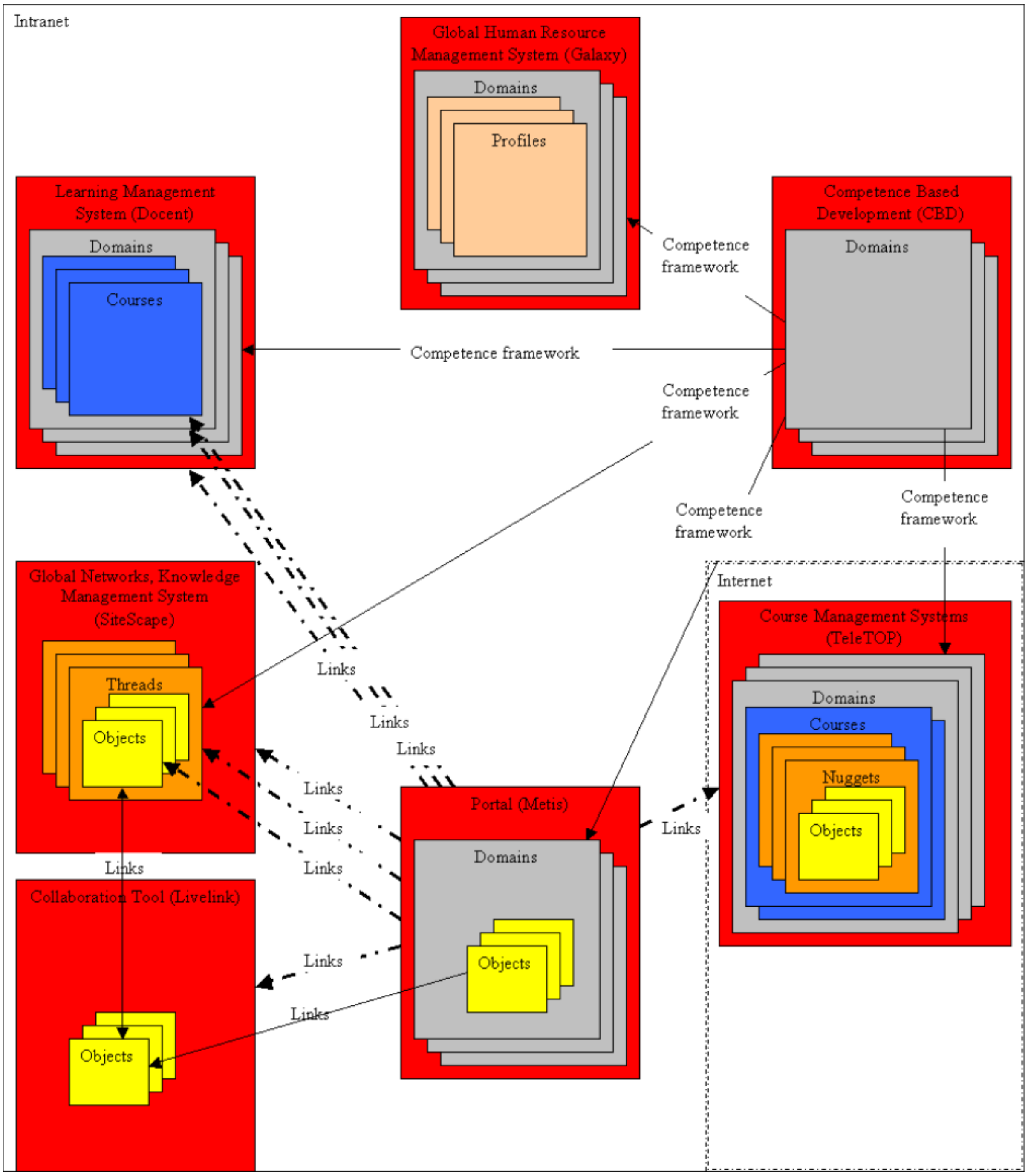


Figure 147 The systems used in the Shell EP Learning Centre and types of data they contain

- Livelink is used as a document-management system and is an important tool for knowledge management in Shell EP. When the system was implemented, Livelink was a leading application focusing on document management including a strong version-control function and facilities to store large sets of large documents through Web clients. The document-management system is designed to provide the user with information worldwide. Livelink is used to store documents, provide search engines to navigate documents, cataloguing, version control, and master reference. Livelink is being used to move the organisation to a more-distributed information-management system approach. Fourteen local instances of Livelink are part of this distributed approach. The up-scaling of Livelink to a global level ran into problems because of the large number of documents and numbers. Problems occurred in performance and a solution was found in the split up of the system into fourteen instances that were locally managed. Another problem of the Livelink system was the tagging of the documents and the fact that the system could not handle multi-value tagging or using more than one taxonomy for tagging.

- Docent is the Learning Management System (LMS) that is used as a portal for learning. CBT courses created before the implementation of the TeleTOP® CMS are accessible through the LMS. The main functionality used from the LMS is the authentication of users and providing access to available courses. The portal gives also information about the courses related to content and enrolment in the courses.
- Metis is a portal that provides a personalized set of links organized around expertise areas. The portal is manually maintained by subject-matter experts that are part of the expertise area. In the near future these functions will be part of the EP1. EP1 is planned to be a portal that will serve as a complete solution for access to all resources based on the needs of the individual user, as well as a communication tool.
- Sitescape is used for the SIGN (Shell EP International Global Networks) and Centra1 for collaboration. Both provide discussion forums for interaction between specialists and novices in different disciplines.

Figure 147 gives an overview of systems related to learning objects used in early 2004 in Shell EP. The different types of material and their granularities within the systems are presented in the figure with their own specific content. There is also a distinction made between Internet and intranet access. In this figure the intranet is the Shell EP private network. Although Docent LMS is the portal for the Shell EP Learning Centre learners, in Figure 147 Metis is presented as the knowledge-management portal for the Shell EP employees and gives access to all resources stored in the different knowledge-management systems using links to the resources.

The portal Metis only provides links to the different available systems. It does not offer any exchange possibilities between the systems. Because all systems are loosely coupled, there is no search possibility that can access all systems and search for desired content. A future learning content management system (LCMS) could be used to exchange material and make this material available for search engines and thus be used to enhance reuse. The competences can be used from a competence-based development taxonomy and used for the several systems as the basis for the structure of their domains, (the HR system, LMS, Livelink, TeleTOP®, and Metis); for discussion topics (Global networks); for courses (TeleTOP®); and for job descriptions (the HR System).

6.4.5 How is reuse supported?

In Rijswijk users are supported during the SWW (Shell WideWeb) Web-pages publishing process. Material is tagged during the publishing process using a “Safety pin” tool. This tool is not visible for the user but automatically assigns 12 metadata tags to the content. The tool also checks GEC (Global Export Control) rules from Shell EP and how long material should be retained. Metadata are abstracted from actual material. This is possible because for example Microsoft Word templates (.dot files) are used that already contain the necessary metadata information.

Another support tool is the so-called “Captured Source” that can provide different sorts of templates to create documents. The documents are stored in the Livelink document-management system with appropriate metadata. The metadata are based on the “document nature” that has to be selected in advance. This sort of tagging however can result in loosing knowledge and breaches in the value chain.

The “captured source” document-production tool uses two sorts of metadata to describe the document. One of these is objective metadata that comes from the formal descriptions defined in the master reference data, based on task and business process and on the context where the material is created. Context can be the location, well, reservoir, hole, or field. This context is used as the starting point when metadata is assigned to the actual document before it is stored in the document-management system. Besides these objective metadata also subjective metadata can be assigned by subject-matter experts to describe the actual documents and make them unique within the larger set of similar documents.

Within the library in Rijswijk a scanning service is used to digitize available reports, books, well reports, and other hardcopies. The library was one of the first large libraries that started such a process in The Netherlands and developed a strategy to digitize all material. The material available in the library is not digitized batch-wise but is scanned when a certain document is requested. The requested documents are gathered and scanned based on the requirements of the library. The current procedure used by the library is that when a document is requested, the document is released from its binding and put in an envelope. The envelope is taken to the reproduction department that sends it to the scan company. The request for digitizing is accompanied with a filename that the eventual scanned material should have. This filename is based on the Shell EP publication number. Every document in the library has such an unique number. These numbers are taken from the reports or the original Shell EP content. If the source is not Shell EP, the library gives the document a so-called “shelf-number” as a unique reference within the library. The reference number is used when the documents are tagged with library-specific metadata for use in the catalogue. The tagging of the documents is done based on the keywords originally stored in the material but also by library domain experts. There is no fixed set of keywords used, but the experts try to use similar keywords to guarantee consistency in the catalogues. The reference numbers are used as the key between the catalogue and the documents. When the material is scanned, the reference number is the only identifier. This identifier is used as filename for the digitized material. All descriptive library information about the document is kept in the catalogue and not used for the scanning procedure. Thus the files do not contain any metadata, except for the filename. Within 74 hours the material is returned and every document is saved on a separate compact disk. The Course Director includes the filename as identifier. The files are stored on the library server that is only used for this purpose. The server is available on the Shell Intranet (SWW) and the digitized documents are available through the library catalogue. If the material is digitally available a link in the catalogue is added. Classified material is not accessible to everyone; even the library staff cannot access this material without official clearance. The security owner has exclusive rights to access the material.

An example of a document nature can be a “Well drilling proposal”. For every well such a document is available and the proposal is the result of a certain task within a certain job that is part of a certain discipline. The differences can be found in the location or context of the well. Figure 148 shows how the different parts of a well can serve as context within the task-based business process. Taking the parts like field, the Surface point, hole, well, reservoir, the Surface, or Subsurface as starting points within the search process, a strict well-defined taxonomy can be used.

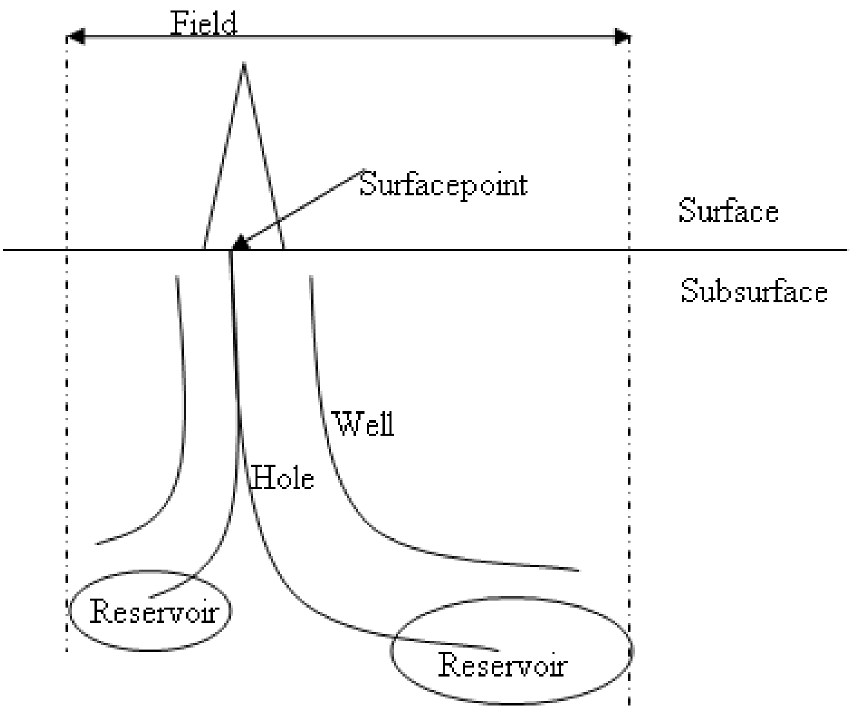


Figure 148 Assets within the NAM taxonomy structure

The AHA (Asset Hierarchy Application) repository only contains metadata that are assigned to the actual documents. Livelink is the document-management system that contains the actual documents. The use of profiles to inherit metadata in support-tagging tools can come from human-resource systems that have the information available from the employees. This is an issue because not all data are available. Contractors or joint ventures with other companies make it difficult to gather the needed information to provide this. Another reason that not all data are available from the users is because it is not stored in the system because of the different contracts and sorts of users. This is a data-management issue but can be a problem for assigning information for the tagging of metadata. Also the access of people to material is an issue because some material is classified and has restricted access.

The taxonomies developed within the database come from different angles and are used within different applications. The approach for a taxonomy structure is based on "assets", their related tasks, and outcomes. Assets are: platforms, rigs, holes, wells, fields, reservoirs, the Surface-points, the Surface, and Subsurface as shown in Figure 148, The search process using the taxonomies can have different interfaces or views. For a global implementation the interfaces are all Web enabled and do not require special dedicated clients. Discovey.com and Geological View are therefore interesting taxonomy browsers. The browsers use different taxonomies to retrieve the needed information.

For the initial vocabularies for metadata the Tulsa thesaurus (Petroleum Abstracts, 2003) is used. A thesaurus, by definition, is:

> *"a controlled vocabulary arranged in a known order in which equivalence, homographic, hierarchical, and associative relationships among terms are clearly displayed and identified by standardized relationship indicators, which must be employed reciprocally. Its purposes are to promote consistency in the indexing of documents, predominantly for post coordinated information storage and retrieval systems, and to facilitate searching by linking entry terms with descriptors (NISO, 2004)."*

The Tulsa thesaurus covers the Exploration and Production expertise area in terms of keywords. This thesaurus is used as basis but is stripped down to an essential useable list and has been restructured in a three-level node structure by Heye (2003). Heye reduced the Tulsa set to 600 defined nodes. Figure 149 shows a keyword and the three keywords related to the first one. This classification is based on the Tulsa taxonomy.

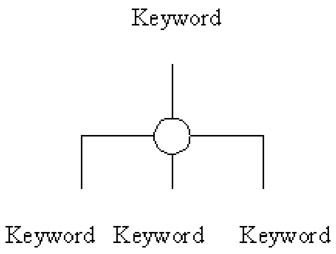


Figure 149 One node and related keyword structure

Figure 150 shows how a node is used in the whole taxonomy with a maximum of three levels deep. The idea is to keep the taxonomy as shallow as possible.

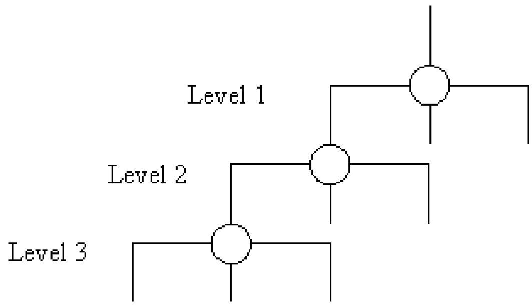


Figure 150 Levels within the taxonomy based on the nodes and related keyword structure

Several tools are available for automatic tagging of material such as: Autonomy, Convera, Entopia, Mohomine, Quiver Semio, Stratify, Textology, TopicalNet, Verity, and Wherewithal. Research about the functionalities can be found at the Web site of the Delphi Group (http://www.delphigroup.com) that compared these tools. Autonomy and Verity were tested within the Shell EP context to see how they can be used within the different systems such as Livelink, Sitescape, and the Shell EP Global Networks. These tools assign metadata based on the content that is available within the documents. Material is clustered based on the type and content of the documents. The use of semantic-Web search engines was also tested. The result of the test was not very promising. Building the needed ontologies took eight months for a only small part of the domain and did not fulfill all of the desired needs of clients.

From a geosciences' point of view the regions are an interesting and key entry for searching and selecting material. Figure 151 shows the use of the different taxonomies and their relation with the AHA database. Users think in their own context and are only able to use certain taxonomies if they are aware of the terminology used. If they are not aware of key terms that they have to use, the taxonomy cannot be used. Another way to classify material and develop taxonomies is based on document natures. Document natures can be types of material such as evaluation reports, project proposals, and research reports. If taxonomies shift in time, the actual metadata of the documents does not need to be changed, the taxonomies can be edited, and the related documents are automatically restructured based on these taxonomy changes. The system is built in such way that a document nature can be assigned to different taxonomies. The consumer can use a taxonomy that fits the need for the task. Figure 151 shows the different taxonomies that can be used to select material. One piece of material can be selected using different search strategies and appropriate taxonomies.

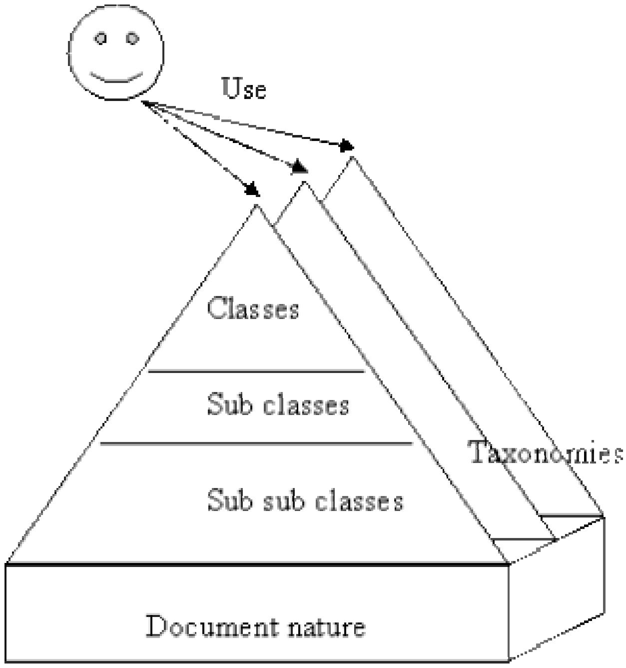


Figure 151 Different taxonomies can be used to select a needed document nature

Only 10% of the content of the intranet of Shell EP, the Shell EP Worldwide Web (SWW) is indexed and can be found with search engines at this moment. The need for different sorts of browsing for example for the Geosciences discipline requires different sorts of metadata. The location is therefore an example of metadata type that should be handled. Geo tagging, providing global positioning coordinates of a field or well is needed for building such a kind of taxonomy. Besides the work related to taxonomies, there is also effort being put in the building of vocabularies. The terms used in vocabularies are under control of the responsible subject-matter experts. The vocabulary is categorized based on the disciplines used in EP. Selecting material is provided with different applications like Discovery.com that use a taxonomy to zoom in on the eventual document. Taxonomies that are hierarchically structured like Figure 152 can offer a predefined structure that the user can use to navigate.

Different taxonomies are available to make it easier for the different consumers to find the actual needed documents. Search engines like Varity and Autonomy are used to full index the stored documents and automatically create taxonomies based on the actual content. Search engines can be used if taxonomies do not lead to the desired documents. The use of document natures as taxonomy organisation and as formalized sort of types within the organisations is another approach different from the use of the competence framework or an application of the competence framework in Metis (another knowledge-management system at Shell EP, discussed earlier).

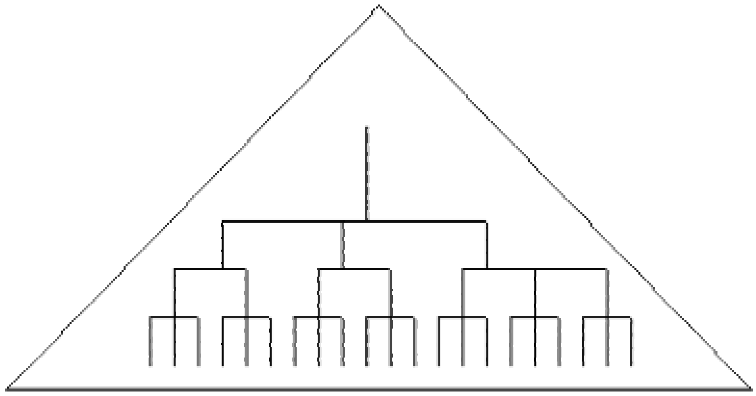


Figure 152 Hierarchical structure in taxonomy

6.4.6 Where does reuse take place in terms of systems?

Different systems are used to deal with the needs of the Shell EP business. Each of these systems is described shortly.

- AHA (the Asset Hierarchy Application) is a metadata repository. The repository only contains metadata that are assigned to the actual documents. The AHA repository has functions available to show documents that are available but can also show the properties of the stored documents. These functionalities can be extended to extracting or exporting material. All functionalities are developed to be delivered using Web clients.
- Livelink is the document-management system that contains the actual documents. The repository has functions available to show documents that are available but can also show the properties of the stored documents. These functionalities can be extended to extracting or exporting material. All functionalities are developed to deliver using the Web.
- Search engines like Varity and Autonomy are used to full index the stored documents.

The systems and their relations are shown in Figure 153. This figure shows the interaction between producer of material and user (consumer) of material. The systems support this interaction between producer and consumer. The producer and consumer are in most cases not aware of each other and taxonomies are for both groups help in the selection process.

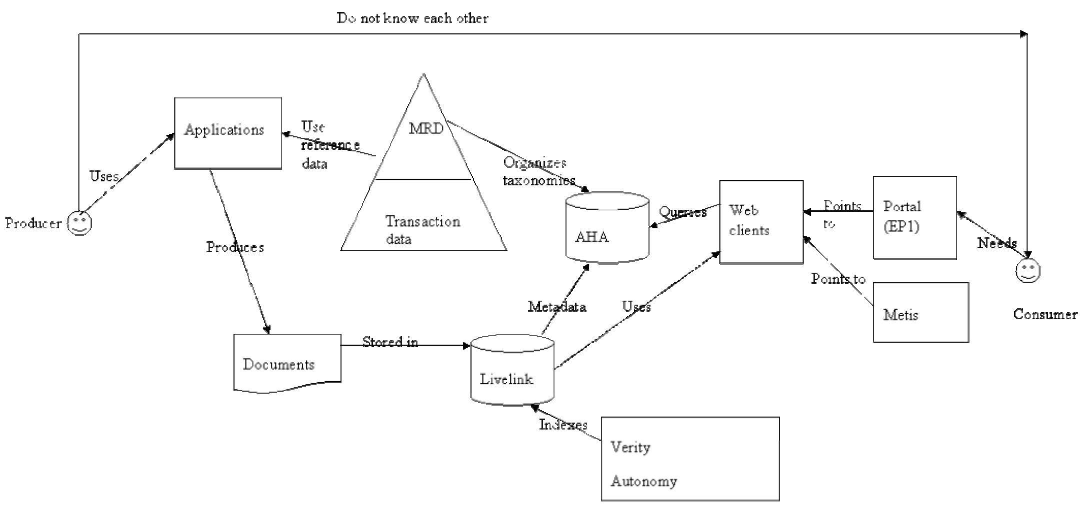


Figure 153 Production and consumption of material and the used systems

The producer creates documents and places these in the Livelink database. Placing the document in the database can be done using an application that automatically assigns metadata based on the reference data stored in the master reference database. Once stored in the Livelink system, the metadata is stored in the AHA database. This database assigns based on this metadata a document nature to the material and taxonomies that correspond to the document natures.

When the consumer needs a certain piece of material he accesses a portal to search for such a piece of material. The search functionality of the portal points to a requested Web client to search for material. Different Web clients are available to search for material using different taxonomies. The taxonomies are based on the Master Reference Data (MRD) set and generated manually or automatically with tools like Verity and Autonomy. Within the Shell EP taxonomy browsers based on location, assets, and keywords are available. When material is located, the material is retrieved from the Livelink document-management system.

A problem in the interaction between producer and consumer is the shift in time and the change of taxonomies in this period. When material is produced and placed within taxonomy, the terms used within the taxonomy may not fit when the consumers tries to find the material.

6.4.7 The learning-object lifecycle: Summary of the Knowledge-Sharing project

The Knowledge-Sharing project focuses on the reuse aspects of content material at Shell EP. For every stage a short description is given how of the Knowledge-Sharing Project is related to the stages:

Obtain - For digitizing non-digital material procedures are in place to support the users. When a piece of non-digital material is requested from the Rijswijk library it is immediately retrieved from its original location and is gathered for digitizing. At the end of every day, the non-digital material is sent to a company that is specialized in digitizing material. The next day the material is sent back in digital form. This procedure is twofold. It offers a fast delivery to the user, selections are made by the request of the users, material can be exchanged easily by email and reproduced when needed, and the material is accessible in the future for further use. The material is stored using the Portable Document Format (PDF) developed by Adobe (http://www.adobe.com), because extensive research made clear that this format could be used for longer-term (meaning 20 years), archiving because of the tools available for dealing with PDF. The pictures digitized are stored on a "Adobe images server" that makes it possible to provide the pictures to the corporate setting. Digitizing the large amounts of material resulted in disk-space problems that still need solutions.

Label – Library experts that have knowledge of the different expertise areas label material stored in the library. When material is digitized the library metadata are assigned to the material. In the Knowledge-Sharing project where Course Directors have to provide the material to be reused, labelling is initially a task of the Course Directors. They know why they selected the material for reuse and can provide the keywords related to the expertise area in which they work.

Offer – The specific material in the Knowledge-Sharing project focuses on the knowledge and material locally stored with the Course Directors. The material available in the offices can be offered once it is digitized and stored in the repository. A method of offering the material is possible by using it in courses or as answers given using the global networks. The Knowledge-Sharing project is being used to establish connections between the knowledge-management systems and the course-management systems. This aspect is the task for the researcher and the work is still in progress during the writing of this dissertation.

Select – Selection of course material is mainly based on the expertise and interests of the Course Director. Also the material available and the experiences with the systems play a role in the selection of material. The costs and benefits of the digitizing procedure may be important selection criteria.

Use – The global networks are used for knowledge management and a large population of the Shell EP employees uses the material exchanged. Using such material for learning may need tailoring for the different contexts and new ways of use. Digitized material can be used for learning but can also have benefits for sharing knowledge because its accessibility and availability increases.

Retain – When material is stored in the repository the creator of the material and the expertise area are used as tagging values. These relations can be used to make groups of people responsible for retaining the material.

6.4.8 Answers to the secondary research questions for the Shell EP Knowledge-Sharing project

Based on the learning-object lifecycle and findings in the human and technical perspective questions the secondary research questions can be given preliminary answers:

TQ1. Granularity and standards – The granularity of the material is not really an issue because the material is based on actual hardcopies. These hardcopies of material differ in size and type. Complete books, but also pictures or presentations can be digitized. The standards are the main starting point for tagging and storing material in such way that it can be selected and used easily.

TQ2. Tools – The tools discussed are mainly developed to make working with metadata as easy as possible. Tools such as Autonomy and Verity provide functionalities that create taxonomies based on the actual content. Procedures for digitizing material can also be seen as tools to help Course Directors.

TQ3. Systems – The different systems such as the Global Networks, Livelink, Metis, and the TeleTOP® CMS focus on their specific tasks such as knowledge management, document management, portal, and course-management functionalities. The need to integrate these kinds of systems for human-resource development is a clear goal. The use of standards to achieve this goal is a prerequisite to go on in the future. What standards should be used is not clear for all systems because learning is only a small part in the whole process of document management and the ADL SCORM™ specifications have not yet proved to be the best exchange possibility.

HQ1. Organisational context – The need for sharing knowledge is large and is supported from different disciplines. The support in terms of projects groups, systems, and research is an important part in Shell EP's IT development. The recent (2003) integration of the knowledge management and course-design groups are steps to facilitate the exchange of knowledge within the organisation using various streams and strategies.

HQ2. Learning scenarios – The blended-learning approach is also closely related to the Knowledge-Sharing project. The blended-learning approach can be developed further when tools and systems are in place to exchange material from the learning context to the actual workplace.

HQ3. Object creation – The Knowledge-Sharing project shows that material not specifically created for learning can be made available for learning. Also material gathered by the individual Course Directors can be interesting to use for learning purposes. The material may also have specific characteristics that are problematic for a learning context. An example is manuals from vendors that can contain very interesting material, but also because of their commercial aspects only can be used in a very specific setting.

HQ4. User support – The support in terms of user support groups and tools is a main focus of the Knowledge-Sharing project. The development of tools and the ease of use are key requirements to deliver support for sharing knowledge. The need for user support is also the focus for the research on taxonomies and vocabularies that fit the organisational context.

HQ5. Metadata – During the project metadata requirements and guidelines will be developed based on the needs and available vocabularies and taxonomies. The competence framework offers an organisational-wide structure to use as taxonomy. Also a constantly maintained vocabulary such as Tulsa can be used to present initial values for the metadata elements.

6.4.9 Key observations of the researcher for the Shell EP Knowledge-Sharing project

Within the Shell EP organisation there is an interesting set of tools and systems available to support document management but the material is not easy to use for learning purposes although the material can be very valuable. The constant search of different interest groups for usable taxonomies did not result in one overall usable set of vocabularies that can be used in the Shell EP learning context. The available taxonomies such as the competence framework, document types, and Tulsa vocabulary are not ready to use or not available to use directly. There is no "fixed" set of keywords or structure available within the organisation. Also the library uses a set of keywords that is flexible and not fixed or hierarchal. The "standards" used within the Shell EP organisation are based on the needs of the organisation and not focused on interaction with other organisations. Standards are seen as procedures or specifications created and used within the organisation. Specifications such as ADL SCORM™ are seen as something that is important, but not needed as organisational standards.

6.5 Results, Within the Corporate-Learning Context

The results are described first (Section 6.5.1) in terms of the secondary research questions addressed in the projects. A major result of this descriptive analysis is that the pedagogical distinction emphasized in theory that resulted in two descriptive figures for the corporate context (Figures 15 and 16 in Section 2.5.2., and Figure 36 in Section 3.5.2) reduces to only one descriptive view in practice (Section 6.5.2). Following this, the issues are discussed in terms of the corporate projects (Section 6.5.3). Section 6.5.4 identifies key success and failure factors as criteria of success for learning objects in the corporate context as part of the explanatory task of the research, and Section 6.5.5 concludes the chapter with a preliminary set of guidelines for the corporate context, relating to the prescriptive task of the research.

6.5.1 Answers to the secondary research questions for the corporate-learning context

TQ1. Granularity and standards – The granularity aspect is important in the corporate-learning context when this is related to learning. Defining learning objects and defining their size and content can help managers to gain insight about the time investment for learning but also for content development. Such a kind of learning-object definition can also help Course Directors as a sort of template for how they can construct course material. This definition can also be seen as a sort of standardization of learning content. Although granularity is closely related to the definition of learning objects, material from a CMS can also be used to construct such learning objects. The granularity of the material from the CMS can have various formats and sizes. Seen from that kind of view, granularity is not important and is mainly based on the tools and systems used. Also for the knowledge-management aspects the granularity of material is not defined and can have various sizes. The standards related to exchange and reuse are seen as IT solutions. The importance of standards for reuse were noticed and addressed in terms of a research program, but the tools needed for exchange need to be part of IT-infrastructure development. Those responsible for the IT-infrastructure development are aware of problems related to document management and retrievability of material but do not focus on the special need for the development of course material.

TQ2. Tools – The tools available for reuse are mainly focused on automatically tagging or providing full-text search indexes of the stored material. The development of taxonomies and vocabularies are important tasks to structure available content. Within the CMS tools are available to exchange material between courses. Accessibility and authorization related to stored material are the largest underestimated problems in the exchange of material.

TQ3. Systems – The large number of documents available in the different systems in the Shell EP organisation can be seen as a valuable repository. The documents that can be seen as candidates for the development of learning material can be made available if the systems can exchange material. For a large set of resources Web access within the private Shell EP network is already possible. However, the different systems do not have a centrally organized search engine or repository where metadata is stored. Before searching a choice has to be made in which system a query will be made. Portals are used to give access to different resources and related systems. Links to the material can be made to make material available. Linking to material is possible but can also be dangerous because static links need to be maintained and because of evolving developments the locations of material change resulting in dead links if maintenance is not done frequently.

HQ1. Organisational context – The size of the organisation causes a set of interesting possibilities and problems. The numbers of people working on different projects and the documents delivered for each project are huge. The management of the projects and the strategies chosen have a large impact on the organisation. Strategies chosen for learning, knowledge management, and the supporting IT infrastructure are important for each individual Shell EP employee and reflect the way of working.

HQ2. Learning scenarios – The implementation of the blended-learning approach is key for the reuse strategies. The participation of employees in courses via submissions based on work-based activities offers new ways of working because submitted work can be reused in new courses.

HQ3. Object creation – The creation of material is mainly a task during the development of courses. The material is created especially for a course with clear educational goals. Using other systems offers the possibility to also use resources that were created with no educational objectives. The material can be useful when instructions are given as to how to use such material.

HQ4. User support – Various types of support are provided within the Shell EP organisation. For each sort of problem or need support can be requested. Most support is organized in procedures that have to be followed. These procedures can take a lot of time and can be very frustrating. Once procedures are clear and no special requests are made the users are supported as well as possible. The development of procedures and finding the resources for support is an important task within the corporate-learning context.

HQ5. Metadata – Within the organisation several vocabularies are used to describe material. Several Shell EP projects have tried to identify a general set of keywords that can be used for tagging material. Also various sets are implemented such as the parts of the competence framework and taxonomies are built using the Tulsa vocabulary. The use of document types and the implementation of the AHA database showed that different types and sorts of taxonomies can be assigned to material and that this is needed for different user groups. The subject-matter experts, thus the Course Directors, have to provide the initial metadata based on the predefined vocabularies.

6.5.2 Key observations of the researcher for the corporate-learning context

While the summary in Section 6.5.1 is closely derived from the summaries of each of the three projects, the researcher made many different higher-order conclusions during the three years of work with the Shell EP Learning Centre context. These personal conclusions of the researcher are summarized here.

- The use of standards is important although it is unclear what is meant when they should be used. Because of the size of the organisation, most standards are defined by the organisation self. Adaptation of other existing standards and specifications, such as LOM and ADL SCORM™, are avoided because it is easier to develop context-specific specifications than to apply general standard solutions. It is also expected that third-party vendors will adapt Shell EP specifications and standards such as house style and database connections.

The following observations were also striking to the researcher:

- The definition of learning objects and the related granularity is important because learning objects can be used as a unit for cost estimations for development and courses.

- There is a need to describe the size in terms of what the learning object contains and to what competences the object is related.
- The reuse aspects are important because it is efficient to use material more than once. In the corporate setting Course Directors are willing to share material because costs are important.
- Tagging is an issue because different taxonomies can be used. Different taxonomies need to be available for tagging material, and experts may need to assign specific metadata themselves.
- The different sorts of systems used, the confidentiality of some material, the global activities, and the different networks used are key problems for exchanging material.
- The use of a combination of Internet and intranet solutions makes it difficult to see if material is accessible to all users. The use of material stored on the intranet may not be accessible from the Internet for all users.
- Time investment is a key issue. The ease of use of the tools that support reuse is therefore important. The use of profiles and software agents can support time consuming and difficult tasks.
- The effectiveness depends on the set of material available and how much is actually reused. Is reusing and sharing with others more effective than creating own resources? This is an issue because most material needs to be tailored for actual use in new courses.
- The awareness of costs and the non-competitive way of working encourages Course Directors to share material in their expertise areas. The number and the selection of material is an issue because if too much effort is needed to retrieve desired material, the process of reusing is no longer satisfying and the engagement to tag material for others for reusing will be less.

6.5.3 Validating the descriptive view for the corporate-learning context, perspective by lifecycle

Based on the secondary research questions and issues for the different projects the descriptive view for the corporate-learning context can be validated. Figure 154 shows the integration of perspectives, life cycle, and brief answers to the secondary research questions in a corporate-learning context.

<table>
<tr><th></th><th>Perspective questions</th><th>Obtaining</th><th>Labelling</th><th>Offering</th><th>Selecting</th><th>Using Pure</th><th>Using Adapted</th><th>Retaining</th><th>Learning objects</th></tr>
<tr><td rowspan="2">Human</td><td>Why?</td><td>HQ1. Organisational strategy and</td><td colspan="7">HQ1. Organisational strategy,
HQ2. Development of blended-learning scenarios,
HQ5. For personal convenience,</td></tr>
<tr><td>Who?</td><td>HQ3. Participating Shell EP employees, Third-party developers</td><td>HQ5. Subject-matter experts, Course Directors, library experts</td><td colspan="6">HQ5. Course Directors</td></tr>
<tr><td rowspan="3">Technic</td><td>What?</td><td colspan="8">TQ1. Course material, material from knowledge-management systems</td></tr>
<tr><td>How?</td><td colspan="8">TQ2. CMSs, tools or CMSs, Portals for Shell EP private network</td></tr>
<tr><td>Where</td><td colspan="8">TQ3. CMSs, knowledge-management systems</td></tr>
</table>

Figure 154 Corporate-learning context revised

The descriptive view that can be summarized from the projects shows that there is no difference within the corporate-learning context between knowledge acquisition and knowledge sharing for reusing material related to the learning-object lifecycle. The course directors involved in the development of course material are also the subject-matter experts that participate in the knowledge sharing networks.

6.5.4 Explanatory task: Key success (and fail) factors in the corporate-learning context

Table 21 shows the key success factors from Section 4.1.2 for learning objects in a corporate context based on the three Shell EP projects. Each factor is given a value for success rated on a five-point scale, where 1 represents the researcher's opinion of very poor or no success and 5 indicates the researcher's opinion of a successful factor for the context, as observed at the end of each project.

Table 25 Success in the corporate-learning context

Coding	**Success factor**	**Value for success 1=lowest 5=highest**
SF1	The tools are in place	3
SF2	Rules are understood and followed	3
SF3	Roles related to the learning objects are identified	5
SF4	Organisational embedding has occurred leading to learning objects	5
SF5	Learning objects are being used and reused by a critical mass of users within the organisation	1
SF6	Learning objects are being used and reused in appropriate ways	1
SF7	The use and reuse of learning objects is valuable to the organisation	5

The largest success factor in the Shell EP corporate setting is the organisational strategy that is focused on knowledge sharing and exchange. The tools that can support these strategies have been further developed and different projects are taking place to make resources available to the various target groups. The research on taxonomies and the management of the document-management systems are important factors to make exchange possible for the future. The implementation of the TeleTOP® CMS is also a success because the Course Directors are developing courses using the blended-learning scenario and reuse course material for different user groups. The facilities of the TeleTOP® CMS make it possible to share and exchange material within expertise areas and Course Directors use these functionalities. Course Directors also develop new strategies for learning focusing on distance learning and combining work experiences in the courses.

Another success factor is the use of a database-driven course-management system that makes it possible to exchange data with the already existing knowledge-management systems. The development of connectors between the systems offers interactivity and exchange of data. The original CBT material (e-modules) that is used in combination with the Docent LMS did not offer such functionalities.

6.5.5 Prescriptive task: Recommendations for the corporate-learning context

The prescriptive task for the corporate-learning context focuses on guidelines in the form of recommendations that can be used for implementing a reuse strategy.

- *Corporate learning guideline 1: Strategy at a technical level*

  Different projects should be initiated to make data available and to provide overall search engines. The size of the organisation makes it difficult to control if the different projects and systems are in place. To make exchange possible with different systems and to let learning and knowledge management benefit from the shared resources the organisational strategy should be stretched to a technical level. A centrally organized and authorized team should be able to specify learning technology standards and how the systems should interact on a technical level. This should also include the definition of vocabularies and taxonomies. The needs of the different user groups such as course teams and knowledge-management teams should be taken in account because their needs may differ from those of the standard users of document-management systems.

- *Corporate learning guideline 2: Apply taxonomies when converting*

  The integration of an upcoming human-resource management system may include various features of the different systems. The question will arise if such functionalities cover the needs of a blended-learning approach and if a dedicated course-management system is still not the best solution. The convergence of different systems to one overall system may still need a conversion of available material using standards for solutions. Such conversions can only be made if taxonomies are applied or available in the different systems.

- *Corporate learning guideline 3: Use metadata to exchange material*

  Metadata from the different systems should be gathered and stored in an LCMS to make valuable content available for search engines. This metadata can be used to find and select material, but can also serve as data for agents to exchange material between systems. This exchange can be done based on linking to the actual content as described in Section 3.2.5.3. If the actual content is copied, agents are needed for each system so that material can be exchanged and made available for learning or knowledge management. When useful material is found, the LCMS can retrieve the content or the content link from a system and send it to another system where it is needed.

As an example of the last guideline, when material is available in the Global Networks that is only useful in edited form for a certain course, the material needs to be edited before reuse. The material needs to be available within the TeleTOP® system before it can be edited. Therefore it needs to be exchanged between the systems. The main reason for using a LCMS is gathering metadata and facilitating the selection process of finding, selecting, and reusing material. Search engines and taxonomies to support a structured search can support this process. Although searching using keywords may seem the best way for finding material, experiences with large amounts of data have shown that keywords result in too many hits to be useful (Delphi Group, 2002). Clustering material and adding taxonomies is seen as an important solution to keep large amounts of material manageable. Figure 155 builds upon the current state of object repositories shown previously in Figure 147 to illustrate the proposed relation of the Shell EP systems and a new-to-be-designated LCMS (Strijker, 2003).

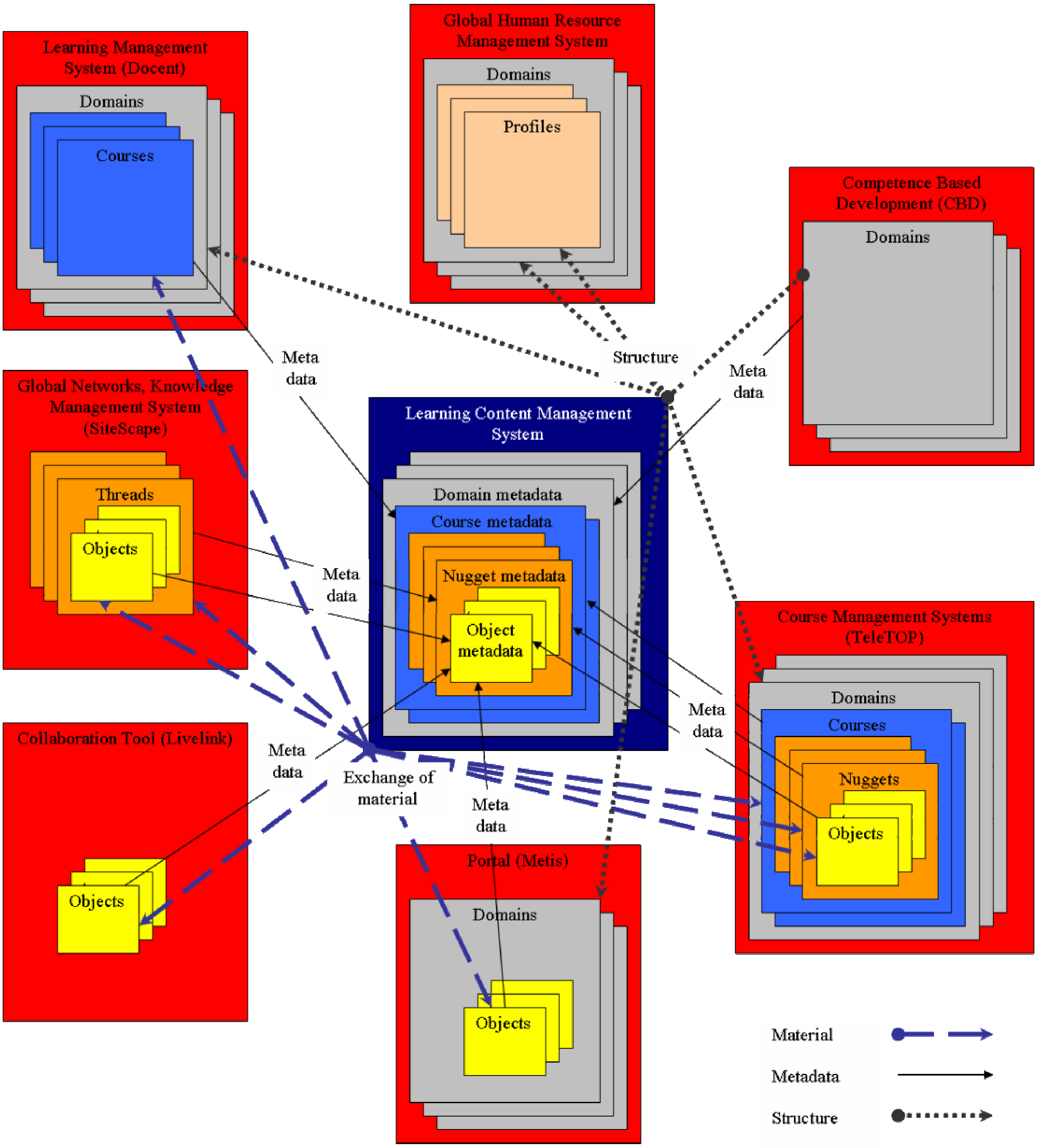


Figure 155 Proposed learning content management system for exchange of material

In comparison with Figure 147, there are several important differences shown in Figure 155. The proposed Learning Content Management System can be used as a repository. This repository can contain descriptions (metadata) from material (objects, courses, nuggets, discussion threads) that is selected by the subject-matter expert as exchangeable or reusable. This material can have different aggregation levels and come from different systems. The LCMS can also provide structure (such as the competence framework, but also other taxonomies) to other systems to couple the different resources within the systems. Building upon systematic vocabularies makes it possible to use existing taxonomies more efficiently. When materials are searched, and selected for reuse, the LCMS can also exchange objects between different systems to convert the objects in a required format. Because the repository is a database-driven hyperlinked environment, the system allows access to the contents in a variety of different ways (similar to the way that a digital hyperlinked encyclopaedia operates). In order to maximize the likelihood of the encyclopaedia being seen as useful by Course Directors and learners, a rapid-prototyping approach to design and development should be used, so that a series of rounds of pilot version and feedback will occur before a final design is concluded.

This concludes the description of the results of the corporate-learning context. In the next chapter the military context is described.

7 Military Context

The military context is based on a set of four projects as Figure 156 shows. The research regarding to reuse issues carried out by the Royal Netherlands military was part of projects initiated by TNO (Nederlandse Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek, The Dutch Organisation for Applied Scientific Research, http://www.tno.nl. The main focus of the projects was the implementation of and building experience with the current learning-technology standards. Section 7.1 gives a general description of the military as an organisation and the strong relation between research activities and TNO. Section 7.2 gives an overview of the ADL SCORM™ pilot for the Royal Netherlands Air Force project where technical issues are described related to the use of a LMS and redesigning courses based on ADL SCORM™. Section 7.3 describes the prerequisites and development of an LCMS for the Royal Netherlands Air Force and the experiences with such an LCMS. Section 7.4 describes the implementation of ADL SCORM™ in the existing system (IMAT) that automatically converts technical manuals to tagged fragments for learning purposes. Section 7.5 describes experiences with reuse in the Royal Netherlands Naval College where TeleTOP® is used as a pilot system. Section 7.6 describes the structured interviews within the military context. Section 7.7 presents the results in the military context.

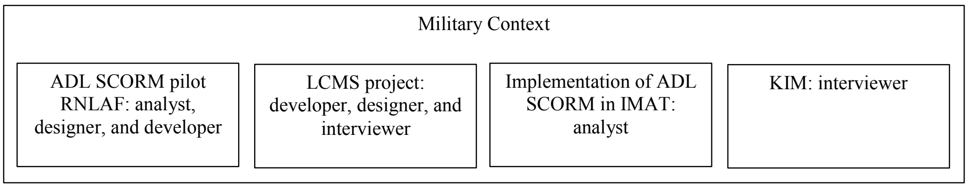


Figure 156 Overview of Chapter 5, military context and roles of the researcher

7.1 General Description of the Military Context

Section 7.1.1 describes the structure of the Netherlands Military as an organisation and Section 7.1.2 gives an overview of the activities and role of TNO related to the Netherlands Military and this research.

7.1.1 Netherlands military

The Ministry of Defence in the Netherlands consists of the Department (the so-called Central Organisation), the Armed Forces, and the Defence Inter Service Support Command (DICO). The ministry is led by the minister and secretary of state as assistant. The “Central organisation” shows similarities with other large organisations. The Armed Forces Royal Netherlands Navy (RNLN), Royal Netherlands Army (RNLA), the Royal Netherlands Air Force (RNLAF), Royal Netherlands Military Police (RNLMP), and the Defence Inter service Support Command (DICO) can be seen as individual companies. The Department of Defence situated in The Hague, employs 1,559 civilians and soldiers. The Ministry of Defence estimates that in 2002 more then 69.500 persons were employed: approximately 52,000 soldiers and 17,500 civilians, and is as such one of the largest employers of the Netherlands. Table 26 shows the distribution of employees in 2002.

Table 26 Distribution of employees in 2002 Ministry of Defence, The Netherlands

Company	*Estimated number of employees*
Central organisation	1,550
Royal navy	16,000
Royal army	30,500
Royal air force	12.,500
Royal military police	6,000
Defence Inter service support command	2,500
Defence telematic organisation	2,100
Service buildings, installations, and land	1,.000

The Armed Forces counted in 2001 4,500 female soldiers. The defence expenses for 2002 were more than 7 billion Euro (Rijksbegroting, 2003) According to the Ministry of Defence (2004) the core tasks of the Dutch Armed Forces are the following:

- Protecting the integrity of the national and allied territory, including the Netherlands Antilles and Aruba;
- Advancing international rules of law and stability;
- Assisting the civil authorities in the context of law enforcement, disaster relief and humanitarian aid, both nationally and internationally.

The level of ambition for the Dutch Armed Forces as laid down in the Government Policy Accord comprises contributions to NATO in the framework of collective defence and participation in a maximum of four peacekeeping operations simultaneously with battalion-sized units or their equivalent, if necessary for a period of three years. This is in keeping with the ambitions and capabilities of a country such as the Netherlands and expresses the country's commitment to international involvement.

According to a summary of the Defence White Paper (Ministry of Defence, 2004) the future of the Dutch Armed Forces lies in international cooperation. Dutch military units must, therefore, be able to fit easily into multinational alliances. This imposes heavy demands on the teaching and training of personnel and on equipment. The best example of multinational military cooperation is the integrated military structure of NATO. This form of cooperation goes beyond combined operations. NATO also plays a key role in the coordination of standards and procedures of member states. The Netherlands is striving for optimal harmonization, since compatibility, or interoperability, is vitally important now that personnel operate more than ever before in changing international settings (Ministry of Defence, 2004).

7.1.2 TNO

According to the website of TNO (http://www.tno.nl), TNO was established by law in 1930 to support companies and governments with innovative, practice-oriented knowledge. As a legal organisation TNO has an independent position that allows it to give objective, scientifically founded judgments. TNO is in its current form a knowledge organisation for companies, government bodies, and public organisations. The daily work of some 5,500 employees is to develop and apply knowledge. TNO provides contract research and specialist consultancy as well as grants licenses for patents and specialist software. TNO tests and certifies products and services, and issues an independent evaluation of quality. TNO also sets up new companies to market innovations. The key focus of TNO is the development and application of innovative knowledge. TNO is active in five core areas:

- Quality of life
- Defence and public safety
- Advanced products, processes, and systems
- Natural and built environments
- ICT and services.

Experts from various disciplines are used in integrated project teams in these areas, with combinations such as material technologists with product developers, and behavioural scientists with technicians. The intention of TNO is to develop knowledge together with companies. Projects can be carried out with the support of the TNO co-financing facility. TNO strives to hold a prominent position in the international science community. TNO also participates in a large number of projects within the European Union's R&D programs. Through the development of knowledge, TNO strives to offer its clients the latest high-quality knowledge. Its expertise is applied in the assignments TNO carries out for its clients including many in the innovative small and middle-sized sector. The statutory TNO organisation is supplemented by the holding company TNO Management BV. This group sets up new companies to market innovations that would otherwise remain unutilized (TNO, http://www.tno.nl).

For the research TNO has the role of project facilitator. Research projects for the Netherlands Military can be carried out by third-party research organisations such as TNO. TNO facilitates the projects in terms of resources of specialists, locations, hardware, and software. When specialists are not available in the TNO organisation other organisations such as universities are asked to participate in projects. Through TNO, the researcher was asked to participate in the ADL SCORM™ project, the IMAT project, and the LCMS project.

7.2 Project ADL SCORM™ Pilot RNLAF

The ADL SCORM™ pilot RNLAF (Royal Netherlands Air Force) project introduces the military context for learning objects with a general description of the project in Section 7.2.1. Sections 7.2.2 and 7.2.2 focus on the human perspectives. Sections 7.2.4 through 7.2.6 describe the technical perspective based on the What?, How?, and Where? questions. Section 7.2.7 summarizes the project based on the stages of the learning-object lifecycle and Section 7.2.8 summarizes the key issues.

7.2.1 General description and role of the researcher

The ADL SCORM™ pilot was requested by the RNLAF and the project where the research occurred took place in TNO-FEL. TNO-FEL is one of the departments of TNO that focuses on Physics and Electronics (http://www.fel.tno.nl). The University of Twente was asked to participate in the project because of the experience of ADL SCORM™ implementation in the TeleTOP® ™ CMS. The researcher was invited to join the project group because of his experiences with the development of tools related to the ADL SCORM™ specifications. The project related to the ADL SCORM™ pilot RNLAF focused on two aspects:

- Building experience with an ADL SCORM™ based LMS.
- Building experience with the implementation of the ADL SCORM™ in existing computer-based training (CBT) course material.

Because of the Air Force's lack of experience with ADL SCORM™ LMSs and the expected interests in the future for these systems, the functionalities of such an LMS were tested. Building up experience with a learning management system was also one of the main focuses of the research. The Royal Air Force selected from a wide range of e-learning systems a particular learning management system (LMS) to test ADL SCORM™ compliant material. The system chosen was "Avilar Webmentor™ LMS" (http://www.avilar.com). This system was in February 2003 the first to receive a certificate of ADL SCORM™ compliancy from ADL. The ADL SCORM™ compliant material tested in the LMS came from two sources: Example courses distributed by ADL and the air force's own redeveloped CBT. The LMS Webmentor™ was installed within TNO FEL and a research plan was written for how experiences with such a system could help in future developments. TNO FEL initiated the project to see how an ADL SCORM™ compliant system works within a military setting addressing the following items during the research;

- Technical implications
- Security of data for classified material
- Possibilities for data retrieval
- Possibilities for integration in a large company
- Connection speed
- Report possibilities
- Behaviour of ADL SCORM™ compliant courses.

For the project two courses were selected to see if ADL SCORM™ could be applied. The application of ADL SCORM™ related to the conversion of existing courses to SCOs and assets and the use of metadata and course-structure formats. The selection of the two courses was based on their complexity and structure. The course "Military Ranks" was selected as a simple course with little interaction, almost no use of multimedia, and a total running time of 4 hours. A more complex course in terms of structure, interaction, use of multimedia, and a total running time of 20 hours was found in the course "Aircraft Recognition". The intended target group of the courses was a part of the central reserve. This large group of 80.000 soldiers and 20.000 staff members (http://www.knvro.nl) are no longer in active duty but do need training and education for these areas. The courses selected for the project are examples of these areas. The LMS was tested with already existing courses that were redesigned according to the ADL SCORM™ specifications. The lessons learned and experiences with the system were gathered in the report "Lessons learned ADL SCORM™" (Strijker, 2002b).

The main role of the researcher was to be a developer and the tasks focused on the setup of the hardware and software required for the LMS and testing various functionalities of the LMS. Besides the setup of the LMS the researcher was involved in the redesign of the existing CBT courses.

7.2.2 Why does reuse take place?

On a high level, reuse is related to the overall policy of the Armed Forces in the Netherlands. The following is summarized from the website at www.defensie.nl:

> *"Armed forces personnel must have the professional knowledge and skills and the flexibility required to be able to carry out all their tasks properly. This will lead to far-reaching changes in the personnel structure in the coming decade, as well as to a considerable reduction in the average age of the personnel. This change is not caused by international*

> *developments and changes in tasks of the Armed Forces alone. Changes in Dutch society also have an important bearing on the structure and procedures of the Armed Forces. Social developments and developments concerning conditions of employment, which apply to employees in the Netherlands as a whole, in principle also apply to military personnel. The Defence organisation must offer its personnel challenging and motivating work and good working conditions. The men and women employed by the Armed Forces must be offered attractive opportunities for career development, both in the Defence organisation itself and with a view to their return to the civilian labour market. In this context it is likewise of the utmost importance for conditions to be created which enable work and private life to be combined as well as possible. Annually, an additional NLG 150 million will be made available for the purpose of intensifying personnel policy summary".*

The policy supports the use of computer-based training as a way to provide more flexibility and career advancement as well as efficiency of learning. Thus the military has been a forerunner in the use of CBT for certain training areas (Kuiper, 1995)

The Netherlands military initiated the research for standards during the first developments of the ADL SCORM™. In 1998, the military looked at several systems for e-learning. The focus on the ADL SCORM™ was based on the developments undertaken by the Ministry of Defence in the United States of America.

A more specific reason for this particular project was to serve the central reserve as an intended user group of the LMS and redeveloped courses. The use of such LMSs and Web-based courses was expected to be save participants time related to travelling and give possibilities for learning anywhere, anytime, and anyplace.

7.2.3 Who is involved?

The project was initiated by TNO and the researcher was part of the research team formed by TNO. The implementation of the ADL SCORM™ within the courses was carried out in cooperation with the air force course developers Groep Geleide Wapens (GGW) De Peel [Group Guided Missiles De Peel]. The two existing courses were developed and made by the "120 training squadron" of the GGW. The researcher supported the GGW in the redesign of the courses.

The roles identified in the military context are related to the type of course material developed. The course material of the two courses is created, gathered, and assembled by a support team. Subject-matter experts (SMEs) provide knowledge about a certain expertise area. In some cases SMEs are part of the support staff. The support team has several tasks in assembling the course material. Because of the large variety and high quality of fragments (assets) used, the support team includes graphical designers, photographers, multi-media specialists, video editors, and educational designers.

7.2.4 What was reused?

The learning material in the project could be characterized as already existing CBT. This means that material is developed so that a course can be provided without teachers or support staff. Courses are developed mostly in teams and tailored for different audiences. The use of multimedia is a very important aspect when material is produced. The sorts of multimedia depend on the type of learning material needed. Types of material include animations, pictures, and movies. The following sections describe two different courses Military Ranks in Section 7.2.4.1, and Aircraft Recognition in Section 7.2.4.2.

7.2.4.1 The course Military Ranks

The original course “Military Ranks” can be represented as shown in Figure 157, where two lessons can be identified. One lesson contains the content divided according to the companies in the Armed Forces: Royal Netherlands Air Force, Royal Netherlands Army, Royal Netherlands Navy, and Royal Netherlands Military Police. The other lesson contains the final test. This is simplified representation because each part in Lesson 1 also contained a small test at the end.

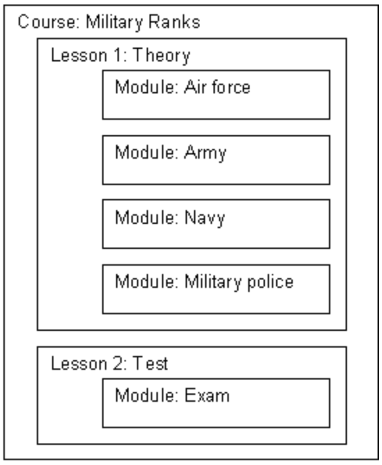


Figure 157 Original structure of the course Military Ranks

An inventory was made of how the course was developed in terms of tools and systems used and how the pieces were programmed. The inventory was made with the initial course developers and programmers. This inventory was made after an introduction by the researcher of the ADL SCORM™ specifications and an explanation of the possibilities and limitations within the ADL SCORM™. The size of the objects was chosen based on reusability. The reusability of the objects within the course was determined with the course developers. The determination was based on experiences in the past with course development, the frequency of revising of the material, and the time investments that were needed to tailor material for reuse. Another issue was the sequence of material within the course. The sequence of the pieces of material within the course was essential because SCOs (Section 3.2.3) may never start in parallel. SCOs always have to be started sequentially according to the conditions set by the ADL SCORM™. Pieces of material that have to be presented in parallel are combined to form one large SCO. This condition has a direct influence on the size of objects identified. It means that some course parts cannot be split up into reusable, separate small pieces. This was the reason that SCOs became disproportionately large. Splitting up SCOs into assets can help to get a good balance between reusability, size, and sequence because assets do not have the restrictions on parallel use.

Based on the inventory the course structure was redefined to the ADL SCORM™ specifications to see what material needed modifications and how these modifications needed to be applied. A new course-structure format was developed using the existing course structure as the model. Figure 158 shows the ADL SCORM™ representation of the course. Each part in the lessons was identified as a SCO. Every part in the course is restructured as a SCO. Lesson 2 consists of one module and is a test about the first lesson. The module can be seen as one integrated SCO. The questions are not divided in smaller pieces because they are too specific and too much interwoven with each other. The structure was chosen because content about each Armed Forces group such as the Navy could be reused as a stand-alone part in another course with a tailored test. If ranks within a certain module change, not all the SCOs have to be redeveloped, only the concerned SCO.

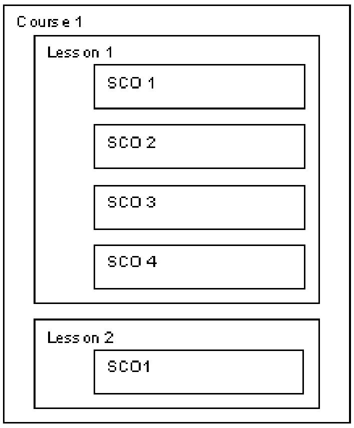


Figure 158 ADL SCORM™ representation of the course Ranks

To make the course ADL SCORM™ compliant only small changes were needed. The main task was to make the material available on the Web. The original content was developed with Authorware™ using a fixed screen resolution and large local resources. The total course used 60 Mb of storage space mainly for pictures. A set of 100 pictures was used for showing the different ranks and rank-levels. The course was intended to be distributed via the WWW and accessible for modem users. Figure 159 shows a screen dump of the web-based software application.

Figure 159 Ranks screen dump

7.2.4.2 The course Aircraft Recognition

The second military course Aircraft Recognition is divided into three lessons. Every lesson is based on a timeframe of four hours, bound to a portion of the day that can be planned for a morning or afternoon. Within two of these timeframes a set of aircrafts is handled in terms of specific characteristics. These characteristics are shown with photos, drawings, video, sounds, and by listing specification of the different aircrafts. Pictures of different aircrafts are shown simultaneously to explore differences and similarities. Also different backgrounds are used to help the trainees recognize aircrafts in different situations. Figure 160 shows the original structure of the course.

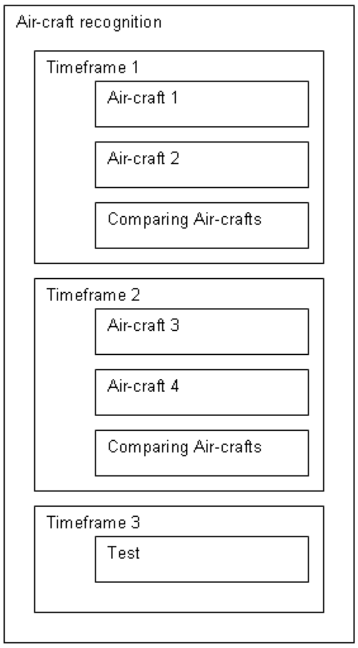


Figure 160 Original structure of the course Aircraft Recognition

In practice courses are developed for a certain region in the world. Courses only contain aircrafts that are active in that region. So the set of aircrafts selected vary in different regions.

With the course developers a choice was made about the size and content of the learning objects. To make assembly of courses as practical as possible, every aircraft is defined as a SCO. The SCOs are developed based on assets. The assets can contain videos, pictures, drawings, specifications, and sounds of the aircraft. Figure 161 shows a structure that represents the course based on the ADL SCORM™.

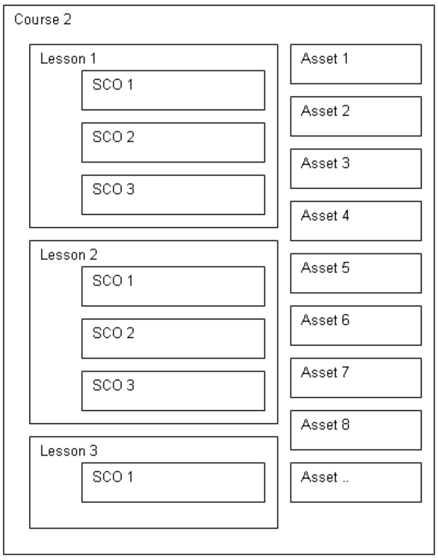


Figure 161 ADL SCORM™ representation of the course Aircraft Recognition

This redevelopment on the course level means that the structure needs large revisions for conversion of the course according to the ADL SCORM™ and in effect means a complete redesign of the course. The main focus was on the accessibility for the Internet and the implementation of the ADL SCORM™ runtime specifications. Problems related to the Internet were the current limitations of bandwidth and the interaction possibilities of Web-browser plug-ins compared with native Authorware™ applications. The complete file size of the original Aircraft-Recognition course was around 480 Mb and contained over 340 assets. The majority of the files were large because of the high-resolution videos. Down sampling the quality of the existing videos to reduce file size was not possible because the high detail was needed for correct recognition of the aircrafts. The course was mainly based on comparing different aircrafts in various situations. This meant that two aircrafts are shown at the same moment. According to the ADL SCORM™ the solution for defining each aircraft as a SCO this is not possible because according to the ADL SCORM™ two SCOs cannot run at the same moment. Sets of aircrafts needed to be combined and used within a SCO. This reduced the possibility for reuse and flexibility in assembling new region-based courses.

7.2.5 How is reuse supported?

The tools used for the development of course material were a combination of software programs for video-editing, picture-editing such as Photo Shop, authoring tools such as Authorware™, dedicated military authoring tools such as Course-Generator, and HTML editors. The intranet and the computers connected to it were configured as a repository using shared drives and project names of the courses as identifiers for the content. Each team of course developers contributed different skills such as multimedia programming and editing for the creation of course material. The development of course material was mainly based on Authorware™. This software program has implemented current standards for ADL SCORM™ and web accessibility; however the course developers did not have any experience with these options because they were never requested before. During the development of course material subject-matter experts were used to get information about the expertise area. Web access was very limited and only accessible through a 28,8kb modem.

During the redevelopment of the course into ADL SCORM™ compliant course material tools were used to test ADL SCORM™ compliancy (Section 2.3.2). ADL provided for ADL SCORM™ Version 1.1 a sample LMS to show how material could be developed in terms of

AICC interaction. The ADL SCORM™ Version 1.2 included a test suite that could be used to test metadata requirements for different types of aggregation levels such as assets and SCOs but also included LMS functionalities to test SCO runtime interaction. Figure 162 shows the test tool.

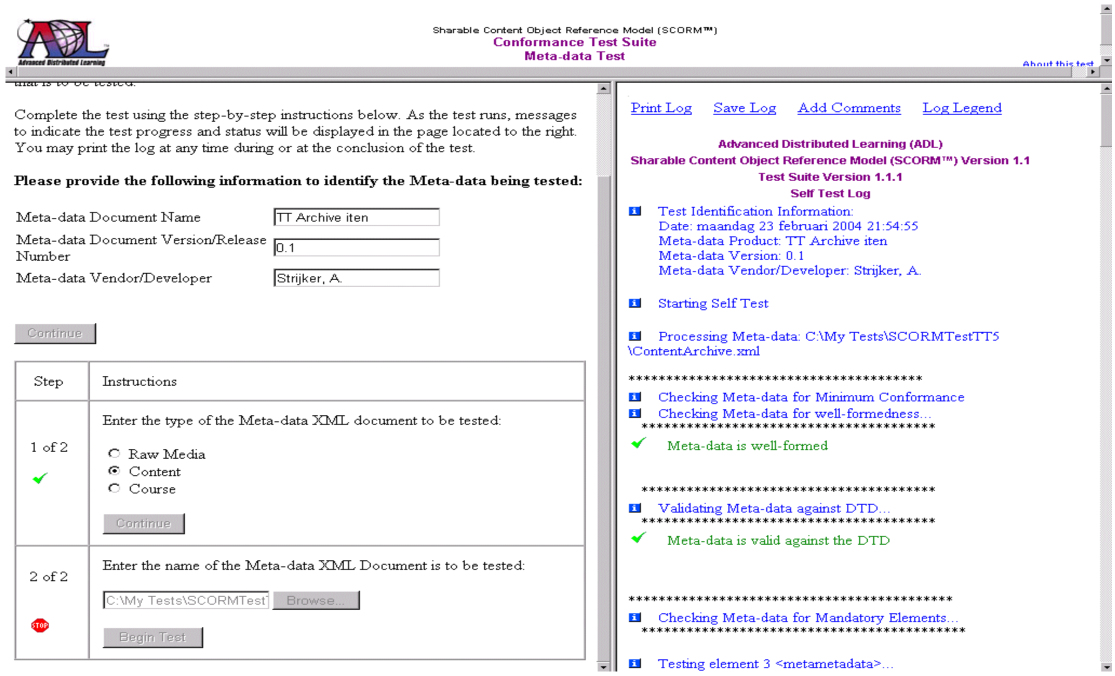


Figure 162 Screen dump of the ADL Conformance test tool

7.2.6 Where does reuse take place in terms of systems?

Several systems were used in the research project to test the re-developed course material and see how LMS systems behave. The system provides the possibility to use ADL SCORM™ compliant packages. It unpacks the zip files, reads the metadata, and stores the needed information in the system. The system provides and stores all user data required to make a ADL SCORM™ compliant course work. The system uses databases to hold the different types of data such as test results, user information, and time needed for assignments. The organisation can decide based on its needs what kind of database to use. LMS functionalities include tracking, tracing, user management, and course handling. The LMS just “plays” the courses as they are developed and no human interaction is needed during the courses. The use of ADL SCORM™ compliant courses within the LMS supports the interoperability of learning material and the requirement that material can be exchanged between different systems.

The use of databases, the use of the Internet and web-based applications, and the constant interaction between users, course material, and LMS, ask for large resources in terms of servers, clients, and connections. The LMS engines have to provide personalized web pages based on the requests of the user, the structure of the course, and the former actions of the user. These data sources have to be combined and assembled in real time. Different systems have to work together to provide the actual course. Figure 163 shows the software applications involved in this process.

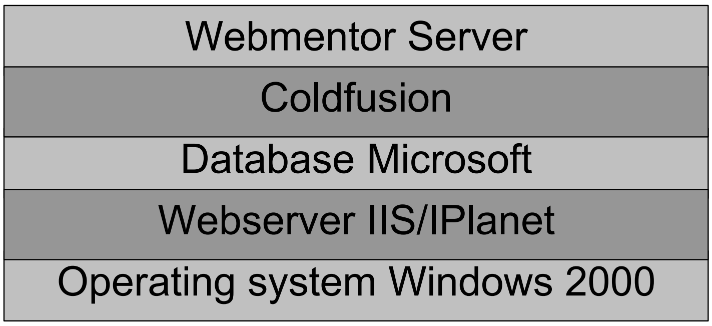


Figure 163 Applications and systems needed for Webmentor™

This descriptions of levels is given because technical problems occurred on every level during the research.

The Webmentor™ server is based on a set of software applications that all have their own functionality. Webmentor™ is a set of templates and interfaces developed with Coldfusion™. The developed templates provide interfaces using forms and documents to present data. To make the use of database functionalities available to the web Webmentor™ uses Coldfusion™ as database manager. Coldfusion™ is a package that can be used to develop templates, interfaces, and database functionality. Coldfusion uses an own script language for development of the database interfaces. Database connections such as ODBC are used to access and manage databases. Coldfusion™ gets its requests from the web server and acts upon these requests using the database as data source and templates to construct HTML pages which are sent to the web server.

This means that the system can be configured to the wishes of a certain organisation. If an organisation already works with a set of applications and knowledge is available, such an application can be used. The flexibility of the systems is completely based on applied standards. Between every layer such as Coldfusion™ and the Microsoft™ database different standards are used. Some standards are configured automatically, but others such as open database connections (ODBC) and port numbers for the web server need to be configured manually. This is mainly a task of the IT department, but the specific needs of the complete set of applications did not match the available knowledge and support of the IT department. For the set of software packages the following choices had to be made:

- Type of operating system and version
- Web server
- Database

The initial choice to use Webmentor™ forced the IT department to set up a Microsoft™ environment because only Windows™ was supported by Webmentor™. A Windows™ 2000 version was selected as latest stable version available. The web server was not part of the Webmentor™ software package and had to be installed and configured separately. The initial web server used was part of the Microsoft™ Internet Information Services (IIS). This system was very vulnerable for unauthorised access because of security problems in the source code of the Microsoft™ web services. After a new installation with updated software the web server was still vulnerable for unauthorised access and the decision was made to install a Netscape IPlanet web server because of the good experiences of the IT department with this software package. This included another level of user management, because the IIS user management was integrated in the operating software, but the IPlanet web server needed a separate user-management system of its own.

Various databases such as Oracle, DB2, and Microsoft™ can be used to store the data that are managed by the Webmentor™ LMS. Different interfaces are available to make connections to the different databases. However a connection such as ODBC had to be established to make the database available to various applications such as web services. Because no system databases were available a default Microsoft™ database was installed. This database was included with the Webmentor™ package. Microsoft™ Access was used to access the database to see the data stored by the LMS.

Because of security risks and the attacks on the LMS server, a firewall was installed to secure the web server against hacking. Only a port for HTTP requests was made available using the default port 80. Initially also a FTP port was made available, for sending course material over the WWW to the LMS, but the fact that username and password are sent unencrypted over the WWW was not tolerable for a military setting. Because of this security problem course material had to be physically put on the server. Small errors had to be fixed in the neighbourhood of the server to test if the material actually could run. Otherwise there was no possibility to place the redeveloped material on the server. Material developed in GWW-The Peel had to be transported using CDs (compact discs) to the server in Den Haag because the network could not be used for security reasons.

The use of a firewall because of security reasons caused problems with the use of the LMS. The configuration of the firewall and the LMS are shown in Figure 164. The data needed for the runtime environment did not pass the firewall. Several tests with sample courses did not succeed with the firewall in place. The developer of the Webmentor™ LMS Avilar did not have experience with the use of firewalls, and could not support the problems experienced with the system. Avilar could also not support the research with ADL SCORM™ compliant sample files that could serve as test material.

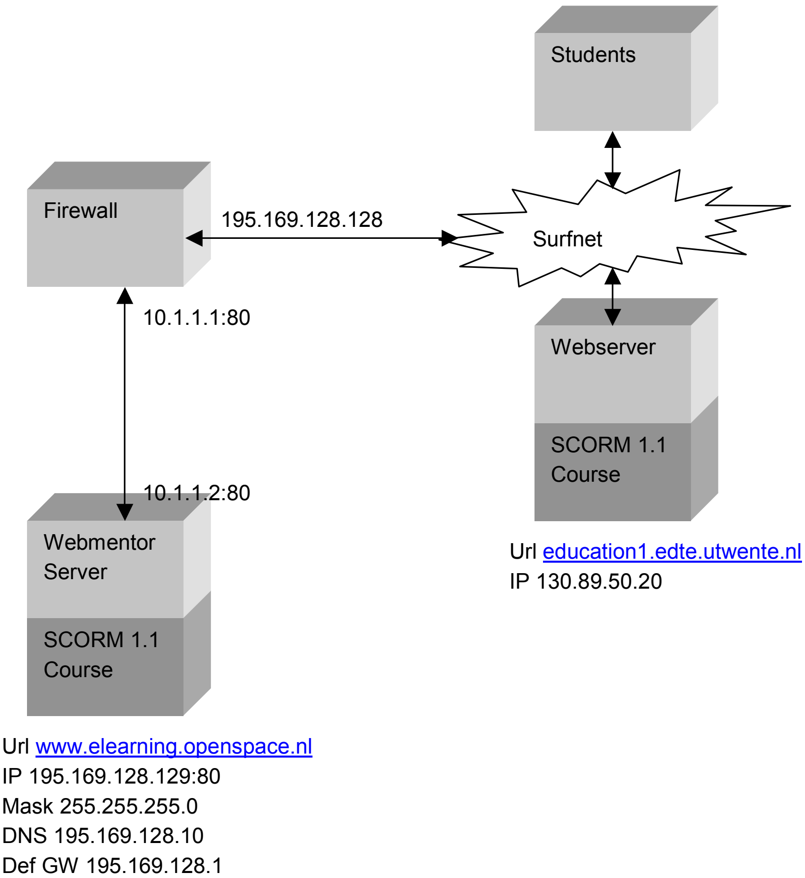


Figure 164 Configuration firewall

The LMS was also tested without the firewall with the draft versions of the redeveloped course “Military Ranks”. Also TeleTOP® CMS courses were tested to see if the implemented ADL SCORM™ functionality could be used in the Webmentor™ LMS. These tests varied in success, resulting in the fact that material was accessible and did run on the TNO network, but was not accessible on the network of the University of Twente. Reasons could be found in different operating systems or browsers. The sets of material were tested for ADL SCORM™ compliancy with the ADL SCORM™ testing suite and no errors were found. Figure 164 shows the configuration of the network and the servers with LMS, CMS, and firewall. Material was stored locally on the LMS or remotely on the TeleTOP® CMS server of the University of Twente. The locations of the material were defined in the course-structure format file that was used by the LMS server to locate the content.

Another problem related to the use of the LMS was the use of a proxy. The HTTP Proxy was used for caching pages and pictures that were heavily used. This reduces the server load because not all requests have to be handled by the server, but the proxy can only serve requests that are already available from the cache. The LMS however needs all requests to run properly. Also the user-tailored pages gave problems, showing not-updated pages.

The courses from the TeleTOP® CMS did run after loading the course structure (CSF) files into the LMS. Within these TeleTOP® courses no AICC (Section 3.3.1.7) was used so tracking user data was not possible. TeleTOP® courses with AICC runtime implemented did not run because of problems with data exchangeability between domains using JavaScript. The redesigned part of the “Ranks” course ran only within the TNO FEL network but was not accessible outside the TNO network. Also ADL example courses did not run properly because of problems with AICC runtime and exchanging data with the LMS.

7.2.7 The learning-object lifecycle: Summary of the ADL SCORM™ pilot RNLAF project

Obtain – The material obtained came from different resources. The main resource was the developed CBT material for two courses from the division of GGW - de Peel. This material was selected and modified to the ADL SCORM™ modifications. The material was originally developed with authoring tools such as Authorware™. Also photo-editing software such as Photoshop was used for the development of course material.

Label – The material such as movies, pictures, and pieces of course material were not labelled for reuse but stored on hard drives in a network environment. The courseware developers could access material when needed and find material based on the folder names and file names.

Offer – Offering of material was not part of the learning-object lifecycle in this project because no material was actually available for use outside the specific Air Force in this project context.

Select – The selection of material was mainly based on a folder structure and file names in the folders. The folder names were based on the courses, and the source code of the courses was also stored in these folders.

Use – The material are revised when pieces of courses are outdated. Old versions of the course are used to create new versions of the courses. The source code is updated and new runtime versions of the courses are created.

Retain – Courses are no longer used if the material no longer fits the needs of the instructors. Course material is mainly used in the Air Force Learning Centre and new versions are used when available. When new courses are developed, old versions are no longer used for training.

The overall conclusions of the ADL SCORM™ pilot RNLAF project were related to technical problems such as software and hardware, but also transforming the ADL SCORM™ specifications in practice. Only very simple courses (Military Ranks) could be redesigned to the ADL SCORM™ specifications. Also the technical problems with the LMSs were very surprising. The fact that no actual "ADL SCORM™ Compliant" material was available for testing made the setup and evaluation very problematic.

7.2.8 Secondary research questions for the ADL SCORM™ pilot RNLAF project

Based on the learning-object lifecycle and findings from the human and technical perspective questions the secondary research questions can be answered:

TQ1. Granularity and standards – The granularity of the material is based in the experiences of the courseware developers. The size of the objects depends on the intended reuse in practice and the possibilities offered by the ADL SCORM™. Material needing regular revision is seen as more important for definition as learning objects compared with material that has a long lifecycle. The implementation of the ADL SCORM™ specifications in existing course material was possible in the simple Military Ranks course. The fact that original source codes were reusable for implementation and the experience of the developers made it possible to create pilot versions of portions of the course to test with a LMS. The ADL SCORM™ implementation focused mainly on the restructuring of courses in SCOs and the aspects relating to runtime specifications.

TQ2. Tools – To develop courses, mainly Macromedia Authorware™ was used to create highly interactive course material. Authorware™ is an authoring tool that is used worldwide for developing courseware and the product follows new developments related to ADL SCORM™ very closely. Early implementations of AICC were already available in the Authorware™ tools. The functionalities to create ADL SCORM™ compliant material are available in Authorware™. Authorware™ includes different sorts of packagers that make it possible to create courses as stand-alone executables, but also available for the Web. A Shockwave web-browser plug-in is needed for actually using the material. If needed the packager used for the web can also reduce the file size of large pictures using compression algorithms but this may also result in lower quality of pictures.

TQ3. Systems – The LMS system used was intended to test redeveloped course material and to help TNO become aware of the practical issues related to ADL SCORM™. The installation of the system resulted in a set of security problems that caused problems in the LMS functionality. The technical problems were related to the use of web servers, a database, a firewall, security, and the particular LMS software.

HQ1. Organisational context – In this project reuse and research concerning standards were part of the organisational strategy. The military context demands a secure and protected environment. This is related to access to buildings but also to networks and computers. The awareness of these risks and also the experiences with attacks on the LMS server show that these precautions are also needed.

HQ2. Learning scenarios – The learning scenarios within the military context focus on training. Training can be face to face but also computer based (CBT). This CBT material will become more important in the future because of the travelling costs involved with face-to-face instruction. The use of the Internet is expected to be effective in terms of time investment, travelling costs, and individual learning.

HQ3. Object creation - Authorware™ can be used to integrate multimedia in course material and provides possibilities to make multimedia material interactive in terms of clickable hotspots on videos or pictures. The multimedia material used during the development of the courses was provided by multimedia specialists via photos, pictures, videos, and animations. These types of material are edited with tools such as Adobe Photoshop or Adobe Premiere which have been designed for a user market.

HQ4. User support – The course developers of the RNLAF are supported with TNO research projects to gather information about new developments in learning technologies. Most of the knowledge of the course developers about the Authorware software tools comes from manuals and courses. Instructors are supported if they have technical problems with the provided courseware.

HQ5. Metadata – The material is not described with metadata. In the project some metadata descriptions were created to use the material in the LMS. These descriptions were added to the course-structure format to let the LMS know what course material was placed in the LMS. Material was selected based on folder names that carried the name of the course and filenames in combination with extensions. The extensions are used to recognize the different types of material.

7.2.9 Key observations of the researcher for the ADL SCORM™ pilot RNLAF

The project showed a lot of unresolved problems within the ADL SCORM™ specifications related to the AICC runtime specifications but also in the documentation. Also the security issues within the military context were interesting to see. Most time in the project was not spent on the actual implementation of the standards but solving security issues and setting up software and hardware. The implementation of the standards was easy in the simple course once the specifications were clear. The project showed also some important limitations of the ADL SCORM™ model. The Aircraft-Recognition course needed a complete redesign and educational ideas within the course were difficult to realize using ADL SCORM™ specifications. The fact that SCOs were not able to start in parallel was a problem.

7.3 LCMS Project

The LCMS project begins with an introduction of the context with a general description in Section 7.3.1. Section 7.3.2 describes why reuse takes place in this context, Section 7.3.2 describes who was involved, Section 7.3.4 describes what material was reused, Section 7.3.5 how reuse takes place, and Section 7.3.6 where the learning objects are stored in terms of systems. Section 7.3.8 summarizes the project based on the stages of the learning-object lifecycle, and Section 7.3.9 summarizes the key observations of the researcher.

7.3.1 General description and role of the researcher

The LCMS project was initiated by the RNLAF as a research project to discover the use of LCMS functionalities in CBT development. This section describes the development of the LCMS for the research project.

Three main aspects of the LCMS project were important for the research:

- The development of a LCMS for the RNLAF and RNLA and tools to make material accessible for the course developers.
- The implementation of the ADL SCORM™ specifications in the LCMS. The development of classification paths and the construction of a set of keywords.
- Because of future developments related to learning technologies and reuse of material using learning objects the RNLAF and RNLA required a LCMS for an inventory of possibilities of a repository for learning objects.

The researcher in the role of developer was asked to develop such a LCMS based on the ADL SCORM™ specifications and requirements of the RNLAF and RNLA.

The requirements were based on the learning scenarios used in the RNLAF and RNLA. The RNLAF and RNLA use within their internal training and learning processes more and more computer-based training (CBT). To get a grip on the widespread developments in CBT production and to get optimal benefits for its undertaken efforts, the Royal Army is standardizing methodology and content for producing CBT. Standardizing methodology and content creation involves a focus on tools that can support the course developers with developing and reusing learning materials. Template-based authoring tools for the development of multimedia content and the use of learning content management systems (LCMSs) for the management of available e-learning/CBT material are also used for standardization. Related to the implementation of the standards, aspects related to functionality, usability, and technical issues of these tools and systems are researched. Thus one of the focuses of the LCMS research was the metadata labels that would be needed and another focus was the use of this metadata in terms of searching and storing material in a LCMS (Boot & Bots, 2002).

The role of the researcher could be characterized as developer. The researcher was asked to participate in the research and to develop the LCMS used within the LCMS research project.

7.3.2 Why did reuse take place?

Reuse takes place within the military context because the development of new material for CBT course material is expensive and time consuming. Reuse from earlier developed material can reduce production costs, and support a efficient way of working. The LCMS research project was initiated by the RNLA to see if reuse of material could be harmonized using standards. The use of various authoring systems within the military make it difficult to share and exchange material. The LCMS project focused on the question of how reuse could be supported in terms of systems and tools and what should be the requirements when a LCMS and an authoring tool are in place.

7.3.3 Who was involved?

A project group was formed by TNO to carry out the LCMS research for the RNLA and RNLAF. The University of Twente was asked to participate in the project because of its specialized experiences with ADL SCORM™ implementation in the TeleTOP® CMS. The researcher was asked to join the project because of his specific knowledge in this domain. The LCMS was developed for the RNLA and RNLAF.

7.3.4 What was reused?

The material used within the project could be characterized as assets and SCOs. The assets were in the form of photos, videos, and Microsoft Word documents. The SCOs were created with the SCO-Generator. The SCO-Generator is described in the next section. The results of user experiences with the reused objects and the LCMS are described in Section 7.3.7.

7.3.5 How was reuse supported?

For obtaining material a software program SCO-Generator was used. This program was developed for the RNLAF (Royal Netherlands Air Force), based upon a prototype of the RNLA (Royal Netherlands Army) namely the CBT Generator. Both tools where based upon a similar commercial product, the Easy Generator developed by NIAM-TMS (www.niam-tms.nl). The SCO-Generator is an authoring tool based upon didactical templates that can simply be filled by means of wizards. Different kinds of multimedia files (in ADL SCORM™ terms: assets) can be easily imported. The learning content obtained with the SCO-Generator consists of a set of ADL SCORM™ version 1.2 compliant learning objects packaged together into a course. According to the ADL SCORM™, these learning objects can be SCOs (lessons, parts of lessons, or exercises) that can be run separately, or Assets (graphics, documents, or video files) that are included in SCOs. The didactical model embedded in the templates corresponds completely with the didactical principles used within the RNLA (Boot & Bots, 2002). The pedagogy is oriented to the acquisition of content. Figure 165 shows a screen dump of the wizard of the SCO-Generator.

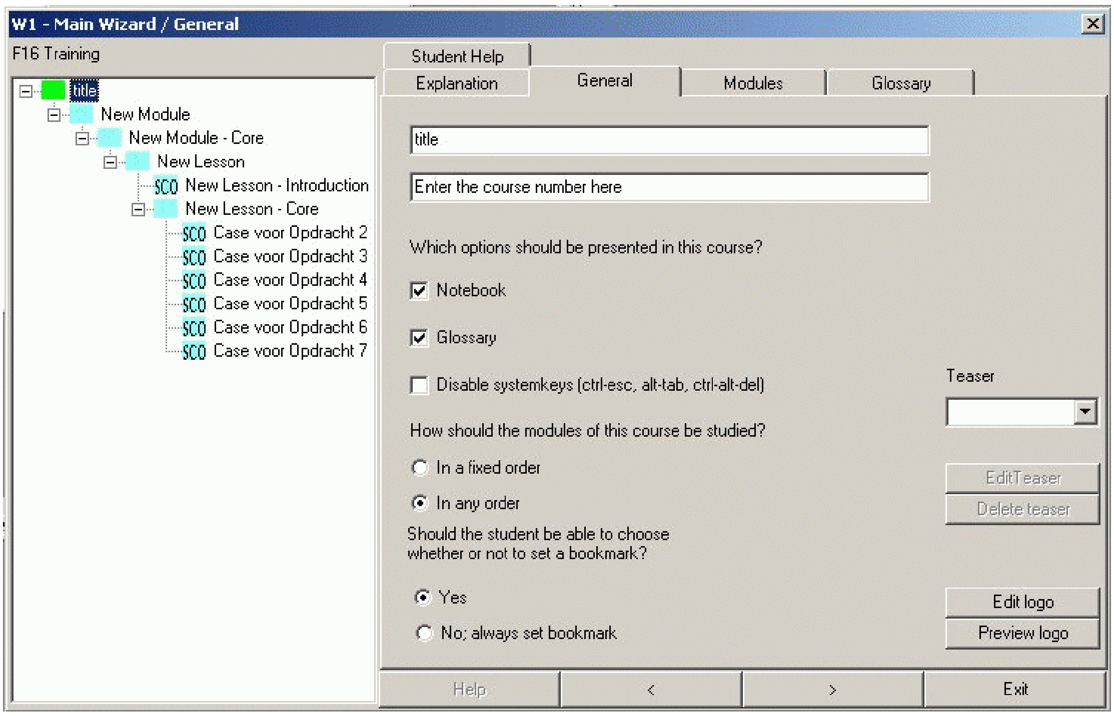


Figure 165 Screen dump of the SCO-Generator wizard

Functionalities were implemented in the SCO-Generator to describe the course material with metadata. Figure 166 shows the metadata editor of the SCO-Generator.

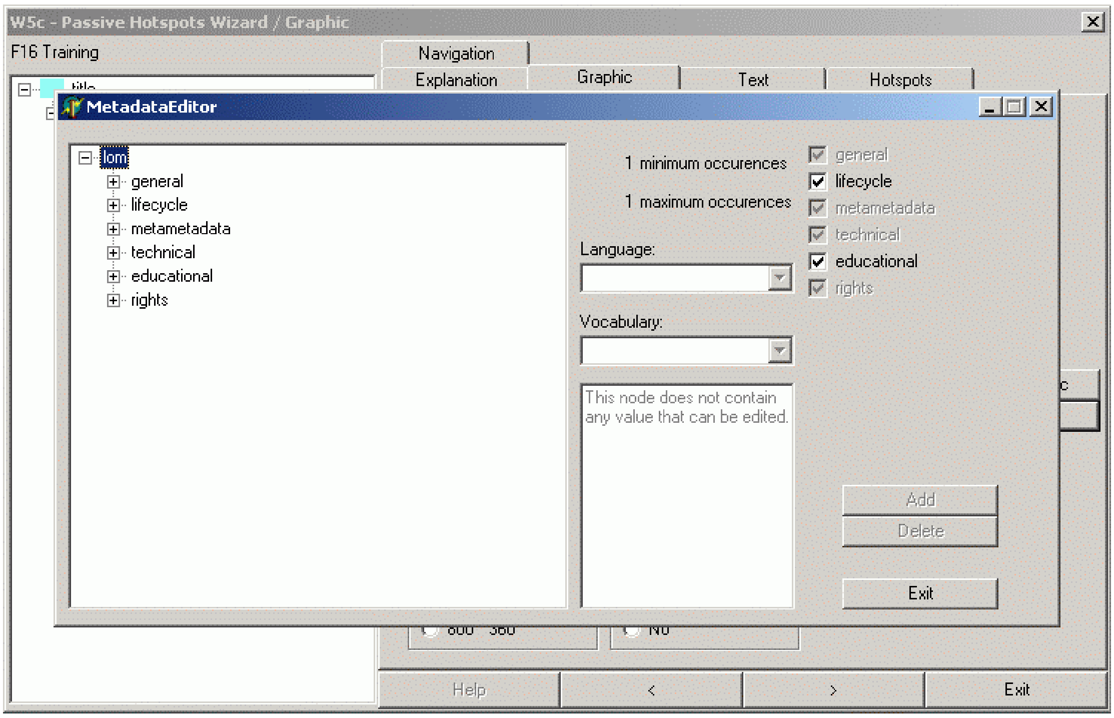


Figure 166 SCO-Generator metadata editor

To store the course material a LCMS was developed based on the functionalities available in the TeleTOP® CMS. The SCOs created with the SCO-Generator were stored in this LCMS as zip files for reuse. Figure 167 shows the form used to store SCOs in the LCMS. The required metadata is based on the ADL SCORM™ version 1.2. The form used was tailored for the user group and for the description field a guideline was developed. This guideline was developed for a more consistent and readable description for the material. Several search options were offered to find useful material.

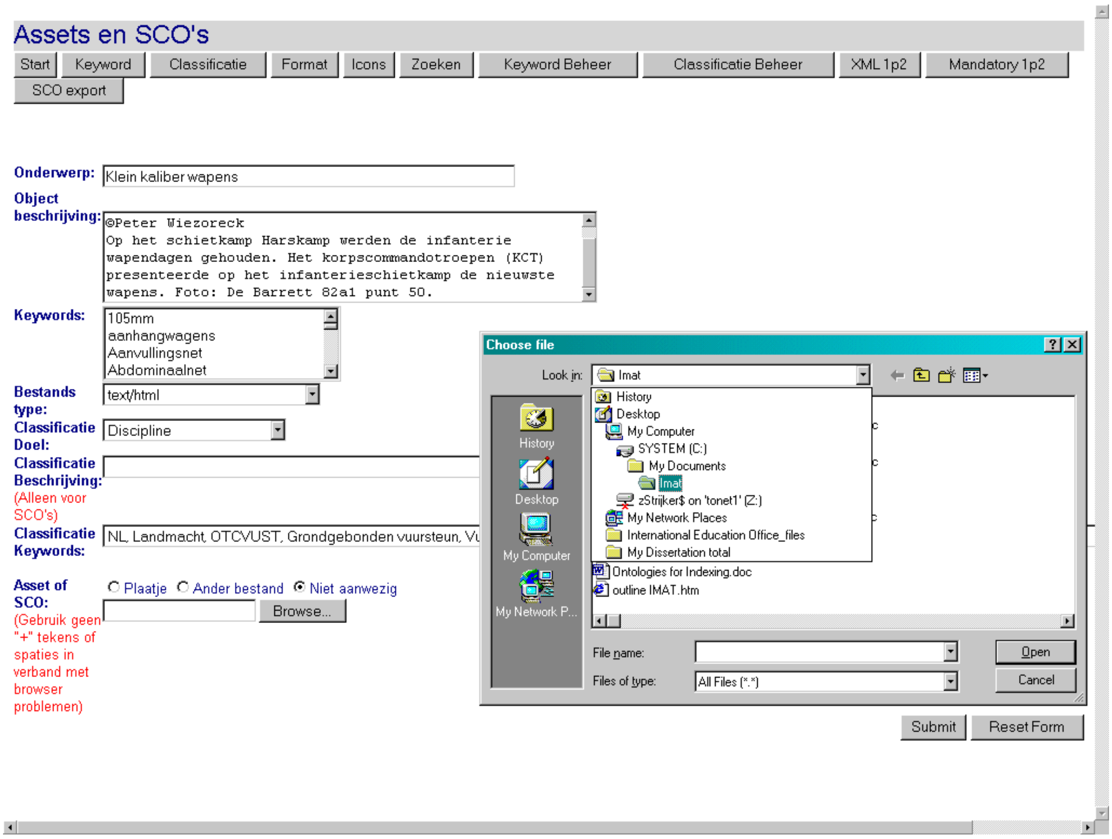


Figure 167 Assigning metadata to material in the LCMS

7.3.6 Where did reuse take place in terms of systems?

The LCMS used for the LCMS research project was developed by the researcher based on the requirements of the RNLA. These requirements were mainly based on the specifications for elements of the ADL SCORM™ metadata set. Visscher (2002) describes why the metadata set is used. A Dutch translation (Table 27) was used for the metadata items to make the assignment of metadata as easy as possible for the instructors.

Table 27 ADL SCORM elements used in the LCMS

ADL SCORM™ elements	Dutch translation
1.1 Title	Onderwerp
1.5 Description	Object beschrijving
1.6 Keyword	Kewords
4.1 Format	Bestandstype
9.1 Purpose	Classificatie Doel
9.2 Description	Classificatie beschrijving
9.3 Keyword	Classificatie Keywords

Required elements that could be calculated from the stored material such as file size and file type were not shown as fields that had to be filled in. The material was stored by subject-matter experts (SMEs). These SMEs filled in the metadata based on a guideline for describing the material such as describing the location and what is shown on photos. Figure 167 shows the form and the metadata set that had to be assigned to each piece of stored material.

The selection of keywords and classifications was based on vocabularies to make the data set consistent. The vocabularies can be managed by adding and deleting keywords and classification paths. Figure 168 shows how classifications can be added to the vocabulary.

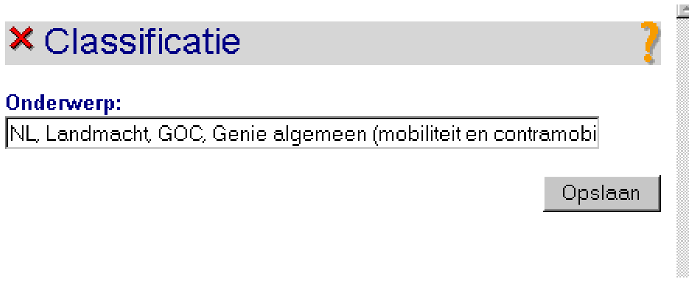


Figure 168 LCMS management and the creation of classifications

The classification path is based on the organisational structure of the Armed Forces. This classification path is based on the country, armed force, department, sub-department, sub-sub-department. Figure 169 shows examples of how this is used in practice. The comma separates the different values in the classification path. This to exclude the possibility that participants in the user trials research would find more than one path applicable.

Figure 169 LCMS management of classifications

Based on the provided classification path the material could be selected. The classification path was shown as a tree structure and participants could browse through this structure. Figure 170 shows how the classification structure was used to select material. The selection was made based on the classification path and the final selection was based on the creation date, creation time, subject, and a small icon of the pictures or an icon related to the file type. Icons were used because in many cases the same titles, such as “Voertuigen” in the following figures, were given to different materials.

Figure 170 Selection of material in the LCMS based on classification

The management of keywords was used for several reasons. The use of a consistent list of words makes it easier to assign material predefined set of words, participants do not have to make up new words as they can be selected from a predefined list. This means that users do not have to type words and wrong spelling does not occur. Figure 171 shows keywords that could be used in the LCMS. An original list of keywords was defined in by the multimedia team who had stored the material in the LCMS.

Figure 171 LCMS management of keywords

The keywords could be used to select material. Based on the metadata element “keyword” list of used keywords was presented showing all material assigned to the keywords, Figure 172 shows this. Text used for other elements such as description and classification were not used in this list. The selection was made based on the keyword and the final selection was based on the creation date, creation time, subject, and a small icon of the pictures or an icon related to the file type.

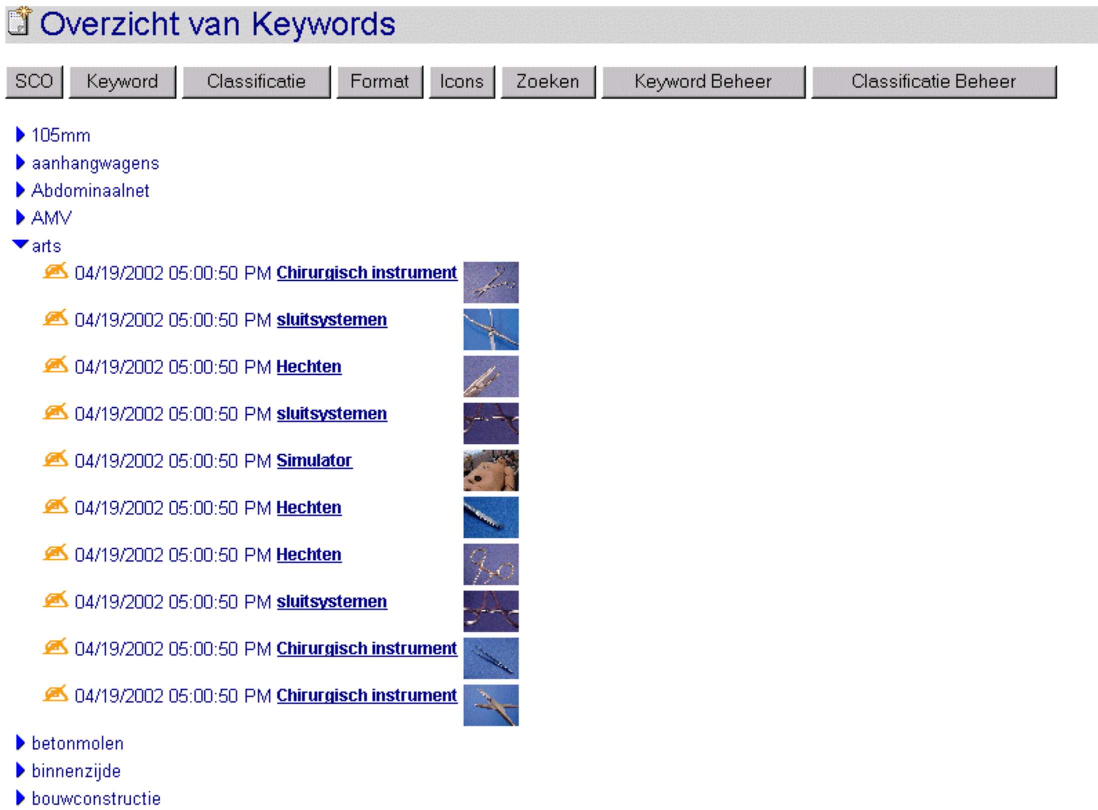


Figure 172 Selection of material in the LCMS based on keywords

The metadata related to the file types of the material were based on the extension of the stored material. Figure 173 shows how different types material such as flash, zip, gif, jpeg, and, HTML are used to make selections possible of certain material. Once a type of material is selected, choices are made based on the date of creation, the subject of the material, and a representing icon if available.

Figure 173 Selection of material in the LCMS based on file type

Because a large set of the material is pictures, material could also be selected based on icons. Figure 174 shows how this selection possibility was made available to the users.

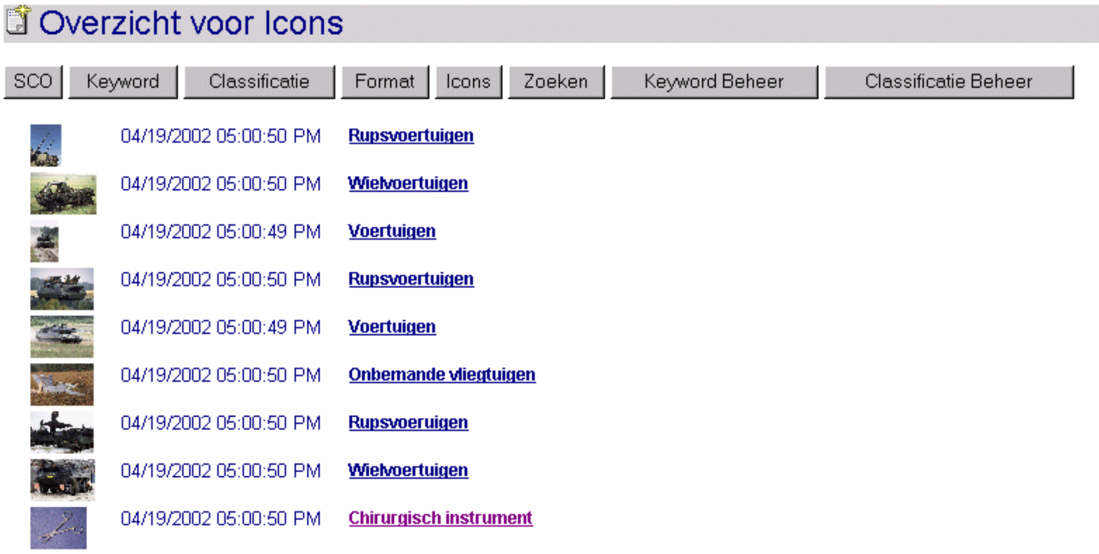


Figure 174 Selection of material in the LCMS based on icons

Besides the structured selection of material, also a full-text search was available on all metadata. This means that keywords can be provided, and the search engine searches in all metadata elements such as subject, description, classification path, and file type. Figure 175 shows the simple search option available.

Figure 175 Searching for material in the LCMS based on keywords

Besides a simple search form a more advanced form was available to search with more criteria such as creation date and similar words. This search functionality was based on the Lotus Notes Search engine for databases. This makes it possible to search for close related words specified. Figure 176 shows the advanced search form for users.

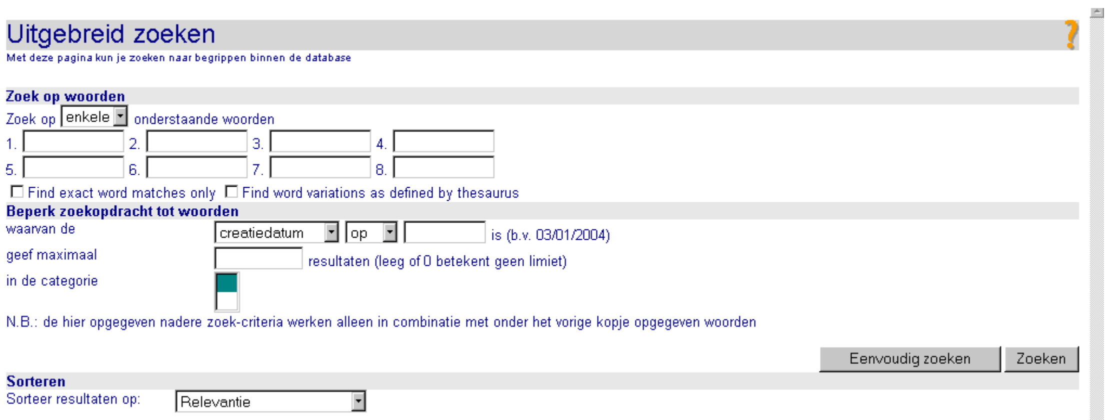


Figure 176 Advanced search for material in the LCMS

Figure 177 shows how the search results are displayed when search options are used.

Figure 177 Search results within the LCMS

Related to the developments of the LCMS for the military a summary was conducted based on the experiences with users, systems and requirements. The following section describes the user experiences and research results of the LCMS

7.3.7 User experiences and research results of the LCMS

The LCMS was developed for a research initiated by the military and carried out by TNO Human Factors. The outcomes of the research are described in Boot, Bots, and van Schaik (2003) and summarized here because the outcomes are relevant for the research. Besides the summary from the research done by Boot and Bots (2002), log files and the contents of the repository were analysed by the researcher and added to the conclusions. The research questions, experimental design, participants, test environment, tasks, materials, and results are described as follows:

- *Research questions for the LCMS research project*

  The three research questions defined for the RNLA research were the following:

  > *"Firstly, are domain experts as non-experienced developers able to develop qualitative good learning content efficiently by means of creating, reusing and adapting learning objects? Secondly, what are the requirements for template-based authoring tools and LCMSs to support non-experienced developers optimally in these efforts? Thirdly, how should metadata for learning objects be used to support non-experienced developers optimally in these efforts? (Boot &Bots, 2002)"*

- *Design*

  Eight representative non-experienced developers from the RNLA were asked to participate in an exploratory study of six days in a laboratory setting. During the six days the developers received a set of develop and content management assignments. The developers were expected to do the assignments with the offered tools that support course development and content management. Before, during and after the development assignments, questionnaires were used to gather information about their opinions. During the development process the developers were monitored by observers. Table 28 shows the design used for the first session during the research. The second session used the same kind of assignments, but for other topics.

Table 28 Design used for the RNLA research (Adapted from Boot &Bots, 2002)

		Teams 1, 2, 3, & 4	
	Days	Assignment	Topic
Session 1	1 morning	1. Saving assets provided by the researchers, by adding metadata and storing in repository	“Medical Instruments”
	1 afternoon	2. Searching assets saved by another team, by means of metadata	Field orientation
	2 whole day	3. Developing SCOs based on a provided didactical scenario using the assets from assignment 2	Field orientation
	3 morning	4. Saving developed SCOs in the repository by adding metadata.	Field orientation
	3 afternoon	5. Search SCOs developed by other teams, by means of metadata.	“Medical Instruments”

- *Participants*

During the assignments the experts worked in teams of two. The teams were used to represent the normal way of working where they are used to work in couples. Working in teams gives the participants also the possibility to articulate their reflections that benefits the process observations. The participants were all subject-matter experts in the domains of Engineering, Medical, Artillery, and Air defence.

- *Environment*

The teams worked independently in small rooms, with two computers with the SCO-Generator installed and access to the LCMS web-client. The computers were connected through a 100 Mb high-speed connection to the server where the LCMS repository was stored.

- *Tasks*

The developers were asked to do five different assignments as described in Table 28. In both sessions different topics for the assets and SCOs were used.

- *Materials*

The LCMS was initially filled with relevant and redundant assets. The redundant assets were provided to challenge search strategies. The relevant assets were available to prevent developers creating multimedia files themselves instead of using existing objects, as this wasn’t the scope of the study.

- *Results*

According to Boot and Bots (2002) the main conclusion of the RNLA research is:

> *“Non-experienced developers like domain experts are able to develop and reuse ADL SCORM™-compliant learning objects, if supported properly. So, the promised benefits of learning objects seem to hold. But this does not mean that reuse occurs automatically and easily within organisation”.*

Related to reuse Boot and Bots identified three bottlenecks in the laboratory situation that should be taken seriously when applied in a real world setting:

- Developers didn’t know from each other that others had learning content available.
- Once developers found out about a potential reuse possibility, problems with the accessibility of learning content and the interoperability between learning systems occurred.

- Incompatibility of the many different technical formats often causes customization, which is often as expensive as creation from scratch.

The functionalities of the LCMS were rated positive and when implemented in practice the same level of functionalities are required. Boot and Bots recommend a concrete policy concerning content management when a LCMS is used in practice. The application of the LCMS repository was successful, but the recommendation of Boot and Bots is that there should be more search functionalities implemented that allow searching by keywords or to do an open search. The usability of the template-based authoring tool, the SCO-Generator, was ranked not very positively because of serious defects and bugs in the software program, but once such a good working authoring tool is available the developers think they can benefit from it. The developers were not familiar with metadata but they rapidly got used to it. Boot and Bots noticed that some metadata elements, such as keywords, are strongly preferred over others. The usability and relevance of the elements Title, Description, and Keyword were rated higher than other fields. The Classification purpose was rated lower than all other elements.

The databases and log files were analyzed to inventory the characteristics of the material stored in the LCMS. Also the use of keywords and the use of metadata for the objects was inventoried to get an overview of practical use. Table 29 gives an overview of the material types in the LCMS during the research. An initial set of 103 keywords was provided to describe all 1006 objects. This set was extended during the research to 270 different keywords, 168 objects were not assigned with keywords. 436 different titles were used to describe the objects, 2 objects did not have a title. Descriptions did change in objects with the same title. 273 different classification paths were provided and 56 different classification paths were used.

Table 29 Overview of material after the research

Type of material	**Number of objects**	**Average size**	**Number of wrong type assigned**
JPG	571	142Kb	20 x gif
ZIP	212	3,22Mb	
BMP	74	165Kb	
AVI	11	10,2Mb	1 x WAV
GIF	28	10,0Kb	
TXT/HTML	11	60,1Kb	27 x JPG 5 x ZIP 3 x DOC 2 x WAV 1 x BMP 1 x PSD
Wav	9	7,14Mb	
PNG	0	73Kb	22 x JPG 8 x GIF
	916		

The research shows that the use of an LCMS in a military context can benefit reuse and support course developers with the development of course material.

The research was repeated in a similar setting for the RNLAF with 16 other course developers. The topics for the assignments were related to “Safety Wiring”. The results of this research were not available at the time of writing the dissertation, but a partial inventory could be made related to the material stored in the database. The inventory is made to give an overview of the type of assets, the size of the files that are reused.

For the RNLAF research some old material was removed and new material was added to the LCMS because a new group of course developers in another expertise area were participating in the research. All new material was assigned with the same keywords and classification path. Differences could be found in the titles and descriptions. A set of 66 redundant objects were used from the RNLA research to make searching in repositories more realistic. A key issue using material from the RNLA research was the language. Within the RNLA research Dutch terms were used for keywords and classification paths, the RNLAF research used English terms. The material in the LCMS for the RNLAF research was a mixture of material in two languages. This resulted also in the English use of the Royal Netherlands Army (RNLA) instead of "NL, Landmacht" in the classification path. 103 keywords were provided and 64 objects were assigned to the default keyword values "Safety wiring" and "Air force", 46 different keywords were used to describe all 130 objects, 14 objects were not assigned with keywords. The material was described with 125 different titles and descriptions and seven objects did not have a title. 275 classification paths were provided, 13 different classification paths were used, and 74 objects were assigned to the default classification value "RNLA, group safety wiring". Two objects were not assigned with a classification path. Table 30 shows the characteristics of the material used in the LCMS.

Table 30 Overview of material after the RNALF research

Type of material	Number of objects	Average size	Number of wrong type assigned
DOC	8	754 Kb	
PDF	11	213 Kb	
RTF	1	2,04 Kb	
ZIP	8	6,46 Mb	1 x EXE
JPG	87	142 Kb	
TXT/HTML		4,06 Mb	6 x ZIP 1 x empty
AVI	6	6,35 Mb	1 x WAV
	121		9

The overviews of the material used in the LCMS show that in even in a controlled experimental setting errors are made in assigning metadata to objects.

7.3.8 The Learning-Object Lifecycle: Summary and conclusion LCMS project

Obtain – Course developers used the SCO-Generator to create SCOs. These SCOs were placed in the LCMS. The SCOs were packaged as zip files and immediately reusable in the SCO-Generator.

Label – The material was labelled by the course developers when stored in the LCMS. The initial material was labelled by subject-matter experts.

Offer – Material was offered through the LCMS. After storing material in the LCMS all other course developers could reuse the stored material. Besides the material stored by the course developers the LCMS was filled with material that was selected for the tasks.

Select – The material was selected using different taxonomies such as based on keywords, file type, and organisational classification. Also search engines were available for full text searches on the metadata.

Use – The course developers could use each other's SCOs, but also other resources in the LCMS. Initial stored material for the research in the LCMS was selected based on near fit. Used material was expected to be edited before use.

Retain – The research did not focus on retaining material.

7.3.9 Secondary research questions for the LCMS project

Based on the learning-object lifecycle and findings in the human and technical perspective questions the secondary research questions can be given preliminary answers:

TQ1. Granularity and standards – The LCMS project used a LCMS that was ADL SCORM™ compliant. Also the SCO-Generator was based on the ADL SCORM™ specifications. The research was based on the need of the organisation to harmonize the various tools used and to see how a future solution could work. The granularity of the material differed from assets such as pictures and movies to compete modules and lessons. The SCO-Generator gives the possibility to export SCOs of every size, including complete lessons or just parts.

TQ2. Tools – The tools used in the research were limited to the SCO-Generator and the LCMS. Restrictions were made for Internet access and the use of other tools to keep control over the material used and the changes made to the material. Changes were only allowed in the textual parts of the material such as descriptions, assignments, and explanations to avoid that course developers spent hours on graphical details.

TQ3. Systems – The LCMS used was developed for the research and was based on the ADL SCORM™ specifications. This meant that the functionalities for assigning metadata were implemented, but also stored material could be exported as a SCO.

HQ1. Organisational context – Using standards and following ADL SCORM™ are organisational strategics of the RNLA. This research project shows how future systems can work using a central repository where material can be stored.

HQ2. Learning scenarios – The learning scenarios within the research are based on original acquisition-oriented course designs, but also on the templates used in the SCO-Generator. The templates used in the SCO-Generator guide the course developer during the creation of a course. Based on templates clues are given how to interact during several stages within a course such as introduction, content, and evaluation.

HQ3. Object creation – The objects are created with the SCO-Generator and contain various sorts of material such as pictures, movies, and text. The created objects have a fixed format because of the used templates in the SCO-Generator. The structure of objects within lessons is also fixed because of the use of the templates. The subjects and content of the material depend on the course developers.

HQ4. User support – During the research the course directors were constantly supported for technical problems. This was also needed because of the problems with the SCO-Generator. This version was not tested in real practice and some problems came up during the research. Also the use of the LCMS and new functionalities needed to be supported.

HQ5. Metadata – Metadata could be assigned when material was placed in the LCMS. Course developers could use these metadata to search and select valuable material. A minimal ADL SCORM™ set of metadata elements was used to describe the material.

7.3.10 Key observations of the researcher for the LCMS project

The development of an LCMS for a military context based on ADL SCORM™ specifications shows that a minimal set of metadata is sufficient to select material. Finding useful and consistent vocabularies or taxonomies is very difficult. The fact that material such as competence descriptions and learning objectives are classified makes them impossible to use as taxonomies for all users.

The type of material stored in the LCMS can mainly be characterized as photos and videos. This type of material is difficult to describe and an extra guideline was developed to describe each photo to make each photo unique in terms of metadata.

7.4 Project Implementation of ADL SCORM™ in IMAT

The IMAT (Integrating Manuals and Training) project is introduced with a general description of the project in Section 7.4.1. Sections 7.4.2 and 7.4.3 focus on the human perspectives. Sections 7.4.4 – 7.4.6 describe the technical perspective based on the What?, How?, and Where? questions. Section 7.4.7 summarizes the project based on the stages of the learning-object lifecycle and Section 7.4.8 gives initial answers to the secondary research questions. Section 7.4.9 describes the key conclusions of the researcher. The section is based on the TNO report TM-02-A028 “Future developments: A ADL SCORM™ compliant system” written by Veermans, Veldhuis, Jacobs, and Strijker (2002).

7.4.1 General description and role of the researcher

The goal of the project “Implementation of ADL SCORM™ in IMAT” was to describe how well the ADL SCORM™ specifications can be implemented in the existing IMAT system. IMAT is a system that makes it possible to convert technical manuals to tagged fragments for learning purposes. The project was initiated to research if the outcomes of the IMAT system in terms of fragments could be used as learning objects compliant with ADL SCORM™. The IMAT data model was compared with the ADL SCORM™ specifications and the IMAT data model was mapped to the ADL SCORM™ data model. Within the research the IMAT elements were also mapped or converted to the required ADL SCORM™ data model. Missing elements were constructed from other similar IMAT elements. Also the use of the ADL runtime model was researched and recommendations were given to implement such a runtime model. Within this project description the IMAT system will be described in detail to give information about tagging fragments with instructional metadata and using ontologies for the fragmentation tools.

The ADL SCORM™ IMAT project is based on the earlier IMAT projects where a set of tools was developed to support effective and efficient reuse of technical manuals for instructional purposes. In 1999 the IMAT Project started with the development of the IMAT P1 (The first prototype of the tools). This project was followed in 2000 with the development of IMAT P2 and the IMAT P-final in 2001. The project for the current research is based on the IMAT P-final. Besides the tools to support reuse also a repository has been developed in the IMAT Project to store and exchange material.

The material was obtained from technical manuals as delivered by the manufacturers of equipment. The manuals are divided in small fragments of homogeneous content. The content is stored in the developed repository in such way that it could be retrieved to create computer based training (CBT) using an authoring environment.

An inventory was made of IMAT users during the project. The inventory of the IMAT system was a substantial part of the project because the IMAT data-model was much too limited for a full implementation. The inventory gave insight information of the interpretation of the used elements in the IMAT data model. The inventory focused on the type of users, the characteristics of the material, and the learning scenarios used.

The role of the researcher in the ADL SCORM™ IMAT Project could be characterized as system analyst. The researcher was invited to join the project because of his specific knowledge of the ADL SCORM™ specifications.

7.4.2 Why did reuse take place?

The ADL SCORM™ in IMAT project was initiated by the head of training of the Royal Netherlands Air Force to see if the IMAT system could be used for future ADL SCORM™ compliant systems and make reuse possible. Making use of technical manuals in a digital form for training is seen as a cost effective and efficient use of resources. The initiatives of ADL SCORM™ are seen as important for future exchange of learning material. Indexing, fragmenting, and structuring material for reuse create possibilities for creating new learning material. The addition of instructional ontologies makes it possible to create more individual learning material based on various learning scenarios.

7.4.3 Who was involved?

Within the project an inventory was made of users of the IMAT system to get an overview of who is involved. An inventory of users is important because the users may be important for the implantation of the ADL SCORM™ specifications. An inventory is key for elements such as “Creator” and “Author” in the metadata set.

In the IMAT scenarios Barnard, Kabel, Riemersma, Desmoulins, & Grandbastien (2000) identify three main categories of stakeholders: learners, instructors, and developers of instructional material. The restriction to these categories is not made because there is no importance for the other stakeholders, but because the focus of the IMAT project is on the re-use of technical material for training purposes. These three categories are the direct users involved in this process and the IMAT tools offer them support.

7.4.4 What was reused?

In the project an inventory was made related to the characteristics of the reusable material. The inventory was needed within the project to make estimations how the fragmented manuals could be used as learning objects and how meaning full metadata mappings could be created.

The material stored in the IMAT database comes from technical manuals and Figure 178 gives an example of a piece of a manual that is digitally scanned and analysed using OCR techniques for recognizing text. Text is recognized by using OCR techniques. The reliability of OCR was an important issue because no mistakes are allowed in technical diagrams the user must be assured about the quality of the OCR (De Hoog, Wielinga, Kabel, Anjewierden, Verster, Barnard, DeLuca, Desmoulins, and Riemersma, 2004a). In the ADL SCORM™ in

IMAT project no specific reuse occurred. Instead the focus was on studying the metadata characteristics which would support reuse in later practice (outside the scope of the ADL SCORM™ in IMAT project).

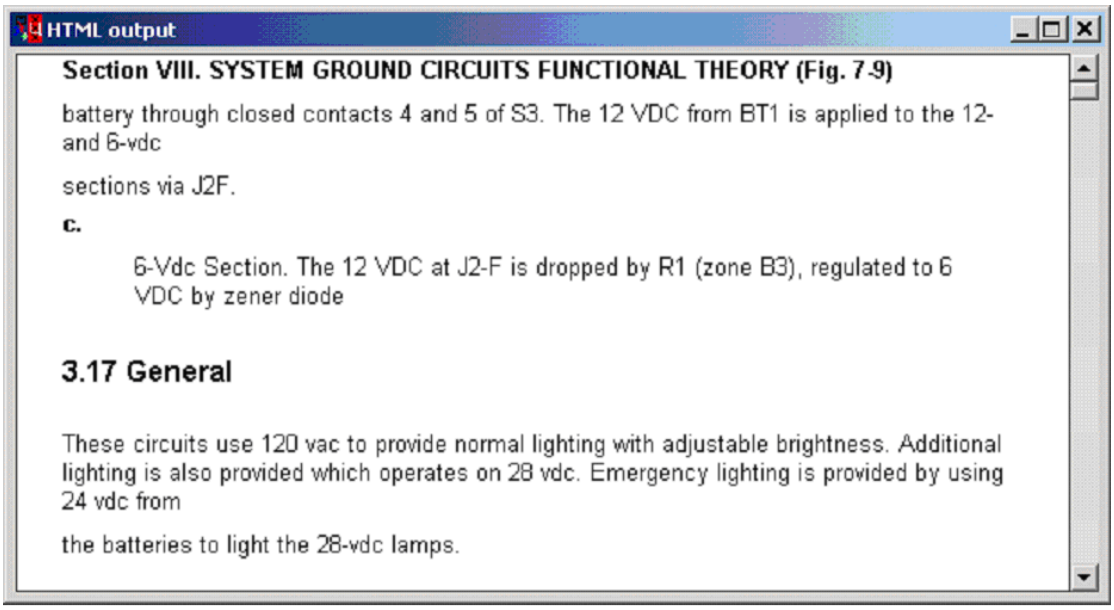


Figure 178 HTML output based on a scanned manual

From the IMAT fragments, different kinds of instructional material can be created. The format and medium differ (paper document, electronic slides, CBT, etc) as well as the authoring tools with which the instructional material is constructed (Word, PowerPoint, Authorware, Toolbook) (Barnard, Kabel, Riemersma, Desmoulins, & Grandbastien, 2000).

7.4.5 How was reuse supported?

Different tools are developed within the IMAT project to support the users in tagging fragments and reusing material with authoring tools. An inventory of tools was made because the use of the tools includes the development of vocabularies, taxonomies, and ontologies that are important for the elements within the ADL SCORM™ metadata set. The different stages within the IMAT process are researched to see how the implementation of the ADL SCORM™ specifications could be integrated in the already available tools.

The different tools and processes within the IMAT system are summarized here to give an overview of related components to come to a useful ADL SCORM™ implementation.

In the IMAT system technical manuals are converted to PDF files. The manuals are the source documents which are analyzed in the document analysis tool based on domain ontologies, fragment ontologies, descriptive ontologies and instruction ontologies. Kabel, Riemersma, & Wielinga, (2001) describe in detail how these ontologies are developed and used for tagging analysed material. Figure 179 shows the different stages of the different conversions used during the analyzing process before material is stored. The digital scanned material is saved as PDF and converted to HTML to make document analysis possible. The digitally scanned material is saved as PDF and converted to HTML to make document analysis possible. The tools developed in the IMAT project were used at three different user sites, each representing different approaches to creating training material and teaching: maintenance of anti-aircraft weapons, car repair, and maintenance of traffic control equipment. For every site another domain ontology was developed.

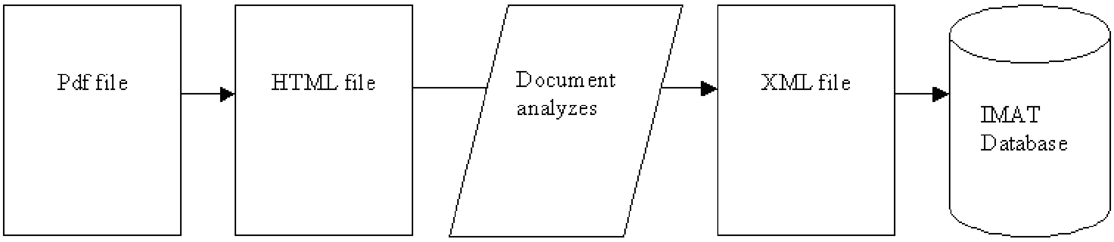


Figure 179 Stages of the IMAT process

How material is analyzed differs based on electronically or paper-based provided material. Supported with different types of ontologies the material is analysed and indexed. Based on this process material is fragmented and labelled according to its specific content. An ontology can be defined as a conceptual description for things such as domains, systems, or tools. Using the analysing tools and indexing tools, metadata are assigned to different levels of the material. This process is done partly automatically (syntactic, semantic, and based on outline) but has to be completed by hand for the domain ontologies and instructional ontologies. Users can add changes, feedback, and experiences to the material using the Organisational Memory and Feedback system.

These annotations are also stored in the repository containing all metadata of the stored material. Using a Scenario tool and an Authoring Environment Interface indexed material can be retrieved from the repository. Using an existing authoring system the material can be reused for task specific course material. Figure 180 shows the different processes involved in the IMAT system

- Digitizing material
- Transformation to PDF format
- Interpretation of the PDF documents
- Finding logical structure in the documents using incremental analysis
- Fragmenting the logical structure and indexing based on ontologies
- Storing material in a multimedia database
- Retrieving materials from the database using Retrieval Tools
- Using the Scenario Tool to create course material in the form of “Instructional Bags”

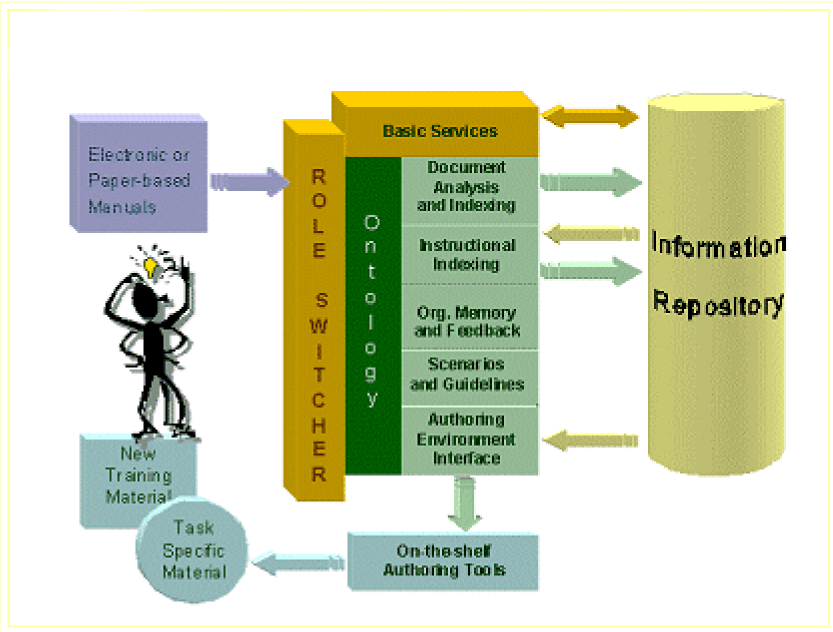


Figure 180 The IMAT system (Veermans, Veldhuis, Jacobs, & Stijker, 2002)

Fragmenting the logical structure and indexing based on ontologies is based on four different ontologies:

- Fragment ontologies
- Domain ontologies
- Descriptive ontologies
- Instruction ontologies

The domain ontologies played a very important part in the IMAT project. They were the cornerstones for automatically indexing fragments as performed by the Documents analysis tool, which in turn was the main prerequisite for making retrieval possible. As instructional indexing cannot (yet) be done in an automatic way, domain concepts hold the key to the operational effectiveness of the IMAT toolset (De Hoog, Wielinga, Kabel, et al. 2004a).

Using ontologies to map the original material, the material can be structured, fragmented, and indexed for storing the material in a database. This means that in the IMAT system four different metadata ontologies are assigned to the fragments that form together the original material. The mapping of the material to the ontologies (assigning metadata) is mainly an automated task. Only in the instructional ontology do annotations have to be made manually. This means that material intended for instructional purposed needs to be classified by hand because the task is too complex to do automatically. The complexity is found in the needed instructional skills and the domain-specific expertise to do so. De Luca and Toritto (2001) describe this issue more in detail.

Based on the ontologies a data model was developed to describe the different objects in the IMAT repository. The data model also describes four categories of objects stored in the database. A object-oriented Jasmine™ database is used as repository to store the indexed material. The four main categories of data types used to store the ontologies are:

- Fragments
- Instructional Material Entities (IM)

- Organisational Memory Entities (OM)
- Contextual Entities Model

The complete IMAT taxonomy is described in Kabel and Wielinga (1999). Based on this IMAT taxonomy an inventory was made in the ADL SCORM™ in IMAT Project of what elements could be identified in the data model. Table 31 gives an overview of elements found in the IMAT P-final data model.

Table 31 IMAT P-Final metadata elements and description, as analyzed in the ADL SCORM™ in IMAT Project

IMAT P-final metadata	metadata description
Fragment	It is the common characterisation for any unit of information. It has no immediate instances of its own but exists only as for defining the characteristics common to audio, pictorial, textual and video fragments
Contents	It is a short mandatory content description
Name	It a label, a name a title identifying the object
userRemark	User's short remarks
content Keywords	Set of concepts in the domain ontology
structuralType	It is a concept in the Fragment structuralType ontology
version	A progressive integer indicating the fragment version: each fragment modification generates a new version of it.
Status	It indicates the progress status: 'Draft of Final'
creator	Is the agent who has created the fragment (person, team or organisation)
creationDate	Is the creation date
Fragment entity	It inherits from the ImatObject. Is an abstract type, which means it has no immediate instances of its own but exists only as the basis for defining characteristics common to all its subclasses
IMAT Third prototype data model	See scheme in p. …..
fragmentSize	The fragment size.
medium	It's a mandatory field provided by the fragment medium ontology
url	Fragment location
Instructional material entity?	
Instructional ontology?	
Instructional bag?	
MaterialUse	It is a set of instructional concepts about the suitable use of the fragment
Author?	
Novice vs expert	Novice versus Expert (values 0...5;Not set, very Low, Low, Medium, High, very High)
Professional Formation?	
Adult trainees ?	
Understanding Efficiency	Understanding Efficiency (values 0…5: Not set, Not easy at all, Not easy, medium, easy, very easy)
annotations	User comments on educational usability and usefulness of the IMAT item.
Pertinent Fragment	It is an abstract type which means it has no immediate instances of its own but exists only as the basis for defining characteristics common to all its subclasses. It defines Fragment-to-Fragments relationship.
pertinence	Its describes the type of relation between pertinent fragments
name	It a label, a name a title identifying the object
Annotation	User comments on educational usability and usefulness of the IMAT item.
maker	Name of the person who made the annotation
VersionDate	The version date
otherinfo	Free text/additional information
Description	It provides information about the content of a fragment. Content's semantics and domain are detailed.
Domain Ontology	Ontology which forms a conceptual description of a specific domain
topic	A domain related concept
ContentKeywords	Set of concepts in the domain ontology

For the ADL SCORM™ in IMAT Project the elements from the IMAT P-final were mapped in Table 31 against the elements in the LOM 1.0. and ADL SCORM™ 1.2. This is shown in Table 32. The table is based on previous work of the University of Amsterdam where the elementary elements from LOM1.0, ADL SCORM™ 1.0, IMAT P-1, and IMAT P-final has been already compared (Veldhuis & Boot, 2001).

Table 32 Mapping of LOM, ADL SCORM™ and IMAT elements (Veermans, Veldhuis, Jacobs, & Strijker, 2002)

IMAT P-final	ADL SCORM™ 1.2	mandatory/ optional/ reserved	LOM-1.0d5
Fragment	1.0 general	M	General
	1.1 identifier	R	Identifier
Contents	1.2 title	M	Title
	1.3 catalogentry	M	CatalogEntry
	1.3.1 catalog	M	Catalogue
Name	1.3.2 entry	M	Entry
	1.4 language	O	Language
Content, user Remarks	1.5 description	M	Description
content Keywords	1.6 keyword	M	Keywords
	1.7 coverage	O	Coverage
structuralType	1.8 structure	O	Structure
?	1.9 aggregation level	O	AgreggationLevel
Fragment	2.0 lifecycle	M	LifeCycle
version	2.1 version	M	Version
Status	2.2 status	M	Status
	2.3 contribute	O	Contribute
	2.3.1 Role	O	Role
creator	2.3.2 Entity	O	Entity
creationDate	2.3.3 Date	O	Date
Fragment entity?	3.0 metametadata	M	MetaMetaData
	3.1 identifier	R	Identifier
	3.2 catalogentry	O	CatalogEntry
	3.2.1 catalog	O	Catalogue
	3.2.2 entry	O	Entry
	3.3 contribute	O	Contribute
	3.3.1 role	O	Role
	3.3.2 entity	O	Entity
	3.3.3 date	O	Date
IMAT Third prototype data model	3.4 metadata scheme	M	MetaDataScheme
	3.5 language	O	Language
Fragment	4.0 technical	M	Technical
medium	4.1 format	M	Format
fragmentSize	4.2 size	O	Size
url	4.3 location	M	Location
	4.4 requirement	O	Requirements
	4.4.1 type	O	Type
	4.4.2 name	O	Name
	4.4.3 minimum version	O	MinimumVersion
	4.4.4 maximum version	O	MaximumVersion
	4.5 installation remarks	O	InstallationRemarks
	4.6 other platform requirements	O	OtherPlatformRequirements
	4.7 duration	O	Duration

Table 32 continues…

Table 32 (continued)

Instructional material entity/ Instructional ontology/ Instructional bag	5.0 educational	O	Educational
	5.1 interactivity type	O	InteractivityType
MaterialUse	5.2 learning resource type	O	LearningResourceType
	5.3 interactivity level	O	InteractivityLevel
	5.4 semantic density	O	SemanticDensity
Author!? Novice vs expert	5.5 intended end user role	O	IntendedEnduserrole
Professional Formation?	5.6 context	O	Context
Adult trainees?	5.7 typical age range	O	TypicalAgeRange
Understanding Efficiency	5.8 difficulty	O	Difficulty
	5.9 typical learning time	O	TypicalLearningTime
annotations	5.10 description	O	Description
	5.11 language	O	Language
	6.0 rights	M	Rights
	6.1 cost	M	Cost
	6.2 copyrights and other restrictions	M	CopyrightandOtherRestrictions
	6.3 description	O	Description
Pertinent Fragment	7.0 relation	O	Relation
pertinence	7.1 kind	O	Kind
	7.2 resource	O	Resource
name	7.2.1 identifier	R	Identifier
	7.2.2 description	O	Description
	7.2.3 catalogentry	O	CatalogEntry
	7.2.3.1 catalog	O	
	7.2.3.2 entry	O	
Annotation	8.0 annotation	O	Annotation
maker	8.1 person	O	Person
Version Date	8.2 date	O	Date
otherInfo	8.3 description	O	Description
Description	9.0 classification	M	Classification
	9.1 purpose	M	Purpose
	9.2 taxonpath	O	TaxonPath
Domain-ontology	9.2.1 source	O	Source
	9.2.2 taxon	O	Taxon
	9.2.2.1 id	O	Id
Topic	9.2.2.2 entry	O	Entry
		M	Description
content Keywords		M	Keywords

? - Elements with a question mark could not be distilled from the available documentation.
! – Author / Professional Formation, and Adult trainees seem logical choices for these metadata elements. Unfortunately these can not be found in the data model.

Table 32 showed that the mandatory elements of the ADL- ADL SCORM™ metadata set were available within the IMAT data model. The terminology used in the IMAT data model differs from the ADL SCORM™ terminology but based on the inventories it is expected that a valid mapping is made.

To further analyse the data in Table 32 a mapping was made between the elements used in the data model and specifications. Table 31 gave the elements in the final version of IMAT (P-Final) and the elements in the ADL SCORM™ 1.2 and LOM-1.0 metadata models. Figure 181 shows an example of how elements could be mapped from IMAT to ADL SCORM™.

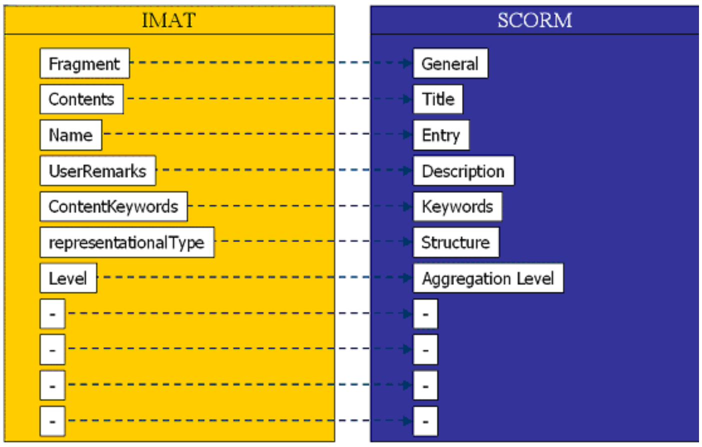


Figure 181 IMAT mapping to ADL SCORM™

Based on the different components available in ADL SCORM™ version 1.2 different profiles can be created with initial values. This is needed because the ADL SCORM™ metadata set can vary for Assets, SCOs, and Content Aggregation. The profiles can be considered as pre-structured scenarios to which an object can be assigned. This can support in the future that objects can be selected based on a certain learning scenario.

Profiles can be used to fill elements that are not (yet) available in IMAT but required for ADL SCORM™. These profiles can contain initial values for sets of material supplied by the inventories made for the Who?, Where?, and How? questions. When mandatory metadata fields are needed the material can be extracted from these profiles. Figure 182 shows how profiles can be used to provide data not available in IMAT but available in a profile.

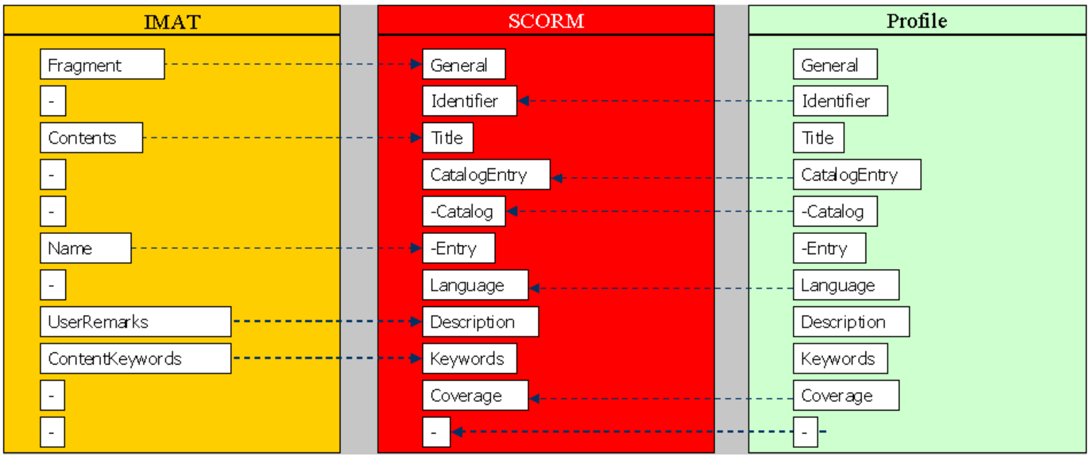


Figure 182 IMAT and the use of profiles

In the ADL SCORM™ version 1.2 objects can have three aggregation levels: Assets, SCOs, and Content Aggregation. Table 33 shows the relation between the different versions of ADL SCORM™ and the IMAT P-final.

Table 33 IMAT and ADL SCORM™ aggregation levels

ADL SCORM™ Version 1.1 Meta-data Application Profile Name	ADL SCORM™ Version 1.1 Content Aggregation Model Components	ADL SCORM™ Version 1.2 Meta-data Application Profile Name	ADL SCORM™ Version 1.2 Content Aggregation Model Components	IMAT
Course Meta-data	Course	Content Aggregation Meta-data	Content Aggregation	Bag
Content Meta-data	Block	Content Aggregation Meta-data	Content Aggregation	Bag

Content Meta-data	SCO	SCO Meta-data	SCO	Fragment met Onderwijskundige context
Raw Media Meta-data	Asset	Asset Meta-data	Asset	Fragment

Table 33 shows that during the versions of ADL SCORM™ the aggregation levels have shifted from four levels to three levels and that the IMAT aggregation levels can be mapped against these three levels. This means that based on the mapped aggregation levels, the ADL SCORM™ specifications for metadata can be used.

7.4.6 Where did reuse take place in terms of systems?

During the project the IMAT repository was inventoried to see how the ADL SCORM™ specifications could be implemented in practice. The inventory focused on the export possibilities of the IMAT database using the ADL SCORM™ XML binding. A summary of the inventory and recommended implementation of the ADL SCORM™ specifications is given here.

The material is stored in the IMAT database as an information repository. The repository forms the basis for the tools that store and retrieve material from the database for different purposes. This material is indexed and stored as XML in the database. When material is retrieved by the tools such as the Authoring tools, the material is interpreted and handled by the tool. To make exchange possible based on the ADL SCORM™ specifications an exchange tool can be developed using the ADL SCORM™ XML binding. Based on the available metadata and profiles a complete metadata set can be constructed. The actual fragments can be converted to HTML to make material available for web browsers. Figure 183 shows how SCOs or assets can be generated from the IMAT database.

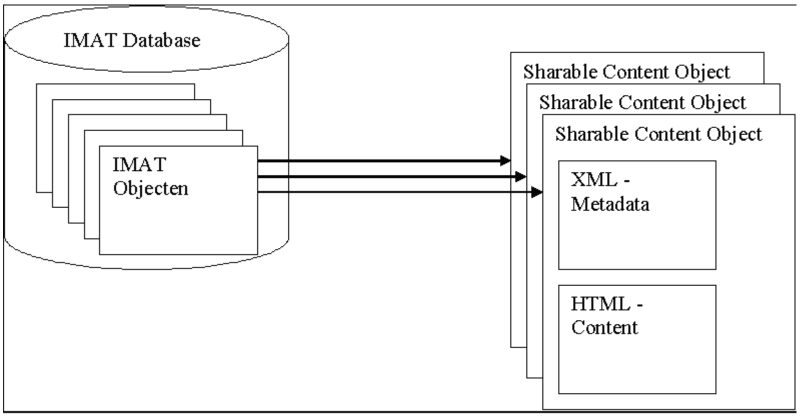


Figure 183 IMAT export of ADL SCORM™ compliant material

Figure 183 shows that the export from the database to reusable learning objects can be realized using the IMAT database functionalities. The IMAT database structure can support export of the IMAT objects as ADL SCORM™ Sharable Content Objects (SCOs).

7.4.7 The learning-object lifecycle: Summary and conclusion ADL SCORM™ in IMAT project

The summary and conclusion describes the IMAT database and its functionality related to the learning-object lifecycle. The life cycle is based on the inventories that were needed to see if an ADL SCORM™ implementation would be possible. The summary is made to give an overview of the stages within the learning-object lifecycle as they are possible within the IMAT system.

Obtain – The material in the IMAT project is extracted from manuals. This can be already in a digital form, but also scanned hardcopies which are translated to PDF files. The manuals are created by the manufactures of tools and products such as cars, traffic control equipment, and anti-aircraft equipment.

Label – Labelling of material is an automated process based on the structure within the content of the material. This means that content structure such as headings, sections, line breaks, and emphasis of texts are used for assigning metadata. Ontologies are important for the definition of relations between the objects. Different ontologies have to be created for each manual because no common ontology can describe every set of material.

Offer – The IMAT database offers a set of indexed material that can be used for training.

Select – The material can be selected using the ontologies. The different sorts of ontologies make it possible to select material based on an instructional structure or based on domain-specific characteristics.

Use – Different tools are available to create course material. Using a Scenario tool and an Authoring Environment Interface indexed material can be retrieved from the repository to create new material.

Retain – The material is retained based on the annotations that can be made to the different fragments in the material. Based on the annotations decisions can be made about the usefulness of the material.

7.4.8 Secondary research questions for the ADL- ADL SCORM™ in IMAT project

Some of the secondary research questions can be answered based on the ADL SCORM™ in IMAT project, but also the IMAT project itself. The questions are answered based on the inventories made for the current project:

TQ1. Granularity and standards – During the development of the IMAT system the specifications of IMS and Ariadne were used as the basis for the data model. Although these specifications were used as a starting point not all elements are addressed in the same way. The mapping to the ADL SCORM™ metadata set showed that most elements were available in the IMAT data model, but also there was a set that was not available. The IMAT data model was extended to make it possible to build instructional bags based on the defined ontologies, which also led to differences with the ADL SCORM™ specifications.

TQ2. Tools – The proposed mapping of elements from the IMAT data model to the ADL SCORM™ metadata data set can be used for the development of tools to make reuse possible based on ADL SCORM™ specifications.

TQ3. Systems – The underlying database of the IMAT system is important for the project because it offers functionalities to generate SCOs from the existing fragments. The repository can be seen as underlying system for the tools.

HQ1. Organisational context – The RNLAF initiated the research project to see how material automatically can be converted to reusable learning objects based on ADL SCORM™ specifications. The RNLAF shows an interest in learning-technology standards and made a budget available as part of its organisational strategy for reusing material.

HQ2. Learning scenarios – The implementation of the ADL SCORM™ specifications did not cover all the different learning scenarios that could be developed in the IMAT system. The description of material and related ontologies were more sophisticated than specified in ADL SCORM™

HQ3. Object creation – The export of objects from the database can be seen as the creation of learning objects. The results of the export are SCOs that are reusable within other systems.

HQ5. Metadata – The metadata are part of the ontologies used. The domain ontologies in IMAT have to be developed separately for each different manual to be analyzed. The more general an ontology is developed the more domains can be covered by a taxonomy but the less specific material can be assigned. The metadata set for instructional purposes is more specific than the metadata set specified in LOM because learning scenarios are used in the instructional ontology in IMAT.

7.4.9 Key observations of the researcher for the ADL SCORM™ in IMAT project

The project showed that a database-driven system that contains valuable material can be used to produce learning objects according to ADL SCORM™ specifications. The mapping of elements is rather simple if an extensive inventory is made of the system. The project also shows that the functionalities within a system such as IMAT cannot be replaced by an ADL SCORM™ data model but can offer exchange possibilities with other systems.

7.5 KIM Project

The KIM is project introduced in Section 7.5.1. Sections 7.5.3 and 7.5.2 focus on the human-perspective questions. Sections 7.5.3 – 7.5.6 describe the technical-perspective questions. Section 7.5.7 summarizes the project based on the stages of the learning-object lifecycle and Section 7.5.8 gives initial answers to the secondary research questions.

7.5.1 General description and role of the researcher

The KIM (Koninklijk Instituut voor de Marine [Royal Netherlands Naval College]) project describes another dimension within the military context, this dimension focuses on learning in a higher-education setting. The tools and type of education differs in the KIM from the other military settings. One of the tools used as a pilot in the KIM one year during 1999 was the TeleTOP® CMS. Based on these experiences with TeleTOP® and potential reuse possibilities the KIM instructors were interviewed and an inventory of their educational approaches and support systems was made. The researcher was not involved in new developments related to learning or tools but did an inventory based on the experiences of the instructors with a CMS in a military setting.

This section describes the context where the interviews were done. The results are used to answer the perspective questions and the secondary research questions. A more-detailed description of the results within the KIM is given in Appendix E: “Results of the structured interviews”. A complete overview of the interviews for the military is summarized in Section 7.6. In Chapter 8 the responses from the military context will be compared to those from the university and corporate contexts.

The KIM is based in Den Helder and its main tasks are the training of Navy officers and carrying out Navy-related research. Although the KIM is a military context, the educational developments and organisation are closely related to the Netherlands university context. The scientific establishment of the KIM at the beginning of the nineteenth century was already at a scientific level. The formal equalization of KIM with civil universities has never established but the current scientific basis relies on a Royal Decree from 1950, which has been adjusted in later years. In 1963 the KIM was granted a university status by law.

The courses in the KIM's education programme vary from practical training to scientific education. The academic part of the education is organized within faculties. The practical training focuses on competencies required for the first functions in the fleet and the military aspects within operational entities. These different components within the training require for each aspect an appropriate didactical set-up. KIM is itself in a route of education renewal, necessarily by change in the intake of its learners and new insights concerning to study and "learning to learn".

The role of the researcher could be characterized as observer and interviewer of the instructors in this project.

7.5.2 Why did reuse take place?

The reuse of material is closely related to the educational strategy and developments initiated by the KIM staff policy, development, and evaluation training office (BEO). The task of this staff office is on one hand to support instructors in the development and evaluation of their courses and on the other hand to deliver an educational policy for the KIM. The policy is based on the developments and experiences within higher education more broadly. The office plays an important role in the implementation of educational renewal. The office supports this renewal through contacts with education institutions within and outside the defence organisation. Current educational developments such as project-based learning, e-learning, and the setting-up of the bachelor-master structure (Bama) important points of interest of the office.

The developments of ADL related to ADL SCORM™ are also seen as an important movement within educational renewal.

These renewals in education are the basis for the use of CMSs and related reuse of material. The development of new material is too expensive. Reusing material from previous courses and restructuring this material for the new educational needs can be cost effective.

7.5.3 Who was involved?

For the interview 10 employees of the KIM were asked to participate. The participants were all involved in the development of learning material. Learning material for training is developed within faculties and the largest part of training takes place within the Faculty of Maritime Military Sciences. The faculty stands under the guidance of a dean and has been built upon five professional groups and a faculty office. Each profession group includes approximately 10 to 15 employees and has a professor as a group leader. The professional groups are:

- Maritime military company sciences
- International security studies
- Maritime technical sciences
- Nautical sciences

- Information and Weapon technology sciences

7.5.4 What was reused?

Within the KIM a variety of specific material is reused within courses. Because of the specific nature of the expertise areas instructors also develop then own software that is used within the courses. Besides the software programs developed by the instructors other software programs are used such as simulation software. Students can download these software programs to work with. Also lists with symbols and abbreviations are seen as important for reuse. Another interesting type of object that was seen as a candidate for reuse was style sheets or templates for Word documents. The templates could avoid missing information when writing assignments such as dates, names, titles, and conclusions.

7.5.5 How was reuse supported?

Reuse of material was not actually supported in terms of tools. The tools available in the TeleTOP® CMS were not used because the pilot was too short to actually reuse material in new courses. During the pilot some instructors used material from their own previously developed websites or created links to their websites in the TeleTOP® CMS.

7.5.6 Where did reuse take place in terms of systems?

Within the KIM context the term ELO (Electronische Leer Omgeving [Electronic Learning Environment]) is used for course-management system. The use of a CMS is based on various reasons:

- Enrichment of the learning surroundings by offering multi-purpose information
- Facilitate of flexible communication between student and docent
- Promote of transparency in the set-up and implementation of the education

The KIM started with a pilot with the TeleTOP® CMS for one year in 2001. This pilot is the basis for the project described here. The CMS was still a research version and still under development. In 2003 the decision was made to continue to use the TeleTOP® CMS as a basis for the renewal in education. However, the researcher has not been involved in the new developments. Based on experiences within the University of Twente and the Shell EP Learning Centre the TeleTOP® CMS was seen as a system that could fulfil the desired requirements.

Besides the use of the TeleTOP® CMS instructors also used self-developed websites to support their courses.

7.5.7 The learning-object lifecycle: Summary and conclusions KIM project

Obtain – The instructors mainly create the material obtained within the KIM project. The material is based on their own experiences and research in their expertise areas. Instructors also develop their own software applications used for simulation and modelling.

Label – The use of the TeleTOP® CMS made it possible to label material but because of the version of TeleTOP® available in the pilot of the project the instructors did not have the chance to actually label material using the tools.

Offer – Offering material for reuse happens through personal communication. Instructors in the same expertise area exchange material when they find out from each other what is available.

Select – Material is selected from several resources. Material from the web is selected when possible, but also books and manuals are selected as learning material.

Use – Material is used based on the need for new or revised courses. Various tools are used to support the courses such as instructor's own developed websites and syllabi. Some material is explicitly made to use in certain tools but material is also developed from previously used material.

Retain – Because the courses are given within a certain time slot, courses and thus the course material are revised each cycle. The instructor controls the material used in the courses and decides if material should be retained or not.

7.5.8 Secondary research questions for the KIM project

The following observations are partially based on the results of the structured interviews with KIM staff, which will be summarised in Section 7.6.

TQ1. Granularity and standards – The granularity of the material depends on the instructors who select material for the courses. ADL SCORM™ as a specification is important for the KIM because future developments are expected to shift to ADL SCORM™ compliancy.

TQ2. Tools – For the development of material Office tools such as Word and PowerPoint are used. Also software packages to create simulation software and develop new software applications are used.

TQ3. Systems – For a pilot the experimental version of TeleTOP® CMS available in 2001 was used. Based on these experiences the use of this CMS is now being continued with the commercial version of TeleTOP®.

HQ1. Organisational context – The organisational strategy in the KIM focuses on the renewal of education and follows the developments in the civil higher-education setting. The organisation's strategy for reuse is part of this educational renewal. The tools needed for reuse are expected to be part of the CMS to be used by the organisation.

HQ2. Learning scenarios – The KIM is working on a blended-learning approach and is following the new developments in the civil higher education by developing a bachelor-master structure. Project-based learning is seen as one of the learning scenarios where students improve their skills such as learning to learn in a practical setting.

HQ3. Object creation –The KIM as a scientific setting in the military context does not develop CBT in the ways used for training. Material is selected based on the subject and the instructor's own resources.

HQ4. User support – The instructors are supported during the implementation of the new educational approaches by the BEO staff, which provides support for project-based learning, e-learning, and the implementation of the bachelor-master structure.

HQ5. Metadata – The use of metadata is limited to the local organisation on the hard drives of the instructors. Material stored in the TeleTOP® CMS system is automatically tagged based on the course structure, but these results are not used by the instructors.

7.5.9 Key observations of the researcher for the KIM project

The KIM project showed that within the military context not only CBT is used for learning. CMSs such as TeleTOP® are used to structure courses in a flexible way that is based on learning scenarios used within university contexts. The use of CMSs and the material used within the CMSs require different reuse strategies and other types of material than used in the development of CBT.

7.6 Results of the Structured Interview in the Military Context

This section describes results from the structured interview used within the LCMS and KIM projects. Section 7.6.1 describes the procedure and respondents and Section 7.6.2 the results.

7.6.1 Procedure and respondents

The structured interview is already discussed in Section 4.2.7.3 and was translated to Dutch to support the military course developers.

For the inventory 22 instructors were used from different Armed Forces. 12 instructors that participated in the LCMS research project and 10 members of the KIM were interviewed. The instructors that were involved in the LCMS research project were asked for the interview because of their experiences with the LCMS. Four of the instructors were interviewed separately, the other eight filled in the questionnaire on their own after using the LCMS. Instead of the planned one-hour interviews each interview took more than two-and-half hours giving much detail. The detailed information is used describing the cases. Each instructor could choose different roles that reflected the tasks within the military setting. From the 22 instructors 15 identified themselves as course-material assembler, 13 as subject-matter expert, 2 as course director, 16 as instructor, and 3 as participant. Five instructors were part of a multimedia team and 9 of a development team. The experience with authoring systems or CMSs varied from never (8), two years (3), three or four years (7), to five years or more (4).

7.6.2 Results

A comprehensive summary of the responses is given in Appendix E: “Results of the structured interviews”. The results are grouped around themes that were seen as important issues: Reuse experiences, reuse what?, metadata, giving the opportunity for reuse, controlling reuse, structuring material, selecting material for reuse, reuse of one’s own materials by others, and reuse of materials made by others.

- *Reuse experiences*

  Reuse was seen as needed for 11 instructors varying from sometimes (1), often (4), and very often (6). One instructor did not the feel the need for reuse and two instructors thought that reuse almost never was needed. 18 instructors think that tailoring courses for different target groups is needed once (2) or often (16). 12 instructors think that reuse definitely saves time, 4 think that reuse can save time sometimes, 4 think that it will not save much time, and one thinks that reuse does not save time at all. The new functionalities are understood by most instructors reasonably well (15) or very well (3). Three instructors understood some of the new functionalities. 16 instructors think that the functionalities are needed and will be used often (10) or very often (6). Some instructors (2) think that such functionality is needed sometimes and four think that the LCMS functionalities will be almost never used.

- *Reuse what?*

  Because various authoring systems are used a set of reusable types of material was given. If a type of material was not listed, instructors could add other specific types. Materials that were seen as the most interesting candidates for reuse were Movies, Pictures, Presentations, Word documents or PDF files, and Animations. Material that was not listed but added by the instructors were simulations, software programs, Word templates, and glossaries. Less expected for reuse were the commercial off-the-shelf modules and CBT e-modules. Material is often (7) or very often (4) needed according to instructors from older courses for reuse to create new courses. Eight instructors think that this is needed sometimes, and three instructors think that is almost never needed.

- *Metadata*

  The minimal metadata set used in the TeleTOP® CMS based on category and subject was found to be not sufficient by ten instructors. Four instructors thought that it was usually enough, if the material was created by themselves. Eight instructors were willing to provide metadata for some items, five for many items, and six for all that is needed. Only one was willing to invest a little bit of time by filling in metadata. The LOM metadata set was used to describe the materials. The terminology used for the metadata elements was understood for 25% by four members, three members understood 50%, nine members 75%, and six did not have a problem with the provided set of metadata elements.

- *Giving the opportunity for reuse*

  Within the military context all instructors see possibilities for reuse but they vary in how much. 11 instructors think that sometimes material is available within the department they work in, six instructors think that there is often material available, and one very often. Four instructors think that it is almost never available.

- *Controlling reuse*

  Four instructors do not care how their material is reused, nine are interested in some occasions, and seven do always want to know how their material is reused. Instructors are afraid that their material will be used by people who are not aware of all aspects and that material will be misused. The fact that in many cases classified material is used makes reuse difficult and is a reason only to share material after clearance.

- *Structuring material*

  The instructors made different suggestions for how material should be structured in the LCMS to make searching easier. The use of keywords was mentioned ten times, also the use of semantic networks and advanced search possibilities using combinations of words were seen as helpful search strategies. Also taxonomies based on Institute or organisation, Course, subject, and content were seen as interesting search structures. Other ideas were related to search for authors, type of material, location of the source, and most-downloaded files.

- *Selecting material for reuse*

  The keywords are seen as the most important metadata identifier. The subject of the material, the date of last edit, the type of material, categories, and the time needed to learn were also identified as important when material is selected. Less important were the file size and course code.

- *Reuse of one's own materials by others*

  The instructors and course developers are willing to share material although classified material is seen as problematic to share. Eleven instructors think that there is material available within the department that can be reused sometimes. Seven instructors think that material is often available, and one very often. Four instructors think that this is almost never the case. Remarks were made about reuse by inexperienced people. Instructors are afraid that material will be misused because material is interpreted wrongly or was created for certain purposes.

- *Reuse of materials made by others*

  All instructors think that there is material available outside the department that can be used. 11 instructors think this is often (6) or very often (5) the case. Ten instructors think that there is sometimes material available, and one thinks that is almost never available. Using material from others includes that the quality control of the material is done by the instructor or course developer. Most material is found on the Internet, but also other sources such as publishers were seen as interesting repositories.

7.7 Results within the Military Context

The results are described first (Section 7.7.1) in terms of the secondary research questions addressed in the projects. In Section 7.7.2 the key observations of the researcher for the military context are given, Section 7.7.3 adjusts the Perspective-Lifecycle figure based on Figure 17 in Section 2.5.2 and Figure 37 in Section 3.5.2. A discussion of results in terms of the explanatory task of the research occurs (Section 7.7.4) and also on identification of key success and fail factors as criteria of the success for learning objects in the military context as part of the explanatory task of the research, Section 7.7.5 concludes the chapter with a preliminary set of guidelines for the military context, relating to the prescriptive task of the research.

7.7.1 Secondary research questions for the military context

TQ1. Granularity and standards – The granularity in the projects differ in each context and are mainly based on the needs of the course developers and the estimation of how useful it is to split up certain pieces of material in reusable objects. The projects focus on reuse and standards. ADL SCORM™ is the specification the Netherlands army wants to follow to make future exchange possible.

TQ2. Tools – The tools used in the military context to create material are various. The main tool to develop CBT in the RNLA is Authorware because of the functionality available. The freedom to use such functionality makes it possible to create sophisticated CBT such as the aircraft-recognition course. Other template-based applications such as the SCO-Generator are based on the idea that pieces of material are available and need to be structured as a new course.

TQ3. Systems - The systems used range from shared network drives in practice to dedicated repositories in research settings. The LCMS used for experiences in the RNLA and RNLAF contain already many resources that may be interesting for future use. TeleTOP® was used as a CMS in the KIM.

HQ1. Organisational context – The main issues in the ADL SCORM™ in the RNLAF project were the constant involvement of security risks and the implications of these risks. The access to material and the expected classified material in the courses gave unexpected results in the use of the LMS and the development in course material. The military as an organisational context was technically a challenge because of these technical problems related to security. The organisational context stimulated a focus on research projects related to learning-technology standards. The course developers are involved in these new research projects to see how different initiatives work in practice. During the research course developers were asked to test new tools within this organisational orientation.

HQ2. Learning scenarios – Different learning scenarios can be identified in the various settings. The use of CBT and the development of such content-acquisition training material in the RNLA and RNLAF settings, differs from the higher-education approach in the KIM with an emphasis on problem solving. Also the tools to support such learning scenarios differ.

HQ3. Object creation – Objects are created on different aggregation levels and for different purposes. The assets such as photos and videos used for CBT are mainly created based on requests and specifications. In the training setting course developers tell the multimedia teams to make or use existing resources for the actual training. This approach is expensive and time consuming because the quality of the CBT is expected to be high and very specific. The course Ranks is a good example of this kind of material. Every picture is needed to be made according to detailed specifications to make it usable in the training material. The materials are not intended to serve as examples, the materials should reflect actual representations of situations. For training purposes this is mostly the case because the material is mostly task based and related to certain specific tools or machines. Also for the aircraft-recognition course very specific video material was needed. Exact examples are needed to reflect actual situations because errors can result in causalities. A video of a flying object found on the web will not fulfil the strict requirements needed for such a kind of CBT. The requirements and the need for such sophisticated material may not always be clear and revisions result in very expensive course material. The KIM as a scientific setting in the military context does not develop multimedia resources in such a way.

HQ4. User support – The user support in the military context differs in each project. In the KIM project the instructors are supported by a human team with the implementation of new learning scenarios such as project-based learning, e-learning, and bachelor-master. In the ADL SCORM™ for the RNLAF project the course developers were supported in research projects to learn how to use the ADL SCORM™ specifications with their existing course material.

HQ5. Metadata – Metadata based on ADL SCORM™ were only used for research purposes for the LCMS project. Tagging a large set of assets and also the experiences with such sets of material will make it possible to do research with course developers in a future setting. The development of tools and the use of vocabularies for keywords and classifications will be useful for future developments.

7.7.2 Key observations for the military context

- The focus on learning-technology standards is important in the military context. The number of initiated research projects reflects an organisational reuse strategy. A problem of the different research projects is the distance between reality and research settings. The research projects do not reflect, or connect to the daily working strategy and possibilities of course developers. This distance between daily practice and research settings make it difficult for course developers to see the benefits of systems such as LCMSs, LMSs, authoring tools, and the implementation of learning-technology standards.
- The use of CBT in the military context is a typical target group for the ADL SCORM™ specifications. The granularity of reuse for the development of CBT is most on an Asset level. Within the KIM the granularity is different because the used learning scenarios differ from CBT.
- Because some of the material is classified and not all material is accessible to every one, reuse is difficult. The use of a combination of Internet and intranet solution makes it difficult to see if material is accessible to all users. The use of material stored on the intranet may not be accessible from the Internet for all users. The security aspects related to the military context make it difficult to exchange material over the network.
- The infrastructure within the military organisation is not capable to exchange the multimedia files needed for the sophisticated CBT material available.

7.7.3 Validating the descriptive view for military context, perspective by lifecycle

Based on the secondary research questions for the different projects the descriptive view for the military context can be validated. Figure 184 shows the new version of the integration of perspectives, life cycle, and brief answers to the secondary research questions in a military context.

	Perspective questions	**Obtaining**	**Labelling**	**Offering**	**Selecting**	**Using Pure**	**Using Adapted**	**Retaining**	**Learning objects**
Human perspectives	Why?	HQ1. Organisational strategy, HQ2. Support for course development HQ5. For personal convenience,							
	Who?	HQ3. Multimedia teams, Instructors HQ5. Instructors, course developers							
Technical	What?	TQ1. Assets, Pictures, Animations, Movies							
	How?	TQ2. Authoring tools							
	Where	TQ3. LCMS, Repositories							

Figure 184 military context revised

The revision of Figure 184 can be made because the stages of the lifecycle are not clearly distinguished within the military context. The way of working does not reflect fixed steps within the workflow that map the stages within the learning-object lifecycle. This means that for all stages the same answer can be applied.

7.7.4 Explanatory task: Key success (and fail) factors in the military context

Table 34 shows the key success factors from Section 4.1.2 for learning objects in a military context. Each factor is given a value for success based on applying to the projects a five-point scale where five indicates the researcher's opinion of a success and one represents the researcher's opinion of a fail situation for the context based on the conclusions at the end of each project. The overall military context described in the projects is difficult to value because of the different aspects of the projects in the military context.

Table 34 Success in the military Learning context

Coding	Success factor	Value for success (1= least success, 5= most success)
SF1	The tools are in place	5
SF2	Rules are understood and followed	1
SF3	Roles related to the learning objects are identified	2
SF4	Organisational embedding has occurred leading to learning objects	4
SF5	Learning objects are being used and reused being used and reused by a critical mass of users within an organisation in	1
SF6	Learning objects are being used and reused in appropriate ways	2
SF7	The use and reuse of learning objects is valuable to the organisation	4

The success factors in the military context are closely related to the research projects where tools are tested and shown to be very successful in themselves, offering possibilities for metadata tagging, storing learning objects, and creating courses based on learning scenarios. Also the authoring tools such as Authorware™ and the SCO-Generator include functionalities to create course material based on ADL SCORM™ specifications. However because of the fact that tools were only tested in research settings, no actual embedding in use has taken place in the organisation. Some in-depth research projects have created awareness for reusable development but an overall reuse strategy on all levels is not implemented. Besides the rules for reuse are the roles related to reuse are not clear. All responsibility is placed on the instructors and course developers who are not able to influence the larger organisation. On the other hand there is the organisational strategy focused on the implementation of standards using specifications and similar authoring tools to create course material. Because no actual implementation of a reuse strategy on all levels has taken place, there is no critical mass of material available yet in one central accessible repository. On the other hand a variety of independent repositories can be identified such as the LCMS repository, the IMAT repository, and The KIM TeleTOP® CMS repository which are not connected to each other or accessible to instructors who could benefit from these systems. According to the interviewed instructors and course developers reuse can save time and is useful in the military context. The experiences within the research projects are very valuable and show the limitations and strengths of the implementation of learning-technology standards. They particularly show the impact of security issues and the risks involved. The fact that security problems related to the servers used for learning are an issue show that precautions must be taken to overcome vulnerability.

7.7.5 Prescriptive task: Recommendations for the of the research for the military context

The prescriptive task for the military context focuses on guidelines in the form of recommendations that can be used for implementing a reuse strategy.

- *Military guideline 1: Provide an adequate technical infrastructure*

  For the military context the organisational strategy for reuse should focus on the support for reuse in terms of infrastructure, systems, and guidelines. The research projects have a clear line focusing on standards for learning technology and use interesting tools, but the projects are scattered in terms of the systems and tools used. All course developers and instructors involved in the development of courses should have appropriate access to the already available repositories and one repository should be made available for actual storage of material. The huge file sizes that are used to develop courses require fast network connections and computers that can deal with the tools. A private network can be used to overcome security issues and the publication of classified material.

- *Military guideline 2: Use available research outcomes*

  The strategy for reuse should not only focus on research aspects but should also include a policy for the actual course developers and instructors related to security issues and how to deal with classified material. The research projects can serve as a basis for setting up guidelines for what systems to use, how to develop reusable material, and what authoring tools to use. The guidelines should also indicate what roles are identified and how different groups access, provide, and metatag material available for reuse.

- *Military guideline 3: Work together within the organisation*

  The military context can be seen as a set of departments such as the Royal Army, Royal Navy, Royal Air force, and Royal Military Police. Each department is working more or less on learning-technology standards such as ADL SCORM™ but all departments can share valuable material. The different departments should be able to share material with each other using a common set of systems, tools, network, and guidelines.

- *Military guideline 4: Use various learning scenarios and related tools*

  There is difference in complexity in the developed course material for the military. An inventory should be made of what tasks should be mastered and what learning scenarios can be used. The complexity of some tasks cannot be solved with template-based CBT authoring tools and need more advanced settings involving an instructor

- *Military guideline 5: Differentiate in granularity*

  The complexity of some course material seems to be problematic with specifications such as ADL SCORM™, but the interpretation of the specifications offers a large degree of freedom and makes it possible to solve many problems. There may not always be reuse possible in terms of modules, lessons, or courses but on asset level there is a huge amount of material available for reuse and sharing.

This concludes the description of the projects in the three contexts. In the following chapter the conclusions of the various projects will be summarized based on the research questions.

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8 Synthesis of the Results of the Three Contexts

This chapter is a synthesis of the three contexts: university, corporate learning, and military, described via projects in Chapters 5, 6, and 7. Based on the secondary research questions from Chapter 2 and Chapter 3 preliminary answers were given for each of the projects described in the previous chapters. The projects were also summarized based on the stages of the learning-object lifecycle. Based on the human perspectives and technical perspectives and the related research questions from Chapter 1 a synthesis is given in this chapter. Section 8.1 summarises the results of comparing the three groups of respondents on the structured interview and the questionnaire. In Section 8.2 an overview of the main research questions and related secondary research questions is given. Section 8.3 combines the human and technical perspectives.

8.1 Comparative Results of the Structured Interview and Questionnaire

The results of the structured interviews and the answers to the questionnaire (Section 4.2.7.3) in the different contexts are summarized in this section. Section 8.1.1 gives information about the respondents in the three different contexts. Section 8.1.2 compares the actual results of the interviews.

8.1.1 Information about the respondents

In total 57 participants were interviewed: 14 from a university context (Section 5.3.7), 21 from a corporate-learning context (Section 6.2.7), and 22 from a military context (Section 7.6). Table 35 shows the roles that were selected by the respondents; more than one role could be selected.

Table 35 Question 03 - Role

Course Material Assembler	Subject-matter expert	Course Director	Part of a CD team	Instructor	Participant	Part of a Multimedia team	External Course Provider	Part of a Development Team	Line Manager
34	34	14	9	38	4	11	0	22	3

The respondents differed in experience in using a CMS. This is shown in Table 36. As can be seen, almost all of the respondents from the university context had 3 to 4 years experience with a CMS, the respondents from the Corporate context differed from 1 to 7 or more years of experience with a CMS. Only in the military context were there respondents with no experience at all (8 out of 22), but the majority had 2 to 7 or more years of experience with a CMS.

Table 36 Question 04 - How many years have you worked with a Course Management System (for example TeleTOP®)?

Context Years of experience	University (n=14)	Corporate (n=21)	Military (n=22)	Total (n=57)
no experience	0	0	8	8
1 year experience	2	9	0	11
2 years experience	0	9	3	12
3-4 years experience	12	0	7	19
5-6 years experience	0	2	2	4
7 or more years experience	0	1	2	3

In Section 8.1.2 it will be explored if the number of years of experience with a CMS has an influence on the way the respondents think about reusing materials.

8.1.2 Results

This section compares the results of the questionnaire and the structured interviews that were held in the three contexts. The results are ordered by the sequence of the questions in the questionnaire. The results are grouped around themes (Section 8.1.2.1 to Section 8.1.2.8) that were seen as important issues and used in the previous chapters: Reuse experiences, reuse what?, metadata, giving the opportunity for reuse, controlling reuse, structuring material, selecting material for reuse, reuse of one's own materials by others, and reuse of materials made by others. Each section is based on the questions from the questionnaire and each question number is given to show the relation between themes and questionnaire.

8.1.2.1 Reuse experiences

The respondents were asked to what extent they feel the need for reusing material. Table 37 shows that only some respondents in the military context feel that there is no need to reuse material. In all three contexts the majority of the respondents do feel that there is a need to reuse material with no significance among the groups (χ^2 =13; p=0,119).

Table 37 Question 05 - To what extent do you feel the need of reusing material?

Context Need for reuse	University (n=14)	Corporate (n=21)	Military (n=20)	Total (n=55)
never			3	3
almost never			2	2
sometimes	2	7	2	11
often	5	7	5	17
very often	7	7	8	22

In relation to different target groups the respondents were asked to what extent they feel the need to tailor or reuse courses for these different target groups. Table 38 shows that many respondents do not feel the need or have only tailored their courses once, twice, or three times. Less then 20% of the respondents in the three contexts had tailored or reused courses for different target groups more than three times. Thus needing tailoring is not a current motivation for reuse but there are significant differences among the groups, with the corporate respondents less likely to tailor than the other groups (χ^2 =19; p=0,013).

Table 38 Question 06 - To what extent do you feel the need to tailor or reuse courses for different target groups?

Context Tailoring for different groups	University (n=14)	Corporate (n=21)	Military (n=20)	Total (n=55)
never		9	2	11
once		4	2	6
twice	7	3	6	16
three times	2	3	5	10
more than three times	5	2	5	12

The respondents were asked that if there were a LCMS available for reusing material, to what extent they would feel the need of using this functionality. From Table 39 it can be seen that the respondents from the Military feel this need more than the respondents from the university and the corporate context. The respondents from the corporate context are the most negative about this idea. This may be because within the corporate-learning context the course directors think that their expertise area is too specific for reuse by others (χ^2 =30; p=0,000).

Table 39 Question 07 - If there is a Learning Content Management System available for reusing material, to what extent do you feel the need of using it?

Need for LCMS	Context University (n=14)	Corporate (n=20)	Military (n=22)	Total (n=56)
never		9		9
almost never	1	2	4	7
sometimes	7	3	2	12
often	5	2	10	17
very often	1	4	6	11

The respondents were asked if they expected that reuse saves time (Table 40). On this they agree: 63% of the respondents in all three contexts think that reuse definitely saves time with no significance among the groups (χ^2 =9,7; p=0,284).

Table 40 Question 34 - Do you think that reuse saves time?

Saves time	Context	University (n=12)	Corporate (n=21)	Military (n=21)	Total (n=53)
not at all			1		1
not much				1	1
no opinion			1	4	5
sometimes		4	2	4	10
definitely		8	16	12	36

The respondents were asked how well the presented functionalities for reuse within the TeleTOP® CMS were understood in order to get an impression of the difficulty of the new tools for the intended users. More than 60% of the respondents understood the tools reasonably well. As Table 41 shows, more than 30% in the corporate context did not have a very good understanding of the tools. Within the university and military context the problems with understanding were less. This may be because in the corporate context the designers rather than the course directors or LDLs were the main persons who set up the TeleTOP® environments whereas in the university and KIM context the instructors handled all aspects of TeleTOP® use themselves. The differences among the groups were however not significant (χ^2 =9,7; p=0,284).

Table 41 Question 53 - How well do you understand these new functionalities?

Understand functionalities	Context	University (n=11)	Corporate (n=20)	Military (n=21)	Total (n=52)
not at all			1		1
a little			4		4
some		1	3	3	7
reasonably well		6	12	15	33
very well		4		3	7

The respondents were asked if they expected to use LCMS functionalities in the future. Most respondents expected to use the LCMS functionalities often. A smaller group expected to use the tools sometimes. Table 42 shows also that within the university context the expected use is most while within the corporate-learning context there is the most variability. Perhaps in the corporate context, a number of course directors (LDLs) who were not before aware of the TeleTOP® features were motivated by them when they saw the demonstration. However differences among the groups were not significance (χ^2 =14; p=0,062).

Table 42 Question 55 - How often do you think you will use these new functionalities?

Use LCMS functionalities	Context	University (n=11)	Corporate (n=20)	Military (n=21)	Total (n=52)
never			2		2
almost never			3	2	5
sometimes		5	7	6	18
often		5	4	13	22
very often		1	4		5

8.1.2.2 Reuse what?

Next, the respondents were asked to what extent they feel the need to reuse material from several other courses to create new courses. The answers can be seen in Table 43. Here, the answers are more scattered, but the tendency is that most respondents feel that they can reuse material from previous courses (χ^2 =23; p=0,004). Only a high proportion of the respondents from the corporate-learning context indicate that they never feel this need (nine out of 21).

Table 43 Question 08 - To what extent do you feel the need to reuse material form several other courses to create new courses?

Context Reuse from previous courses	University (n=14)	Corporate (n=20)	Military (n=22)	Total (n=56)
never		9		9
almost never	1	2	3	6
sometimes	6	4	8	18
often	5	1	7	13
very often	2	4	4	10

The respondents were asked how often they expect to reuse specific types of material. Because of the difference in the CMS systems used in the different projects the respondents of the university and the corporate-learning context were asked about different types of material. The types of materials in the questionnaire were tailored to the specific contexts where the respondents came from and their experiences with systems and tools. For the university and corporate-learning contexts the types of material were tailored to the use of the TeleTOP® CMS. Table 44 shows the material types used in the questionnaire for the university and corporate-learning context. The types of material are ordered based on the score (mean of the questions, never = 1, very often = 5) and importance of reuse. In the last column the outcomes between the corporate-learning context and university are compared. In Appendix E: “Results of the structured interviews” the full frequencies of the related questions are given.

Table 44 Question 16-31 - How often do you expect the following types of material will be reused, university and corporate-learning context?

			Frequencies						
Types of material	**Mean**	**Std. Deviation**	**never**	**almost never**	**sometimes**	**often**	**very often**	**Total**	**Comparison**
News items	4,50	,93	1	1	1	8	23	34	Similar
Course information	4,06	1,23	3	1	3	11	16	34	Similar
Archive items	3,75	1,44	5	1	4	9	13	32	Similar
Feedback items	3,06	1,56	9	2	7	6	8	32	Different
Roster items	2,97	1,22	5	6	12	7	4	34	Different
Submitted work items	2,97	1,22	5	6	12	7	4	34	Different
Web links items	2,88	1,63	12	1	9	3	9	34	Little different
Category items	2,73	1,64	11		5	5	5	15	Different
Question and answer items	2,65	1,39	11	3	11	5	4	34	Different
Presentation items	2,59	1,62	14	4	5	4	7	34	Different
Discussion items	2,18	1,03	11	9	12	1	1	34	Little different
Poll items	2,04	1,34	15	1	5	4	1	26	Little different
Group items	2,03	1,03	14	8	9	3		34	Similar
Glossary items	1,88	1,30	20	5	5	1	3	34	Similar
Workspace items	1,65	,81	19	8	7			34	Similar
Page items	1,54	,99	19	2	3	2		26	Similar
Publications items	1,48	,94	20	3	2	2		27	Similar

Table 44 shows that there is not much difference between the two contexts. The differences between the contexts such as poll items, presentation items, and category items can vary because the users in different contexts were not aware of these functionalities in the TeleTOP® CMS. Because they didn't know that these functionalities were available, material was not reused.

The respondents of the military context were also asked about how often they expect to reuse specific types of material. The types of material to reuse for the military context are presented in Table 45, including the scores of the interviews transformed in the same way as Table 44.

Table 45 Question 16-31 - How often do you expect will the following types of material be reused, military context?

			Frequencies					
Types of material	**Mean**	**Std. Deviation**	**never**	**almost never**	**sometimes**	**often**	**very often**	**Total**
Movies	3,82	,85		1	7	9	5	22
Pictures	3,82	,85		1	7	9	5	22
Attachments	3,68	1,09	1	1	8	6	6	22
Presentations	3,55	,91		1	13	3	5	22
Animations	3,45	1,06	1	1	12	3	5	22
Web links	3,36	1,22	2	3	6	7	4	22
Lessons	3,27	,88		4	10	6	2	22
Test items	3,24	1,04	1	3	10	4	3	21
Courses	3,23	,87		5	8	8	1	22
Modules	3,09	1,07	2	3	10	5	2	22
E modules	2,64	1,14	5	3	10	3	1	22
COTS, CBT	2,09	1,07	8	7	4	3		22

Table 45 shows that material such as movies, pictures, attachments, and presentations are expected to be reused more than materials such as COTS, e-modules, courses, and test items.

8.1.2.3 Metadata

The respondents were asked if material could only be selected based on subject and type, would this information be sufficient? Table 46 shows that there is no significant difference (χ^2 =11; p=0,186) between the three contexts in their responses. But the respondents of the university context are a little bit more positive about this issue than the respondents from the corporate context. The respondents from the military context are more negative on this, they feel that simple metadata will not be of much help.

Table 46 Question 33 - If, material could only be selected based on subject and type, is this information sufficient?

Context Simple metadata enough	University (n=12)	Corporate (n=19)	Military (n=14)	Total (n=45)
not at all		1	1	2
not much	3	5	9	17
no opinion	2	5		7
usually	5	7	4	16
always	2	1		3

The respondents were asked how much of the metadata terminology was understood. Many respondents felt they understood 75 % of the whole set of metadata elements presented in the example. But another large group only understood about 25 % of the terminology however, the group differences were not significant (χ^2 =9,4; p=0,313). Table 48 shows that respondents in the corporate-learning context have most understanding problems, while most respondents in the military setting understood more then half of the metadata terminology used.

Table 47 Question 37 - Approximately what percentage of the terminology do you understand?

Context Percentage metadata terminology	University (n=10)	Corporate (n=20)	Military (n=22)	Total (n=52)
0%		2		2
25%	3	7	4	14
50%	3	4	3	10
75%	3	6	9	18
100%	1	1	6	8

The respondents were asked if they were willing to invest time in assigning metadata to learning objects. Most respondents were willing to fill in metadata for some items. In the corporate learning setting 33% of the respondents were not willing to assign metadata for reuse. Table 48 shows this and also that the military context is most positive with significant difference among the groups (χ^2 =19; p=0,017).

Table 48 Question 54 - Some of the metadata has to be filled in manually. Are you willing to invest time to add specific information?

Context Time investment	University (n=11)	Corporate (n=20)	Military (n=20)	Total (n=51)
not at all	1	6		7
a little	3	1	1	5
for some items	6	9	8	23
for many items		3	5	8
all what is needed	1	1	6	8

The participants within corporate-learning context mentioned the time pressure as one of the most important reason not to invest time. Also the expected reuse possibilities are low within the corporate-learning context.

8.1.2.4 Giving the opportunity for reuse

The respondents were asked to what extent they think there is material available *within* their own department or team that can be used within this same department or team. In general the respondents were positive about this, as is shown in Table 49. The respondents from the university context are slightly more optimistic than those from the corporate and military contexts but the group differences were not sifnificant (χ^2 =11; p=0,201).

Table 49 Question 09 - To what extent do you think there is material available within your department or team that can be reused within your department?

Context Reuse within department	University (n=14)	Corporate (n=20)	Military (n=22)	Total (n=56)
never	1	1		2
almost never	1	1	4	6
sometimes	3	12	11	26
often	5	3	6	14
very often	4	3	1	8

8.1.2.5 Controlling reuse

The previous questions could be related to the need for control over what material will be made available for reuse. The respondents in the three contexts answered this question as presented in Table 50. As can be seen, the respondents from the university context were the most eager for control over their materials, over 50% indicate that they want to have this control always. The respondents of the other contexts feel this need a little less, but it is still an important issue to them, thus there is no significant differences among the groups (χ^2 =10; p=0,262).

Table 50 Question 12 - To what extent should there be control over what material will be made available for reuse?

Context Keeping control over material	University (n=14)	Corporate (n=21)	Military (n=22)	Total (n=57)
don't care	1	4	3	8
almost never	1	4	2	7
no opinion	2	1	7	10
sometimes	2	5	5	12
always	8	7	5	20

8.1.2.6 Selecting material for reuse

For the selection of material metadata elements are used and Table 51 shows the results of the respondents and the frequencies of use for each type of metadata. The frequencies for each metadata element show what can be used for taxonomies in the different contexts and what is used most or not used at all. In Appendix E: "Results of the structured interviews" the results within the different contexts are given. Table 51 summarizes the outcomes for the different contexts (sorted by mean, never = 1, very often = 5), and gives a short conclusion.

Table 51 Selection of metadata elements in the different contexts

			Frequencies						
Metadata element	**Mean**	**Std. Deviation**	**never**	**almost never**	**sometimes**	**often**	**very often**	**N**	**Comparison**
Subject	3,98	1,12	2	4	9	16	22	53	All agree, useful
Keywords	3,87	1,11	2	5	9	19	18	53	Agree
Types of material	3,58	1,23	4	7	9	19	13	52	Stronger in corporate then in military
Name of the course	3,49	1,12	4	3	18	16	10	51	Agree, but there is a spread
Date of last edit	3,40	1,26	7	3	14	18	10	52	Similar, vary
Author	3,21	1,35	7	9	14	10	12	52	Important for university, less for military and corporate
Categories	3,21	1,19	5	9	16	14	8	52	Differ: university vs corporate and military
Date of creation	3,04	1,37	10	8	15	10	10	53	All vary
Copyrights	2,96	1,40	13	5	12	15	7	52	Not expected, see military (more then expected), university (less then expected)
Version	2,88	1,35	12	7	13	13	6	51	Differ, military highest
Time needed to learn	2,83	1,18	9	10	18	11	4	52	University less then other contexts
Course code	2,63	1,45	17	4	16	4	8	49	Interesting that university is so low
Number of attachments	2,45	1,17	15	11	17	8	2	53	Military more interested
File Size	2,12	1,17	21	13	11	5	2	52	All agree, not useful

Table 51 shows that the subject of the type of material is seen as most important and that metadata elements such as keywords, type, and course name are also expected to be useful for the selection of material. Metadata such as file size, attachments and course code are seen as less important.

8.1.2.7 Reuse of one's own materials by others

The previous two questions were related to the use of materials within the respondent's own department. The respondents were also asked to what extent they think there is material available within their own department or team that can be used outside the department or team. Table 52 shows that here the respondents are the least optimistic. Even though more than 50% of the respondents of the university context feel that this is often a possibility, in the corporate and the military context this percentage is only 30% leading to a significant difference of opinion among the groups ($\chi^2 = 18$; p=0,018).

Table 52 Question 11 - To what extent do you think there is material available within your department or team that can be reused outside your department?

Context Material available for outside	University (n=14)	Corporate (n=21)	Military (n=22)	Total (n=57)
never	1	6	1	8
almost never		8	6	14
sometimes	4	1	8	13
often	7	5	5	17
very often	2	1	2	5

The respondents of the three contexts were asked to what extent will there be problems if material within or outside your department is reused? Again, the respondents of the university context are more concerned about this than the respondents from the other two contexts although this time not significantly ($\chi^2 = 15$; p=0,057). This is shown in Table 53.

Table 53 Question 13 - To what extent will there be problems if material within or outside your department is reused? (For example copyrights, embargo)

Context Problems with outside exchange	University (n=14)	Corporate (n=21)	Military (n=21)	Total (n=56)
don't care	1	6	5	12
almost never	1	8	5	14
no opinion	2	2	6	10
sometimes	8	4	5	17
always	2	1		3

The awareness within the university context about copyrights may be higher compared with the other contexts. Foreseeing problems with reuse outside one's own department can be a reason for this.

8.1.2.8 Reuse of materials made by others

In relation to the previous question the respondents were asked to what extent they think there is material available *outside* their own department or team that can be used within their own department or team. Table 54 shows that the respondents are a little less optimistic about this than using their own material within the department but the group differences are not significant (χ^2=13; p=0,100). But still, the majority of the respondents see possibilities.

Table 54 Question 10 - To what extent do you think there is material available outside your department or team that can be reused within your department?

Context Outside department material available	University (n=14)	Corporate (n=20)	Military (n=22)	Total (n=56)
never	1	1		2
almost never	1	1	1	3
sometimes	4	13	10	27
often	8	2	6	16
very often		3	5	8

Based on these results some overall conclusions can be made in the following section.

8.1.3 Overall conclusions

The overall conclusions can be grouped in: User's experience related conclusions, results related to the need of reuse, results related to time investment, and results related to context.

- *User's experience and related conclusions*

  By calculating crosstabs it is possible to see if there are relationships between the user's experience and several other questions asked during the interviews. For instance, by comparing the years of experience of the user with a CMS and the perceived need for reuse it can be seen if there is a relationship between these two variables (the more years of experience, the more the respondents feel the need for reuse). But defining a relationship significant if p is at most 0,05, this relationship between the years of experience and the need for reuse is not significant (χ^2=22; p=0,314).

  Similarity there is no significant relation between the years of experience and the need for a LCMS (χ^2=28; p=0,1), reuse within the department (χ^2=21; p=0,383), making material available outside the department (χ^2 =26; p=0,165), making material available for outside the department (χ^2=26; p=0,162) , keeping control over material (χ^2=24; p=0,237), perceived problems outside exchange (p=0,733), understanding the metadata terminology (χ^2=13; p=0,866), understanding the functionalities (χ^2 =28; p=0,105), the willingness to invest time for assigning metadata (χ^2 =25; p=0,203), and between the years of experience and the intended use of LCMS functionalities (χ^2=27; p=0,133).

In contrast significant results were found for the years of experience and the perceived need for tailoring course material for the different groups (χ^2=34; p=0,029), and the years of experience and likelihood of reuse from previous courses (χ^2=31; p=0,048). A reason for these results can be that the longer a user is developing courses, the more courses are available to copy from and the more material for reuse.

In other words, only a few significant relationships between the user's experience with a CMS and reuse-related topics are found.

- *Results related to the need of reuse*

  Similar calculations can be carried out for the perceived need for reuse, combined with other reuse-related topics. When the perceived need for reuse is compared with the respondent's need for an LCMS there is no significant relationship (χ^2 =15,842; p=0,464). Also the need for related has no significant relationship with the basic use of metadata (p=0,956), and this is the same for the expected time saving (p=0,317), and the willingness to invest time for assigning metadata (p=0,709). Here it can be conluded that there seems to be no significant relationship between the user's perceived need for reuse and other reuse-related topics.

- *Results related to time investment*

  Next to the years of experience and the perceived need for reuse there is another variable that can have influence on the results of the interviews: the results related to time investment. But again, by calculating the relationship between the time investment of assigning metadata and the expected time saving of reusing materials, no significant relationship was found (p=0,602)

In summary, combining the years of experience with several reuse-related variables, the perceived need for reusing materials with other reuse-related topics, the time investment of assigning metadata, and the expected time saving of reusing materials does not result in significant relationships within any of the three contexts.

8.2 Overview of the Main Research Questions and Related Secondary Research Questions

Based on the results of the various projects the different contexts can be compared. Figure 185 hows how the results of the different projects are combined.

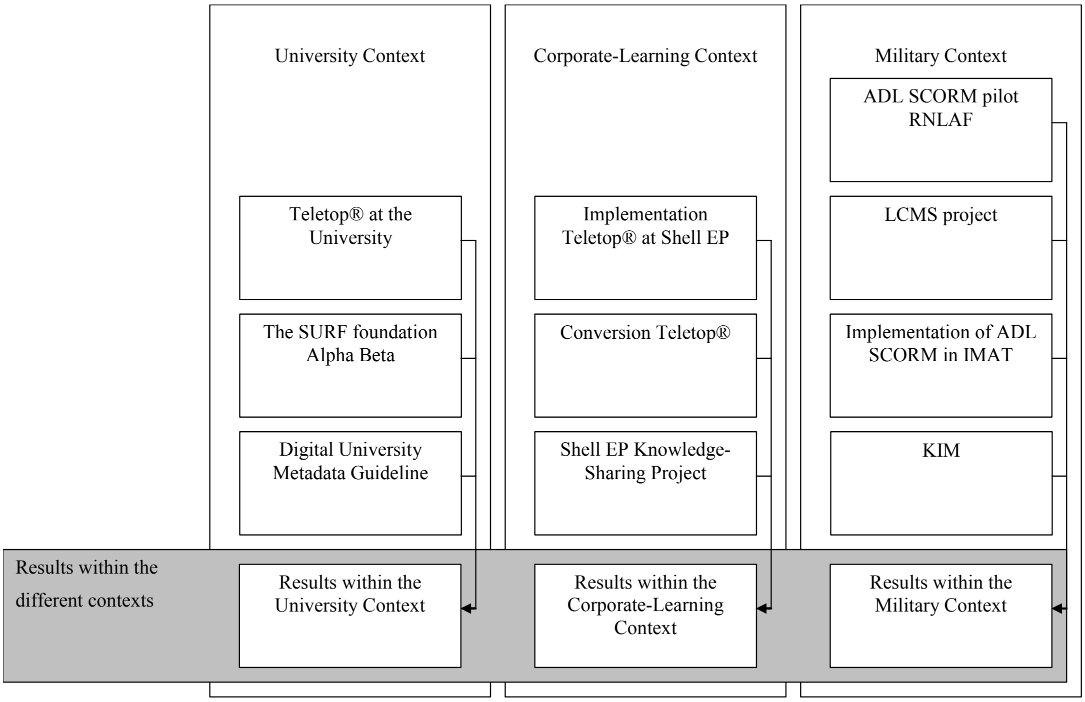


Figure 185 Structure and results of the dissertation

Three main research questions were identified in Chapter 1: Human perspectives (RQ1), Technical perspectives (RQ2), and Combining Human and Technical perspectives (RQ3). Each of the questions is repeated here with the related secondary questions. The research questions and the refined secondary research questions can be seen as overall questions for the Why?, Who?, What?, How?, and Where? questions. The questions are related to each other as shown in Table 55.

Table 55 Research questions, perspectives, perspective questions, secondary research questions, and issues

Main research question		Perspectives	Perspective questions	Secondary research questions	Issues
RQ3. Combining human and technical perspectives - What are key dimensions to guide the selection of tools, technologies and human procedures to support the different stages of the lifecycle of a learning object for users in different usage contexxt, particularly university, corporate learning centre, and military training?	RQ1: Human perspectives – What human aspects are important to support the different stages of the lifecycle of a learning object?	Human	Why?	HQ1. Organisational context - Is the use of learning objects embedded in an organisational strategy? If yes, how and why? If not, what then is the meaning of reusable learning objects for the individuals in the organisation? HQ2. Learning scenarios - What are the implications of different learning scenarios or approaches, particularly the contrast between knowledge acquisition and collaborative problem solving and knowledge creation, for the use of learning objects, for their structural requirements, for their quality control, and for their metadata? HQ5. Metadata - Is there a need or wish for assigning metadata to learning objects within the organisation? Assuming its application, who decides what terms and relationships to express? Are these decided from a logical or a user-generated approach? Who applies the metadata, what will motivate them to do this, and how much time will they be willing to spend on the process?	HI2. Effectiveness HI4. Environment
			Who?	HQ3. Object creation - Who creates the learning objects in a repository or otherwise available for sharing? And what is it that they create: A pedagogically neutral or pedagogical specified resource? Does the object have to be created specifically for learning? What about the quality control of what is created; who affirms this? The creator or the user? HQ4. User support - What training, support, incentives, tools, and services are needed, for whom, for each of the stages in the lifecycle of learning objects? Who designs these? Who provides these?	HI1. Ease of use HI3. Engagement
	RQ2: Technical perspectives - What tools and technologies are important to support the different stages of the lifecycle of a learning object?	Technical	What?	TQ1. Granularity and standards - What granularity level of learning objects can be identified in the different organisational contexts and how can these learning objects be mapped against existing standards?	TI1. Specifications and standards TI2. Granularity
			How?	TQ2. Tools - How do tools in the varying organisational contexts support the different stages within the learning-object lifecycle?	TI3. Reuse TI4. Meta-tagging
			Where?	TQ3. Systems - What systems are in use with the actual reuse of learning objects in the different organisational context, and how do they vary?	TI5. Access and privileges

Table 55 shows the relation between the research questions, and the secondary research questions. These are elaborated in the following sections with combined results from the projects.

8.2.1 Human perspectives

The research questions and issues related to the human perspectives are summarized in this section. The first main research question focuses on the Human Perspective:

> *RQ1: Human aspects – What human aspects are important to support the different stages of the lifecycle of learning object?*

This main question about the Human Perspective was elaborated in Chapter 2 resulting in a set of in-depth human secondary research questions summarized in Sections 8.2.1.1 - 8.2.1.6:

8.2.1.1 Organisational context

> *HQ1. Organisational context - Is the use of learning objects embedded in an organisational strategy? If yes, how and why? If not, what then is the meaning of reusable learning objects for the individuals in the organisation?*

Between the different contexts a similarity can be seen in the approach for a reuse strategy. All three organisations think that reuse is important and decision makers support research in this area. Within the university context this is done within the Digitale Universiteit, the corporate-learning context started a research program for reuse and standards, and in the military context several research programs are being carried out. The approaches of the research programs however are fundamentally different with various results. Within the university context the university-wide implementation of the TeleTOP® CMS and tools to reuse material gave instructors the possibility to reuse material one year (1999) after the implementation (1998). Based on these experiences the Shell EP group in the corporate-learning context started to use the TeleTOP® CMS in 2002 reusing its own material in 2003. The various experiments in the military context done with TNO resulted in a set of tools and experiences but did not evolve further because no actual systems were available to continue. The corporate context, the Shell EP LLD organisation, is currently stretching its reuse strategy to include actual tools for reuse and procedures for the course directors. Based on experiences with reuse in the last years of their own material the course developers expect that material can be found outside the organisation or shared more effectively within. The projects in the corporate-learning context provide examples of an important set of requirements that can be useful for the military context:

- An organisational strategy that focuses on sharing knowledge
- An organisational strategy that sees IT as a prerequisite for global learning
- A fast and well utilized private network
- A world-wide accessible database-driven Web-based learning environment

Based on the experiences in the different contexts and their related learning scenarios the following conclusions can be made:

- The culture underlying any specific context determines the value system for the reuse situation

8.2.1.2 Learning scenarios

> *HQ2. Learning scenarios - What are the implications of different learning scenarios or approaches, particularly the contrast between knowledge acquisition and collaborative problem solving and knowledge creation, for the use of learning objects, for their structural requirements, for their quality control, and for their metadata?*

Within the IMAT project (De Hoog, Wielinga, Kabel, et. al., 2004a) the following learning situations were identified:

- The developer uses the material for the development of course material such as CBT or readers.
- The instructor uses material during lessons
- The student uses material for doing assignments
- The student uses the material as self-study material
- The material is used on-the-job to solve problems.

These different learning situations can be seen in each of the organisational contexts. The RNLA and RNLAF use mainly CBT in combination with face-to-face training and training in practice. Within the corporate setting small pieces of CBT are used to create assignments and provide course material. But also in the Shell EP as well in the KIM project students or participants are expected to steer their own learning and instructors have a role more oriented toward coaching than content presentation. Within the corporate-learning context the knowledge-management tool and systems are used for on-the-job learning to solve problems.

The organisational strategy in all contexts is strongly focused on renewal of learning scenarios. Within the university projects, the renewal was focused on increased flexibility while with the Shell EP context the renewal focusing on “workplace learning” involving problem solving in the workplace. In the KIM project the renewal focuses also on the use of learning objects and project-based learning. Although renewal of learning scenarios in the different contexts is highly stimulated, support in terms of reuse and tailoring tools for the instructors, course developers, and course directors is not much available. Instructors themselves have to find ways how to use the systems for the new educational implementations. The tools needed for reuse to support the new learning scenarios on the instructor level are not yet implemented on a large scale. Reuse is still a local activity managed by the instructor or course developer. Tools to exchange material in a broader perspective are still not available.

The different renewals in the contexts reflect on the learning scenarios used but also the learning objectives related to the training programs.

The following conclusions can be made:

- The level of learning objectives is determined by the context
- The learning scenarios underlying reuse are determined by the context

8.2.1.3 Object creation

> *HQ3. Object creation - Who creates the learning objects in a repository or otherwise available for sharing? And what is it that they create: A pedagogically neutral or pedagogical specified resource? Does the object have to be created specifically for learning? What about the quality control of what is created; who affirms this? The creator or the user?*

In the university context, as well as partly in the military context and partly in the corporate-learning context material is gathered from different resources. This can be by using Google for searching the Internet or using material stored on one's own hard drive. Also old learning material is reused to create new courses. Material is selected by the instructors and course developers because of its potential quality for a course. For educational purposes information may be added about how to use the material in a certain course. In the military context and in the corporate-learning context the materials are specifically created for learning to serve as pieces of CBT. The subject-matter expert and course developer determine the pedagogical structure of the course and the quality of the selected material.

Different roles can be identified within a context that are related to the creation of learning objects. The organisational structure and culture within a context determines how the roles are part of a workflow.

Regarding to roles and object creation the following conclusion can be made:

- The roles of those involved with learning objects is determined by the context

8.2.1.4 User support

> *HQ4. User support - What training, support, incentives, tools, and services are needed, for whom, for each of the stages in the lifecycle of learning objects? Who designs these? Who provides these?*

The user support is in the university context and corporate-learning context centralized. The user support is more likely to be available during the implementation of a new system focused on several aspects of e-learning such as technological support and development of other learning scenarios. The support in the military context focuses on the course developers in terms of research projects. During the research projects the course developers were involved in new developments. In the corporate-learning setting support comes from different sources. The supports in terms of educational renewal come from the LLD research group. More practical support can be requested from the course designers who can help course developers with technical problems, layout requests, and turning educational ideas into practice. In the university context the faculties have contact persons that can offer support to teachers.

The type of human support given for training and services depends on the resources and incentives of an organisation and is therefore determined by the organisation. The designers of course material also decide about the quality of material used. The quality of material is determined by the skills of the course developer and the support that is given by specialists during the development of material.

Another type of support can be found in the human interaction between instructor and learner. This interaction may also build in CBT materials where course developers provide interaction with the learner. The type of support for human interaction depends on the learning scenarios that are appropriate for a certain context.

The conclusions that can be made are the following:

- The need for human interaction is determined by the context
- Those who control the quality of learning objects are determined by the context

8.2.1.5 Metadata

> *HQ5. Metadata - Is there a need or wish for assigning metadata to learning objects within the organisation? Assuming its application, who decides what terms and relationships to*

express? Are these decided from a logical or a user-generated approach? Who applies the metadata, what will motivate them to do this, and how much time will they be willing to spend on the process?

All contexts are working on metadata specifications and the application of these specifications. The corporate-learning context is working on competence descriptions and automatic taxonomy generation to make it possible to assign material to appropriate taxonomies. Within the university context a metadata guideline has been developed at the DU level to make exchange of material in the future possible. The military context has worked on vocabularies in research settings. The use of classifications was used in these different projects to see how they could be implemented in the specific corporate-learning context at Shell EP. The use of the classifications may be interesting in larger sets of material. Instructors in all three contexts use keywords to search for material. The use of prespecified metadata of any sort is directly related to an organisational policy otherwise instructors will choose their own ways of organizing resources via folder structures on their hard drives.

The use of metadata for reusing material in the various projects depends on organisational strategy or personal incentives.

The following conclusion can be made:

- The incentives for reuse are determined by the context

For the different sorts of research various issues within the projects could be identified.

8.2.1.6 Issues related to the human perspectives

The issues related to the human perspectives for the different contexts can be summarized as follows:

HI1. Ease of use – The material of previous developed courses is reused in each of the different contexts. In each of the contexts tools are available to do so. The tools are part of the systems used or by individual actions taken to make reuse possible such as the use of shared network drives.

HI2. Effectiveness – Within the different contexts it is expected that reuse can be effective in terms of time saving and flexibility. Flexibility can be seen as creating new courses using material from other courses. Also the development of courses for various target groups is seen as effective. The use of long forms to fill in metadata is not seen as very effective because it is expected that the provided metadata does not provide the desired information.

HI3. Engagement – In the three different contexts people are willing to reuse material but have also limitations related to expectations. Limitations are found in the availability of learning material and if others can use their own created material for purposes different from those for which the material was originally intended. To enhance engagement people also want to be rewarded in terms of benefits from reuse such as recognition, money, or time. The motivation for reuse is also great when material is created in teams, because instructors were part of the development process so the “not invented here” syndrome does not apply.

HI4. Environment – The different environments have certain characteristics that have implications for the reuse of learning material. The university setting consists of instructors that work mainly independently in very specific expertise areas. The courses are based on the expertise areas of the instructors and the research they are involved in. The expertise area is related to a department. The members that work in the department decide how a set of courses are related to each other. The university board decides how the curriculum is organized in terms of relations with other universities and in Europe and sets the regulations for accreditation. Within the military setting the course developers are bound to the curriculum developed by the educational policy offices. Based on the tasks and goals defined in these policy offices the course material is developed. The corporate-learning context develops courses based on the competences described for each course. The competences are defined by a group of accredited experts in a certain expertise area. Another way of developing courses is based on the requests of customers. When courses are requested they are mainly developed based on existing available courses. The way of working in each context reflects also the freedom of course development, but also the responsibility of the involved people.

8.2.2 Technical perspective

The research questions related to the technical perspectives are summarized in this section. The second main research question focuses on the Technical Perspective:

> *RQ2: Technical perspective - What tools and technologies are important to support the different stages of the lifecycle of a learning object?*

The main research question about the Technical Perspective is elaborated in Chapter 3 and resulted in the following set of technical secondary research questions summarized in Sections 8.2.2.1 - 8.2.2.4:

8.2.2.1 Granularity and standards

> *TQ1. Granularity and standards - What granularity level of learning objects can be identified in the different organisational contexts and how can these learning objects be mapped against existing standards?*

The granularity of the learning objects depends on the authoring systems that are used. The use of the authoring systems prescribes what the sizes of the objects are and how they can be reused. For example within the TeleTOP® CMS the objects are closely related to the database records and how they are constructed and when the SCO-Generator is used the granularity is based on the templates available. Also the type of learning material developed is bounded to a certain granularity. When CBT is developed, reuse will occur in terms of assets such as pictures, movies, and animations. When material is developed for a university context reuse is focused on more-general documents such as articles, papers, and presentations. In all three contexts there is a focus among decision makers on learning-technology standards such as ADL SCORM™ and learning object metadata (LOM). The military context uses the standards in their research projects to predict future outcomes when such standards are used. Although research is carried out in the field of development, the military context is searching for tools that are compliant to standards and is not developing a system itself for the support of reuse based on standards. In the corporate-learning context standards are important but standards also have another meaning. Because of the size of the organisation standards are seen as “doing something in the same way as it was done before”. The need for the implementation of learning standards is seen as useful in some settings, but in most cases the corporate organisation defines the requirements that are seen as “the standard”. The current learning-technology standards are seen as not mature enough and not able to fulfill the needs of such a sophisticated organisation. It is also expected that standards such as ADL SCORM™ are implemented by the software vendors for future use. The main goal of the corporate learning center is to provide courses and not the development of systems. Systems and related standards are implemented to support and facilitate course directors and course designers. For the university context the learning-technology standards are important because of the different course-management systems that are used within university settings. By exchanging between universities digital material can be more cost effective and interesting for knowledge dissemination. The use of standards can avoid custom-built connections between different course-management systems and lead to a uniform exchange mechanism.

Based on the different projects and the use of learning objects within different systems and learning scenarios the following conclusions can be made:

- The “instructional packaging” of learning objects depends on their origin.
- The reusability of learning objects is determined by their specificity
- The reusability of learning objects is determined by the adaptability of the objects

8.2.2.2 Tools

TQ2. Tools - How do tools in the varying organisational contexts support the different stages within the learning-object lifecycle?

In all contexts similar tools are used to obtain and edit source material in the form of assets. Assets such as pictures and multimedia are edited with appropriate tools, and for presentations and texts. Office tools are used to create these. The actual development of courses is in the university context is done with the authoring tools available in the CMS. Assets are uploaded in the system and an educational setting is described in terms such as structure, assessment, competencies, resources, and assignments. The corporate-learning context uses the same approach with the addition that also CBT materials are developed and used as individual pieces in the courses. The military context uses the largest scale of tools because of the various learning scenarios that call for realistic visualizations. Within the RNLA and RNLAF mainly CBT is developed but the KIM uses a CMS to support courses.

Within the different contexts the specifications of the learning objects are closely related to the available tools. The available tools depend on the type of course material that is required for a certain context. The role of the learner depends on learning scenarios used and the type of material developed for a certain scenario.

Based on these experiences from the projects the following conclusions can be made:

- Specifications of learning objects are determined by the context
- The role of the learner is determined by the context
- The characteristics of the tools that support reuse are determined by the context

8.2.2.3 Systems

TQ3. Systems - What systems are in use with the actual reuse of learning objects in the different organisational context, and how do they vary?

The three different contexts all use a CMS with facilities to reuse material. The university context and the corporate-learning context have used the CMS for several years with an organisation-wide implementation and have the benefit of older resources created in the previous years. The military context does not have such an organisation-wide implementation of a CMS. Because of the relatively short time the military research projects ran, the instructors could not benefit from previously developed material that could be reused for new courses. The CMSs which are used in the university context and corporate-learning context, can be seen as large repositories which contain large sets of valuable material. Using the standards it is possible to exchange this material between other courses, universities, and interested companies.

Where the material is stored depends on the organisational strategy. When reuse is part of the strategy a learning content management system (LCMS) can be installed that can be used to store material based on predefined taxonomies.

Based on these interpretations the following conclusions can be made:

- Where the learning objects are stored is determined by the context
- Taxonomies are determined by the context

8.2.2.4 Issues related to the technical perspectives

The issues related to the technical perspectives for the different contexts are closely related to technical research questions and can be summarized as follows:

TI1. Specifications and standards – All three contexts focus on the implementation of specifications and standards to make exchange and reuse possible. The intentions are there as are various research projects and tools to support exchange, however the tools are difficult to use. But despite availability of specifications there is no piece of material being exchanged in the projects based on the described standards and specifications. Reuse in real practice is based on system-specific tools that still offer no exchange possibilities.

TI2. Granularity - The size of the learning objects and the definition of these learning objects differs in the various contexts. Within the corporate-learning context a definition is desired because it could offer a mathematic unit to calculate costs for development, time investment, return-on-investment data, running time for courses, requirements for tools, requirements for systems, and human resources. Within the military setting the size definition and related granularity is for some situations important. For example the development of some CBT could be done based on templates which are the structure for learning objects. The use of templates or wizards makes it possible to develop clearly defined learning objects with a fixed granularity and built upon specific learning scenarios. The use of templates and strict definitions are not always possible in the military context and can be compared to the university context where the definition of learning objects is not important and where the authoring systems within the CMSs specify the granularity of the reused objects. None of the projects has a specification available for how to develop or maintain learning objects

TI3. Reuse – In all contexts course developers reuse their own created material. Within the military context the reuse varies from pictures to source code used in authoring tools. The university context and corporate-learning context focus on material used in the CMSs but also material selected from the Internet is used. In none of the projects is reuse established based on IMS packaging specifications

TI4. Meta-tagging – The structure in terms of functionalities used in the CMSs can be used for initial values for the metadata elements. How a CMS is used in a certain context can also be part of the metadata tags. Within the corporate-learning setting the research for taxonomies and classifications has an important focus for the IT department because of its responsibilities with the document systems. Missing documents that are wrongly indexed can have far-reaching consequences with high costs. The military used a set of vocabularies and classifications within their reuse experiences but did not define a set of material that can be used for meta-tagging. Within the university context the metadata guideline developed for the Digital University is a first step for a prescription for how to use metadata tags and who can be involved. None of the contexts has consistent sets of vocabularies or taxonomies available. There is also no policy for how to obtain such vocabularies for actual use within different systems.

TI5. Access and privileges – All of the contexts have problems with classified material or material that needs special care in terms of copyrights. Within the military context and corporate-learning context the technical implementations for the security give various problems with the implementation of systems needed for the support of e-learning. The corporate-learning context uses a dedicated global intranet for its employees to overcome security issues. The global intranet cannot prevent slow and bad connections to parts of the world with weak utilized technical infrastructures where accessibility is still a problem in term of bandwidth and old computers. Also the military uses such kinds of solution but does not offer the flexibility and bandwidth to make the exchange of the CBT material possible. Thus accessibility is problematic for some development groups. The privileges required for some classified resources are another problem in all contexts. Also export controls (GEC), which are closely related to privileges and access to material, are an issue in the corporate context. In none of the contexts is there strategy or policy to deal with intellectual property, or accessibility in reuse situations.

8.2.3 Overall conclusion

The approaches of the different contexts for reuse vary in terms of implementation, strategy, research, needs, and expectations. The university-wide implementation for TeleTOP® gave instructors at the University of Twente the possibility to experiment with different learning scenarios and simple reuse possibilities. This implementation was supported with pedagogic support in terms of research projects such as TeleTOP® Alpha Beta. The projects in the corporate context followed such a kind of approach with the implementation of the TeleTOP® CMS in the Shell EP Learning Center. The reuse of previously created material made it possible to develop different requested versions of courses for clients. The use of pieces of CBT made an object-based structure of course material possible. The use of a CMS made it also possible to store the knowledge of course directors in a system used for learning. Obtaining material from the Shell EP course instructors (called LDLs) is an interesting task because they move every three years to a new job. The use of the CMS makes it possible to gather a set of resources for new course directors.

Two sorts of research can be identified when the different contexts are compared. The scientific research carried out in the military context was from a high level of abstraction and delivered very interesting tools for metadata tagging. The research also delivered insight and information about the search strategies and use of LCMSs for the development of CBT. The other type of research is applied such as the implementation of TeleTOP® in the university and shows practical issues related to human motivation and incentives for doing things such as assigning metadata for future reuse.

8.3 Combining Human and Technical Aspects

The third main research question focuses on the different contexts and their specific characteristics related to the perspectives.

> *RQ3. Combining human and technical aspects - What are key dimensions to guide the selection of tools, technologies and human procedures to support the different stages of the lifecycle of a learning object for users in different usage contexts, particularly university, corporate learning centre, and military training?*

The three key components of the overall research question are answered in the following sections. The key dimensions in Section 8.3.1, the learning-object lifecycle in Section 8.3.2, and the different contexts in Section 8.3.3.

8.3.1 Conclusions as dimensions

One of the main components of the overall research question is the identification of key dimensions to guide the selection of tools, technologies, and human procedures. The answers to the secondary research questions from Section 8.2.1 and 8.2.2 were all summarized in short conclusions that can used as key dimensions for the research. Table 56 shows the perspectives, the perspective questions, the conclusions from the secondary questions, and the dimensions extracted from the conclusions. The dimensions will be further discussed in Chapter 9.

Table 56 Conclusions as reuse-strategydimensions

Perspective	Perspective question	Conclusion	Dimension
Human	Why?	The culture underlying any specific context determines the value system for the reuse situation.	Cultures within the context
		The level of learning objectives is determined by the context	Level of learning objectives
		The learning scenarios underlying reuse are determined by the context	Learning scenarios
		The incentives for reuse are determined by the context	Incentives for reuse
	Who?	Those who control the quality of learning objects are determined by the context	Quality of the object
		The roles of those involved with learning objects is determined by the context	Work process
		The need for human interaction is determined by the context	Need for human interaction
Technical	What?	The “instructional packaging” of learning objects depends on their origin.	Purpose for creating the object
		The reusability of learning objects is determined by their specificity	Nature of he course object
		The reusability of learning objects is determined by the adaptability of the objects	Adaptability of the learning object
		The role of learning objects determines their “instructional packaging”	The role of the learning object
	How?	Specifications of learning objects are determined by the context	Specifications for the learning object
		The role of the learner is determined by the context	Personal control over learning
		The characteristics of the tools that support reuse are determined by the context	Tools for reuse of learning objects
	Where?	Where the learning objects are stored is determined by the context	How learning objects are stored
		Taxonomies are determined by the context	Structuring of learning objects

8.3.2 Refining the learning-object lifecycle

The learning-object lifecycle is an important component in all the research questions and is used in the dissertation as an organizer for the summaries of the projects. For the synthesis of the ten projects a summary is made for the use of the learning-object lifecycle within this research:

Obtain – Material is mainly obtained and created for reuse for two reasons: external and internal motivation. External motivation comes from the organisation’s needs or strategy and course developers are forced to obtain material. Internal motivation is related to the expected future benefits to the course developer. From the university context the initial use of a CMS was forced by the organisation because of the decreasing number of students. The reuse possibilities in the years after the implementation made it easier for instructors to create new versions of courses. Within the corporate-learning context course directors were personally motivated to use a CMS and store material needed for courses. Because of the job-rotation cycles every three years at Shell EP material is automatically being reused by new course developers. The course material is available in old courses and can be reused as resources for new courses. Within the military material is obtained by course developers but also by multimedia specialists who create material such as photos and movies for the developed CBT material.

Label – Labeling material is still not part of daily procedures in any of the contexts. Material is labeled based on the use in the various systems used. The category or folder, course name, title or course code, and description are the most important identifiers when material is labeled. In the different projects there are roles identified for who should actually label material. Because of the specific expertise area of the course developer or subject-matter expert, it is expected that this person can provide a specific set of metadata. The main reason to ask the subject-matter expert or course director is because this person decides about the quality aspect of the material in a certain setting. Besides the subject-matter expert it is also expected that a librarian will be involved to streamline the metadata that are used and to provide more-specific organisational metadata such as reference numbers, locations within existing taxonomies, or classifications. A course developer is not trained to work with thesauri and strict classification of material. On the other hand the subject-matter expert is responsible for specific descriptions of objects and kinds of use. So for the labeling of material different roles can be identified with different tasks and expertise areas.

Offer – Because of the lack of actual accessible functional repositories there is also no systematic offering of learning objects in the projects in the three contexts in terms of systems. Material is offered in all contexts through personal communication. Shared network drives such as available in the military and corporate context can be seen as a way to offer material. Material is also offered through personal websites using the Internet or in a structured way using forums. The knowledge-sharing networks and Metis portal used in the Shell context is an example of how material is offered within communities interested in similar subjects.

Select – The selection of material is mainly based on keywords and done by using search engines such as Google. Also in the experiments in the military context were material was structured based on various taxonomies, keyword search is mainly used.

Use – In all contexts material is adapted before reuse. Adaptions are made to make material usable in new settings and can be related to learning scenarios, aging, or target groups. For the choice of the course material the course developers decide what will be used in the courses. No other control system is used to verify the quality of the used material.

Retain – How material is retained depends on the course developers. The course developer decides in all contexts if material can be reused or not. Material is removed or replaced based on the experience of the course developers.

The lifecycle thus helps to compare and contrast the contexts and project. However using a rigid linear model for all projects made clear that the model did not fit all projects in the various contexts. The dimensions in Section 8.3.1 (to be discussed further in Section 9.1) show that there can be differences in how reuse occurs and that there can be different types of learning scenarios and learning objects. Because of the differences in reuse also the sequence and stages within the learning-object lifecycle can be discussed. The sequence of the stages may not always be the same and some stages may not be relevant for certain settings. Figure 186 shows this alternative version of the lifecycle.

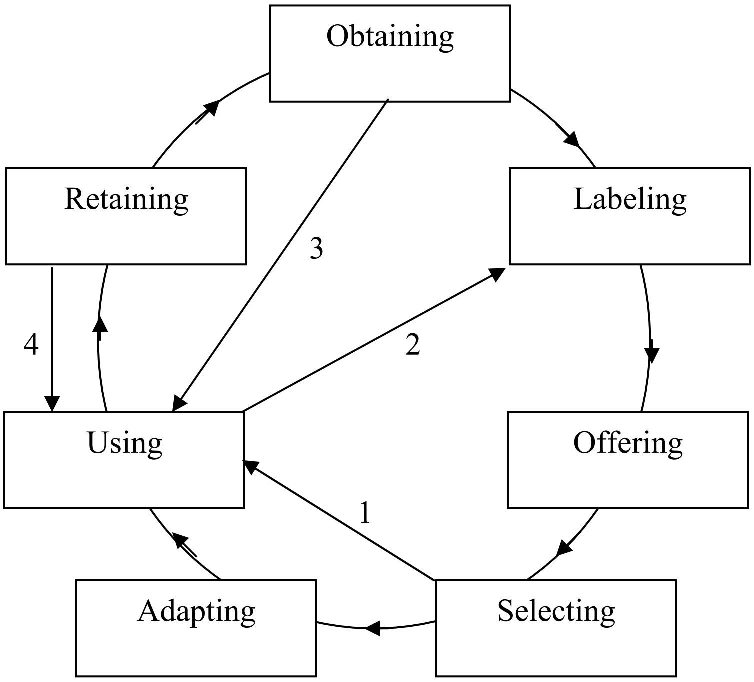


Figure 186 Alternative learning-object lifecycle

Although Figure 186 is shown as a circle for representing the stages in the original learning-object lifecycle there are also new arrows added which represent other ways of working identified in the different contexts. Material is in different cases obtained for a certain use. Arrow 3 shows that all other stages are skipped in such situations. Labeling and offering is in most settings only the case when material is already used in a certain context. Arrow 2 shows this. This means that metadata can be retrieved from the setting where the material is used in. Arrow 4 in Figure 186 shows that retaining of material is in most cases only done when material is used again. The material is reviewed and the decision is made if the material is still up to date and relevant for a new course. Arrow 1 shows that material can be used as it is. The learning-object lifecycle used in the previous chapters did not have a stage where material is adapted to its new situation. The stage is added in Figure 186 because in different projects material was adapted to the new situation where the material will be used.

The most important change in the model is the sequence of the stages and the implication this has for the metadata. Labeling course material before it is used once is sometimes difficult and time consuming. When material is obtained or created to be used in a certain educational setting a large set of metadata can be extracted from the type of use, the user, the related tasks, the target group, the learning scenario used, the platform used, the related categories, description, title, and closely related other material. Especially when database-driven CMSs are used, different resources can be accessed to retrieve such kinds of metadata. Another interesting remark can be made about quality control. The control of quality is not a separate stage in the learning-object lifecycle. Quality control is one of the tasks of the course developers and involves actions in all of the different stages.

8.3.3 *Refining the definition of context*

In the previous chapters context was defined as an organisational setting, university, corporate learning, and military. The results in this chapter show that for the application of reuse strategies not the organisational settings as a whole are different but rather dimensions that are present in all three contexts vary. In other words: For the application of reuse strategies a context depends on various dimensions more general than “university-corporate-military. These dimensions are summarized in Table 56. This will be elaborated in Chapter 9.

9 A New Approach to Context: The Learning Object Context Profiling Tool

This chapter provides a new view focused on reuse strategies based on the data gathered in the research. Chapter 8 provided the answers to the research questions formulated in Chapter 1 using the secondary research questions. The answers to the research questions form the basis for a new set of dimensions, each sharing bipolar end values which define two new extremes of context (identified as “System oriented’ and “Personal oriented”) and are important for a reuse strategy. Section 9.1 gives an overview of the different dimensions and the values used for these dimensions. The dimensions are structured around the Why? (Section 9.2), Who? (Section 9.3), What? (Section 9.4), How? (Sections 9.5), and Where? (Section 9.6) questions used in the projects. Based on these dimensions a model for reuse strategies is developed that reflects these two new opposites of context. Section 9.7 describes the Learning Object Context Profile Model related to key dimensions sharing a Systems and Personal orientation, and Section 9.8 describes how the model can be used as the basis for a tool for different tasks related to reuse strategies. In Section 9.9 and Section 9.10 reflections on the model, tool, and research methodology are discussed while Section 9.11 concludes the research with a speculation about a new development relating to reuse, the Semantic Web.

9.1 Dimensions for Context

The research questions answered in Chapter 8 focused on the differences and similarities in the university, corporate learning, and military contexts. The results in Chapter 8 show that there are differences and also similarities between the university, corporate learning, and military contexts but broader relations can be identified in terms of context. The broader relation can be found in each of the endpoints of the dimensions. On reflection, the researcher proposes that these endpoints be aligned so that the left extreme is related to a context that can be *Systems oriented* and the right extreme can be *Personal oriented*. The Systems orientation focuses on technical specifications, rules, policy, and procedures as the key identifiers and a Personal orientation is related to human interaction, personal needs, personal incentives, and personal values. The two orientations can be seen as the end points of each dimension where also values between the endpoints can reflect the involvement of both orientations as follows:

	S	Context	P
Orientation	Systems	⟵⟶	Personal
Identifiers	Technical specifications, rules, policy, procedures, formality		Human interaction, personal needs, personal incentives, personal values

While these contexts might seem to reflect the Technical and Human perspectives that structured this dissertation, they are not fully the same. A Systems orientation is broader than technology, and involves people and organisations, but in ways that are structured and systematic. A Personal orientation may involve an individual using technology also in a structured way, but a way that he has determined for himself. Thus both technical and human perspectives are involved in both of the new orientations; the difference relates to the structure of a system compared to the structure of the individual. Based on these Systems and Personal orientations the different dimensions identified in Chapter 8 in terms of answers to the secondary research questions can be aligned and used to predict how reuse will occur and what the implications are for the granularity, standards, design model, and specifications for the learning objects for different contexts as described on the Systems-Personal dimensions. How this occurs will be explained in Section 9.2. The definition of the learning object given in Section 3.1.1 is still used but can be specified differently for the different orientations. The following definition was originally used:

A learning object is any digital entity that may be used for learning, education, or training.

Different specifications can be made in terms of pedagogy, structure, quality, format, sequence, prerequisites, scoring, assessment, time constraints, size, and layout guidelines focused on each of the Systems and Personal contexts. In Chapter 8 the dimensions were identified, based on the Why?, Who?, What?, How?, and Where? questions used in the projects. Table 101 expands on Table 99 from Chapter 8 by adding a label for each endpoint of the dimensions, labels that reflect a Systems-oriented value or a Personal-Oriented value. The reasoning behind these labels will be discussed in Sections 9.1-9.6:

Table 57 Dimensions for reuse, expanded from Table 99 (last two columns)

Perspective	Question	Conclusion from Chapter 8	Dimension	Systems-oriented value	Personal-oriented value
Human	Why?	The culture underlying any specific context determines the value system for the reuse situation.	Cultures within the context	*The industrial world*	*The world of inspiration*
		The level of learning objectives is determined by the context	Level of learning objectives	*Knowledge*	*Evaluation*
		The learning scenarios underlying reuse are determined by the context	Learning scenarios	*Acquisition*	*Participation*
		The incentives for reuse are determined by the context	Incentives for reuse	*Organisational*	*Personal*
	Who?	Those who control the quality of learning objects are determined by the context	Quality of the object	*Formal processes*	*Personal*
		The roles of those involved with learning objects is determined by the context	Work process	*Formal workflow*	*Personal habits*
		The need for human interaction is determined by the context	Need for human interaction	*Low*	*High*
Technical	What?	The “instructional packaging” of learning objects depends on their origin.	Purpose for creating the object	*Created for learning*	*Not created for learning*
		The reusability of learning objects is determined by their specificity	Nature of he course object	*Specific*	*General*
		The reusability of learning objects is determined by the adaptability of the objects	Adaptability of the learning object	*Fixed*	*Editable*
		The role of learning objects determines their “instructional packaging”	The role of the learning object	*Replace the instructor*	*Supporting the instructor*
	How?	Specifications of learning objects are determined by the context	Specifications for the learning object	*Predefined*	*Defined when needed*
		The role of the learner is determined by the context	Personal control over learning	*Low*	*High*
		The characteristics of the tools that support reuse are determined by the context	Tools for reuse of learning objects	*Specific*	*General*
	Where?	Where the learning objects are stored is determined by the context	How are learning objects stored	*Repository*	*Locally*
		Taxonomies are determined by the context	Structuring of learning objects	*Organisational*	*Personal*

The implications of the Systems and Personal orientations for the specification of learning objects, granularity, and reuse are described for each dimension in Sections 9.2-9.6, organized again around the Why? Who? What? How?, and Where? questions that have helped to structure the research since its start.

9.2 Why Does Reuse Takes Place?

The reason why reuse takes place is determined by the underlying culture in a reuse situation (Section 9.2.1), the level of learning objectives within a certain context (Section 9.2.2), the underlying learning scenarios within a context (Section 9.2.3), and the incentives for reuse within a context (Section 9.2.4).

9.2.1 Cultures within the context

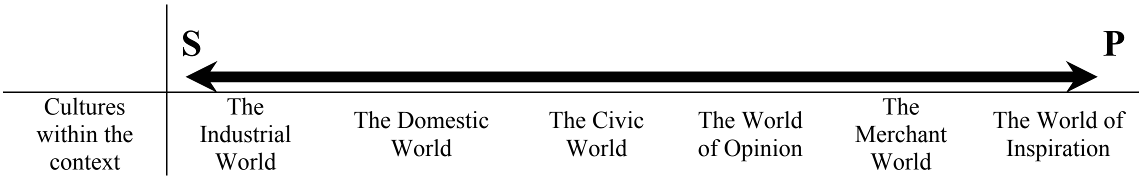
The culture underlying any specific context determines the value system for the reuse situation.

The organisational cultures of the contexts can be seen as different worlds where different values and attitudes can be applied. The organisation culture is a key variable in the motivation for why reuse takes place. In Section 2.1.2.5 the worlds defined by Boltanski and Thevénot (1991) were used to describe different culture within organisational contexts. Table 58 shows the characteristics of the different worlds only in terms of verbs, value features, and attitudes which are relevant for a reuse strategy.

Table 58 Relevant characteristics of the worlds (adapted from Boltanski and Thevénot, 1991)

	Verbs	**Value features**	**Attitudes**
The Industrial World	To organise, to control, to formalise, to standardise	Efficiency, performance, productivity, professionalism, reliability, system	Responsibility, professional, discipline, seriousness
The Domestic World	To behave, to give, receive and give back; to respect; to interact.	Responsibility, convention, hierarchy, generation; rules and confidence	Common sense, repetitive, reproductive, reliable
The Civic World	To debate, to gather, to inform	The general will, the common interest, the group, collective action, collective entities (ideas, values, symbols and institutions).	Concerned with the general will, giving collective interest a higher rank than personnel Interests.
The World of Opinion	To convince, to persuade, to seduce, to promote, to orientate, to compare.	Reputation, credibility, Identification.	Contributive, communicative, participative, personality,
The Merchant World	To desire, to buy, to sell, to negotiate, to deal, to rival, to conclude, to accumulate.	Wealth, money, luxury; business, fair deals, good deals, contract; competition, rivalry, freedom,	Attractive, respectfulness to the customers, open-minded, willing to help, thoughtful, reactive
The World of Inspiration	To create, to discover, to research	Singularity, difference, innovation, originality	Independent, intuitive

Based on the characteristics in the table the worlds can be ordered in terms of flexibility needed for the specification of learning objects. The verbs, value features, and attitudes reflect this flexibility and can be used to order the worlds, from a Systems orientation to a Personal orientation. The Industrial World can be seen as a systematic, controlled, stable environment where procedures are formalized and standardized. At the other extreme, the World of Inspiration focuses on a Personal orientation including discovering, singularity, difference, and intuition. Based on the terms in Table 58 the worlds are ordered and combined in a dimension related to cultures within a context. Contexts that can be compared with worlds with a Systems orientation are expected to define clear specifications of learning objects because of the professional needs within the organisation. Learning objects in a culture with a Personal orientation are difficult to specify because there are no clear boundaries accepted beyond the individual level. The dimension relating to cultures within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:

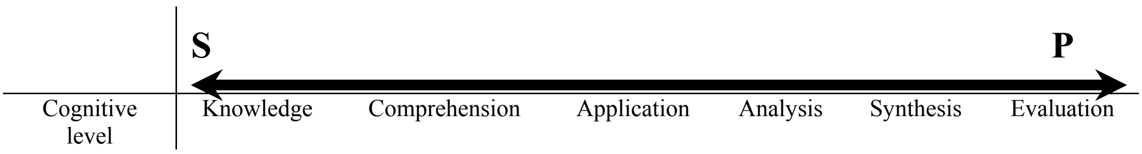


For example, reflecting an underlying Industrial World culture, the development of courses in the corporate-learning context is formalized in terms of stages and related responsibilities for learning-object development. In contrast, reflecting an underlying World of Inspiration, the courses in the university context are developed by an independent instructor based on his own research.

9.2.2 Level of learning objectives

The level of learning objectives is determined by the context

Why reuse takes place is closely related to the required learning objectives in a certain context. The context determines the required skills for the tasks that need to be carried out. In Section 2.1.4.3 different levels of learning objectives are described based on the taxonomy of Bloom (1956) for the cognitive domain. The different cognitive levels can be seen as a dimension where “knowledge” represents the lowest cognitive level and “evaluation” the highest cognitive level. The specification of learning objects is expected to be specific when learning objectives focus on knowledge transfer and general when learning objectives for complex open-ended tasks such as evaluation are involved. The dimension relating to complexity level of learning objectives within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:



For example the course “Ranks” in the military context is focused on acquisition of pre-identified knowledge while a course in the university context can have evaluation, for example of a design or a literature review, as a learning objective. The latter will be much less likely to be able to make use of pre-specified instructional designs and learning-objects with pre-specified instructional metadata than will the learner dealing with knowledge-acquisition objectives.

9.2.3 Learning scenarios

The learning scenarios underlying reuse are determined by the context

Besides the cultural differences in the organisations and related to the learning objectives, there can also pedagogical differences identified that relate to either a Systems orientation or a Personal orientation. The differences in learning scenarios are related to the type of learning objects that can be reused. The reason for a certain learning scenario is related to the learning objectives needed within a certain context but also to the underlying view of teaching and learning. In Chapter 3 the diagram shown in Figure 187 was used to show the relation between organisation and pedagogy.

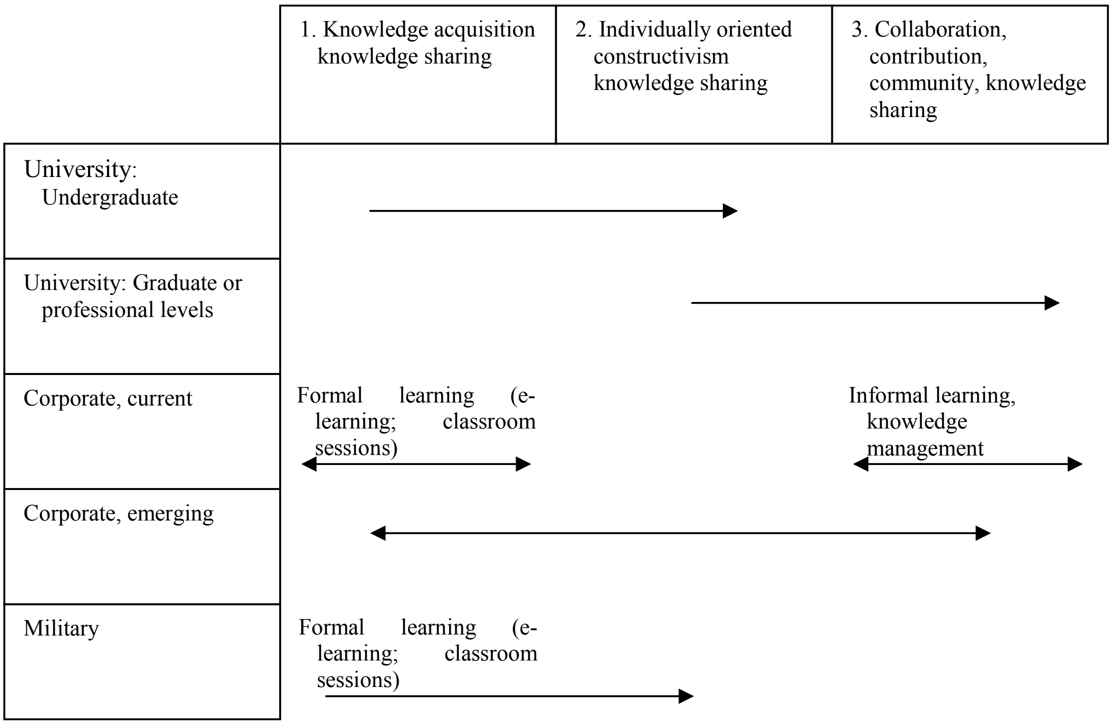


Figure 187 Relation between organisation and pedagogy (Reproduced from Chapter 3)

The differences in pedagogy in the contexts can also be used as identifiers for the specification of learning objects. When learning scenarios focus on knowledge acquisition learning objects can be simple pieces or objects representing information. When the learning scenarios are based on participation more support for human interactivity is needed for making use of the learning objects. The specification of interactive learning objects containing support for communication is more difficult than the specification of learning objects for acquisition of knowledge such as CBT page turners associated with knowledge acquisition. The dimension relating to learning scenarios within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:

For example a CBT e-module in the military context such Ranks is focused on acquisition while a blended-learning course in the corporate-learning context focuses on working in groups writing a production-analysis proposal.

9.2.4 Incentives for reuse

The incentives for reuse are determined by the context

The reason for reuse can be related to organisational policy or personal incentives. Reuse can be part of a policy because of efficiency, effectiveness, knowledge management, or cost reduction. Such a top-down approach can support users within an organisation with tools, systems, and procedures to make reuse part of the daily tasks. Learning objects can also be specified in terms of structure, content, and granularity so that objects can be exchanged within a CMS between users. In contrast, individual users can also reuse objects based on their own personal experiences for reducing course-development time. Structuring of objects in terms of labels is then organized locally and exchange of object with others is based on personal needs. Learning objects created by individual users for personal needs can have various specifications in terms of structure, content, and granularity. Therefore reuse or exchange may be problematic. The dimension relating to incentives for reuse within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:

	S ⟷	**P**
Reason for reuse	Organisational	Personal

For example within the corporate-learning context organisational policy is focused on sharing knowledge and course material. In contrast, within the military context the instructor decides how to reuse material and is thus motivated by personal incentives for reuse.

9.3 Who is Involved?

The users involved in the reuse strategy play a role in the different stages of the lifecycle of the learning object. The users for the related tasks are determined by the context and are related to quality determination (Section 9.3.1), the roles related to a work process (Section 9.3.2), and the human interaction needed for learning to occur (Section 9.3.3). Each of these has different forms in a Systems or a Personal orientation.

9.3.1 Quality of the object

Those who control the quality of learning objects are determined by the context

The quality of the object can be defined in terms of efficiency and effectiveness. Efficiency refers to outcomes and the effort needed achieve these. Effectiveness refers to the impact on learning or on the organisation, such as the number of graduate students, student performance, time effectiveness, motivation, ease of use, satisfaction, and test scores. The quality aspects can be formalized in terms of review groups and responsibilities but can also be a personal decision based on expertise. When a formal review group is involved, rules and policy within the group need to be established. When an individual instructor determines the quality of material no organisational guidelines are involved. The dimension relating to quality control within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:

	S ⟷	**P**
Quality of learning object	Formal processes	Personal

Examples of this dimension occur within the Digital University project where different roles are identified for assigning metadata and controlling the quality of the developed learning objects, and in contrast, in the Military KIM context where the course developers individually decide if learning objects are suitable for a certain course.

9.3.2 Work process

The roles of those involved with learning objects are determined by the context.

The work process is closely related to the number of participants involved in reuse and how much work is involved in the development and management of learning objects. Reflecting a Systems orientation, publishers have a tradition of formal workflows with strict procedures and clear tasks. Each person has his own responsibility for a certain task. Material is gathered from different subject-matter experts and reviewed by other experts to control quality aspects. Editors control the content and the structure of the material. Graphical designers are used to control the layout and for illustrations. This systematic way of working can only take place when organisationally determined financial resources are available. Also the time to go through all the steps may not be available. In contrast, in a Personal orientation, all tasks may be combined within one person. This means that personal habits become dominant because external control on the different aspects is missing. The dimension relating to learning-objects work processes within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:

For example within the corporate-learning context the development of a course is based on procedures and different roles are identified such as course designers that support course instructors. In contrast, within the university context all work processes are done by an individual instructor who decides about how to carry out all of the aspects.

9.3.3 Need for human interaction in learning

The need for human interaction is determined by the context.

The need for human interaction in learning is also closely related to the question of who is involved in the learning scenario, in this case as it is experienced by the learner. In the blended-learning scenario human interaction is an important aspect for learning and participation in a course. In contrast, in the sort of learning typical of Systems orientations, human interaction may not be needed if the course object is simple and created for “knowledge” or “comprehension” purposes. For “application”, “analysis”, “synthesis”, or “evaluation” levels of learning objectives, human interaction is required for feedback or discussing new constructions of ideas. Human interaction may occur between the instructor and learners or among the learners themselves. These relate more to a Personal orientation than a Systems orientation. For the levels of knowledge or comprehension human interaction is not necessarily needed. For “application”, “analysis”, “synthesis”, and “evaluation” human interaction is essential. On the dimension for the need of human interaction “low” means that learning objects can be easily created and can be rather small. When the human interaction is high the development of learning objects should include plans for communication outside of the learning objects for human interaction. The reusable objects can consist of threads of discussion themes or question-and-answer items. The reusable objects may be extracted from the learner’s interactions or submitted assignments. The dimension relating to the need for human interaction in learning within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:

For example the “Aircraft Recognition” course does not require human interaction and learners can succeed by only working with the computer. In contrast, within a course developed at the KIM in the military context, learners are expected to interact with each other to do assignments.

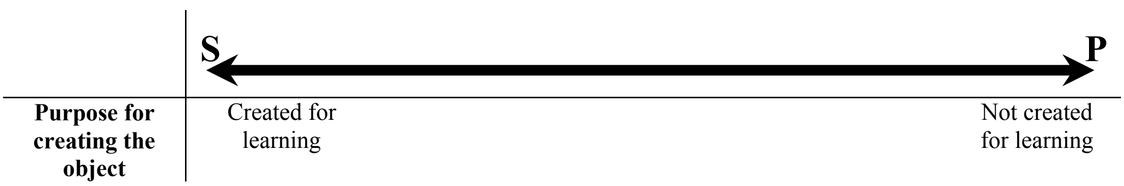
9.4 What is Reused?

The type of learning objects used and reused is determined by their origin and their instructional packaging (Section 9.4.1). Also specificity of learning objects (Section 9.4.2), adaptability (Section 9.4.3), and the role of learning objects depend on the requirements of the context (Section 9.4.4).

9.4.1 Purpose for creating the object

The “instructional packaging” of learning objects depends on their origin.

The type of learning object reused depends on the reason the object was created and obtained. The intended origin of material can be for learning or not. Material created for learning may include instructional packaging in terms of instructional guidelines. When objects are specifically created for learning, specifications for learning objects can be used, the granularity can be controlled, and learning scenarios can be incorporated. When material is used that originally was not intended to be for learning purposes, such as journal articles or resources found via Google from the WWW, the objects may differ in granularity and no instructional packaging may be expected. This is more likely to be the case in a Personal orientation than a Systems orientation where such lack of specification would not be tolerated. In Systems settings, however, reuse possibilities may be reduced when learning objects contain instructional packaging because other contexts do not use the same learning scenario. An instructionally neutral object such as a map can in contrast be reused in many Personal situations. The dimension relating to the purpose for creating the objects within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:

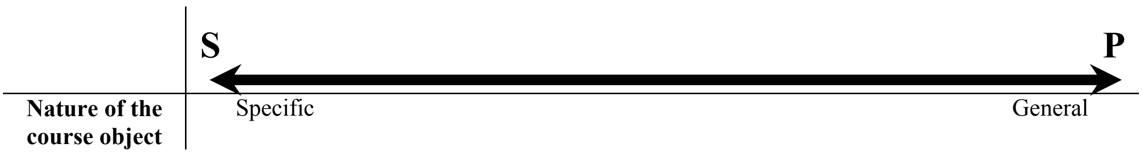


For example syllabi used for learning in universities are selections of objects that are originally not created for learning. Also while manuals used in the military context were originally not written for learners, most CBT objects on the other hand are developed only for learning. These examples show some of the complexity of this dimension however, in that the manual segments that were extracted and recombined for learning in the IMAT project reflected a Systems orientation rather than a Personal orientation even though the objects were originally taken from maintenance manuals not produced for learning.

9.4.2 Nature of the course object

The reusability of learning objects is determined by their specificity

The specificity of learning objects plays a large role in their reusability. Material can be very specific when certain tasks are described for a specific tool including pre-specified pictures and related procedures. This sort of learning situation is frequently associated with a Systems orientation. Material on the other hand can be general when learning objects are linked to different kinds of resources and based on broader goals such as assignments for writing a paper. In the latter situation, related to the Personal orientation, the learning object can be part of a set of interrelated pieces that may not be coherent among themselves and need to be constructed by the learner. The nature of the material in terms of its specificity is thus determined by context and is based on the requirements for the tasks and the intended learning objectives. The dimension relating to the nature of the course objects within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:

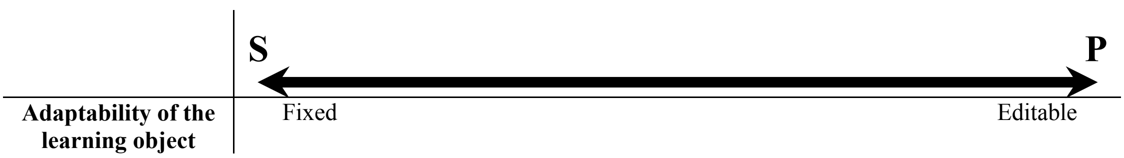


For example the course "Ranks" in the military context where specific pictures of insignias are required represents a Systems orientation as the pictures are carefully indexed using a common taxonomy for reuse in other military learning settings. Within the university context in contrast, resources for courses are often based general resources such as journal articles.

9.4.3 Adaptability of the learning object

The reusability of learning objects is determined by the adaptability of the objects

When learning objects can be adapted to a certain context reuse of these learning objects is possible in other situations. This means that the learning object are created in such kinds of format that they are editable by others in other locations. Tools should be available to edit such kinds of learning objects. When learning objects are fixed and offered in a way that it is difficult to make changes when used, reuse is expected to be low because the learning objects may not precisely fit the needs of course developers. Providing an object in PDF offers little possibilities to make changes in layout or content. Compiled CBT packages are also not editable and can only be reused as a whole. When commonly available authoring tools such as PowerPoint can be used to edit objects for the user's own purposes reuse is expected to be easier. This relates to a Personal orientation. Fixed learning objects are however easier to manage in terms of copyrights and control over how the objects are used and thus correspond better with a Systems orientation. Editable objects in a Personal approach can be changed by anyone; this can be problematic in relation to copyrights and intellectual property. The dimension relating to the adaptability of course objects within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:



For example the e-learning modules used in the corporate-learning context are obtained from an external vendor and the modules are not editable. In contrast, learning objects created with the TeleTOP® CMS are editable and can be changed when needed by the individual instructor.

9.4.4 The role of the learning object

The role of learning objects determines their "instructional packaging"

Similar to the dimensions on learning scenarios and human interaction, the pedagogy in terms of learning scenarios being used can be part of the learning object or outside the learning object. When instructional packaging is part of the learning objects the material is expected to replace the instructor. When pedagogy thus resides in the object reuse may be restricted to similar situations in terms of learning scenarios, target groups, and the educational level of the student. This assumption is frequently the case in a Systems scenario, with applications stressing time- and place-independent learning. In contrast, when no instructional packaging is involved, the learning object may be edited to make is suitable for a certain learning scenario or even used in different ways by the same instructor and the reuse possibilities may be higher. For the specification of learning objects instructional packaging of the object can be part of the structure. Instructional principles can be used as a basis for the specification of a learning object. For objects not containing any instructional packaging specifications are difficult because the range of ways the object potentially can be used is high. In a Personal orientation, this material can be used for the development of different courses and can support the instructor within different learning scenarios. The dimension relating to the relationship of the learning object to the instructor within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:

For example within the military context courses such as "Ranks" and "Aircraft Recognition" are developed to replace the instructor during the learning process and reflect a Systems orientation. Within the university, corporate-learning, and KIM contexts course material is used to support the instructor.

9.5 How is Reuse Supported?

How reuse is supported is determined by the context in terms of available specifications for learning objects (Section 9.5.1), the role of the learner (Section 9.5.2), and the characteristics of the tools that are available for reuse (Section 9.5.3).

9.5.1 Specifications for the learning object

Specifications of learning objects are determined by the context

The specifications for learning objects can be of various natures and can differ from very specific with constraints such as time, content, structure, and underlying instructional model to very general with only a subject and description. The tools to develop learning objects with particular specifications need to offer the functionality to do so. When the specifications of learning objects are clear it may be expected that the objects are well defined and well structured. The specifications can be a tool for course developers to obtain or create learning objects. Clear specifications for learning objects make it possible to exchange objects easily between systems that use a similar specification of the learning objects. The learning objects can be specified by the organisational needs for learning and specifications may include pedagogy, structure, quality, format, sequence, prerequisites, scoring, assessment, time constraints, size, and layout guidelines. The more specifications learning objects contain the more specific an educational context is needed and system requirements are expected. This restricts the possibilities for reusability. The more specific the learning-object specifications are, the easier templates can be used to create course object but fewer types of learning scenarios can be addressed. In contrast, learning objects can also be defined at the time when object is needed. The user in a Personal orientation uses his own judgement and perhaps his own skill at using a search engine to find and decide to use a particular item. The constraints such as quality, size, and content are defined by the instructor or course developer based on the needs in the learning setting. Pieces of material become learning objects when an instructor or course developer decides that the piece is useful within a learning context. The instructor or course developer decides how the object is used and defines the learning object. CMS systems provide the facilities to make the learning objects reusable and exchangeable, at least within the instructor's own courses. The dimension relating to the specifications of course objects within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:

	S	**P**
Specification for the learning object	Predefined	Defined when needed

For example the SCO-generator in the military context uses strict specifications of learning objects based on instructional templates. In contrast, the material used within the university context is selected by the individual instructor based on the course topics and defined when needed within the CMS by the instructor or even by the learner.

9.5.2 Personal control over learning

The role of the learner is determined by the context

The tools used for the development of course objects are specific for the type of learning objects that are created. When personal control is high the learning objects are expected to be more general. This means also that more pedagogy has to reside in the learner. When a learning object is on the level of "knowledge", "comprehension", or "application", the control of learning can be managed by using pre-structured learning scenarios as used in CBT. When "analysis", "synthesis", or "evaluation" is involved the learner is more in control over learning. The learner has to extend what he already knows but has to learn to use the knowledge in a more-general way and structure his or her own learning. When personal control over learning is low, the individual interactivity is also low or shallow because the system controls the learning. When the personal control over the learning object is high, features to give the learner control over the learning should be supported to make this possible. For the specification of learning objects this means that objects with low personal control over learning are easier to define than learning objects with high personal control over learning. It also means that the reusable objects may differ in granularity because the objects for personal control can be larger and more general while for objects with low personal control learning reusable object can be at the assets or module levels of granularity. For low personal control, the objects should contain strong pedagogic guidance but for high personal control over learning there may be little pedagogic steering because the learner or instructor has to control the learning. The more complex the learning situation, the more decisions have to reside in the learner. The dimension relating to learning control within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:

	S	**P**
Personal control over learning	Low	High

For example within the CBT courses in the military context the personal control is low. In contrast, the Knowledge-Sharing project in the corporate-learning context focuses on high personal control over learning where learners have to search for material in their workplaces and share new developments.

9.5.3 Tools for reuse of learning objects

The characteristics of the tools that support reuse are determined by the context

The tools to support the use of learning objects can be very specific or general and are determined by the learning scenarios used, the learning objectives required, and the incentives for reuse. The different tools are closely related to the type of course object developed. The use of the specific tools in the military context requires also specific skills to work with the tools. The specifications for the development of learning objects can be incorporated in the authoring tools and can make structured exchange within a certain setting possible. The granularity of the object can be part of the specifications. In contrast, when general tools such as word processors or PowerPoint are used for the development of learning objects, the learning objects are difficult to specify and granularity can vary in each individual setting. The dimension relating to tools for the reuse of learning objects within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:

	S	**P**
Tools for reuse of learning objects	Specific	General

For example within the military context specific authoring tools such as the SCO-generator are used. These require more of a Systems orientation, in that special licensing is involved that is supported by the organisation and special training is needed to use the tools. In contrast, within the university context general Office tools such as Microsoft Word or Microsoft PowerPoint are used.

9.6 Where Does Reuse Take Place in Terms of Systems?

Where learning objects are stored (Section 9.6.1) and how the learning objects are structured when stored is determined by the context (Section 9.6.2).

9.6.1 Where learning objects are stored

Where the learning objects are stored is determined by the context

The objects available for reuse can be stored in repositories such as LCMSs. This makes it possible to offer the objects to other users of the LCMS. Using LCMSs makes it possible to exchange objects in a systematic way and selections can be made on the metadata that are available for each object in the LCMS. The metadata need to be consistent and structured to make them logical for searching for different users. These characteristics relate to a Systems orientation. In contrast, objects can also be stored locally on an individual's own hard drive or a local network. When the object is stored on a local hard drive it is expected that the owner uses his own way of structuring of folders and naming conventions for file names. Selecting objects based on these user-specific metadata is difficult and therefore problematic for reuse possibilities beyond the individual. In contrast, within a structured environment supported with a repository the selection of objects can support reuse. The dimension relating to the storage location of learning objects within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:

	S	**P**
Where learning objects are stored	Repository	Locally

For example in the corporate context all material is stored in a repository for reuse. Material for the course "Ranks" in the military context is all stored locally because of network limitations but the storage is not based on an individual's own way of organizing information but rather, on decisions made by the group.

9.6.2 Structuring of learning objects

Taxonomies are determined by the context

When material is stored the metadata for describing the material can come from a pre-determined vocabulary or filled in based on the expertise of an individual. The taxonomies for the vocabularies depend on the organisational incentives for reuse. Predefined structures can support selection and reuse of learning objects across an organisational setting or even outside an organisation. When material is reused mainly by the ones that obtained the material a personal description may be enough. The dimension relating to structuring of learning objects within the context can be visualized with endpoints reflecting Systems-Personal orientations as follows:

	S	**P**
Structuring of learning objects	Organisational	Personal

For example within the Shell-TeleTOP® corporate-learning context learning objects are mainly described based on the personal needs of the individual Course Director. In contrast, the university project about the Digital University focused on a vocabulary that can be used in a broader perspective.

9.7 The Learning Object Context Profiling Model

All the dimensions presented in Section 9.2-9.6 can be combined to one model. Figure 188 shows the full set of dimensions.

		S					P
Why?	**Cultures within the context**	*The industrial world*	*The Domestic world*	*The Civic world*	*The world of Opinion*	*The Merchant*	*The world of inspiration*
	Level of learning objectives	*Knowledge*	*Comprehension*	*Application*	*Analysis*	*Synthesis*	*Evaluation*
	Learning scenarios	*Acquisition*					*Participation*
	Incentives for reuse	*Organisational*					*Personal*
Who?	**Quality of the object**	*Formal processes*					*Personal*
	Work processes	*Formal workflow*					*Personal habits*
	Need for human interaction	*Low*					*High*
What?	**Purpose for creating the object**	*Created for learning*					*Not created for learning*
	Nature of the course object	*Specific*					*General*
	Adaptability of the learning object	*Fixed*					*Editable*
	The role of the learning object	*Replace the instructor*					*Supporting the instructor*
How?	**Specifications for the learning object**	*Predefined*					*Defined when needed*
	Personal control over learning	*Low*					*High*
	Tools for reuse of learning objects	*Specific*					*General*
Where?	**How learning objects are stored**	*Repository*					*Locally*
	Structuring of learning objects	*Organisational*					*Personal*

Figure 188 Learning Object Context Profiling Model (all dimensions)

However, as was apparent from the descriptions of the individual dimensions in Sections 9.2 – 9.6, many of the dimensions relate to overlapping situations. This occurred through their evolution within the Why?, Who?, What?, How?, and Where? questions as a structure for the research. This structure may have served its purpose however, if a reduced set of dimensions can cover the same general ideas with respect to the Systems-Personal orientations. To make the Model as concise as possible (to support its use in practice), the following reductions of dimensions could occur:

- One dimension relating to **Cultures within the context:** Remains as separate dimension

Eight dimensions relating to pedagogical/learning issues: **Level of learning objectives, Learning scenarios, Need for human interaction, Purpose for creating the object, Nature of the course object, The role of the learning object, Specifications for the learning object, and Personal control over learning:** Can be represented by the dimension **Learning scenarios**

- One dimension relating to **Incentives for reuse:** Remains as a separate dimension

Three dimensions relating to processes for dealing with learning objects: **Quality of the object, Work processes, and Structuring of learning objects:** Represented by the dimension **Work processes**

- And the remaining three dimensions, all having to do with tools relating to learning objects, **Adaptability of the learning object, Tools for reuse of learning objects, and How learning objects are stored:** Represented by the dimension **How learning objects are stored**

This process reduces the original set of 16 dimensions to a concise set of five dimensions, representing the main differentiating aspects of the set of 16. With these five, the simplified Learning Object Context Profiling Model takes the form shown in Figure 187.

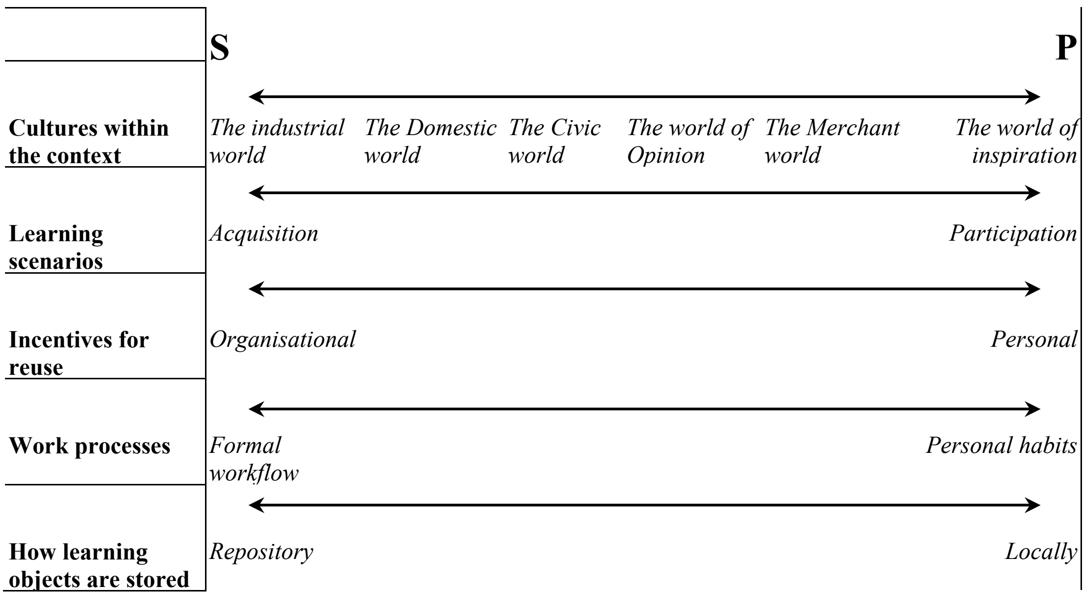


Figure 189 Learning Object Context Profiling Model, short form

9.8 From Model to Tool

Two Learning Object Context Profiling Models have been developed, a long form and a short form. These have been derived from the results of the ten projects in the research. A next step is to use the Models to develop a toolset that can be used for the three main tasks of the research. Section 9.8.1 describes the simple transition from model to tool, the Learning-Object Context Profiling Tool. The Learning Object Context Profiling Tool can be used for the three different tasks that are also used in the research: A descriptive task (Section 9.8.2) to describe a certain context, an explanatory task to explain certain outcomes in a context (Section 9.8.3), and a prescriptive task to predict certain outcomes in a certain context and on that basis suggest guidelines for how to proceed (Section 9.8.4).

9.8.1 Description of the tool

The Learning Object Context Profiling Model has been deliberately presented as a set of parallel dimensions, each of which has a left-hand extreme value that corresponds to a Systems orientation toward learning objects and reuse, and a right-hand extreme value that corresponds to a Personal orientation. It is simple from a representational point of view to convert either the short or long form of the Model into a paper-based tool that can be used for different purposes in relation to the Model. The tool is no more than the same graphic representation of either the short or long form of the Model, but with each dimension labelled "1" to "5", with "1" corresponding to Systems oriented, with a vertical grid running through all of the "1" values on each dimension, and similarly all of the "2", "3", "4", and "5"values. These gridlines are used to plot the representation of a context involved with reuse and learning object, by marking each dimension on a scale of "1" to "5". By plotting the scores (usually obtained through a researcher's subjective assessment rather than a formal measurement) the characteristics of a course or curriculum or other setting can be placed on the different dimensions in the Learning Object Context Profile Model. The profile of the particular context can be found when all dimensions are filled in and connected with a line and can show if the particular context for learning objects is Systems oriented or Personal oriented. Thus the profiling process supported by the tool can be used to predict how learning objects can be specified in a certain setting and what type of learning objects can be expected to be effective and efficient for reuse. The model can also be used to observe, explain, or predict how dimensions interrelate. When a course object is analyzed and found to be mainly on the left side of the scale, it is expected that a specific specification of learning objects can be made including a various set of characteristics such as a predefined instructional model, time constraints, testing, tracking, structure, and interactivity within the learning object rather than with humans as they make use of the learning object. Reuse is expected to be on an asset level because of the specific requirements. If a context or object is analyzed and is found to be mainly on the right side of the scale the specification of learning objects has to be more general but is still possible with such descriptors as subject and description. Reuse can occur with assets, but also sets of objects with a larger granularity can be reused. Because of the general nature of the object it is expected that reuse will be interesting if course developers/instructors can change or add pedagogical annotations to make a learning object useful for their own contexts.

The profiling possible with the tool can be used for descriptive, explanatory, or prescriptive tasks related to reuse, as described in Sections 9.8.2 to 9.8.4.

9.8.2 Descriptive task

The Learning Object Context Profiling Tool can be used to describe a certain context by filling in the values on each dimension. Plotting the values for each dimension can give insight about a certain context and help to describe the characteristics of a given context. An example is given for the "Ranks" course from the military context and a university course. The Ranks course is represented in the model as a set of small triangles. The university course is represented with small circles. This reflects a course given in a blended-learning approach such as provided in the TeleTOP® projects in the university, corporate-learning, and military contexts. Figure 188 shows the Tool with the two different courses represented.

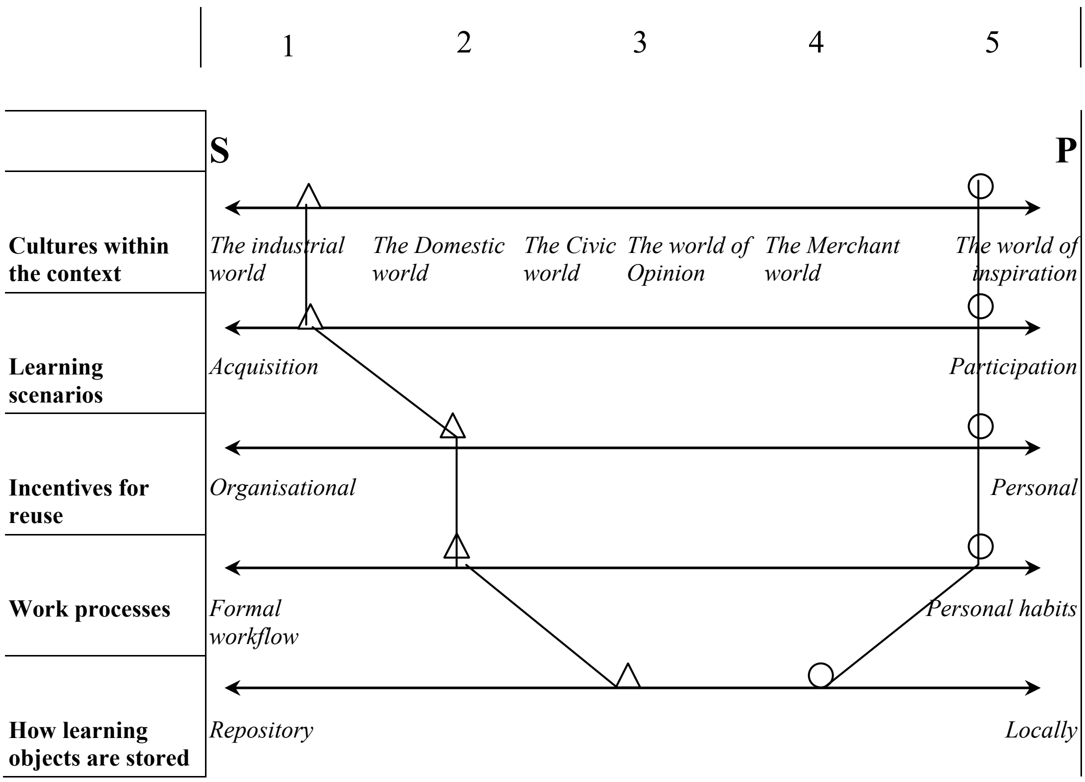


Figure 190 Learning Object Context Profiling Model, short form used for descriptive purposes

The differences in profiles of the two courses on the dimensions have a large impact on the specifications for the learning objects. For the "Ranks" course the profile is shown by a non-vertical line, indicating discrepancies in the orientation on the different dimensions. This can be seen via the graphic; the more a profile is vertically aligned, the more likely that aspects of reuse will proceed smoothly in a particular context. In the university TeleTOP® project reuse was occurring but in a Personal-oriented way. The profile shows a near vertical alignment. And conversely, the more the profile deviates from a vertical line, the less likely that reuse will proceed successfully.

9.8.3 Explanatory task

For the explanatory task the Learning Object Context Profiling Tool can be used to do more than describe but also to explain certain outcomes based on the alignment of values of the dimension. When the values for a given context are plotted on the dimensions and there is no alignment in the values, the tool can explain the reasons for failure of success with the dimensions that are out of line.

The Learning Object Context Profiling Tool tries to identify important aspects for a reuse strategy but when the tool is used not all dimensions may have the same orientation because of the complexity of organisations and the different blends in learning scenarios. The results of the profiling with the tool may be difficult to interpret when such complex contexts are analyzed. The tool can be used to give information about courses and curriculums in order to help explain why reuse may or may not be likely to take root. For example, problems may arise when the curriculum covers a very large cognitive domain whose objectives range from knowledge to evaluation. This means that for one sub-context in the setting, one dimension may be system oriented and for another, a dimension may have a personal orientation. Such complex profiles are likely to explain why reuse strategies fail to become embedded in an organisation.

A particular source of discongruency can come from a lack of vertical alignment between the underlying “worlds” or world view in a particular setting, and the values of other dimensions, or when a particular organisational context has within it different world views in different subsets of the organisation. Boltanski and Thevénot describe how opinions about the underlying values of a culture can be influenced by the culture which dominates one’s way of thinking. Table 59 shows an adaptation of Boltanski and Thevénot’s interpretation of how the cultures react to each other and what the criticisms are from one world to another.

Table 59 Criticism from one world to another (adapted from Boltanksi and Thevénot)

Criticism	Criticism of the World of Inspiration	Criticism to the Domestic World	Criticism of the World of Opinion	Criticism of the Civic World	Criticism of the Merchant World	Criticism of the Industrial World
From the world of Inspiration		Habits, inherited social norms and principles, fossilized institutions form a break to creativity and initiatives.	Vanity of appearance, personal rivalry, the higher attention paid to the image of the self, inhibit imagination.	Cold institutional frameworks freeze human warmth and affective relationships	Self-interested people and dependence on "money' hijack invention and innovation to reroute them for business	Rigidity of routines, impersonality, methods and know-how can hinder spontaneity and creativity.
From the Domestic world	Disorder, carelessness, disorganized behaviour. Too much attention given to the emotional component		Good manners require discretion and caution. Exhibitionism is incompatible with common decency	The collective reinforces an underlying anonymity and obstructs individual responsibility	You can't buy everything. Self-interest corrupts social bounds.	Assemply-line production brings low quality. Technical expertise sweeps away common sense and realism.
From the world of Opinion	Esoteric. False depth and elitism. Selfishness.	Domestic secrets, paternalism. Opacity. Lack of daring. Refusal to be compared and to be assessed.			The commercial focus of communication and information through self-interested advertising.	The esotericism of specialists
From the Civic World	Individualistic approach, irresponsibility, spontaneity, adventurism.	Paternalism, family secrets (corruption, etc.), authoritarianism, pollution of authentic human relations.	Public opinion is manipulated, does not reflect aggregation of interests.		Egoism of the wealthy and individualism in a merchant world puts democracy at risk.	Technocracy, attention paid to individual promotion more than to collective enrichment.
From the Merchant World	Lack of emotional distance and control of emotions, in business one needs to keep one's self-control	Personal relations, traditions, prejudices, and routines hold back competition and opportunistic merchant relationships.	Deviousness, mass culture, snobbery	Collective processes inhibit action.		Rigidity of tools and methods, heaviness of organisations, mentality of engineers conflict with commercial principles.
From the Industrial World	The wastefulness of improvisation, uncertainty, unreliability	Tradition is not adapted to present times, the old is outmoded.		Inefficiency of administrative procedures. Costs of social policies.	Useless luxury goods, unjustified prices, market impulsive drives	

The sorts of criticisms or scepticisms identified in Table 59 may be deeply submerged in a cultural setting, not acknowledged or even articulated. Yet a balance emphasizing a particular world view is likely to underlie any context and if not identified, may result in a subsequent lack of vertical alignment on the Learning Object Context Profiling Tool. This lack of alignment can help explain why a learning object sharing and reuse strategy fails to take root.

9.8.4 Prescriptive task

The tool can also be used to predict success or failure based on the alignment (or lack of alignment) of the profile mapped onto the five dimensions of the short form of the tool. For example, when three of the five dimensions are focused on a Personal orientation and the other two on a Systems orientation, it is expected that reuse in the context will not be very successful. However, suggestions can be made to improve the likelihood of success if the alignment is not severely non-vertical. The following guidelines relate to predictions made using the Tool, and are summarized from the guidelines expressed at the ends of Chapters 7, 8, and 9. They can be used for increasing the likelihood of success in implementing a reuse strategy:

- *Guideline 1*

  An organisational-wide strategy for reuse is needed for different reasons such as critical mass, copyrights, rewarding, and expectations. A policy for how to deal with exchange for individual course developers is essential. Course developers need to be aware of what to expect and what to do in terms of reuse and exchange of learning material. For the Personal orientation the organisational policy can make individual persons aware of the potential of their own resources and provide rules for how to exchange material. A Systems orientation can focus on giving access to resources in repositories based on the organisational reuse strategy.

- *Guideline 2*

  Research projects that focus on new systems-oriented developments should also have a strong implementation component to test different scenarios in practice. The outcomes of the research should be validated by practical use. For the Personal orientation the research results should be available to see what the benefits for personal use can be, within a Systems orientation the organisational strategy should use research outcomes for a more efficient way of working, providing course developers with the tools and infrastructure that were validated in the research.

- *Guideline 3*

  An IT infrastructure should be available to all users such as course developers and participants to distribute and exchange available materials. For the Personal orientation the IT infrastructure is less important because most material is kept on a local hard drive. For a Systems orientation, an adequate network infrastructure is a prerequisite for efficient reuse and exchange possibilities

- *Guideline 4*

  Because various types of learning scenarios may be in used in a certain context, different approaches regarding to reuse possibilities and definition of learning objects may be needed. Within a Personal orientation learning scenarios depend on the course developer, while within a Systems orientation designers can make use of predefined template-based authoring tools that express a certain learning scenario.

- *Guideline 5*

  Exchange of material can be easily implemented when resources are based on structured data such as databases or XML. Standards should be implemented for future reuse of course material. Within the Personal orientation standards based on CMSs can support exchange of learning objects on a general level. An implementation of standards within a Systems orientation can support reuse on asset level.

- *Guideline 6*

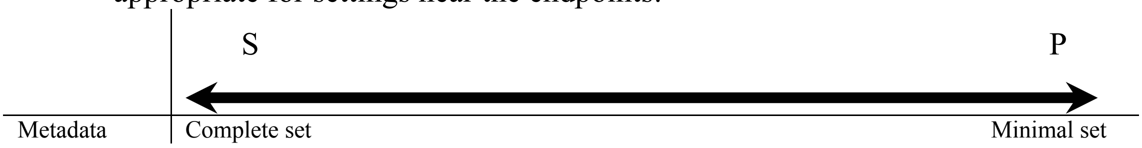
  A policy related to security and classified material should be developed in terms of accessibility to material. Encryption of material, network access, and export regulation are issues that need to be covered. Within a Personal orientation the security is organized by the individual who decides what to offer for reusability. A Systems orientation focuses on structured repositories and related database-access controls to protect classified content.

9.9 Reflections on the Model

Section 9.8 indicated how the Learning Object Context Profiling Model and Tool can be used for descriptive, explanatory, and prescriptive tasks relating to reuse of learning objects. In this section some reflections on the Model are given in terms of key issues that have been considered throughout this research. Does the Model help to understand and interpret those issues? Standards and metadata, granularity, and the lifecycle of a learning object will be discussed first, followed by the fit of the Model to the 3-Space Design Strategy (Moonen, 2002) and the 4-E Model (Collis, Peters, & Pals, 2001) introduced in Chapter 1 and used through the research to structure the observations.

- *Standards and metadata*

  For the use of standards different approaches can be chosen for the metadata, packaging, and runtime specifications. The expected metadata are closely related to the results of the tool. When the results of the tool are Systems oriented, the assumption can be made that most LOM metadata are available for tagging the learning objects. These metadata can be based on a predefined vocabulary and build upon professionally structured taxonomies. When the results are Personal oriented, it is expected that only a minimal ADL SCORM™ set of mandatory fields is relevant. The metadata used are individually created for personal use, for identification of learning objects and for the individual's own reuse purposes. Thus, standards and metadata map onto the Systems-Personal orientation, with different variations appropriate for settings near the endpoints:



- *Packaging*

  For packaging, a Systems orientation can be helpful for the specification of learning objects that are part of a larger, composite learning object. The packages can be constructed in such a way that learning objects are also editable in other CMSs. Using structured data for the content and full metadata descriptions makes it also possible to present content on mobile devices such as telephones and PDAs. In contrast, when the Tool indicates a Personal orientation, packaging may be more general in terms of fixed pieces of HTML. The use of a limited set of metadata may present barriers for exchange of learning objects outside of one's own reuse. Thus, packaging maps onto the Systems-Personal orientations, with different variations appropriate for settings near the endpoints:

	S	P
Packaging	Strict defined	General

- *Runtime orientation*

  Runtime interaction with an LMS is expected to be mainly involved in a Systems orientation. The human-computer interaction in CBT can be used to make learning more attractive when learning scenarios are focused on acquiring knowledge. In contrast, when the results are more Personal oriented, the runtime model is not used because interaction comes from instructors or other learners. Thus, the characteristics of the runtime model map onto the Systems-Personal orientations, with different variations appropriate for settings near the endpoints:

	S	P
Runtime model	Based on interaction	No interaction

- *Granularity*

  The development of CBT-oriented learning objects in a Systems-oriented context may require smaller learning objects than in a Personal-oriented context. The use of assets such as pictures, text fragments, and videos are part of the development process of CBT for knowledge acquisition. In contrast, a Personal-oriented context is expected to reuse larger learning objects and use combined learning objects. Thus, granularity maps onto the Systems-Personal orientations, with different variations appropriate for settings near the endpoints:

	S	P
Granularity	Small	Large

- *Lifecycle of a learning object*

  When the results of an application of the tool are Systems oriented, the lifecycle of a learning object can be static and formalized, as used for the description of several of the projects in Chapters 5, 6, and 7. In contrast, a hyperlinked and flexible use of the lifecycle as described in Section 8.3.2 is appropriate when the results of an application of the Tool show a Personal orientation for the context. Some lifecycle stages may not be relevant for development in some cases in a Personal-orientation setting. Thus, the lifecycle of learning object maps onto the Systems-Personal orientations, with different variations appropriate for settings near the endpoints:

	S	P
Lifecycle	Static formalized	Flexible

- *3-Space Design Strategy*

  The tool can also be used to predict what kind of design strategy can be used for the development of learning objects. When the results from application of the Tool are Systems oriented, the development of learning objects can be structured or rational, and based on rationally expressed development strategies and models. When the result of an application of the tool shows a Personal orientation to the context, the development is expected to be associative and creative, not following predefined models for software engineering and instead a good candidate for methods such as user-centered design and rapid prototyping (Moonen, 2002). Thus, Moonen's 3-Space Design Strategy can also map onto the Systems-Personal orientations, with different variations appropriate for settings near the endpoints:

	S	P
3-Space Design Strategy	Structural	Associative

- *4-E Model*

  The 4-E Model (Collis, Peters, & Pals, 2001) was introduced in Chapter 1 as a tool for predicting the likelihood of an individual's uptake of a technological innovation in his or her own working situation. It was used as the basis for the secondary research questions related to the human perspective throughout the research. How does it relate to the Learning Object Context Profiling Model? According to the 4-E Model, the likelihood is related to four clusters of variables: an individual's perception of effectiveness, ease of use, personal engagement, and characteristics of his or her organisational environment. When the results of an application of the tool are Systems oriented, the 4-E clusters are likely to be underrepresented because they focus on human aspects. When the results of an application of the tool are Personal oriented, it is expected that all aspects from the 4-E model will be relevant and applicable. Thus, the 4-E Model maps onto the Systems-Personal orientations, with different variations appropriate for settings near the endpoints:

	S	P
4E Model	Not represented	All applicable

- *Combining the issues*

  Reflecting on the overall results through the frame of reference of the Model has led to the following general observations. The results of the research show that reuse may not be focused on a wide exchange of all available material but on a small level within departments and particularly on the reuse of one's own course material. The use of specifications such as ADL SCORM™ may not have the expected impact on adaptive learning and building courses based on learning objects from large repositories as expected by many. Also the runtime specifications for tracking and tracing may not be suitable for the required learning scenarios in a certain context. Also the complete set of metadata to select material from a large repository may not be required or efficient. Reuse of material is important for individual users or for knowledge management Reusing material from colleagues that move to another job can be very efficient and time saving. The fact that knowledge of instructors is stored in courses that can be (partly) reused can also been seen as a form of knowledge management in large companies such as Shell EP or the military.

The use of CMSs can be compared with the use of e-mail as a tool that can help work processes related to learning objects and reuse. Instructors use CMSs as a tool to provide course material in their own ways, supported by a Personal oriented system. The ease of use of the systems and the freedom offered to the instructors make such a widespread use possible. In contrast, the use of courseware-development tools such as Authorware™ and Easygenerator™ is very much limited to a group of specialized users, likely to represent a Systems orientation. The complete specification bundle of ADL SCORM™ seems to focus on this small group of courseware developers. The strength of the specifications will be found in the extent they become taken up in the frequently-used and flexible CMSs to make exchange and reuse of material possible under the control of the individual instructor and with a Personal orientation.

9.10 Reflections on the Research Methodology

As this dissertation draws to a close, it is appropriate to not only reflect on the insights and implications of the topic of the research, the reuse of learning objects, but also on the research methodology as a process in which the researcher, as an Action Researcher, spent nearly four years. This section reflects on how well the research tasks have been carried out (Section 9.10.1) and the limitations of the research despite the care of the researcher to maintain structure and consistency over ten different projects (Section 9.10.2).

9.10.1 How well have the three tasks set out for the research been carried out?

This question focuses on how well the descriptive task, the explanatory task, and the prescriptive tasks of the research have been carried out. It can be asserted that these tasks have been done, carefully and systematically (as well as, occasionally, from a Personal orientation). Within the dissertation the different tasks can be clearly identified. For each project in the three contexts the aspects are described using the common Why?, Who?, What?, How?, and Where? questions. The learning-object lifecycle and secondary research-question summaries explain what aspects are key for reuse strategies and the implementation of learning-technology standards for that particular project. The Learning Object Context Profiling Tool is part of all three of the descriptive, explanatory, and prescriptive tasks in the research. The five dimensions in the short form of the Learning Object Context Profiling Tool can be used to predict if a reuse strategy within a certain context will be successful. Thus yes, the three tasks set out in Section 4.1.2 were never forgotten, and guided the research from beginning to end.

9.10.2 Limitations of the research methodology

As earlier discussed in Section 4.1.8, Action Research has some limitations related to the personal over-involvement of the researcher, the limited amount of control that the researcher has on the environment where the research takes place, and the generalizability of the research. All of these remain limitations for the present study.

The personal over-involvement or the researcher in the research is a limitation of the research because the role of the researcher in the different projects was essential. The projects were based on the skills and knowledge of the researcher and could not be carried out by others.

The control of the environment was not determined by the researcher but given by the organisations which set the boundaries of the projects. Also the time planning for the research was determined by the projects. The evolving character of the projects was also important because every cycle within the project included learning aspects for the next cycle and thus changed the starting point for the new project and made inter-project comparisons different.. The specific character of the research also included restrictions on the sorts of projects available to the research and the number of organisations with an interest in the domain of the research who were willing to be test beds for the research.

The generalizability of the research is also a limitation because only a limited set of organisations and projects was used for the research. The three contexts give an overview of different types of organisations where reuse plays an important role, but the range of institutions within the original contexts was limited. The ten described projects give detailed information about the different organisations but they may not reflect projects in other university contexts, corporate-learning contexts, or military contexts. The University of Twente developed its own CMS in contrast with other universities that use CMSs such as BlackBoard™. The development of such a CMS (TeleTOP®) had special advantages for reuse functionalities within the organisation. Also the fact that the TeleTOP® CMS was used within the corporate-learning context gave opportunities for reuse tailored to the organisational needs that are not likely to be possible with a CMS that was not so much under the control of the researcher in terms of design innovations. Outside of TeleTOP®, within the military context a tailor-made LCMS was developed to support the users. Such tailored systems may not be used or not be available within other contexts.

9.11 Where Next?

With the reflection on the methodology of the research, this dissertation is effectively over. Four year's of work and immersion in a topic have supported the researcher's conviction that many barriers and difficulties confront the mainstream uptake of reuse and even use of digital learning objects in practice. Successes can be found, but often these are successes within a Personal orientation whereas the focus of research and industry development with metadata and standards and reuse typically represents a Systems orientation. Does this mean the problems will never be solved? New technological developments are occurring that many feel will stimulate the same step-change as occurred when the World Wide Web first became available to the broad public. These technological developments relate to the Semantic Web. During the last year of this research a rapid growth in articles, conference, workshops, special issues of journals, and Web sites sprang up, indicating that the Semantic Web would in fact be the real breakthrough for sharing, finding, and reusing resources. The researcher and promoter were asked in early 2004 to contribute to a special issue of a journal focused on the question of whether the Semantic Web was going to lead to mass-scale breakthrough with respect to the lifecycle of learning objects and in particular to the ontologies and taxonomies that serve as the basis for metadata. The reflection we wrote can also serve as a closing thought for this dissertation. We repeat the final portion of our reflection here[7]:

The Semantic Web and Ontologies: An answer? To what question?

> *In discussions of the Semantic Web, it seems that the focus is predominately on only two of the six lifecycle stages: "select", and before that, "label". The assumption seems to be (perhaps this is an unfair interpretation) that if these functions work well, then this is the key that will "forever change the shape and form of learning" (Hodgins, 2000a). However, our argument is that all stages are important, particularly the "use" stage; and also that context*

[7] From Collis, B. and Strijker, A. (2004). Technology and Human Issues in Reusing Learning Objects. *Journal of Interactive Media in Education,* 2004 (4). Special Issue on the Educational Semantic Web. ISSN:1365-893X [www-jime.open.ac.uk/2004/4]

and learning philosophy give very different views of these stages. For many of the issues identified in the special issue, the Semantic Web and ontologies have little or no relation to the sorts of questions that are raised.

There are lessons already being learned from the current work with standards and metadata. All of the standard bodies are developing taxonomies for their metadata. While these taxonomies may seem appropriate from a systems perspective, in practice they may not reflect a personal orientation: the way human users think about learning objects if they go to find them, or have to label them. There are two major issues: Can a taxonomy be generalized across all potential users? How much detail is necessary and how much detail is it feasible to collect?

In terms of the first question, a number of groups have tried to define taxonomies for metadata based on pedagogical analyses of potential end users. In the CANDLE Project (2000-2003), sponsored by the European Union, considerable effort was put into the modelling of different user groups in order to provide input for the set of metadata to be used (Scott & Van Helvert, 2001). To help users in the CANDLE Project assign the metadata to a potential learning object, a software Wizard was created to guide assigners through each of the metadata categories (Liu, 2003). As far as possible, pull-down menus were available in the Wizard, and for each metadata category, an example and set of definitions were supplied. However, even with this level of detail, the use of the Wizard by an instructor intending to use an eventual object as a potential resource, particularly for a generative or contribution-type activity, turned out to be problematic in user trials (Brostoff & Kent, 2003). One reason is that with a generative or collaborative approach, the activity is not inherent to the learning object itself, but depends upon what the learner does with the learning object. It may be useful, for example, that a broad selection of learning objects be made available, so that the learner can decide for himself which are the most useful for his task.

Another problem is the selection of a taxonomy. Sets of tags that might appear generally appropriate in a university context would lack many elements that would be necessary in a corporate or a military setting. In a corporate setting, objects are likely to be labelled in terms of their relation to a competency framework (Mulder, 1999) where personal authorship is of little importance. More fundamentally, there is considerable debate about the possibility of developing taxonomies that involve the same ontologies for different groups of users. Kraan (2003) notes that objects are "best described by using multiple vocabularies. There is no way to determine which vocabulary will be relevant to either an author or user of a given object…What may be a learning object to you, is a news article, archive context or a use case for somebody else. An object's meaning, in other words, depends on its context of use".

Berners-Lee, Hendler, and Lassila, (2001) in their work with "The Semantic Web" see ontologies as one solution to this problem. "Ontologies are a shared and common understanding of a domain that can be communicated between people and application systems" (Davies, Fensel, & Harmelen, 2003, pp. 4-5). Much of the current research on ontology development follows a rational approach (see for example, Berners-Lee, Hendler, & Lassila, 2001). Engers and Lech (2003) however note that "within current approaches to the Semantic Web, it is debatable what should be central --the human using the Web or the possibility of performing machine processing on Web content. In the former case, logical representations are probably not the most intuitive for use with humans, and different, more 'cognitive' representations of such knowledge might be more convenient" (p. 114).

However, even with tools focused on ontology development and a relatively well-defined knowledge domain (ontologies about skills, job functions, and education in a knowledge-management setting), Reimer, Brockhauser, Lau, and Reich (2003) point out that many human problems occurred when trying to use a Semantic Web approach to ontologies. Problem areas were a lack of domain experts to build the ontology, difficulties with ontology evaluation beyond a certain range of core concepts, and user difficulties in selecting the right concepts. Doctorow (2002) anticipates these problems when he notes that "there is more than *one way to express something". Another difficulty is the problem of "ontological drift" (Fensel, Stask, Studer, Harmelen, & Davies, 2003).*

The latter see the combination of peer-to-peer collaboration and ontology development as the future: "Only by bringing together Semantic Web (specifically ontologies) and P2P (peer-to-peer) technology can we fully realize the potential…by giving participants freedom to use their own ontology structures" (p. 264). User-tailored descriptions for metadata are a form of peer-to-peer collaboration being studied in a number of locations. Recker, Walker, and Wiley (2000) describe an approach similar to that used on the Web in public sites such as Amazon Books in which patterns of choices and responses of users are used to identify which objects might be of interest to which persons. Called "collaborative filtering", the approach involves "developing and evaluating a collaborative filtering system, which enables users to share ratings, opinions, and recommendations about resources".

However, if such a system would be taken up in widespread practice throughout an organisation is not clear. An incentive for content specialists to take the time to add comments about a particular object is likely to be lacking.

With regard to incentives for the labelling of learning objects with metadata, a major issue is the amount of metadata that is feasible to expect, given the time constraints of those who enter metadata and given the interests of those who make use of the metadata for the selection of objects. Bois (2002) says that "all" that is needed is that learned societies develop domain ontologies, authors use the new tag editing application to complete their texts with tags, and retrievers use the new browsers that allow the selection of documents by specifying tag contents and relations. However, she acknowledges that while "this is simple it doesn't mean that there is no effort" (p. 343). The effort involved needs organisational embedding and incentives in order to occur.

All of these problems have been studied for many years within the domain of information retrieval. Swanson, in 1988, summarizing 30 years of fundamental research on information retrieval concluded that:

"Our relevance judgements and our thinking entail, among other things, artful leaps of the imagination unconstrained by logic, reasoning, or the clammy hand of consistency; more important, they entail knowing who we are, what kind of world we live in, and why we want what we seek. It is hardly imaginable that a mechanism other than a human could acquire such self-knowledge, be given it, or do the job without it." (p. 95)

This insight is not out of date; it is the basis of a new research line at the University of Twente in The Netherlands (Huibers, 2003). Due to the insight of this research as well as our on-going analyses of the impact of context and learning philosophy on the lifecycle of learning objects (Collis & Strijker, 2001-2002, 2002, 2003; Strijker, 1999, 2000a,b, 2001, 2002a,b, 2004[8]) we remain sceptical about how a focus on the Semantic Web or ontology development will act as keys to change the way people learn.

It is not that we are sceptical about the power of improving agents to select objects from the Web based on semantic approaches. The site KartOO (http://www.kartoo.com/en/servlet/H) for example shows that currently available tools can help locate and select objects but also expose a network that you didn't know existed in terms of who is linking to objects you find particularly useful, something that goes beyond finding a particular object. There are new efficiencies, new power, new ways of thinking and "new forms of intelligence and meaning being added to display and navigation of context in the current World Wide Web" (Anderson & Whitelock, 2003). We encourage continued development toward these ends, but we are constrained by two sets of concerns: (a) the process should not be over formalized; and (b) intelligence and creativity are more important during the use process than during the find and select processes, and intelligence and creativity will come from humans, individually or

[8] This dissertation

collectively, outside of the Web (whatever sort, Semantic or World Wide). In a participation or contribution approach to learning, learning objects are only a tool; human processes involving communication, sharing, and collaboration are more important.

With regard to procedural/conceptual difficulties and the dangers of over-formalization, it appears to us that the Semantic Web as now described depends too much on a pre-formed structure; maybe finding this will succeed in certain cases, but for this to happen, too much must be organized, too many people (user groups, etc) must be in agreement about the structure, and a clear description in a shared language of the domain is needed. Shanks, Tansley, and Weber (2003) note that ontology theory requires the following rules when modelling a domain: "Composites and aggregates should be modelled as entities, not relationships, Relationship should not be modelled with attributes, Entities should not be modelled with optional attributes, Conceptual models should clearly distinguish between classes and instances, and Things and their properties should be clearly distinguished in the conceptual model" (p. 88). What does all this mean? Shanks, Tansley, and Weber continue by noting problems in practice in carrying out these rules, such as misclassifications and dual classifications. Putting groups together to form the ontology may be possible but requires too much discipline to be feasible in practice. Ontological drift and human drift will be unavoidable.

With regard to the underlying learning model, we recognize that in many cases knowledge transfer is the goal and thus an acquisition-based learning model is appropriate. However we agree with Euler (2003) that this is the lowest level of learning. In the knowledge-building and sharing model represented by the right-side of the Systems-Personal Model, the essence of learning is not so much concerned with finding or being presented with objects but in learning situations where collaboratively creating and constructing the objects may be a larger goal. We see this kind of learning occurring in a setting where a great deal of formalism isn't needed to make sense of objects, because humans are around to supply the sense and be aware of the tacit understandings involved. A human-to-human "ontology" that comes from personal shared understandings and communication is not likely to be simulated/paralleled by technology. Thirty years of attempts to model learners for intelligent tutoring systems shows us the limitations of trying (Park, 1996). Even if we can find objects more quickly and more accurately doesn't mean a higher-quality learning experience. For many types of cognitive development, finding and deciding about the appropriateness of knowledge is a major learning goal in itself, and striving for a situation where an agent or system presents "what you need" without mental effort or responsibility on the learner's part will not even be desirable. We also agree that the use of technology in the form of agents and their capabilities never will and can replace human-to-human communication. "Human-to-human communication will always be a important component of the educational experience" (Anderson & Whitelock, 2003). The promises of the semantic web are high but the costs to achieve such a kind of automatism may be unobtainable in practice. Even more fundamentally, the focus on content may not be the solution for the needs of a pedagogy based on a participation or contribution-oriented educational philosophy (Anderson & Whitelock, 2003).

Thus the dissertation is over. But the issues and challenges will remain, as well as controversies related to how to interpret and deal with them.

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Summary

The reuse of electronic learning material has been a goal and a problem for more than two decades in the educational sector. Already in the 1980s a number of initiatives occurred with the aim of promoting the reuse of educational software outside of its original market. These initiatives came to little success for a number of reasons. One certainly was the technology of the time, with incompatibilities in operating systems and storage media forming major barriers. In addition, there were problems in awareness and access. Potential users had little opportunity to be aware of what was available or to see or try it out. Since the 1980s some progress has been made, but there are still many aspects that can be studied.

This dissertation focuses on the application of learning technology standards for learning objects and the differences in reuse in university, corporate, and military contexts. This is addressed from two different perspectives: the technology involving learning objects and the human aspects that influence the (re)usability of learning objects.

Learning objects are defined as digital entities, available for use or reuse in different learning settings. These objects themselves may or may not have been originally created as learning objects; it is their use for learning purposes that makes them learning objects. Each learning object has a life-cycle. Stages in this lifecycle are obtaining an object, labelling an object, offering an object, selecting an object, using an object and retaining an object.

Technical aspects of reusing learning objects include the technology of the objects themselves; technology related to the repository in which the objects are collected; technology for services related to the use of the repositories; and technology to support the sharing or interoperability of learning objects between systems and repositories.

As complex as these technical aspects are, human factors involved with the use and re-use of learning objects are even less easy to deal with than technical issues. An example of such an aspect is the instructor's perception that material created elsewhere does not fit well enough with the situation in his own instructional setting. This relates to another human aspect that influence the (re)usability of learning objects: not only must they be available and findable, but the instructor must be motivated to look for them, supported in making decisions about how to not only find them but more importantly integrate them into the rest of his course and instructional planning, and then must have easy-to-use tools that help him make this integration.

Through the combination of technological and human considerations, a number of the barriers limiting the potential reuse of digital resources are addressed in this dissertation, particularly those that relate to fit with the local context: the research positions the study of metadata requirements and standards within a broader context that relates to the situation in which potential learning-object use occurs. Therefore the research focuses on the application of learning technology standards for learning objects and the differences in reuse in three different contexts: university, corporate, and military. Within the three contexts the human and technical perspectives will be key elements for the responses to the research questions which are:

> *Human perspective – What human aspects are important to support the different stages of the lifecycle of a learning object?*
>
> *Technical perspective - What tools and technologies are important to support the different stages of the lifecycle of a learning object?*
>
> *Combining human and technical perspectives - What are key dimensions to guide the selection of tools, technologies, and human procedures to support the different stages of the*

lifecycle of a learning object for users in different usage contexts, particularly university, corporate learning, and military training?

A series of projects over three years provides answers to these and related sub-questions.

Chapter 2 gives a conceptual overview, analysis, and literature review focused on the human aspects. From the human-aspects perspective, key elements include the definition of learning objects, the organizational contexts in which the humans function, the actors and their roles, pedagogy, and usability. It appears that there is no single definition of the term learning object from a human perspective. Key variations in the definitions that are relevant to human creators and users of learning objects include the questions whether a learning object is be explicitly created for learning purposes or can be any digital entity which can have a learning function in a broader learning context. And if a learning object is explicitly created as such, should the creation be done within a structured framework? Key aspects in answering these questions relate to the nature of the course and of reuse of learning objects within it, to the course delivery and technology, to ownership, and access to learning objects. These aspects are addressed in Chapter 2 and a first comparison between the three contexts is made. Both the organizational cultures of the contexts and the actors that are somehow related to learning objects play an important role in these comparisons. Each of these actors have different roles (such as content specialists, instructors, support staff, managers, and learners) and different perspectives.

Chapter 2 also addresses the way learning is structured by the institution and its influence on the reuse of learning objects. For instance, in traditional higher education, courses often involve lectures by the instructor, supported by objects such as PowerPoint presentations or self-made lecture notes. These can serve as reusable learning objects for self-study outside of the lecture setting. In this context, digital learning resources are not often used to replace the instructor or the textbook but to complement them in some way. In contrast, in the corporate and the military context, when electronic learning objects are used this is generally in the context of e-learning defined as self-study or anytime, anyplace learning. The presumption is that no instructor or classmates are involved, although there may be access to tutors or human coaches available, and thus the learning objects in combination must carry out the instructional role.

Another key element of learning objects from the human perspective relates to usability characteristics. Key features of usability relate to consistency, learnability, friendliness in terms of helping the user to avoid errors or in responding to errors, ease of remembering how to use the object once it has been used before, and attractiveness. Attractiveness involves presentation style, appropriate language, appropriate tone and style of communication, as well as visual engagement.

With regard to the issue of metadata, metadata has different meanings within each context setting from the human perspective. In the university setting, metadata are likely to be related to the individual instructor's own way of managing files. In the corporate sector, metadata are likely to be focused on the organization's competence framework. In the military setting, metadata often relate to the technical features of images and specifics relative to the place of an object in a handbook or manual.

In Chapter 2 a number of issues that relate to learning objects from a human perspective are identified that expand on the general research questions presented in Chapter 1. Therefore six secondary research questions from the human perspective are identified, underpinning all of the three overall research questions presented in Chapter 1 and related to the organizational context, learning scenarios, object creation, user support, and metadata which will be answered by carrying out the projects as described in Chapters 5, 6, and 7.

Chapter 3 gives a conceptual overview, analysis, and literature review focused on the technical aspects. From the technical perspective the key elements are the definition of a learning object, issues related to granularity, metadata and standards, and tools and technologies are described. Starting with the definition from a technical perspective, a learning object is described as any entity, digital or non-digital, that may be used for learning, education or training. This definition of IEEE/LOM is used for this research but with the important difference that the "non-digital" kind of material will not be included in the research. Discussing learning objects from a technical perspective includes taking into account aggregation levels and the granularity of a learning object, because the definition of a learning object does not prescribe the size of learning objects, but the granularity of material plays a role during the exchange of material and the size of the objects.

In relation to metadata from a technical perspective two definitions of metadata are given that are both used in the research:

> *Metadata is information about an object, be it physical or digital. As the number of objects grows exponentially and our needs for learning expand equally dramatically, the lack of information or metadata about objects places a critical and fundamental constraint on our ability to discover, manage and use objects (LTSC, 2002).*
>
> *The purpose of metadata (data about data) is to provide a common nomenclature enabling learning resources to be described in a common way. Metadata can be collected in catalogues, as well as directly packaged with the learning resource it describes. Learning resources that are described with metadata can be systematically searched for and retrieved for use and reuse (Dodds, 2001b).*

Next to metadata standards are an important element from the technical perspective. Standards are developed for exchangeability and interoperability between platforms. Different organizations work on the development of these standards related to learning technologies, which are defined as a set of technologies related to learning that includes the development of learning objects standards. Many organizations that focus on learning technologies are working together in some form. Two main standard-setting bodies are the Institute of Electrical and Electronics Engineers (IEEE) working group called the Learning Technology Standards Committee (LTSC), and the Advanced Distributed Learning group developing ADL SCORM – the Sharable Content Object Reference Model.

Standards can be developed in two ways: (a) development by an official standardization body, like the International Standardization Organization (ISO) or Institute of Electrical and Electronics Engineers, Inc (IEEE); or (b) development of the standard without the help of a standardization body. The success of the standard can be measured by how many people use the standard.

Four different sorts of technologies in terms of systems and tools can be identified to create, edit, manage, maintain, and use learning objects in different organizational settings. To obtain or create learning objects *authoring tools* are used. These authoring tools vary in complexity, features, and the skills needed to use. Once the learning objects are created they can be stored in the *Learning Content Management System* (LCMS). A LCMS can be compared with a repository that holds a large set of learning objects that are structured in such a way that users should be able to retrieve every learning object based on metadata. A *Course Management System* (CMS) can be used to structure and organize so that the learning objects have a logical order, sequence, and consistent behaviour in a course, lesson, or module. The learning objects used can be selected from the LCMS or taken directly from an authoring tool. The interaction between learning objects that can be part of a course and users is regulated and managed by a *Learning Management System* (LMS)

In Chapter 3 a number of issues that relate to learning objects from a technical perspective are identified that expand on the general research questions presented in Chapter 1. Therefore three secondary research questions from the technical perspective are identified, underpinning all of the three overall research questions presented in Chapter 1 and related to granularity and standards, tools, and systems which will be answered by carrying out the projects as described in Chapters 5, 6, and 7.

Chapter 4 describes a methodology that supports the three main tasks that are carried out during the research: validating the views from the literature in practice, explaining experiences from practice, and testing prescriptions for procedures and requirements that will lead to successful use of learning objects in different contexts. The methodology chosen to carry out these tasks is the Action Research paradigm. Action Research (AR) belongs to the case-study family of methodologies, but they are intentionally treated as separate forms: Action-Research studies likely include cases, but a case study can certainly avoid using an action-research approach.

AR aims to contribute to both the practical concerns of people in an immediate problematic situation and to further the goals of social science simultaneously. This means that there is a dual commitment in action research to study a system and concurrently to collaborate with members of the system in changing it in what is together regarded as a desirable direction. Accomplishing this requires the active collaboration of the researcher and the client. Consequently the main characteristic and strength of AR is that it suggests intervention carried out in a way that may be beneficial to the organisation that is participating in the research study. Therefore AR is used in real situations, rather than in contrived, experimental studies, since its primary focus is on solving real problems. It is often the case that those who apply the AR approach are academics who have been invited into an organization (or other domain) by decision-makers aware of a problem requiring (action) research, but lacking the requisite methodological knowledge to deal with the problem. This is also the case in the research described in this dissertation. The researcher's role was to "implement the AR method in such a manner as to produce a mutually agreeable outcome for all participants, with the process being maintained by them afterwards". To accomplish this, AR may necessitate the adoption of many different roles for the researcher at various stages of the process. In this case the researcher fulfilled the roles of developer, designer, analyst, and interviewer.

Action Research allows for several different research tools to be used. In this research several methodologies were used for data collection in the projects, such as a literature study, a structured interview with a questionnaire, an unstructured interview, log-file analysis and course material analysis. The most important method for data collection in all three contexts was the questionnaire and the structured interview.

The questionnaires were filled in during a face-to-face interview schema. The questionnaire was accompanied by a demonstration of the reuse functionalities in the TeleTOP® CMS. During the structured interview, the different functionalities were shown when relevant. The TeleTOP® CMS and reuse support tools were used to give the users an idea of what was meant with the concepts such as learning objects, reuse, labelling, and learning material. Also the use of taxonomies, searching, and LOM were addressed with the demonstration as the purpose of the demonstration was to show some practical examples and to make the users aware of their own reuse possibilities. Besides the possibilities also problems and issues were addressed with the demonstration. The structured interview took over 90 minutes because of the demonstrations involved. The results of the questionnaires are grouped around themes that were seen as important issues. Every theme was mapped against a set of questions used in the questionnaire. The results of the AR-approach, including the interviews and questionnaires, are described in Chapters 5, 6, and 7.

Chapter 5 describes the projects and preliminary results within the university context. Three projects were object of research. The focus in two of the projects which were carried out at the University of Twente is on the reuse and exchange of material. The other project related to the development of a guideline relating to metadata for the Digitale Universiteit (Dutch Digital University).

Two of the projects within the university context took place at the University of Twente (UT), an internationally-oriented institute of scientific education and research. It has stressed the interconnectedness of technical and social sciences since its foundation in 1961. The UT aims for knowledge transfer to society and has a part of its mission to make a contribution to technological and societal innovation, in close co-operation with public and private parties in society. In the Netherlands the UT is at the forefront of innovations in terms of ICT, infrastructure, and research and is a member of the Digitale Universiteit.

The first project that is described is the Project TeleTOP® at the University. This project describes how tools for reuse within the TeleTOP® CMS were developed, where the use of metadata and ADL SCORM specifications was part of the TeleTOP® development. The project describes also the implementation of the TeleTOP® CMS in the University of Twente and how reuse within this context was organized.

The second project in the university context was the SURF project Alpha Beta. This project focused on reuse and implementation of learning technology standards and was carried out in the context of the Faculty of Educational Science and Technology because the development of the TeleTOP® CMS took place there. The developed functionalities were also tested in this context. The project mission was twofold. The first was the test if the TeleTOP® course-management system developed for a particular faculty in a technical university also could be used in a social-sciences university like Leiden in the Faculty of Law. The second part of the project focused on reusability of course material within course-management systems based on standards. Different tools were developed for the TeleTOP® system during the project that could support reusability of learning objects using standards. The support system built for the Alpha Beta project was based on the ADL SCORM 1.1 specifications. Although the implementation of the specifications was a success, no actual reuse with other systems took place because no other "SCORM compliant" systems were available to test reusability possibilities.

The third project in the university context was the project Digital University Metadata Guideline. The Digitale Universiteit (DU) of the Netherlands initiated a project to define a metadata guideline for their consortium members. A guideline of how metadata can be used in a certain setting is also called an application profile. The term application profile is used as a more general term in various systems and contains sets of vocabularies to be used for meta-tagging learning objects. For several metadata fields a set of predefined values is given. The project focuses thus mainly on the third stage of the learning-object lifecycle. The project delivered a manual explaining how to metatag learning material using the vocabularies. The guideline was intended to be a manual for content developers in different projects and was developed to support these content developers in creating consistent and interoperable metadata.

Chapter 6 describes the projects and preliminary results within the corporate context. Three projects were objects of research. These projects were carried out at the Shell EP Learning Center in Noordwijkerhout in the Netherlands. In 2000, a wave of change in the delivery of learning occurred when the Shell EP Learning Center began offering a new range of services to meet learning needs, through a combination of employee profiling in terms of the Shell EP Competence Framework and provision of both time- and place-independent e-modules or blended learning in addition to classroom training all anchored in the competence gaps of the learner. The projects at this Centre are used for the study of the corporate-learning context.

The first project in the corporate context is the Implementation TeleTOP® at Shell EP Project. This project involved the use of the TeleTOP® system and how the reuse of learning material within this system influences the strategies used for learning. How the implementation of the TeleTOP® CMS took place and the possibilities offered for creating learning material were questions addressed in this project. The need for reuse, the tools offered, and how the curriculum is structured all had an impact on reuse aspects. The tools and reuse possibilities are mainly developed to support the Course Directors. The project focused on the needs of the course developers during the implementation of TeleTOP for blended learning. This included also the redesign of several TeleTOP® functionalities for the corporate-learning context. For the use of e-learning modules specifications for external course-material developers were defined.

The second project in the corporate context is the TeleTOP® Conversion Project. This project was based on the project to move the TeleTOP® CMS from a university-based version to a commercial version for use at the Shell EP Learning Center. The development of the (commercial) Version 5 of TeleTOP® started in January 2002 and was initiated by the ITBE of the University of Twente. The TeleTOP® CMS used until then at Shell EP was developed according to a rapid-prototyping design approach with relatively little time available for documentation. Because of the interest of several third-party organizations such as Shell EP a new version of TeleTOP® was built to make it possible to give professional IT support based on documentation. Another reason for rebuilding the system was to solve inconsistencies and small interface problems that were raised during the prototype-design phase of the TeleTOP® system. The new version was reprogrammed from scratch using the functional design from the original system. An inventory of the functionalities of the existing system was made including interface aspects relating to the layout of the screens. Because the whole system was reprogrammed, also the data model changed from the first four TeleTOP® versions which were all based on the same data model. The differences in data models made the conversion a difficult task because all fields had to be mapped from the old design to the new design. An important role for exchange based on standards was found to be the key in this process. Another problem was the fact that some courses had to be migrated while they were active because no timeslot was available for the conversion when all courses were finished.

The third project in the corporate context is the Shell EP Knowledge-Sharing Project. This project focuses on a broader scope than the TeleTOP® implementation and is much more related to a greater context where different locations such as NAM in Assen, Rijswijk, as well as the Shell EP Learning Center in Noordwijkerhout are involved. This project describes the Knowledge-Sharing Project and focuses on the integration of knowledge management and learning that occurred at the creation of the LLD unit in October 2003 and will be intensified in practice when the Shell EP Learning Center moves to a new location in Rijswijk in early 2005. This integration started with merging the learning and knowledge-management departments in the new LLD organization and the Knowledge-Sharing project was a direct result of this merger. For the integration of knowledge management with course-based learning, reuse of material is a key aspect. Material from real practice needed to be digitised and is seen as highly valuable and reusable in the near future for learning activities. The materials used in the different knowledge-management activities have the same high potential value for learning and are also candidates for reuse purposes. The project focuses on strategies to make reuse possible between different current systems using standards. An inventory in the organisation was made to see if existing tools for knowledge-sharing among systems can be used and if material from different repositories can be reused, and what is needed to achieve this reuse.

Chapter 7 describes the project and preliminary results within the military context. Four projects were objects of research. These projects were carried out at the Royal Netherlands military and were part of projects initiated by TNO (Nederlandse Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek, The Dutch Organization for Applied Scientific Research). The main focus of the projects was the implementation of and building experience with the current learning technology standards.

The first project in the military context is the ADL SCORM Pilot RNLAF Project. This project focused on two aspects: building experience with an ADL SCORM based LMS and building experience with the implementation of the ADL SCORM™ in existing computer-based training (CBT) course material. Because of the lack of experience with ADL SCORM LMSs and the expected interest in the future for these systems, the functionalities of such a LMS were tested. Building up experience with a learning management system was also one of the main focuses of the research. The ADL SCORM™ compliant material tested in the LMS came from two sources: Example courses distributed by ADL and the air force's own redeveloped CBT. The project was initiated to see how an ADL SCORM™ compliant system works within a military setting addressing the following items during the research:

- Technical implications
- Security of data for classified material
- Possibilities for data retrieval
- Possibilities for integration in a large company
- Connection speed
- Report possibilities
- Behaviour of ADL SCORM™ compliant courses.

For the project two courses were selected to see if ADL SCORM™ could be applied. The selection of the two courses was based on their complexity and structure. The course "Military Ranks" was selected as a simple course with little interaction, almost no use of multimedia, and a total running time of 4 hours. A more complex course in terms of structure, interaction, use of multimedia, and a total running time of 20 hours was found in the course "Aircraft recognition". The LMS was tested with then already existing courses that were redesigned according to the ADL SCORM specifications.

The second project in the military context is the LCMS Project. This project was initiated to discover the use of LCMS functionalities in CBT development. The main aspects of the LCMS project that were important for the research are:

- The development of a LCMS for the RNLAF and RNLA and tools to make material accessible for the course developers.
- The implementation of the ADL SCORM™ specifications in the LCMS. The development of classification paths and the construction of a set of keywords.

Because of future developments related to learning technologies and reuse of material using learning objects the RNLAF and RNLA required a LCMS for an inventory of possibilities of a repository for learning objects. The requirements for developing a LCMS based on both the SCORM specifications and the requirements of the RNLAF and RNLA were based on the learning scenarios used in the RNLAF and RNLA, where computer-based training (CBT) is used within their internal training and learning processes. To get a grip on the widespread developments in CBT production and to get optimal benefits for its undertaken efforts, the Royal Army is standardizing methodology and content for producing CBT. Standardizing methodology and content creation involves a focus on tools that can support the course developers with developing and reusing learning materials. Template-based authoring tools for the development of multimedia content and the use of learning content management systems (LCMSs) for the management of available e-learning/CBT material are also used for standardization. Related to the implementation of the standards, aspects related to functionality, usability, and technical issues of these tools and systems were researched. Therefore one of the focuses of the LCMS research was the metadata labels that would be needed, were in terms of searching and storing material in a LCMS.

The third project in the military context is the Implementation of ADL SCORM in IMAT Project. The goal of this project was to describe how well the ADL SCORM specifications can be implemented in the existing IMAT system. IMAT is a system that makes it possible to convert technical manuals to tagged fragments for learning purposes. The project was initiated to see if the outcomes of the IMAT system in terms of fragments could be used as learning objects compliant with ADL SCORM. The IMAT data model was compared with the ADL SCORM specifications and the IMAT data model was mapped to the ADL SCORM data model. Within the research the IMAT elements were also mapped or converted to the required ADL SCORM data model. Missing elements were constructed from other similar IMAT elements. Also the use of the ADL runtime model was researched and recommendations were given to implement such a runtime model. Besides tools to support reuse also a repository has been developed in the IMAT Project to store and exchange material. The material was obtained from technical manuals as delivered by the manufacturers of equipment. The manuals are divided in small fragments of homogeneous content. The content is stored in the developed repository in such way that it could be retrieved to create computer based training (CBT) using an authoring environment. An inventory was made of IMAT users during the project. The inventory of the IMAT system was a substantial part of the project because the IMAT data-model was much too limited for a full implementation. The inventory gave insight and information on the interpretation of the elements in the IMAT data model. The inventory focused on the type of users, the characteristics of the material, and the learning scenarios used.

The fourth project in the military context is the KIM Project. The KIM (Koninklijk Instituut voor de Marine [Royal Netherlands Naval College]) project describes another setting within the military context, this dimension focuses on learning in a higher-education setting. The KIM is based in Den Helder and its main tasks are the training of Navy officers and carry out Navy related research. Although the KIM is a military context, the educational developments and organization are closely related to the Netherlands university context. The development of the KIM at the beginning of the nineteenth century was already at a scientific level. In 1963 the KIM was granted a university status by law. The courses in the education on KIM vary from practical training to scientific education. The academic part of the education is organized within faculties. The practical training focuses on competencies required for the first functions in the fleet and the military aspects within operational entities. These different components within the training require for each aspect an appropriate didactical set-up. All this means that the tools and type of education differs in the KIM from the other military settings. One of the tools used as a pilot in the KIM one year during 1999 was the TeleTOP® CMS. Based on these experiences with TeleTOP® and potential reuse possibilities the KIM instructors were interviewed and an inventory of their educational approaches and support systems was made.

The results of the research in the projects in the university, corporate, and military contexts are described in Chapter 8. Based on the human perspectives and technical perspectives and the related research questions, this chapter gives the synthesis with answers to the research questions based on the framework used within the three contexts.

The first main research question focused on the Human Perspective: *What human aspects are important to support the different stages of the lifecycle of learning object?* The results of the research show that a similarity can be seen in the different contexts in the approach for a reuse strategy. All three organizations think that reuse is important and decision makers support research in this area. The approaches of the research programs however are fundamentally different with various results. This means that the culture underlying any specific context determines the value system for the reuse.

The organizational strategy in all contexts is strongly focused on renewal of learning scenarios. Although renewal of learning scenarios in the different contexts is highly stimulated, support in terms of reuse and tailoring tools for the instructors, course developers, and course directors is not much available. The tools needed for reuse to support the new learning scenarios on the instructor level are not yet implemented on a large scale. Reuse is still a local activity managed by the instructor or course developer. Tools to exchange material in a broader perspective are still not available. For these results it can be concluded that the level of learning objectives is determined by the context and the learning scenarios underlying reuse are determined by the context.

In the university context, as well as partly in the military context and partly in the corporate-learning context material is gathered from different resources. Material is selected by the instructors and course developers. The subject-matter expert and course developer determine the pedagogical structure of the course and the quality of the selected material. From this it can be concluded that the roles of those involved with learning objects is determined by the context.

The user support in the university context and in the corporate-learning context is centralized. The user support is more likely to be available during the implementation of a new system focused on several aspects of e-learning such as technological support and development of other learning scenarios. The support in the military context focuses on the course developers in terms of research projects. The type of human support given for training and services depends on the resources and incentives of an organization and is therefore determined by the organization. The designers of course material also decide about the quality of material used. The type of support for human interaction depends on the learning scenarios that are appropriate for a certain context. From this it is concluded that the need for human interaction is determined by the context and those who control the quality of learning objects are determined by the context.

All contexts are working on metadata specifications and the application of these specifications. Also the use of classifications was used in the different projects. The use of metadata for reusing material in the various projects depends on organizational strategy or personal incentives and the incentives for reuse are determined by the context.

The second main research question focused on the Technical Perspective: *What tools and technologies are important to support the different stages of the lifecycle of a learning object?* The results of the research show again that the approaches of the different contexts for reuse vary. For instance, the granularity of the learning objects depends on the authoring systems that are used. The use of the authoring systems prescribes what the sizes of the objects are and how they can be reused. The need for the implementation of learning standards is seen as useful in some settings, but in most cases the corporate organization defines the requirements that are seen as "the standard". The current learning-technology standards are seen as not mature enough and not able to fulfill the needs of such a sophisticated organization. It is also expected that standards such as ADL SCORM™ are implemented by the software vendors for future use. From this it was concluded that the "instructional packaging" of learning objects depends on their origin, the reusability of learning objects is determined by their specificity, and the reusability of learning objects is determined by the adaptability of the objects.

In all contexts similar tools are used to obtain and edit source material in the form of assets and office tools are used to create these. Within the different contexts the specifications of the learning objects are closely related to the available tools. The available tools depend on the type of course material that is required for a certain context. The type of material developed depends on the learning scenario that is chosen. From this it is concluded that the specifications of learning objects are determined by the context, the role of the learner is determined by the context and the characteristics of the tools that support reuse are determined by the context.

The three different contexts all use a CMS with facilities to reuse material. The CMSs which are used in the university context and corporate-learning context can be seen as large repositories which contain large sets of valuable material. Using the standards it is possible to exchange this material between other courses, universities, and interested companies. Where the material is stored depends on the organizational strategy. When reuse is part of the strategy a learning content management system (LCMS) can be installed that can be used to store material based on predefined taxonomies. Based on this the following conclusions were made: the place where the learning objects are stored is determined by the context, taxonomies are determined by the context.

The third main research question focused on the different contexts and their specific characteristics related to the perspectives: *What are key dimensions to guide the selection of tools, technologies and human procedures to support the different stages of the lifecycle of a learning object for users in different usage contexts, particularly university, corporate learning centre, and military training?* In answering this question it appeared that the learning-object lifecycle is an important component in all the research questions. The lifecycle helps to compare and contrast the contexts and projects. However using a rigid linear model for all projects made clear that the model did not fit all projects in the various contexts. It has been showed that there can be differences in how reuse occurs and that there can be different types of learning scenarios and learning objects. Because of the differences in reuse also the sequence and stages within the learning-object lifecycle can be discussed. The sequence of the stages may not always be the same and some stages may not be relevant for certain settings. It was found that the most important change in the model is the sequence of the stages and the implication this has for the metadata. For example, labelling course material before it is used once is sometimes difficult and time consuming. When material is used in a certain educational setting a large set of metadata can be extracted from the type of use, the user, the related tasks, the target group, the learning scenario used, the platform used, the related categories, description, title, and closely related other material. Another interesting remark can be made about quality control. The control of quality is not a separate stage in the learning-object lifecycle. Quality control is one of the tasks of the course developers and involves actions in all of the different stages.

In the previous chapters context was defined as an organizational setting, such as a university setting, a corporate learning setting, or a military setting. The results in Chapter 8 showed that for the application of reuse strategies not the organizational settings as a whole are different but rather dimensions that are present in all three contexts vary. In other words: For the application of reuse strategies a context depends on various dimensions more general than “university-corporate-military” dimension. This is further elaborated in Chapter 9.

In Chapter 9 it is argued that there are differences and also similarities between the university, corporate learning, and military contexts but broader relations can be identified in terms of context. A new set of 16 dimensions was proposed as a model, each sharing bipolar end values which define two new extremes of context, identified as “System oriented’ and “Personal oriented”. The broader relation can be found in each of the endpoints of the dimensions. The researcher proposed that these endpoints be aligned so that the left extreme is related to a context that can be *Systems oriented* and the right extreme can be *Personal oriented*. The Systems orientation focuses on technical specifications, rules, policy, and procedures as the key identifiers and a Personal orientation is related to human interaction, personal needs, personal incentives, and personal values. The two orientations can be seen as the end points of each dimension where also values between the endpoints can reflect the involvement of both orientations. Based on the initial full set of 16 dimensions a combined set of five dimensions was extracted that can be used as a tool if the dimensions are expressed as parallel lines each with a scale of 1 to 5. Figure 191 shows the tool based on the five overall dimensions.

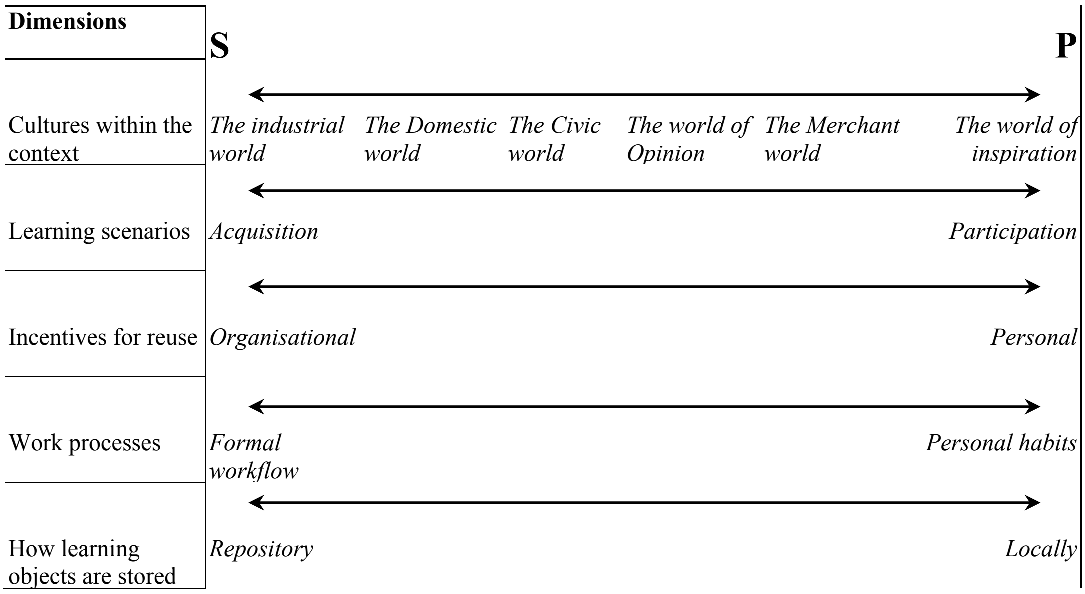

Figure 191 The five overall dimensions presented as Learning Object Context Profiling Model

The tool can be used to describe a certain context where reuse occurs, it can be used to explain why reuse in a certain context is a problem, and it can be used to predict how reuse in the future will occur. Reflections on the model and tool were made using the key issues as discussion points.

Chapter 9 concludes with a reflection on the research and the methodology used and a view on the semantic web as a new development that can support course development in the future.

Reflecting on the overall results through the frame of reference of the Model has led to the following general observations. The results of the research show that reuse may not be focused on a wide exchange of all available material but on a small level within departments and particularly on the reuse of one's own course material. The use of specifications such as ADL SCORM™ may not have the expected impact on adaptive learning and building courses based on learning objects from large repositories as expected by many. Also the runtime specifications for tracking and tracing may not be suitable for the required learning scenarios in a certain context. Also the complete set of metadata to select material from a large repository may not be required or efficient. Reuse of material is important for individual users or for knowledge management. Reusing material from colleagues that move to another job can be very efficient and time saving. The fact that knowledge of instructors is stored in courses that can be (partly) reused can also been seen as a form of knowledge management in large companies such as Shell EP or the military.

Instructors use CMSs as a tool to provide course material in their own ways, supported by a Personal oriented system. The ease of use of the systems and the freedom offered to the instructors make such a widespread use possible. In contrast, the use of courseware-development tools such as Authorware™ and Easygenerator™ is very much limited to a group of specialized users, likely to represent a Systems orientation. The complete specification bundle of ADL SCORM™ seems to focus on this small group of courseware developers. The strength of the specifications will be found in the extent they become taken up in the frequently-used and flexible CMSs to make exchange and reuse of material possible under the control of the individual instructor and with a Personal orientation.

Chapter 9 also describes how well the descriptive task, the explanatory task, and the prescriptive tasks of the research have been carried out. Within the dissertation the different tasks can be clearly identified. For each project in the three contexts the aspects are described using the common Why?, Who?, What?, How?, and Where? questions. The learning-object lifecycle and secondary research-question summaries explain what aspects are key for reuse strategies and the implementation of learning-technology standards for that particular project. The Learning Object Context Profiling Tool is part of all three of the descriptive, explanatory, and prescriptive tasks in the research. The five dimensions in the short form of the Learning Object Context Profiling Tool can be used to predict if a reuse strategy within a certain context will be successful.

Thus the dissertation is over. But the issues and challenges will remain, as well as controversies related to how to interpret and deal with them.

Samenvatting

Dit proefschrift concentreert zich op de toepassing van standaarden voor leertechnologie voor leerobjecten en de verschillen in hergebruik van deze objecten in universitaire, commerciële en militaire contexten. Dit wordt onderzocht vanuit twee verschillende perspectieven: de technologie van de leerobjecten en de menselijke aspecten die de (her)bruikbaarheid van leerobjecten beïnvloeden.

Het hergebruik van elektronisch leermateriaal is al meer dan twee decennia zowel een doel als een probleem in de onderwijssector. Al in de jaren '80 waren er een aantal initiatieven met het doel om het hergebruik van onderwijssoftware buiten haar originele markt te bevorderen. Deze initiatieven hadden weinig succes om een aantal redenen. Een reden was de technologie van die tijd, besturingsystemen waren niet op elkaar afgestemd en ook de verschillende opslagmedia vormde een belangrijke barrière. Bovendien was het besef voor het nut van hergebruik nog niet aanwezig en waren er problemen met toegang tot materialen. De potentiële gebruikers hadden daardoor weinig kans om bewust te worden van wat beschikbaar was of om het uit te proberen. Sinds de jaren '80 is er wat vooruitgang geboekt, maar er zijn nog vele aspecten die kunnen worden bestudeerd.

Leerobjecten worden in deze dissertatie gedefinieerd als digitale entiteiten, beschikbaar voor gebruik of hergebruik in verschillende leersituaties. Deze objecten zelf kunnen, maar hoeven niet, ontwikkeld te zijn als leerobjecten; het is het gebruik voor leerdoeleinden dat hen tot leerobjecten maakt. Elk leerobject heeft een levenscyclus. De stadia in deze levenscyclus zijn: het verkrijgen van een object, het labelen van een object, het aanbieden van een object, het selecteren van een object, het gebruiken van een object en het behouden van een object.

De technische perspectieven van het hergebruiken van leerobjecten betreft de technologie van de objecten zelf, de technologie die betrekking heeft op de databank waarin de objecten worden verzameld, de technologie voor de functionaliteiten die beschikbaar zijn in de databanken en de technologie om het delen van of de interoperabiliteit tussen de leerobjecten te ondersteunen.

Hoewel deze technische perspectieven zeer complex zijn, zijn de menselijke factoren die bij het (her)gebruik van leerobjecten betrokken zijn nog gecompliceerder. Een voorbeeld van een dergelijk menselijk aspect is het idee van docenten dat materiaal dat ergens anders ontwikkeld is, niet goed genoeg past binnen zijn of haar eigen onderwijssituatie (het not-invented-here syndroom). Dit heeft ook op een ander menselijk aspect betrekking dat de (her)bruikbaarheid van leerobjecten beïnvloedt: niet alleen moeten de leerobjecten beschikbaar en vindbaar zijn, maar de docent moet ook worden gemotiveerd om de objecten te zoeken. Daarnaast moet hij of zij ondersteund worden in het nemen van besluiten over hoe de objecten te vinden en nog belangrijker, hoe ze te integreren in de rest van zijn of haar onderwijs. De docent moet daarbij eenvoudig te gebruiken functionaliteiten tot zijn of haar beschikking hebben die hem helpen deze integratie te bewerkstelligen.

Doordat in deze dissertatie zowel de technologische als de menselijke perspectieven zijn opgenomen, worden een aantal problemen besproken die het potentiële hergebruik van digitale middelen beperken. In het bijzonder worden die aspecten besproken die betrekking hebben op lokale contexten maar het onderzoek gaat ook in op de bredere context waarin het hergebruik van leerobjecten voorkomt. Daarom ligt de nadruk van het onderzoek op de toepassing van standaarden voor leertechnologie met betrekking tot leerobjecten en wordt ingegaan op verschillen in hergebruik in drie verschillende contexten: de universitaire, de commerciële en de militaire context. Binnen deze drie contexten zullen de menselijke en

technische perspectieven belangrijke elementen zijn die antwoord geven op de onderzoeksvragen, die als volgt geformuleerd zijn:

> *Menselijk perspectief - Welke menselijke perspectieven zijn belangrijk om de verschillende stadia van de levenscyclus van een leerobject te ondersteunen?*
>
> *Technisch perspectief - Welke toepassingen en technologieën zijn belangrijk om de verschillende stadia van de levenscyclus van een leerobject te ondersteunen?*
>
> *Combineren van menselijke en technische perspectieven - Wat zijn de belangrijkste aspecten bij het begeleiden van gebruikers bij de selectie van toepassingen, technologieën en activiteiten om de verschillende stadia van de levenscyclus van een leerobject in verschillende gebruikscontext te ondersteunen, in het bijzonder de universitaire, de commerciële en de militaire context?*

Door het uitvoeren van een reeks aan projecten gedurende ruim drie jaar worden antwoorden op deze onderzoeksvragen en op gerelateerde subvragen gegeven.

Hoofdstuk 2 geeft een conceptueel overzicht, analyse en een literatuuroverzicht dat zich concentreert op de menselijke aspecten. Vanuit het menselijk perspectief wordt een definitie gegeven van leerobjecten. Daarnaast wordt de organisatorische context waarin de betrokkenen functioneren beschreven, wordt ingegaan op hun rollen en op de gebruikte didactiek en worden de gebruiksmogelijkheden van verschillende toepassingen voor hergebruik van leerobjecten beschreven. Het blijkt dat er vanuit het menselijk perspectief niet een eenduidige definitie voor de term leerobject is te geven. De belangrijkste vraag die hierbij van belang is, is of een leerobject uitdrukkelijk wordt gecreëerd voor leerdoeleinden of dat een leerobject elke digitale eenheid kan zijn die een leerfunctie kan hebben. Als een leerobject uitdrukkelijk als dusdanig wordt gecreëerd, moet het creëren dan binnen een gestructureerd kader worden gedaan? Aspecten bij het beantwoorden van deze vragen hebben betrekking op de aard van het onderwijs en van hergebruik van leerobjecten binnen dit onderwijs, op de uitlevering en de technologie van het onderwijs, op eigendom van leerobjecten en op toegang tot de leerobjecten. Deze aspecten worden besproken in Hoofdstuk 2 en er wordt een eerste vergelijking tussen de drie verschillende contexten gemaakt. Zowel de organisatorische cultuur van de contexten als de actoren die op de een of andere manier betrokken zijn bij het leerobject spelen een belangrijke rol in deze vergelijkingen. Elk van de actoren hebben verschillende rollen (zoals inhoudsdeskundigen, docenten, ondersteunend personeel, managers en studenten) en verschillende perspectieven.

Hoofdstuk 2 richt zich ook op de manier waarop het leren door de instelling gestructureerd wordt en de invloed hiervan op het hergebruik van leerobjecten. In traditioneel hoger onderwijs bijvoorbeeld bestaat onderwijs vaak uit colleges door de docent, ondersteund door objecten zoals PowerPointpresentaties of zelfgemaakte college aantekeningen. Deze presentaties en aantekeningen kunnen gebruikt worden als herbruikbare leerobjecten voor zelfstudie. Hierbij worden de digitale leermiddelen meestal niet gebruikt om de docent of het handboek te vervangen maar om het onderwijs aan te vullen. In de commerciële en militaire context echter worden digitale leerobjecten over het algemeen gebruikt in de context van e-leren (zelfstudie of tijd- en plaatsonafhankelijk leren, digitaal ondersteund). Hoewel men bij dit e-leren wel ondersteuning kan krijgen wordt in deze situatie aangenomen dat er geen docenten of medestudenten betrokken zijn in het onderwijsproces. De taken van de docent worden overgenomen door het leerobject.

Een ander belangrijk element van leerobjecten gezien vanuit het menselijke perspectief is bruikbaarheid. Bruikbaarheid heeft betrekking op consistentie, toepasbaarheid als leermateriaal, de mogelijkheid waarop het de gebruiker ondersteuning biedt bij het vermijden van fouten, het gemak om zich te herinneren hoe het leerobject gebruikt kan worden en de aantrekkelijkheid van het leerobject (presentatiestijl, taalgebruik, toon en visuele aspecten).

Ook metadata blijkt verschillende betekenissen te hebben binnen verschillende contexten. Binnen de universitaire context zullen metadata gerelateerd worden aan de manier waarop de docent zijn met eigen bestanden omgaat. In de commerciële sector worden de metadata gerelateerd aan het competentiekader van de organisatie. In de militaire context hebben de metadata vaak betrekking op technische eigenschappen van beelden en andere details in relatie tot de plaats van een leerobject in een handboek.

In Hoofdstuk 2 wordt verder een aantal extra aspecten beschreven die betrekking hebben op leerobjecten gezien vanuit het menselijk perspectief. Deze aspecten zijn uitbreidingen op de eerste onderzoeksvraag. Daarom worden er zes secundaire onderzoeksvragen vanuit het menselijke perspectief geïdentificeerd. Deze secundaire onderzoeksvragen dragen bij in de verduidelijking van de onderzoeksvragen en hebben betrekking op de organisatorische context, onderwijsbenaderingen, het creëren van leerobjecten, ondersteuning van de gebruiker en op metadata. Deze vragen zullen door het uitvoeren van de projecten zoals beschreven in de Hoofdstukken 5, 6 en 7 worden beantwoord.

Hoofdstuk 3 geeft een conceptueel overzicht, een analyse en een literatuuroverzicht gericht op de technische aspecten. Vanuit het technische perspectief zijn de belangrijkste elementen de definitie van een leerobject, kwesties met betrekking tot granulariteit, metadata en standaarden en toepassingen en technologieën. Vanuit een technisch perspectief kan een leerobject worden beschreven als een eenheid, digitaal of niet digitaal, dat kan worden gebruikt voor het leren, onderwijs of opleiding. Deze definitie van IEEE/LOM wordt gebruikt voor dit onderzoek maar met het belangrijke verschil dat het "niet digitale" soort materiaal niet in het onderzoek wordt meegenomen. Het bespreken van leerobjecten vanuit een technisch perspectief houdt rekening met aggregatieniveaus en granulariteit van het leerobject, omdat de grootte van een leerobject niet is opgenomen in de definities, maar granulariteit wel een rol speelt tijdens de uitwisseling van materiaal.

In relatie tot metadata vanuit een technisch perspectief worden twee definities gebruikt:

> *Metadata is informatie over een object, fysiek of digitaal. Omdat zowel het aantal objecten als de behoefte aan leermateriaal exponentieel groeit en tegelijkertijd de informatie of de metadata over objecten ontbreekt, wordt de mogelijkheid om materiaal te vinden, beheren en te gebruiken beperkt (LTSC, 2002).*
>
> *Het doel van metadata (data over data) is het geven van een algemene structuur dat het mogelijk maakt dat leermaterialen worden beschreven op een consistente manier. Metadata kunnen worden verzameld in catalogi en kunnen direct worden samengesteld met het leerobject dat ze beschrijven. Leermateriaal die beschreven zijn met metadata kunnen systematisch worden gezocht en gevonden voor gebruik en hergebruik (Dodds, 2001b).*

Naast metadata is standaarden een belangrijk element vanuit het technisch perspectief. Standaarden zijn ontwikkeld met het doel uitwisselbaarheid en interoperabiliteit tussen systemen mogelijk te maken. Verschillende organisaties werken aan de ontwikkeling van standaarden die gerelateerd zijn aan leertechnologie en een aantal van hen werken samen. Twee belangrijke standaardisatie-organisaties zijn het Institute of Electrical and Electronics Engineers (IEEE) werkgroep Learning Technology Standards Committee (LTSC) and de Advanced Distributed Learning group (ADL) developing ADL SCORM – the Sharable Content Object Reference Model.

Standaarden kunnen ontwikkeld worden op twee manieren: (a) ontwikkeling door een officieel standaardisatie instituut zoals het International Standardization Organization (ISO) of het IEEE, of (b) ontwikkeling van een standaard zonder de hulp van een standaardisatie instituut. Het succes van de standaard kan gemeten worden door het aantal mensen dat de standaard gebruikt.

Vier verschillende typen van technologie, systemen en toepassingen kunnen worden onderscheiden om leerobjecten te maken, te bewerken, te beheren, te onderhouden en te gebruiken in verschillende organisatorische contexten. Om leerobjecten te maken of te verkrijgen kunnen *auteursomgevingen* worden gebruikt. Deze auteursomgevingen variëren in complexiteit, mogelijkheden en benodigde vaardigheden van de gebruiker. Wanneer leerobjecten eenmaal zijn verkregen kunnen ze worden opgeslagen in een *Learning Content Management System* (LCMS). Een LCMS kan vergeleken worden met een databank waarin een groot aantal leerobjecten zijn opgeslagen en gestructureerd zijn op een zodanige manier dat gebruikers door middel van de metadata materiaal moeten kunnen vinden. Een *Course Management System* (CMS) kan worden gebruikt om leerobjecten zodanig te structureren dat de leerobjecten een logische volgorde hebben en een consistent gedrag vertonen in een cursus, les of module. De leerobjecten die gebruikt worden kunnen geselecteerd worden uit een LCMS of kunnen direct met een auteursomgeving worden gemaakt. De interactie tussen de leerobjecten en de gebruikers in een cursus wordt gereguleerd door een *Learning Management System* (LMS).

In Hoofdstuk 3 wordt verder een aantal extra aspecten beschreven die betrekking hebben op leerobjecten gezien vanuit het technisch perspectief. Deze aspecten zijn uitbreidingen op de tweede onderzoeksvraag. Daarom worden er drie secundaire onderzoeksvragen vanuit het technisch perspectief geïdentificeerd. Deze secundaire onderzoeksvragen dragen bij in de verduidelijking van de onderzoeksvragen en hebben betrekking op granulariteit, standaarden, toepassingen en systemen. Deze vragen zullen door het uitvoeren van de projecten zoals beschreven worden in de Hoofdstukken 5, 6 en 7 beantwoord.

Hoofdstuk 4 beschrijft de methodologie die de drie taken binnen het onderzoek ondersteunt. Deze taken zijn het valideren van de gezichtspunten uit de literatuur in de praktijk, het uitleggen van gebruikerservaringen en het testen van procedures en vereisten die zullen leiden tot een succesvol gebruik van leerobjecten in verschillende contexten. De methodologie die gekozen is om deze taken uit te voeren is Action Research. Action Research (AR) maakt deel uit van de case study benadering, maar kan worden gezien als een bijzondere vorm: binnen AR kunnen wel case studies uitgevoerd worden, maar binnen de case study benadering hoeft geen AR uitgevoerd te worden.

AR richt zich op het oplossen van praktische problemen van mensen in een directe probleemsituatie. Dit betekent dat er zowel een systeem op zich bestudeerd wordt, maar ook wordt samengewerkt met mensen binnen dat systeem richting de gewenste oplossing. Om dit te bereiken is het nodig dat er een actieve samenwerking is tussen onderzoeker en klant. Dit betekent dat het belangrijkste kenmerk van AR is dat de onderzoeker interventies kan uitvoeren op een zodanige manier, dat het voordelig is voor de organisatie. Daarom wordt AR gebruikt in bestaande situaties en niet in experimentele onderzoeken. Vaak wordt AR uitgevoerd door academici die uitgenodigd worden door besluitvormers van een organisatie die zelf de methodologische kennis niet in huis hebben. Dit is ook het geval in het onderzoek dat in deze dissertatie wordt beschreven. De rol van de onderzoeker was de methode van AR op een dergelijke manier uit te voeren om te komen tot een wederzijds voldoende resultaat voor alle deelnemers, inclusief een continuering van het proces door de organisatie. Om dit te verwezenlijken heeft de onderzoeker verschillende rollen in diverse stadia van het proces vervult: de rollen van ontwikkelaar, ontwerper, analist en interviewer.

Action Research staat verschillende type van onderzoeksmiddelen toe. In dit onderzoek werden verscheidene methodologieën gebruikt voor gegevensverzameling in de projecten, zoals een literatuurstudie, een gestructureerd interview met een vragenlijst, een ongestructureerd interview, log-file analyse en analyse van cursusmateriaal. De belangrijkste methode voor gegevensverzameling in de drie contexten was de vragenlijst en het gestructureerde interview. De vragenlijsten werden ingevuld tijdens het interview en werd ondersteund door een demonstratie van hergebruikmogelijkheden het TeleTOP® CMS. Tijdens het gestructureerde interview werden de verschillende functionaliteiten getoond. De hergebruikmogelijkheden van het TeleTOP® CMS werden gebruikt om de gebruikers een idee te geven van wat bedoeld werd met concepten zoals leerobjecten, hergebruik, labelling, en leermateriaal. Ook het gebruik van taxonomieën, zoeken en LOM maakte deel uit van de demonstratie om praktische voorbeelden te geven en de gebruikers van hun eigen hergebruikmogelijkheden bewust te maken. Naast de mogelijkheden werden ook problemen belicht tijdens de demonstratie. Het gestructureerde interview duurde meer dan 90 minuten vanwege de demonstraties. De resultaten van de vragenlijsten werden gegroepeerd rondom thema's die als belangrijk werden gezien. Elk thema werd gerelateerd aan een reeks vragen uit de vragenlijst. De resultaten van de AR-benadering, inclusief de interviews en de vragenlijsten, worden beschreven in Hoofdstukken 5, 6 en 7.

Hoofdstuk 5 beschrijft de projecten en de resultaten binnen de universitaire context. Drie projecten maakten deel uit van het onderzoek. De nadruk in twee van de projecten, uitgevoerd bij de Universiteit Twente, lag op het hergebruik en de uitwisseling van materiaal. Het derde project had betrekking op de ontwikkeling van een richtlijn voor metadata binnen de Digitale Universiteit.

De twee projecten binnen de universitaire context vonden plaats bij de Universiteit Twente. De Universiteit Twente (UT), opgericht in 1961, is een internationaal georiënteerde universiteit voor zowel technisch als sociaal wetenschappelijk onderwijs en onderzoek. De UT streeft naar kennisoverdracht in de maatschappij en heeft de opdracht om bij te dragen tot technologische en sociale innovatie, in nauwe samenwerking met openbare en particuliere partijen. In Nederland is de UT betrokken bij innovaties in termen van ICT, infrastructuur en onderzoek en is een lid van de Digitale Universiteit.

Het eerste project dat wordt beschreven is het Project TeleTOP® bij de universiteit. Dit project beschrijft hoe de functionaliteiten voor hergebruik binnen het TeleTOP® CMS werden ontwikkeld, waarbij het gebruik van metadata en ADL SCORM specificaties deel uit maakten van de ontwikkeling van TeleTOP®. Het project beschrijft ook de implementatie van het TeleTOP® CMS op de Universiteit Twente en hoe hergebruik binnen deze context werd georganiseerd.

Het tweede project binnen de universitaire context is het Alpha-Bèta project uitgevoerd in opdracht van de Stichting SURF. Dit project concentreerde zich op hergebruik en de implementatie van standaarden voor leertechnologie en werd uitgevoerd binnen de context van de Faculteit Toegepaste Onderwijskunde, omdat de ontwikkeling van het TeleTOP® CMS daar plaats vond. De ontwikkelde functionaliteiten werd ook getest in deze context. De projectopdracht was tweeledig. Het eerste onderzoek richtte zich op de vraag of het TeleTOP® CMS in plaats van op een technische universiteit ook op een sociaal-wetenschappelijke universiteit zoals Leiden in de Faculteit Rechten zou kunnen worden gebruikt. Het tweede deel van het project concentreerde zich op de mogelijkheden om materiaal te hergebruiken door middel van standaarden voor leertechnologie. De verschillende functionaliteiten voor hergebruik van leermateriaal werden ontwikkeld binnen het TeleTOP® systeem. De functionaliteiten die voor het Alpha-Bèta project zijn ontwikkeld zijn gebaseerd op de specificaties ADL SCORM 1.1. Hoewel de implementatie van de specificaties een succes was, vond geen daadwerkelijk hergebruik met andere systemen plaats omdat er geen andere systemen beschikbaar waren met de benodigde functionaliteiten voor hergebruik.

Het derde project in de universitaire context was het Metadata Richtlijn project van de Digitale Universiteit. De Digitale Universiteit (DU), een consortium van 10 Nederlandse instellingen voor Hoger Onderwijs, initieerde een project om een metadata richtlijn voor haar consortiumleden te definiëren. Een richtlijn van hoe de metadata in bepaalde contexten kan worden gebruikt, wordt ook wel een applicatieprofiel genoemd. Een applicatieprofiel is een specificatie voor verschillende systemen en bevat reeksen woordenlijsten die voor het toevoegen van metadata aan leerobjecten kan worden gebruikt. Voor verschillende metadata-elementen is een woordenlijst gedefinieerd. Het project leverde een handboek op met richtlijnen hoe metadata kan worden gebruikt binnen de DU context en welke woordenlijsten gebruikt kunnen worden. De richtlijn dient als handboek voor ontwikkelaars in verschillende projecten om hen te ondersteunen in het maken van consistente en uitwisselbare metadata.

Hoofdstuk 6 beschrijft de projecten en de eerste resultaten binnen de commerciële context. Drie projecten maakten deel uit van het onderzoek. Deze projecten werden uitgevoerd binnen het Shell Learning Centre voor Exploratie en Productie (Shell EP Learning Center) in Noordwijkerhout, Nederland. In 2000 begon het Shell EP Learning Center met het aanbieden van een combinatie van diensten om verschillende nieuwe onderwijsvormen te ondersteunen. Dit werd gerealiseerd door gebruik te maken van de Shell EP competentie structuur en het aanbieden van tijd en plaats onafhankelijke e-modules en “blended learning” als toevoeging op klassikaal onderwijs gebaseerd op de missende competenties van de lerenden. De projecten binnen het Shell EP Learning Center zijn gebruikt voor het onderzoek.

Het eerste project in de commerciële context is de Implementatie TeleTOP® bij het Shell EP Learning Center. Het gebruik van TeleTOP® en hoe hergebruik van materiaal binnen dit systeem de strategieën voor leren beïnvloedt maakte deel uit van het project. Daarbij werd gekeken naar de manier waarop de implementatie van het TeleTOP® CMS plaatsvond en hoe de functionaliteiten voor het maken van cursusmateriaal werd ondersteund. De behoefte aan hergebruik, de aangeboden functionaliteiten en hoe het curriculum is gestructureerd had invloed op hergebruikaspecten. De toepassingen en de functionaliteiten voor hergebruik werden hoofdzakelijk ontwikkeld om de cursusontwikkelaars te steunen. Het project concentreerde zich op de behoeften van de cursusontwikkelaars tijdens de implementatie van TeleTOP® voor blended learning. Dit omvatte ook het herontwerp van verschillende TeleTOP® functionaliteiten binnen de commerciële context. Voor het gebruik van modules voor e-leren werden specificaties ontwikkeld voor externe cursusontwikkelaars.

Het tweede project in de commerciële context is de TeleTOP®-conversie. Dit project richtte zich op de versieverandering van de universitaire versie naar een commerciële versie van het TeleTOP® CMS voor gebruik binnen het Shell EP Learning Center. De ontwikkeling van de (commerciële) Versie 5 van TeleTOP® begon in januari 2002 en werd uitgevoerd door het ITBE van de Universiteit Twente. Het Shell EP Learning Center gebruikte tot die tijd een onderzoeksversie van het TeleTOP® CMS die volgens een rapid prototyping was ontwikkeld. Redenen om een nieuwe commerciële versie te ontwikkelen was o.a. de interesse van verschillende externe instellingen zoals het Shell EP Learning Center en om inconsistentie en kleine interfaceproblemen op te lossen die tijdens de rapid prototyping fase van het systeem ontstonden. De nieuwe versie werd opnieuw geprogrammeerd op basis van het functionele ontwerp van het originele systeem, waarbij de interface van het originele systeem gehandhaafd werd. Wel veranderde het datamodel dat tijdens de eerste vier versies van TeleTOP® ongewijzigd was gebleven. De verschillen in het datamodel maakten de omzetting tot een moeilijke taak, omdat alle velden van het oude ontwerp en het nieuwe ontwerp in kaart moesten worden gebracht. Belangrijk voor de uitwisseling van data was het gebruik van standaarden binnen dit proces. Een probleem bij de conversie was het feit dat sommige cursussen nog actief waren.

Het derde project in de commerciële context was het Shell EP Knowledge-Sharing Project. Dit project is uitgevoerd in een bredere context waarbij verschillende locaties zoals NAM in Assen, Shell in Rijswijk, en het Shell EP Learning Center in Noordwijkerhout betrokken zijn. Het project richt zich op de integratie van kennismanagement en leren. Deze integratie begon met het samenvoegen van de afdelingen Leren en Kennismanagement in de nieuwe afdeling Learning Leadership and Development (LLD). Het Knowledge-Sharing Project was een direct resultaat van deze fusie. Om de integratie van kennismanagement en cursus-gebaseerd leren te bevorderen is het hergebruik van materiaal een zeer belangrijk aspect. Daarom werd materiaal uit de onderwijspraktijk dat werd gezien als erg waardevol om opnieuw te gebruiken in de nabije toekomst voor leeractiviteiten gedigitaliseerd. De materialen die in verschillende kennismanagement activiteiten worden gebruikt hebben dezelfde hoge potentiële waarde voor leren en zijn ook geschikt voor hergebruik. Het project richt zich op strategieën om hergebruik tussen de verschillende huidige systemen mogelijk te maken door middel van standaarden. Binnen de organisatie werd daarom een inventarisatie uitgevoerd om te zien welke bestaande systemen voor kennismanagement werden gebruikt, of materiaal van verschillende databases kan worden hergebruikt en wat nodig is om dit hergebruik te ondersteunen.

Hoofdstuk 7 beschrijft projecten en resultaten binnen de militaire context. Vier projecten maakten deel uit van het onderzoek. Deze projecten werden uitgevoerd bij de Nederlandse Defensie en maakten deel uit van projecten die geïnitieerd werden door TNO (de Nederlands Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek). De projecten richtten zich met name op de implementatie en ontwikkeling van en ervaringen met de huidige standaarden voor leertechnologie.

Het eerste project in de militaire context vond plaats binnen de Koninklijke Luchtmacht (Royal Netherlands Airforce, RNLAF) door middel van een pilot met ADL SCORM. Vanwege het gebrek aan ervaring met ADL SCORM LMS-en en de verwachtte interesse in de toekomst voor dit soort systemen werd de functionaliteit van een dergelijk LMS getest. Dit project concentreerde zich daarom op twee aspecten: ervaring opdoen met een op ADL SCORM gebaseerd LMS en ervaring opdoen met de implementatie van ADL SCORM in bestaande Computer-Based Training (CBT)-cursussen. Het materiaal gebaseerd op ADL SCORM dat in het LMS werd getest kwam uit zelfontwikkeld materiaal en uit voorbeeldcursussen van ADL. Het project werd uitgevoerd om te zien hoe een ADL SCORM cursus zich gedraagt binnen een militaire context, gericht op de volgende punten:

- Technische implicaties
- Beveiliging van geclassificeerd materiaal
- Mogelijkheden voor het zoeken van gegevens
- Mogelijkheden voor de integratie in een groot bedrijf
- Verbindingssnelheid
- Rapportagemogelijkheden
- Gedrag van op ADL SCORM gebaseerde cursussen.

Voor het project werden twee cursussen geselecteerd om te zien of ADL SCORM kon worden toegepast. De keuze voor de twee cursussen was gebaseerd op hun complexiteit en structuur. De cursus "Rangen en Standen" werd geselecteerd als eenvoudige cursus met weinig interactie, bijna geen gebruik van multimedia, en een totale cursusduur van 4 uur. Een complexere cursus in termen van structuur, interactie, gebruik van multimedia, en een totale cursusduur van 20 uur was de cursus "Vliegtuigherkenning". Het LMS werd getest met reeds bestaande cursussen die volgens de specificaties ADL SCORM zijn herontworpen.

Het tweede project in de militaire context is het LCMS-Project. Dit project werd geïnitieerd om het gebruik van LCMS-en voor de ontwikkeling van CBT te onderzoeken. De belangrijkste aspecten die binnen het LCMS-project die voor het onderzoek belangrijk waren zijn:

- De ontwikkeling van een LCMS voor de RNLAF en de Koninklijke Landmacht (Royal Netherlands Army, RNLA) en toepassingen om materiaal beschikbaar te maken voor cursusontwikkelaars.
- De implementatie van ADL SCORM specificaties in een LCMS. De ontwikkeling van classificaties en de identificatie van lijsten met bruikbare sleutelwoorden.

Vanwege de verwachte toekomstige ontwikkelingen met betrekking tot standaarden voor leertechnologie voor hergebruik van leerobjecten werd een LCMS gebruikt binnen de RNLAF en RNLA om een inventarisatie te kunnen maken. De vereisten voor de ontwikkeling van een LCMS waren gebaseerd op zowel de specificaties van ADL SCORM als op de onderwijsbenaderingen die binnen de RNLAF en RNLA worden gebruikt zoals het gebruik van CBT binnen interne opleidingen en trainingen. Om grip te krijgen op de wijdverspreide ontwikkelingen in productie van CBT en om het productieproces te optimaliseren, standaardiseert defensie zowel de methodologie als het cursusmateriaal voor de ontwikkeling van CBT. Het standaardiseren van de methodologie en de ontwikkeling van cursusmateriaal legt de nadruk op programmatuur waarmee het cursusmateriaal wordt ontwikkeld. Het gebruik van templates tijdens de ontwikkeling van multimediaal cursusmateriaal en het gebruik van een LCMS voor cursusmateriaal maakt deel uit van de standaardisatie. Het gebruik van standaarden is gerelateerd aan aspecten met betrekking tot functionaliteit, bruikbaarheid, en technische aspecten. Daarom lag de nadruk van het onderzoek tijdens het LCMS project op het gebruik van de standaarden voor metadata en hoe die konden worden gebruikt om materiaal te zoeken en op te slaan in een LCMS.

Het derde project in de militaire context is de implementatie van ADL SCORM in het IMAT (Integrating Manuals and Training [Integratie van handleidingen en trainingen]) systeem. Het doel van dit project was te beschrijven hoe de ADL SCORM specificaties in een bestaand systeem kunnen worden uitgevoerd zoals IMAT. IMAT is een systeem dat het mogelijk maakt om technische handboeken te fragmenteren voor gebruik als leermateriaal. Het project was bedoeld om te onderzoeken of het gefragmenteerde materiaal uit IMAT zou kunnen worden gebruikt als leerobjecten die gedefinieerd zijn volgens ADL SCORM specificaties. Het IMAT-datamodel werd vergeleken met de specificaties van ADL SCORM en de elementen binnen het IMAT-datamodel werden gerelateerd aan de elementen binnen het ADL SCORM datamodel. Binnen het onderzoek werden de elementen binnen IMAT ook gerelateerd aan of omgezet in de verplichte elementen van het ADL SCORM datamodel. De ontbrekende elementen werden geconstrueerd op basis van vergelijkbare elementen binnen IMAT. Ook werd het gebruik van het ADL runtime-model onderzocht en werden aanbevelingen gegeven om een dergelijk runtime-model toe te passen voor het IMAT systeem. Naast functionaliteiten om hergebruik te ondersteunen is ook een database in het IMAT systeem aanwezig om materiaal op te slaan en uit te wisselen. Het materiaal werd verkregen uit technische handboeken zoals die door fabrikanten wordt aangeleverd. De handboeken zijn opgedeeld in kleine fragmenten met een homogene inhoud. De inhoud wordt opgeslagen in de database op een zodanige manier dat het kan worden terug gevonden om CBT cursusmateriaal te ontwikkelen met behulp van auteursomgevingen. Tijdens het project werd een inventarisatie gemaakt van de gebruikers van IMAT. De inventarisatie van het IMAT systeem was een wezenlijk onderdeel van het project omdat het datamodel van IMAT te beperkt was voor een volledige implementatie. De inventarisatie gaf inzicht en informatie over hoe de verschillende elementen in het IMAT datamodel moesten worden geïnterpreteerd. De inventarisatie concentreerde zich op de verschillen in gebruikers, de kenmerken van het materiaal, en de gebruikte scenario's voor leren.

Het vierde project binnen de militaire context is uitgevoerd binnen het KIM (Koninklijk Instituut voor de Marine). Het project binnen het KIM beschrijft een afwijkende situatie binnen de militaire context en concentreert zich op leren zoals dat in het hoger onderwijs gebruikelijk is. Het KIM is gestationeerd in Den Helder en de hoofdtaken richten zich op de opleiding van officieren en het uitvoeren van onderzoek voor de marine.

Hoewel het KIM een militaire context is, zijn de onderwijsontwikkelingen en de organisatie nauw verwant met de universitaire context van Nederland. De ontwikkeling van het KIM aan het begin van de negentiende eeuw was reeds op wetenschappelijk niveau en in 1963 werd het KIM een universitaire status verleend. De cursussen op het KIM variëren van praktische training tot wetenschappelijk onderwijs. Het academische deel van het onderwijs wordt georganiseerd binnen faculteiten. De praktische training concentreert zich op de competenties die nodig zijn om binnen de vloot te kunnen functioneren. De verschillende componenten binnen de training vereisen voor elk aspect een bepaalde didactische benadering. Dit betekent dat de onderwijsmiddelen en het type van onderwijs in het KIM verschilt van andere militaire opleidingssituaties. Eén van de onderwijsmiddelen was het TeleTOP® CMS dat als pilot binnen het KIM gedurende 1999 gebruikt werd. Gebaseerd op de ervaringen met TeleTOP® en potentiële mogelijkheden voor hergebruik werden de instructeurs van het KIM geïnterviewd en werd er geïnventariseerd welke onderwijsbenaderingen en -middelen gebruikt werden.

De resultaten van het onderzoek van de projecten in de universitaire, commerciële, en militaire contexten zijn beschreven in Hoofdstuk 8. Gebaseerd op de menselijke perspectieven en de technische perspectieven en de gerelateerde onderzoeksvragen, geeft dit hoofdstuk een synthese met antwoorden op de onderzoeksvragen.

De eerste hoofdvraag richt zich op het menselijke perspectief: *Welke menselijke perspectieven zijn belangrijk om de verschillende stadia van de levenscyclus van een leerobject te ondersteunen?* De resultaten van het onderzoek tonen aan dat er vergelijkbare benaderingen zijn in de verschillende contexten voor een strategie voor hergebruik. Alle drie de organisaties denken dat hergebruik belangrijk is en de besluitvormers ondersteunen onderzoek op dit gebied. De opzet van de onderzoeksprogramma's verschilt wel fundamenteel in elke context. Dit betekent dat de onderliggende cultuur in elke specifieke context bepaald hoe hergebruik gewaardeerd wordt.

De strategie in elke organisatie richt zich voornamelijk op vernieuwing van onderwijsbenaderingen, inclusief het hergebruik van onderwijsmateriaal. Hoewel de vernieuwing van onderwijsbenaderingen in de verschillende contexten wordt gestimuleerd, is ondersteuning voor het hergebruik van materiaal voor docenten, instructeurs en cursusontwikkelaars niet voldoende beschikbaar. Ook de toepassingen die nodig zijn voor docenten om hergebruik te ondersteunen zijn nog niet op grote schaal aanwezig. Daarnaast is hergebruik vaak nog steeds een individuele activiteit die vooral wordt uitgevoerd door de docent, instructeur of cursusontwikkelaar. De middelen om materiaal in een bredere context uit te wisselen zijn nog niet beschikbaar. Op basis van deze resultaten kan geconcludeerd worden dat het hergebruik binnen het onderwijs wordt bepaald door de context: een specifieke context bepaalt de gekozen onderwijsbenadering, deze onderwijsbenadering bepaalt de leerdoelen en deze leerdoelen bepalen het type van hergebruik.

In de universitaire context, de militaire context en gedeeltelijk in de commerciële context wordt cursusmateriaal verzameld uit verschillende bronnen. Het materiaal wordt geselecteerd door de instructeurs en de cursusontwikkelaars. De domeindeskundige en de cursusontwikkelaar bepalen de structuur van de cursus en de kwaliteit van het geselecteerde materiaal. Op basis hiervan kan worden geconcludeerd dat de rollen voor de ontwikkeling van cursusmateriaal worden bepaald door de context.

De ondersteuning voor gebruikers in de universitaire context en in de commerciële context is centraal georganiseerd. De ondersteuning voor gebruikers is tijdens de implementatie van een nieuw systeem beschikbaar en richt zich op verschillende aspecten van e-leren zoals technische en onderwijskundige ondersteuning. De ondersteuning in de militaire context richt zich vooral op cursusontwikkelaars door middel van onderzoeksprojecten. Het type ondersteuning dat wordt gegeven hangt af van de beschikbare middelen en hoe de organisatie daarmee omgaat. De ontwikkelaars van het cursusmateriaal beslissen zelf over de kwaliteit van het materiaal. Uit de resultaten komt naar voren dat de specifieke context de onderwijsbenadering bepaalt en dat de gekozen onderwijsbenadering het type leermateriaal bepaalt en daardoor ook de interactie binnen dit materiaal. De ontwikkelaars van het materiaal bepalen de kwaliteit en de herbruikbaarheid hiervan.

Uit het onderzoek blijkt verder dat alledrie de contexten bezig zijn met de toepassing van specificaties voor metadata. Ook worden classificaties voor metadata ontwikkeld in de verschillende projecten. De toepassing van metadata voor het hergebruiken van materiaal in de diverse projecten hangt af van de strategie binnen de organisatie of van individuele motivatie.

De tweede hoofdvraag richt zich op het technische perspectief: *Welke toepassingen en technologieën zijn belangrijk om de verschillende stadia van de levenscyclus van een leerobject te ondersteunen?* De resultaten van het onderzoek tonen aan dat vanuit het technisch perspectief de benaderingen van de verschillende contexten voor hergebruik variëren. Een voorbeeld daarvan is de granulariteit van leerobjecten die door verschillende auteurssystemen wordt bepaald. Het gebruik van auteurssystemen bepaalt wat de grootte van de objecten zijn en hoe zij kunnen worden hergebruikt. De toepassing van gecertificeerde standaarden voor hergebruik wordt in sommige situaties als bruikbaar gezien. Binnen de commerciële context worden de standaarden echter door de organisatie zelf bepaald, aangezien de huidige standaarden voor leertechnologie nog niet worden gezien als volwaardige standaarden die in de behoeften van een dergelijke organisatie voorzien. Men verwacht wel dat standaarden zoals ADL SCORM worden geïmplementeerd door leveranciers zodat deze in de toekomst te gebruiken zijn. Hieruit kan afgeleid worden dat de uitwisseling van leerobjecten afhangt van hoe ze ontwikkeld zijn. Het hergebruik van de leerobjecten hangt af van hun specifieke ontwerp en de mogelijkheid om de objecten aan te passen in verschillende auteursystemen.

In de drie contexten worden vergelijkbare toepassingen gebruikt om objecten te maken en te bewerken. De specificaties van de uiteindelijke leerobjecten hangen nauw samen met de beschikbare toepassingen. Uit de resultaten blijkt dat de specificaties van leerobjecten door de context worden bepaald: de context bepaalt de onderwijsbenadering, de onderwijsbenadering bepaalt welk type cursusmateriaal ontwikkeld moet worden en het type materiaal bepaald welke toepassing voor het ontwikkelen van het materiaal gebruikt gaat worden. De gekozen toepassing heeft consequenties voor de technische aspecten van het ontwikkelde leerobject en deze hebben weer consequenties voor de interactie van de lerende met het leerobject.

In de drie verschillende contexten wordt een CMS gebruikt om het hergebruik van materiaal mogelijk te maken. CMS-en die in de universitaire en de commerciële context worden gebruikt kunnen als grote databases worden gezien die grote hoeveelheden waardevol materiaal bevatten. De toepassing van standaarden voor hergebruik maakt het mogelijk om materiaal uit te wisselen tussen andere cursussen, universiteiten en bedrijven. Waar het materiaal wordt opgeslagen hangt af van de strategie van de organisatie. Wanneer hergebruik deel van deze strategie uitmaakt kan een LCMS worden geïnstalleerd dat kan worden gebruikt om materiaal op te slaan dat op vooraf bepaalde taxonomieën wordt gebaseerd. Hieruit blijkt dat de plaats waar de leerobjecten worden opgeslagen en hoe ze worden ingedeeld op basis van taxonomieën wordt bepaald door de context.

De derde hoofdvraag van het onderzoek is: *Wat zijn de belangrijkste aspecten bij het begeleiden van gebruikers bij de selectie van toepassingen, technologieën en activiteiten om de verschillende stadia van de levenscyclus van een leerobject in verschillende gebruikscontext te ondersteunen, in het bijzonder de universitaire, de commerciële en de militaire context?* Bij het beantwoorden van deze vraag bleek dat de levenscyclus van een leerobject een belangrijke component is in de onderzoeksvragen. De levenscyclus helpt om de contexten en de projecten met elkaar te vergelijken. Het gebruik van een lineair model van de levenscyclus maakte echter duidelijk dat dit niet in alle projecten even goed toepasbaar was. Het bleek dat er verschillen waren in de manier waarop hergebruik van leerobjecten voorkomt in de verschillende onderwijsbenaderingen. Door de verschillen in hergebruik kan de volgorde en de stadia binnen de levenscyclus van een leerobject ter discussie worden gesteld: de volgorde van de stadia blijkt niet altijd hetzelfde te zijn en sommige stadia kunnen voor bepaalde situaties niet relevant zijn. De belangrijkste verandering in het model is daarom de volgorde van de stadia en de gevolgen die dit voor het toevoegen van metadata heeft. Bijvoorbeeld: het toevoegen van metadata aan een object voordat het is gebruikt kan moeilijk en tijdrovend zijn. Wanneer het materiaal is gebruikt in een bepaalde onderwijssituatie dan kan een groot gedeelte van de metadata worden onttrokken aan bijvoorbeeld het soort gebruik, de gebruiker, de gerelateerde taken, de doelgroep, de onderwijsbenadering, het gebruikte platform, de gerelateerde categorieën, de beschrijving, de titel en ander gerelateerd materiaal. Een andere opmerking kan gemaakt worden over kwaliteitszorg. Kwaliteitszorg is geen afzonderlijk stadium in de levenscyclus van een leerobject. De kwaliteitszorg is één van de taken van de cursusontwikkelaars en impliceert acties in elk van de verschillende stadia.

In de vorige hoofdstukken werd de context gedefinieerd als een organisatie, zoals een universiteit, een commerciële instelling, of defensie. De resultaten in Hoofdstuk 8 toonden aan dat strategieën voor hergebruik niet verschillen in de organisatorische context als geheel, maar in dimensies die in alle drie de contexten aanwezig zijn en daarbinnen variëren. Met andere woorden: strategieën voor hergebruik hangt meer af van verschillende interne dimensies dan van de indeling universiteit – commercieel - defensie. Dit wordt verder uitgewerkt in Hoofdstuk 9.

In Hoofdstuk 9 wordt beargumenteerd dat er verschillen en overeenkomsten zijn tussen de universitaire, de commerciële en de militaire context, maar dat er ook verschillende dimensies kunnen worden geïdentificeerd in termen van context. Een combinatie van 16 dimensies vormen een model met bipolaire eindwaarden die elk een waarde hebben die uitersten van een context definiëren: "Systeem georiënteerd" en "Persoonlijk georiënteerd". Het eindpunt aan de linkerkant van de dimensies is systeem georiënteerd en het eindpunt aan de rechterkant is persoonlijk gerelateerd. De systeem georiënteerde kant richt zich op technische specificaties, regels, beleid en procedures als belangrijkste kenmerken en de persoonlijk georiënteerde kant richt zich op menselijke interactie, persoonlijke behoeften, persoonlijke motivatie en persoonlijke waarden. De twee oriëntaties kunnen worden gezien als eindpunten van elke afmeting, maar ook waarden tussen de eindpunten kunnen aangeven hoe een bepaalde dimensie kan worden geïnterpreteerd. Gebaseerd op de oorspronkelijke combinatie van de 16 dimensies werd een set van vijf dimensies gekozen die als hulpmiddel kunnen worden gebruikt om te bepalen hoe de verschillende dimensies zich tot elkaar verhouden en zo ondersteuning bieden bij het bepalen van de strategie voor hergebruik. Figuur 192 toont het model gebaseerd op de vijf basisdimensies.

Dimensions	**S**					**P**
Cultures within the context	*The industrial world*	*The Domestic world*	*The Civic world*	*The world of Opinion*	*The Merchant world*	*The world of inspiration*
Learning scenarios	*Acquisition*					*Participation*
Incentives for reuse	*Organisational*					*Personal*
Work processes	*Formal workflow*					*Personal habits*
How learning objects are stored	*Repository*					*Locally*

Figuur 192 De vijf basisdimensies gepresenteerd als model voor Profilering van Leerobjecten in Context

Het model kan worden gebruikt om een bepaalde context te beschrijven waar hergebruik voorkomt. Ook kan het worden gebruikt om te verklaren waarom hergebruik in een bepaalde context een probleem is en kan het voorspellen hoe hergebruik in de toekomst zal plaatsvinden.

Hoofdstuk 9 besluit met een reflectie op het onderzoek en de gekozen methodologie en op het semantische Web als een nieuwe ontwikkeling die cursusontwikkeling kan ondersteunen in de toekomst. De reflectie op het onderzoek heeft geleid tot de volgende algemene opmerkingen:

De resultaten van het onderzoek tonen aan dat hergebruik van leerobjecten zich niet moet richten op brede uitwisseling van al beschikbaar materiaal, maar meer op een lager niveau binnen afdelingen en in het bijzonder op het hergebruik van eigen cursusmateriaal.

Het gebruik van specificaties zoals ADL SCORM hebben misschien niet het verwachte effect op adaptief leren en cursusontwikkeling op basis van leerobjecten uit grote databases zoals verwacht. Ook de specificaties voor "tracking and tracing" zijn misschien niet altijd te gebruiken binnen een onderwijsbenadering in bepaalde contexten. Daarnaast is het gebruik van een volledige reeks metadata om materiaal uit een grote database te selecteren niet altijd nodig of efficiënt.

Hergebruik van materiaal is belangrijk voor individuele gebruikers of voor kennismanagement. Hergebruik van materiaal van collega's die veranderen van baan kan veel tijd besparen en erg efficiënt zijn. Het feit dat kennis van docenten in cursussen wordt opgeslagen die (gedeeltelijk) kunnen worden hergebruikt kan gezien worden als vorm van kennismanagement in grote bedrijven zoals Shell EP of defensie.

Docenten gebruiken een CMS als hulpmiddel om cursusmateriaal te ontwikkelen op hun eigen manier, ondersteund door een persoonlijk georiënteerd systeem. Het gebruiksgemak van de systemen en de vrijheid die de docenten wordt geboden hebben een brede implementatie mogelijk gemaakt. Daarentegen is het gebruik van auteurssystemen zoals Authorware en Easygenerator beperkt tot een groep gespecialiseerde gebruikers, die systeem oriëntatie vertegenwoordigen. De specificaties van ADL SCORM richt zich op deze kleine groep cursusontwikkelaars. De kracht van de specificaties zal in de omvang toenemen wanneer ze meer persoonlijk georiënteerd zijn en worden gebruikt in een meer toegankelijker CMS-en om zo uitwisseling en hergebruik van leerobjecten mogelijk te maken voor de individuele docent.

Hoofdstuk 9 beschrijft tot slot hoe de beschrijvende taak, de verklarende taak, en de voorschrijvende taken van het onderzoek zijn uitgevoerd. De verschillende taken worden duidelijk geïdentificeerd: voor elk project in de drie contexten worden de aspecten beschreven met de vragen Waarom?, Wie?, Wat?, Hoe?, en Waar?. Aan de hand van de levenscyclus van een leerobject en de samenvattingen van de antwoorden op de onderzoeksvragen wordt aangegeven welke aspecten belangrijk zijn voor strategieën voor hergebruik en voor de toepassing van standaarden voor leertechnologie. Het model voor Profilering van Leerobjecten in Context maakt deel uit van de beschrijvende, verklarende en voorschrijvende taken in het onderzoek. De vijf dimensies in het model kunnen worden gebruikt om te voorspellen of een strategie voor hergebruik in een bepaalde context succesvol zal zijn.

Het proefschrift wordt afgesloten, maar de vragen en uitdagingen rondom het hergebruik van leerobjecten zullen blijven bestaan, evenals de controverses die er aan gerelateerd zijn en hoe we hier in de toekomst mee verder gaan.

Curriculum Vitae

Allard Strijker was born in Hoogeveen and raised in Noordscheschut. After finishing secondary education at the Griendtsveen MAVO in Hoogeveen he completed the program for electronic engineering at the MTS in Hoogeveen followed by a study for teacher training in the field of electronic engineering for the Dutch vocational technical schools at the PTH in Zwolle. In 1994 he started at the University of Twente in the Faculty of Educational Science and Technology. He did his final thesis in 1996-1997 for the Department of Instrumentation Technology for which he developed a WWW-based educational environment for the Dutch middle vocational schools. From 1997 to 2000 he worked as Design Consultant Tele-learning for the Faculty of Educational Science and Technology, at the University of Twente. Allard Strijker is the main designer of the TeleTOP WWW-based course-management system, now used not only throughout the faculty but also in the university, other universities and corporate learning contexts. Since 2000 his research has focused on the implementation of learning technology standards for the reuse of learning material in different contexts. For a more-detailed overview of his work and background, see http://users.edte.utwente.nl/strijker.

Appendices

Appendix A: ADL SCORM 2003 application profile

Table 1 SCORM Meta-data Application Profile Requirements (adapted from SCORM, 2003, pp. 3-89)

Name	**Actual element**	**Package**	**Content Aggregation**	**Activity**	**SCO**	**SCA**	**Asset**
1.0 General		O	M	M	M	M	M
1.1 Identifier		O	M	M	M	M	M
1.1.1 Catalog	1	O	M	M	M	M	M
1.1.2 Entry	1	O	M	M	M	M	M
1.2 Title	1	O	M	M	M	M	M
1.3 Language		O	O	O	O	O	O
1.4 Description	1	O	M	M	M	M	M
1.5 Keyword	1	O	M	M	M	M	O
1.6 Coverage		O	O	O	O	O	O
1.7 Structure		O	O	O	O	O	O
1.8 Aggregation Level		O	O	O	O	O	O
2.0 Life Cycle		O	M	M	M	M	O
2.1 Version	1	O	M	M	M	M	O
2.2 Status	1	O	M	M	M	M	O
2.3 Contribute		O	O	O	O	O	O
2.3.1 Role		O	O	O	O	O	O
2.3.2 Entity		O	O	O	O	O	O
2.3.3 Date		O	O	O	O	O	O
3.0 Meta-Metadata		O	M	M	M	M	M
3.1 Identifier		O	M	M	M	M	M
3.1.1 Catalog	1	O	M	M	M	M	M
3.1.2 Entry	1	O	M	M	M	M	M
3.2 Contribute		O	O	O	O	O	O
3.2.1 Role		O	O	O	O	O	O
3.2.2 Entity		O	O	O	O	O	O
3.2.3 Date		O	O	O	O	O	O
3.3 Metadata Scheme	1	O	M	M	M	M	M
3.4 Language		O	O	O	O	O	O
4.0 Technical		O	M	M	M	M	M
4.1 Format	1	O	M	M	M	M	M
4.2 Size		O	O	O	O	O	O
4.3 Location	1	O	M	M	M	M	M
4.4 Requirement		O	O	O	O	O	O
4.4.1 OrComposite		O	O	O	O	O	O
4.4.1.1 Type		O	O	O	O	O	O
4.4.1.2 Name		O	O	O	O	O	O
4.4.1.3 MinimumVersion		O	O	O	O	O	O
4.4.1.4 MaximumVersion		O	O	O	O	O	O
4.5 InstallationRemarks		O	O	O	O	O	O
4.6 Other Platform Requirements		O	O	O	O	O	O
4.7 Duration		O	O	O	O	O	O
5.0 Educational		O	O	O	O	O	O
5.1 Interactivity Type		O	O	O	O	O	O
5.2 Learning Resource Type		O	O	O	O	O	O
5.3 Interactivity Level		O	O	O	O	O	O
5.4 Semantic Density		O	O	O	O	O	O
5.5 Intended End User Role		O	O	O	O	O	O
5.6 Context		O	O	O	O	O	O
5.7 Typical Age Range		O	O	O	O	O	O

5.8 Difficulty		O	O	O	O	O	O
5.9 Typical Learning Time		O	O	O	O	O	O
5.10 Description		O	O	O	O	O	O
5.11 Language		O	O	O	O	O	O
6.0 Rights		O	M	M	M	M	M
6.1 Cost	1	O	M	M	M	M	M
6.2 Copyright and Other Restrictions	1	O	M	M	M	M	M
6.3 Description		O	O	O	O	O	O
7.0 Relation		O	O	O	O	O	O
7.1 Kind		O	O	O	O	O	O
7.2 Resource		O	O	O	O	O	O
7.2.1 Identifier		O	O	O	O	O	O
7.2.1.1 Catalog		O	O	O	O	O	O
7.2.1.2 Entry		O	O	O	O	O	O
7.2.2 Description		O	O	O	O	O	O
8.0 Annotation		O	O	O	O	O	O
8.1 Entity		O	O	O	O	O	O
8.2 Date		O	O	O	O	O	O
8.3 Description		O	O	O	O	O	O
9.0 Classification		O	M	M	M	M	O
9.1 Purpose	1	O	M	M	M	M	O
9.2 Taxon Path		O	O	O	O	O	O
9.2.1 Source		O	O	O	O	O	O
9.2.2 Taxon		O	O	O	O	O	O
9.2.2.1 Id		O	O	O	O	O	O
9.2.2.2 Entry		O	O	O	O	O	O
9.3 Description	1	O	M	M	M	M	O
9.4 Keyword	1	O	M	M	M	M	O

Appendix B: The LOM metadata set

Table 2 All elements defined in LOM (LOM, 2001)

Name
1.0 general
1.1 identifier
1.2 title
1.3 catalogentry
1.3.1 catalog
1.3.2 entry
1.4 language
1.5 description
1.6 keyword
1.7 coverage
1.8 structure
1.9 aggregationlevel
2.0 lifecycle
2.1 version
2.2 status
2.3 contribute
2.3.1 role
2.3.2 centity
2.3.3 date
3.0 metametadata
3.1 identifier
3.2 catalogentry
3.2.1 catalog
3.2.2 entry
3.3 contribute
3.3.1 role
3.3.2 centity
3.3.3 date
3.4 metadatascheme
3.5 language
4.0 technical
4.1 format
4.2 size
4.3 location
4.4 requirement
4.4.1 type
4.4.2 name
4.4.3 minimumversion
4.4.4 maximumversion
4.5 installationremarks
4.6 otherplatformrequirements
4.7 duration
5.0 educational
5.1 interactivitytype
5.2 learningresourcetype
5.3 interactivitylevel
5.4 semanticdensity
5.5 intendedenduserrole
5.6 context
5.7 typicalagerange
5.8 difficulty
5.9 typicallearningtime
5.10 description
5.11 language
6.0 rights
6.1 cost

6.2 copyrightsandotherrestrictions
6.3 description
7.0 relation
7.1 kind
7.2 resource
7.2.1 identifier
7.2.2 description
7.2.3 catalogentry
7.2.3.1 catalog
7.2.3.2 entry
8.0 annotation
8.1 person
8.2 date
8.3 description
9.0 classification
9.1 purpose
9.2 taxonpath
9.2.1 source
9.2.2 taxon
9.2.2.1 id
9.2.2.2 entry
9.3 description
9.4 keyword

Appendix C: The Dublin Core metadata set

Title:	Dublin Core Metadata Element Set, Version 1.0: Reference Description
Date Issued:	1998-09
Identifier:	http://dublincore.org/documents/1998/09/dces/
Supersedes:	Not Applicable
Is Superseded By:	http://dublincore.org/documents/1999/07/02/dces/
Latest version:	http://dublincore.org/documents/dces/
Translations:	http://dublincore.org/resources/translations/
Status of document:	This is a DCMI Recommendation.
Description of document:	This document is the reference description, version 1.0 of the Dublin Core Metadata Element Set. See the DCMI Home Page (http://dublincore.org) for further information about the workshops, reports, working group papers, projects, and new developments concerning the Dublin Core Metadata Element set.

Note: This document has also been published as: Weibel, S.; Kunze, J.; Lagoze, C.; Wolf, M. 1998. Dublin Core Metadata for Resource Discovery. IETF #2413. The Internet Society, September 1998.

1.1 Introduction

This document is the reference description of the Dublin Core Metadata Element Set. See the Dublin Core Home Page (http://dublincore.org) for further information about the workshops, reports, working group papers, projects, and new developments concerning the Dublin Core Metadata Element set.

The current list of elements and their general definitions were finalized in December 1996. The elements and their names are not expected to change substantively from this list, though the application of some of them is currently experimental and subject to varying interpretation from implementation to implementation.

Note that elements have a descriptive name intended to convey a common semantic understanding of the element. To promote global interoperability, a number of the element descriptions may be associated with a controlled vocabulary for the respective element values. It is assumed that other controlled vocabularies will be developed for interoperability within certain local domains. In the element descriptions below, a formal single-word label (expressed in all upper case) is specified to make the syntactic specification of elements simpler for encoding schemes. Each element is optional and repeatable.

Questions or comments regarding the Dublin Core Element Set may be addressed to http://dublincore.org/feedback/dcmiFeedbackServlet.

1.2 Element Descriptions

Title
Label: Title
The name given to the resource, usually by the Creator or Publisher.

Author or Creator
Label: Creator
The person or organization primarily responsible for creating the intellectual content of the resource. For example, authors in the case of written documents, artists, photographers, or illustrators in the case of visual resources.
Subject and Keywords

Label: Subject

The topic of the resource. Typically, subject will be expressed as keywords or phrases that describe the subject or content of the resource. The use of controlled vocabularies and formal classification schemas is encouraged.

Description
Label: Description
A textual description of the content of the resource, including abstracts in the case of document-like objects or content descriptions in the case of visual resources.

Publisher
Label: Publisher
The entity responsible for making the resource available in its present form, such as a publishing house, a university department, or a corporate entity.

Other Contributor
Label: Contributor
A person or organization not specified in a Creator element who has made significant intellectual contributions to the resource but whose contribution is secondary to any person or organization specified in a Creator element (for example, editor, transcriber, and illustrator).

Date
Label: Date
A date associated with the creation or availability of the resource. Recommended best practice is defined in a profile of ISO 8601 (http://www.w3.org/TR/NOTE-datetime) that includes (among others) dates of the forms YYYY and YYYY-MM-DD. In this scheme, the date 1994-11-05 corresponds to November 5, 1994.

Resource Type
Label: Type
The category of the resource, such as home page, novel, poem, working paper, technical report, essay, dictionary. For the sake of interoperability, Type should be selected from an enumerated list that is under development in the workshop series.

Format
Label: Format
The data format and, optionally, dimensions (e.g., size, duration) of the resource. The format is used to identify the software and possibly hardware that might be needed to display or operate the resource. For the sake of interoperability, the format should be selected from an enumerated list that is currently under development in the workshop series.

Resource Identifier
Label: Identifier
A string or number used to uniquely identify the resource. Examples for networked resources include URLs and URNs (when implemented). Other globally-unique identifiers, such as International Standard Book Numbers (ISBN) or other formal names would also be candidates for this element.

Source
Label: Source
Information about a second resource from which the present resource is derived. While it is generally recommended that elements contain information about the present resource only, this element may contain metadata for the second resource when it is considered important for discovery of the present resource.

Language
Label: Language
The language of the intellectual content of the resource. Recommended best practice is defined in RFC 1766 http://info.internet.isi.edu/in-notes/rfc/files/rfc1766.txt

Relation
Label: Relation
An identifier of a second resource and its relationship to the present resource. This element is used to express linkages among related resources. For the sake of interoperability, relationships should be selected from an enumerated list that is currently under development in the workshop series.

Coverage
Label: Coverage
The spatial and/or temporal characteristics of the intellectual content of the resource. Spatial coverage refers to a physical region (e.g., celestial sector) using place names or coordinates (e.g., longitude and latitude). Temporal coverage refers to what the resource is about rather than when it was created or made available (the latter belonging in the Date element). Temporal coverage is typically specified using named time periods (e.g., Neolithic) or the same date/time format (http://www.w3.org/TR/NOTE-datetime) as recommended for the Date element.

Rights Management
Label: Rights
A rights management statement, an identifier that links to a rights management statement, or an identifier that links to a service providing information about rights management for the resource.

Appendix D: All LOM elements related to actors and sources

In Table 3 the following values for content aggregation, SCOs, and Assets are given: M = Mandatory, R = Recommended, and O = Optional.

Table 3 All LOM elements related to actors and sources

Name	Actors	Source	Value	Content Aggregation	SCO	Asset
1.0 general				M	M	M
1.1 identifier				R	R	R
1.2 title	Human	Content	The subject the object	M	M	M
1.3 catalogentry				M	M	O
1.3.1 catalog	Human	Profile	Predefined from profile: Name of the department or organization used. "Teletop catalog"	M	M	O
1.3.2 entry	System	Database	Unique number in database "988080897654"	M	M	O
1.4 language	Human	Profile	The language the material is written in. "English"	O	O	O
1.5 description	Human	Content	A summary of the material or the first 255 caracters of the subject	M	M	M
1.6 keyword	Human	Content / Profile / Taxonomy	The category used to place the material in the environment. Also added with predefined keywords from the profile.	M	M	O
1.7 coverage	Human	Profile / CMS / organization	Based on the type of learning material and the course management used a suitable choice can be made. From the predefined LOM set	O	O	O
1.8 structure	CMS	Profile / CMS / organization	Based on the type of learning material and the course management used a suitable choice can be made. From the predefined LOM set	O	O	O
1.9 aggregationlevel	CMS	Profile / CMS / organization	Based on the type of learning material and the course management used a suitable choice can be made. From the predefined LOM set	O	O	O
2.0 lifecycle				M	M	O
2.1 version	Organization			M	M	O
2.2 status	Organization			M	M	O
2.3 contribute				O	O	O
2.3.1 role	CMS			O	O	O
2.3.2 centity	System			O	O	O
2.3.3 date	System			O	O	O
3.0 metametadata				M	M	M
3.1 identifier				R	R	R
3.2 catalogentry				O	O	O
3.2.1 catalog	Organization		Fixed	O	O	O
3.2.2 entry	System		Variable	O	O	O
3.3 contribute				O	O	O
3.3.1 role	CMS			O	O	O
3.3.2 centity	System			O	O	O
3.3.3 date	System			O	O	O
3.4 metadatascheme	Organization			M	M	M
3.5 language	Human			O	O	O
4.0 technical				M	M	M

4.1 format	System			M	M	M
4.2 size	System			O	O	O
4.3 location	System			M	M	M
4.4 requirement				O	O	O
4.4.1 type	CMS			O	O	O
4.4.2 name	CMS			O	O	O
4.4.3 minimumversion	CMS			O	O	O
4.4.4 maximumversion	CMS			O	O	O
4.5 installationremarks	CMS			O	O	O
4.6 otherplatformrequirements	CMS			O	O	O
4.7 duration	Human	Profile		O	O	O
5.0 educational				O	O	O
5.1 interactivitytype	CMS			O	O	O
5.2 learningresourcetype	CMS			O	O	O
5.3 interactivitylevel				O	O	O
5.4 semanticdensity	Human	Profile/ organization		O	O	O
5.5 intendedenduserrole	CMS			O	O	O
5.6 context	Organization			O	O	O
5.7 typicalagerange	Organization			O	O	O
5.8 difficulty	Organization			O	O	O
5.9 typicallearningtime	CMS			O	O	O
5.10 description	CMS			O	O	O
5.11 language	Human / Profile			O	O	O
6.0 rights				M	M	M
6.1 cost	Organization			M	M	M
6.2 copyrightsandotherrestrictions	Organization			M	M	M
6.3 description	System			O	O	O
7.0 relation				O	O	O
7.1 kind	CMS			O	O	O
7.2 resource				O	O	O
7.2.1 identifier	System	Content		R	R	R
7.2.2 description	System	Content		O	O	O
7.2.3 catalogentry				O	O	O
7.2.3.1 catalog	Organization	Database		O	O	O
7.2.3.2 entry	System			O	O	O
8.0 annotation				O	O	O
8.1 person	CMS			O	O	O
8.2 date	System	LOM		O	O	O
8.3 description	Organization			O	O	O
9.0 classification				M	M	O
9.1 purpose				M	M	O
9.2 taxonpath				O	O	O
9.2.1 source	Organization	Taxon		O	O	O
9.2.2 taxon				O	O	O
9.2.2.1 id	System			O	O	O
9.2.2.2 entry				O	O	O
9.3 description				M	M	O
9.4 keyword				M	M	O

Appendix E: Results of the structured interviews

Table 4 Question results

	Question										
	2	3									
User	Context	Course Material	Subject-matter expert	Course Director	Part of a CD team	Instructor	Participant	Part of a Multimedia	External Course	Part of a Development	Line Manager
U1	University	,	yes	,	,	yes	,	,	,	,	,
U2	University	yes	yes	,	,	yes	,	,	,	,	,
U3	University	,	,	,	,	,	,	,	,	,	,
U4	University	,	,	,	,	yes	,	yes	,	yes	yes
U5	University	,	,	,	,	,	,	,	,	,	,
U6	University	yes	yes	yes	yes	yes	,	yes	,	yes	yes
U7	University	,	yes	,	,	yes	,	,	,	,	,
U8	University	yes	yes	,	,	yes	,	,	,	,	,
U9	University	yes	yes	,	,	yes	,	,	,	,	,
U10	University	yes	yes	,	,	yes	,	,	,	,	,
U11	University	yes	yes	,	,	yes	,	,	,	,	,
U12	University	yes	yes	,	,	yes	,	,	,	,	,
U13	University	yes	yes	,	,	yes	,	,	,	,	,
U14	University	yes	yes	,	,	yes	,	,	,	,	,
C1	Corporate	,	,	yes	,	,	,	,	,	,	,
C2	Corporate	yes	yes	yes	yes	yes	,	,	,	,	,
C3	Corporate	yes	yes	yes	,	yes	,	,	,	,	,
C4	Corporate	yes	yes	yes	,	yes	,	,	,	,	,
C5	Corporate	yes	yes	yes	yes	yes	,	yes	,	yes	,
C6	Corporate	yes	yes	yes	yes	yes	,	,	,	,	,
C7	Corporate	,	,	,	,	,	,	yes	,	yes	,
C8	Corporate	,	,	yes	,	,	,	,	,	,	,
C9	Corporate	yes	,	,	yes	,	,	,	,	yes	,
C10	Corporate	,	,	,	,	,	,	,	,	yes	,
C11	Corporate	,	,	,	,	,	,	yes	,	yes	,
C12	Corporate	yes	yes	yes	,	yes	,	,	,	,	,
C13	Corporate	,	yes	,	,	yes	yes	,	,	,	yes
C14	Corporate	,	,	,	yes	,	,	yes	,	yes	,
C15	Corporate	,	,	,	,	,	,	,	,	yes	,
C16	Corporate	yes	yes	yes	yes	yes	,	,	,	yes	,
C17	Corporate	,	,	,	,	,	,	,	,	yes	,
C18	Corporate	,	,	,	,	,	,	,	,	yes	,
C19	Corporate	,	,	,	,	,	,	,	,	yes	,
C20	Corporate	yes	yes	yes	,	yes	,	,	,	,	,
C21	Corporate	yes	yes	yes	,	yes	,	,	,	,	,
M1	Military	yes	,	,	,	yes	,	,	,	,	,
M2	Military	yes	yes	,	,	yes	,	yes	,	yes	,
M3	Military	yes	yes	,	,	,	,	,	,	yes	,
M4	Military	yes	yes	,	,	yes	,	yes	,	yes	,
M5	Military	,	yes	,	,	yes	,	,	,	,	,
M6	Military	yes	yes	,	,	yes	,	,	,	,	,
M7	Military	,	yes	,	,	,	,	yes	,	yes	,
M8	Military	yes	yes	,	yes	yes	,	,	,	yes	,
M9	Military	yes	yes	yes	yes	yes	yes	,	,	,	,
M10	Military	yes	,	,	,	yes	,	,	,	yes	,
M11	Military	yes	yes	,	,	yes	,	,	,	,	,
M12	Military	yes	yes	yes	,	yes	,	,	,	,	,
M13	Military	,	,	,	,	,	,	,	,	yes	,
M14	Military	yes	,	,	,	yes	,	,	,	,	,
M15	Military	yes	,	,	,	yes	,	,	,	,	,
M16	Military	yes	,	,	,	yes	,	,	,	,	,
M17	Military	,	,	,	,	yes	,	,	,	,	,
M18	Military	yes	yes	,	,	yes	,	yes	,	yes	,
M19	Military	yes	yes	,	,	,	,	yes	,	yes	,
M20	Military	,	,	,	,	,	yes	,	,	,	,
M21	Military	,	yes	,	,	,	yes	,	,	,	,
M22	Military	,	,	,	,	yes	,	,	,	,	,

Table 5 Question results

User	Question					
	4	**5**	**6**	**7**	**8**	**9**
U1	1 year experience	sometimes	twice	sometimes	sometimes	often
U2	3-4 years experience	very often	three times	often	often	very often
U3	1 year experience	very often	three times	almost never	very often	very often
U4	3-4 years experience	very often	twice	sometimes	sometimes	sometimes
U5	3-4 years experience	very often	twice	often	almost never	very often
U6	3-4 years experience	very often	twice	sometimes	sometimes	sometimes
U7	3-4 years experience	very often	more than three times	sometimes	often	very often
U8	3-4 years experience	often	more than three times	sometimes	sometimes	often
U9	3-4 years experience	often	twice	very often	very often	never
U10	3-4 years experience	often	twice	often	often	almost never
U11	3-4 years experience	often	more than three times	often	often	sometimes
U12	3-4 years experience	sometimes	more than three times	sometimes	sometimes	often
U13	3-4 years experience	often	twice	sometimes	sometimes	often
U14	3-4 years experience	very often	more than three times	often	often	often
C1	1 year experience	very often	never	never	never	sometimes
C2	2 years experience	sometimes	twice	sometimes	sometimes	sometimes
C3	1 year experience	often	never	very often	very often	sometimes
C4	2 years experience	often	more than three times	very often	very often	never
C5	2 years experience	often	more than three times	never	never	very often
C6	1 year experience	very often	never	never	never	sometimes
C7	2 years experience	often	once	often	often	very often
C8	1 year experience	very often	twice	almost never	almost never	very often
C9	2 years experience	very often	three times	never	never	sometimes
C10	5-6 years experience	very often	three times	very often	very often	sometimes
C11	5-6 years experience	often	once	sometimes	sometimes	often
C12	1 year experience	sometimes	never	never	never	sometimes
C13	2 years experience	very often	three times	often	sometimes	often
C14	2 years experience	sometimes	once	almost never	almost never	almost never
C15	1 year experience	sometimes	never	never	never	sometimes
C16	2 years experience	often	twice	very often	very often	often
C17	1 year experience	often	once	sometimes	sometimes	sometimes
C18	2 years experience	sometimes	never	,	,	,
C19	7 or more years experience	very often	never	never	never	sometimes
C20	1 year experience	sometimes	never	never	never	sometimes
C21	1 year experience	sometimes	never	never	never	sometimes
M1	5-6 years experience	often	twice	often	sometimes	almost never
M2	no experience	often	three times	very often	sometimes	sometimes
M3	3-4 years experience	often	twice	almost never	very often	often
M4	7 or more years experience	often	once	almost never	almost never	often
M5	5-6 years experience	very often	twice	often	sometimes	almost never
M6	3-4 years experience	very often	three times	very often	sometimes	sometimes
M7	2 years experience	almost never	three times	often	often	sometimes
M8	3-4 years experience	very often	once	very often	sometimes	often
M9	3-4 years experience	almost never	more than three times	very often	very often	sometimes
M10	3-4 years experience	very often	twice	often	often	almost never
M11	2 years experience	never	never	sometimes	sometimes	very often
M12	3-4 years experience	very often	three times	often	sometimes	sometimes
M13	2 years experience	very often	three times	often	often	often
M14	3-4 years experience	sometimes	twice	often	often	almost never
M15	no experience	never	never	sometimes	sometimes	sometimes
M16	no experience	never	twice	very often	very often	sometimes
M17	no experience	very often	,	almost never	almost never	often
M18	7 or more years experience	very often	more than three times	very often	very often	sometimes
M19	no experience	often	more than three times	often	often	sometimes
M20	no experience	sometimes	more than three times	often	often	sometimes
M21	no experience	,	more than three times	often	often	sometimes
M22	no experience	,	,	almost never	almost never	often

Table 6 Question results

	10	11	12	13	14	33	34	37
U1	often	often	sometimes	no opinion	sometimes	not much	sometimes	,
U2	very often	sometimes	often	always	no opinion	no opinion	sometimes	75%
U3	very often	often	sometimes	always	sometimes	,	,	,
U4	sometimes	sometimes	sometimes	always	sometimes	no opinion	definitely	,
U5	very often	often	often	no opinion	no opinion	not much	definitely	,
U6	sometimes	sometimes	sometimes	always	sometimes	,	,	75%
U7	very often	often	often	almost never	almost never	usually	sometimes	100%
U8	often	often	often	sometimes	sometimes	always	definitely	50%
U9	never	never	often	always	sometimes	usually	definitely	25%
U10	almost never	almost never	often	sometimes	sometimes	usually	sometimes	75%
U11	sometimes	sometimes	very often	always	always	not much	definitely	50%
U12	often	often	often	don't care	sometimes	always	definitely	50%
U13	often	often	very often	always	always	usually	definitely	25%
U14	often	often	never	always	don't care	usually	definitely	25%
C1	sometimes	sometimes	often	always	sometimes	not at all	definitely	50%
C2	sometimes	sometimes	almost never	sometimes	almost never	usually	definitely	25%
C3	sometimes	sometimes	never	always	don't care	usually	definitely	75%
C4	never	never	never	don't care	don't care	not much	definitely	75%
C5	very often	very often	almost never	almost never	almost never	usually	definitely	50%
C6	sometimes	sometimes	never	almost never	don't care	,	definitely	0%
C7	very often	very often	almost never	almost never	almost never	not much	definitely	75%
C8	very often	very often	often	don't care	sometimes	usually	definitely	25%
C9	sometimes	sometimes	often	sometimes	sometimes	always	definitely	75%
C10	sometimes	sometimes	almost never	sometimes	almost never	not much	definitely	25%
C11	often	often	never	sometimes	don't care	not much	definitely	25%
C12	sometimes	sometimes	almost never	always	almost never	no opinion	definitely	25%
C13	often	sometimes	often	always	no opinion	usually	sometimes	25%
C14	almost never	almost never	never	don't care	don't care	no opinion	not at all	0%
C15	sometimes	sometimes	often	sometimes	sometimes	not much	definitely	50%
C16	often	often	never	don't care	don't care	no opinion	definitely	50%
C17	sometimes	sometimes	almost never	always	almost never	usually	definitely	100%
C18	,	,	very often	always	always	,	,	,
C19	sometimes	sometimes	sometimes	no opinion	no opinion	no opinion	no opinion	75%
C20	sometimes	sometimes	almost never	almost never	almost never	usually	sometimes	75%
C21	sometimes	sometimes	almost never	always	almost never	no opinion	definitely	25%
M1	almost never	very often	almost never	don't care	don't care	usually	definitely	75%
M2	sometimes	sometimes	very often	always	sometimes	not much	definitely	75%
M3	often	almost never	almost never	sometimes	almost never	not much	not much	100%
M4	often	sometimes	sometimes	always	,	not much	sometimes	50%
M5	almost never	very often	almost never	don't care	don't care	usually	definitely	75%
M6	sometimes	sometimes	sometimes	almost never	almost never	not much	definitely	75%
M7	sometimes	very often	often	no opinion	sometimes	not much	definitely	100%
M8	often	sometimes	often	almost never	almost never	not much	definitely	25%
M9	sometimes	very often	very often	always	no opinion	not much	sometimes	25%
M10	almost never	very often	often	no opinion	no opinion	not at all	sometimes	100%
M11	very often	often	sometimes	sometimes	don't care	not much	no opinion	100%
M12	sometimes	often	sometimes	no opinion	sometimes	not much	definitely	100%
M13	often	often	sometimes	sometimes	no opinion	usually	,	75%
M14	almost never	often	almost never	don't care	don't care	usually	sometimes	75%
M15	sometimes	sometimes	sometimes	always	no opinion	,	no opinion	75%
M16	sometimes	sometimes	sometimes	always	no opinion	,	definitely	75%
M17	often	often	often	no opinion	sometimes	,	no opinion	25%
M18	sometimes	sometimes	sometimes	sometimes	no opinion	,	definitely	50%
M19	sometimes	sometimes	never	no opinion	don't care	,	definitely	100%
M20	sometimes	sometimes	almost never	no opinion	almost never	,	definitely	50%
M21	sometimes	sometimes	almost never	sometimes	almost never	,	definitely	75%
M22	often	often	often	no opinion	sometimes	,	no opinion	25%

Table 7 Question results (1 – never, 2 – almost never, 3 – sometimes, 4 – often, and 5 – very often)

	Question																
	39	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**51**	**52**	**53**	**54**	**55**	**56**
U1	2	3	3	4	4	3	3	5	4	4	3	2	4	3	some	for some items	sometimes
U2	4	3	3	4	3	4	2	3	4	2	4	3	4	2	reasonably well	for some items	often
U3	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,
U4	,	5	5	5	5	5	3	5	5	4	4	3	5	5	very well	for some items	often
U5	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,
U6	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,
U7	5	5	5	5	5	,	,	5	5	5	3	3	5	,	very well	all what is needed	very often
U8	1	3	1	5	1	5	2	5	1	1	1	1	4	1	reasonably well	not at all	sometimes
U9	1	5	2	5	5	4	3	4	1	1	1	1	3	1	reasonably well	for some items	often
U10	1	1	5	5	4	1	1	1	4	1	3	1	1	1	reasonably well	for some items	often
U11	1	3	4	5	2	4	3	4	2	2	1	2	4	3	very well	for some items	sometimes
U12	1	2	5	3	2	1	2	5	4	3	3	1	1	1	reasonably well	a little	often
U13	1	1	5	5	1	1	1	5	1	5	3	1	1	1	reasonably well	a little	sometimes
U14	1	4	4	2	2	3	3	3	3	4	1	2	4	1	very well	a little	sometimes
C1	1	3	4	5	4	5	3	4	5	5	3	3	5	5	reasonably well	for some items	very often
C2	1	1	3	4	4	3	2	2	1	2	1	1	3	2	a little	for some items	sometimes
C3	1	3	3	5	4	4	4	5	3	3	2	2	3	3	reasonably well	for some items	very often
C4	1	1	1	5	4	4	5	4	4	4	2	3	4	1	reasonably well	for many items	often
C5	4	5	3	1	4	4	3	5	4	1	4	1	5	5	reasonably well	for many items	very often
C6	1	2	2	3	1	2	1	5	1	1	1	1	2	1	some	not at all	almost never
C7	3	5	5	3	5	4	5	4	4	3	5	4	5	5	reasonably well	all what is needed	very often
C8	3	3	4	4	4	4	4	4	3	3	2	2	3	3	reasonably well	for some items	sometimes
C9	5	5	5	5	5	5	5	5	5	5	5	5	5	,	reasonably well	not at all	never
C10	3	2	3	5	4	4	5	4	2	3	3	2	4	3	reasonably well	not at all	often
C11	3	5	5	4	5	3	4	4	2	2	3	2	3	4	reasonably well	for some items	often
C12	1	2	2	3	4	5	2	2	1	1	2	1	1	5	a little	for some items	sometimes
C13	4	4	3	5	5	3	1	2	3	2	2	4	4	1	a little	not at all	almost never
C14	1	1	1	1	1	,	1	1	1	1	1	1	1	1	not at all	not at all	never
C15	3	4	4	4	,	4	4	4	4	,	4	2	4	,	some	a little	sometimes
C16	1	2	3	4	2	4	4	3	1	1	1	1	2	4	reasonably well	not at all	almost never
C17	3	3	4	4	4	3	4	3	3	3	3	3	3	4	reasonably well	for some items	often
C18	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,
C19	2	2	2	2	2	3	3	3	4	4	4	4	3	3	some	for some items	sometimes
C20	1	1	5	5	3	3	4	4	4	4	3	1	2	3	reasonably well	for many items	sometimes
C21	1	2	2	3	4	5	2	2	1	1	2	1	1	5	a little	for some items	sometimes
M1	2	4	2	4	2	3	3	4	4	4	4	2	4	3	reasonably well	all what is needed	often
M2	1	1	1	5	3	1	4	5	1	1	1	1	3	1	reasonably well	all what is needed	often
M3	1	1	4	2	5	2	3	5	1	1	2	3	1	1	reasonably well	for some items	sometimes
M4	4	3	3	5	4	3	3	4	2	4	3	3	4	1	reasonably well	all what is needed	often
M5	2	4	2	4	2	3	4	4	4	,	,	2	,	,	,	,	,
M6	2	4	2	5	4	4	3	5	5	1	2	4	4	1	reasonably well	for many items	sometimes
M7	2	4	4	2	3	3	2	4	3	2	4	3	4	1	very well	a little	often
M8	3	5	3	4	5	5	4	5	,	3	2	2	5	5	reasonably well	all what is needed	often
M9	2	4	5	3	4	4	5	5	4	2	3	3	4	1	reasonably well	for some items	often
M10	4	5	5	5	3	3	3	3	5	4	3	4	4	1	reasonably well	for many items	often
M11	2	5	4	4	4	3	5	5	3	5	5	1	3	2	very well	,	often
M12	1	2	3	4	3	3	4	5	3	4	3	3	4	3	reasonably well	for many items	sometimes
M13	3	4	4	4	4	2	4	4	4	4	4	4	4	2	very well	for many items	often
M14	2	3	5	3	4	4	2	4	2	3	2	3	5	4	reasonably well	for some items	often
M15	2	4	1	4	3	4	3	4	3	4	4	4	5	3	reasonably well	all what is needed	often
M16	2	1	3	5	5	5	4	4	5	5	5	5	5	5	reasonably well	for some items	sometimes
M17	3	3	3	3	3	3	3	3	3	3	3	3	3	3	some	for some items	almost never
M18	2	3	1	5	5	5	5	5	3	4	3	3	4	3	reasonably well	for many items	often
M19	1	1	2	5	5	3	2	2	1	3	3	4	3	3	reasonably well	all what is needed	sometimes
M20	3	3	3	4	4	4	4	3	4	3	4	3	3	3	some	for some items	sometimes
M21	2	3	1	5	5	5	5	4	1	3	4	3	3	3	reasonably well	for some items	often
M22	3	3	,	3	3	3	3	3	3	3	3	3	3	3	some	for some items	almost never

Table 8 Question results(1 – never, 2 – almost never, 3 – sometimes, 4 – often, and 5 – very often)

	Question																													
	16		17		18		19		20		22		23		24		25		26		27		28		29		30		31	
U1	4	,	5	,	4	,	4	,	3	,	3	,	3	,	3	,	4	,	2	,	5	,	4	,	,	,	,	,	,	,
U2	3	,	4	,	4	,	4	,	2	,	3	,	3	,	3	,	4	,	3	,	5	,	3	,	4	,	,	,	,	,
U3	4	,	4	,	4	,	4	,	3	,	3	,	3	,	3	,	2	,	3	,	5	,	3	,	,	,	,	,	,	,
U4	2	,	4	,	4	,	4	,	3	,	3	,	3	,	3	,	4	,	3	,	5	,	4	,	,	,	,	,	,	,
U5	5	,	3	,	4	,	4	,	3	,	2	,	2	,	2	,	2	,	5	,	2	,	,	,	,	,	,	,	,	,
U6	4	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	5	,	3	,	,	,	,	,	,	,	,	,
U7	5	,	3	,	5	,	5	,	2	,	2	,	3	,	1	,	4	,	2	,	5	,	4	,	,	,	,	,	,	,
U8	5	,	5	,	1	,	1	,	4	,	1	,	1	,	1	,	5	,	1	,	1	,	1	,	1	,	1	,	1	,
U9	5	,	5	,	1	,	1	,	1	,	1	,	1	,	1	,	5	,	1	,	1	,	5	,	1	,	1	,	1	,
U10	5	,	1	,	1	,	1	,	1	,	1	,	1	,	1	,	5	,	1	,	5	,	5	,	1	,	1	,	1	,
U11	5	,	5	,	1	,	1	,	1	,	1	,	1	,	1	,	1	,	1	,	5	,	1	,	1	,	1	,	1	,
U12	5	,	1	,	5	,	5	,	1	,	1	,	1	,	1	,	5	,	1	,	1	,	5	,	1	,	1	,	1	,
U13	5	,	5	,	2	,	2	,	4	,	1	,	1	,	1	,	1	,	1	,	1	,	1	,	1	,	1	,	1	,
U14	5	,	5	,	5	,	5	,	1	,	1	,	1	,	1	,	5	,	1	,	1	,	5	,	1	,	1	,	1	,
C1	5	,	5	,	4	,	4	,	1	,	3	,	4	,	1	,	5	,	1	,	5	,	3	,	1	,	1	,	1	,
C2	5	,	4	,	3	,	3	,	3	,	4	,	2	,	2	,	1	,	1	,	3	,	4	,	1	,	1	,	3	,
C3	4	,	4	,	3	,	3	,	2	,	2	,	2	,	2	,	2	,	2	,	3	,	4	,	2	,	2	,	4	,
C4	5	,	5	,	3	,	3	,	2	,	1	,	3	,	1	,	1	,	1	,	3	,	3	,	1	,	1	,	3	,
C5	5	,	5	,	4	,	4	,	1	,	1	,	1	,	1	,	1	,	1	,	1	,	5	,	1	,	1	,	1	,
C6	4	,	5	,	3	,	3	,	3	,	3	,	5	,	2	,	1	,	1	,	1	,	1	,	1	,	1	,	1	,
C7	5	,	4	,	3	,	3	,	3	,	3	,	4	,	2	,	2	,	2	,	3	,	5	,	2	,	1	,	3	,
C8	5	,	5	,	3	,	3	,	1	,	3	,	3	,	1	,	1	,	1	,	1	,	5	,	1	,	1	,	1	,
C9	5	,	5	,	3	,	3	,	2	,	3	,	3	,	1	,	3	,	3	,	4	,	4	,	3	,	4	,	3	,
C10	5	,	4	,	2	,	2	,	4	,	2	,	4	,	2	,	1	,	1	,	3	,	5	,	1	,	3	,	2	,
C11	5	,	4	,	3	,	3	,	1	,	2	,	4	,	2	,	1	,	4	,	4	,	5	,	1	,	3	,	3	,
C12	5	,	5	,	2	,	2	,	1	,	2	,	5	,	1	,	1	,	1	,	1	,	5	,	1	,	1	,	1	,
C13	4	,	2	,	3	,	3	,	2	,	3	,	3	,	3	,	3	,	1	,	3	,	2	,	,	,	,	,	,	,
C14	4	,	4	,	2	,	2	,	2	,	1	,	1	,	1	,	1	,	1	,	1	,	4	,	1	,	1	,	1	,
C15	5	,	4	,	3	,	3	,	2	,	2	,	4	,	2	,	5	,	5	,	4	,	4	,	2	,	2	,	4	,
C16	5	,	5	,	3	,	3	,	1	,	5	,	5	,	1	,	1	,	1	,	1	,	5	,	1	,	1	,	5	,
C17	5	,	5	,	5	,	5	,	3	,	3	,	3	,	3	,	3	,	2	,	5	,	5	,	3	,	3	,	4	,
C18	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,
C19	1	,	1	,	1	,	1	,	1	,	1	,	1	,	1	,	3	,	3	,	3	,	4	,	4	,	4	,	4	,
C20	4	,	4	,	2	,	2	,	1	,	2	,	1	,	1	,	1	,	1	,	3	,	1	,	1	,	1	,	1	,
C21	5	,	5	,	2	,	2	,	1	,	2	,	5	,	1	,	1	,	1	,	1	,	5	,	1	,	1	,	1	,
M1	,	3	,	3	,	4	,	4	,	2	,	1	,	2	,	1	,	3	,	1	,	4	,	2	,	,	,	,	,	,
M2	,	5	,	4	,	4	,	4	,	2	,	4	,	4	,	1	,	4	,	3	,	1	,	2	,	3	,	3	,	,
M3	,	1	,	3	,	3	,	3	,	4	,	1	,	4	,	1	,	2	,	1	,	1	,	5	,	,	,	,	,	,
M4	,	3	,	4	,	4	,	4	,	3	,	3	,	3	,	5	,	5	,	4	,	4	,	4	,	,	,	,	,	,
M5	,	3	,	3	,	2	,	2	,	2	,	2	,	2	,	2	,	1	,	2	,	4	,	4	,	,	,	,	,	,
M6	,	5	,	5	,	3	,	3	,	5	,	4	,	5	,	2	,	5	,	1	,	5	,	3	,	,	,	,	,	,
M7	,	5	,	5	,	4	,	4	,	4	,	3	,	3	,	4	,	5	,	2	,	4	,	1	,	,	,	,	,	,
M8	,	4	,	3	,	5	,	5	,	4	,	4	,	4	,	4	,	4	,	1	,	4	,	3	,	,	,	,	,	,
M9	,	5	,	2	,	5	,	5	,	4	,	5	,	4	,	3	,	5	,	1	,	5	,	3	,	5	,	,	,	,
M10	,	5	,	3	,	5	,	5	,	4	,	4	,	4	,	1	,	5	,	1	,	3	,	3	,	4	,	,	,	,
M11	,	3	,	3	,	3	,	3	,	2	,	2	,	3	,	1	,	4	,	1	,	5	,	4	,	4	,	,	,	,
M12	,	4	,	5	,	5	,	5	,	3	,	3	,	3	,	3	,	5	,	4	,	4	,	3	,	4	,	4	,	4
M13	,	3	,	3	,	4	,	4	,	3	,	2	,	2	,	3	,	4	,	4	,	4	,	,	,	4	,	,	,	,
M14	,	3	,	5	,	4	,	4	,	3	,	3	,	2	,	3	,	3	,	2	,	5	,	5	,	,	,	,	,	,
M15	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	,	,	,	,	,
M16	,	3	,	4	,	5	,	5	,	4	,	5	,	5	,	3	,	4	,	1	,	2	,	5	,	,	,	,	,	,
M17	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	,	,	,	,	,
M18	,	3	,	3	,	4	,	4	,	2	,	3	,	3	,	3	,	3	,	2	,	3	,	3	,	4	,	5	,	,
M19	,	4	,	5	,	4	,	4	,	3	,	3	,	3	,	3	,	3	,	2	,	3	,	4	,	,	,	,	,	,
M20	,	3	,	3	,	3	,	3	,	4	,	4	,	4	,	4	,	4	,	2	,	2	,	3	,	,	,	,	,	,
M21	,	2	,	3	,	4	,	4	,	4	,	3	,	3	,	2	,	3	,	2	,	2	,	2	,	4	,	,	,	,
M22	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	3	,	,	,	,	,	,

1.3 Question 14 - What kind of problems do you think of?

1.3.1 Corporate learning

- If my materials are re-used within Shell then I don't care who is using it as it will benefit my intended audience. The only caveat is if my material was found to be incorrect later and I had to search for all the instances used in other places. Then I guess I would care. Giant e-modules are not the way tot go! Individual CD's should be developing their own materials (with help, of course) so the materials can be supported by the CD's and so it will be completely appropriate to use the material in the relevant course(s).
- xxx is a software instruction course - would lend itself to complete e environment conversion but it has a limited market and limited shelf life the distinctly obtuse introduction technique - left a feeling a no value return

1.3.2 Military

- Within eigen spullen geen probleem, als ... is controle voor up to date houde
- Outside CBT van buiten geen probleem Als defensie dat wil?!
- Within Defensie = geen commerciele club
- Outside alles is toch van internet te halen, niemand strafrechtelijk vervolgen
- Within: Confidential material
- Within: confidential material, Sharing of information
- Within : Timing (solution of exercises after corresponding college)
- Outside : Copyrights
- Within : Material sometimes classified. Solutions for assignments should only be offered when work is submitted or predefined point in time
- Within & Outside: Confidential/secret material (clearance needed)
- Within : Intelectual "kwetsbaarheid"
- Outside : Intellectual "property
- beveiliging incidente
- Niet alles wat we in de lessen zetten mag naar buiten
- Within reuse by wrong people
- Outside copyright and misuse of confidential material
- Within: classified
- Outside: Classified
- Within geen problemen
- Outside geen problemen
- Outside Beschikbaar stellen van materiaal bij geheimhouding
- Outside Geclassificeerd materiaal

1.4 Question 15 - Do you have any remarks about the previous section?

1.4.1 Corporate learning

- Re-use for me as SOU team member: mainly small pieces like on boarding activities and learner agreement, no "technical material nuggets". Re-use of material: system requires you know what you are looking for (course code, category, title).
- 2: metatagging should make search easier.

- IT is a big issue! "Blend" of learning techniques: individual vs group vs reading vs tasks etc Costs: still needs some work to get an accurate picture. Local OU support (coaching/mentoring) - very critical.
  Face-to-face workshops: critical for the P-142 style of course
- Referring to 4; I clicked "three times" because that's how often I ran it including pilot. However, I expect to invest re-design time in each cycle, because one of the drivers of the course is to continuously improve it. referring to 5; I clicked "never" because this was the first run of SOLB, for all the coming cycles I would have clicked "very often". ref. 11; copyright clearance is an issue ref 12; again the copyright issue.
- Teletop for this course is very pre-work focussed. The intention is to grow the post event return to work part. In summary it is currently +/- 2 days TeleTOP®, 10 days classroom event.

1.4.2 Military

- Het is moeilijk standarisatie te vinden binnen key-words, iedere ontwikkelaars beschrijft hiermee zijn eigen bedoelingen niet de media.
- 33/ Within definitely, without: not much
- Some Questions can better be answered by an amount instead of a frequency
- How often do you expect will the following types of material be reused:

1.5 Question 56 - If you have any other ideas for the search process, please specify:

1.5.1 Corporate learning

- Add in the keys for the EPCF (E&P Competence Framework) which has 3 levels of Expertise Area, Building Blocks and Elements. The other dimension is the skill level (AKSM). With this, it should me possible to find any material for fill any specific gap as defined in the competency process.

  Tricky to balance usability when constructing the proper tags with rigorous definitions and rules for the tags themselves. The best way would be to spend significant effort upfront to define exactly what the tag options would be (making lists of acceptable entries for each tag category) then enforcing the use of only those entries (vi dropdowns?).
- I am afraid that this will not get enough priority by Course Directors to justify the investment
- Great idea but be AWARE of duplication of efforts viz-a-viz other KM efforts in the Shell Group (refer NWW, NAM, LiveLink etc. etc.)

  Question should be asked: do you have the time....(refer Q.4)

  Best way of searching: "key words" and "subjects"
- Has to be by high level competence desription - Shell leadership Framework, Maintenance, Production etc.
  Then agree sub description - Mainteneance/EP/gas plants. Could be Maintenance/OP/Refineries

  This is going to be the foundation tor coaching. It has to be intuitive for people with narrow fields of technical vision. Keep boredom at a low level.
- Use Google
- The issue is time/resources!
  We first need a strategic commitment to Teletop, then some re-education, and some standardisation in the way we work. Big "change" project, which in current climate would probably be poorly managed - no one has the time!
- ref. 5+6; I am being a negative and very contradictive to my answers before - because the whole nugget/re-usable object concept scares me a nit. I am saying this because I know there are dissonant voices out there when it comes to the practicality of the concept.

  Please get me right here. I am nog saying that having a library of reusable objects is not a good idea, in fact I think it is a great idea.
  However, it's also something we have been using already for quite some time - I'd call it: the encyclopaedia.

  Again, referring to s.th. that is already existing does not mean that the whole concept of meta-tagging is nog a revolutionary concept. The opposite is true, However, when we look again at the example of the encyclopaedia, then we have to understand that developing an encyclopaedia and more importantly maintaining its quality is a huge task. It requires good thinking, and eventually more people to develop it and make it a sustainable undertaking. Are we ready at the Centre to take on this challenge?

- User name
  structure/categories as in Roster to keep consistency in Archive, especially when more people (SME's) are involved.
- Hoe vaak materiaal daadwerkelijk is gekopieerd/gebruikt voor een cursus.
  - type/format (.ppt,.doc,.html,.swf)
  - onderwerp + moeilijkheidsgraad
  - onderwerp + subonderwerp + sub-sub onderwerp...
  - nieuw materiaal
- Full text search else, course codes, names, keywords.
- If I was looking for material, I would sit with a TeleTOP admin person, dicsuss which courses may overlap with the one I'm trying to develop and then print out the Roster & find out which topics might be of interest and whether they are in the right context
- google type of search (keywords + logical connections)

  Competence Framework --- but one to many relations have to be

1.5.2 Military

- Gebruik van meerdere keywords die eventueel met .or. of .and. aan elkaar gekoppeld kunnen worden
- keywords with "Advanced" search
- Specify Queries, That is how most of the time is searched.
- Search for keywords, depends on type of media (Image/animation/sound/clip)
- Mainly search on keywords, sometimes author, depends on subject
- Deterministic approach vanuit de gratuities
- Institute, course, subject, content
- Intelligent search systems, (Semantic networks)
- Search by –words, -combination of words (AND)
- Search for most downloaded files
- Other users also searched for or were interested in "full search" -> in content using strings like "this product is best because..."
- Organisation, predefined instances, search string
- Authors, keywords, location of source
- Juiste benaming en voorbeeld functie met bijvoorbeeld photoshop tbv plaatjes
- zo niet, moet eerst eens goed over denken bij plaatsjes een groter afbeelding zo dat je niet steeds de file moet opvragen om te zien wat er op staat. goede omschrijvingen kom ik weer de ene omschrijving is voor een ander niet te volgen wat hij bedoeld
- More keys: level, author, place in curriculum, granularity, goals, etc

Appendix F: Werken met metadata in DU-projecten

The following 24 pages is the full report:

Benneker, F., Delchot, B., Ham, R., Pannenkeet, K., Schoonenboom, J., & Strijker, A., (2004). *Werken met metadata in DU-projecten: Deel 1 handleiding [Working with metadata in DU projects: Part 1 manual]*. Stichting Digitale Universiteit: Utrecht.

Werken met metadata in DU-Projecten

6 januari 2004

samenwerken aan vernieuwing van het Hoger Onderwijs

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Datum
6 januari 2004

Kenmerk
ELO.DEL.735.werken met metadata in DU-projecten – Deel 1: Handleiding; versie 0.99

Inhoudsopgave

1 Werken met metadata in DU-projecten

1.1 Inleiding

In deze handleiding wordt een vaste procedure beschreven voor het werken met metadata binnen afzonderlijke DU-projecten. Daarbij worden de volgende rollen onderscheiden:

- diegenen binnen het project die keuzes maken over de te gebruiken metadata;
- auteurs (ontwikkelaars) van materiaal die metadata toevoegen;
- documentalisten, die weer andere metadata toevoegen;
- gebruikers van digitaal materiaal, die mogelijk opmerkingen willen toevoegen over het gebruik van het materiaal in de praktijk.

De handleiding bestaat uit een korte inleiding waarin het hoe en waarom van het werken met metadata in DU-projecten wordt besproken. Daarna worden in een korte handleiding de werkzaamheden geschetst die horen bij de verschillende rollen. Tot slot bevat dit document een aantal bijlagen, checklists die behulpzaam zijn bij het maken van keuzes en het toevoegen van metadata.

1.2 Waarom metadata?

Binnen DU-projecten wordt veel digitaal materiaal ontwikkeld. Dit digitale materiaal moet ergens worden opgeslagen, zodat het door mensen die het willen gebruiken kan worden gevonden. Mensen willen zoeken naar materiaal, en ze willen kunnen inschatten of een stuk materiaal voor hen bruikbaar is. Daarom is het nodig dat het materiaal wordt voorzien van een beschrijving, waarin staat aangegeven wat voor soort materiaal het is, waar het over gaat, hoe en waarvoor het materiaal gebruikt kan worden, wat dat kost, wie het materiaal heeft gemaakt etc. Een dergelijke beschrijving is opgesplitst in een aantal ‘velden’ die als een soort labels aan het materiaal worden gehangen. De beschrijving wordt aangeduid met de term ‘metadata’.

Het onderstaande fictieve voorbeeld, dat gebaseerd is op een bestaand DU-object, geeft een indruk van de voor één object ingevulde metadatavelden, het ‘metadatarecord’. In dit en volgende voorbeelden hebben de velden die ingevuld kunnen worden een witte achtergrond. Velden op een hoger niveau, die meerdere in te vullen velden omvatten, hebben een grijze achtergrond. Zij kunnen zelf niet ingevuld worden. De namen en nummers van de velden zijn ontleend aan de LOM-standaard (zie paragraaf 1.3). Zoals uit het voorbeeld blijkt, zijn er velden die meerdere malen kunnen voorkomen, in dit geval het veld ‘Bijdrage’. De in dit voorbeeld genoemde velden zijn allemaal velden die verplicht ingevuld moeten worden, met uitzondering van het laatste veld, 6.3 Omschrijving:

LOM nr.	Naam	Invulling
		Ingevuld door auteur
1	Algemeen	
1.2	Titel	(nl, Exploitatiehandboek Virtueel Milieuadviesbureau)
1.4	Omschrijving	(nl, 'In Company Milieuadvies' is een operationeel virtueel bedrijf. Dit handboek bundelt de werkzaamheden en instrumenten waar studenten en docenten in 'InCompany Milieuadvies' mee te maken krijgen.)
1.5	Sleutelwoord	Handboek
1.5	Sleutelwoord	Virtueel Milieuadviesbureau
2	Levenscyclus	
2.1	Versie	1.0
2.2	Status	definitieve versie
2.3	Bijdrage	
2.3.1	Rol	Auteur
2.3.2	Persoon of organisatie	BEGIN:VCARD FN:Darco Jansen EMAIL;TYPE=INTERNET:darco.jansen@digitaleuniversiteit.nl END:VCARD
2.3.3	Datum	2003-03-01
2.3.1	Rol	Auteur

LOM nr.	Naam	Invulling
2.3.2	Persoon of organisatie	BEGIN:VCARD FN:Angelique Lansu EMAIL;TYPE=INTERNET:Angelique.lansu@digitaleuniversiteit.nl END:VCARD
2.3.3	Datum	2003-03-01
2.3.1	Rol	Auteur
2.3.2	Persoon of organisatie	BEGIN:VCARD FN:Wilfried Ivens EMAIL;TYPE=INTERNET:wilfried.ivens@digitaleuniversiteit.nl END:VCARD
2.3.3	Datum	2003-03-01
		Ingevuld door documentalist
1	Algemeen	
1.1	Identificatie	
1.1.1	Schemanaam	DUCat
1.1.2	Identificatiecodes	DI.PROD.HANDB.VMAB.1
1.3	Taal	Nl
2.3	Bijdrage	
2.3.1	Rol	Uitgever
2.3.2	Persoon of organisatie	BEGIN:VCARD FN:Stichting Digitale Universiteit EMAIL;TYPE=INTERNET:buro@digiuni.nl END:VCARD
2.3.3	Datum	2003-03-01
3	Metametadata	
3.2	Bijdrage	
3.2.1	Rol	Maker
3.2.2	Persoon of organisatie	BEGIN:VCARD FN:Kees Pannekeet EMAIL;TYPE=INTERNET:kees.pannekeet@digitaleuniversiteit.nl END:VCARD
3.2.3	Datum	2004-01-04
3.2.1	Rol	Documentalist
3.2.2	Persoon of organisatie	BEGIN:VCARD FN:Judith Schoonenboom EMAIL;TYPE=INTERNET:judith.schoonenboom@digitaleuniversiteit.nl END:VCARD
3.2.3	Datum	2004-01-05
3.3	Metadataschema	DULOMnlv1.0
3.4	Taal	Nl
4	Technisch	
4.1	Bestandsformaat	application/msword
4.3	Locatie	http://www.digiuni.nl/digiuni//download/temp/07_VMBA.pdf?CFID=125695&CFTOKEN=58152576
6	Rechten	
6.1	Kosten	Nee
6.2	Auteursrechten en andere beperkingen	Ja
6.3	Omschrijving	Deze uitgave is binnen het consortium van de Digitale Universiteit vrijelijk te gebruiken, mits voorzien van adequate bronvermelding. Niets uit deze uitgave mag buiten het consortium openbaar worden gemaakt, verspreid en/of verveelvoudigd door middel van internet, druk, fotokopie, microfilm of op welke andere wijze dan ook zonder voorafgaande schriftelijke toestemming van het bureau van de Digitale Universiteit.

1.3 DU-metadata en standaarden

De metadata die gebruikt worden voor materiaal van de DU zijn niet vanuit het niets bedacht. Er is inmiddels een aantal standaarden in omloop waarop men zich kan baseren. Het aansluiten bij een standaard heeft als voordeel dat men kan bouwen op wat reeds bedacht is. Daarnaast wordt het makkelijker om materiaal uit te wisselen met organisaties buiten de DU die zich op dezelfde standaard baseren.

Bij het ontwikkelen van de DU-richtlijn metadata hebben twee bestaande standaarden een belangrijke rol gespeeld. De eerste is de conceptnorm voor leerobject-metadata, kortweg de LOM genoemd. Het LOMnlv1.0-Basisschema, dat een letterlijke vertaling is van het corresponderende Engelstalige schema, classificeert de metadata-elementen in negen categorieën:

> "a) In de categorie Algemeen wordt de algemene informatie die een leerobject als geheel beschrijft, samengebracht.
> b) In de categorie Levenscyclus worden de kenmerken gegroepeerd die samenhangen met de geschiedenis en de huidige toestand van dit leerobject en van die welke dit leerobject gedurende zijn ontstaansgeschiedenis hebben beïnvloed.
> c) In de categorie Metametadata staat informatie over de metadata-instantie zelf (in plaats van over het leerobject dat door de metadata-instantie beschreven wordt).
> d) In de categorie Technisch staan de technische vereisten en technische kenmerken van het leerobject.
> e) In de categorie Educatief worden de onderwijstechnische en pedagogisch-didactische kenmerken van het leerobject gegroepeerd.
> f) In de categorie Rechten staan de intellectuele eigendomsrechten gegroepeerd en de voorwaarden waaronder het leerobject mag worden gebruikt.
> g) In de categorie Relatie zijn die kenmerken samengebracht die verbanden tussen het leerobject en andere, verwante leerobjecten beschrijven.
> h) In de categorie Annotatie staan commentaren op het gebruik van het leerobject in een onderwijscontext gegroepeerd; ook is aangegeven wanneer en door wie het commentaar werd aangemaakt.
> i) In de categorie Classificatie wordt beschreven hoe dit leerobject zich verhoudt tot een bepaald classificatiesysteem". (Sloep, Benneker en Gorissen 2003: 7.)

In de DU-richtlijn metadata wordt uitgegaan van de metadatavelden zoals die gedefinieerd zijn binnen de LOM, en de in de LOM genoemde benamingen voor deze velden. Ook wordt zoveel mogelijk vastgehouden aan de waarden die de LOM voor verschillende velden noemt als mogelijke invulling. Waar de DU-context dat vereist is gekozen voor andere mogelijke invullingen. Zo geldt binnen de DU-richtlijn metadata als mogelijke invulling van het veld 5.6 Context "master" en "bachelor" met een onderverdeling naar jaar.

Een tweede belangrijke standaard is het Sharable Content Object Reference Model (SCORM). Een behandeling van dit model valt buiten het bereik van deze handleiding. Van belang is dat SCORM gebaseerd is op de LOM en dat binnen de SCORM-standaard een aantal metadatavelden van de LOM verplicht ingevuld dienen te worden; andere velden zijn optioneel. Strikt genomen wordt binnen SCORM onderscheid gemaakt tussen leerobjecten van verschillende omvang. Voor leerobjecten van de kleinste omvang, zgn. 'assets', gelden een aantal verplichtingen niet; denk hierbij aan losse afbeeldingen, grafieken etc. Omdat dit niveau voor DU-leerobjecten minder relevant is, blijft dit verder buiten beschouwing.

In de DU-richtlijn metadata is geprobeerd om zoveel mogelijk aan te sluiten bij SCORM. Op deze manier wordt het uitwisselen van leerobjecten met instanties buiten de DU vergemakkelijkt, wanneer deze zich ten minste ook aan SCORM houden.

De specifieke context van de DU maakte het noodzakelijk om naast de verplichte SCORM-velden nog een aantal velden uit de LOM verplicht te stellen. Het gaat daarbij met name om gegevens van degene(n) die het leerobject gemaakt heeft/hebben en degene(n) die de metadata heeft/hebben ingevuld. Binnen de context van de DU kan het om verschillende redenen nodig zijn om in contact te treden met degenen die aan het leerobject hebben bijgedragen, bijvoorbeeld omdat een gebruiker de auteur wil laten weten hoe het leerobject gebruikt is, of omdat men ontdekt dat het leerobject niet juist beschreven is.

Daarnaast moet de uitgever van het leerobject verplicht worden vermeld; dit is standaard de Stichting Digitale Universiteit. Dit is met name van belang wanneer leerobjecten buiten de Digitale Universiteit gebruikt worden. Tot slot moet de taal van het leerobject (default: Nederlands) worden aangegeven.

Er is één metadatacategorie die binnen SCORM verplicht is, terwijl die volgens de DU-richtlijn metadata optioneel is. Dat is de categorie Classificatie. Hoewel er een DU-classificatieschema bestaat (zie deel 2 Bijlagen, bijlage 5), is dit niet specifiek voor de metadatering van leerobjecten ontworpen. Daarom is op dit moment onduidelijk of dit classificatieschema in de praktijk voor alle

DU-projecten bruikbaar zal zijn. Vandaar dat classificering volgens het DU-classificatieschema op dit moment niet verplicht is.

Wie dus geheel wil voldoen aan SCORM, zal volgens een eigen classificatiesysteem de categorie Classificatie moeten invullen. Daarbij geldt dat de classificatievelden Doel, Omschrijving en Sleutelwoord verplicht zijn.

In onderstaande tabel staan de verschillen tussen de DU-richtlijn metadata en SCORM weergegeven.

LOM nr.	Naam	Evt. vaste waarde	DU-richtlijn metadata	SCORM
1	Algemeen			
1.3	Taal		verplicht	Optioneel
2	Levenscyclus			
2.3	Bijdrage			
2.3.1	Rol	auteur	Verplicht	Optioneel
2.3.2	Persoon of organisatie	-	Verplicht	Optioneel
2.3.3	Datum	-	Verplicht	Optioneel
2.3.1	Rol	uitgever	Verplicht	Optioneel
2.3.2	Persoon of organisatie	BEGIN:VCARD FN:Stichting Digitale Universiteit EMAIL;TYPE=INTERNET:buro@digiuni.nl END:VCARD	Verplicht	Optioneel
2.3.3	Datum	-	Verplicht	Optioneel
3	Metametadata			
3.2	Bijdrage			
3.2.1	Rol	maker	Verplicht	Optioneel
3.2.2	Persoon of organisatie	-	Verplicht	Optioneel
3.2.3	Datum	-	Verplicht	Optioneel
3.2.1	Rol	documentalist	Verplicht	Optioneel
3.2.2	Persoon of organisatie	-	Verplicht	Optioneel
3.2.3	Datum	-	Verplicht	Optioneel
3.4	Taal	-	Verplicht	Optioneel
9	Classificatie			
9.1	Doel	-	Optioneel	Verplicht
9.3	Omschrijving	-	Optioneel	Verplicht
9.4	Sleutelwoord	-	Optioneel	Verplicht

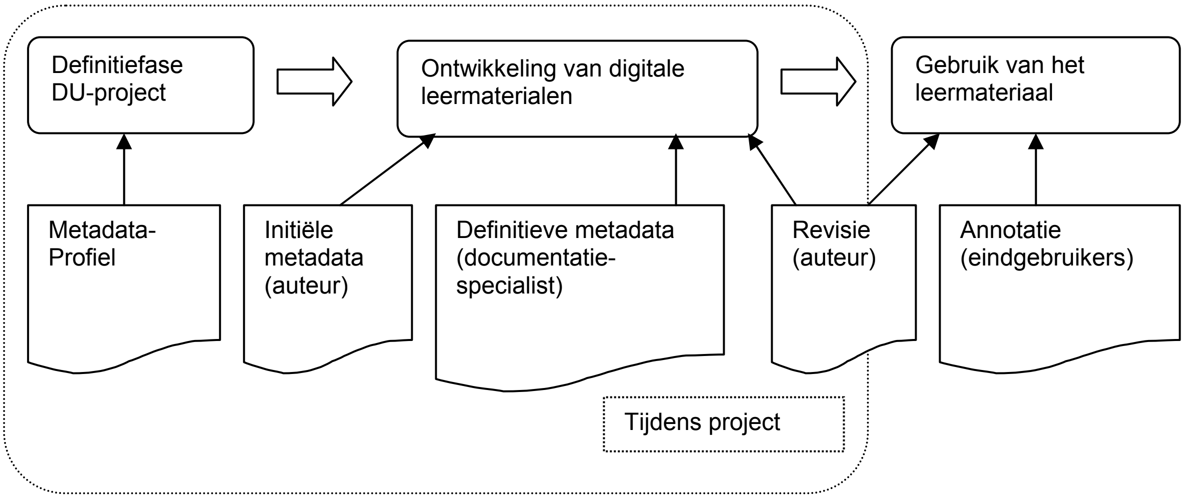
Tabel 1 Verschillen tussen DU-metadata richtlijn en SCORM

1.4 Werken met metadata in DU-projecten

In het werken met metadata in DU-projecten onderscheiden we vijf fasen (zie de weergave in figuur 1:

1. Vaststellen van het metadataprofiel: Het maken van keuzes met betrekking tot de metadata die men gaat gebruiken voor digitale materialen die binnen het project worden ontwikkeld. Bij deze keuze zullen doorgaans meerdere leden van het project betrokken zijn. Het maken van deze keuzes wordt besproken in paragraaf 2.
2. Toekennen van de initiële metadata: Degenen die materiaal ontwikkelen kennen een eerste set metadata toe aan het materiaal. Degene die deze metadata toekent wordt in het vervolg de ‘auteur’ genoemd. Het toekennen van metadata door de auteur wordt besproken in paragraaf 3.
3. Toekennen van de definitieve metadata: De door de auteur toegekende metadata worden gecheckt door een documentalist. Deze voegt zelf een set metadata toe. Het toekennen van de definitieve metadata wordt besproken in paragraaf 4.
4. Revisie: Zowel tijdens het ontwikkelen als tijdens het gebruik van het materiaal kunnen meer of minder ingrijpende revisies nodig blijken, die consequenties hebben voor de metadata. Het omgaan met revisies wordt besproken in paragraaf 3.5.
5. Toevoegen van annotaties: Tijdens het gebruik kunnen gebruikers hun opmerkingen toevoegen aan het materiaal. Deze annotaties zijn voor het doel van deze handleiding, het

toekennen van metadata binnen DU-projecten, niet relevant. Annotaties worden besproken in hoofdstuk 5.



Figuur 1 Fasen in het werken met metadata in DU-projecten

Het op deze manier werken met metadata veronderstelt dat het leermateriaal wordt opgeslagen in een systeem dat het toevoegen van metadata mogelijk maakt. Een dergelijk systeem heet een Learning Content Management System (LCMS). Ook veronderstelt deze werkwijze dat er tools zijn (al dan niet ingebakken in het LCMS) waarmee men de metadata aan het materiaal in het LCMS kan toevoegen.

De DU heeft voorlopig als standaard-LCMS gekozen voor Learn eXact, dat het werken met de LOM- en SCORM-standaarden ondersteunt. Er zijn meer LCMS-en die het werken met de LOM- en SCORM-standaarden ondersteunen. Voorbeelden zijn Fronter, Hive, Aspen en Topclass. Meer informatie over het werken met een LCMS en met invoertools is te vinden in het door de DU uitgegeven *Handboek technologie en standaarden voor het ontwikkelen van digitale content* (Damstra, Van Geloven en Kresin 2003).

2 Vaststellen metadataprofiel

In de definitiefase van het project dienen de projectleden een metadataprofiel op te stellen. In dit profiel wordt vastgelegd welke metadatavelden en –waarden gebruikt zullen worden voor het beschrijven van materialen binnen het project.

Het metadataprofiel is een afspraak voor de rest van het project. Deze afspraak wordt gemaakt tijdens de definitiefase, en vastgelegd in een beslisdocument, dat onderdeel vormt van het verslag van de definitiefase. De DU moet als opdrachtgever het metadataprofiel goedkeuren. Het is dus een belangrijk stuk.

Bij het vaststellen van het metadataprofiel gelden een aantal randvoorwaarden. De eerste is dat de metadata toegekend worden aan alle *eind*producten van het project. Er worden dus geen metadata toegekend aan tussenproducten. De tweede is dat het metadataprofiel in overeenstemming dient te zijn met de metadatarichtlijn, die is weergegeven in Deel 2 Bijlagen, bijlage 3. In deze metadatarichtlijn is vastgelegd welke velden verplicht of optioneel zijn en wat de mogelijke waarden zijn. In het project zal minimaal gebruik moeten worden gemaakt van de verplichte velden. Het minimale metadataprofiel is weergegeven in Deel 2 Bijlagen, bijlage 1.

De beslissingen over het metadataprofiel vallen uiteen in twee soorten: beslissingen over het gebruik van optionele velden en beslissingen over mogelijke waarden van optionele en sommige verplichte velden. Deze worden hieronder afzonderlijk behandeld.

Binnen het project moet besloten worden welke van de in de metadatarichtlijn genoemde optionele velden zullen worden gebruikt. Men kan hier verschillende beslissingen nemen, en besluiten om bepaalde optionele velden binnen het project te gebruiken bij de beschrijving van:

- geen enkel stuk materiaal;
- alle materialen;
- bepaalde soorten materialen;
- materialen, naar eigen inzicht van de auteur en/of documentalist;

Binnen de optionele velden neemt het gebruik van classificatieschema’s (onderdeel 9. in de metadatarichtlijn) een bijzondere plaats in. Bij het invullen van dit veld mag men gebruik maken van ieder classificatieschema dat men wil, bestaande of zelf bedachte. Voor veel vakgebieden bestaan classificatieschema’s. Men kan dus beslissen om een dergelijk classificatieschema te gaan gebruiken. Een voorbeeld van een classificatieschema dat men zou kunnen gebruiken is het DU-classificatieschema, bedoeld voor het categoriseren van projecten en expertise van projectmedewerkers. Zie daarvoor Deel 2 Bijlagen, bijlage 5.

De tweede beslissing betreft mogelijke waarden van velden. In het formulier voor het invullen van de metadata (zie Deel 2 Bijlagen, bijlage 2) wordt onder het kopje ‘schema’ aangegeven wat mogelijke waarden zijn voor dit veld. Het is mogelijk om binnen een project te besluiten om slechts met een selectie van de mogelijke waarden te werken. Een andere optie is dat men in het project besluit te werken met een andere defaultwaarde dan in de metadatarichtlijn is aangegeven.

Twee beslissingen over mogelijke waarden moeten in ieder geval worden genomen. De eerste betreft het gebruik van identificatiecodes binnen de DU-catalogus. Nadat is vastgesteld welke producten het project zal opleveren, krijgt ieder product op verzoek vanuit het project door het DU-bureau een productnummer toegewezen, bijvoorbeeld: ‘DI.VMAB.001’. Het kan zijn dat een product meerdere deelproducten omvat. Zo zal een toetsbank doorgaans een groot aantal toetsvragen bevatten. Indien men de deelproducten apart wenst te identificeren, zal men vanuit het project een voorstel moeten doen voor de wijze waarop men de deelproducten wenst te nummeren (bijvoorbeeld. ‘DI.VMAB.001.AA.toetsvraag1’). Dit voorstel wordt samen met de metadatakeuzes in de definitiefase aan het bureau voorgelegd.

De tweede beslissing over mogelijke waarden gaat over het gebruik van sleutelwoorden door de auteur (veld 1.5 in de metadatarichtlijn). Men zal binnen het project moeten afspreken welke sleutelwoorden gehanteerd worden. Daartoe dient men een lijst van bij voorkeur niet meer dan twintig sleutelwoorden op te stellen.

Voor het aanleveren van het metadataprofiel kan gebruik worden gemaakt van het invulformulier in Deel 2 Bijlagen, bijlage 2.

3 Metadata voor de auteur: initiële metadata en revisie

3.1 Inleiding

Na de definitiefase van het project, waarin het metadataprofiel wordt vastgesteld, volgen de ontwerpfase en de realisatiefase, waarin materiaal wordt ontwikkeld. In deze fase wordt per ontwikkeld leerobject metadata toegekend, volgens de afspraken die hierover in het metadataprofiel zijn gemaakt. Zoals figuur 1 laat zien, zijn bij het toekennen van metadata aan een leerobject twee rollen betrokken. Vaak zullen dit verschillende personen zijn. Eerst wordt een aantal metadatavelden, de zgn. 'initiële metadata', ingevuld door de *auteur*. Dit kan de maker van het leerobject zijn, maar noodzakelijk is dit niet. Vervolgens worden deze metadata gecontroleerd door de *documentalist*, die tevens enkele andere metadata toevoegt, en daarmee de metadata definitief maakt.

In dit hoofdstuk wordt het toevoegen van metadata door de auteur behandeld. Het hoofdstuk gaat grotendeels over het toevoegen van initiële metadata. Daarnaast komt ook het onderwerp revisie, het wijzigen van leerobjecten en de bijbehorende metadata, aan de orde.

Deze handleiding verschaft de auteur de volgende hulpmiddelen bij het toevoegen van de metadata:

- Paragraaf 3.2 bevat een overzicht van velden die in DU-projecten verplicht ingevuld moeten worden en velden die optioneel zijn. Let op: welke velden binnen een specifiek project verplicht zijn, kan hiervan afwijken. In de definitiefase van een project kan immers besloten worden om bepaalde optionele velden voor dat project verplicht te stellen.
- In paragraaf 3.3-3.5 wordt het invullen van respectievelijk de verplichte velden, de optionele velden en de velden betrokken bij revisie, toegelicht. De uitleg zal in veel gevallen voldoende zijn voor het invullen van de metadata.
- Voor wie bij het invullen meer informatie nodig heeft, bevat Deel 2 Bijlagen, bijlage 4 per veld een uitgebreide toelichting.
- Voor alle metadatavelden geldt dat bij het invoeren gebruik moet worden gemaakt van een beperkte set tekens en codes, bijvoorbeeld bepaalde tekens van het toetsenbord, codes voor de namen van talen, of indelingen uit een classificatie. In Deel 2 Bijlagen, bijlagen 5 tot en met 9 zijn de relevante sets weergegeven.

3.2 Overzicht verplichte en optionele velden

De verplichte velden voor de auteur

LOM nr.	Naam	defaultwaarde	vaste waarde
1	Algemeen		
1.2	Titel	-	-
1.4	Omschrijving	-	-
1.5	Sleutelwoord	-	-
2	Levenscyclus		
2.1	Versie	0.1	-
2.2	Status	ontwerp	-
2.3	Bijdrage		
2.3.1	Rol	-	Uitgever
2.3.2	Persoon of organisatie	-	BEGIN:VCARD FN:Stichting Digitale Universiteit EMAIL;TYPE=INTERNET:buro@digiuni.nl END:VCARD
2.3.3	Datum	-	-
2.3.1	Rol	-	Auteur
2.3.2	Persoon of organisatie	-	-
2.3.3	Datum	-	-

De optionele velden voor de auteur

LOM nr.	Naam	defaultwaarde	vaste waarde
1	Algemeen		
1.1	Identificatie		
1.6	Dekking	-	-
1.7	Structuur	-	-
1.8	Aggregatieniveau	-	-
5	Educatief		
5.1	Soort interactiviteit	-	-
5.2	Soort leerbron	-	-
5.3	Interactieniveau	-	-
5.4	Semantische dichtheid	-	-
5.5	Beoogde eindgebruiker	-	-
5.6	Context	-	-
5.7	Beoogde leeftijdgroep	-	-
5.8	Moeilijkheidsgraad	-	-
5.9	Studiebelasting	-	-
5.10	Omschrijving	-	-
5.11	Taal	-	-

3.3 Initiële metadata: de verplichte velden

Voor de auteur van een leerobject zijn de metadatavelden die in dit gedeelte worden beschreven verplicht om in te vullen. Deze velden vormen de basis van de DU metadataset. Het zijn de minimaal noodzakelijke velden om herbruikbaarheid en terugvindbaarheid van een leerobject te garanderen.

3.3.1 Algemeen(1)

Deze categorie bevat algemene informatie waarmee het leerobject als geheel beschreven kan worden. Het doel van deze metadatavelden is de algemeen beschrijvende eigenschappen van een leerobject vast te leggen.

LOM nr.	Naam	Omschrijving	Voorbeeld
1.2	Titel	De naam van dit leerobject	“Inleiding in de …”
1.4	Omschrijving	Een tekstuele omschrijving van de inhoud van dit leerobject. Er mogen meerdere omschrijvingen worden gegeven.	(“nl”, “In dit videofragment wordt een kort overzicht gegeven van het leven en werk van Leonardo da Vinci. Bijzondere aandacht is er voor zijn artistieke werken, waarvan de Mona Lisa de bekendste is.”)
1.5	Sleutelwoord	Een sleutelwoord of zin waarmee het onderwerp van dit leerobject wordt beschreven. Minimaal één, maximaal 10 sleutelwoorden. Let op: het gaat om de *beschrijving* van het object, niet om *classificatie*. Zie voor dat laatste paragraaf 4.5.3.	Goede voorbeelden: “arrest Pietje Puk”, “Mona Lisa” Slechte voorbeelden: “privaatrecht”, “schilderij”

3.3.2 Levenscyclus (2)

In deze categorie worden de wordingsgeschiedenis en de huidige stand van zaken van dit leerobject beschreven, alsmede de personen en organisaties die hebben bijgedragen aan de huidige versie van dit leerobject in elke fase van de gehele levenscyclus ervan (bijvoorbeeld ontwikkeling, bijstelling, publicatie).

LOM nr.	Naam	Omschrijving	Voorbeeld
2.1	Versie	De versie van dit leerobject	“0.1”, “0.11”, “1.0”, “1.1”
2.2	Status	De volledige status of stand van zaken van dit leerobject	Kies uit: “ontwerp”, “definitieve versie”, “herziene versie”, “niet beschikbaar”
2.3.1	Rol	Soort bijdrage; de rol “auteur” is verplicht. Hiermee wordt aangegeven wie het leerobject heeft gemaakt. Er mogen meerdere rollen worden omschreven.	Kies uit: “auteur”, “uitgever”, “onbekend”, “initiatiefnemer”, “beëindiger”, “verantwoordelijke”, “redacteur”, “grafisch ontwerper”, “technisch implementator”, “onderwijskundig verantwoordelijke”, “scenarioschrijver”, “instructieontwerper”, “inhoudsdeskundige”
2.3.2	Persoon of organisatie	Voor iedere rol: minimaal de naam en email van de persoon of organisatie die deze rol heeft vervuld, genoteerd volgens het vCard-formaat	“BEGIN:VCARD FN:Jan de Vries EMAIL;TYPE=INTERNET:jdevries@host.nl END:VCARD”
2.3.3	Datum	De datum van opname van de bijdrage	“2001-08-23”

3.4 Initiële metadata: de optionele velden

De volgende velden kunnen worden toegevoegd aan het metadataprofiel dat de auteur van een leerobject dient in te vullen. In de definitiefase wordt besloten of, en welke van de volgende optionele auteursvelden aan het metadataprofiel van het project worden toegevoegd.

3.4.1 Algemeen(1)

Deze categorie bevat algemene informatie waarmee het leerobject als geheel beschreven kan worden. Het doel van deze metadatavelden is de algemeen beschrijvende eigenschappen van een leerobject vast te leggen.

LOM nr.	Naam	Omschrijving	Voorbeeld
1.6	Dekking	Het tijdsbestek, de cultuur of de geografische regio waarop dit leerobject van toepassing is. Er mogen meerdere omschrijvingen van de dekking worden gegeven.	“Nederland tijdens het Interbellum”
1.7	Structuur	De interne structuur die bestaat tussen de eventuele onderdelen waaruit dit leerobject is opgebouwd.	Kies uit: “atomair”, “collectie”, “netwerk”, “hiërarchie”, “lineair”
1.8	Aggregatie-niveau	Het niveau van dit leerobject, variërend van een los fragment (niveau 1) via een les (niveau 2) en een cursus (niveau 3) complete (deel)opleiding (niveau 4).	Kies uit: “1”,”2”, “3”, “4”

3.4.2 Educatief (5)

In deze categorie worden de wezenlijke didactische en pedagogische kenmerken van het leerobject beschreven. In Deel 2 Bijlagen wordt uitgebreid stilgestaan bij het toepassen van de velden.

LOM nr.	Naam	Omschrijving	Voorbeeld
5.1	Soort interactiviteit	De mate waarin het leerobject actief leren of juist passief leren ondersteunt.	Kies uit: “actief”; “uiteenzettend”; “gemengd”
5.2	Soort leerbron	De soorten leerbron(nen) die dit leerobject omvat. Er mogen meerdere soorten leerbronnen worden genoemd. Vermeld de meest dominante soort als eerste.	Kies uit: “simulatie”; “vragenlijst”; “diagram”; “figuur”; “grafiek”; “register”; “diaplaatje”; “tabel”; “leestekst”; “examen”; “experiment”; “probleemstelling”; “zelfbeoordeling”; “voordracht”
5.3	Interactie-niveau	De mate van interactiviteit die kenmerkend is voor dit leerobject. Onder interactiviteit wordt in dit verband verstaan de mate waarin een lerende het uiterlijk of het gedrag van het leerobject kan beïnvloeden.	Kies uit: “erg laag”; “laag”; “gemiddeld”; “hoog”; “erg hoog”
5.4	Semantische dichtheid	De mate van compactheid van de taal waarin het leerobject is geschreven. De semantische dichtheid kan worden geschat in termen van de grootte, het bereik, of – in het geval van bronnen met een vaste speelduur zoals audio- en videomateriaal – duur ervan.	Kies uit: “erg laag”; “laag”; “gemiddeld”; “hoog”; “erg hoog”
5.5	Beoogde eindgebruiker	De gebruiker of gebruikers voor wie dit leerobject voornamelijk bedoeld is of zijn. Er mogen meerdere beoogde eindgebruikers worden genoemd. Vermeld de belangrijkste eerst.	Kies uit: “leerling/student”; “docent”; “auteur”
5.6	Context	De onderwijscontext waarin het leren en gebruik van dit leerobject voornamelijk bedoeld is plaats te vinden. Er mogen meerdere onderwijscontexten worden genoemd.	Kies uit: “bachelor – eerste jaar”, “bachelor – tweede jaar”, “bachelor – derde jaar” “bachelor – vierde jaar”, “master”
5.7	Beoogde leeftijdsgroep	Leeftijd van de beoogde gebruiker. Er mogen meerdere leeftijdsgroepen worden genoemd.	“7-9”; (“nl”, “geschikt voor kinderen ouder dan 7”)
5.8	Moeilijkheids-graad	Hoe moeilijk is het voor de beoogde gebruikersgroep met of aan dit leerobject te werken.	Kies uit: “erg makkelijk”, “makkelijk”, “gemiddeld”, “moeilijk”, “erg moeilijk”
5.9	Studie-belasting	Tijd die het bij benadering of gewoonlijk van de beoogde gebruikersgroep vergt om met of aan dit leerobject te werken.	Het aantal ECTS of SBU’s punten omgerekend naar uren: “PT1H30M”
5.10	Omschrijving	Aanwijzingen hoe dit leerobject te gebruiken. Er mogen meerdere aanwijzingen worden gegeven.	(“nl”, “docenthandleiding die met het tekstboek wordt meegeleverd”)
5.11	Taal	De natuurlijke taal of talen van de karakteristieke beoogde gebruiker. Er mogen meerdere talen worden genoemd. Vermeld de belangrijkste eerst.	“nl”

3.5 Revisie: verplichte velden

Nadat een leerobject in gebruik is genomen, kan blijken dat er aanpassingen aan het object noodzakelijk zijn. In dat geval zullen de onder Levenscyclus (2) vermelde gegevens over de versie en status moeten worden aangepast. Bij kleine aanpassingen kan volstaan worden met het ophogen van het versienummer met 0.1. Bij grote aanpassingen wordt het versienummer opgehoogd naar het eerstvolgende gehele getal (bijvoorbeeld van 1.6 naar 2.0), en verandert de status van “definitieve versie” in “herziene versie”. Het is mogelijk om een herziene versie op haar beurt opnieuw te herzien. In dat geval geldt voor het versienummer wat hierboven geschreven staat. De status blijft na iedere verdere herziening “herziene versie”.

LOM nr.	Naam	Omschrijving	Voorbeeld
2.1	Versie	De versie van dit leerobject	“0.1” “3.21”
2.2	Status	De volledige status of stand van zaken van dit leerobject	Kies uit: “ontwerp”, “definitieve versie”, “herziene versie”, “niet beschikbaar”

4 Metadata voor de documentalist: definitieve metadata

4.1 Inleiding

Nadat een stuk leermateriaal door de auteur is voorzien van een eerste beperkte set metadata, wordt het vervolgens onder handen genomen door een documentalist. De documentalist heeft twee taken: het controleren van de door de auteur toegevoegde metadata en het toevoegen van metadata. Ook voor de documentalist geldt dat een aantal velden verplicht moet worden ingevuld; andere velden zijn optioneel.

Deze handleiding verschaft de documentalist de volgende hulpmiddelen bij het toevoegen van de metadata:

- Paragraaf 4.2 verschaft aanwijzingen over het controleren van de door de auteur ingevoerde metadata.
- Paragraaf 4.3 bevat een overzicht van velden die in DU-projecten verplicht ingevuld moeten worden, en velden die optioneel zijn. Let op: welke velden binnen een specifiek project verplicht zijn, kan hiervan afwijken. In de definitiefase kan besloten worden om bepaalde optionele velden voor dat project verplicht te stellen.
- In de paragrafen 4.4 en 4.5 wordt het invullen van respectievelijk de verplichte velden en de optionele velden toegelicht. De uitleg dient voor de meeste velden voldoende te zijn voor het invullen van de metadata.
- Voor wie bij het invullen meer informatie nodig heeft, bevat Deel 2 Bijlagen, bijlage 4 per veld een uitgebreide toelichting.
- Voor alle metadatavelden geldt dat bij het invoeren gebruik moet worden gemaakt van een beperkte set tekens en codes, bijvoorbeeld bepaalde tekens van het toetsenbord, codes voor de namen van talen, of indelingen uit een classificatie. In Deel 2 Bijlagen, bijlagen 5 tot en met 9 zijn de relevante sets weergegeven.

4.2 Controle metadata auteur door documentalist

Van de door de auteur aangeleverde metadata is een aantal elementen verplicht. Voor de terugvindbaarheid is het van belang dat de velden correct zijn ingevuld. Enkele richtlijnen voor de controle op de verplichte velden:

LOM nr.	Naam	Richtlijn voor controle
1.2	Titel	Controleer de eenduidigheid van de titel. De titel is niet het onderwerp van het object maar een duidelijk zichtbare tekst. Probeer bij beeldmateriaal een duidelijke omschrijving te geven. Koppel bij problemen terug naar de auteur.
1.4	Omschrijving	Let op de richtlijnen bij dit element. Het gaat hier om een korte samenvatting van de inhoud van het object.
1.5	Sleutelwoord	Hierin dienen geen trefwoorden te staan, maar specifieke beschrijvingen. Zie ook de voorbeelden bij de richtlijnen voor dit element.
2.3.1	Rol	Degene die het aangeleverd heeft is in veel gevallen de auteur. Kijk naar andere verantwoordelijken zoals redacteur, inhoudsdeskundige, initiatiefnemer
2.3.2	Auteur	Hier staan de namen van degenen beschreven in het veld met nummer 2.3.1. Let op dat de invulling van de namen volgens het vCard-formaat is gedaan.
2.3.3	Datum	Controleer de datum op juistheid en vorm. Zie ook de instructie bij de beschrijving van dit element.

4.3 Overzicht verplichte en optionele velden

De tweede taak van de documentalist is het invullen van de overige metadatavelden. Net als voor de auteur, geldt dat er voor de documentalist verplichte en optionele velden zijn. Deze staan hieronder opgesomd.

Verplichte velden voor de documentalist

LOM nr.	Naam	Defaultwaarde	Vaste waarde
1	Algemeen		
1.1	Identificatie		
1.1.1	Schemanaam	-	DUCat

LOM nr.	Naam	Defaultwaarde	Vaste waarde
1.1.2	Identificatiecodes	-	-
1.3	Taal	Nl	-
2	Levenscyclus		
2.3	Bijdrage		
2.3.1	Rol	-	uitgever
2.3.2	Persoon of organisatie	-	BEGIN:VCARD FN:Stichting Digitale Universiteit EMAIL;TYPE=INTERNET:buro@digiuni.nl END:VCARD
2.3.3	Datum	-	-
3	Metametadata		
3.2	Bijdrage		
3.2.1	Rol	-	maker
3.2.2	Persoon of organisatie	-	-
3.2.3	Datum	-	-
3.2.1	Rol	-	documentalist
3.2.2	Persoon of organisatie	-	-
3.2.3	Datum	-	-
3.3	Metadataschema	-	DULOMnlv1.0
3.4	Taal	-	nl
4	Technisch		
4.1	Bestandsformaat	-	-
4.3	Locatie	-	-
6	Rechten		
6.1	Kosten	Ja	-
6.2	Auteursrechten en andere beperkingen	Ja	-
6.3	Omschrijving	“neem contact op met DU voor voorwaarden”	-

Optionele velden voor de documentalist

LOM nr.	Naam	Defaultwaarde	vaste waarde
4	Technisch		
4.2	Bestandsgrootte	-	-
4.4	Technisch vereiste		
4.4.1	Of-groep		
4.4.1.1	Type	-	-
4.4.1.2	Naam	-	-
4.4.1.3	Minimaal vereiste versie	-	-
4.4.1.4	Maximaal vereiste versie	-	-
4.5	Installatie-aanwijzijngen	-	-
4.6	Aanvullende technische vereisten	-	-
4.7	Afspeelduur	-	-
6	Rechten		
6.3	Omschrijving	“neem contact op met DU voor voorwaarden”	-
7	Relatie		
7.1	Soort	-	-
7.2	Bron		
7.2.1	Identificatie		
7.2.1.1	Schemanaam	-	-
7.2.1.2	Identificatiecode	-	-
7.2.2	Omschrijving	-	-
9	Classificatie		
9.1	Doel	-	-

LOM nr.	Naam	Defaultwaarde	vaste waarde
9.2	Taxonpad		
9.2.1	Bron	-	-
9.2.2	Taxon		
9.2.2.1	Identificatiecode	-	-
9.2.2.2	Lemma	-	-
9.3	Omschrijving	-	-
9.4	Sleutelwoord	-	-

4.4 Verplicht in te vullen door de documentalist

De in deze paragraaf besproken velden dienen verplicht door de documentalist te worden ingevuld.

4.4.1 Algemeen (1)

Deze velden beschrijven een aantal generieke eigenschappen van het object.

LOM nr.	Naam	Omschrijving	Voorbeeld
1.1	Identificatie	De velden 1.1.1 en 1.1.2 beschrijven tezamen een wereldwijd unieke identificatiecode met behulp waarvan het leerobject kan worden geïdentificeerd. Hiervoor is binnen de Digitale Universiteit de 'DU-catalogus' ontwikkeld. Er mogen meerdere identificatiecodes worden genoemd.	zie onder 1.1.1 en 1.1.2
1.1.1	Schemanaam	De naam van het gebruikte indelingsschema. Heeft de als vaste waarde "DUCat", afkorting van "DU-Catalogus".	"DUCat"
1.1.2	Identificatie-codes	De identificatiecode die het object binnen de DU-catalogus heeft.	"DI.CONT.003.DIVIDU.1"
1.3	Taal	Er wordt van uitgegaan dat een leerobject over het algemeen in het Nederlands opgesteld is. Daarom zal de waarde meestal "nl" zijn. Er mogen meerdere talen worden genoemd. Vermeld de belangrijkste eerst.	"nl"

4.4.2 Bijdrage (2.3)

In de bijgaande velden dient aangegeven te worden wie een bijdrage heeft/hebben geleverd aan de totstandkoming van het object dat beschreven wordt.

LOM nr.	Naam	Omschrijving	Voorbeeld
2.3	Bijdrage	In dit veld wordt aangegeven wie de uitgever is.	Nvt.
2.3.1	Rol		"uitgever"
2.3.2	Persoon of organisatie	De uitgever voor producten die binnen de DU worden opgeleverd is de Digitale Universiteit. Dit veld heeft een vaste waarde, zie het voorbeeld.	"BEGIN:VCARD FN:Stichting Digitale Universiteit EMAIL;TYPE=INTERNET:buro@digiuni.nl END:VCARD"
2.3.3	Datum	Datum waarop het object wordt uitgegeven.	"2003-12-08"

4.4.3 Metametadata (3)

Aan de hand van deze gegevens is het mogelijk om duidelijk te maken wie het object van metadata voorziet. Op deze manier wordt de metadata zelf beschreven. Zo kan worden geïdentificeerd wie de metadata heeft gemaakt, hoe, wanneer en met welke referenties. Invulling van de metametadatavelden is verplicht, met uitzondering van de velden onder 3.1, Identificatie. Het identificatieschema voor DU-metametadata is nog in ontwikkeling.

LOM nr.	Naam	Omschrijving	Voorbeeld
3.2	Bijdrage	Onder ‘bijdrage’ worden de personen of instanties genoemd die bijgedragen hebben aan het invullen van de metadata. In DU-projecten worden twee rollen onderscheiden, ‘maker’ en ‘documentalist’.	n.v.t.
3.2.1	Rol	Aanduiding van de rol van maker.	“maker”
3.2.2	Persoon of organisatie	Naam van degene die als maker de metadata heeft ingevuld.	“BEGIN:VCARD FN:Jan de Vries EMAIL;TYPE=INTERNET:jdevries@host.nl END:VCARD”
3.2.3	Datum	Datum waarop de maker de metadata heeft ingevuld.	“2001-08-23”
3.2.1	Rol	Aanduiding van de rol van documentalist	“documentalist”
3.2.2	Persoon of organisatie	Naam van degene die als documentalist de metadata heeft ingevuld.	“BEGIN:VCARD FN:Jan de Vries EMAIL;TYPE=INTERNET:jdevries@host.nl END:VCARD”
3.2.3	Datum	Datum waarop de documentalist de metadata heeft ingevuld.	“2001-08-23”
3.3	Metadata-schema	Het bij het invullen gebruikte metadataschema. Dit is de op het moment van invullen gangbare DU-metadatarichtlijn en implementatiehandleiding.	“DULOMnlv1.0”
3.4	Taal	De taal die bij het invullen van de metadata is gebruikt.	“nl”

4.4.4 Technisch (4)

Aan de hand van deze gegevens is het mogelijk om het formaat, ten behoeve van het afspelen, en de plaats van het bestand in te voeren.

LOM nr.	Naam	Omschrijving	Voorbeeld
4.1	Bestandsformaat	Technisch datatype van het object. Er mogen meerdere datatypen worden genoemd. Vermeld de belangrijkste eerst.	“video/mpeg”
4.3	Locatie	Plaats waar het leerobject zich bevindt. Er mogen meerdere locaties worden genoemd. Vermeld de belangrijkste eerst.	“http://host/id”

4.4.5 Rechten (6)

Hierin worden de copyright eigenschappen van alle DU documenten beschreven. Binnen de Digitale Universiteit geldt hiervoor een standaard. Het laatste veld, 6.3 Omschrijving, is een optioneel veld, maar wordt voor het gebruiksgemak hier samen met de verplichte velden behandeld.

LOM nr.	Naam	Omschrijving	Voorbeeld
6.1	Kosten	Brengt het gebruik van het object kosten met zich mee? Dit is binnen de DU vaak, maar niet altijd, het geval. De defaultwaarde is “ja”.	“ja”
6.2	Auteursrechten en andere beperkingen	Zitten er auteursrechten en andere beperkingen op het gebruik van het object? Dit is altijd zo. De vaste waarde is “ja”.	“ja”
6.3	Omschrijving	Een omschrijving van de kosten en auteursrechtelijke beperkingen. Dit veld is optioneel; de defaultwaarde staat hiernaast weergegeven.	“neem contact op met DU voor voorwaarden”

4.5 Optionele velden voor de documentalist

In deze paragraaf worden de velden behandeld die voor de documentalist optioneel zijn. Binnen een project is het mogelijk om invulling van deze velden verplicht te stellen.

4.5.1 Technische vereisten (4)

Aan de hand van de onderstaande velden is het mogelijk om het object nader te beschrijven. In deze velden wordt aangegeven of het afspelen van het leerobject alleen mogelijk is met bepaalde technologie, of met bepaalde versies van deze technologie, en of er aanvullende technische vereisten zijn. Daarnaast is het mogelijk om afspeeltijden en aanwijzingen voor de installatie op te nemen.

LOM nr.	Naam	Omschrijving	Voorbeeld
4.2	Bestandsgrootte	De bestandsgrootte van het object in bytes	“4200”
4.4.1.1	Type	Type waartoe de vereiste technologie behoort. Er mogen meerdere vereiste technologieën worden genoemd.	Kies uit: “besturingssysteem”, “webbrowser”, “elektronische leeromgeving”; andere waarden ook toegestaan
4.4.1.2	Naam	Naam van de technologie die vereist is	“ms-windows”, “netscape communicator”, “blackboard learning system”
4.4.1.3	Minimaal vereiste versie	Laagst mogelijke versie van de vereiste technologie die nodig is om het leerobject te gebruiken	“3.1”
4.4.1.4	Maximaal vereiste versie	Hoogst mogelijke versie van de vereiste technologie waarmee het leerobject nog gebruikt kan worden	“10.6”
4.5	Installatie-aanwijzingen	Aanwijzingen voor het installeren van het leerobject	(“nl”, “Pak het zipbestand uit en start index.html in je webbrowser”)
4.6	Aanvullende technische vereisten	Aanvullende eisen die aan programmatuur en apparatuur worden gesteld	(“nl”, “geluidskaart”)
4.7	Afspeelduur	Tijd die het kost om het leerobject af te spelen op de bedoelde snelheid	“PT1H30M”

4.5.2 Relatie met andere objecten (7)

Hiermee kan de relatie van het ge-metadateerde object met andere objecten worden weergegeven. Deze groep kan meerdere malen voorkomen bij een element. Voor iedere relatie kan deze set opnieuw worden gebruikt.

LOM nr.	Naam	Omschrijving	Voorbeeld
7.1	Soort	Het soort relatie tussen het object en het andere element.	Kies uit: “isdeelvan” “heeftdeel” “isversievan” “heeftversie” “isformaatvan” “heeftformaat” “referenties” “wordtnaarverwezendoor” “isgebaseerdop” “isbasisvoor” “vereist” “wordtvereistdoor”
7.2.1.1	Schemanaam	Naam van het schema dat gebruikt wordt bij het identificeren van het andere element. Er mogen meerdere schema’s gebruikt worden.	“DUCat”
7.2.1.2	Identificatie-code	Identificatiecode van het andere element binnen dat schema.	“DI.PROJ.14.1”
7.2.2	Omschrijving	Beschrijving van de inhoud van het andere object. Er mogen meerdere omschrijvingen worden gegeven.	(“nl”, “De QuickTime-film van de Mona Lisa op de website van het Louvre-museum”)

4.5.3 Classificatie (9)

De terugvindbaarheid van het object wordt vergroot door bij het beschrijven gebruik te maken van één of meer classificatieschema’s. Bij die invulling wordt wat onder <9.2 taxonpad> staat ook verplicht. Men kan hierbij zelf een classificatieschema kiezen. Te denken valt bijvoorbeeld aan classificatieschema’s die op het eigen vakgebied gangbaar zijn. Een algemeen classificatieschema is de Nederlandse Basisclassificatie. Speciaal voor DU-projecten en expertise bij projectmedewerkers is een DU-classificatieschema ontwikkeld (zie Deel 2 Bijlagen, bijlage 5). Men kan ook een eigen classificatieschema ontwikkelen.

Men kan hetzelfde object met meerdere classificatieschema’s beschrijven. Bijvoorbeeld met het DU-classificatieschema om aan te duiden wat voor soort onderwijshulpmiddel het object is, met een classificatieschema van het vakgebied om het onderwerp van het object aan te duiden, en met een leerdoelentaxonomie om het soort leerdoel van het object aan te duiden.

Hieronder volgt een voorbeeld van een classificatie volgens het DU-classificatieschema. Wanneer je een project beschrijft dat over bedrijf gaat dat zich bezighoudt met diergeneeskunde, en je wilt de nadruk leggen op diergeneeskunde, beschrijf dat dan als volgt:
9.1 <u>Doel</u>: discipline
9.2.1 <u>Bron</u>: DU-classificatie
9.2.2.1 <u>Identificatiecode</u>: "3.2.3.4"
9.2.2.2 <u>Lemma</u>: Diergeneeskunde
9.3 <u>Omschrijving:</u> Bedrijf dat zich bezighoudt met de verspreiding van medicijnen voor dieren
9.4 <u>Sleutelwoord:</u> Bedrijf in de diergeneeskunde

LOM nr.	Naam	Omschrijving	Voorbeeld
9.1	Doel	In dit veld wordt aangegeven met welk doel men classificeert binnen het classificatiesysteem.	Kies uit: “discipline”, “idee”, “vereiste”, “leerdoel”, “toegankelijkheid”, “beperkingen”, “leerniveau”, “vaardigheidsniveau”, “beveiligingsniveau”, “competentie”. Andere doelen zijn ook toegestaan
9.2.1	Bron	De naam van het gebruikte classificatiesysteem.	(“en”, “ACM”)
9.2.2.1	Identificatiecode	De identificatiecode van het lemma waar het object onder valt. Er mogen meerdere identificatiecodes en bijbehorende lemma’s worden genoemd.	“4.3.2”

9.2.2.2	Lemma	De naam van het lemma waar het object onder valt.	(“nl”, “medische wetenschap”)
9.3	Omschrijving	Beschrijving van het object binnen het doel van de classificatie	“een medisch instrument om te luisteren wordt een stethoscoop genoemd”
9.4	Sleutelwoord	Sleutelwoorden waarmee het object beschreven wordt binnen het doel van de classificatie. Er mogen meerdere sleutelwoorden worden opgegeven.	“diagnostisch instrument”

5 Opmerkingen van gebruikers tijdens het gebruik van leermateriaal

Het metadata-veld ‘Annotatie’ bevat opmerkingen bij het didactisch gebruik van dit leerobject, alsmede informatie over wanneer en door wie de opmerkingen zijn gemaakt. Deze categorie stelt gebruikers (bijvoorbeeld onderwijsgevenden) in staat hun waardering van leerobjecten, suggesties voor het gebruik ervan, etcetera, met anderen te delen. Aan een object mogen meerdere annotaties worden toegevoegd.

Voor het werken met metadata binnen DU-projecten is dit veld minder relevant. Het veld wordt immers niet tijdens het project ingevuld, zoals te zien is in figuur 1. Ook het nemen van beslissingen over het invullen van dit veld behoort niet tot de activiteiten van het DU-project.

Annotaties kunnen zeer bruikbaar zijn voor groepen gebruikers die met hetzelfde materiaal werken. Het op deze manier werken met metadata is een groepsproces van een geheel andere aard dan het toekennen van metadata in DU-projecten, en valt verder buiten het bereik van deze handleiding.

LOM nr.	Naam	Omschrijving	Voorbeeld
8.1	Persoon of organisatie	Naam van degene die de annotatie gemaakt heeft	“BEGIN:VCARD FN:Jan de Vries EMAIL;TYPE=INTERNET:jdevries@host.nl END:VCARD”
8.2	Datum	Datum waarop de annotatie is gemaakt	“2001-08-23”
8.3	Omschrijving	De inhoud van de annotatie	(“nl”, “ik heb dit videofragment met studenten gebruikt. Ze zoomen met veel plezier in op bepaalde details van het schilderij. Zorg voor een breedbandverbinding, anders verloopt het leren te moeizaam om onderwijskundig interessant te blijven.”)

Literatuur

Sloep, Peter B., Frank Benneker en Pierre Gorissen (red.) (2003), Conceptnorm voor Leerobject-metadata; Nederlandse vertaling. Openbaar concept, versie 1.0. In opdracht van NEN, normcommissie Leertechnologie. Op 4-1-2004 gehaald van http://learningnetworks.org/downloads/36_NEN_71_LOMNLv1.0_OC.pdf.

Damstra, Auke, Michiel van Geloven en Frank Kresin (2003), Handboek technologie en standaarden voor het ontwikkelen van digitale content. [z.p.], Stichting Digitale Universiteit.

SCORM documenten:
http://www.adlnet.org

SCORM Conformance lijst:
http://www.adlnet.org/ADLDOCS/Document/SCORM_1.2_ConformanceReq.pdf

IMS Learning Resource Metadata Information Model:
http://www.imsproject.org/metadata/imsmdv1p2p1/imsmd_infov1p2p1.html

IMS Learning Resource Metadata Best Practice and Implementation Guide:
http://www.imsproject.org/metadata/imsmdv1p2p1/imsmd_bestv1p2p1.html·

Appendix I: TeleTOP® Corporate-Learning Context Conversion Mapping

Table 9 Velden voor standaard formaat formulieren

Veldnaam TT4	Inhoud	Opmerking	Gemapt veld TT5	Conversieregels
Attachments			sf-Attachments: $File	
Content	Type materiaal		sf-Description: TextHtml	1 = text 2 = html
Beschrijving		Kan Richttext zijn: ARoosterPaginaForm	sf-Description: Description	
Categorie			sf-Category: Category	
Date(created)			sf-References CreatedDate	
Feedback		Kan Richtext zijn: AInleverForm	sf-Feedback: Feedback	Richtext >>> Text
From	Auteur		sf-References: CreatedBy	
Link			sf-Link: Link	
Onderwerp		CursusInfo1Form CursusInfo2Form	sf-Subject: Subject	
Onderwerp		CursusInfoForm	sf-Subject: SubjectSelected	
Punten			sf-Feedback FeedbackAlternativeSelected	
PuntenZelf		Samen met punten 1 waarde	sf-Feedback: FeedbackAlternative	Als “FeedbackAlternative” is ingevuld, dan is “FeedbackAlternativeSelected” automatisch “custom”
OmgevingNaamLookup		Kan leeg zijn	Niet aanwezig	>>> SourceName
			sf-References: DocId	@Text(@DocumentUniqueID)
			IsNewDoc	IsNewDoc = 0

Table 10 Betreffende formulieren en uitzonderingen op het standaard formaat formulieren

Functionaliteit TT4	Gebruikte formulieren TT4	Extra velden TT4	Missende velden	Opmerking TT4	Gemapte Formulieren	Gemapte velden TT5	Conversieregels

			TT4		TT5		
Archief	Archief1Form Archief2Form ArchiefForm				f-ContentDocument	DocumentType = “archive”	
Rooster	ARoosterKopForm	Zelfstudie Beschrijving Aantekeningen Vervolg SorteerKolom		RosterHeading1 RosterHeading2 RosterHeading3 RosterHeading4 RosterDateTimeColumn	f-RosterHead	DocumentType = “rosterhead”	De automatisch aangemaakt roosterkop dient eerst verwijderd te worden.
	AroosterForm	Onderwerp Zelfstudie Beschrijving Aantekeningen Vervolg ZelfstudieLink BeschrijvingLink AantekeningenLink VervolgLink			f-RosterRow	RosterRowNr RosterRowItem1 RosterRowItem2 RosterRowItem3 RosterRowItem4 RosterRowLink1 RosterRowLink2 RosterRowLink3 RosterRowLink4	DocumentType = “rosterrow”
	AroosterPaginaForm	OnderwerpDT BechrijvingDT WelGeenOpdracht Opdracht OnderwerpAlgemeen		Gekoppeld aan AroosterForm	f-RosterPage	ExtraSubject ExtraDescription Assignment AssignmentDescription Subject	DocumentType = “rosterpage” WelGeenOpdracht: 1 = 1 (ja) 2 = 0 (nee) ParentDocId = DocId van bijbehorende Roster Row ParentColumnNumber = Kolom hierbij dient Kolom geconverteerd te worden: VoorCollege = “1” DatumPlaats = “2” TijdensCollege = “3” NaCollege = “4”
	AinleverenForm	GroepsNaam Opdracht Oplossing	Beschrijving	Gekoppeld aan ARoosterPagina	f-Assignment	AssignmentGroup AssignmentDescription AssignmentSolution	DocumentType = ”assignment”

		From				AssignmentOwners	RosterRowDocId = Kolom, hierbij dient Kolom geconverteerd te worden: VoorCollege = “1” DatumPlaats = “2” TijdensCollege = “3” NaCollege = “4”
Begrippenlijst	Begrippenlijst1Form BegrippenlijstForm	ContentLiteratuur Literatuur ContentVakken Vakken			f-ContentDocument	LiteratureTextHtml LiteratureDescription RelatedTextHtml RelatedDescription	DocumentType = “glossary” 1 = text 2 = html
Categorieen	Categorie1Form CategorieForm				f-ContentDocument		DocumentType = “category”
Werkplaats	Werkplaats1Form WerkplaatsForm				f-Workspace		DocumentType = “workspace”
	CategorieWerkplaatsForm				f-Folders		DocumentType = “wsfolder” TT4 folder documenten converteren naar één “Folders” document per werkplaats binnen TT5 ParentDocId = DocId van de Werkplaats
	DocumentForm	Categorie			f-WorkspaceDocument	Folder	DocumentType = “wsdoc” TT4: ParentUNID = DocumentUniqueID van de Werkplaats TT 5: ParentDocId = DocId

							van de Werkplaats
Cursusinfo	CursusInfo1Form CursusInfo2Form CursusInfo3Form CursusInfoForm	SessieNr			f- ContentDocum ent		DocumentType = “info”
Discussie	Discussie1Form DiscussieForm	Stelling		Alleen op zichzelf staande discussies	f-Discussion	Description	DocumentType = “discussion”
	DiscussieResponse Form	ContentStellingRespo nse StellingComputed StellingResponse OnderwerpComputed			f-Discussion	TextHtml Description (discussion) Description Subject	DocumentType = “response” ParentDocId ParentDocumentType
	DiscussieResponse ToResponseForm	ContentStellingRTR StellingResponseCo mputed StellingRTR OnderwerpResponse Computed			f-Discussion	TextHtml Description (response) Description Subject	DocumentType = “resptoresp” ParentDocId ParentDocumentType
Feedback	Feedback FeedbackResource 1Form FeedbackResource Form				f- ContentDocum ent		DocumentType = “feedback”
Groepen	Groep1Form GroepForm			Wel namen geen inhoud	f-Group		DocumentType = “group” GroupType = “target”
Vote	VoteForm			Niet gemapt, afwijkend formaat	-		
Poll	PollForm	Title			f-Poll	Subject	DocumentType =

		Question				PollQuestion	“poll”
Kwis	Kwis1Form KwisForm KwisMKForm KwisResultaatFor m KwisAntwoordFor m			Niet gemapt, afwijkend formaat			
	KwisOpenForm	Vak Kwisnaam Gebruiker Datum Vraagnummer Vraag Antwoord Oplossing WatVoorVraag		Niet gemapt, afwijkend formaat			
Multimedia	MultiMedia1Form MultiMediaForm				f- ContentDocum ent		DocumentType = “archive”
Nieuws	NieuwsForm				f- ContentDocum ent		DocumentType = “news
Presentatie	PresentatieForm				f- ContentDocum ent		DocumentType = “presentation”
Sheet	Sheet1Form SheetForm				f- ContentDocum ent		DocumentType = “archive”
Vraag en antwoord	VragenForm				f- ContentDocum ent		DocumentType = “qanda”
Weblinks	WebLinks1Form WebLinks2Form WebLinksForm				f- ContentDocum ent		DocumentType = “link”

Website	WebsiteForm			Wordt Archief	f-ContentDocument		DocumentType = “archive”
Publicatie	Publicatie1Form PublicatieForm	Auteur Auteur2 Auteur3 Auteur4 Auteur5 Auteur6 Jaartal			f-ContentDocument	PublicationAuthor01 PublicationAuthor02 PublicationAuthor03 PublicationAuthor04 PublicationAuthor05 PublicationAuthor06 YearTxt	DocumentType = “publication”
Reacties	ReactieForm	OriginalOnderwerp OriginalBeschrijving ContentStelling Stelling	Beschrijving	Afwijkend formaat Gekoppeld aan ander form?			
	ReactieResponseForm	OriginalOnderwerp OriginalBeschrijving ContentStellingResonse StellingResponse ContentStelling	Onderwerp Beschrijving	Afwijkend formaat Gekoppeld aan Reactieform			
	ReactieResponseToResponseForm	OriginalOnderwerp OriginalBeschrijving ContentStellingRTR StellingRTR	Onderwerp Beschrijving	Afwijkend formaat Gekoppeld aan ReactieResponsForm			
	ReactieResponseToResponseFormOUD			Afwijkend formaat			
Pagina	Pagina1Form PaginaForm PaginaMUForm				f-ContentDocument		DocumentType = “page”

Appendix H: Conversion Results Shell EP TeleTOP

Converted 100 docs of 143 docs total, Left: 42 (db: "02shellM148 Water Treatment", file: "courses\02shellM148.nsf")
Converted 1016 docs of 1090 docs total, Left: 80 (db: "02Shellprodchem Production Chemistry", file: "courses\02Shellprodchem.nsf")
Converted 112 docs of 241 docs total, Left: 128 (db: "01ShellM191 M191", file: "Courses\01ShellM191.nsf")
Converted 125 docs of 161 docs total, Left: 36 (db: "02Shelltemplate1 Shell Template 1", file: "courses\02Shelltemplate1.nsf")
Converted 13 docs of 52 docs total, Left: 38 (db: "02ShellFrontEnd Shell Front End", file: "courses\02ShellFrontEnd.nsf")
Converted 130 docs of 168 docs total, Left: 38 (db: "02ShellCE Me & My Service", file: "Courses\02ShellCE.nsf")
Converted 139 docs of 175 docs total, Left: 36 (db: "02shelltemplate4 Quick start site 4", file: "courses\02shelltemplate4.nsf")
Converted 139 docs of 182 docs total, Left: 41 (db: "02ShellIntro Introduction to Blended Learning Course", file: "courses\02ShellIntro.nsf")
Converted 143 docs of 199 docs total, Left: 79 (db: "02ShellComMind Commercial Mindset", file: "courses\02ShellComMind.nsf")
Converted 148 docs of 205 docs total, Left: 66 (db: "01ShellNewProfessionals1 New Professionals 1", file: "Courses\01ShellNewProfessionals1.nsf")
Converted 163 docs of 543 docs total, Left: 382 (db: "02ShellP310 P310", file: "Courses\02ShellP310.nsf")
Converted 176 docs of 305 docs total, Left: 129 (db: "01ShellE209a E209a", file: "Courses\01ShellE209a.nsf")
Converted 180 docs of 233 docs total, Left: 58 (db: "02shellP317 3D Geocap Reservoir Modelling", file: "courses\02shellP317.nsf")
Converted 180 docs of 428 docs total, Left: 92 (db: "02ShellPreview 02ShellPreview Shell Preview", file: "courses\02ShellPreview.nsf")
Converted 187 docs of 252 docs total, Left: 68 (db: "02ShellP229 P229 Facilities Integration", file: "courses\02ShellP229.nsf")
Converted 189 docs of 225 docs total, Left: 36 (db: "02Shellmodlib Business & Leadership modules Library", file: "Courses\02Shellmodlib.nsf")
Converted 199 docs of 258 docs total, Left: 59 (db: "02ShellIPO Information Planning On-Line", file: "courses\02ShellIPO.nsf")
Converted 209 docs of 562 docs total, Left: 416 (db: "02shellpetrophysics Petrophysics", file: "courses\02shellpetrophysics.nsf")
Converted 213 docs of 432 docs total, Left: 277 (db: "02ShellP262 Petrophysics for Petrophysicists", file: "courses\02ShellP262.nsf")
Converted 218 docs of 263 docs total, Left: 49 (db: "02shellSPS-ITIB IT in the Business", file: "courses\02shellSPS-ITIB.nsf")
Converted 241 docs of 364 docs total, Left: 126 (db: "01ShellStart Start page for Shell", file: "Courses\01Shellstart.nsf")
Converted 2458 docs of 2536 docs total, Left: 77 (db: "02ShellP211 Production Chemistry", file: "courses\02ShellP211.nsf")
Converted 250 docs of 332 docs total, Left: 91 (db: "02ShellBLP EP Business Leadership Programme", file: "Courses\02ShellBLP.nsf")
Converted 251 docs of 363 docs total, Left: 118 (db: "00Shellcommind Commercial mindset", file: "courses\00shellcommind.nsf")
Converted 290 docs of 326 docs total, Left: 36 (db: "02Shelldevelopmentpath2 Development Path Part 2", file: "courses\02Shelldevelopmentpath2.nsf")
Converted 3017 docs of 19149 docs total, Left: 16342 (db: "00ShellP142 Production service operations", file: "Courses\00ShellP142.nsf")
Converted 349 docs of 2099 docs total, Left: 1787 (db: "02shellonlinebidding Online Bidding", file: "courses\02shellonlinebidding.nsf")
Converted 356 docs of 474 docs total, Left: 145 (db: "02ShellFLLP Front Line Leadership Program", file: "courses\02ShellFLLP.nsf")
Converted 384 docs of 427 docs total, Left: 38 (db: "01ShellDevelopmentPath Shell Development Path", file: "Courses\01shelldevelopmentpath.nsf")

Converted 390 docs of 451 docs total, Left: 68 (db: "02ShellP284 P284", file: "courses\02ShellP284.nsf")
Converted 41 docs of 77 docs total, Left: 36 (db: "01ShellNewProfessionals5 Shell New Professionals 5", file: "courses\01ShellNewProfessionals5.nsf")
Converted 45 docs of 81 docs total, Left: 36 (db: "01ShellNewProfessionals6 Shell New Professionals 6", file: "courses\01ShellNewProfessionals6.nsf")
Converted 455 docs of 521 docs total, Left: 66 (db: "02ShellHRA09 Health Risk Assessment", file: "Courses\02ShellHRA09.nsf")
Converted 46 docs of 82 docs total, Left: 36 (db: "01ShellNewProfessionals4 Shell New Professionals 4", file: "Courses\01ShellNewProfessionals4.nsf")
Converted 47 docs of 159 docs total, Left: 51 (db: "00ShellTT TeleTOP overview", file: "courses\00ShellTT.nsf")
Converted 481 docs of 553 docs total, Left: 73 (db: "02shellEP10602 EP10602", file: "courses\02shellEP10602.nsf")
Converted 485 docs of 1508 docs total, Left: 1033 (db: "00ShellG170 Shell G170", file: "courses\00ShellG170.nsf")
Converted 49 docs of 85 docs total, Left: 36 (db: "01ShellNewProfessionals3 New Professionals 3", file: "courses\01ShellNewProfessionals3.nsf")
Converted 50 docs of 103 docs total, Left: 37 (db: "02ShellNewProfessionals8 Striving for Excellence", file: "courses\02ShellNewProfessionals8.nsf")
Converted 50 docs of 107 docs total, Left: 37 (db: "02ShellNewProfessionals9 Thinking more Creatively", file: "courses\02ShellNewProfessionals9.nsf")
Converted 51 docs of 87 docs total, Left: 36 (db: "02ShellNewProfessionals12 Management Fundamentals", file: "Courses\02ShellNewProfessionals12.nsf")
Converted 523 docs of 582 docs total, Left: 59 (db: "02ShellHRA11 Health Risk Assessment", file: "Courses\02ShellHRA11.nsf")
Converted 523 docs of 582 docs total, Left: 59 (db: "02ShellHRA11 Health Risk Assessment", file: "Courses\02ShellHRA11.nsf")
Converted 523 docs of 582 docs total, Left: 59 (db: "02ShellHRA11 Health Risk Assessment", file: "Courses\02ShellHRA11.nsf")
Converted 62 docs of 98 docs total, Left: 36 (db: "02Shelltemplate3 Shell Template 3", file: "courses\02Shelltemplate3.nsf")
Converted 661 docs of 654 docs total, Left: 109 (db: "02ShellSPS-DANDI Data and Information Management", file: "courses\02ShellSPS-DANDI.nsf")
Converted 661 docs of 654 docs total, Left: 109 (db: "02ShellSPS-DANDI Data and Information Management", file: "courses\02ShellSPS-DANDI.nsf")
Converted 67 docs of 104 docs total, Left: 37 (db: "01ShellNewProfessionals2 New Professionals 2", file: "Courses\01ShellNewProfessionals2.nsf")
Converted 70 docs of 112 docs total, Left: 41 (db: "00shellP229 P229", file: "Courses\00shellP229.nsf")
Converted 76 docs of 115 docs total, Left: 39 (db: "02ShellNewProfessionals7 Managing Priorities and Resources", file: "courses\02ShellNewProfessionals7.nsf")
Converted 92 docs of 130 docs total, Left: 38 (db: "03ShellProjectTeam Shell Project Team", file: "courses\03ShellProjectTeam.nsf")

This book is intended for those in education management and consultancy, course design and development involved in the reuse of digital educational material. The book describes issues related to the reuse of learning objects and the implementation of learning technology standards for reuse of these learning objects in different contexts (university, commercial, and military) and the human and technical aspects involved. Learning objects are defined as digital entities, available for use or reuse in different learning settings. These objects themselves may or may not have been originally created as learning objects; it is their use for learning purposes that makes them learning objects. Human aspects relate to motivation for reuse, organizational incentives, and applied learning scenarios. Technical aspects related to reuse of learning objects include the development of objects, repositories, services of repositories, and technology to exchange learning objects. The research identified dimensions related to use of learning technology standards for reuse such as organizational cultures, learning scenarios, incentives for reuse, work processes, and how learning objects are stored. The results of the research show that reuse in practice may not so much be focused on a wide exchange of all available material but rather on local level sharing within departments and even primarily on the reuse of one's own course material. The use of specifications for learning technology may not have the expected impact on adaptive learning and building courses based on learning objects from large repositories as expected by many. Instead, new developments for specifications may focus on support for more-personal reuse strategies.

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