A DISTRIBUTED ONLINE CURRICULUM AND COURSEWARE DEVELOPMENT MODEL

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF INFORMATICS
OF
THE MIDDLE EAST TECHNICAL UNIVERSITY

BY

PINAR ONAY DURDU

IN PARTIAL FULLFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN
THE DEPARTMENT OF INFORMATION SCIENCE

NOVEMBER 2007

Approval of the Graduate School of Informatics

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ABSTRACT

A DISTRIBUTED ONLINE CURRICULUM AND COURSEWARE DEVELOPMENT MODEL

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November 2007, 257 pages

A distributed online curriculum and courseware ($DONC^2$) development model is proposed in this study. Collaborative courseware development teams which may work in distributed academic or private institutions who need to develop higher quality, reduced cost, on time products are the users of $DONC^2$ development model. The related features from the disciplines of instructional design and software engineering were combined and concepts like usability, especially in terms of formative and summative evaluation, interoperability and reusability were integrated into the model.

The research is conducted as a collective case study, including four cases with distinctive characteristics to reveal the several practices in online curriculum and

courseware development work. The DONC^2 development model was proposed using the results gathered from the investigated cases and a literature survey. The model uses the iterative incremental and agile software development approaches in order to overcome the disadvantages of other linear system development approaches. This enables building releasable products in short time periods with increased quality. Furthermore, continuous communication, evaluation and feedback as well as good project management and readiness to adapt to changes are integrated as the essential characteristics. DONC^2 development model is different than previous linear and non-adaptive models in all of these aspects.

Keywords: Virtual learning environments, online curriculum and courseware development, e-learning, adaptive software development

ÖZ

DAĞITIK ÇEVRİMİÇİ MÜFREDAT VE DERS MATERYALİ
GELİŞTİRME MODELİ

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Kasım 2007, 257 sayfa

Bu çalışmada, dağıtık çevrimiçi müfredat ve ders materyali (DÇMDM) geliştirme modeli önerilmektedir. Yüksek kalitede, düşük maliyetle zamanında ürün geliştirme ihtiyacında olan ve de aynı zamanda dağıtık olarak akademik ya da özel kurumlarda çalışan işbirlikçi ders materyali geliştirme takımları DÇMDM geliştirme modelinin kullanıcılarıdır. Öğretim tasarımı ve yazılım mühendisliği disiplinlerinden ilgili özellikler birleştirilerek kullanılabilirlik, özellikle biçimlendirici ve sonuç değerlendirme, birlikte işlerlik ve yeniden kullanılırlık gibi kavramlar modele entegre edilmişlerdir.

Araştırma, çevrimiçi müfredat ve ders materyali geliştirme ile ilgili farklı uygulamaları ortaya çıkaran ayırt edici özellikleri olan dört durumun incelendiği

kolektif durum çalışması olarak gerçekleştirilmiştir. DÇMDM geliştirme modeli incelenen durumlardan çıkan sonuçlar ve literatür araştırması kullanılarak önerilmektedir. Model lineer sistem geliştirme yaklaşımlarının dezavantajlarını gidermek için tekrarlanan artışlı ve çevik yazılım geliştirme yaklaşımlarını kullanmaktadır. Bu da kaliteli ve kısa sürede kullanıma sunulabilir ürünler geliştirmeyi sağlar. Bunun yanında, sürekli iletişim, değerlendirme ve geribildirim, iyi proje yönetimi ve değişikliklere adapte olabilme gerekli özellikler olarak entegre edilmişlerdir. DÇMDM geliştirme modeli önceki lineer ve değişime adapte olamayan modellerden tüm bu yönlerden farklıdır.

Anahtar Kelimeler: Sanal öğrenme ortamları, Çevrimiçi müfredat ve ders materyali geliştirme, e-öğrenme, uyarlamalı yazılım geliştirme

To my beloved husband

Levent

ACKNOWLEDGMENTS

Heartfelt thanks go to my advisor Professor Neşe Yalabık for her support, guidance, encouragement and patience throughout the study. She has been the driving force in the completion of this dissertation. Until present, she has taught me more than being a good academician by sometimes being a friend or sometimes being a family. Our Monday lunches, cooking sessions and many other activities we did together provided motivation as well as relaxing study atmosphere. Her insight and enlightenment will provide guidance in my future life.

I owe special thanks to Professor Semih Bilgen and Associate Professor Kürşat Çağıltay who have always welcomed me whenever I had questions throughout the whole progress. I have truly enjoyed the guidance and the thought stimulating conversations I had with them.

I wish to extend my sincere thanks to Professor Petek Aşkar and Associate Professor Onur Demirörs for their suggestions and remarks for the study. I would also thank to Professor Hülya Yıldırım from Kocaeli University for her support and belief in me.

I am sincerely grateful to Professor Murat Tanık from University of Alabama (UAB) for providing a research opportunity at his department and for providing support and guidance during my visit.

I would like to acknowledge all the interviewees and the participants in the case studies who spent their time, and shared their views and experience with me. They deserve more than a simple “thank you”.

I would like to thank to my friends Selma-Levent Bayram, Gonca-Bülent Emiroğlu, Selvim-Mohammed Khalil, Duygu-Halil Ersoy, Canan Kılınç, Ercan Top, Özkan Ülgen for their in-valuable supports and friendships since my undergraduate years. Also thanks go to little Ahmet, my sweetheart, for his joy brought to my life. A special thanks to Erden Ülgen, as my second sister, I cannot imagine my whole undergraduate and graduate years without her insight, positive energy and support.

Also thanks go to my present friends and future colleagues from OYP-Kocaeli group; especially Nadide Seyhun, Berna Unutmaz, Mutlu Pilavtepe, Özlem Karaırmak, Bora Acun and Gökhan Özdemir for their continuous and full support (hep destek tam destek). The activities we did together added joy and motivation to this tiring dissertation process.

I also want to thank to my friends in the IS department, especially to Nigar Şen Köktaş and my office roommate Hacer Karacan for their endless support and motivation and without tea breaks with them the thesis writing process could not be finalized. Thanks go to Yasemin Karagül for her being a gracious friend since my first day at the department and Cemile Serçe especially for her invaluable help during the qualification study period. Thanks to our departmental secretaries Sibel Gülnar, Ali Kantar and Ayşe Ceylan for solving every academic or administrative problem in the shortest time as much as possible with a smiling face as well.

I would also like to thank Demet Gürler from UAB for sharing her house with me, without knowing me before and for her being a helpful friend on all my struggles and Özgür Aktunç for his friendship and help on all administrative issues at UAB.

Thanking my parents can never be enough; I felt their support and trust in me in every frame of my life. I express special appreciation to my beloved parents, my mother Sevim and my father Süleyman Onay for thanks for their endless love,

blessing, care, support, understanding, encouragement, enthusiasm, patience, teaching me all the good manners and everything and most of all for being my parents and being just the way they are. Mummy, daddy, I hope I made you proud. The love, joy and support of my lovely sister, Deniz, has definitely made my life a better place. Special thanks to my dear mother-in-law Nevin Durdu and father-in-law Atıf Durdu and my brother-in-law Mehmet for their support, understanding and patience*.

Most of all, I am particularly indebted to my beloved husband, my love, my life Levent Durdu for his endless love, care, patience, understanding, support, motivation, encouragement, respect, belief in me, making life easy, making world a better place to live, giving me the power to make a stand against all the negativeness, and taking care of meals and housework. Without him, it was impossible for me to finish my Ph.D.

*Aileme ne kadar teşekkür etsem azdır: Destek ve güvenlerini hayatım boyunca hep hissettim. Sevgili ailem, annem Sevim ve babam Süleyman Onay'a bana olan sonsuz sevgileri, hayırduaları, destekleri, anlayışları, sabırları, bana öğrettikleri iyi davranışlar ve her şeyden önemlisi ailem oldukları ve de oldukları gibi oldukları için çok teşekkür ederim. Anneciğim babacığım umarım sizi gururlandırabilmişimdir. Kardeşim Deniz'in sevgisi, neşesi ve desteği hayatımı daha iyi bir hale getirdi. Sevgili Nevin annem, Atıf babam ve kardeşim Mehmet'e de destekleri, anlayışları ve sabırları için özel olarak teşekkür etmek isterim.

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LIST OF ABBREVIATIONS

ADDIE	Analyze Design Develop Implement Evaluate
ADL	Advanced Distributed Learning
AECT	Association for Educational Communications and Technology
AICC	Aviation Industry CBT Committee
AKC	Avicenna Knowledge Center
AP-1	Avicenna Phase 1
AP-3	Avicenna Phase 3
ASD	Adaptive Software Development
AVD	Audio/Video Director
C	Coordinator
CBT	Computer-Based Training
CD	Content Developer
CME	Continuing Medical Education
CMS	Content Management System
$DONC^2$	Distributed Online Curriculum and Courseware Development
DSD	Distributed Software Development
EM	Evaluation Matrix
EPPICC	Equipping Primary Care Physicians to Improve Care of Children
EUMEDIS	EURO-MEDiterranean Information Society
HCI	Human Computer Interaction
ID	Instructional Design
IEEE	Institute of Electrical and Electronics Engineers
INT_1	Interview Guide 1

INT_2	Interview Guide 2
INT_3	Interview Guide 3
ISD	Instructional System Design
ISO	International Standards Organization/International Organization for Standardization
LCMS	Learning Content Management System
LMS	Learning Management System
LO	Learning Objects
LOM	Learning Object Metadata
LTSC	Learning Technology Standards Committee
MD	Multimedia Designer
PE	Pedagogical Expert
PI	Principal Investigator
PD	Project Director
PM	Project Manager
PMBOK	Project Management Body of Knowledge
SBS	Siemens Business Services
SCORM	Sharable Content Object Reference Model
SD	Software Developer
SME	Subject Matter Expert
TE	Technical Expert
TM	Team Manager
UNESCO	United Nations Organisation for Education, Science, Culture and Communications
VD	Visual Designer
VLE	Virtual Learning Environment

CHAPTER 1

INTRODUCTION

This introductory chapter addresses the issues that underlie the background of the study, the purpose of the study including the problem statement; significance and contributions of the study and finally, the outline followed throughout this thesis report.

1.1. BACKGROUND OF THE PROBLEM

The number of people who are seeking a university degree, skill enhancements or lifelong learning has increased tremendously. This forced universities/companies to find new ways to provide education to the mass learners and recent developments in information technology and Internet have enabled these such as delivering web-based courses via "virtual learning environments" (VLE) (Xu, Wang &Wang, 2005, p.525). Many institutions started projects to employ e-learning, which have the goal of "learning anytime and from any place" (Barjis, 2003, p.4).

The features of the VLEs should be very different from the traditional classroom settings since there is no face to face interaction between the instructor and the students. On the other hand, VLEs may provide many additional opportunities for achieving enhanced and enriched learning outcomes through the use of the web for effective instruction and can be a promising alternative to traditional settings

(Zhang, Zhao, Zhou & Nunamaker, 2004). Web-based teaching can facilitate learner interactivity and also can provide a great amount of resources. Courses should use innovative and dynamic learning materials in order to enhance learner interaction. Unfortunately, these advantages are still not being used effectively since usually traditional instructional design methods are transferred to the web as if they were in the traditional settings. In addition, there is still no commonly accepted framework to guide developers in their design of curricula (Oliver & Mcloughlin, 1999). On the other hand, collaboration of a number of institutions might be important for the use of best resources in online material development and teaching.

One of the important requirements for the effective learning environment is the learning resources and activities to be included. This requirement is also valid for the VLEs which are made up of online courses. In the literature, any form of computer or web based learning materials or computer-learning systems using digital media is called courseware (Dwolatzky, Kennedy, Owens, 2002). Similar to that definition for courseware, Grützner, Weibelzahl and Waterson (2004) defined the term as "all kind of educational material and content that is distributed via the web for training purposes from the users point of view as well as collections of multimedia documents interrelated by means of navigational structures" (p.946).

The quality of the developed courseware is affected by many factors such as the content being correct, functional and the way it is presented (Grützner, Weibelzahl and Waterson, 2004). These factors are directly related to the area of instructional design. Approaches other than instructional design should also be considered since they may help the development of effective courseware. One of these areas is the software development approach, as developing a courseware involves the development of computer-mediated material, which is also a software product. Moreover, its users also determine the effectiveness of courseware, just as in any software product. How easily and quickly they can learn to use the material and their interaction with the courseware are important issues. Based on these

assumptions, knowledge from the human computer interaction (HCI) or usability field could also be helpful. In addition to this, the integration of approaches like formative and summative evaluation from the field can also be helpful to the developed model. Furthermore, requirements for the online courseware to be quickly available necessitate rapid development or update. This issue brings forth the concept of reusability of the courseware materials in order to enable to re-use the materials for different courses.

1.2. PURPOSE OF THE STUDY

In order to understand the key concepts and processes included in any approach, we need models. They are the shorthand methods of communication and they can be verbal, visual or the combination of both. They can also be considered as road maps or guides that suggest what to do and when to do but not how to do that (Molenda, Pershing & Reigeluth, 1996). Gustafson and Branch (1997) claim that, "models help us to conceptualize representations of reality" (p.17).

In this study, the major purpose is to propose "a distributed online curriculum and courseware development model" ($DONC^2$) by considering all related disciplines of instructional design, software engineering, usability specifically in terms of formative and summative evaluation approaches and some concepts like reusability and interchangeability. This model can be applied as a roadmap to develop a complete program or curriculum in addition to develop an individual courseware. Specifically, this study aims at determining the distinctive characteristics of design and development process which will result in an effective courseware, in addition to avoiding the bad practices which will affect the process in a negative way. Additionally, it concentrates on the working principles and tries to make suggestion to improve them or to eliminate the excessive ones with an interdisciplinary approach.

The following research questions were investigated to form a model for distributed online curriculum and courseware development:

- What are the primary distinctive characteristics of an effective design and development process that combines the best practices of instructional development and software development models?
- Which activities should an effective distributed development model incorporate?

1.3. SIGNIFICANCE OF THE STUDY

The effectiveness of courseware materials is important for the success of the VLEs. On the other hand, actually the curriculum, which the courseware is included in, is essential. In the scope of this study, the term "curriculum" is used to represent a group of courses that will serve for a degree or a certification program or a group of related courses that will be served together for any common goal. Based on this definition, all courses in the curriculum are needed to be considered as related to each other. That will help learners progress from basic levels to higher ones in harmony while each course being unique with its own purpose, objectives and requirements. All the courses should be evaluated in the context of the whole curriculum. The course must have its own special correct place in a program to lead to a degree (Porter, 2004). No study that develops a model for curriculum development, which also incorporates all the issues of collaborative courseware development in it for the VLEs, has yet been proposed. Instructional design models are not sufficient as they lack many issues related to the development of course software. There are some attempts that have tried to integrate the instructional design models with software engineering models (Tripp and Bichelmeyer, 1990, Willis, 1995, 2000). However, these are generally direct adaptations of the software models, so instructional issues are not satisfactorily included. Besides, usability, reusability or standardization issues are usually missing. Furthermore, the collaboration issue is not considered in most. It is believed that the findings of this study will reveal important information for the success of online courseware development efforts and create a flexible development model that will aid the developers.

The developed model (DONC^2) which constitutes the main contributions of this study covers the necessary principles from instructional design. These principles are careful analysis of the setting and learner needs; design for an effective, efficient and relevant learner environments; development of all learner and management materials; and evaluation of the results of development both formatively and summatively.

The model also adopts and integrates the methodologies from software engineering especially the ones that emphasize iterative and incremental development. This is based on the negative experiences of the linear methodologies. They emphasize the linear development by analyzing all the requirements at the very beginning of the development process so they cannot be succeeded due to the changeable nature of requirements. In addition, the scope of this study involves the human whose behavior cannot be predicted, which also makes it impossible to determine all the requirements at the beginning of the development process. Therefore, the model integrates components from the agile development methodologies as well, due to the changeability of the environment. Adaptive software development (ASD) approach is mainly adapted as the software development approach.

In addition to the above, the model integrates issues from the usability field, in order to ensure the usability of the materials as the main interaction is held between the computers and students. Usability ensures the ease of learnability of the learning environment as well as the learning content, which increases the effectiveness. In addition to that usability approaches are also considered since they focus on formative and summative evaluation methods needed to be implemented throughout the whole development process in order to ensure the effectiveness of an instructional product (Crowther, Keller, Waddoups, 2004).

Due to the high-speed and high-change in knowledge generation, there is a need of quick processes for the development and possible changes in the material. Therefore, some other concepts which can improve the quality of the product as

well as fasten the development process like reusability and interchangeability are also integrated in the model.

To sum up, the proposed model primarily is different from the previous systems in that it provides a roadmap to develop online courseware all of which will be combined in the scope of a curriculum. The model gives the necessary components that should be considered in a development effort starting from the planning of the work to the development and integration of the individual courseware. In other words, it represents the generic design and development processes, rather than giving step by step individual activities. In addition to these it also emphasizes to the usability and formative evaluation, interoperability and reusability concepts and involves components that ensure to provide them.

1.4. RESEARCH METHODOLOGY USED

The nature of this research required the use of qualitative data collection and analysis techniques. Case study research is the most common qualitative method used in information systems. It is defined as an empirical enquiry that examines a fact or process in its real life settings especially when it cannot be seperated from environmental factors (Yin, 2003). Online courseware development projects were examined as cases to see the problematic points as well as best practices that could be applied to the proposed development model.

An iterative incremental approach was used in the design of the study. In the first iteration, an online courseware development project was investigated (Avicenna Phase 1). At the end of this iteration first version of the development model was defined. In the second iteration, one more online courseware development project was investigated (SBS). In addition, validation activities for the proposed model took place by applying the model as an evaluation framework to an online courseware development project (EPPICC) in the second iteration and applying it for planning the implementation of another courseware development project

(Avicenna Phase 3) in the third iteration. At the end, final form of the model was established after the necessary revisions.

1.5. ORGANIZATION OF THE DISSERTATION

In Chapter 1, first the concept of online courseware development as well as its need is introduced and then the statement of problem, the purpose and significance of the study are briefly explained.

In chapter 2, a review of related disciplines of instructional design, software engineering, usability approaches, and concepts of reusability and interchangeability considered in the development of the proposed model is given. The chapter provides the background to the study by describing what has been done so that document the significance of this study by showing the work that has not been covered by prior research.

In Chapter 3, the design of this study is explained in detail. The section first explains the research strategy and its rationale. Next the data collection techniques that are used are presented. Afterwards the implementation process is presented by giving information about the background of the selected cases including their context and participants. Then the data analysis procedure is defined. Finally the trustworthiness of the study is discussed.

In Chapter 4, the findings of the four cases are reported. Major common and distinctive findings of the cases are discussed. Answers to two fundamental research questions mentioned in Section 1.2 are elaborated in this chapter.

In Chapter 5, the DONC^2 development model is described in detail.

In Chapter 6, first, main results, strengths and shortcomings of the study are presented. Next, further research opportunities are suggested.

Finally, in the appendices section, the data collection instruments used for the cases, evaluation matrices applied, the sample project schedule based on the

model, the detailed overview of the models and the screenshots of the web interface provided for the model are included.

CHAPTER 2

A SURVEY OF THE METHODOLOGIES USED

This chapter addresses the disciplines related to the thesis work. More specifically, disciplines that are used to develop the proposed model are summarized. The work done in the disciplines of curriculum development, instructional design (ID), software development, virtual learning environments, usability and reusability are presented. The adapted and applied principles from the related discipline are also listed. In addition to these directly related disciplines, some other areas that will help increase the effectiveness of model such as distributed software development or virtual teamwork are also mentioned.

2.1. VIRTUAL LEARNING ENVIRONMENTS (VLE) AND DELIVERY METHODS USED

VLEs are the new forms for providing education. In other words, they are the online learning systems which provide a complete environment including various features such as course materials, evaluation instruments or communication and collaboration tools (Ryan, Scott, Freeman & Patel, 2000). Some of the advantages of these VLEs can be listed as that they provide learning anywhere and at any time with various others, who have different backgrounds and who are distributed geographically, in a cost effective way (Bourne, McMaster, Rieger & Campbell,

1997). On the other hand, these advantages may turn into disadvantages if traditional classroom settings are tried to be applied directly.

Course materials are delivered generally in two ways which are HTML-based or video-based lectures in these VLEs. The HTML-based lectures are formed of text-based material as in web pages sometimes supported with the graphics, simulations or graphics while video-based courses are in the form of real lecture in a classroom and sometimes supported with other multimedia elements as in HTML-based lectures (Kurbel, 2002; Deniz & Karaca, 2004). Therefore online delivery methods can be categorized more specifically under these two general categories as follows (Anderson, Barnwell, Hayes & Jackson, 2000, p.3)

1. HTML only
2. HTML synchronized with audio
3. HTML with audio and Flash animation
4. Streaming video only
5. Streaming video synchronized with an HTML presentation
6. Streaming video, Flash animation, HTML slides, Java enhanced pages, etc.

Especially the video based or multimedia supported video based lectures have been emerged especially due to the developments in streaming video technologies since their delivery become easier. However, careful consideration is required for the implication of these delivery types since the preparation time required for them takes longer. In addition people's internet connections can still be limitations so the smallest possible Internet connection types of the users should be considered for integrating video (Kurbel & Pakhomov, 2004). Besides, some researchers (Carr-Chellman & Duchastel, 2000) propose minimal use of videos rather than delivering whole lecture in this form to prevent "transfer of the traditional sage in the stage experience to sage in the box version" (Bourne, et al., 1997). Use of additional materials is needed to support both video-based or

HTML-based lessons are required for them to be pedagogically effective as in the third, fifth or sixth category above.

2.2. ONLINE CURRICULUM DEVELOPMENT

Possibly the most important factor for the success of the virtual learning environments (VLE) as well as traditional ones is well developed curriculum which is enhanced with effective learning. Students seek innovative and interactive online programs with a successful curriculum. They require effective learning environments that will provide better experiences than traditional face to face environments (Porter, 2004). The features of effective learning environments can be listed as "knowledge centered, learner centered, assessment centered and community centered" (Pellegrino 2004, pp. 34-35) Therefore, there is a need to find better ways to deliver the learning materials and to produce effective learning environments rather than copying the traditional classroom experience by simply putting the materials on websites.

Tanner and Tanner define a curriculum, in general, as a "set of planned and guided learning experiences for the learners' continuous and willful growth" (p. 5, cited in Wiles, 1999). Similar to that, Dijkstra (2004a) gives the definition as "a plan to realize a goal of education that prescribes a) the content of the information and problem-solving methods of a domain; b) the objectives the students should reach in the cognitive, affective and motor domains; and c) the sequence in which these can be learned by students of a certain group in an estimated period of time" (p.149). Based on these definitions, it can be revealed that developing curriculum for teaching online also requires a well-developed plan.

Alternatively, the term "curriculum" is used in a different way than the above definitions. Without excluding the above definitions, it is mainly used to represent a group of courses that will be served for a degree or a certification program in the scope of this study. Moreover the courses can be a group of related courses that will be served together for any common goal.

Porter (2004) stated determining the type and amount of interaction that is adequate for effective instruction can be the starting point for developing an online curriculum and listed the other points to be considered are as follows:

- Each course forming the curriculum should be well developed and complete in itself.
- Courses in the curriculum should present a manageable amount of content in a specific time period, as well as activities that can be completed online.
- Although each course is unique in itself, it should have similarities in design with the other courses in the curriculum. Their structure and the technologies used in them should also be similar. This provides learners to transfer their skills they got from one course to others.
- Each individual course in the curriculum has a different role and a different level from basic and introductory to high levels of knowledge, involving critical thinking and mastery of skills. There can also be courses from interrelated disciplines. When all these courses come together, they make contribution to an overall purpose like a degree.
- Interaction provided to learners in the courses is also very important. Creating an online community of learners and providing socialization are the crucial parts of online courses and curriculum.
- The order of learning in the arrangement of the courses should consider the pre-requisites and complementary nature of the material.

It can be understood from the above-mentioned points that deciding to offer online education in your institution is not enough; effective curriculum is also required for success. The structure and design should provide complete, well designed and cohesive as well as innovative and interactive curriculum. Although the Web technologies provide useful tools and settings for providing effective learning environment, there is still no commonly agreed upon curriculum

framework to guide developers in their designs (Oliver & Mcloughlin, 1999). However, Dijkstra (2004a) mentions about a general heuristic, which is suggested for the curriculum design, including the steps of "needs analysis, the description of the goals and the knowledge and skills to be acquired and the selection, description and analysis and sequencing of the main components of the domain" (p.151).

Particularly, curriculum development deals with the determination of objectives, learner characteristics, instructional contents and strategies, learning assessment and learning resources which are also the components of the field of instructional design. On the other hand, curriculum development is more limited than ID as it only covers the determination issues regarding the learning environments whereas ID involves all steps of planning and construction of these learning environments. Alternatively the scope of ID is less than curriculum as it concerns the activities in a larger time scale like a whole grade level or degree. To sum up curriculum development implies a "global planning" whereas ID implies "detailed planning" (Seel, 2004, p.137). After the global structure of the curriculum is designed, the instructional design theory and rules are applied to the design of the learning environment specifically. Curriculum affects the ID while ID bridges the global planning of curriculum and the construction of learning environment (Seel, 2004).

2.3. INSTRUCTIONAL DESIGN

Dijkstra (2004b) refers the ID as the rules for designing and developing effective learning environments. Therefore, ID is also an essential discipline for the VLEs development. The terms 'design' and 'development' are used interchangeably in the literature. Instructional design is a systematic approach to designing instruction and instructional materials to achieve specified learning objectives whereas instructional development is primarily the process of developing instruction for computers or other media (Bostock, 1996). Seels and Richey (1994) provide another term, 'Instructional System Design' (ISD), instead of instructional development by defining it as a procedure composed of analyzing,

designing, developing implementing and evaluating instruction. Schiffman (1995) defines ISD as "a blend of psychology, education, communications, management, systems theory and social sciences" (p.133). Similar to that, Association for Educational Communications and Technology (AECT) (1977) also adds management patterns to the definition of instructional development and proposes that instructional development is more than design as design is one of the steps involved in the development process. Based on these definitions, it can be understood that instructional development is more than just only preparing the lessons but also involves the determination of instructional strategies, motivation elements and learner actions (Gustafson, Branch, 1997). Another view is from Reigeluth (1983) who defines 'instructional design' as the production of knowledge of instructional methods whereas 'instructional development' as the process of developing instruction with the methods produced by instructional design.

Instructional design is independent of the use of computers to deliver the instruction (Bostock, 1996). After the process of learning, each individual gets different learning outcomes and Gagne (1985, cited in Gagne, Briggs & Wager, 1992) proposes that the same types of instructional activity are needed to gain the learning outcomes for all learning process. He suggests that there are Nine General Events of Instruction:

1. Gaining attention
2. Telling learners the learning objective
3. Stimulating recall of prior knowledge
4. Presenting the stimulus
5. Providing learning guidance
6. Eliciting performance
7. Assessing performance
8. Providing informative feedback
9. Enhancing retention and transfer to other contexts

These activities provide a good starting point for designing any instruction. Based on these activities, the development process can be described as follows (Gagne, 1985, cited in Bostock, 1996):

- *Analyzing the requirements:* First, the types of learning outcomes are identified. From these outcomes, a learning hierarchy is formed. Then the internal and external conditions that enable the learner to achieve the determined outcomes are defined.

- *Selecting Media*: This stage involves recording the learning context as well as the characteristics of the learners. Moreover, the media required for the delivery of instruction is selected.

- *Design Instruction*: This stage involves planning the instructional activities that will support learning based on the Nine Events of Instruction. The developed instruction is tested and after the use of the instruction, a summative evaluation is done.

2.1.1. Instructional Design/Development Models

Models are needed to understand the key concepts and processes included in any approach. They are the shorthand methods of communication and they can be verbal, visual or the combination of both. They can also be considered as road maps or guides that suggest what to do and when to do but not how to do that (Molenda, Pershing, Reigeluth, 1996). Gustafson and Branch (1997) claim that, "models help us to conceptualize representations of reality" (p.17). They (1997) also propose four components that should be included in all instructional development models:

- Analysis of the setting and learner needs;
- Design of a set of specifications for an effective, efficient and relevant learner environments;
- Development of all learner and management materials; and

- Evaluation of the results of the development both formatively and summatively. (p. 12)

They have also added a fifth activity, which is the distribution and monitoring of the learning environment across varied settings, over an extended period of time.

Instructional development is a complex process that also involves some degree of creativity and interactivity and requires continuous feedback. Therefore, the instructional development models communicate their processes visually. They also provide "some communication tools for determining appropriate outcomes, collecting data, analyzing data, generating learning strategies, selecting and constructing media, authentic assessment, revision and implementation" (Gustafson and Branch, 1997, p.18). ADDIE (Analyze, design, develop, implement and evaluate) is the prescriptive instructional design model, which describes the essential components of any instructional development process. Core elements of instructional development and their interaction are given in Figure 2.1.

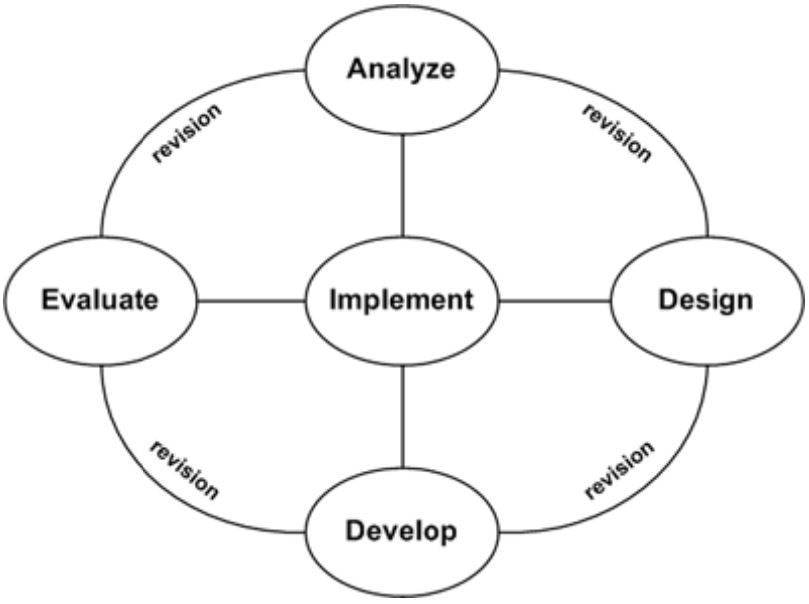

Figure 2.1: Core elements of instructional development (Gustafson & Branch, 1997, p.21)

Since the 60s, there have been an increasing number of models published in the literature. Gustafson and Branch (1997) have provided taxonomy for the classification of the major known instructional development models. This taxonomy can be helpful for understanding the assumptions in each model as well as helping to decide which one of the many alternatives to choose and when to choose it (Plotnick, 1997). This taxonomy includes three sub-categories:

- *Classroom orientation ID models*: These models include only a few functions and simply provide guides to the classroom teacher in their instruction. The size of the planned instructional event and the amount of resources planned to be used are small and there is no requirement of a team effort. There is only one who plans the use of the existing material rather than creating new ones.
- *Product Orientation ID Models*: These models are more than classroom oriented ones in that they require developing new materials, which take at least a few hours or days of length. These also require the involvement of a team.
- *System Orientation ID Models*: These models involve a substantial amount of instruction, such as an entire course or an entire curriculum. Therefore, a team and significant amount of resources are required.

The models that have been published since 60s are mainly based on ADDIE at their core (Gagne, Wager, Golas & Keller, 2005). The Smith and Ragan's Instructional Design (1993) and Dick and Carey's Systematic Design of Instruction model (1996) are two classical examples. Both are categorized in the system orientation since they include systematic design concepts and applications. Both can be considered as detailed and comprehensive models which consider the components of an instructional context like the learners and the environment and also emphasize on examination and revision of instruction and enable making improvements. However, they are criticized as being rigid and linear (Figure 2.2 and Figure 2.3).

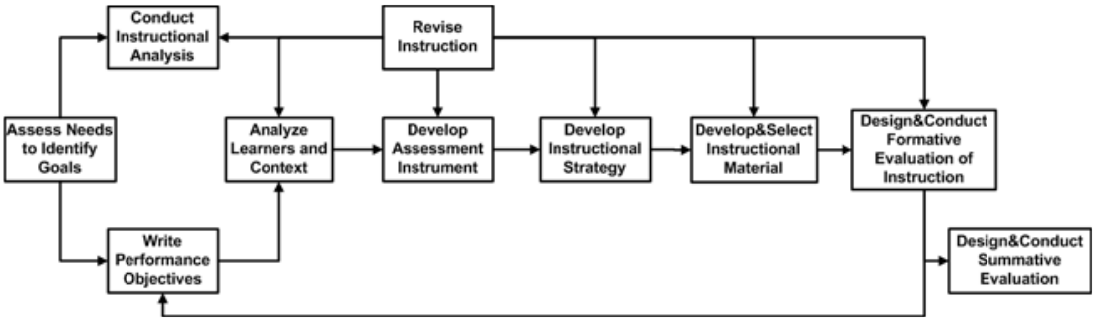

Figure 2.2: Systematic Design of Instruction (Dick & Carey, 1996, pp. 16-17)

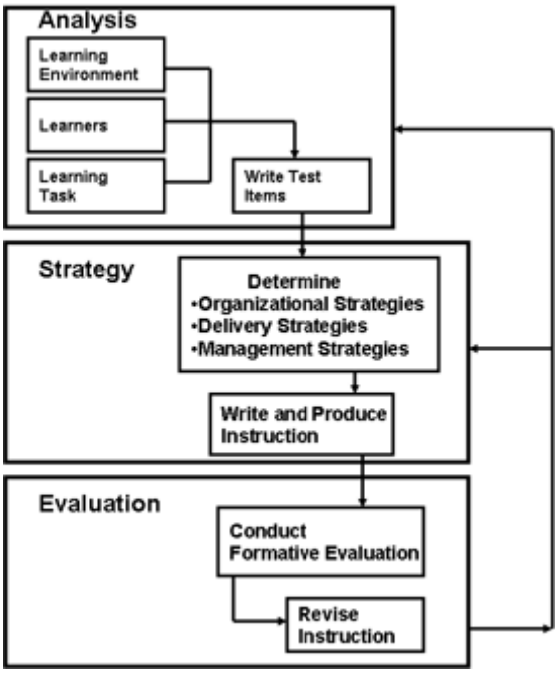

Figure 2.3: Instructional Design (Smith & Ragan, 1993, p.8)

After the advent of microcomputers in 1980s, the instructional development models have been affected due to the added capabilities and interaction required by this new technology as well as the requirements based on the new status of society. Reigeluth (1999) outlines a major shift from Industrial Age to Information Age thinking which can be seen in Table 2.1. A need for alternative instructional design strategies, which did not use linear strategies were needed

based on these shifts from industrial age to information age (Reigeluth, 1999). In addition to that, the similarities exist between instructional design and software engineering fields caused instructional design models affected by the software engineering applications.

Table 2.1: Key markers that distinguish industrial-age and information age organizations (Reigeluth, 1999, p. 17).

Industrial Age	**Information Age**
Standardization	Customization
Bureaucratic organization	Team-based organization
Centralized control	Autonomy with accountability
Adversarial relationships	Cooperative relationships
Autocratic decision making	Shared decision making
Compliance	Initiative
Conformity	Diversity
One-way communications	Networking
Compartmentalization	Holism
Parts oriented	Process oriented
Planned obsolescence	Total quality
CEO or boss as a “king”	Customer as a “king

The first adaptations of software engineering can be seen in rapid prototyping model that was adapted to the development of instructional environments, by Tripp and Bichelmeyer (1990). In the traditional design models, the linear design process assumes the predictability of human behavior but the entire process of learning cannot be determined fully at the beginning. On the other hand, the rapid prototyping approach brought in “the pragmatic design principle of minimum commitment” (Asimow, 1992, cited in Tripp & Bichelmeyer, 1990, p.37, Wilson & Wilson, 1965, cited in Tripp & Bichelmeyer, 1990, p.37)

As in software engineering field, the rapid prototyping design in instructional systems is “the building of a model of the system to design and develop the system itself” (Tripp & Bichelmeyer, 1990, p.36). It allows the parallel processes

of core elements of instructional development (Gustafson & Branch 1997) as can be seen from the Figure 2.4.

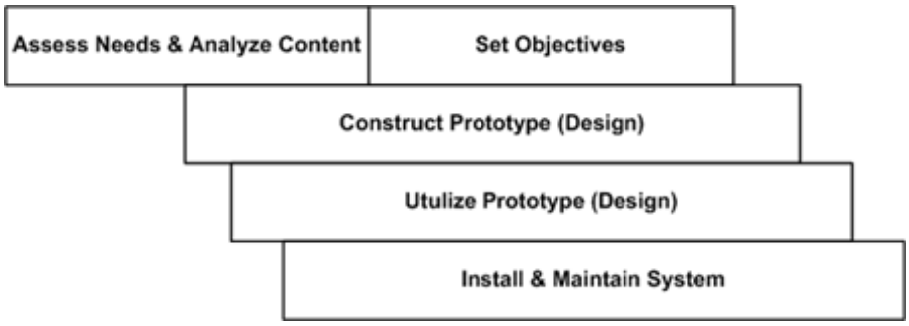

Figure 2.4: Rapid prototyping approach adapted to Instructional Design

In this model, after the needs and objectives are briefly stated, research and development are conducted as parallel processes that create prototypes, which go under testing and which may or may not evolve into a final product. This provided the design of full system and allowed the rapid synthesis and modification of the system. Moreover, an efficient process replaced the slow process of detailed specification. On contrary, it has tendency to encourage informal design methods, which may introduce more problems than they eliminate. While applying this method, care should be taken in order to prevent very early commitments to design and reduced creativity. Prototyping can lead to the less efficient designs (Tripp & Bichelmeyer, 1990).

A recent instructional design model is the one that was proposed by Kemp, Morrison and Ross (2004) and is called as the "instructional design plan". It contains nine elements that can be seen in Figure 2.5. In addition to the activities seen in the figure, assessment and measurement activities as well as planning and project management activities for designing instruction in an organization are added. This model is different from all the previous ones as it does not apply any specific sequence and considers the design and development process as a continuous cycle.

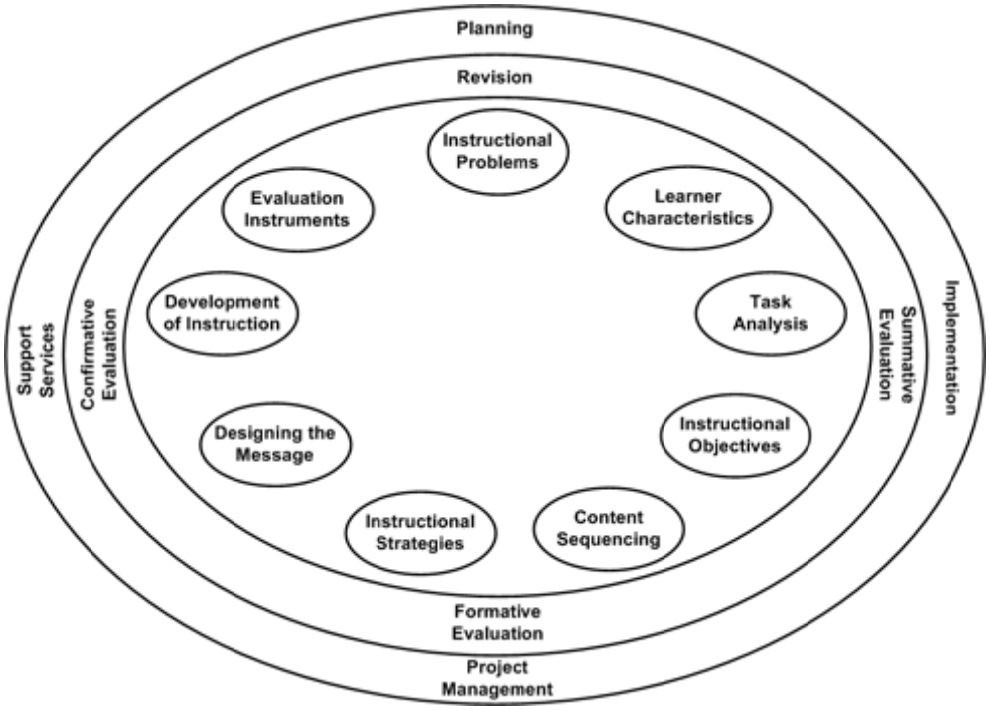

Figure 2.5: Instructional Design Plan (Kemp, Morrison and Ross, 2004, p.1)

2.4. SOFTWARE ENGINEERING METHODOLOGIES

Developing educational software has many commonalities with software development. Especially the design and production stages are similar because in each case the product as well as the production medium and tools are the same. Some differences can be seen at early stages (Bostock, 1996) such that design activities in a software development actually can be considered as an activity at the end of requirements specification since the design in instructional design is actually related to the requirements of the software system (Demirörs, Demirörs, Tarhan & Yıldız, 2000) .

Software engineering is "the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software, that is, the application of engineering to software," (IEEE Standard 610.12, 1990, p.67). It encompasses a process, management techniques, technical methods, and the use of tools. It requires performing many tasks in order to produce a software product.

These tasks are requirements analysis, specification, design and architecture, coding, testing, documentation and maintenance.

In the software engineering field, many development models were proposed in order to perform these tasks efficiently and effectively to produce a quality product. These models determine the set of activities, actions, tasks, milestones, and work products. The process flow shows differences between these. The first models have linear flow while the later models have evolutionary or iterative workflows. This is mainly due to the challenges in the software field. Recently, creating software that can communicate across vast networks, simple but sophisticated applications, open source computing applications, mass communication and mass product distribution are essential challenges (Pressman, 2005).

When the early instructional development models or courseware models are investigated it can be seen that they all are affected by the linear process of software engineering models. The main linear approach to software engineering is the Waterfall model. This model consists of the main tasks of software development in a steady flow, as seen in Figure 2.6.

Based on the challenges of software, the waterfall model is criticized for its non-iterative approach. The models follow the steps in order and after each step is finished the model proceeds to the next stage. There is no opportunity for correcting errors. The lifecycle can also be very long so there is the risk that requirements determined at the beginning can be outdated. The users can only see the working system at the very end of the project (Sommerville, 2004).

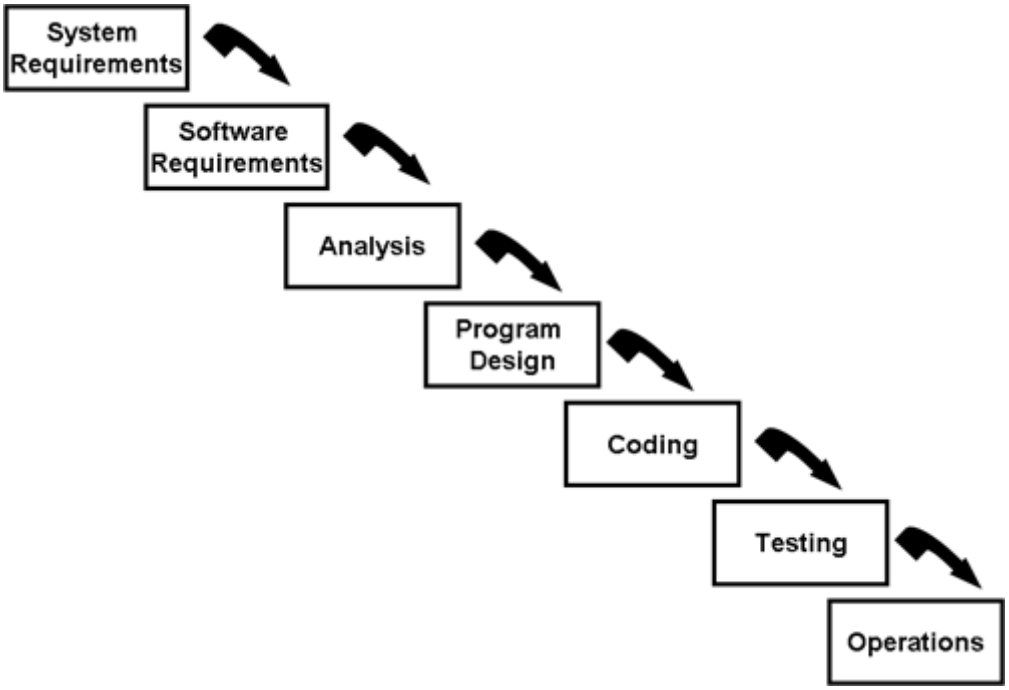

Figure 2.6: The waterfall development model (Royce, 1970, p.2)

In order to overcome the drawbacks of waterfall or non-iterative models, some evolutionary models are proposed. In mid 80s prototyping approach was presented. In this model, prototypes are models of the screens of applications that help users to get an idea of what the system look like before the whole system is built. The major steps of the model can be seen in Figure 2.7. This model increases the communication among the users and developers and eases the decision making process for design activities. The major drawbacks of this model are invisibility of the development process, deterioration of the software due to the changes, much focus on the user-interfaces rather than producing the system (Sommerville, 2004).

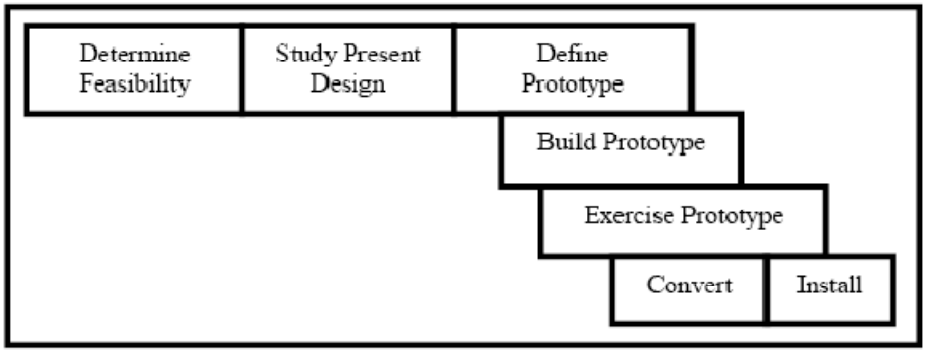

Figure 2.7: Prototyping Approach to Software Design

Another alternative approach to linear models is agile and iterative methods. These methods are based on the software best practices which are commercially proven to be successful. These best practices are commonly used in industry with good results. They are as follows (Kruchten, 1999, p.6):

- Develop software iteratively
- Manage requirements
- Use component-based architectures
- Visually model software
- Verify software quality
- Control changes to software

The key motivations to iterative development can be listed as follows (Kruchten, 1999, Larman, 2001, 2004):

- Iterative development has lower risk than waterfall as it enables to reveal the misunderstanding in early phases in the development process
- It provides continuous feedback from the user to define real requirements.
- It forces to focus on most risky issues at the beginning of the project so risk mitigation and discovery is achieved.
- Early in the process, concrete evidence of the product can be presented so communication is established and inconsistencies can be detected in time. These trigger higher quality and fewer defects

Early iterative process model was proposed by Boehm (1986) as the spiral model. Spiral model combines the elements of both design and prototyping in stages. In other words, it combines the iterative nature of prototyping with the systematic aspects of linear sequential model (Pressman, 2005). In this model each phases starts with a design goal and ends with the client review. Analysis and engineering efforts are applied to each phase of the project till the end. The details of the phases can be seen in Figure 2.8.

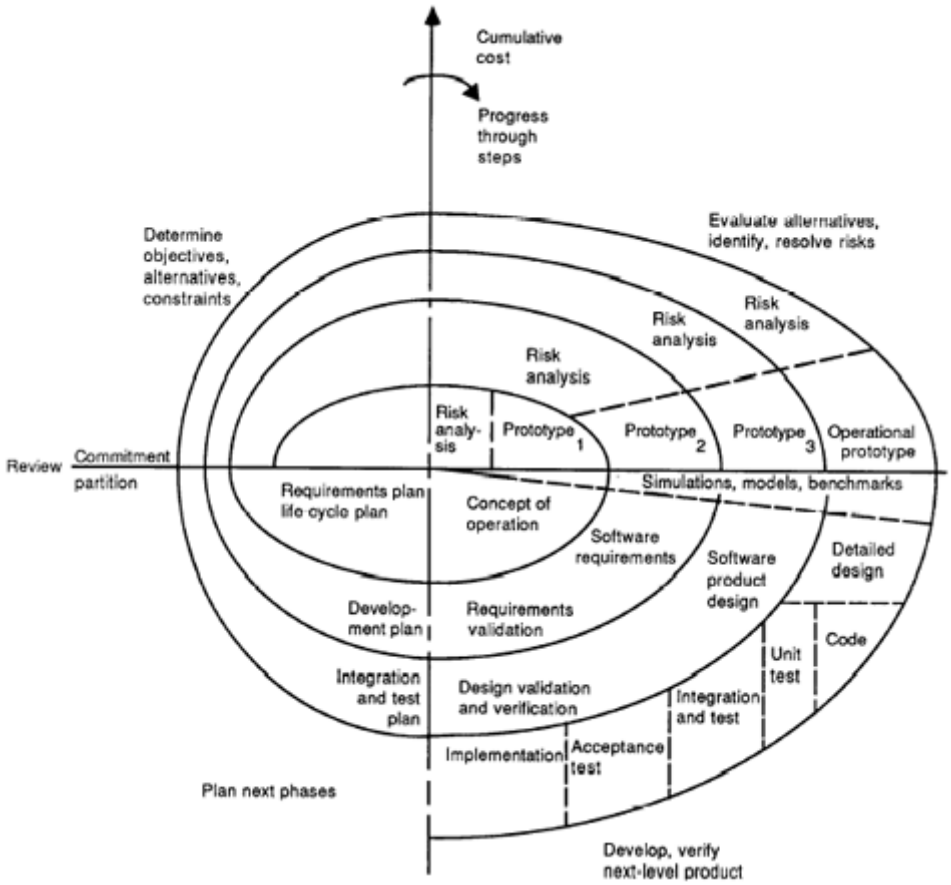

Figure 2.8: The Spiral Model (Boehm, 1988, p. 64)

At the end of 90s, a new approach to software development was evolved as “agile development methodologies”. Agile methods are evolved as a reaction against the so-called heavyweight methods, which means, bureaucratic and slow. Agile

methods are often characterized as being at the opposite end of a spectrum from "plan-driven" or "disciplined" methodologies. The proponents of agile methods formed the agile alliance and provide the Agile Manifesto:

> We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:
>
> Individuals and interactions over processes and tools
>
> Working software over comprehensive documentation
>
> Customer collaboration over contract negotiation
>
> Responding to change over following a plan
>
> That is, while there is value in the items on the right, we value the items on the left more. (Manifesto for Agile Software Development, 2001, para.1)

The Agile Manifesto is accompanied by the Principles behind the Agile Manifesto (Principles behind the Agile Manifesto, 2001, para.1):

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
4. Business people and developers must work together daily throughout the project.
5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.
6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
7. Working software is the primary measure of progress.
8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.
9. Continuous attention to technical excellence and good design enhances agility.
10. Simplicity--the art of maximizing the amount of work not done--is essential.

11. The best architectures, requirements, and designs emerge from self-organizing teams.
12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

Most agile methods share iterative development's emphasis on building releasable software in short time periods. Agile methods differ from iterative methods in that their time period is measured in weeks rather than months. On the other hand agile development has less in common with the waterfall model. The waterfall model is the most predictive of the methodologies, stepping through requirements analysis, design, coding, and testing in a strict pre-planned sequence, partially completing every feature at each stage. The waterfall model produces releasable software at the very end of the cycle, a time period typically extending from several months to several years. Agile methods, in contrast, produce completely developed features (but a very small set subset of the total) every few weeks (Highsmith & Cockburn, 2001). These features can be seen from the Figure 2.9

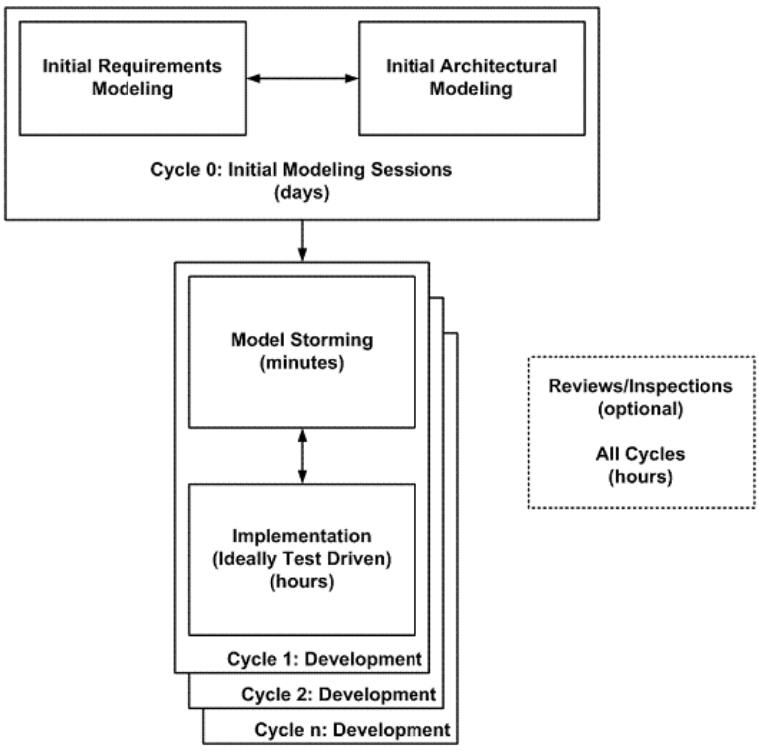

Figure 2.9: Agile Development Model (Ambler, 2003-2007)

Agile development models are sometimes considered as unplanned or undisciplined. They are also criticized as being suitable for only senior-level developers, having less and inadequate documentation and include little design. Moreover, agile methods are considered as they require too much cultural change to adopt.

Adaptive Software Development (ASD) (Highsmith, 2000) is an example framework which emphasizes more on project management and collaboration practices among the agile approaches (Highsmith, 2002). It is going to be explained in Section 2.5 in more detail.

2.5. ADAPTIVE SOFTWARE DEVELOPMENT (ASD)

ASD is an iterative development model that stemmed from rapid application development. Uncertainty and change in development environments are acknowledged in ASD so rigid control strategies as well as predictions are not used. It focuses on emergent order rather than imposed order which involves linear deterministic world view. Emergent order is a feature which is generally related with living organisms. Therefore, ASD approaches the software project as a living organism and considers the software development as an adaptive task. Adaptation can be defined as an "organism's ability to alter its internal rules of operation in response to external stimuli" (Highsmith, 2002, p. 10). In addition to the acceptance of emergence as well as the ability of adaptation for the success of the projects, acceptance of our need of continuous learning with collaboration is essential in this approach.

ASD uses iterative cycles like spiral or evolutionary development. However, it is primarily different from them in that its acceptance of emergent order. Based on this assumption it provides a dynamic speculate-collaborate-learn life cycle which is different from static plan-design-build life cycle models, as can be seen in Figure 2.10. In complex environments it is not likely to determine all specifications at the beginning. Therefore speculation is offered as a replacement

for planning. Rather than providing rigid project plans, providing a general goal which gives an idea about the point to be achieved as well as the mechanism to enable this will be more helpful. Defining a mission statement as well as sharing this among all the stakeholders is required in this stage of the life cycle. Collaboration creates emergence in the developing organization and creates diversity. It is required to balance unpredictable and predictable specifications. Learning is occurred as a result of this collaboration. Stakeholders make small mistakes based on their false assumptions and they learn from their mistakes and gather better experience and mastery. As a result, this dynamic cycle enables continuous learning and adaptation to the emergent situations (Highsmith , 2000, Highsmith, 2002).

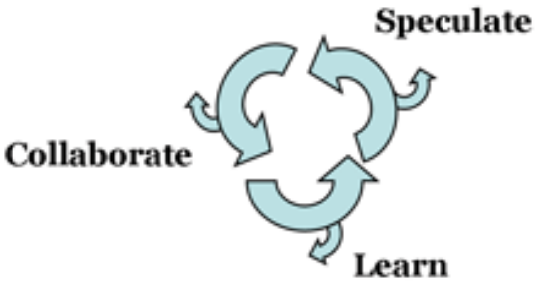

Figure 2.10: The Adaptive Development Life Cycle (Highsmith, 2002, p. 41)

High speed is tried to be achieved by the use of iteration, concurrency, feedback and collaboration in this model. It emphasizes adaptation rather than optimization. It assumes that change and flexibility is necessary so change management is at the core of the development model. It is also a component-based rather than a task-based approach (Highsmith, 2002)

The ASD life cycle stages can be examined in more detail as can be seen in Figure 2.11. Project initiation and adaptive cycle planning steps are considered in the Speculate stage. Project initiation is mainly deals with mission statement definition, project management information and initial requirements. Cycle planning step deals with the identification of components and assignment of these components into following cycles. The Collaborate stage is divided into cycles

number of which is determined according to the needs of the project. In these cycles, components are developed. The Learn stage involves the quality reviews of the product as well as the performance of the development teams.

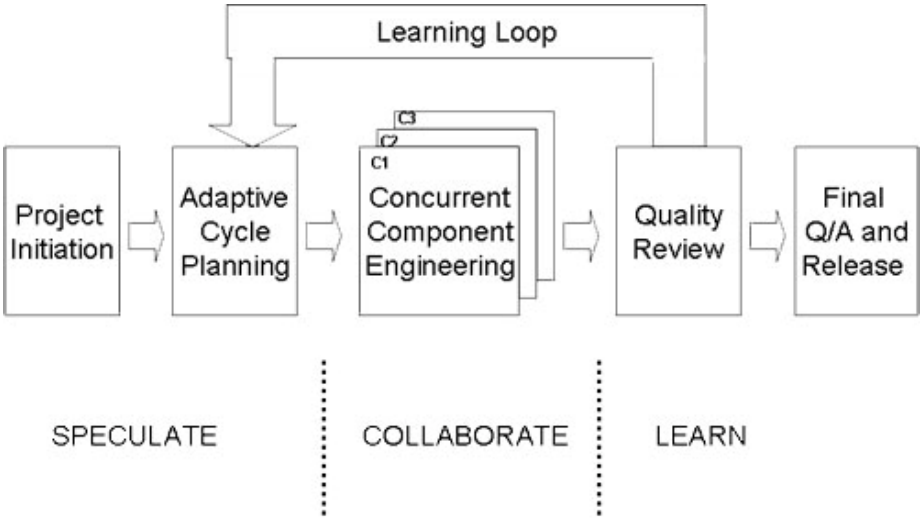

Figure 2.11: The detailed ASD Life Cycle

The features of its life cycle involves the characteristics of 'mission-focused, feature-based, iterative, time-boxed (Figure 2.12), risk-driven and change-tolerant' (Highsmith, 2000, p.7; Highsmith, 2002, p.83). In adaptive development, change is approached positively as it is believed as an opportunity for learning which may create advantage. To respond the changes, adaptive cycling approach is used in the model. These cycles are organized as time-boxed iterations "which help keeping team members focused, force hard trade-offs and force convergence and learning" (Highsmith, 2002, pp.88-89).

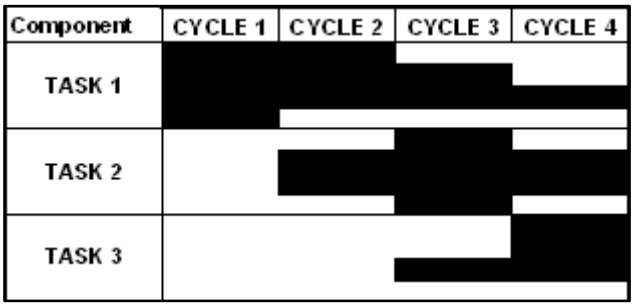

Figure 2.12: Component Development in time-boxed iterations

2.6. USABILITY AND DESIGN/DEVELOPMENT

Usability issues are required for the development model from two persectives. One of the perspectives is ensuring the usability of the developed courseware while the other is the evaluation approaches that can be integrated into the development model such as formative and summative evaluation.

The main interaction between the users and learning materials in VLEs occurs at the user interface level therefore providing an effective user interface will affect their value. Thus, incorporating Human Computer Interaction (HCI) issues to the development approach is essential for the overall quality of learning since the user will judge the system on the basis of interface which is the first contact point (Faulkner, 1998). In VLEs, since the core aim is to learn the contents rather than learn to use the system, the more usable the system is the more effective the learning takes place. The concept of "usability" has come out from the ergonomics side of HCI and it addresses mostly the practical issues of HCI rather than theoretical ones (Faulkner, 1998). Usability concept is defined as "allowing the user to execute his task effectively, efficiently and with satisfaction in the specified context of use" in ISO 9241 Standard (Abran, Khelifi, Suryn, Seffah, 2003, p.331). Another definition for usability can be given as "the quality of system with respect to ease of learning, ease of use and user satisfaction" (Rosson and Carroll, 2002, p.9). It is understood from these definitions that usability mainly deals with learnability, efficiency of use, and satisfaction. Nielsen (1993) also counts memorability and few error rates among these attributes of usability. Furtado, Vasco Furtado, Mattos and Vanderdockt (2003) look at the issue from another perspective and apply the usability concept to VLEs as "pedagogic usability" (p.70) which deals with how easily and effectively a user can learn from the system.

Usability inspection methods are used to examine the usability-related features of systems by usability experts, software developers or by the end users. These inspections are mainly aimed to evaluate the user interface designs (Nielsen &, Mack 1994). There are many inspection methods which are summarized by

Nielsen and Mack (1994) in their Usability Inspection Methods book, such as heuristic evaluation, guideline reviews, pluralistic walkthroughs, consistency inspections, standards inspections, cognitive walkthroughs, formal usability inspections and feature inspections. Usability heuristics are commonly used and practical basic inspection method which includes ten general principles for user interface design to improve the usability (Nielsen, 1994a, p.30, 1994b). The heuristics are as follows:

1. Visibility of system status
2. Match between system and the real world
3. User control and freedom
4. Consistency and standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility and efficiency of use
8. Aesthetic and minimalist design
9. Help users recognize, diagnose, and recover from errors
10. Help and documentation

"Prototyping" is another commonly used technique in usability engineering. It can serve many goals from the requirements gathering in early development to test the systems during the implementation (Rosson & Carroll, 2002). Storyboards which include the sketches or screen shots of any functionality or prototypes of working partial systems which show the executable version of any functionality to be tested are the common forms of prototyping in the projects.

Although HCI is an essential function for the design of the user interface component of the VLEs, little attention has been given to its integration in instructional design models (Plass, 1998). Likely, HCI issues or concerns are not systematically covered in many software development approaches as there are no known methods to integrate these concepts to the development life cycle. HCI issues are generally considered only at the screen-interface or at the final design processes although it is more than the user interface development (Zhang, Carey,

Te'eni & Tremaine, 2005; Rosson & Carroll, 2002). Darnell and Halgren (2001) compared the typical development cycle showing where usually usability testing occurs with the one where variety of usability techniques can be applied throughout the system development as can be seen in Figure 2.13 and Figure 2.14. Typically high fidelity usability testing or in other words high fidelity prototyping is applied at the later stages of the development cycle instead of applying many other techniques throughout the whole process from pre-design to future planning of the system such as ethnographic reviews, natural observation, focus group, usability walkthroughs, low or high fidelity prototypes, competitive evaluation or retrospective work evaluation.

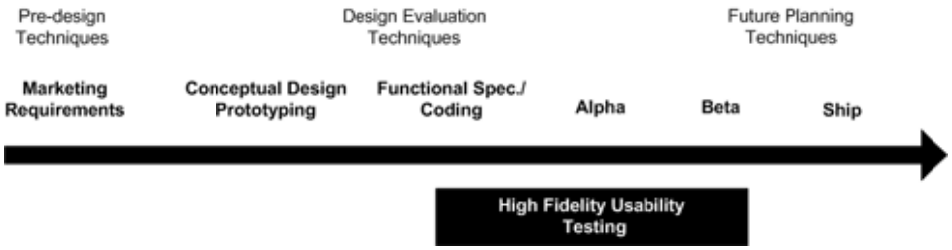

Figure 2.13: Typical development cycle where usability testing occurs (Darnell & Halgren, 2001, p. 80)

On the other hand, Rosson and Carroll (2002) suggest that "usability is not everything" (p. 15). They (2002) also point out that some other constraints can affect the development of usable systems such as the formation of teams or assignment of resources. However, these issues can be resolved by the development approaches used throughout the projects. Therefore there is a need to incorporate all the usability issues to the development approach to be used. Many of the software developing organizations are beginning to pay more attention to the usability of their products. In addition they also realize the importance of implementing these techniques early in the development processes (Ferre, 2003; Anderson, Fleek, Garrity, Drake, 2001).

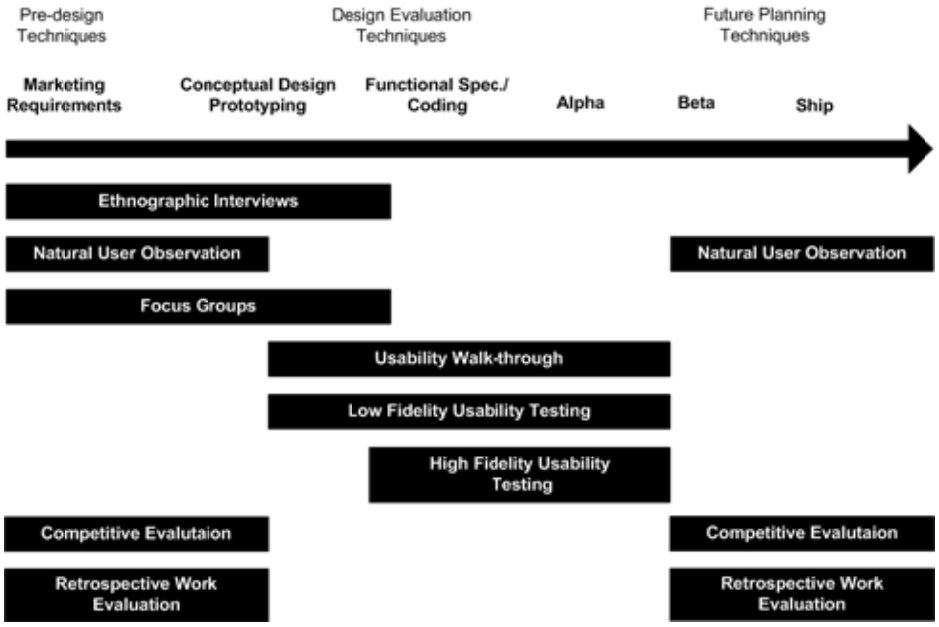

Figure 2.14: Typical development cycle where variety of usability testings can be applied (Darnell & Halgren, 2001, p. 81)

Usability engineering comes out as a discipline that tries to achieve the usability in user interface design during the product life cycle. However, it is not a "one-shot affair where user interface is fixed up before the release of a product" (Nielsen, 1993, p. 71). Usability engineering provides a systematic way which tries to define usability through metrics by setting attributes and then assessing those attributes by getting feedback from the users until the desired system is developed throughout the development life cycle (Faulkner, 1998).

Mayhew (1999) applied the usability engineering tasks in the overall development cycle which uses rapid prototyping or object oriented software engineering approaches. Her model shows the particular order of the tasks and their interaction as can be seen in Figure 2.15. She emphasizes the iterative design, development and testing phases rather than being linear as in other modern approaches discussed before.

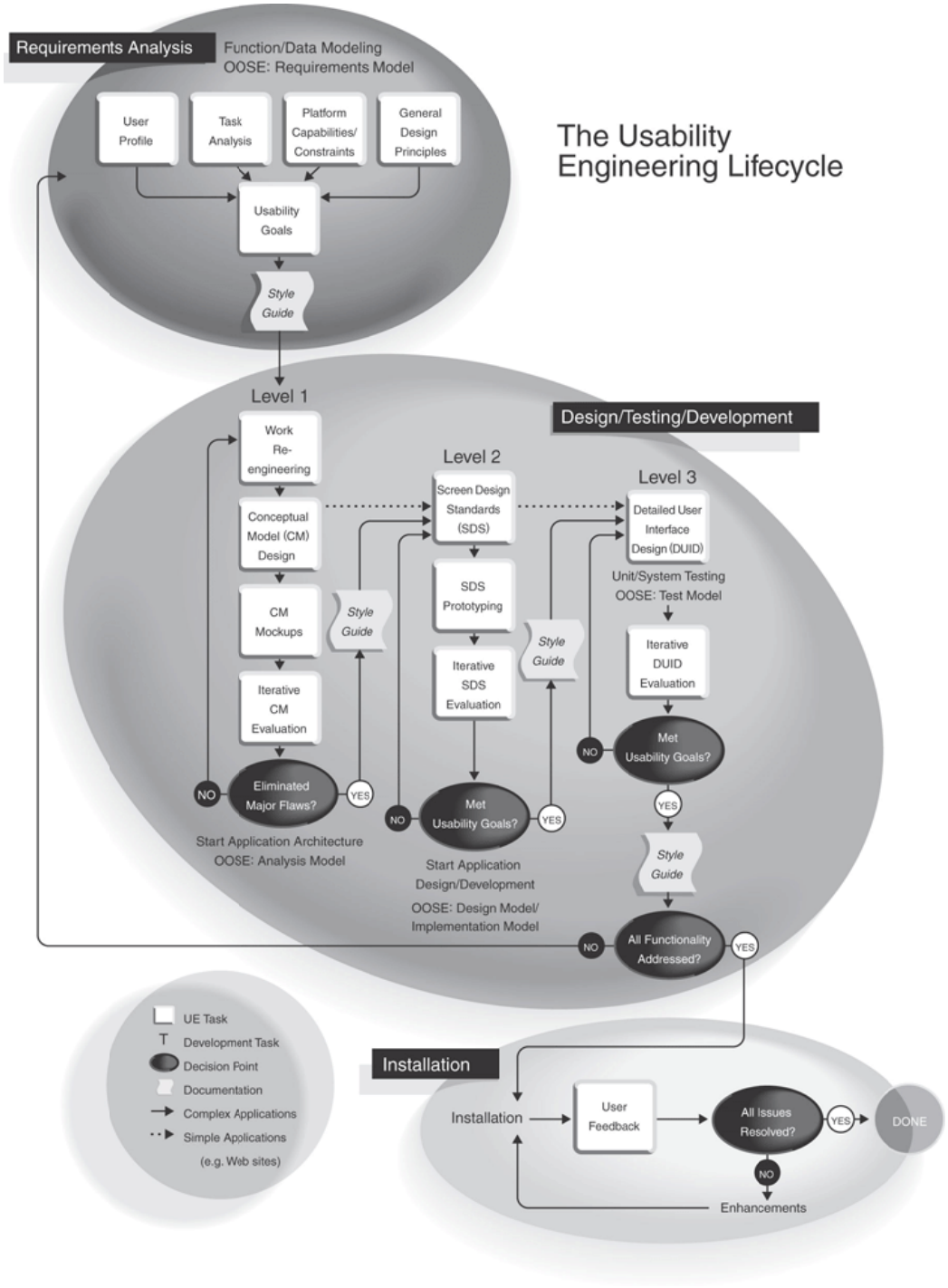

Figure 2.15: The Usability engineering life cycle (Mayhew, 1999, p.vi)

In a more recent study, Detweiler (2007) proposed another approach that integrates usability engineering tasks into development cycle which uses agile development approach. His approach emphasizes to engage the real end users

early in the development process by getting feedback from them. Similar to Mayhew, he also stresses iterative approach. Therefore, he included three iterative phases which are repeated in all development phases of an agile software development project. This approach enables users to test the system from the beginning to the end of the development effort and to design, prototype and develop user interfaces iteratively, as seen in Figure 2.16.

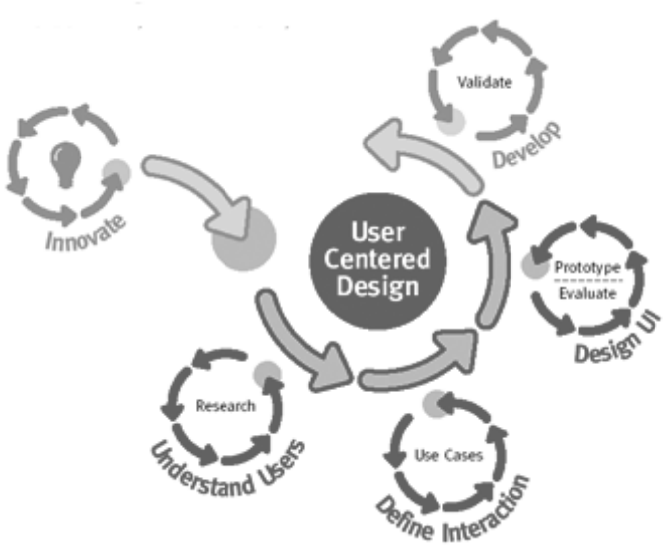

Figure 2.16: Three Iterative UCD Phases (Detweiler, 2007, p. 41)

The importance of usability is also realized in instructional development field. In addition to traditional evaluation done generally at the end of development cycle, the need to incorporate usability evaluation from the beginning to end is usually realized. Therefore systematic formative and summative evaluation methods are needed to be implemented throughout the whole development process in order to ensure the effectiveness of an instructional product (Crowther, Keller, Waddoups, 2004). The formative evaluation can be distinguished from summative evaluation as the former being held during the design and development process to improve the system whereas the latter being held at the end of a development process to test whether the system meets the specified usability objectives (Scriven, 1997, cited in Rosson & Carroll, 2002).

2.7. REUSABLE LEARNING OBJECTS APPROACH

The development of an online curriculum involves the development of many courses related to each other. Many of the concepts can be commonly related with more than one course. Therefore, there is a need of models and tools that can provide the development of high quality education and learning materials that are re-usable and sharable in VLEs (Kramer & Schmidt, 2001). Standards allow the combination of products from different vendors to create customized applications and systems. Likely, Koper and Manderveld (2004) propose the development of learning technology specifications as a solution for these new requirements of the world and they define learning technology specifications as "specifications of methods and techniques which support the realization of e-learning" (p. 538). IMS Global Learning Consortium (IMS), Institute of Electrical and Electronics Engineers (IEEE) Learning Technology Standards Committee (LTSC), Advanced Distributed Learning (ADL) and Aviation Industry CBT (Computer-Based Training) Committee (AICC) are some of the mostly known initiatives or organizations that work on the e-learning specifications or standards.

So far, these organizations or initiatives generally focus on developing specifications for learning objects (LO) (Koper & Manderveld, 2004). As many authors (Wiley, 2000; Mortimer, 2002; Richards, McGeal, Hatala & Friesen, 2002) suggest that there are many definitions for this term. IEEE LTSC (2002) defines LO as "any entity, digital or non-digital, that may be used for learning, education or training" (p.6). Any instructional or multimedia content, learning objectives, instructional software or software tools, persons, organizations, or events referenced during technology supported learning can be considered as learning objects. Wiley (2000) specifically critiques the definition given by LTSC as having a broad scope and makes his definition for LO as "any digital resource that can be reused to support learning" (p. 7). His definition includes anything that is in any size and that can be reused by delivering through network on demand while excluding the non digital resources. The categories that all the LO definitions take account of as the content including the objective, learning

activities and assessment; size or duration, context and tagging and storage (Mortimer, 2002).

Since the concept of learning object primarily depends on the object-oriented paradigm of computer science (Wiley, 2000), many of the on-line education specialists have been attracted by the terms such as ‘component’ and ‘object’ that enable the re-use and interoperability (Kramer & Schmidt, 2001). Wiley (2000) explains the fundamental idea behind the use of learning objects as

> Instructional designers can build small (relative to the size of an entire course) instructional components that can be reused a number of times in different learning contexts. Additionally, learning objects are generally understood to be digital entities deliverable over the Internet, meaning that any number of people can access and use them simultaneously (as opposed to traditional instructional media, such as an overhead or video tape, which can only exist in one place at a time). Moreover, those who incorporate learning objects can collaborate on and benefit immediately from new versions. (p. 3)

Instructional designers will have the chance to avoid one of the initial steps of instructional design which involves the decomposition of the materials into its components (Reigeluth and Nelson, 1997, cited in Wiley, 2000) by the use of LOs and this will increase the efficiency and the speed of the development process. This LO concept is used in instructional design field with other names by some researchers. For instance, Merrill (1998) uses the term knowledge objects for the knowledge components that need to be taught while Gibbons, Nelson and Richards (2000) uses the term instructional objects that can be assembled to create an instructional event momentarily.

Learning objects are tagged with metadata which was proposed by Learning Object Metadata (LOM) to facilitate the search and re-use (2002). LOM specifies a data pattern for describing learning resources through a standardized vocabulary of the subject domain. Literally, metadata means “data about data” (Wiley, 2000, p. 10). LOM (2002) standard specifies nine metadata categories which are general, lifecycle, meta-metadata, technical, educational, rights, relation,

annotation, classification to enable to find LOs by searching rather than browsing one by one (Wiley, 2000).

LOM was extended by a common technical framework for web-based learning named as Sharable Content Object Reference Model (SCORM) (ADL, 2004). The basic premise of SCORM is the decomposition of the learning content into discrete entities which are dependent from any context and then it provides a data model for composing learning components from these re-usable sources (Lukasiak, Agostinho, Bennett, Harper, Lockyer & Powley, 2005). SCORM claims to be "pedagogically neutral" (Learning Systems Architecture Lab, 2004, p.1) so does not prescribe any instructional design or strategies. In addition, it rather has a technical scope specifies the systems functionality to be included in order to be compliant rather focusing on making effective e-learning (Pasini, 2004). It enables interoperability, accessibility and reusability of Web-based learning content. In the SCORM Best Practices Guide for Content Developers Guide (Learning Systems Architecture Lab, 2004, p.7), the SCORM concepts are defined as summarized in Table 2.2.

The use of LOs seems very promising for the instructional design field as they will enable the reuse of parts of materials rather than developing them from scratch every time. This will reduce the costs while improving efficiency. However, designing objects may create some challenges. First of all, instructional designers are required to change their mindset as this is fundamentally different from their past practices of creating multimedia or web learning (The Herridge Group, 2002). In addition in spite of the standardization studies done by the above mentioned organizations, LOM is argued to be having a broad definition for LO and having inadequate metadata structure to apply it to specific scenario (Di Nitto, Mainetti, Monga, Sbatella and Tedesco, 2006). Wiley (2003) also points out other problematic point of LOs in his later study as the paradox based on decontextualization requirement of LOs while contextualization requirement of learning theories which is also related with the sequencing issue. Similar to LOM, SCORM has some problems of not specifying metadata that describing LOs and

composition of LOs properly (Di Nitto, Mainetti, Monga, Sbatella and Tedesco, 2006). Besides, SCORM provides the functionality that a system must have in order to be compliant rather than specifying the way to create effective e-learning (Pasini, 2004). Therefore, effort is required in both technology and instructional design field as there is a need to implement an instructional design theory to facilitate learning to realize the actual potential of the learning objects (Wiley, 2000, 2002).

Table 2.2: SCORM concepts and their definitions (Learning Systems Architecture Lab, 2004, p.7)

SCORM Concept	Definition	Example
Reusable	Content is independent of learning context. It can be used in numerous training situations or for many different learners with any number of development tools or delivery platforms.	Content developed by a refinery to train its employees to respond to a petroleum spill could be reused by the fire department as part of a hazardous materials training program
Interoperable	Content will function in multiple applications, environments and hardware and software configurations regardless of the tools used to create it and the platform on which it is delivered.	Content developed in one authoring system where the delivery platform is a CD on a non-networked Macintosh will also operate over the Web on a PC using both Internet Explorer and Netscape equally well.
Durable	Content does not require modification to operate as software systems and platforms are changed or upgraded.	Upgrading an operating system from Windows NT to Windows 2000 has no impact on the delivery of content to the learner.
Accessible	Content can be identified and located when it is needed and as it is needed to meet training and education requirements	A manager can conduct an online search for training on sexual harassment and identity appropriate materials for her specific organizational needs based on information provided in the content metadata.

2.8. LEARNING CONTENT MANAGEMENT SYSTEMS

The evolution of reusable learning objects concept in the e-learning field bring out an application need for systematic management and presentation of these LOs. These applications which are used to store and track the LOs can be grouped into three categories as Content Management Systems (CMS), Learning Management Systems (LMS) and Learning Content Management Systems (LCMS) (Irlbeck and Mowat, 2007).

Although their names are very similar, they are complementary systems that have different features to support e-learning (Greenberg, 2002). CMSs are used to store and provide access to information in the form of LOs. In other words, they can be considered as knowledge management tools. While the aim of CMS is to store and distribute the content, LMS is used to launch it. It provides administrative and learner management functions by focusing on the course rather than course content used during teaching. Apart from these, LCMS store, manage and enable to reuse the content by the use of databases (Irlbeck and Mowat, 2007). Another distinctive feature of LMS from LCMS is having the focus of managing learners, keeping track of their progress and performance in addition to the administrative tasks while LCMS having the focus on learning content (Greenberg, 2002, Hall, 2003). In addition LMS provides content while LCMS provides authoring environments that are used to create learning environments (Di Iorio, Feliziani, Mirri, Salomoni & Vitali, 2006).Different features of CMS, LMS and LCMS with their functionality as being robust (R), limited (L) and no functionality are summarized by Irlbeck and Mowat (2007) as in Table 2.3.

Some of the capabilities of LMS can be listed as support for blended learning, integration with human resources, administration tools, content integrations, adherence to standards, assessment capabilities and skills management, configurability, creation of online communities and content management capabilities (Greenberg, 2002, Evangelisti, 2002).

Table 2.3: Features of CMS, LMS and LCMS (Irlbeck and Mowat, 2007, p. 10-11)

Feature	**Functionality**		
	CMS	**LMS**	**LCMS**
Manage Learners		R	L
Manage Content	R		R
Create Content	L		R
Manages Instructor-led Sessions		R	
Course Catalogue		R	
Registration System		R	L
Competency Management		R	L
Launch and Track eLearning		R	L
Assessment Creation, Evaluation, and Feedback		R	R
Searchable Library of Reusable Content	R		R
Collaboration / Synchronous Learning Tools		L	R
Integration with Human Resources Applications		R	
Locate and Deliver Specific Content to a Learner	R		R

Greenberg (2002) also lists the key components of LCMSs as learning object repository, automated authoring application, dynamic delivery interface, administrative application. Likewise, Donello (2002, cited in Irlbeck and Mowat, 2007) lists the core components of LCMS as an authoring tool that does not require comprehensive programming skills, dynamic delivery interface for the content delivery, and administrative component for the management of learner records, launches courses and tracks progress and a learning object repository which is a central database.

The use of LCMS provides a potential for the organizations as it creates competitive advantage through the ability to create and share their proprietary knowledge, cost reduction, accelerated launch of the content, consistent and timely content. The use of LCMS which is integrated with LMS are needed for organizations that need to achieve success in their e-learning initiatives (Robbins,

2002) as richer learning experience can be provided to learners by the information exchange enabled between them. Di Iorio, Feliziani, Mirri, Salomoni and Vitali (2006) specify seven dimensions to consider while gathering a system for the organizations' requirements. These are ease of use of the system, ease of reuse provided by the system, ease of editing and updating, standards that are supported, visual homogeneity provided by templates and styling mechanism, universality and accessibility.

2.9. DISTRIBUTED SOFTWARE DEVELOPMENT/VIRTUAL TEAMWORK

Many institutions begin to prefer to collaborate rather than compete to make full use of their resources. Therefore, developing VLEs may require the distributed development environment and virtual development teams. For that reason, issues related to the distributed development and the uses of virtual teams are needed to be considered and integration of them to the development model will be helpful.

Distributed software development (DSD) concept which is used by many major software organizations will help to determine the issues to be integrated. This is the software development activities distributed to more than one location (Mockus & Herbsleb, 2001). Despite the many opportunities provided by DSD such as the access to limited number of trained human resources or reduced costs, it has some problems mainly based on lack of differences in infrastructure used in different sites, dependent modules of the work, difficulties in coordination and communication and control of the development process (Mockus & Herbsleb, 2001; Ebert & De Neve, 2001; O'Conchuir, Holmstrom, Agerfalk & Fitzgerald, 2006). The conflict resolution and software development activities are needed to be carefully planned and considered in this kind of development environments in order to provide on time, within budget and high quality products (Liu, 2005). In addition to these challenges, application of the agile methodologies to the distributed development activities seems incompatible since agile development required continuous face to face communication and close collaboration. On the

other hand, iterative and incremental development which is also one of the core practices of agile development methodologies provides advantages to distributed development (Paasivaara & Lassenius, 2004). In addition, the features that seem to be the biggest challenge can also be regarded as benefits by transferring the practices provided in agile methodologies to the distributed environment. This can be achieved by using appropriate tools (Fowler, 2006).

In all the cases, software development requires teamwork (Ebert & De Neve, 2001). And virtual teams are used for the development effort that takes place in distributed environments. Virtual teams are the groups of people who communicate through electronic means to achieve a common goal (Lau, 2004). They are also geographically dispersed so do not have the chance to meet face to face frequently (Jones, Oyung & Pace, 2005). These virtual teams "work across time, space and organizational boundaries with link strengthened by webs of communication technologies" (Lipnack & Stamps, 1997, p.7, cited in Bal & Teo, 2000). When people are face to face, they can exchange information by directly pointing to objects or making diagrams. On the other hand, virtual teams require additional features to support their knowledge exchange or conversation (Olson, Teasley, 1996).

The needs of virtual teams can be summarized as sharing of information in various forms, real-time interaction for providing rapid feedback as well as facilitation for spontaneous and informal real-time communications, maintenance of awareness of the daily project activities among all the team members and compatible technology infrastructures (Steinfield, Jang & Pfaff, 1999). Jones, Oyung and Pace (2005) stress that communication and trust among the team members are the vital competencies required for the virtual teams. They also state skills such as "multi-tasking, time management, attention to detail, listening and testing for understanding, empathy and encouragement and ability to work in ambiguous environment" (pp.75-76) are essential for the members of virtual teams. Communication, coordination, knowledge sharing mechanisms, project management, travel, development environment, communities of practices, cultural

differences, technical deficiencies are listed as the essential elements to be considered carefully for the success and efficiency of virtual teams (Herbsleb, Paulish & Bass, 2005, Herbsleb & Moitra, 2001). Team members are needed to communicate whenever necessary to make the team efficient (Ebert & de Neve, 2001) although there is a lack of informal and spontaneous conversation among the members of virtual teams (Herbsleb & Moitra, 2001).

Electronic communication and collaboration systems are required and essential for the successful working of virtual teams in DSD environments based on all the above mentioned points. These tools will bring them together by supporting their communication, coordination and cooperation. Commonly come across collaboration systems can be listed as bulletin boards, discussions, e-mail, e-mail notifications, online paging, chat whiteboard, audio/video conferencing, task list, contract management, screen sharing, surveys/polling, meeting minutes/records, meeting scheduling tools, presentation capability, project management, file and document sharing, document management and synchronous work on files/documents (Bafoutsu & Mentzas, 2002). Duarte and Snyder (1999, cited in Peterson & Stohr, 2000) summarizes some of the mentioned technologies regarding their appropriateness for the different requirements of virtual teams as can be seen in Table 2.4

In addition to the collaboration infrastructure, other tools, practices and processes are also needed for the success such as the common development environment which involves change and problem management and version tracking; common calendar and instant messaging to provide presence awareness information among the team members in addition to the communication aim; practices that will determine the communication rules and ways and finally a web site that will enable the view of project management information (Mockus & Herbsleb, 2001).

Table 2.4: Technology vs. requirements matrix of the virtual teams (Duarte and Snyder, 1999, cited in Peterson & Stohr, 2000)

Technology	**Information Sharing**	**Discussion and Brainstorming**	**Collaborative Decision-Making**	**Collaborative Product Production**
Voice mail	Somewhat effective	Not effective	Not effective	Not effective
Audio Conference	Effective	Somewhat effective	Somewhat effective	Not effective
E-mail	Effective	Somewhat effective	Not effective	Not effective
Bulletin Board	Somewhat effective	Somewhat effective	Not effective	Not effective
Real-time data conference (no audio or video)	Effective	Somewhat effective	Not effective	Somewhat effective
Video conference without shared documents	Effective	Somewhat effective	Effective	Not effective
Real-time data conference with audio/video and text and graphics support	Effective	Effective	Effective	Effective
Electronic meeting system with audio/video and text and graphics	Effective	Highly effective	Highly effective	Effective
Collaborative writing with audio/video	Effective	Effective	Somewhat effective	Highly effective

CHAPTER 3

DESIGN METHOD OF THE STUDY

This chapter presents the methodological foundation of this study. The research strategy chosen as the case study will be discussed first. Later, data collection instruments, the overall implementation of the study including the descriptions of the investigated cases, data analysis procedure and limitations of the study will be explained in detail.

3.1. THE RESEARCH STRATEGY

This study was conducted according to multiple (collective) case study method since the nature of the research requires the use of qualitative data collection and analysis techniques. Multiple (collective) case study method is defined as "the study that may contain more than a single case" (Yin, 1994, p.44). Collective case study method will be explained later in detail. Case study is one of the five types of qualitative research methods ("the basic or generic qualitative study, ethnography, phenomenology, grounded theory and case study" (Merriam, 1998, p.11)). In order to understand the case study method, it is important to discuss qualitative research first.

The definitions of the qualitative research include some key concepts such as "phenomenon", "understanding", "authentic", "natural environment", and so on. For example, Merriam (1998) defines qualitative research as "understanding and

explaining the meaning of social phenomenon as little disruption of the natural setting as possible" (p.5). This definition gives emphasis to gathering social knowledge without having any effect or control to the investigated situation in her definition. Similarly, Hoepfl (1997) also focuses on investigating phenomena in its specific context and defines it as being a naturalistic inquiry. Additionally, Lodico, Spaulding & Voegtle (2006), also stress investigating a social phenomenon by gathering the perspectives of the participants in their naturalistic setting. It should be noted that the general definitions stress understanding of a social phenomenon in its context.

Besides these general definitions, qualitative research is useful especially when little is known about the phenomenon (Strauss & Corbin, 1990). In addition it is also helpful when statistical or quantitative techniques cannot be applicable to produce the results. Qualitative methods enable to understand the situations or cases by gathering more detailed information from a much smaller sample (Patton, 1990).

Case study research is the most common qualitative method used in information systems. As it was stated above, the types of qualitative research methods can be listed ethnography, case study research, phenomenological research, and grounded theory (Merriam, 1998, Lodico, Spaulding & Voegtle, 2006). Case study research is an empirical enquiry that examines a fact or process in its real life settings especially when it cannot be distinguished from its environment (Yin, 1994). It is used to provide an understanding about the situation and meaning given by participants who experience it. (Merriam, 1998; Creswell & Clark, 2007). It is an appropriate research strategy when the research and theory is at their conception phases and the researcher wants to understand the context as well as practice based problems (Benbasat, Goldstein, & Mead, 1987). It is mainly interested in "process rather than outcomes, in context rather than a specific variable, in discovery rather than confirmation" (Merriam 1998, p.19).

Case studies can be either single or multiple-case designs. Single-case design is appropriate under certain settings. It is used when the case is critical for the theory

in that it meets all the necessary conditions to test the theory; when the case represents an extreme or a unique event or when the case was previously inaccessible to the investigators (Yin, 1994). When the study involves more than one case then it can also be named as "collective case studies, cross-case, multicase, multisite studies, comparative case studies" (Merriam, 1998, p.40) or multiple- case studies (Yin, 1994). In this study, this type of study will be referred as multiple or collective case study respectively. The rationale behind multiple case design selection is also considered as same as the single-case design selection in addition to having the aim of achieving more variation so that to get more robust and convincing results (Merriam, 1998; Yin, 1994). On the other hand, multiple-case studies are also suitable when the aim of the research is description, theory building or theory testing (Benbasat, Goldstein, & Mead, 1987). In addition, this will also enable to conduct cross-case analysis among cases which may help to extend a theory.

In multiple (collective) case studies, case selection is done according to the replication logic which is similar to the one used in multiple experiments. Cases can be selected according to two criteria. First one is "literal" replication where similar results are predicted whereas the other is "theoretical" replication where contradictory results are predicted (Yin, 1994).

In order to propose a courseware development model for online learning environments, there is a need to explore and understand how the processes are conducted in addition to reveal the problematic areas as well as the best practices of online courseware development projects experienced. Therefore, case study research is appropriate for this study mainly for the following reasons

- There is a need to understand the phenomenon in its natural setting (Yin 1994)
- There is a need to gather the participants' viewpoints (Merriam 1998)
- It will reveal the practice-based problems (Benbasat, Goldstein, & Mead, 1987).

- The objective of this study involves organizational and social issues as well as the technical dimensions (Benbasat, Goldstein, & Mead, 1987).

In this study, four development projects were examined. The main purpose to investigate these cases was to gather data that will reveal common themes and propose a development model based on the results.

3.2. DATA COLLECTION METHODS

Yin (1994) listed the six sources of evidence that work well in case research as *documentation*, *archival records*, *interviews*, *direct observations*, *participant observation* and *physical artifacts*. Likewise, Lodico, Spaulding and Voegtle (2006), named the data collection techniques which are employed in qualitative research methods, as *interviews*, *observations* and *examination of documents* and *artifacts* and also proposed to apply multiple methods rather than using one method. Multiple sources are required to get a complete perspective because each data type has its own strengths and weaknesses. Using a combination compensates each other's weaknesses and provides a cross-check (Patton, 1990; Yin, 1994).

In this study, interviews and documentation techniques were used to collect data as multiple data collection approach. Interviews were the main data collection instrument. They were conducted with experts with different roles who take part in the projects. In addition to the interviews, as for the documentation, the products (such as developed courses, web sites, etc.) developed in the project by different people were also examined to see whether the applied project practices resulted successfully. These documents were investigated in order to compare with the interview results as well as to understand and triangulate the interview results with the document analysis applied.

3.3. INTERVIEWS

Interviews are the main data collection instruments in many of the qualitative research studies as it is in case studies. They are specifically used to gather a kind of information that we cannot observe directly and to obtain a large amount of data from the participants (Merriam, 1998). Three main types of interviews are listed by many of the researchers (Merriam, 1998; Patton, 1990) as highly structured which are like in the oral form of surveys; semi structured which are the mix of some structured and open ended questions and unstructured (informal) which are more like a conversation.

In order to gather as much information as possible without loosing the focus, semi structured interviews were used specifically in this study. These semi-structured interviews also enabled to gather same kind of information from the participants as it allowed the interviewer freely explore the case. In addition, this kind of interview provided a more systematic and comprehensive way to collect in-depth information in a limited time (Patton, 1990; Hoepfl, 1997).

Throughout the study, three different interview question guides were used based on the nature of the investigated cases. In the following paragraphs, the details of these interview sets are explained.

- First interview question guide (INT_1) was formed of open-ended questions for the semi-structured interview sessions (See APPENDIX A). In those interview sessions, the researcher tried to gather as much information as possible about the reactions of the team members for the courseware development processes. The interview questions were grouped into two categories. First category involves the general questions, which tried to gather general information about the project as well as the interviewees. The second category involves main questions related to the development process, starting from the strategic decision making to the lowest level activities. These main questions can be classified into three layers.

- Management layer: This layer deals mainly with the project management level strategic decision making activities as well as issues which are directly related with the project manager or project management team. Furthermore the issues considered in this layer are the ones that are needed to be considered earlier for the successful planning and implementation of the project
- Integration layer: This layer mainly acts as a middle layer among the management layer and the micro layer. It deals mainly with the curriculum development activities. This layer also includes some activities which can also be considered as management activities. These activities are considerd in this layer since they are based on the outcomes of curriculum decision activities and their effects are mainly seen on the micro layer activities. Therefore this layer includes the activities which integrate the management activities with the courseware development activities
- Micro layer: This layer is mainly deals with the courseware development level activities. It includes all issues to be considered for the development of an individual courseware.

- Second interview question guide (INT_2) was an evaluation matrix (EM) which was developed based on the proposed development model (See Appendix B). This EM was applied to a developed courseware project as an evaluation framework in a structured interview session. There were four matrixes covering the three layers of development processes as given above in addition to interlayer processes of communication and evaluation and revision. Matrixes include all the elements that should be integrated to the development effort and checks whether they were realized in the investigated project as well as at what level they were done. This interview set can be considered as highly structured as it lists the items as a checklist

- Third interview guide (INT_3) was again formed of open-ended questions for the semi-structured interview session (See Appendix C). By this new question guide the researcher tried to gather information about the developer's views as well as their experience on the components from the proposed development model applied to the project. The components adapted and investigated in this interview can be listed as project management component from the management layer; training and style guideline components from the integration layer and all components of micro layer as they were the ones that were appropriate for this case specifically.

The questions in the guides were used as a basic checklist in order to cover all related issues throughout the interview sessions, except the EM that was used. In addition, wording or the sequencing of the questions sometimes had changed or some of the questions were omitted according to the flow of the interviews based on the participants' responses.

All interview question guides were prepared by the researcher. They were both prepared in Turkish and in English except the EM which was only prepared in English. Next they were all checked by two domain experts for their reliability as well as validity. One of the domain experts had an experience on information systems development as well as project management so she checked the interview guides from the information system perspective and the other had an expertise on instructional design models and experience on instructional development so checked according to the educational perspective including curricular aspects to instructional aspects.

All interviews were conducted with the team members of the courseware development teams. The interviewees were working as project directors (PD), content developers (CD), pedagogical experts (PE), software developers (SD) or technical experts (TE) in the development teams. Some of the interviewees had

more than one responsibility in the scope of the project. For example one of the pedagogical experts was also working as content developer or one of the software developers had also some administrative duties in the project. The main aim to conduct interviews with the PDs was to gather information related to strategic level activities of the project. On the other hand the interviews with the CDs and PEs were aimed to gather insight about the instructional development issues while SDs were aimed to gather insight about the software development issues of the courseware development. Generally, information related to integration or micro layer issues were tried to be gathered by these interviews. Interviews with technical experts were done to provide information about the technical problems that could appear from management layer to micro layer activities. In Table 3.1, the interviews conducted in each case were summarized and the roles of interviewees were represented according to their primary responsibility.

Table 3.1: Summary of interviews conducted

	PD	CD	PE	SD	TE	**Total**
Case1-AP-1	PD1,PD2	CD1	CD2_PE	-	TE1,TE2	**6**
Case2-SBS	PD3	CD3	-	SD1	-	**3**
Case3-EPPICC	PD4	-	-	SD2	-	**2**
Case4-AP-3	-	CD4,CD5, CD6, CD7	-	SD3,SD4, SD5	-	**7**
Total	**4**	**6**	**1**	**5**	**2**	**18**

3.4. DOCUMENT ANALYSIS

Documentation or document analysis is another type of data collection instrument that is used for the qualitative research study (Hoepfl, 1997). Merriam (1998) uses the term documentation for the written, visual and physical materials that are

relevant to the cases and lists the major types of documents as public records, personal documents and physical materials.

For each case, the researcher examined courseware developed by the development teams. The rationale behind the investigation of the product of each case as a documentation is that, in interviews the researcher tried to gather information about mainly the development process which affect the quality of the product in addition to issues directly related to the quality of the product. The features of the developed courseware including their general structure like navigation used, user interface, information representation and interaction provided was examined. These were used to support the findings gathered from the interviews.

3.5. IMPLEMENTATION PROCESS

In qualitative research, sampling is done after the determination of "the unit of analysis" (p.166). This specifies the focus of the study. Next sampling or in other words the selection of the unit of analysis is made. "Purposeful sampling" (p.169) is generally used for qualitative research as it focuses on gathering more information from small samples. This will provide to select "information-rich cases" (p.169) to study in detail (Patton, 1990). About fourteen different purposeful sampling strategies to determine cases were listed by Patton (1990) in his book.

All courseware development projects were determined as unit of analysis in this study. Next the sampling strategy for the selection of cases determined as criterion sampling which depends on selecting cases based on some predetermined criteria (Patton, 1990). The criteria that is seen in Table 3.2 was determined for the selection of the cases but not all of them could be satisfied by all the cases

Table 3.2: Case selection criteria and their occurrences in the selected cases

Criteria	Case 1	Case 2	Case 3	Case 4
Curriculum development focus	-	√	-	√
Online course material development	√	-	√	√
Geographically distributed development environment	√	√	-	-
Teamwork	√	√	√	√

An iterative incremental approach was used in the design of the study. Three iterations which involved the investigation of four online courseware development cases were conducted throughout the study as can be seen in Figure 3.1.

- In the first iteration, Case 1 was investigated by conducting interviews with the courseware developers and by analyzing the courseware developed by them. At the end of iteration 1, based on the outcomes of the Case 1 and literature review, first version of the development model was formed.

- In the second iteration interviews of Case 2 were done. In addition investigation of Case 3 was completed by conducting the interviews and document analysis. Finally, investigation of Case 4 was also started in this iteration. Case 3 was conducted as a validation study for the model by using the developed model at the end of iteration 1 as an evaluation framework. The model was also revised according to the results of this case.

- In the final third iteration, one more interview was conducted for Case 2 and Case 4 was finalized by conducting interviews with the courseware developers. At the end of these iterations final form of the model is developed by getting feedback from the cases to make necessary revisions.

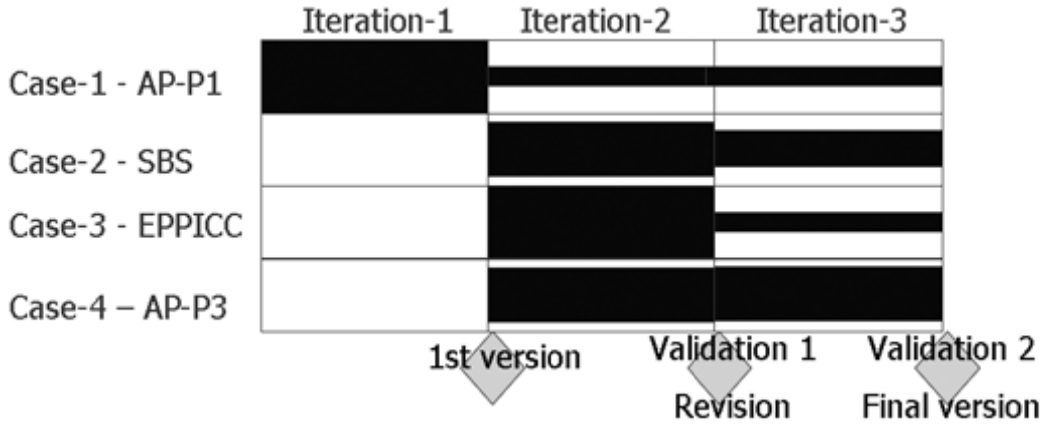

Figure 3.1: Iterative incremental design of the study

The implementation procedure and the investigated cases will be explained by giving background information about the subjects as well as the scope of the projects in the following part. The summary of investigated cases can be seen in Table 3.3.

Iteration-1

In Iteration-1 Avicenna Virtual Campus Phase 1 (AP-P1) project was investigated. The semi-structured open-ended interview question set (Int_1) was used for this case. The main aim in this first iteration was to gather as much as information about all the issues that worked well or issues that caused problems to the project from management level to micro level activities.

Case 1: Avicenna Virtual Campus Phase 1 (AP-P1)

The case (Case 1) investigated in the first iteration was AP-P1. It was the first of three courseware development stages in the scope of the project. The major purpose of this project was to create a new community of Universities from 14 countries sharing best practices and pedagogical innovation in e-learning across the Mediterranean, in the context of the EUMEDIS programme.

Table 3.3: Features of the investigated cases

Case	Case 1- AP-1	Case 2- SBS	Case 3- EPPICC	Case 4 – AP-3
Case Definition	To develop about 200 online courses and share them through the virtual library among the countries for anytime use.	An e-learning project for Malaysia government to develop computer-aided materials for mathematics and science courses of Malaysian education	To develop an online course for primary care physicians to improve their initial screening with regard to eye care of small children	To develop online courses that could be used in Avicenna virtual library as well as in WBL program.
Participants	2 PDs, 1 PE, 1 CD and 2 TEs	1 PD, 1 CD and 1 SD	1 PD and 1 SD	4 CDs and 3 SDs
Online course material development	The developed course materials in this project are primarily for online distribution	The developed course materials in this project are primarily for computer aided instruction rather than online distribution. However, they included features that made them available to use online	The developed course materials in this project are primarily for online distribution	The developed course materials in this project are primarily for online distribution
Curriculum development focus	The course developed in this case did not have a specific aim to attend to a common curriculum	The courses developed in this case were developed in the scope of a defined curriculum	Only one course was developed without the curriculum focus	No curriculum focus from the Avicenna project perspective however, there was an aim to attend to a curriculum by the WBL program perspective
Geographically distributed development environment	The courseware development teams were found in geographically separated AKCs.	The courseware development teams were found in the same organization however the project was held between two geographically separated organizations, one found in Turkey and the other in Malaysia. Specifically the decision making level activities were done in this distributed environment	The courseware development teams were found in the same organization	The courseware development teams were found in the same AKC.
Teamwork	Courseware development was conducted by teams	Courseware development was conducted by teams	Courseware development was conducted by teams	Courseware development was conducted by teams

For the project each partner country forms Avicenna Knowledge Centers (AKCs), which were connected to each other. Each AKC consists of a team of project director, pedagogical expert, technical expert and technicians. Tutors and course producers develop courses under the guidance of these teams (Avicenna, 2006). In the scope of this project, at the beginning it was planned to be developed about 200 online course modules and share all the materials through the virtual library among the countries for anytime use. The courses developed by the countries are uploaded to a content management platform called "Plei@d" for sharing. This project does not aim to develop any degree program. Every partner country in the project has to develop about 20 modules in English and in their own language. The investigated phase of the project was completed at the time of investigation.

In this case the interviews were conducted with team members of development teams belonged to different AKCs which were Turkish, Spanish and Palestinian by using Int_Set1. These were two different project directors (PD1, PD2) and two course developers (CD1, CD2) one of which also works as pedagogical expert in one of the AKCs and two technical experts (TE1, TE2). Two of the interviews, which were with course developers, were conducted face to face while the other interviews were conducted through e-mails. After the interviews the course modules produced were also examined.

Iteration-2

In Iteration-2, SBS- Malaysia Form 2-Form3 (SBS) and Equipping Primary Care Physicians to Improve Care of Children (EPPICC) cases were investigated. The Int_1 questions were used for both of the cases. In addition to this another interview sessions were conducted with the EM matrix developed based on the developed model in the EPPICC case. In this second iteration, again best and problematic practices were tried to be revealed form the cases. In addition to this, the main aim of the second case in this iteration was to validate the proposed development model by applying it as an evaluation framework to the project.

Case 2: SBS- Malaysia Form 2-Form3 (SBS)

The first case (Case 2) that had begun to be investigated in this iteration was Malaysia Form2, Form 3 project. The investigation of it had continued in the following iterations due to some time constraints. It was an e-learning project for Malaysia government. In this project SBS subcontracted the development to a firm called Rtb which was a partner of SBS and it was an e-learning solution provider company. It was a collaboration project of geographically distributed teams which are found in Turkey and Malaysia. The development teams were formed in Turkey by the developing organization. There were also some specialists from Malaysian Ministry of Education working in the project in collaboration with the developing organization. The project structure of the developing organization consisted of several Process Teams which were responsible for the development of courses under the management of Main Process Team which was responsible for the project management. The major purpose of this project was to develop computer-aided materials for mathematics and science courses of Malaysian formal education at the levels form 2 and form 3 (corresponds to the elementary level). In the scope of this project existing Malaysian education content was transformed into a computer supported form. In the Form 2 phase, 220 courses were converted in about eight months and in the Form 3 phase, 110 courses were converted in again eight months period. At the time of investigation, the project was completed and all these courses developed in the project have begun to be used by the Malaysian teachers and students at the schools since 2005 (Rtb, 2007).

In this case, interviews were conducted with the team members of developing organization by using Int_Set1. Interviews were conducted with the Main Process Team Leader (PD3) who can be considered as project manager, content developer (CD3) and software developer (SD1). The first two interviews were conducted in this iteration however the final interview was conducted in the next iteration. Content developer and software developer had different responsibilities in these two phases. During Form 2 phase they worked as content developer or software

developer primarily in the Process Teams but during Form 3 phase they got additional responsibilities and they also worked as Leaders in the Process Teams.

Case 3: Univesity of Alabama Division of Continuing Medical Education (CME) Equipping Primary Care Physicians to Improve Care of Children (EPPICC)

The second case (Case 3) that had investigated in this second iteration was a courseware development project called EPPICC. It was one of the online collaborative grant projects developed by University of Alabama Division of CME (Continuing Medical Education) with the collaboration of different departments. It is jointly sponsored by the University of Alabama, Alabama Medicaid, and the National Institutes of Health. The goal of the EPPICC project is to improve the initial screening that pediatricians do with regard to eye care of small children. The primary pediatric care providers did not have enough information about vision screening, and this causes optometrists difficulties in caring some eye problems such as lazy eye in the later stages. In order to improve the things in these later stages primary pediatric care doctors should learn more about vision screening to determine some problems at the early ages. Therefore, EPPICC courses are developed to offer fast and convenient education for pediatricians so that they learn more about eye problems. The project includes 4 modules for primary pediatric care providers. Modules are different cases which describe common screening challenges and review guideline-based recommendations for patient management. At the completion of each module in a given deadline online certification and credit are received (EPPICC, 2006). As EPPICC is a grant project, it is collaborative in its nature during all its stages. The decision making of the project while writing the grant was a peer review process among different units and professionals. After completion of the writing of the grant, the development of the project was also collaborative among people from different units. The modules are developed by CME in collaboration with the Principal Investigators (PIs) of the grant. PIs were also responsible for the project management so can be considered as project managers. CME provides courseware development team and PIs provided the content for the courses. The development

of the modules were completed at the time of investigation (Marsh, 2006, personal communication).

In this case, the investigation took place in two phases. In the first phase interviews were conducted with one of the PIs of the project (PD4), software developer (SD2) and assistant director of CME who has some managerial duties in the project on the CME side by using Int_Set1. Most of the information gathered from that assistant director of the CME was related to the division of CME rather than the EPPICC project so her interview could not be used for the model. The software developer interviewed in this case, had also some administrative duties other than his software development responsibility. In the second phase of this case another interview was conducted with the software developer of the project by using EM as the proposed development model was used as an evaluation framework for the project for the validation of the model. The components found in the development model were cross-checked with the practices conducted during the implementation of the project with the help of software developer who had enough information about the whole development process from management level to micro level activities.

Iteration 3

In Iteration-3, the developed model was applied as a development model to the Avicenna Virtual Campus Phase 3 (AP-P3) project. Project plan was formulated with the appropriate components that are necessary for this phase of the Avicenna project. The project management component from the management layer; training and style guideline components from the integration layer and all micro layer components in addition to the communication and continuous evaluation and revision components were adapted for the project and implementation of the project was conducted based on this. After the completion of the project, the Int_Set3 was used. The main aim of this iteration was to validate the proposed development model by applying it to a development project.

Case 4: Avicenna Virtual Campus Phase 3 (AP-P3)

In this case the courseware development effort of the Turkish partner in the last phase of the Avicenna Virtual Campus project was investigated. In this phase six more courses were developed in the scope of the project mentioned in Case 1 by Turkish AKC. The same requirements were still used as in the previous phases of the Avicenna project. On the other hand, this phase of the project also attended to the aim of developing online courses that could also be used for the Work Based Learning (WBL) program of the developing institution.

In this case six interviews were conducted with three content developer (CD4, CD5, CD6, CD7), and with four software developers (SD3, SD4, SD5) by using Int-Set2. This case had a validation dimension as the proposed development model was adapted and applied to this phase of the project by the researcher in planning the project.

3.6. DATA ANALYSIS

In qualitative research, as data analysis is mainly based on open-ended questions, the findings are generally hard to analyze. They are not in standardized form as they are long and detailed. Content analysis which is "the process of identifying, coding, and categorizing the primary patterns" (Patton, 1990, p.381) is applied to the raw data. The findings are gathered in the form of themes, categories, concepts and these findings are reported in narrative form. They are also supported by the use of direct citations from the participants' words in the report (Merriam, 1998).

The data analysis was also continuous and iterative throughout this work. Interviews were recorded during the session and then transcribed by the researcher in time. As multiple cases were used in this study, two stages of analysis were applied to the cases as proposed by Merriam (1998). She suggests first to conduct analysis in each case independently and later conduct analysis among the cases. Therefore, the researcher first looked for similarities and differences in the data from the participant interviews in each case as they were single case study. Then,

the similarities and differences were tried to be revealed across cases. The detailed explanation of this process is as follows

- First, the researcher transcribed the interview records word by word using Microsoft Word processor. And then transferred the responses to Microsoft Excel in the form that each cell includes one response of the interviewer.

- Next these transcriptions were investigated and grouped based on their relationships on Excel sheets as can be seen in Figure 3.2. Each group was assigned to a category. These categories were gouped in three different layers which were management (M), integration (I) and micro (m). Then a code was given to each category and each response was represented in the results section by the use of category code and interviewer code. For instance, the coding scheme of [AP1-M4-TE2_E13] represents the category M4 of AP-1 case which was stated by TE2 and which can be accessed on the cell E13 on the excel sheet.

- Then the same type of categorization was applied to all cases. Example for the categorization and sub-categorization of one of the cases as can be seen in Figure 3.3

- Finally, a list of critical principles was derived from these categories and themes from each case.

In addition to the analysis of the interview transcriptions, the courseware materials developed by the development teams in each case were cross-checked with the findings of interviews of each case. As it was stated in Section 3.2.2, the courseware was analyzed according to their general structure. The findings of this document analysis and its cross-check with the interview findings were used to support mainly the style guideline component of the model.

Code	Category name	Interviewer code	Responses
M1	Strategic decision making	AP1-PD1_E15	Unesco hemen butun kararlari veriyor. Ulke temsilcilerinden olusan 'Management Board' var ama hic toplanamadigindan oldukca etkisiz.
		AP1-CD2_PE_E12&13	Ondan sonra hangi dersler olabilir diye üniversite içinde bir yazı yazdık. Hangi dersler olabilir diye. O sonuçta çok başarılı olmadı ve biz kendi içimize döndük.
		AP1-PD2_E6	It was decided to do this project as an institutional decision
		AP1-TE1_E7	It was decided to do this project as an institutional decision
		AP1-PD2_E7	The people involved in decision making are: Vice-Rector for International Relations, Vice-Rector for Technologies (at that time), AKC Director, Technical and Pedagogical Experts.
M2	Requirements analysis	AP1-PD1_E16	ihtiyac analizi Yapildigini sanmiyorum ama teklif verilirken derslerin 4 konudan secilmesine karar verilmis: Bilgisayar ve Enformatik, Isletme, Fen bilimleri ve teknoloji. Bunlar nasil secildi bilmiyorum o asamada yoktum.
		AP1-CD1_E14&25	İhtiyaç Analizi yapılmış mı bilmiyorum, Belirli dersler, hani ne tür dersler açılabilir denmiş bildiğim kadarıyla Türkiye olarak biz şu şu şu alanlarda ders açabiliriz denmiş.
		AP1-CD2_PE_E14	İhtiyaç AnaliziYaptık. Bütün üniversitelere yazı yazdık mesela
		AP1-CD2_PE_E29	Baktık yeteri kadar ilgi toplayamıyoruz şeyden, üniversitenin kendi içinden, biz Enformatikteki hocalar toplanıp konuştuk, ne yapalım diye? Sonra döndük dolaştık kendimiz yapalım bari dedik bu dersleri. Bir de tabi Enformatik Online tecrübesi var enformatiğin.
		AP1-CD2_PE_E30	Oyle bir şansımız yoktu. Şey önemliydi. Science and technology içerikli olacaktı. Çünkü proje öyle tanımlanmış ve öyle alınmış bir proje.
		AP1-CD2_PE_E32	Tabi amacı biz belirlemedik. Onlar predefined
M3	Budget determination	AP1-CD2_PE_E17	Hayır butcede dominant olan biz değiliz. Belirlenmiş bütçeli bir projeye biz partner olduk. Onu Fransa belirledi. Unesco belirledi.
		AP1-PD1_E18	butceyi belirleyenler: Avrupa birligi- Unesco-ODTU. Sponsorlar
M4_1	Technical problems (hard)	AP1-CD2_PE_E22	şimdi pleiad ta beceremiyoruz. Yani çalışmıyor. Upload ettiğimde çalışmıyor ya da biz bunu beceremedik. Bunun sorumlusu sonuçta bir firma var, bunu geliştiren bir firma onlardan da bir şey alamadık, ciddi bir feedback alamadık.
		AP1-PD1_E21	Teknoloji problemleri, Cok sorunlu. UNESCO'da bu isle ugrasan bir kisi vardi.Projeden ayrildi.
		AP1-TE2_E13	Most of the problems we had to handle internally via technical staff and few were corrected by the developers of the Avicenna platform
		AP1-PD1_E81	Bunlardan baska iyi bir teknik yonetim gerekli.

Figure 3.2: Excel sheet prepared for the analysis of interviews

AP-1		
MANAGEMENT LAYER	M1	Strategic decision making
	M2	Requirements analysis
	M3	Budget determination
	M4	Hard problems
	M4_1	Technical problems (hard)
	M5	Soft problems
	M5_1	Communication problems (soft)
	M5_2	Problems based on project management (soft)
	M5_3	Metholodogical problems (soft)
	M5_4	Workload (soft)
	M6	Conflict resolution
	M7	Curriculum determination
INTEGRATION LAYER	I1	LMS
	I2	Trainings
	I2_1	Benefits of trainings
	I3	Style guideline
	I4	Recruitment
MICRO LAYER	m1	LOs and Standards
	m1_1	Advantages of use of standards
	m1_2	Disadvantages of use of standards
	m2	Instructional strategies
	m3	Evaluation of the courses
	m3_1	Evaluation of the objectives
	m3_2	Accreditation
	m3_3	Usability testing
	m3_4	End-user tests
PROCESS	P1	Development methodology

Figure 3.3: Sample categorization scheme for the case AP-1

At the end of data analysis process, the principles gathered from the interviews were compared with each other and a final critical list was formed. These principles were used to support the existence of some of the components of the model and are defined as the essential features for the online curriculum and courseware development projects.

3.7. TRUSTWORTHINESS OF THE STUDY

Qualitative studies as well as case studies in specific are always criticized in research field because of the propositions of "lacking rigor"; having "little basis for scientific generalization" and "taking too long and resulting in massive, unreadable documents" (Yin, 1994, p.10) when compared to quantitative research. As Lietz, Langer and Furman (2006) emphasized that concepts such as validity and reliability and strategies to enable them are well formulated in quantitative research methodologies so the researchers can conduct more objective studies based on the guidelines provided. However, these two measures are not applicable for qualitative research to enable rigor (Aguinaldo, 2003, cited in Lietz, Langer & Furman, 2006; Morgan & Drury, 2003, cited in Lietz, Langer & Furman, 2006). In order to increase rigor, qualitative researchers proposed another concept "trustworthiness" (Lincoln & Guba, 1985) which is established when the findings reflects the actual result that has to be revealed from the data without the bias of the researcher. They (1985) also proposed an alternative set of criteria to match with the ones in quantitative research as in Table 3.4. These are credibility, transferability, dependability and confirmability.

Table 3.4: Comparison of criteria used in quantitative vs. qualitative research (Lincoln & Guba, 1985, p.300)

Quantitative Research	Qualitative Research
Internal Validity	Credibility
External Validity	Transferability
Reliability	Dependability
Objectivity	Confirmability

The main aim of these criteria is to provide "the accuracy of the final report or the account" (Creswell & Clark, 2007, p. 31). Using multiple source of information or in other words triangulation, allowing member-checking which allows the

participants to check the findings, peer reviewing in which an external reviewer checks all the process and findings of the study are the mostly cited strategies that are used especially to ensure the credibility (validity) of the study (Yin, 1994; Patton 1990; Lincoln & Guba, 1985; Creswell & Clark, 2007). Lodico, Spaulding, and Voegtle (2006) summarized the strategies that can be used to ensure especially the credibility, transferability and dependability in qualitative studies in their book as can be seen in Table 3.5.

For this study in order to ensure to accomplish these criteria, as many of the strategies were tried to be used. First of all in order to ensure the credibility which is mainly defined as the accuracy of the representation of the findings, the researcher acted very carefully in order not to influence the participants while collecting the data through the interviews (Lodico, Spaulding, & Voegtle, 2006). Therefore, an accurate data was gathered from the participants. Next, data gathered by using different techniques such as interviews and document analysis and findings were allowed to be reviewed by another researcher to provide the triangulation of multiple data sources as well as member checks. In addition the interview transcriptions were sent back to participants to allow them to review whether there were any missing or misunderstood points as much as possible. However, this could not be accomplished for all the interview transcriptions that some of the interviewees did not give feedback to their transcriptions.

Transferability is the criterion that mainly deals with the similarity of the research site with the other sites that can be compared by the reader. In other words it is something related to generalizability of the findings. In qualitative studies the researcher cannot ensure the generalizability of the findings. However by giving detailed information about the investigated case, the reader is allowed to compare the situation with others so that can determine whether the findings can be applied or not (Lincoln & Guba, 1985). Therefore, richly detailed information was tried to be given about the investigated cases including the context and participants.

Table 3.5: Strategies to ensure the criteria for qualitative studies (Lodico, Spaulding, & Voegtle, 2006, p.276)

Criteria	Strategies or Techniques
Credibility	Prolonged and meaningful participation in setting
	Triangulation of multiple data sources
	Negative case analysis
	Participant review of interview transcripts
	Member checks
	Peer debriefer
	Attention to voice
	External audit
Transferability	Rich descriptions of setting, participants, interactions, culture, policies, etc.
	Detailed information on context and background
Dependability	Detailed description of data collection and analysis procedures
	Use of videotape and audiotape
	Data made available for review

Dependability is the criterion that is similar to reliability. It is guaranteed when the procedure and processes used throughout the study can be followed by the external reviewers or readers (Lodico, Spaulding, & Voegtle, 2006). In order to ensure this, first of all, the researcher used recorder during the interviews in order to capture the data exactly.

CHAPTER 4

OUTCOMES OF CASE STUDIES

This chapter presents the findings of the investigated cases. The findings will be reported under five subheadings which are background information about the cases including the scope of the projects and the participants interviewed; management layer issues, integration layer issues, micro layer issues and the examination of the developed courses in the investigated cases, respectively. The issues gathered from each layer are also grouped and investigated under some pre-determined general categories. These categories and their general definitions can be seen in Table 4.1. Their names may show variances from case to case based on the specific outcomes of the cases. The common findings of the overall study will be identified and summarized after the findings in individual cases will be discussed in detail. Finally, answers to the two fundamental research questions of this study are elaborated, based on the findings of the case studies.

Throughout the chapter the findings will be supported via English translations of quotations taken from the transcribed interviews made with participants. Since some of the interviews were conducted in Turkish, the originals of these quotations were also included in text following the translations in order to prevent misunderstandings due to translation errors. However, the interview quotations which were gathered from the interviews that were originally conducted in English do not have Turkish versions.

Table 4.1: Category names and their definitions used for the investigation of the outcomes of the interviews

MANAGEMENT LAYER	***Strategic decision making***	Strategic decision making activities such as budget determination or requirements analysis are considered here.
	Project management	Effective project management activities which reveal the practices for the effective management are considered here.
	Project plan	Planning as well as the scheduling of the project plan are considered here
	Resource allocation	Practices related with the human resource allocation of the project are considered under this category. Team formation based on the workloads of the people can be listed as an example
	Communication mechanisms	Communications mechanisms including the infrastructure and rules to be provided to the project personnel based on their requirements are considered under this category
	Curriculum determination	Curriculum determination related activities such as who determine the curriculum as well as how they do are considered here.
	Hard problems	Hard problems are the issues that are mainly related with technical issues based on the hardware or software requirements of the project. The problems based on the CMS provided or data loss issues are considered here
	Soft problems	Soft problems are the issues that are mainly related with people. The problems based on coordination or communication issues or conflicts are considered here
INTEGRATION LAYER	***Training***	Issues related with the training needs of the project personnel are considered here.
	Style guideline	The use of a common style guideline for the developed courses, its advantages or disadvantages are considered here
	Recruitment /Retention	The needs or practices related with the taking attention of the students are considered here

Table 4.1: (Cont.)

MICRO LAYER	***Content determination***	Content determination issues for the courses are considered here
	Instructional strategies	Instructional strategy selection and determination for effective courseware issues are considered here
	LOs and Standards	The need of application of LO approach to the courseware development or use of industry standards are considered here
	Prototyping	Advantages related to the use of prototyping while developing courses are considered here
	Course evaluation	Issues related with the evaluation and accreditation processes or policies are considered here
	Review meetings	Issues related with the advantages of conducting review meetings, their frequency and their effects are considered here.

4.1. CASE 1: AVICENNA VIRTUAL CAMPUS PHASE 1

In this section, data analysis and discussions of the findings of the first case which was investigated in the first iteration of this study will be discussed. The online courseware development investigated in this case was an online courseware library development project among Mediterranean countries in the context of the EUMEDIS programme of UNESCO with the European Union support. Developing online course modules and share all the materials through the virtual library among the countries for anytime use two of the major considerations. Consequently, the case revealed major discussions on online courseware development, geographically distributed development environment in some aspects and teamwork. However, there was no degree program development aim in the scope of this project. Discussions and findings shall be interpreted in that context.

4.1.1. Background Information of the Case

Avicenna Virtual Campus Phase 1 (AP-1) case was the first of three phases of Avicenna project. In the general scope of the project, the main aim was to develop 200 course modules by Avicenna Knowledge Center (AKC) founded in the 14 different Mediterranean countries. Sample screen interface of one of the modulesdeveloped in the scope of this project can be seen in Figure 4.1. The project was divided in three phases and in each phase AKCs were required to develop about six course modules which took 20 hours to complete. The courses developed by the countries are uploaded to a content management platform called "Plei@d" for sharing. The organizational structure of the project can be seen in Figure 4.2. UNESCO was in charge of the project management. There was also a management board formed by the representatives from the countries. In each AKC there was also the project director who is responsible for the coordination with the other countries as well as within the AKC. In addition in each AKC there were pedagogical expert, technical expert and technicians in addition to the courseware development teams which are formed of course developers and software developers.

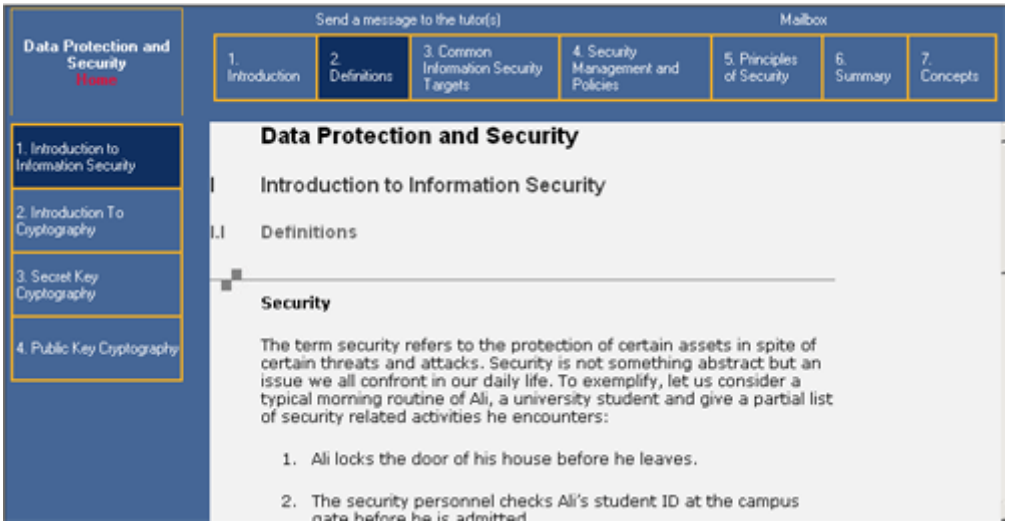

Figure 4.1: Sample interface of a developed courseware in AP-1 Case

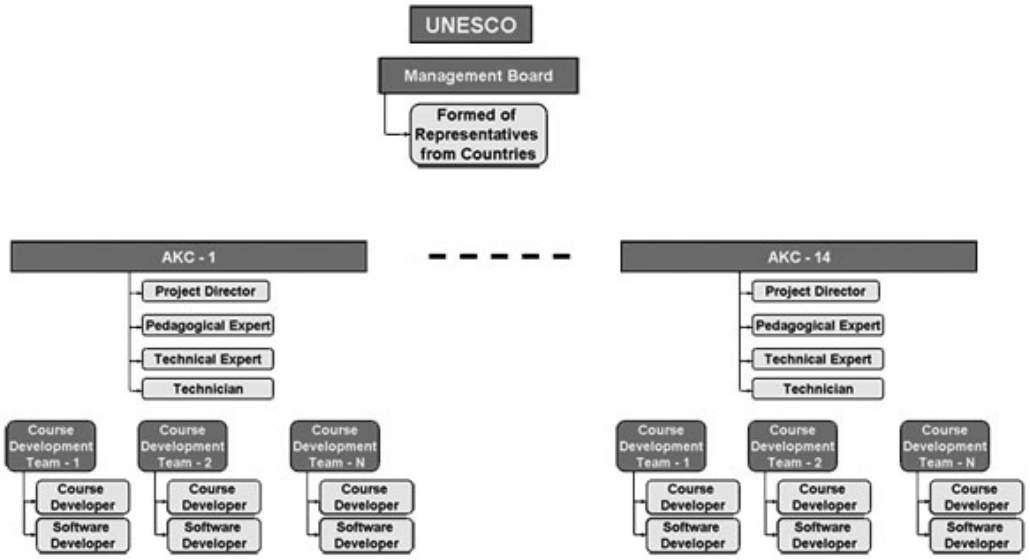

Figure 4.2: Organizational structure of the AP-1 Case

For this case, interviews were conducted with the team members who developed course modules in this phase of the project from three different AKCs (AKC1, AKC2 and AKC3). Six interviews were conducted with two project directors (PD1, PD2) and two course developers (CD1, CD2_PE) one of which also works as pedagogical expert in one of the AKCs and two technical experts (TE1, TE2). Three of the interviewees (CD1, CD2_PE and PD1) were in AKC1 while the other two interviewees (PD2, TE2) were in AKC2 and the last one (TE1) was working in AKC3. Only two of the interviews could be conducted face to face. The others were done through e-mail communication due to the distance with the interviewees and the researcher. Four of the interviewees had previous experience on online courseware development (PD1, CD1, CD2_PE and TE1) while one of them did not have any experience (TE2) and the other (PD2) did not mention about this.

4.1.2. Management Layer Issues

In the management layer, questions were asked to the interviewees about the strategic decision making level of the project. The findings were gathered

especially in decision making including budget determination and requirements analysis, curriculum determination, hard problems related to platform, soft problems related to communication, conflict resolution, pedagogical issues, project management and heavy workload for management layer.

Decision making including budget determination and requirements analysis

The strategic decisions were made at the very top level by UNESCO, who was also the coordinator of the project. There exists a Management Board, formed by the country representatives who participate in the decision making process but this did not work properly as the board could not meet regularly (PD1). Therefore, the project was entirely managed by UNESCO. The partners were not involved in the decision making process of determining the main area tracks for the courses. The main tracks were determined as "Computers and Informatics", "Management" and "Science and Technology". The team members did not know whether these tracks were determined according to any requirements analysis activity. (PD1, CD1). In addition to that, the budget of the project was also determined at the top level during the offer without the knowledge of most of the partners (CD2_PE, PD1).

On the other hand, the decision-making at partners' level was first done as an institutional decision making (PD2 from AKC2, TE1 from AKC3). After the formation of AKCs, issues such as which courses the partner would develop in the pre-determined track and who would develop the courses were determined collectively in all the AKCs. For instance, it was revealed that AKC1 determined the courses by sending questionnaire to various universities throughout the country about the subjects that they would like to have as online courses (CD2_PE). AKC2 also consulted to their faculty and then they determined the courses with their pedagogical experts (PD2).

Curriculum determination

In the scope of the project there was no goal of creating a degree program from these developed courses. On the contrary, one of the CDs who was also the PE of

the team criticized not having any aim for the development of a degree program would result in a handicap by stating:

> This could have been a program, but it was stated to us that it was not considered like that during the planning of the project. For instance, the courses that we are developing also do not serve to a program. This can be a handicap for us in the future. These courses will not be used, that's the handicap. [AP1- M7 - CD2_PE - E68]
>
> Bu bir program olabilirdi, ama bize dendi ki proje yazılırken böyle düşünülmedi. Mesela bizim kendi içimizde bile bakarsan geliştireceğimiz derslerin toplamı bir programa hizmet etmiyor. Bu bir handikap olabilir bizim için ileride. Kullanılmaz bunlar, handikapta o zaten.

However, one of the partners (AKC1) decided to develop courses that will serve for a degree program despite the project still having no such goal. Therefore, they were planning to determine the courses to be developed in the following stages according to that aim (PD1, CD1, CD2_PE).

Hard problems related to the platform (Plei@d) provided

During the project, hard problems mainly occurred depending on the platform provided by UNESCO and these were sometimes solved to a certain extent through e-mail communication whenever the problems occurred (TE2). In fact three of the interviewees (PD1, CD2_PE and TE2) mentioned that they had to handle the technical problems related to platform with their own technical staff internally as TE2 mentioned that as "Most of the problems we had to handle internally via technical staff and few were corrected by the developers of the Avicenna platform" [AP1 - M4_1-TE2_E13].

Similar to that, CD2_PE also mentioned about that they could not get any feedback about their problems related to the platform. The need to provide a good technical management was also mentioned by PD1.

Soft problems related to communication issues and conflict resolution

There were also some soft problems such as communication of the stakeholders, different applications due to different viewpoints. The main communication

mechanism was e-mails and also meetings were held, but these meetings were not adequate (PD1). In addition, PD1 mentioned having no conflict resolution mechanism among all the partners, instead all decisions were made at the top level and then these were declared to members by saying "I do not know to whom UNESCO is consulting when conflicts occurs, but they generally put the things they want to be done to the contracts and then you accept them" [AP1 - M6 - PD1_E24].

> "UNESCO sonunda kime danışıyor bilmiyorum ama yapılmasını istediği şeyi kontrata koyuyor, para almak için imzalıyorsun, bu kadar basit".

One of the technical experts (TE2) mentioned about the positive features of the collaboration as "The collaborations with partners in the project were a useful way of learning things. Looking at what others are doing had influenced the way we think and work" [G5_1- AP1-TE2_E-62]. However, CD1 and CD2_PE stated that they were not aware of what other partners were doing until the first phase of the development process was finalized as CD2_PE said "Partners do not share. For instance, nobody asks about how you handled any problem. I do not remember something like that until now" [AP1-M5_1- CD2_PE_E57].

> "Ülkeler şeyi paylaşmıyor. Mesela kimse şeyi sormuyor, siz şunu nasıl handle ettiniz böyle bir problemi demiyor. Şimdiye kadar böyle bir şey hatırlamıyorum ben."

Soft problems related to pedagogical issues

CD2_PE also mentioned about some pedagogical problems, such as the difficulty in understanding how they should develop the courses, as there was no clear guideline which defined the structure of the courses to be developed. He defined the deficiencies as follows:

> It would be better if a guideline was provided. We have gotten a document which defines the pedagogical approach, development of courses, technical approach, there was nothing much about the technological approach but also when you look at the pedagogical approach, it does not provide any guidance to you. It explains that what the parameters of online learning are. These are generic. There is nothing about what it should be like. For instance it would

> be better it defined how you should develop your storyboard like this or do something like that. I think that would be significant [AP1 - M5_3 - CD2_PE_E26].
>
> Ama merkezde bir guideline olsaydı çok iyi olurdu. Bize doküman verildi işte pedagojik approach, development of courses, technical approach, technical da çok önemli bir şey yok da, pedagojik approachu önüne alıpta, dokümanı Avicenna dokümanını okuduğunda seni guide etmiyor. Neleri anlatıyor? İşte what are the parameters of online learning? Bunlar zaten bilinen şeyler. Hani şöyle olmalı böyle olmalı ama şey değildi mesela. Mesela story boardınızı şöyle geliştirin, şuyunuzu böyle yapın deseydi bence daha iyi olurdu. Önemli olan oydu bence.

They resolved this by their own efforts. They held many meetings among themselves and they tried to reach a consensus for their own structure of the courses (CD2_PE).

The requirement of the project was to develop courses that took about 20 lecture hours to complete. AKC1 had difficulty in justification of this as three of the interviewees (PD1, CD1, CD2_PE) talked about the courses that they had in their institution generally took about 40 hours. They could not understand why the modules were determined as 20 hours and could not get the answer for this issue. Therefore, they had to develop the courses in two parts in order to enable to use those courses by themselves.

Soft problems related to project management

PD1 and CD2_PE brought up the problems caused based on the inadequate project management of the project. Throughout the project, partners sometimes could not get any guidance for about four or six months period (CD2_PE). PD1 mentioned about the requirement of a good project management specifically as stating: "Better project manager is required. Human factor is essential for this kind of distributed systems. People who will track and manage all the communication are necessary. Only providing software is not enough." [AP1-M5_2- PD1_E47]

> "Daha iyi bir proje yöneticisi gerekiyor. Gerçekten de bu dağıtık sistemlerde insan faktörü çok önemli. Zamanında tüm iletişimi yönetip izleyecek kişiler lazım. Sadece yazılımla bir yere varılmıyor."

Soft problems related to heavy workload of team members

Three of the interviewees (CD1, CD2_PE and TE2) pointed out about the heavy workload of the team members and their difficulty of adjusting themselves to the project schedule. One of them emphasized the need of adequate number of team members by saying:

> You work with a limited staff. It is also a big problem. For instance, if only we had five to six technical assistant that we could make them to produce, capture videos. You have to explain some parts; there is a need to synchronize the power points with the videos. But whom else can you make to do, it is time consuming. [AP1-M5_4- CD2_PE _E103]

> Ama az elemanla çalışıyorsun. O da çok büyük bir problem. Mesela bir 5-6 kişilik teknik ekip olsa elimizin altında asistan ve onlara sadece produce ettirsek, neyi produce ettirsek, mesela kendimizi videoya çektirsek, bazı kısımları gerçekten senin anlatman gerekiyor, mesela o videolar işlense ne bileyim ben power point le eşlemelerle birlikte, content-içerik eşlemesi gibi. Ama kime yaptıracaksın ki, çok time consuming.

4.1.3. Integration Layer Issues

In the integration layer, the interviewees were asked about curriculum-level related questions. The findings were gathered especially in training, LMS, style guideline and recruitment issues for integration layer.

Training

There was no planned training for the curriculum and courseware developers. However, there was a requirement for every partner to give seminars, whose structure and content were not determined exactly (PD2). In the scope of these seminars AKC1 team members conducted some meetings, which can be considered as training about curriculum and courseware development. These meetings were more like sharing knowledge and experience among themselves. They discussed their development approach for the modules, the steps to be followed during the development, how an online course should be developed and they tried to reach a consensus (PD1, CD1, CD2_PE). PD1 mentioned about the inadequacy of these trainings as "These trainings are weak. They generally focus

on the LMS use. It would be better if trainings which are broader scope could be provided" [AP1-I2- PD1_E42&43].

> "Bu cılız bir eğitim oluyor. Daha çok LMS'in öğretilmesinde yoğunlaşıyor. Çok daha geniş kapsamlı eğitim verilse çok iyi olur ama"

Meetings that are held throughout the project were also considered as very informal as they provide collaboration among the course development teams in AKC1. CD1 and TE2 referred to the positive effects of these trainings as one of them stated "Authors were trained on how to use the Avicenna pedagogical model, tools etc and it was of great help to the authors on producing good work" [AP1-I2_1- TE2_E30&33]

LMS (CMS in this case)

The inadequacy of the content management system was mentioned by CD2_PE, T1 and TE2. The abilities provided by the platform were defined as "very poor and obsolete, without maintenance and actualizations" [AP1- I1- TE2_E27]. It was found not being user-friendly and some of the interactions provided could not be understood (CD2_PE).

Style guideline

The common structure which can be considered as a style guideline for the courses was tried to be formed by AKC1 as much as possible. CD2_PE stated about this as "We reached an overall standard for the interface presentation. We did not do any storyboards, but we tried to present the content in one screen pages without scrolls" [AP1-I3- CD2_PE _E21] and "Our first opening page include concept map and all the contents were reached from there. Then this approach was accepted by the other groups. They applied the same approach for their courses" [AP1- I3- CD2_PE _E19].

> "Ama overall da bir ara yüz mantığı bir içeriğin sunuluş mantığında bir standart yakaladık bence yani çok clear. Şeyleri kestik. Storyboarding yapmadık ama belki, contenti bir ekranlık sunmaya çalıştık hepimiz, scroll downlar olmasın diye uğraştık. Oralarda bir şeyler başardık gibi."

> "O da neydi bizim ilk açılış sayfamız bir concept map olsun oradan konuyu dağıtalım diye. Ondan sonra bu görüş diğer arkadaşlar tarafından da kabul gördü. Onlarda öyle yaptılar."

In the AKC1, it was preferred to develop courses formed of HTML-based web pages. The use of video material was minimal. They considered including video presentation for the introduction of the courses but this could not be achieved. Moreover, use of video was implemented in only one of the courses as an additional course material (CD2_PE).

Recruitment

Finally, PD1 mentioned the need of publicity for this kind of project by stating "It should be advertised to public that these programs can be very good quality. I think we do this announcement task insufficiently" (AP1-I4- PD1_E84)

> "Ancak en önemlisi, bu tür programların kaliteli olabileceğinin kamuoyuna çok iyi duyurulması. Sanıyorum biz bu duyurma işini eksik yapıyoruz."

4.1.4. Micro Layer Issues

In the micro layer, the interviewees were asked about courseware related questions. The findings were gathered especially in instructional strategies, LOs and standards, course evaluation and accreditation including usability testing issues for micro layer.

Instructional strategies

AKC1 developers applied instructional design models or instructional strategies partially. They did not follow any model strictly as CD1 and CD2_PE stated as

> While developing courses we have followed a process. It is something like a development methodology. But I have some methods that I apply to myself. As I said before we have started from a process of previously developed course. Then it was decided to determine objectives first and than concepts, than concept maps and then the flow should be prepared according to these. Then it was decided that the content of the course should be developed according to that concept map and finally there should be an evaluation section [AP1-m2- CD1_E63&64]

> Kendimize göre bir süreç takip ettik. Burada geliştirme metodolojisi gibi bir şey olarak. Yani hani kendi içimizde kendi kendime yaptığım bir takım yöntemler var. Ama dediğim gibi en başta daha önceden hazırlanmış bir dersten yola çıkarak bir şeyler ortaya kondu. İşte önce hedefler olsun, sonra conceptler olsun, sonra concept map oluşturulsun, ona göre bir akış hazırlansın. Ders içeriği o concept mape uygun bir şekilde düzgün şekilde hazırlansın falan. Sonra bir değerlendirme bölümü olsun gibi bir şey kondu.

> As we were limited with the METU syllabus, the objectives were determined there. Then what have we done? We have grouped these objectives into 5-hour segments. There were 4 segments then. In each of those segments, we have included 20 minutes reading activity, 10 minutes exercise activity and others. But it is not possible to follow this approach strictly because you have your materials and notes and you also try to fit those materials. But generally we tried to accomplish the steps as objectives, what should be the content in the scope of those objectives and what should be the activities in the scope of that content. [AP1-m2-CD2_PE_E74]

> Şunu yaptık aslında yani dediğim gibi syllabusa bağlı kaldığımız için ODTÜ syllabusına, objectiveler orada belliydi. Ondan sonra ne yaptık: Biz bunları şeylere böldük. İşte 5 er saatlik segmentlere böldük. 4 tane segment çıkıyor. O her bir segmentin altında şeyleri mesela 20 dakikalık atıyorum reading activitiy, 10 dakikalık exercise activity. Tamamen böyle böldük. Bu mantıkla başladık ama tabi iş pratiğe dönüştüğünde onu da tam follow up edemiyorsun, elinde bir materyal var, o materyale bir türlü fit etmeye çalışıyorsun. Çünkü kullandığın notların var, bilmem neyin var. Ama genelde şey çalıştık, hedefler, o hedeflerin içeriği ne olacak, o içeriğin içindeki etkinlikler ne olacak. Bu bazda gittik.

From these comments of the course developers, we see that first of all, the objectives were determined, and then the content of those objectives and finally the activities in those contents were determined for each course. Concept maps were formed to show the relationships among the concepts.

On the other hand TE1 and TE2 in AKC2 and AKC3 mentioned that they had used the Avicenna model as a pedagogical model but each developer had used his/her own experience and template for the courses. Conversely, CD2_PE commented on the pedagogical document provided as

> There was a pedagogic approach document. However, we could not digest it well. It was a very incoherent document so we could not train ourselves by using it. Instead what have we done? We trained ourselves. The experience of doing similar works at our institute for five years have helped us very much. [AP1-m2- CD2_PE_E51]

> Mesela pedagojik approach vardı. Tabi biz o dokümanı çok iyi digest edemedik. Çok kopuk bir dokümandı, onu kullanarak kendimizi eğitmedik. Çok faydası olmadı. Biz ne yaptık. Kendi kendimizi eğittik. Şeyin tabi tecrübesi çok işimize yaradı burada yani enformatikte bu işler 5 yıldır yapıldığı için düzenli olarak. Zaten hocalar by heart know how to do.

LOs and Standards

The courses were developed independently rather than determining concepts and developing each concept as re-usable learning objects. Development as learning objects was not the project's goal. However AKC3 used learning objects which are consistent with IMS and SCORM as TE1 mentioned, while TE2 stated that they developed independently but sharing common templates in AKC2 and AKC1 did not used any standards. TE2 mentioned the advantages of the use of standards as "Standards provide a good way to transfer the objects to another LMS or be searched and validated. I see no disadvantages to using standards here" [m1- AP1-TE2_E-44] while TE1 listed them as "Advantages: transportability, interoperability of learning objects" [AP1-m1- TE1_E-45].

However, TE1 also listed the possible disadvantages as "Usually a particular application profile is necessary for each work and environment; there is a need to fill in many metadata items not necessary at all. Nor really necessary for reusing components" [AP1-m1- TE1_E-45].

None of the developers in AKC1 favored developing learning objects since there was no commonly agreed upon standard. Furthermore, the courses determined to be developed in this project did not have any overlapping concepts so this would not help project very much (CD1).

Course evaluation/accreditation

The accreditation of the courses was handled by a private organization assigned by UNESCO (PD1, CD1, CD2_PE). Each course was evaluated by other AKCs by filling in quality forms and then courses sent for the accreditation and feedback was given. The accreditation was mainly dealt with the online course material excluding the content (CD1, CD2_PE).

The developed courses were not tested according to their usability (CD1, CD2_PE). The courses could not be tested whether they had achieved the predicted objectives since no evaluations were done after the courses were thaught. The developers only crosschecked their determined objectives with the concepts they had included in the content. There was no formal mechanism for testing of courses (CD1).

The teams offered their developed courses to students and provide some questionnaires to students in AKC1. There is going to be revisions after the evaluation of courses through these questionnaires by students and instructors although this was not considered by the project (PD1, CD1).

Development Process

The interviewees from all the AKCs defined their course development process evolutionary or iterative rather than traditional waterfall model. Stages of course developments were conducted iteratively.

4.1.5. Summary of the Interview Findings

The interviewed participants mainly faced with problems due to the points summarized on Table 4.2. However, they tried to overcome these problems inside their teams by using their own previous experiences. The teams developed courses in an iterative manner by first discussing and deciding on a common way and then created an example and shared that with each other and then continued the development. They tried to establish meetings whenever required until they got consensus and enabled continuous communication.

Table 4.2: Summary of the issues in Case 1 - AP1

Management Layer	Positive issues	Good project management in knowledge centers
	Negative issues	Inadequate general project management
		Inadequate partner participation to strategic decision making
		Inadequate communication mechanism
		Inadequate technical support
		No conflict resolution mechanism
		Listserv mechanism was provided among partners but no mechanism to enable the partners to use e-mails effectively when they faced with problems
Integration Layer	Positive issues	Frequent meetings conducted in knowledge centers
		Helpful in-group trainings
		Attempt of common style guideline determination for the courses
	Negative issues	Conducting seminars were required but their structure were undetermined
		Inadequate LMS was provided
Micro Layer	Positive issues	Attempt to use concept maps while developing course
		Pedagogical documents were provided but it was inadequate
	Negative issues	No commonly agreed upon instructional design or strategies therefore difficulty occurred in determining the structure of courses
		Inadequate course evaluation

4.1.6. Document Examination

In addition to the interviews, the courses developed by the interviewed developers were examined. The developed courses were uploaded to Plei@d platform. Firstly, the courses developed by AKC1 were investigated and compared to each other in the group. Although the general structure of each course is similar some slight differences in the interface and presentation structure of the courses are examined between the three developers' courses in the same team although they

discussed on common style guide for the courses. The courses were Web Based Training: Design and Implementation (WBT), Object Oriented Programming with Java 1 (OOP) and Data Protection and Security (DPS). Content was divided into chapters and reached through the use of left menu. The differences can be listed as follows and these can be seen from Figures 4.3, 4.4, 4.5:

- Subsections of the chapters can be reached through the upper menu in two of the courses (WBT and DPS) whereas, in OOP course upper menu is used to state the chapter title and access practice test of the chapter.

- Concept maps were used in all courses however with different presentations. In OOP course it was used on the first pages of the chapters to provide access to subsections, in WBT and DPS courses, it was used as optional material to show the relationships among the concepts that enabled you to access them wherever you are on the course. In WBT course it was accessed through a specific icon on the upper menu while in the DPS course it was accessed through a link at the bottom of the pages

- Each chapter had an introduction page on the opening pages of the chapters. These pages listed the objectives or learning outcomes of the courses.

- The navigation structure of each course shows differences. For instance, in the WBT course, upper menu is used for sub-sections of the chapters and also additional navigation bar was used for the inner pages of the sub-sections. On the other hand a table of contents or a concept map on the opening page of each chapter is used for the sub-sections of the OOP course. For the DPS course, navigation is similar to WBT course in the use of left and upper menu structures. The only difference can be seen in the access structure of the inner pages that they could be accessed from the bottom of the pages in DPS course.

- Another difference can be seen in the scrolling structure that in WBT course scroll downs were tried to be eliminated as much as possible, rather information was given on one-screen pages. However, the other courses used the scroll downs on many pages.

- In each course different evaluation methods were used. In WBT course, open ended questions were asked to the students and these can be reached anytime through a special question mark icon on the upper menu. On the other hand, in OOP course, multiple choice practice tests were used and these can be reached anytime through a practice test link on the upper menu. However, in DSP course , again multiple choice tests were used but this time that could be accessed at the end of each chapter in the summary subsection of the chapters.

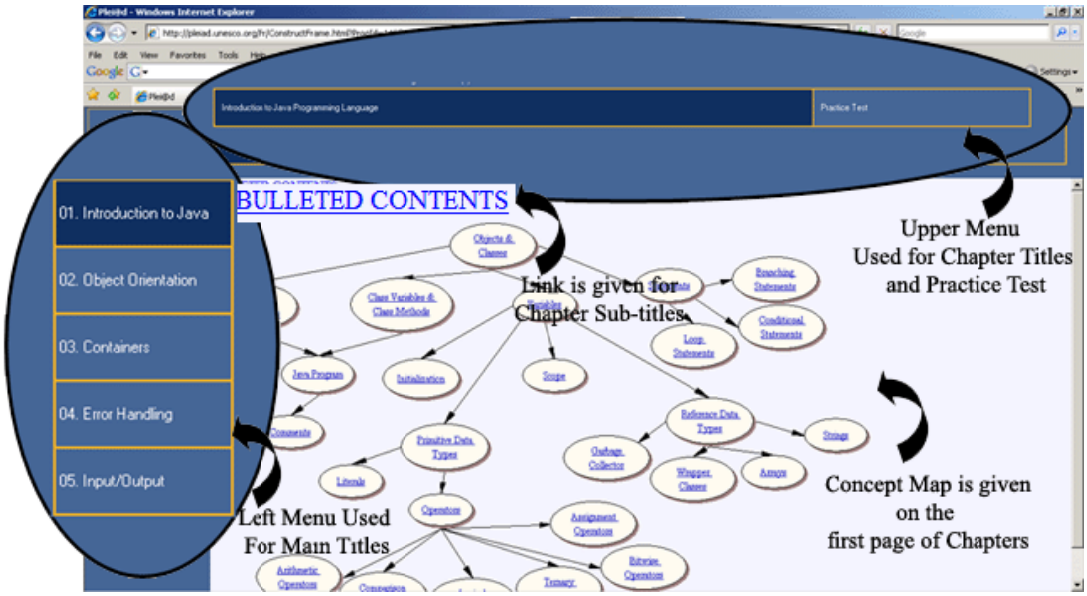

Figure 4.3: Screenshot of OOP Course

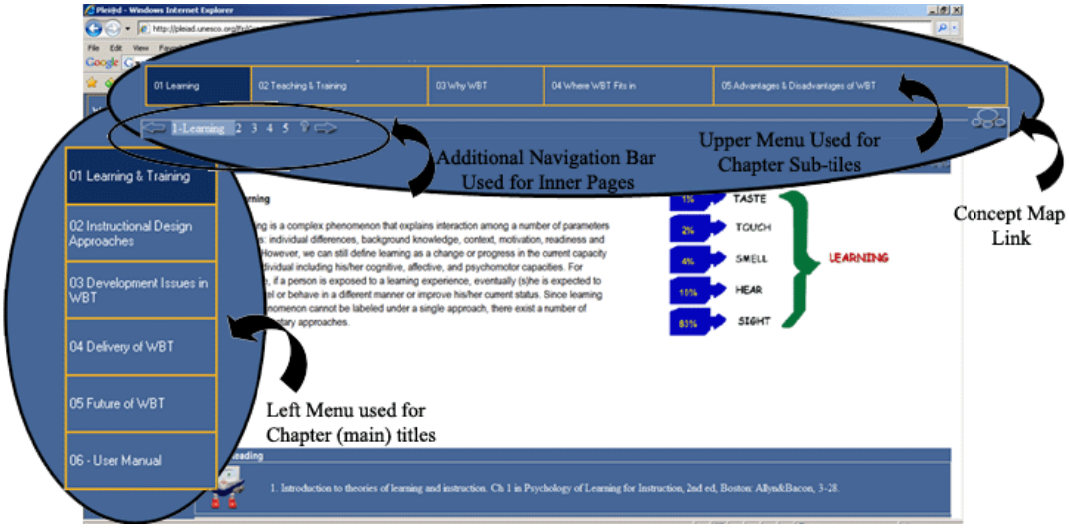

Figure 4.4: Screenshot of WBT Course

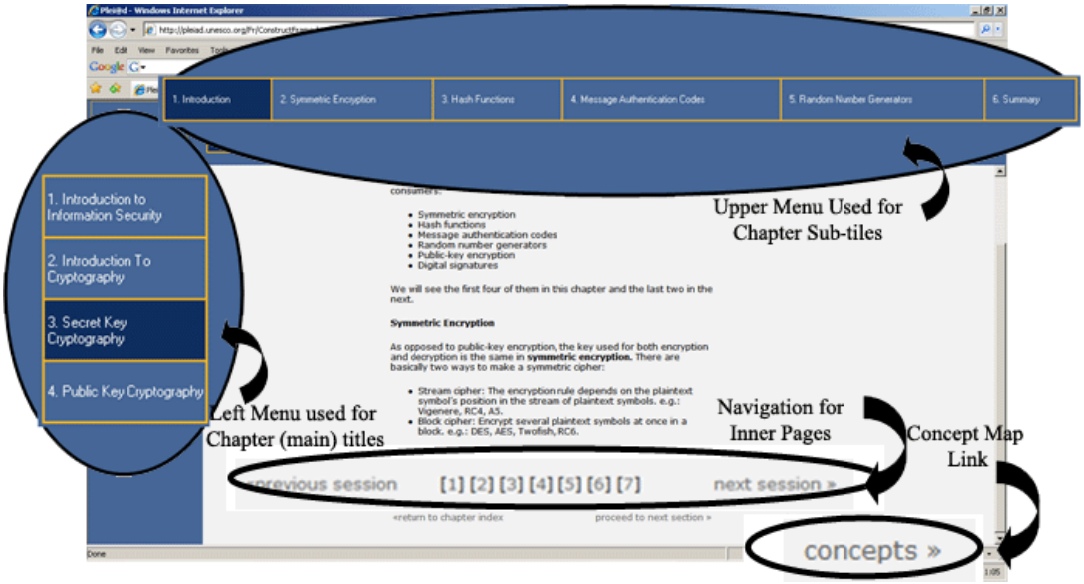

Figure 4.5: Screenshot of DPS Course

No more major differences can be seen on the structure of the course materials, other than the format and use of concept maps, navigation structures and the use of scroll downs as well as the evaluation methods. Minor differences were mainly due to the very different contents as CD2_PE stated

> Finally we have decided an approach for producing our course and we shared it with the other developers in our teams. They also accepted that. What was that approach? The opening page should be a concept map and then content could be explained from it. At that point we discussed a lot about the structure of a concept map. They draw a concept map but we said that it was not a concept map; rather it was a table of contents and they should show the relations among the concepts. Then we have realized that the formation of a concept map for the OOP course is difficult. We saw that content affects the instructions so instructional design cannot be same for all type of courses. Then we decided that each team should be free on this issue. [AP1-m2- CD2_PE_E19]
>
> Sonunda biz kendi dersimiz için bir approach almıştık kendimize, biz böyle yapacağız demiştik. O da neydi? Bizim ilk açılış sayfamız bir concept map olsun oradan konuyu dağıtalım diye. Ondan sonra bu görüş diğer arkadaşlar tarafından da kabul gördü. Onlarda öyle yaptılar. Bir o kısmında baya bi takıldık. Çünkü onlara şeyi anlatmaya çalıştık. Onlar bir şey yaptı biz dedik ki bakın bu concept map değil table of contents hazırlamışsınız sadece şu ilişkileri de gösterin dedik. Sonra şunu fark ettik CD1'in verdiği derste java ile programlama olduğu için orada bir şey kurmak çok zor, concept map oluşturmak. İçerik ve şeyin ne kadar birbirine etkilediğini gördük. Instructional design ın aynı olamayacağını fark ettik. Ondan sonra herkesi serbest bıraktık.

The team enabled to form similar structure courses by holding meetings and discussing the situation until they got consensus despite there was no standard course style or instructional design provided by the project.

> The interim meetings were very helpful. We had a chance to explain our web based training approach and show our concept maps. Maybe they were the best trainings despite they were informal. Because the other teams have asked us how did you do that? How should we do that? Without intervening the content, those meetings were very helpful to decide on a common strategy [AP1-I2- CD2_PE_E47&48]
>
> Ara toplantıları da söylemek lazım. Şey açısından çok büyük faydası oldu ara toplantıların. Belki de formal olmasa bile en iyi eğitim onlar oldu. Çünkü CD1 olsun, başka bir CD olsun onlarında hep bize sorduğu siz şunu nasıl yaptınız, biz bunu nasıl yapalım, tabi içeriğe müdahale etmeden ama bir strateji belirleme konusunda bence o toplantıların çok faydası oldu mesela.

Then the courses developed by other two AKCs whose team members were interviewed in the scope of this case were also investigated. These two AKCs' course structures are also similar to Turkish teams'. There are also some slight differences such as navigation structure. For example they used the upper menu

instead of left menu not for the main titles of the course. For subtitles they also used a kind of Table of Contents or outline format for each chapter. One of the teams used scrolls on the pages. Their evaluation method was also using multiple-choice tests at the end of the course but they did not give the correct answers to students.

In addition to these countries' courses, the other courses developed by the other countries also investigated. Some major differences were seen among some AKCs other than AKC1, AKC2 and AKC3. For example slide shows were used for the presentation of the courses by one of the AKCs while video lessons and slides were used together instead of web pages by another.

4.1.7. Outcomes of the AP-1 Case

The following principles were extracted and developed from the findings of the case. These principles can be applied in the various stages of the development process, and each has some (more or less) impact on different phases.

- *Provide a good project management team*: This is very essential for the project, as they will enable the coordination among the distributed members. Having people who have required competencies in the team is very essential for good decision-making (Theme AP-1_M5_2).

- *Provide a good technical support*: Technical issues can be distracting during this kind of development projects and can de-motivate the teams. Therefore, including a technical support team that will respond the technical needs of development teams in a timely manner is required for the smooth running of the project (Themes AP-1_M4 & AP-1_I4_1).

- *Provide mechanisms to enhance communication and active participation:* As can be seen from the case without adequate participation of any team members, the development approach cannot be succeeded. Many of the missing issues such as undetermined instructional design strategies were

resolved by the active communication of the team members. However as they did not communicate with other partners they had no idea of what they were doing so maybe they accomplished very different materials from the others (Theme AP-1_M5_1).

- *Provide good training mechanisms for the developers:* Training is required for the developers before and during the development process in order those to have the common understanding of the development process as well as what kind of material is going to be produced at the end. Moreover, all course developers cannot have same level of knowledge about the courseware development so the trainings help developers to come to a common level of knowledge and understanding (Themes AP-1_I2 & AP-1_I2_1).

- *Provide capable LMS:* The selected LMS affects the effectiveness of the course materials produced. In addition, its capabilities are also important for the instructional strategies to be chosen. In this case, the capabilities of LMS were very limited and produced difficulties during the upload of their courses. The capabilities of LMS should be determined based on the requirements of the courses to be presented through (AP-1_I1).

- *Create a common understanding about style of the content among all the team members:* In this case, one of the major problems was related to not having a common understanding about the online course material. The team had also difficulties when trying to form a consensus on this issue as no common guideline was provided to them. Therefore there was the possibility of having different format course materials developed by different partners (AP-1_M5_3)

- *Provide a commonly agreed upon pedagogical approach:* There is a need to apply an instructional design and strategies for the development of the courses. Because the materials are needed to have pedagogically sound

principles to aid learning. The development teams need to know these to determine the structure of the courses (AP-1_m2).

- *Provide evaluation mechanisms to test the quality of the material:* The developed courses are needed to be evaluated according to their quality. Accreditation mechanisms, quality check, usability reviews are needed to be determined to develop effective learning environments (AP-1_m3).

- *Follow an iterative/incremental development model*: The finding of the case showed that the course development is not a step-by-step process. In the case, chapters in each course were developed as increments and this prevents the late finding out of errors due to analysis of the courses. While doing the first increment, developers can see the missing points and they can change them in the next increment. This increases the efficiency (AP-1_P1).

4.2. FIRST VERSION OF DONC^2 DEVELOPMENT MODEL

In this section the first version of the DONC^2 will be explained by defining the components involved in the model. This first version was developed after the investigation of the first case at the end of the first iteration of the study. The model was formed based on the outcomes gathered from the investigated case, AP-1, in addition to the related literature.

The model includes components in three main categories, which are previously categorized during the interviews' reporting. These are management, integration and micro layer components. In the model, the components are listed in a circular form in order not to emphasize any order for their sequence, as in Figure 4.6. Based on the derived outcomes from the case, the components in any layer or among the three layers can be conducted concurrently and iteratively. In addition to that each component can give feedback to any other components by continuous

communication and continuous evaluation and revision, which are done in all layers as well as among the layers.

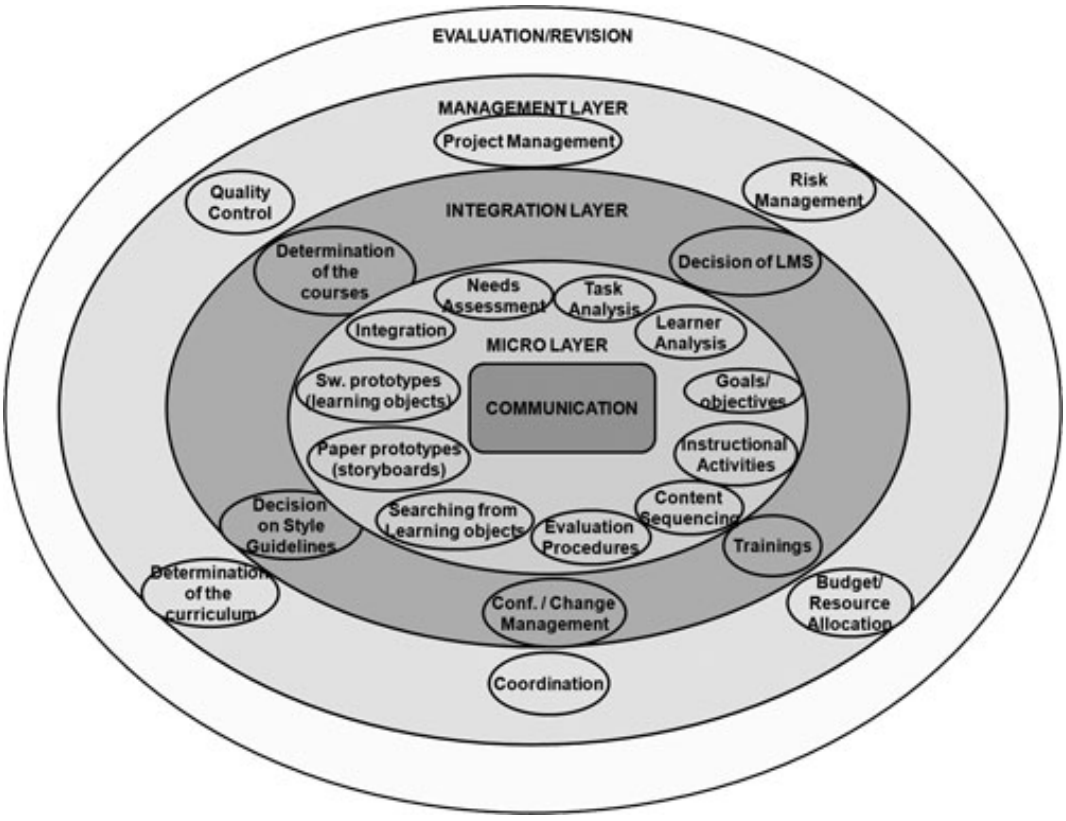

Figure 4.6: First version of DONC2 Development Model

4.2.1. Components of Management Layer

The management layer deals with the strategic decision making activities of the project management team. Within the framework of management layer, there is no pre-determined sequence among these components. They all can be conducted concurrently as well as iteratively throughout the entire project. Management layer components especially the planning activities are conducted heavily at the beginning of the project while the others, which are related to the execution of the plans, continue with different workloads throughout the project.

- *Project Management*: Project Management is one of the main components of the management layer which continues heavily till the end of the project and involves two major sub-activities:

    - *Plan development*: This involves the preparation of a complete guide for the execution of the project. This activity is iterated for several times, as it uses the outputs of the other processes of the management layer and it cannot be completed before the planning activities of other management layer processes are ended.

    - *Management*: This starts from the beginning of the project and ends only when the project is finalized. It involves the control of the execution of the plans for the phases

- *Budget\Resource Allocation*: This kind of project requires a considerable amount of capital and human resources. All the resources need to be planned carefully by the project management team. While deciding on these issues management team gets feedback from other teams in the project. Two major activities in this component are as follows:

    - *Budget/Resource Planning*: This involves the determination of the resources in terms of human, equipment and materials and their quantities for the execution of the components.

    - *Organizational Planning*: This mainly deals with human resource planning. This activity can be repeated during the project for several times according to the availability and workload of the people when performing integration or micro layer components.

- *Determination of the program*: Project management team is responsible for the decision of which degree program or curriculum or which group of courses is to be developed. This component involves the needs assessment activity before making the decision of the program or the common goal for

the group of courses. The workload in this component is heavier at the beginning while it is less at the later stages of the project but continues until the end as small modifications may be needed for the scope of the program

- *Coordination*: Coordination is done by the project management team to provide collaboration and communication among all the teams as well as team members.
    - *Communication Planning*: This involves determining the information and communication needs of the people involved in the project as well as information distribution mechanisms, which enable the required information available to people in a timely manner.
    - *Communication Moderating*: This is the other essential activity done by a coordinator or facilitator who is also the member of project management team.
- *Quality control*: The quality of any degree program is very important for success. Project management team determines the quality criteria as well as accreditation criteria for the degree program as well as the courses in the program.
    - *Quality Planning:* This involves determination of quality policy, standards and regulations to be followed during the project and preparation of quality checklists for the evaluation of the developed curriculum and courseware.
    - *Quality Inspections/Reviews:* This is also another continuous activity. Its workload shows variance during the project.
- *Risk Management*: This kind of project involves many risks that are to be overcome during the project. Risks are generally based on hard or soft

issues. At the beginning of the project, planning is to be made to deal with the possible risks.

- *Risk management planning*: This involves deciding how to approach and plan the risk management activities for the project.
- *Risk Resolution:* This activity is performed whenever any risk is occurred as a response to overcome the risk.

4.2.2. Components of Integration Layer

The integration layer deals with the curriculum development activities.

- *Determination of the courses:* The courses to be included in the determined degree program or the group of related courses are decided in this layer. The related courses from introductory to advanced levels are mainly combined to form a degree program.
- *Decision on LMS:* The decision on LMS that will be used to offer the courses is an important activity. The LMS that is easy to use and handled by the course developers as well as that have many interactive features for the students is to be selected. Careful consideration on these issues is required.
- *Configuration\Change Management:* Continuous communication and feedback mechanisms exist among all layers as well as all processes. This requires continuous revision and change for processes. Therefore, planning of configuration and change is essential.
- *Style guidelines*: Style guidelines provide standard structure in all courses according to the quality issues determined in the management layer. As these courses serve a degree program or they are related, commonalities are required in their style.

- *Training*: Training is required for all people who work in any of these processes. Training programs are essential to give a common insight to distributed development teams on the requirements as well as the development strategies of online materials.

4.2.3. Components of Micro Layer

The micro layer deals with the courseware development activities. There is also no pre-determined sequence among these components. Micro layer components continue to be conducted again and again during the project until all the courses are developed

- *Needs Assessment:* In this component, instructional designer tries to gather what changes in students' knowledge are required by the developed course.

- *Task Analysis:* This is one of the critical components of instructional design. In this activity, the content and the tasks necessary for the course are determined. Subject matter experts are the primary source for this activity.

- *Learner Analysis:* Considering the target audience of the courses is very essential in order to provide effective and efficient learning environment for them.

- *Goals\Objectives*: The main aim of the course is determined by the goals and objectives. They define what the learner would know or perform at the end of the instruction.

- *Instructional Activities*: This component involves determination of activities to be included in the learning environment to provide the interaction of the learners with the material, instructor and each other based on the determined goals and objectives.

- *Content Sequencing*: This involves the combination of the results of the task analysis, the goals and objectives of the instruction and instructional activities to decide on the sequence of the content of instruction.

- *Evaluation Procedures*: Procedures that are going to be applied for the instruction are determined based on the determined goals and objectives.

- *Searching from learning objects*: This component deals with searching for suitable materials in existing learning object repositories before starting to develop new materials to reduce redundant efforts.

- *Paper prototypes (storyboards):* Storyboards are the paper prototypes of learning materials. This will provide to evaluate the learning objects formatively.

- *Software prototypes (learning objects):* All learning materials are developed as learning objects according to a determined standard. This will enable them to be re-used whenever necessary and reduce the redundant efforts.

- *Integration*: Integration involves the incorporation of developed learning objects according to the determined content sequence. They form a complete course in the degree program. All courses are also integrated and form a complete degree program.

4.2.4. Communication

As it was mentioned before, communication is the essential and necessary component required for all level components and for all team members. Mechanisms are to be provided to enhance effective communication to ensure timely and appropriate generation, collection, dissemination, and storage of the project information especially for the geographically dispersed team members.

4.2.5. Evaluation\Revision

Continuous evaluation and revision are also essential elements and conducted at all layers. The components at all layers are continuously tested and evaluated and revisions take place as a result of these evaluations. Evaluations can be either formative or summative. In addition to that usability testing is used. Revisions are conducted as peer reviews or expert reviews in any of the processes. This component is supported by the quality inspections/reviews activity of the quality control process of the management layer.

4.3. CASE 2: SBS: MALAYSIA FORM 2- FORM 3

In this section, data analysis and discussions of the findings of the second case which was investigated in the second iteration of this study will be discussed. Although the investigation of this case had been started in the second iteration it had been finalized in the third iteration due to the need to conduct additional interview with a software developer to gather additional perspective about the project.

The investigated case was a computer-aided course material development project for mathematics and science courses of Malaysian formal education at the levels form 2 and form 3 (corresponds to the elementary level). The project carried out by the collaboration of distributed teams which are found in Turkey and in Malaysia. Although the case was not an online courseware development case, the materials developed in the project could be used for online delivery whenever the infrastructure was provided. The industry standards used for online courseware were also applied to the materials developed in the project. Moreover, the materials were developed in the scope of a curriculum. Consequently, the findings revealed major discussions on curriculum development, geographically distributed development environment and teamwork. Discussions and findings shall be interpreted in that context.

4.3.1. Background Information of the Case 2

SBS - Malaysia Form 2 - Form3 (SBS) case was a computer-aided instruction project developed for Malaysian government. SBS participated in two of the phases, Form 2 and Form 3. They were developed by SBS by subcontracting the development effort to one of its partners, Rtb which was an e-learning solution provider company. In the scope of the project, the main purpose was to develop computer-aided materials for courses of Malaysian formal education at elemenatry level. Malaysian Ministry of Education decided to teach science and mathematics curriculum in English to students. Therefore they planned to supply computer-based English course materials to ease the job of teachers while presenting their lessons. In the first phase, courses were developed for mathematics and science curriculum of the Form 2 level. In the second phase, courses for only mathematics curriculum of the Form 3 were developed. In the Form 2 phase, 220 courses were converted in about eight months and in the Form 3 phase, 110 courses were converted in again eight months period. Sample screen interface of one of the modules developed in the scope of this project can be seen in Figure 4.7.

It was a collaboration project of geographically distributed teams which were found in Turkey and Malaysia. The development teams were formed in Turkey by the developing organization, SBS, Turkey. There were also some officers or specialists from Malaysian Ministry of Education working in the project in collaboration with the developing organization in addition to representatives from SBS, Malaysia. The developer organization had functional groups which could be listed as multimedia (MMD), software (SD), content (CD) development teams, visual design (VD) teams and administrative duties (AD) teams. Represantatives from these groups came together and formed Main Process Team (MPT) for the management of any content developing project. Then, Process Teams (PT) were formed under the MPT for the development of courses. Again, representatives from each group existed in each PT. The organizational structure of the project can be seen in Figure 4.8.

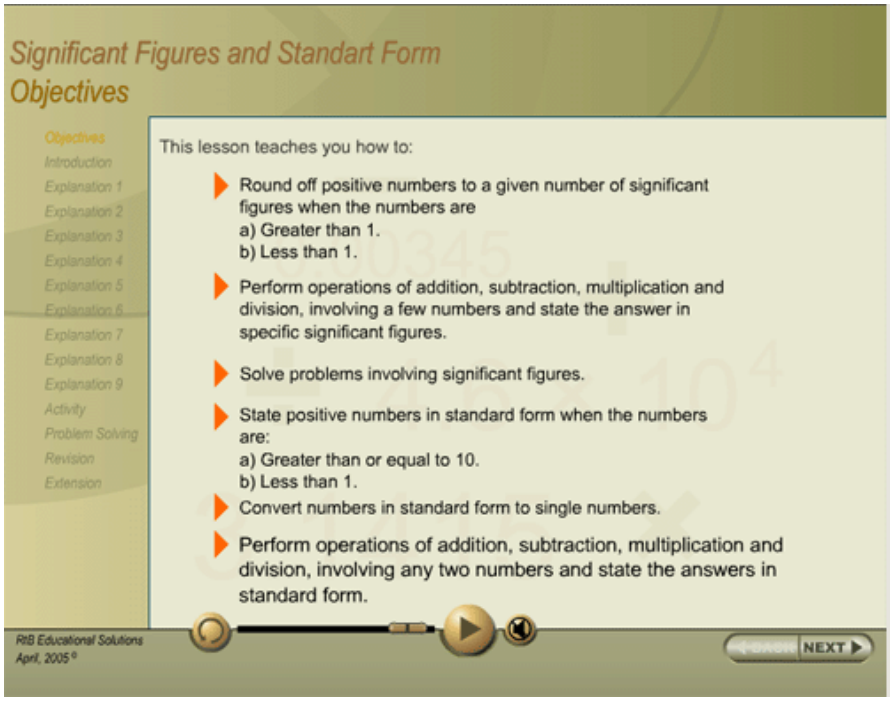

Figure 4.7: Sample interface of a developed courseware in SBS Case

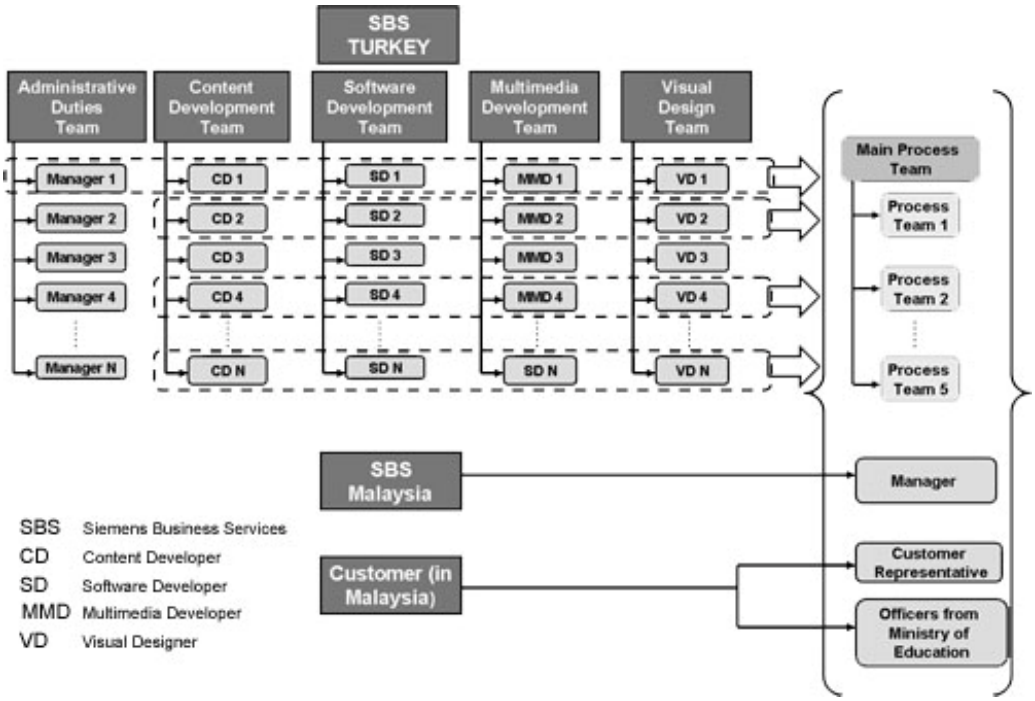

Figure 4.8: Organizational structure of the SBS project

Three interviews were conducted with the team members who worked both in the Form 2 and Form 3 phases. The first two interviews were conducted with the Main Process Team Leader (PD3) who can be considered as project manager, and the content developer (CD3) in this iteration and the final interview was conducted with software developer (SD1) in the next iteration of the study. CD3 and SD1 had different responsibilities in these two phases. During Form 2 phase they worked as content developer or software developer primarily in the PTs but during Form 3 phase they got additional responsibilities and they also worked as Leaders in the MPT. All three interviewees were experienced on computer-based or online courseware development.

4.3.2. Management Layer issues

Interviewees were asked about the strategic issues about the Form 2 and Form 3 projects of SBS in the first part of the interview. The findings were gathered especially in decision making including requirements analysis, good project manager, project plan, budget determination, team formation, communication mechanisms and curriculum determination issues. Moreover, hard and soft problems related to technical issues, coordination and customer management, configuration and change management and conflict resolution issues were also drawn

Decision making including requirements analysis

Malaysian government initiated this project by letting a contract by competitive bidding. SBS participated this bidding and got the project. Therefore, the strategic decision making can be considered as done in two phases for this project. First Malaysian Ministry of Education opened a bid for the development of English mathematics and science curriculum materials (CD3). This can be considered the first phase of the strategic decision making. In the second phase at the SBS side, the department manager, process manager and product manager who are at the top level of organizational hierarchy made the decision to participate to the bid and

formed the project teams (SD1). Main Process Team (MPT) which could be considered as the project management team was first formed. This team was formed of representatives, who were very experienced, from each function (CD3) (as can be seen in Figure 4.7). This team decided on the product to be developed. In addition, the strategic decisions during the process throughout the project were also made in MPT.

The requirements analysis was also done in two phases. The Ministry of Education at Malaysia side conducted a needs analysis and determined their technical and content requirements (SD1). In addition to this analysis, another analysis was conducted at the SBS side. A group was assigned and sent to Malaysia to gather all the requirements at its place. After the technical analysis, it was revealed that not all the essential requirements could be determined by Ministry of Education (SD1, PD3). A prototype was developed by SBS side and the requirements were finalized together both by SBS and Ministry of Education working on the prototype (CD3). PD3, proposed that it was very important to do your own requirements analysis even if there was an analysis done before by saying

> Yes, we did our own requirements analysis there. Because if you are trying to bring out a solution, this is very important …. The requirements analysis is the most important point there. There exist those kinds of studies I know. But you cannot be very successful when you try to do something upon an analysis done before [SBS - M2- PD3_E-23].

> Evet ihtiyaç analizini orada kendimiz yaptık Çünkü genelde eğer çözüm getiriyorsanız bu çok önemli.… Oradaki ihtiyaç analizinin en önemli noktası. Öyle çalışmalar da var biliyorum. Yapılmış ihtiyaç analizi üzerinden bir şeyler geliştirmeye çalıştığınızda hani çok başarılı bir şey olmuyor.

Good project manager

The importance of good project management as well as good project manager was mentioned by both CD3 and SD1 during the interviews. The features of good project manager can be summarized as “the ability to build good communication and close relationships with team members, to motivate them and be an

accelerator". In addition "ability to understand the project generally as well as have mastery on each function such as content, multimedia or software development at some level" is required. For instance CD3 and SD1 mentioned these as follows:

> Communication with him, his understanding about the project, content, his effort to understand. He understands the reasons of problems and then manages the meeting according to them. Because the team leader of the MPT was neither a multimedia developer (MMD) nor a content developer (CD). Project manager can be from any background. Thus, he can be a content developer. For instance the former responsibility of MPTL was visual designer (VD). But he has to understand the content in order to guide the meeting. It is important for the meetings. It is also important for the relations with the teams. When there is a trust among people, then if there is a need to overtime work that night, then everybody stays. Otherwise there can be times that people try to sneak out and job can take longer [SBS - M3- CD3_E-28]

> Onunla iletişim, projeyi iyi anlaması, içeriği iyi anlaması, anlamaya çalışması. Sorunların nedenini anlıyor ona göre toplantıyı yönetiyor. Çünkü AST nin takım kaptanı şey oluyor ne mmp (multimedia programmer) ci ne içerikçi ne bir şey, proje yöneticisi. Proje yöneticisi de herhangibiyerden gelmiş olabilir. Yani içerikçi de olabilir. Mesela önceki görevi görselmiş herhalde ASTK'nın. Ama içeriği de anlamak zorunda ona göre toplantıyı yönlendirmek zorunda. Bir toplantı için çok önemi var. Bir de takımlarla ilişkiler açısından karşılıklı güven olduğu zaman mesela o akşam kalınacaksa kalınıyor. Ama ASTK'ya çaktırmadan da kalınmayıp işlerin uzatıldığı zaman da olabilir.

> TLs are very important for us. Team spirit is very essential. Everybody believes a working team but it is different for us. Because we have a multi-functional structure so there are people from all functions in a team and it is important for them to understand each others' needs. Therefore, we expect much from our TLs for strong communication and early realization of the problems before they are discarded as unimportant[SBS - M3-SD1_E-20].

> Bizde takım kaptanlarının önemi büyük. Takım ruhu çok önemli. Herkes takımın işleyişine inanır ama bizde çok daha farklı. Çünkü bizde çok multifonksiyonel bir yapı var neredeyse her takımın içinde bütün fonksiyonlardan insanlar var ve birbirlerinin ihtiyaçlarını doğru anlamaları önemli. Dolayısıyla biz takım kaptanlarımızdan çok şey bekliyoruz. İletişimin kuvvetli olması için problemlerin erken aşamalarda hasıraltı edilmeden önce fark edilebilmesi için.

Project Plan

PD3 and CD3 talked about the need for a project document or a project plan from the beginning although it could not be possible to predict everything at that point. PD3 also insisted on the importance of having a common project plan which would be accepted by all the stakeholders of the project for the synchronization of the process at each side by stating

> This should be like that: One project plan should be followed. It should be realized clearly by all the stakeholders that everybody's goal should be to execute that project plan, it should be the plan to follow from beginning to the end and it is a plan that should not be violated or if it has to be changed, then it should be updated. Project managers of all stakeholders are the ones who will provide that. If you violate that plan once and you continue without updating, the people cannot be synchronized at each side. You can realize that much later. Therefore, there is a need for commonly accepted goals, project document and project plan. Those project plans are for violations actually. Namely, they are approximations to daily life especially at the beginning of the project. They become clearer near the end of the project and you can determine the metrics better and you can plan better [SBS - M4- PD3_E-11&12].
>
> Bu şöyle olmalı: Tek bir proje planı üzerinden gidilmeli, herkesinin hedefinin o proje planının gerçekleştirmek olduğu başlangıçtan sonuna kadar takip edilecek şeyin o olduğu, proje planının delinmeyecek bir şey olduğu, delinse bile update edilecek bir şey olduğu net olarak iki taraf tarafından da biliniyor olması lazım. Burada da bunu sağlayacak olanlar iki taraftaki proje yöneticileridir. Yani bir kere delerseniz o proje planını ve o planda güncellenmeden devam ederseniz, insanlar projenin başka yerleriyle senkron olmaktan çıkarlar. Bunu da siz çok sonraları fark edersiniz. Onun için bir üzerinde uzlaşılmış hedefler proje dokümanı ve proje planı olması lazım net. O proje planları delinmek içindir aslında. Yani hiçbir zaman tutmazlar yani approximationdır, gündelik hayata bir approximationdır. Hele başlangıçta, projenin sonunda oturur ve metrikleri daha rahat görürsün, önünü daha rahat görür planlarsın.

Project plan should include process plans which defines which task is done by whom, communication with whom and through which stages from beginning to the end. This can also be considered as process map. In addition to this process map, there needs to be a good organizational chart as well as a clear communication plan which shows the roles, their interactions and their communication format. It is essential for these three (process map, organizational chart and communication plan) to be matched and also got a buy-in from

everybody in the project (PD3). SD1 proposed that there was a need for a more detailed main process plan for the courseware development projects as in software development projects by stating

> I think that we had a more determined main process. We generally think we do not perform a software development work; our work is a bit different than that so we did not plan according to that. But I think there is parallelism among them and that could be used that time [SBS - M5- SD1_E-80].
>
> Daha tanımlı bir ana sürecimizin olması gerekiyordu diye düşünüyorum. Biz genellikle, biz yazılım işi yapmıyoruz bizim işimiz biraz ayrı diye düşünüp kendimizi o tür süreçlere kalıp biçmedik. Ama bence çok büyük paralellikler var, o dönemde kullanabilirdi.

Besides CD3 also mentioned about the need of a process plan and communication plan and added that it was required to determine the process plan in detail as much as possible. She also talked about the function processes as well as main process and their match by saying

> First of all, it is essential to determine the communication with the customer. The process should be determined in all details from the beginning by the metrics predicted by experienced people in order to enable this. … The things that are necessary in the process should be determined absolutely… Our main process should match with the function processes. For instance it is no good if a function works well in itself, conduct its reviews well but the others cannot do this. There is a common process. In addition as the reviews and quality follows the main process, control becomes very important in function processes. It is a bit complicated and difficult to understand. It is something complicated and hard [SBS - M5-CD3_E-106&108]
>
> Bir kere müşteri ile iletişimi oturtmak çok önemli. Bunda işte dediğim gibi sürecimizin en baştan bütün detayları ile ve deneyimli insanların öngördüğü metriklerle oturtulması gerekiyor, tartışılması gerekiyor. ..... Ama süreçte olmazsa olmaz şeylerimiz mutlaka belirlenmeli de… Yani bir kendi genel sürecimiz, fonksiyonların kendi içindeki süreçleri de iyi oturtması gerekiyor. Mesela bir fonksiyon kendi içinde iyi çalışıp, reviewlerini de iyi yapıp daha sonra öbür fonksiyonlar bunu şey yaparsa bu da olmuyor. Ortak çalışılan bir süreç var. Bir de, reviewler ve kalite, genel fonksiyon bazlı gittiği için orada da kendi içlerindeki süreç kontrolü de çok önemli oluyor yani ve de karışık biraz anlamak zor. Karışık ve zor bir şey gibi

Budget determination

Budget determination again occurred in two phases in this project. First one was determined at Malaysian side. SD1 developer made a guess that Malaysian side made their technical personnel to do a course estimate to determine a budget according to their resources at hand. At the SBS side the budget determination was done by MPT. MPT determined the metrics, how long the work could take its risks and overheads. Then they reported this to a group formed of general, production and process managers. This group determined the budget and dealt with budget issues throughout the project. MPT did not deal with budget issues during the project rather responsible for the timely and in scope flow of the project (SD1).

Team formation (resource allocation)

At SBS, for this project specifically and for every project in general, development did not occur as functional production. In other words, the process did not work as in the order of content developers produced the content, then graphical designers sketched them and software developers did the programming. A PT was formed for the design of anything and that everybody in that team was responsible for everthing from beginning to end (PD3). At the beginning of any project as well as this one, the main process plan was developed. This plan was managed by MPT. PTs were formed and assigned to the processes. In MPT and every PTs, there were representatives from the members of all functions. The importance of this was described by PD3 as the only way to develop know-how for the organization as follows

> In a PT, there must be an educational specialist, any type of graphical designer which was need like 2D, 3D or interface, programmer and software developer. Adequate number from all of them should come together. There will be a process team, project team and that team will do the steps to accomplish the requirements or to gather requirements if there is not any. A common solution will be formulated together. Because as I said, it happens like that solution is determined at somewhere, then everybody implements it

> and then it comes out. We oppose that. Because clear know-how cannot be developed [SBS - M7- PD3_E-11].
>
> Bir süreç takımında hem eğitimci olmalıdır hem grafik tasarımcı olmalıdır, hangi türden grafik tasarımcı gerekiyorsa, 2D olabilir 3D olabilir interface olabilir, programcı olacak ve yazılımcı olacak. Bunların her birinden yeter miktarda insan bir araya gelecek. Bir süreç takımı olacak bir proje takımı o proje takımı o isterleri ya da isterler yoksa gereksinimler yoksa o gereksinimleri elde etmek için yapılacak adımlar hepsi hep beraber bir araya getirecekler ve herkesin ortak solution ı olarak ortaya bir şey çıkacak. Çünkü öbür türlü dediğim bir yerde solution zaten tanımlanıyor öbür tarafta herkes onu uyguluyor ve çıkıyor gibi bir durum oluyor. Onun karşısındayız biz. Çünkü o zaman gerçekten keskin bir know-how geliştirilemiyor.

Teams were generally formed in fixed numbers for projects. However, sometimes this number can be dynamic based on some of the risks happened or not. Some additional teams could be developed and works could be shared among them (SD1).

Communication mechanisms

As this was a geographically distributed project, communication among the teams was one of the essential issues. During the project, some mechanisms such as e-mail, icq (instant messaging tool), telephone or video-conferencing were used based on the needs. SD1 mentioned about the difficulties of communication by video-conferencing due to its cost as well as time differences and e-mail was not considered as an effective mechanism since it did not include any mimics or facial expressions. Besides, there was a need for “rules of engagement” between stakeholders for effective communication (PD3). This would determine who would talk to whom about what kind of issues or problems and how. At the beginning of this project these were not determined well (SD1, CD3). After some problems were occurred, precautions were taken and a detailed communication plan was developed and shared with the customer. PD3 mentioned about an effective communication to be done like through one communication line. However, this was not possible as many teams were involved. Then the responsibility to synchronize all the teams on the same project plan was on project managers in teams. The meetings were done every week as there were many issues to be resolved based on the requests or feedback from the customer

at the developer organization side. Communication with the stakeholder was also done whenever it was required based on the accessibility of the customer (CD3).

CD3 developer pointed out the need of a tool that all communications could be done through and could be used to keep the history of communication. Some important decisions made through e-mails or icq sometimes could not be reported due to the e-mail or icq history losses (CD3). CD3 also brought up the need for a control of communications of people since sometimes misunderstandings could be occurred due to wrong correspondence.

Hard problems related to technical issues

During the project some technical problems were occurred about the infrastructure of the courses since this was the first platform-independent project of SBS. The solutions to these problems were provided by MPT to the PTs. In addition to these, PTs required some templates that could be used for the courses to speed the production from MPT. MPT provided them these kinds of automation solutions (SD1).

Soft problems related to coordination and customer management

Coordination problems that occurred among the PTs resulted in de-motivation problems (CD3). Additionally, customer management problems were also occurred as the customer had a very different culture from the development teams in this project although some members in MPT had an experience with that kind of cultural background before. Culture effect many issues such as the way they spoke, the way they react or approach or expectations from the developed material. This issue was tried to be resolved by finding a consultant from that country in that project (CD3). In addition to the cultural differences, the lack of facial interaction and the distance also affected the relations. SD1 gave an example for this issue as

> We had some problems related to customer management. Because of the reasons such as the lack of facial communication or distance

> in communication with customer or some other reasons, made to reach an agreement difficult. Ministry of Education personnel sometimes communicated the comments that we could not filter to production teams. … customer's specialists sometimes used expressions such as "you technical people" and this made uncomfortable the team members [SBS - M10_2- SD1_E-21].
>
> Bir de müşteri yönetimi açısından birtakım şeyler yaşadık. Çünkü müşteri ile yüz yüze iletişim ve iletişimdeki mesafeden ve diğer sebeplerden, kısıtlı olması, karşılıklı anlaşmayı çok zor hale getiriyordu. MEB in personeli zaman zaman bizim filtrelemeyi başaramadığımız commentlerini üretim takımına kadar ulaştırabiliyordu… Örneğin bazı o tarafın uzmanları değerlendirirken "you technical people" gibi ifadelerle takımdaki insanların kendilerini iyi hissetmemelerine yol açacak ifadeler kullanabiliyorlardı.

Soft problems related to configuration and change management

During the project, configuration issues were not considered much (SD1). CD3 explained this issue as

> Everybody has a different work style. Some people can work very systematically but some cannot although we said them to do so. Therefore, our versions were mixed so we could not follow up. [SBS - M10_3- CD3_E-59&60].
>
> Herkesin çalışma stili farklı. Bazı insanlar çok sistematik çalışıyorlar ki söylediğimiz halde bu yapıda kurun dediğimiz halde bazı insanlar çalışamıyor. Bunun için bizim versiyonlarımız birbirine çok karışıyordu. Onun için de çok takip edemiyorduk.

Soft problems related to conflict resolution issues

Disagreements among the stakeholders could be resolved by predetermined conflict resolution mechanisms (PD3). SD1 listed the conflict resolution techniques used in the project as "withdrawal, confrontation, escalation and consultation to third objective referee" [SBS - M_11- SD1_E-21]. CD3 developer explained that issues were tried to be resolved by PTLs first and if they could not achieve then they gathered help from members of MPT.

> "İşte geri çekilme, veya yüzleşme veya işte eskalasyon gibi, objektif üçüncü hakeme başvuru gibi yöntemlerle problemler çözümleniyordu"

Curriculum determination

In this project, curriculum was given by Malaysian Ministry of Education to development organization. However, development teams studied on the material first dividing it into lessons, and then they determined the final version collaboratively with the officers from the ministry (SD1, CD3). PD3 explained this process as follows

> Curriculum analysis was conducted according to the given curriculum. Curriculum analysis was done to determine what was included in the curriculum. It was studied to determine how to divide it into 110 lesson hours. Pedagogic team worked on it. They had a guideline that tells how to divide it. We made a prediction based on that guideline. But, this is a process which requires common study. There were officers assigned to this. Our pedagogical team worked with them. They divided the courses to 100 [SBS - M12- PD3_E-46]

> Müfredata göre bir müfredat incelemesi yapıldı. Şimdi bir müfredat analizi yapıldı yani müfredatta neler var ve 110 ders saati olduğu için nerelerden nasıl bölünebilir diye bir çalışma yapıldı. Bu eğitsel takım bir mesai harcadı buna bir nasıl bölebiliriz diye bir ön çalışma yaptılar. Orada nasıl bölünmesi gerektiği ile ilgili bir guideline vardı. Biz bu guideline a göre bir öngörü yaptık. Fakat yine de ortak çalışma gerektiren bir process bu. MEB de konuyla ilgili assign edilen officerlar vardı. Onlarla bizim eğitim grubumuz ortaklaşa bir çalışma götürdüler. 100 derse böldüler.

4.3.3. Integration Layer issues

In the integration layer, training related issues could be gathered from the interviewees.

Training

No formal training sessions were done. However, SBS had a group which was experienced on pedagogical issues. People from this group trained the others by conducting seminars. On the other hand, participation to these seminars were not regulatory (PD3, SD1). CD3 developer added that they had some seminars conducted with their consultants from Faculty of Education on pedagogical issues or content related issues. Pedagogical issues of computer based course material were discussed among the team members internally (CD3). SD1 talked about

there was a need for everybody to have curriculum development knowledge. He also talked about that "the trainings would provide benefit of everybody to talk common language" [SBS - I1- SD1_E-40]

> "Aslında sağladığı faydalar herkesin aynı dili konuşabilmesi"

4.3.4. Micro Layer issues

In the micro layer, course/content determination, LOs and industrial standards and course evaluation related issues were gathered from the interviewees.

Course/content determination

At the courseware development layer, content of courses or lessons were determined based on the curriculum given. The given curriculum was not used directly. CD3 explained the content determination process as follows

> Materials were given at the beginning but we did not take them directly. We consider all the materials. We try to determine the curriculum thus its sequence. We do concept maps. We pass to the table of contents from these concept maps. Sometimes as in Malaysian case when curriculum was very determined, we examined the relations. We created table of contents. Table of contents was our units and lessons. We absolutely try to sequence them. Then what did us? The ideas about what type of pages can we produce in the lessons began to come out. Let's include engagement, explanation or include the class activity. [SBS - m1- CD3_E-68 &32.]

> Burada en başta materyaller direk geliyor, biz bu materyaller uygundur diye almıyoruz. Gelen ham materyalin hepsini koyuyoruz. Bunun bir müfredatını çıkarmaya çalışıyoruz yani sırasını. Bunun için kavram haritaları yapabiliyoruz, kavram haritalarından table of contents e geçiyoruz. Bazen de mesela Malezya'da müfredat çok belliydi, birbiriyle ilişkisi filan onu bir incelemiştik. Burada TOC yaptık. TOC burada ünitelerimiz ve lessonlarımız oldu. Yani mutlaka bir sırasını yapmaya çalışıyoruz. Sonra ne yapıldı? Lessonlarda ne gibi sayfalar üretebiliriz fikirleri çıkmaya başladı. Engagement olsun, explanation açıklama olsun, class aktiviteyi şöyle koyalım.

Courses were developed according to 5E model by first developing a prototype for a sample unit (CD3). Constructivist strategies were used for the activities (PD3).

LOs and standards

Concepts that could be re-used were not considered for this project because of the complicated process as well as the strict deadlines as mentioned by both SD1 and PD3. Both pointed out that to accomplish this was essential and they always wanted to develop courses in this way.

Although this project was not an online courseware development project, industrial standards that were used for online material development were considered. The course materials were developed according to SCORM to enable them to work on LMS whenever required. CD3 explained this as follows

> We have a company vision of agreeing to those standards. Developing as learning objects increases our products reusability from content, multimedia or standards views. We have to apply to standards since we want to serve for different platforms. This can be done by applying standards that are accepted by people such as SCORM [SBS - m2- CD3_E-72].
>
> Bizim şu anda şirket olarak vizyonumuzda bu standartlara uyma hedefimiz var. Çünkü learning object bazlı üretmek bizim bütün şeylerimiz, yani yaptığımız ürünleri içeriksel açıdan ya da multimedia açısında ya da standartlar açısında kullanılabilirliğini arttırıyor. Birçok platforma seslenmek istediğimiz için standartlara uymak zorundayız da. Bu da belli insanlarca kabul edilen mesela SCORM a uymaya çalışıyoruz.

One of the advantages of the use of standards was defined as reusability (PD3). SD1 mentioned the contribution of standards to the quality of materials produced as

> I think every industry should have its own standards and these standards can reveal whether the products provide the required ability or not [SBS-m2_1-SD1_E-57].
>
> Bütün sektörlerin bütün endüstrilerin kendi standartlarının olması ve dolayısıyla bu standartların altında ürünlerin kullanıcıya istenilen ability de bir ürün vermediğini ortaya koyan şeyler olduğunu düşünüyorum

On the other hand, PD3 also pointed out some disadvantages such as the unclear definition of "sco" as how small it should be and problem of SCORM as how these scos can come together or can be worked together. In addition the use of standards could bring some technical constraints as they might lead to a trade off

between the things that were wanted to be accomplished and the things that you could apply from SCORM (PD3).

Evaluation of the courses

Evaluation of the courses was conducted in two phases

- In the first phase, the internal tests were done in the development organization.
- In the second phase they were sent to the Ministry of Education in Malaysia for the officers' reviews.

Two-level evaluation was conducted to ensure the quality of the materials in internal tests (PD3).

- product was evaluated totally
- the individual parts that formed the product were also tested for their individual quality

In addition, SD1 and CD3 developer mentioned about the tests conducted from different functional perspectives such as VDs test according to the visual quality, MMDs test according to adequacy of interaction provided. In addition to these functional tests, each PT performed another's quality checks (QC) in other cross-checks were done among the PTs as well as end-user tests were tried to be conducted by instructor consultants competent about the content from the Faculty of Education (CD3). QCs were formed by the help of checklists (SD1). Reviews were done based on the checklists and missing items were tried to be completed in the next iteration. PD3 emphasized the need and importance of usability tests, especially for the products to the market. CD3 developer also pointed out one important issue about the evaluation of the courses as "the correctness of the content" as follows

> Is mathematics correct? Because one of our most important criteria was prevention of scientific mistake. How you presented it is about

> the instructional design. That is also very important but as I said its scientific side is also important. We had referees from mathematics department. We sent our products to them. They checked whether there were errors in the content. They do not understand about the interaction, they only examine the correctness of the material [SBS - m5- CD3_E-50].

> Matematik doğru mu? Çünkü en önemli kıstaslarımızdan bir tanesi bilimsel hata olmaması. Nasıl verdiğimiz eğitimin tasarımı ile ilgili. Orası da çok önemli ama dediğim gibi bilimsel yönü de. Onunla da matematik bölümünden hakemlerimiz oluyordu. Yaptığımız ürünleri onlara gönderiyorduk. Onlar içerikte hata var mı yok mu, çünkü ürünün etkileşimini şeyini anlamazlar, ham materyalin doğru olup olmadığına bakarlar.

Development Process

The interviewees defined their course development process as evolutionary prototyping or spiral rather than traditional waterfall model. Stages of course developments were conducted iteratively. SD1 explained the reason why they did not use an approach like waterfall as

> Thus we were not using waterfall model here. Because, you cannot realize all the requirements at the beginning. Customer thinks that they know but when we convert it to a multimedia, then their requirements are affected by the possibilities they can see. That time they require some other things. Therefore we generally prefer prototyping in multimedia projects different from software projects. Because customer requirements are changeable. We choose this to respond them better [SBS - P1- SD1_E-78].

> Yani biz burada çağlayan modelini kullanamıyorduk. Çünkü bütün requirementlara baştan hakim olamıyoruz. Müşteri istediğini bildiğini düşünüyor fakat multimedyaya biz bunu çevirdiğimiz zaman ihtiyaçlar bir anda önlerine sunulan imkanlar doğrultusunda etkilenmeye başlıyor. O zaman böylede bir şey olsun şöyle de bir şey olsun diye. Dolayısıyla biz burada multimedya projelerinde yazılım projelerinden farklı olarak genellikle prototiplemeyi şey olarak seçiyoruz. Çünkü müşteri ihtiyaçları çok değişken. Bunları en iyi şey verebilmek için respond edebilmek için bu yöntemi seçiyoruz.

4.3.5. Summary of the Interview Findings

The positive and negative issues of this project at each layer were revealed and summarized as in Table 4.3, according to the words of the interviewed participants The negative issues were tried to be resolved in teams as much as possible and if this was not possible then PD3 or the other functional

representatives in MPT took the conflict resolution responsibility based on the problem type. The teams developed courses in an iterative manner by first developing prototypes and then making decisions working on these prototypes and finally developing the actual materials. The positive issues strengthened the project enable to achieve success.

Table 4.3: Summary of the issues in Case 2 - SBS

Management Layer	Positive Issues	Commonly agreed upon project planning including the process plan
		Effective project management team (MPT)
		Good project manager skills (facilitator, accelerator, motivator, mediator)
		Participatory budget determination
		Effective requirements analysis done for curriculum
		Accommodation of adequate number of teams and team members for the job
	Negative Issues	Inadequate communication infrastructure
		Inadequate pre-determined communication mechanism including the rules of engagement
		Unplanned configuration/change management
Integration Layer	Positive Issues	Experienced personnel trained the others
		Seminars were conducted by external consultants
	Negative Issues	Trainings were not compulsory
Micro Layer	Positive Issues	Effective content analysis for courseware
		Common instructional strategy (5E) use for the implementation of the courses
		Use of industrial standards
		Detailed internal QCs for the courseware
		Checks for the correctness of the content
	Negative Issues	No learning object consideration
		Inadequate usability testing

4.3.6. Document Examination

In addition to the interviews, the courses developed in this project were examined. The courses were actually in the form of computer-based materials that ran on CD-ROMs. Different modules developed during Form 2 and Form 3 were compared and it was revealed that they were very similar. One of the reasons for this similarity was the use of templates for the different page types as stated by SD1. The similarities or differences can be listed as follows and some of them can be seen from Figures 4.9 and 4.10

- Navigation is provided by a bottom menu at the bottom of the pages
- Content is given in problem definitions with the help of graphical materials such as images
- Steps are given for the problems by a menu bar on the navigation menu and it shows at which step the user is currently dealing with.
- Only difference can be seen in the color types used in the courses of Form2 and Form3.

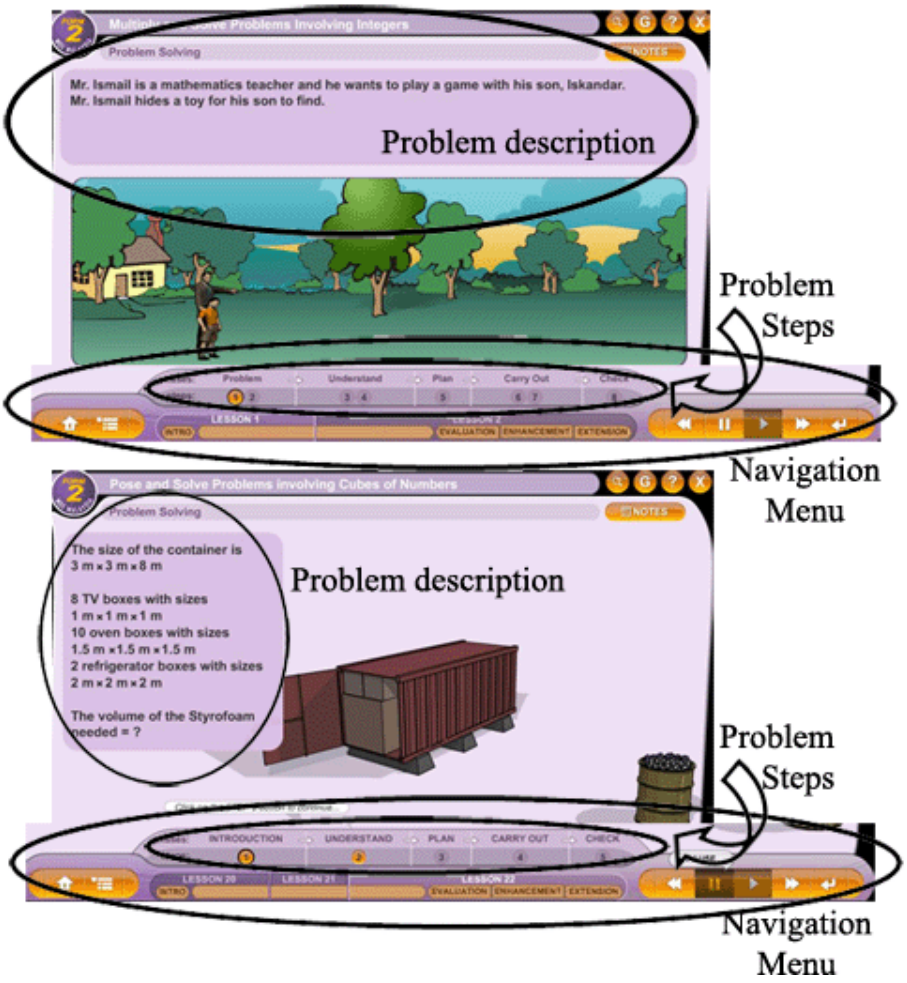

Figure 4.9: Screenshots of mathematics lessons of SBS Malaysia Form 2 project

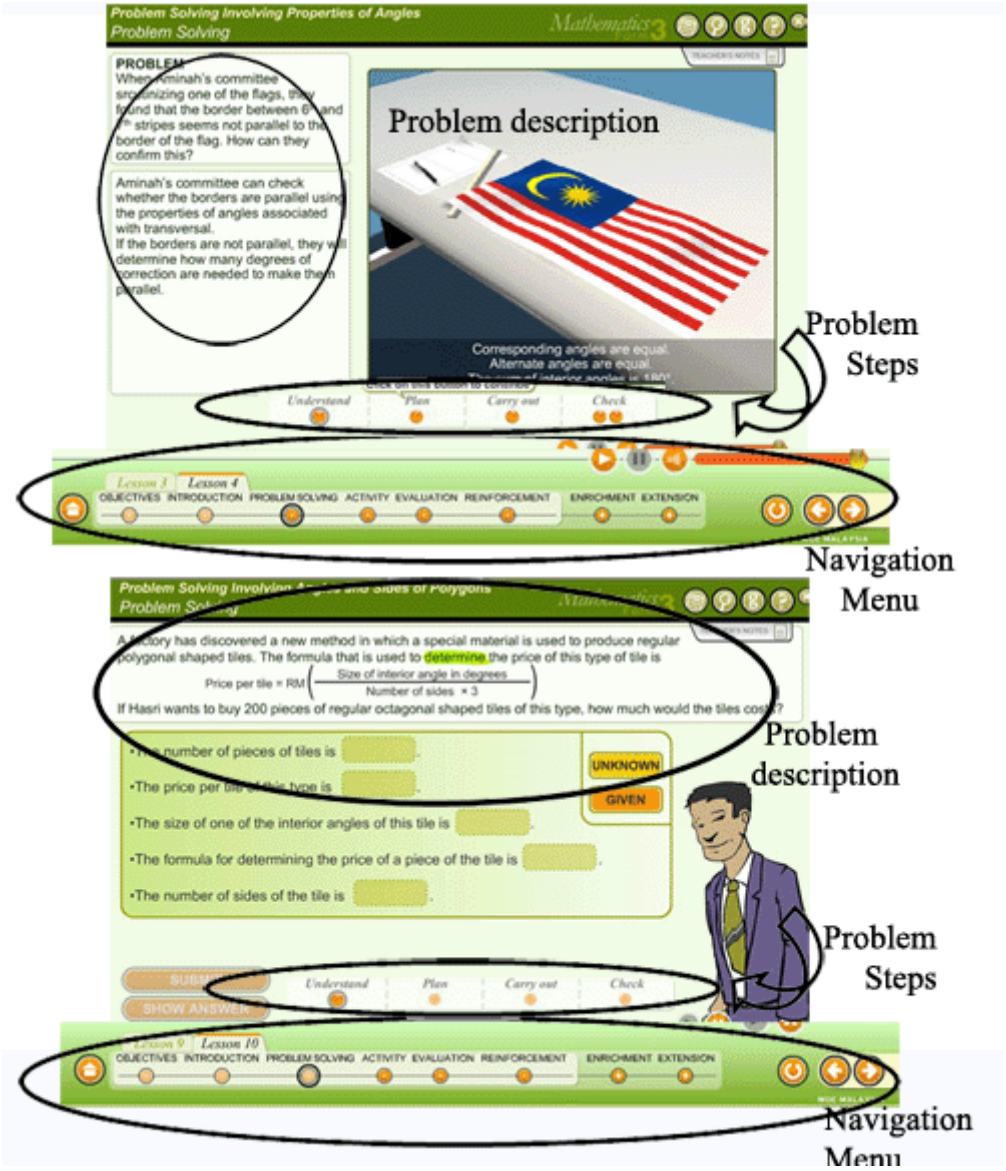

Figure 4.10: Screenshots of mathematics lessons of SBS Malaysia Form 3 project

4.3.7. Outcomes of the SBS Case

The following principles were extracted and developed from the findings of this case. Some of these principles are also similar or complementary with the findings of the first case and they can also be applied in the various stages of the development process, and each has some (more or less) impact on different phases.

- *Provide a project plan which is continuously updateable:* Having a project plan involving the process flow is very essential for the implementation of the project. Everyone should agree on and accept to accomplish this plan as much as possible. However, since it is not possible to predict everything at the beginning of the project, everyone should also realize that there will be need to continuous update of it throughout the project. This is more essential than having a plan which is considered as rigid (Themes SBS_M4 & SBS_G5).

- *Provide an effective project management team*: This is required for the implementation of the project. Having adequate number of people as well as the ones who have required competencies in the team is very essential for effective decision-making and conflict resolution (Themes SBS_M7 & SBS_M11).

- *Provide a good project manager*: Project manager is the leader of the whole project teams and actually the whole implementation of the project generally depends on his/her skills. It is very essential for him to understand the project as a whole. In addition s/he is required to have competency in all the functions that are included in the project at least at some level in order to understand the needs of these functions. The close relationship between the project manager and the team members will increase the trust among them and this will enable the smooth implementation of the project even if problems occur. This also affects the motivation of team members. Therefore, project manager's ability to act as a facilitator, accelerator, motivator or mediator is crucial for the success of the project (Theme SBS_M3).

- *Formation of adequate teams*: Formation of adequate number of teams and allocation of adequate number of team members in these teams are critical for the timely flow of the project. Having representatives from every competency type needed for the type of job is required in these teams. In

other words, at least instructional designer for the pedagogical issues, software developer for programming, visual designers for interface designs should be included. If the job requires multimedia programming or 3D imaging, specialists who have these competencies should also be assigned. Adequate number of development team formation is important. This can be determined at the beginning of the project. However, this number should be adjusted based on the needs throughout the project (Theme SBS_M7).

- *Provide comprehensive requirements analysis at each level*: All the planning including the process plan, budget plan or team formation is done based on the requirements determined. Therefore, requirements analysis for the curriculum at the management layer and for the courses at the courseware should be provided to reveal all the project needs that will be responded by plans (Themes SBS_M2, SBS_M12 & SBS_m1).

- *Provide infrastructure and mechanisms to enhance communication:* Especially in geographically distributed development environments, communication infrastructure which incorporates different communication tools as well as which will enable the tracking of communication by recording will be very helpful since the important data can be lost or misunderstandings can be prevented. In addition to the infrastructure, other mechanisms that define the type and way of communication among all the team members are essential for effectiveness. Rules of engagement should be determined at the beginning of the project (Themes SBS_M8_1, SBS_M8_2, SBS_M8_3 & SBS_M10_1).

- *Provide configuration and change management mechanisms*: Frequent changes may occur in the developed materials based on the requirements and feedback of customers. Therefore versioning will be very important in this kind of projects. In addition the teamwork, the need of more than one person working on the same material, also necessitates the versioning

issue. This can be ensured by the use of configuration management tools (Theme SBS_M10_3)

- *Provide training mechanisms for the developers:* Trainings are required for the team members of development teams since everybody cannot have the same level of knowledge about the courseware development or the applied methods or strategies in the project. These will provide common understanding of the things that are tried to be done and will enable everyone to understand the needs of others (SBS_I1).

- *Include Quality Checks into the process:* Quality of the learning materials developed is vital for the effectiveness of these materials. Therefore review meetings and quality checks should be performed according to the some predetermined quality in the development organization itself. Performing end-user tests as well as usability tests will increase their quality as well (SBS-m5).

- *Provide a commonly agreed upon pedagogical approach:* There is a need to common instructional strategy use for the implementation of the courses Because the materials are needed to have pedagogically sound principles to aid learning. The development teams need to know these to determine the structure of the courses (SBS_m4).

- *Follow an iterative development model:* The finding of this case also showed that the course development is not a step-by-step process which could be performed by waterfall development model. In the case, chapters were developed by first developing prototypes and then making decisions working on these prototypes and finally developing the actual materials (SBS_P1).

The layer of configuration and change managament component of DONC^2 was planned to be changed after the investigation of this case. Since consideration of this component and making decisions about it would affect the proper flow of the

project it was changed from integration layer components to management layer components.

4.4. CASE 3: EPPICC

In this section, data analysis and discussions of the findings of the third case which was investigated in the third iteration of this study will be presented. This case was examined in two phases.

- In the first phase, interviews were conducted with the people who took part in the courseware development project.
- In the second phase, the development project was tried to be evaluated according to the proposed development model in the first iteration of this study. The model was used as an evaluation matrix for the project.

The online courseware development investigated in this case was an online courseware development project for continuing medical education (CME) conducted by University of Alabama (UAB) School of Medicine Division of CME collaboration with faculty from UAB School of Optometry. Consequently, the case revealed major discussions on online courseware development, distributed development environment in a very limited aspects and teamwork. However, there was no degree program development aim in the scope of this project. Discussions and findings shall be interpreted in that context.

4.4.1. Background Information of the Case

Equipping Primary Care Physicians to Improve Care of Children (EPPICC) case was an online courseware development project. It was conducted by a CME department which provided activities to physicians to gather CME credit in many different forms including online delivery. The official definition provided by ACCME for CME is “the educational activities which serve to maintain, develop, or increase the knowledge, skills, and professional performance and relationships

that a physician uses to provide services for patients, the public, or the profession" (ACCME, 2001).

Today, physicians in the US have to participate CME activities for their license renewals while the regulations for the amount of CME activities vary from state to state (Sklar, 2000; Josseran & Chaperon, 2001). At the end of each CME activity, physicians get a CME credit which is essentially a credential and indication that indicates that the physician completed the necessary activities required for that credit. A CME credit is loosely affiliated with one hour work of activity. When the activity grows and lengthen the number of credit earned also increased correspondingly. An activity could also include multiple subjects.

The goal of the EPPICC project was to improve the initial screening that pediatricians do with regard to eye care of small children. The primary pediatric care providers did not have enough information about vision screening, and this caused optometrists difficulties in caring some eye problems such as lazy eye in the later stages. In order to improve the things in these later stages primary pediatric care doctors should have learned more about vision screening to determine some problems at the early ages. Therefore EPPICC courses were developed to offer fast and convenient education for pediatricians by providing guides for testing or screening more effectively (Marsh, 2006, personal communication).

The project included 4 modules for primary pediatric care providers. Modules included different cases which described common screening challenges and review guideline-based recommendations for patient management. At the completion of each module in a given deadline online certification and credit was received. Sample screen interface of one of the modules developed in the scope of this project can be seen in Figure 4.11.

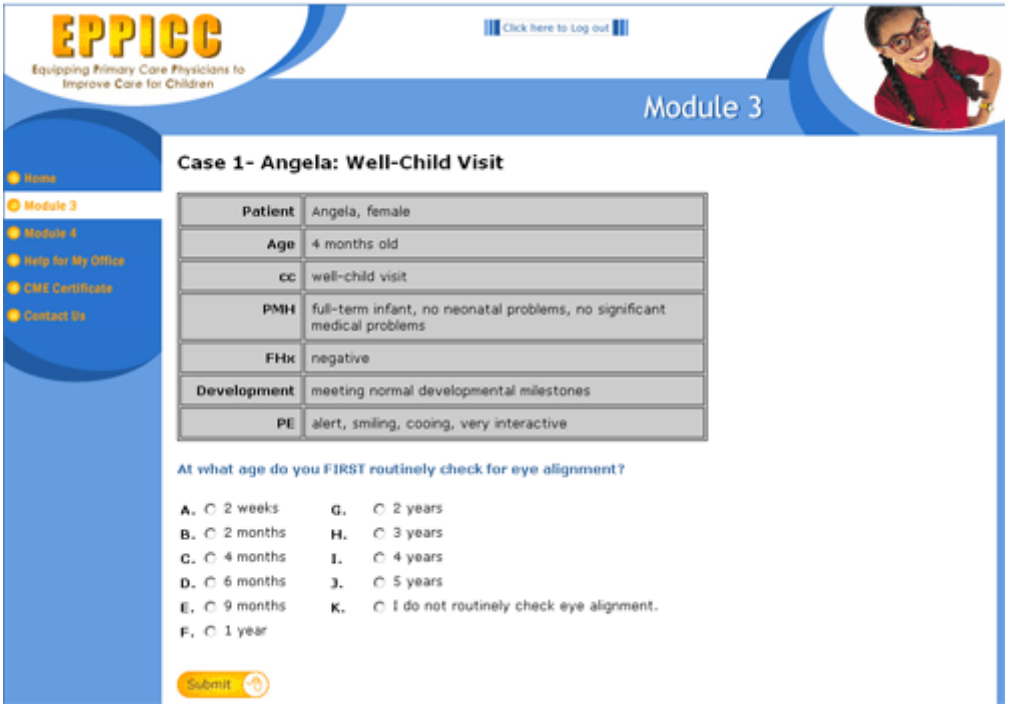

Figure 4.11: Sample interface of a developed courseware in EPPICC Case

EPPICC was one of the online collaborative grant projects developed by CME with the collaboration of different departments and people as can be seen its organizational chart in Figure 4.12. The responsibilities of these people can be summarized as follows:

- At the management level of the project, there were two Principal Investigators (PI), one of which was an optometrist while the other was a primary care physician. One of the PIs was responsible for the daily management activities such as communication with the Medicaid agencies and other external agencies while the other PI was responsible for the development of modules, writing papers as well as providing expert guidance based on her previous experiences.
- There was also a statistician who was responsible for the randomization scheme, complex statistical analysis and projections for the project.

- A database analyst was working in the project for the data acquisition as well as data maintenance.
- On the CME side of the project, Director of CME was responsible for the managerial issues as well as coordination of the programming and development.
- There was a program coordinator who was responsible for the certification process of the course on the CME side
- There was also an information service specialist who was responsible for the development of online modules and accreditation on the CME side.
- In addition to those server management of the project was also outsourced to the UAB Information Technology department while the hosting of the website was still under the responsibility of CME

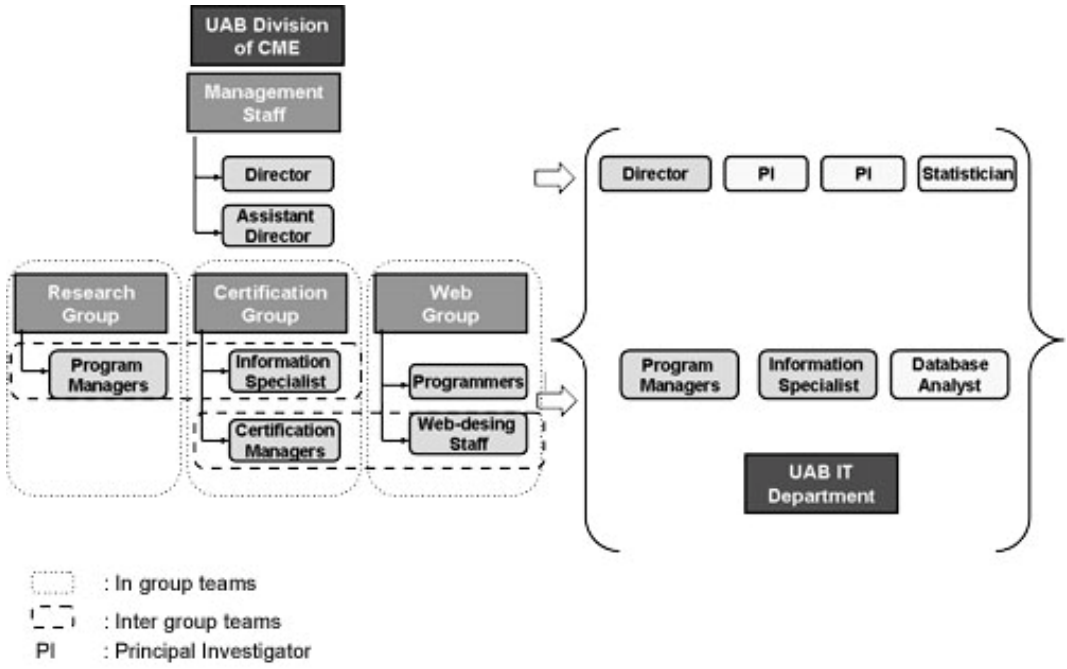

Figure 4.12: Organizational Structure of EPPICC Project

In the first phase two interviews were conducted with the team members who were the principal investigator (PD4) and the software developer (SD2) of the EPPICC project. In the second phase prepared evaluation matrices based on the

development model were filled again by an interview conducted with the same SD2. SD2 was experienced on developing courseware however; PD4 did not have any previous experience on any online courseware development.

4.4.2. Management Layer issues

In the first part of the interview, strategic decision making level questions were answered by the interviewees about the EPPICC project, as regular. In the management layer, related issues were gathered from the interviewees.

Decision making including requirements analysis and budget determination

There were only two hierarchical levels, one of which was the top management level and the other lower level dealing with the development and low level issues (SD2). The strategic decisions were made at the top by project management team which could also be considered as an executive commitee. Project management is also the responsibility of this team, which is formed of two PIs (physicians originally), statistician and the director of CME. Management duties were divided appropriately among the members of this project based on their workloads and experiences. For instance one of the PIs was dealing with managing daily staff as well as things related with other agencies while the other one was dealing with the development activities as well as the coordination of the job with the the director of CME (PD4).

The content to be delivered in the project was determined by the PIs (SD2). For the determination of the need of such a course, detailed requirements analysis was conducted and this was explained by PD4 as follows

> The needs assessment is like the pilot we did, so two perspectives on needs assessment; from the one perspective we looked at medicaid data and we were able to track screening rates and from our perspective there is a huge need to improve the screen rates … From the other perspective we did a small needs survey, we did a facts survey to providers in Alabama and Mississippi and we had a, I can't remember exactly the number of respondients but it was just a small survey [EPPICC_M2- PD4-E9].

Budget determination was conducted as a collaborative activity between the two PIs and the director of CME (SD2). It was determined based on the previous experiences although one of the PIs does not have any previous experience of online courseware development as explained by PD4 as follows

> It is a grant and part of the programming; I think it is from the past experience because this group has developed other ones; first they were able to tell me and giving guidance on what, how long it would take, how much salary we have to pay to get this thing going. … Dr PI and I were co investigators or co-PIs on this project. And from her past experience you know developing one of the prior modules, she was able to give me a realistic idea about what percent effort would we need and so we put that in the grant [EPPICC_M3-PD4-E11].

Hard problems related to communication mechanisms and data loss

There was not specific communication infrastructure provided for this project rather, e-mails or telephone conversations were done for communication. In addition periodic meetings were tried to be done as much as possible (PD4, SD2). However, they faced communication problems when their e-mail server was down for three weeks. This could be considered as one of the hard problems occured throughout the project. Another hard problem was occured as data loss caused by the third party provider, UAB IT depatment which is supposed to back up all the project data including courses as well as the student information (SD2).

Soft problems related to lack of common knowledge among stakeholders

In addition to technical problems some soft problems were also reported by the interviewees. First of all, SD2 mentioned about the misunderstandings occurred between the software developers and PIs based on lack of common technical knowledge as "there are a lot of feedback going on you know, the physicians don't really understand the technical language so they don't get the idea on something unless they see the module in action" [EPPICC_M6_1-SD2-E46].

Soft problems related to heavy workload

PD4 also complained about the heavy workload based on their (two PIs') rigid schedules at their own departmental works. This caused them not to conduct meetings as much as possible if they could solve the issues by e-mail.

Soft problems related to data privacy considerations

Another issue stated by PD4 was the privacy of patient based data they were using. Legal requirements were applied to that data such as they were not able to send that data through e-mail or share them without encryption through the Internet. This issue was resolved by developing an administrative web site that provided encrypted share of it.

Soft problems related to conflict resolution

Whenever a conflic or problem occurred, providing solutions to them was the responsibility of the whole executive committee. However, head of the CME was responsible for the solution of programming issues specifically because the PIs did not have any technical background on those issues (PD4).

4.4.3. Integration Layer issues

In the integration layer, the interviewees talked about training and recruitment and rentention of students issues.

Training

There was no formal training for the project stakeholders either on curriculum or courseware development issues. However at the beginning of the project, expert guidance was taken about the issues of learning theories as well as instructional strategies (PD4).

Recruitment /Retention

Recruitment /Retention issue was brought out by SD2. In order to recruit students for the courses, they sent e-mails or faxes to the list of physicians gathered from the public agency which was authorized to give them the contact information. After accomplishing recruitment, retention was also difficult to enable. SD2 worked on that issue very much. For instance he sent e-mails and faxes about the progress of the students and tried to convince the students to come back to the courses continuously. SD2 mentioned about providing some kind of motivation as follows

> You have to understand the requirements for the physicians you are approaching; you have to take in consideration of time constraints and their needs for taking the course. So as long as it satisfies your participants based in, the course can be a success and a lot of physicians don't get involved unless there is some proven incentive, might not be financial incentive, they need to get some value of the course. So the primary focus is on the participants [EPPICC_I2-SD2-E88].

4.4.4. Micro Layer issues

In the micro layer, the findings were gathered especially in course/content determination, instructional strategies and accreditation/Evaluation of courses

Course/content determination

The module contents were determined according to the analysis conducted by CME on the provided content by PIs. CME side determined the amount of each module would take and what kind of activities involved in order to get a CME credit from that course (SD2). The development sequence of the modules was determined based on the content which includes concepts easiest to newest guidelines published. Therefore first of all modules including the easiest content were developed and presented then the modules including the newest information about the subject were developed (PD4)

Instructional strategies

For the modules no instructional model was followed strictly. However case-based interactive instruction based on questions and answers were used throughout the modules in addition to the explanatory content (PD4). All modules were developed independently from each other rather than determining concepts and developing each concept as re-usable learning objects. Development as learning objects was neither this project's goal nor the other projects of CME. There were not many multimedia elements in the modules but also the ones were developed parallel to the content (SD2).

Course evaluation/accreditation

The accreditations of the modules were done by CME based on the requirements determined by ACCME. Some pilot group testing was conducted for the evaluation of the modules inside the CME as a quality control step (SD2, PD4). Providing usable courseware to the users was an important point considered during the development effort. Usability test were done with a pilot group formed by the people from CME as well as the stakeholders of the project before the release of the modules. The importance of usability was emphasized by SD2 as

> Especially when you are dealing with physicians, you have to keep in mind that they don't have really lot of time to go through a course, completed and give a feedback on anything. So what are the small numbers of physicians you gave, you to make sure they don't go away because of bad usability or testing. Usability is essentially with the efficiency and the effectiveness of the course [EPPICC_m3_2-SD2_E71].

However, there is no mechanism that provides students to use or test the modules before the release. On the other hand at the end of the course, students would evaluate the modules by filling an evaluation questionnaire presented at the end of the course before getting CME certificate. But, the modules were not planned to be revised based on the feedback gathered from the users (PD4).

Development process

The development model used for this project is defined as rapid prototyping process by SD2. However, they also tried to fit their process into waterfall model but this was not possible as they could not get the real requirements from the physicians at first. Therefore, they first developed some prototypes to gather the exact requirements.

4.4.5. Summary of the Interview Findings

The positive and negative issues of this project at each layer were revealed and summarized as in Table 4.4, as said by the interviewees reporting. The negative issues or conflicts were tried to be resolved in project management team whenever occurred. SD2 defined their development model as rapid prototyping process. Developers provided simple templates and developed the actual courses after getting feedback from the PIs. The positive issues could be considered as strengthening features of the project.

Table 4.4: Summary of the issues in Case 3 - EPPICC

Management Layer	Positive issues	Appropriate division of labour in the management team
		Detailed requirements analysis
		Collaborative budget determination
		Pre-determined effective conflict resolution responsibility
	Negative issues	Lack of robust communication infrastructure
		Heavy workload of some of the team members
Integration Layer	Positive issues	Gathering consultation about the pedagogical issues
		Careful consideration of recruitment/retention issues
	Negative issues	No formal training provided
Micro Layer	Positive issues	Effective content analysis for courseware
		Common instructional strategy use for the implementation of the courses
		Internal quality controls for the courseware
		Usability testing conducted

4.4.6. Document Analysis

The modules developed in this project were also examined in the scope of this case which can be seen in Figure 4.13, 4.14. There were four modules developed. These modules were examined and compared. It was revealed that they were very similar. One of the reasons for this similarity might be their development by the same development team. The similarities or differences can be listed as follows and some of them can be seen from Figures:

- Each module started with an introductory page which had a link which enable to access the objectives of the module on another page
- In each module, navigation was enabled by the use of questions related to the given cases
- After each question, the possible answers and related information about the case were listed in the following page
- Each module enabled to access to the previously stopped page when logged in.

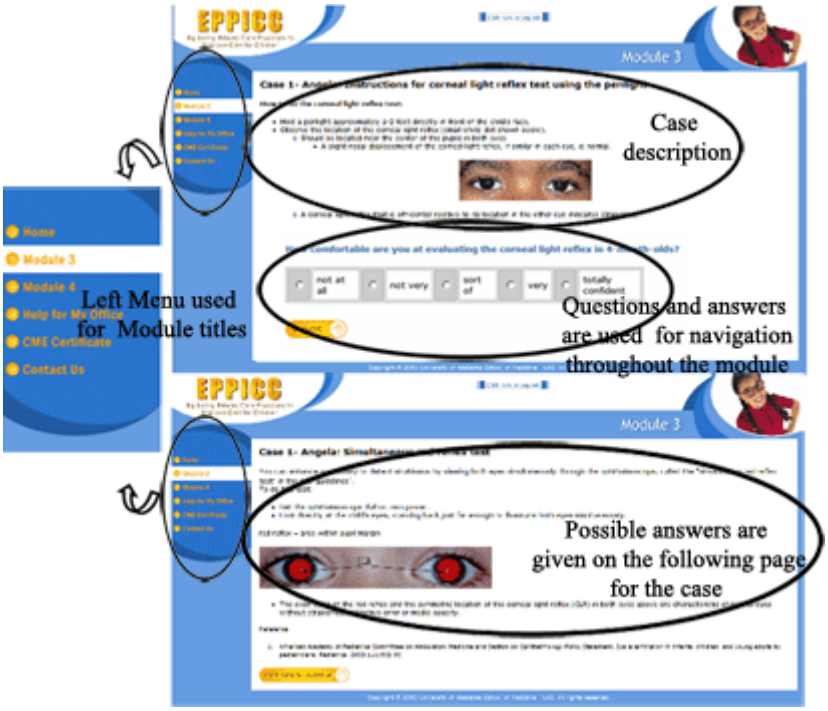

Figure 4.13: Screenshot of Module 3 of EPPICC Course

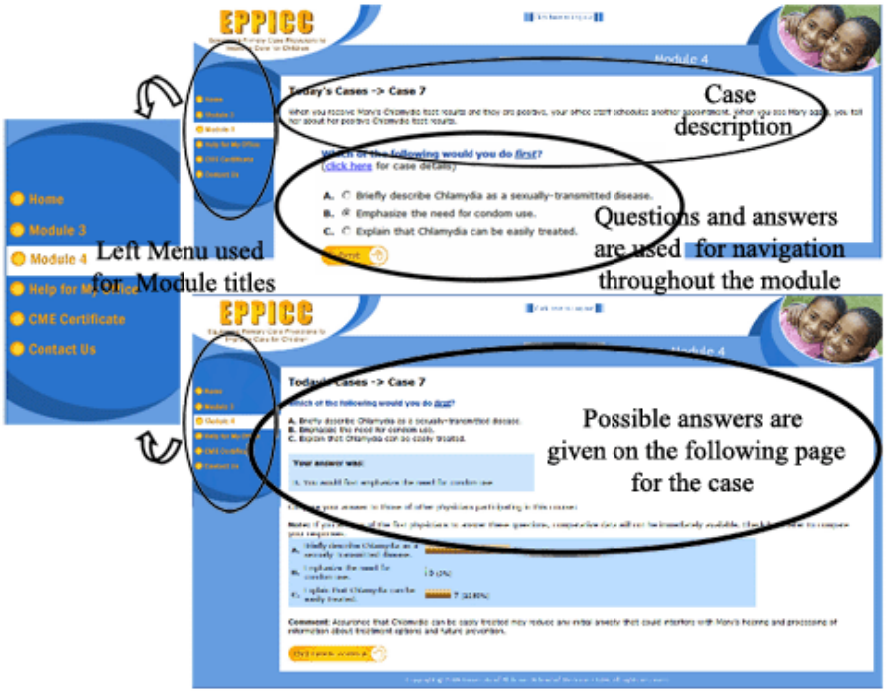

Figure 4.14: Screenshot of Module 4 of EPPICC Course

4.4.7. Findings of Evaluation Matrices

In addition to these interviews, an additional interview was also conducted with SD2 based on the evaluation matrices prepared according to the DONC[2] framework. There were four matrices covering the three layers of development components which were management, integration and micro layer in addition to interlayer components of communication and evaluation and revision. Those matrices can be seen in Appendix B. In the matrices for each component there were different number of items and these were checked whether they were done in the scope of this project as well as what level they were accomplished.

The management layer matrix involved six components of strategic decision making. Many of the management layer components were accomplished with positive values other than the quality control and especially the risk management components as can be seen in Table 4.5. The possible cause of this might be that the project did not have risk or quality plans specific to it. The quality control and

risk management issues were planned to be handled based on CME's own risk and quality plans which were applied to all projects and which were mainly related with the technological issues. In addition to these two components, project management components could be considered having some minor flaws such as extensions required for the project duration due to the changing requirements. However, in most of the projects, requirements could not be gathered exactly at the beginning of the project so some changes might be needed. The important point was to have the ability to overcome this situation by adapting the project schedule by flexibility. In this case project schedule needed to be extended about four months and then the project could be done in updated duration. For this project there was not any full-time predetermined professional project manager, however there was a project management team including the PIs of the project as well as the director from CME. All responsibilities were divided among those people so that eased their job as they all had other responsibilities. This had a positive effect on especially the communication and negotiation issues however it had a negative effect on the leadership feature of the good project management. On the other hand determination of the course process was conducted very successfully for this project as a good need analysis was conducted from various sources. In addition to that as there were configuration and change management plans for the project, required changes and updates could be done smoothly throughout the project.

Table 4.5: Management Layer Components' Accomplishment

	Always	Often	Rare	Never	NA
Project Management	8	3	2	1	0
Budget/ Resource Allocation	4	0	1	0	0
Determination of the courses (program)	1	0	0	0	0
Coordination	3	1	1	0	0
Quality Control	4	0	0	2	0
Configuration/ Change Management	1	2	0	0	0
Risk Management	1	1	0	3	0

The integration layer matrix involved four components of curriculum layer activities. From the Table 4.6 it can be seen that half of the integration layer components were done successfully throughout the project whereas the others did not. There was no consideration for Learning Management System (LMS) determination for the project as for none of the courses developed in CME were presented through any LMS. Each course has its own structure. However, using LMS for course presentation and management might help to reduce some of the development efforts as well as learner management efforts of the projects. In addition to that there were no official trainings provided for the stakeholders of the project neither at the beginning nor at the other stages of the project. Stakeholders from CME had their own trainings about courseware development and had their own previous experiences. On the other hand, PIs of the project, especially one of them did not have any previous knowledge about either online courseware development whereas the other had only past experience not a formal training about this issue. Trainings especially about the online courseware development would help to reduce the time of requirements gathering process. Because this would establish a common understanding among all the stakeholders on some issues so that they might more clearly define their needs to the software developers as they would know what they can do. This would reduce the time needed for requirements analysis as well as reduce the possibility of changing requirements. These training would provide all people speak and understand the common language for all of the issues either technical or non-technical.

Table 4.6: Integration Layer Components' Accomplishment

	Always	Often	Rare	Never	NA
Determination of the modules (courses)	2	0	0	0	0
Decision on LMS	0	0	0	0	3
Style guidelines	3	1	0	0	0
Training	0	0	0	4	0

The micro layer matrix involved eleven components of courseware layer activities. From the Table 4.7, it can be seen that most of the components were done successfully. In this project as there was no consideration of using learning objects or developing modules by the use of learning objects some of the processes were not applicable as any other projects of CME. Therefore especially the software development parts of this project did not match to the requirements of the used evaluation framework. However, prototyping both paper and software versions were used for the modules throughout the project in order to gather the exact requirements. Therefore actually an integration component was done for the developed software parts of the courses rather than the learning objects.

Table 4.7: Micro Layer Components' Accomplishment

	Always	Often	Rare	Never	NA
Needs Assessment	1	0	0	0	0
Task Analysis	1	0	0	0	0
Learner Analysis	2	1	0	0	0
Goals/Objectives	2	0	0	0	0
Instructional Activitis	2	1	0	0	0
Content Sequencing	1	1	0	0	0
Evaluation procedures	3	0	0	0	0
Searching from learning objects	0	0	0	0	1
Paper prototypes (storyboards)	2	0	0	0	0
Software prototypes (learning objects)	2	0	0	0	1
Integration	0	0	0	0	1

In addition to all those components in different layers there were two other important components exist in the DONC^2 framework which were communication and evaluation and revision. These two components were also accomplished successfully throughout this project as can be seen in Table 4.8.

Table 4.8: Inter Layer Components' Accomplishment

	Always	Often	Rare	Never	NA
COMMUNICATION	2	1	0	0	0
EVALUATION/REVISION	5	0	0	0	0

4.4.8. Outcomes of the EPPICC Case

Based on the results of interviews conducted with the project stakeholders and the evaluation matrices following principles were drawn from this courseware development case:

- *Enable appropriate division of responsibilities in teams*: Appropriate resposibility division is essential for the effective and efficient working of the project management team especially for the projects that do not have possibility to hire a professional project manager. This would enable having an effective project management structure for the project as all the members may have some other duties in their own specific jobs. This can be considered for the development teams as well (EPPICC_M1& EPPICC_M6_1).
- *Collaborative decision making*: It would be supportive if all decision making activities are done altogether with the project team members. This will enable easy negotiation among the members. Moreover every member will be aware of what is going on at any time of the project. This results in easy and quick decision making (EPPICC_M1 & EPPICC_M3).
- *Adequate requirements analysis*: Conducting requirements analysis through the use of different data sources to determine the needs of a program or a course is critical to determine the exact needs. These different data sources can be surveys, expert opinions or new guidelines as in this case (EPPICC_M2).

- *Careful consideration of recruitment / retention:* Drawing attention of students to the developed online courses or programs and keeping their attention continuous to them is an important task that should also be considered for the contunity. Planning of publication is crucial (EPPICC_I2).
- *Providing a risk plan:* Risk planning makes the project ready to the unexpected events. Since there was no risk planning in this project, schedule slippage occurred due to several reasons such as the changes required for the presentation of content or data loss incident in the third party provider (EPPICC_M5).
- *Providing usability testing:* Usability testing will enable the students focus on the content rather that the system. This also helps their retention on the courses without frustration (EPPICC_m3_2).
- *Providing trainings*: Trainings enable the common understanding about the possibilities as well as the various needs among the stakeholders. Some of the stakeholders did not have any formal training or either experience about courseware development, misunderstandings occurred at the beginning of the project while determining the requirements in this project. These misunderstandings can also be prevented by providing trainings to all the stakeholders (EPPICC_I1)
- *Iterative development based on prototyping*: Approaches such as prototyping are helpful to gather the exact requirements from the stakeholders who were not technically competent. This will enable them to see the possibilities and define their needs better (EPPICC_P1).

This case revealed a missing component which is recruitment and retention for the DONC^2 evaluation framework. That is important because these courses should attract to the consumers of them and also should keep them interested until the end. This new component can be considered in the integration layer of the framework as it is also related to the curriculum decision making activities. The target groups' features are helpful for the decision of the curriculum. Therefore

after the investigation of this case the recruitment and retention process was planned to be added to the integration layer of the framework.

4.5. CASE 4: AVICENNA VIRTUAL CAMPUS PHASE 3 (AP-3)

In this section, data analysis and discussions of the findings of the fourth case which was investigated in the third iteration of this study will be discussed. This case was examined different than the previous cases since the developed model was first applied as a development framework for this case and then the experiences of the team members who used this framework was gathered through the interviews. This case revealed again the major discussions on online courseware development, teamwork and online curriculum development as there was a planned aim of developing courses which could be serving to a degree program in the scope of this phase of the project. Discussions and findings shall be interpreted in that context.

4.5.1. Background Information of the Case

This case was the third and final phase of the Avicenna Virtual Campus project which was considered in the first iteration. Same background information for the first case was also valid for this case as it was explaned in section 4.1.1. However, there were some differences in this case. For instance, primarily only the development effort that took place only in one of the AKCs was investigated in the scope of this case. In addition, different from the first case, the development effort had an additional aim of developing online courses which would also be used for the degree program of the instution in which the AKC was formed in. This aim was decided specifically by that AKC. Sample screen interface of one of the modules developed in the scope of this project can be seen in Figure 4.15.

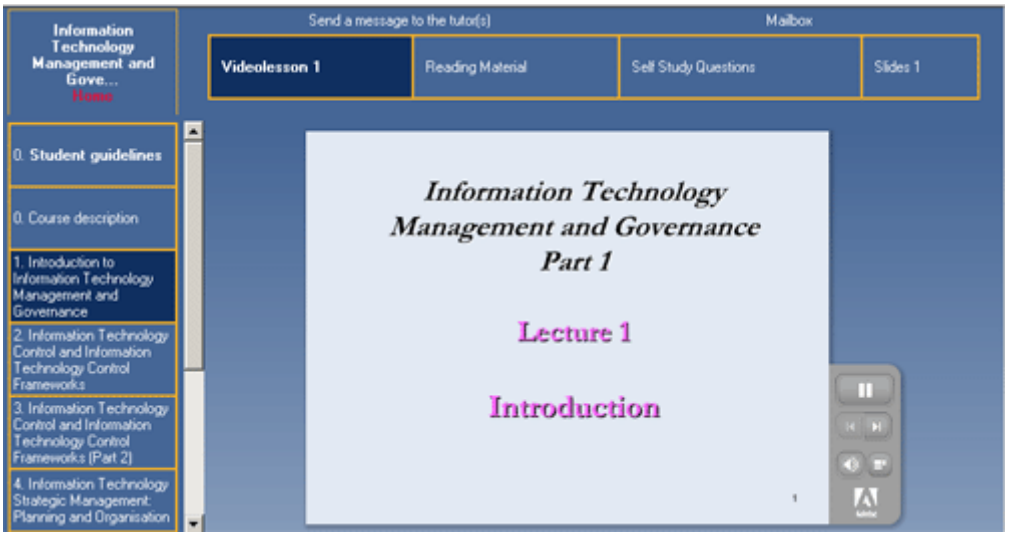

Figure 4.15: Sample interface of a developed courseware in AP-3 Case

For this case new courseware development teams were formed based on the determined courses to be given in the degree program. The same organizational structure of AKC was kept in spite of some changes. For instance, technician had left the project and technical expert was more passive in this phase. On the other hand, another team member who worked as a coordinator was added to AKC. Her responsibility was to enable the communication and coordinator among all the team members in the project. This new organizational structure can be seen in Figure 4.16.

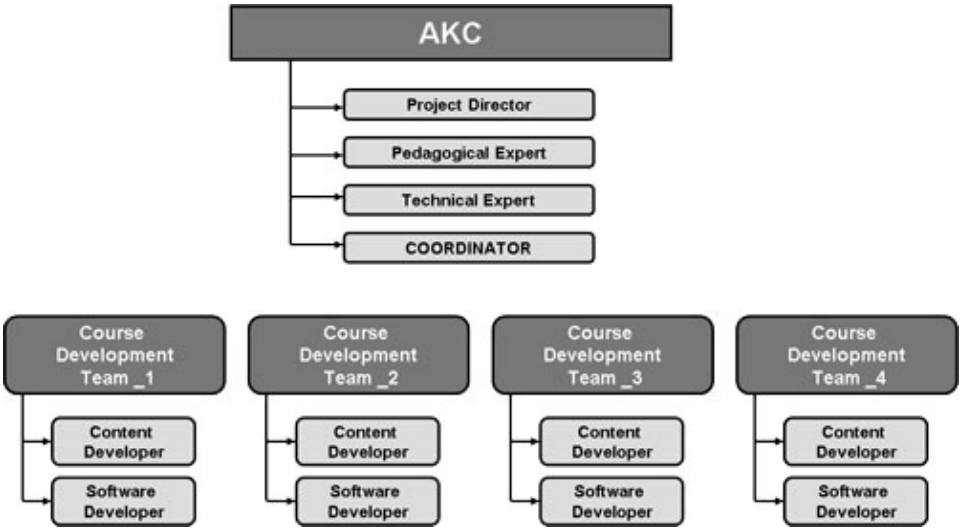

Figure 4.16: Organizational structure of the AP-3 case

This phase of the project was planned according to the DONC^2 development model in this AKC. However, it was not possible to apply all the components of the model to the development process since this phase was only a part of a whole project. Therefore, while most of the micro layer components which dealt with the course development were applied, only just some components could be applied from the management or integration layer.

The project was scheduled according the components that could be applied in about eighth as can be seen in Appendix D. It was planned fixed duration of two weeks for the phases of the project and review meetings were held according to this in every two weeks. Regardless of the review meetings determined to be held in every two weeks, some interim review meetings were also planned for the development teams. Their frequency was left to the groups. However, possible timing was also represented in the project schedule for it being an example.The schedule was as follows based on the methodlogy:

- In the first phase of the project, kickoff meeting was held by project management team with the development teams.

- In the second phase, trainings for the courseware developers were provided by the pedagogical expert. In the trainings, information about the online course development and some instructional strategies that could be applied to online environment were explained. In addition, previous experiences in the previous phases of this project were shared with the new teams. Moreover, one more training was also given about the use of the platform that would be used to upload and present the contents by the previous technician in the project. Style guideline determination was also tried to be done during this phase by investigating sample couses developed before in the scope of the same project. During this style guideline determination meeting, a new approach was considered for the style of the online course materials. This was different from regular web pages that present content and provide some interactions. This was the

presentation of course materials by video recordings of the content developers supported with the slide shows of the content while explaining the content. This idea was accepted by three of the course development teams while the other one selected the other way to offer her course. Therefore project plan was updated according to the use of different styles for the material development.

- In the third phase the development teams were let to determine their course contents, objectives of their courses, instructional activities, evaluation methods and sequence of the contents as well as prepare concept maps.

- In the fourth phase, all teams were to prepare sample module which might represent about 10 % of their courses by the use of paper and software prototypes. The review meeting at the end of this phase was planned for the review and evaluation of the prototypes developed in order to give the courses effective structure by gathering feedback from other teams as well. It was also planned the teams share their problems they faced during the development and helpe each other.

- In the fifth phase, the development teams were to develop the following 30-40 % of their courses andcome to the review meeting by integrating these to the first part of their courses for the assessment and getting feedback.

- In the sixth and seventh phases, the rest of the courses were planned to be developed and integrated as a whole.

- In the eighth and final phase, it was planned to evaluate the courses as a whole.

The whole process was coordinated by a Coordinator assigned by the project management team. This coordinator was responsible for the organization of the

trainings, in addition to the announcement and arrangement of meetings throughout the project. Near the end of the project, she got one more responsibility of checking the developed materials uploaded to the system to determine the missing features or parts and reporting these to the project management and the development teams.

After the completion of the project, the members of the course development teams were interviewed in order to gather feedback about their experiences in this project. New question set (INT_2) was used for this interviews. Four content developers (CD4, CD5, CD6 and CD7) and three software developers (SD3, SD4 and SD3) were interviewed. The software developers had also other responsibilities such as visual design of the materials as well as the video recordings in this case.Two of the content developers did not have any previous experience on online courseware developmet but the rest of the team members interviewed had some previous experiences.

4.5.2. Management layer issues

Although different question set was used since the aim was to gather feedback about their experiences in this project, the interview findings of this case could also be reported in the same three layers. In the management layer, the findings were gathered especially in project management, the need for a technical expert in management team, project plan and the reasons for schedule slippages, hard problems related to technical issues, motivation factors and course maintenance areas.

Project management

Since this was the last phase of a bigger project, many of the strategic decision making activies did not concern the participants in this phase. On the other hand management of these development teams was considered very carefully in this phase by the project management team. Therefore, there was a positive reaction to

the project management. Many of the interviewees (CD4, CD5, CD6 and SD5) mentioned about the effectiveness of project management. CD5 talked about this as follows

> In my opinion, project management was really supportive, directing and understanding as much as possible. Thus, we, the developers in this project, all had to thank to the project manager and the people working with her. They did their best. Even, they were supportive when some of us fell behind. I cannot make any negative criticism to the projectmanagement, only I can say we owe them thanks [AP3 - M1- CD5_E23].
>
> Bence proje yönetimi gerçekten destekleyici, yönlendirici ve olabildiğince de anlayışlıydı. Yani bu konuda proje yöneticisi ve onunla beraber çalışan bütün arkadaşlarıma aslında hepimiz bütün bu projeyi hazırlayan insanlar olarak teşekkür borçluyuz. Hakikaten ellerinden geleni yaptılar. Hatta bazılarımız geri kaldığı halde kırmadılar sadece teşvik etmeye çalıştılar. Proje yönetimine benim yöneltebileceğim olumsuz anlamda hiçbir eleştiri yok sadece teşekkür borçluyuz diyebilirim

The need for a technical expert in management team

There was only one comment about the project management team about not having any technical expert that would respond to the technical needs of the development teams. SD4 also proposed that having atechnical expert would ease the responsibility of the projectmanager as she had to deal with these issues as well other than her managerial and financial duties.

Project plan

At the beginning of the project a project schedule was provided by the project management but, the project could not be finalized as predicted in that schedule. Project management team directed the development teams to implement that plan however this could not be done althought the teams tried to work relevant to it (SD5). The possible reasons for the slippage in the plan were mentioned by some of the interviewees. For instance, one of the resons was the requirement to wait the actual class times since the conent developer wanted to record his classes in real-time (CD5). The possible disconnections occurred between this AKC and the upper management of the whole project was also listed as a possible reason

(CD6). Incomplete materials presented at the meetings presented by the other development teams demotivated the developers for the next meeting to finish their tasks (SD3). On the other hand, SD4 mentioned about they could conform their schedule predictions at the last phases of the project as

> Clearly, we could not implement the schedule we predicted at the beginning. The predictions, such that we can do these tasks in that much week, did not work out. However, near the end we were allowed one more month. In that duration, our predictions like we could finish those in two weeks worked out. Our predictions fitted to the plan really [AP3 - M2_1- SD4_E8]

> Açıkçası ilk başlarda öngördüğümüz plana uyamadık. Hani şu kadar haftada şunları bitiririz şeklindeki plan bir türlü uymadı sarktı. Ama sonlara doğru çünkü proje bitmişti bize ekstradan bir ay daha süre uzatıldı. O sürede artık yani şu zamanda bunları bitiririz, iki haftada bitiririz bitti. Gerçekten o zaman uydu planımız

Hard problems related to technical issues

Technical problems occurred throughout the project based on the chosen method to offer the courses. The location where the videos would be recorded was sometimes difficult to arrange. In addition, as this was the first attempt of video recorded courseware, some problems were occurred due to the inexperience. For instance sound quality was bad at first (SD4). The software that would be used for the presentation of videos through the web had to be changed due to its slow download rates (CD7). These were all resolved by the software developers in the development teams by themselves.

Motivation factors

Motivation factors that might affect the efficiency of the development teams were also discussed with interviewees. The possibility of use of newer technologies was mentioned as an example for motivation (CD4). CD5 called this as the "intrinsic motivation" of the project since this was something that he ever wanted to do. Meetings were considered as positive motivation factors (CD7) whereas the technical problems based on the platform were considered as negative motivation factor (SD3). CD6 discussed the motivation factors as a whole as follows

> One of the ways to increase motivation is the trainings as you mentioned at the beginning, enabling the motivation during the training. After that this is a new and different job and surely support is important. …. The support you have with you and sharing of this with other courses, other faculty and these meeting are very important. …. Who does own its copyright? Can I upload this to my own server and use it? Who will offer this course, me or some other faculty? Will I get any support when I am offering it? What will be the financial returns of this? Why am I doing this? Will this involvement in this kind of development project affect my promotion in the university? Regardless of the financial consideration, will it affect the evaluation? Determination of these issues is very important for the motivation [AP3 -M4- CD6_E31].
>
> Motivasyon arttırmanın bir yöntemi bence en başta bahsettiğimiz bu eğitim, eğitim sırasında bir kere oluşmasını sağlamak. Ondan sonrasında da bu işin çok yeni olduğunu ve farklı bir şey olduğunu ve tabiki destek çok önemli. Asistan desteği diyoruz biz belki ama bu işi bir ekip olarak yapabilmek. ... Ama yanındaki desteğin çok güçlü olması ve bir de bunun paylaşılması diğer derslerle, diğer hocalarla işte o toplantılar çok önemli. .... Bunun copyright ı kime ait. Ben bu hazırlanan dersi buradaki serverıma yükleyip kullanabilir miyim? Şimdi peki bu dersi ben mi vereceğim kullanıldığı zaman başkası mı verecek? Ben verirken destek alacak mıyım? Bütün bunların maddi getirisi ne olacak. Niye yapıyorum bunu? Artı üniversite içindeki sistemde böyle bir projede yer alıp ders geliştirmek benim terfimde işe yarayacak mı hani? Maddiyi bırakalım bir de değerlendirmede yansıyacak mı? Bu tür şeylerin çok net olarak ortaya çıkması bence çok önemli bir motivasyon.

Course maintenance

All the course materials were uploaded to the platform but planning for the update of them was not considered. This showed that the consideration of the course maintenance was missing in the project as SD3 mentioned about this as follows

> If you consider the fact that I've developed them by flash. I have the source code of the flash and now the project was ended. Now nobody can update this. He has to re-develop this. There was no requirement for this in the project and nobody thought about this. …. This should be considered at the beginning of any project similar to this. An item related to providing maintenance at least for a year should be added [AP3 -M5-SD3_E36].
>
> Şu açıdan baktığınız zaman ben bunları flash ile yaptım, şimdi flashın kaynakları bende e şimdi hadi tamam proje bitti, o zaman hiç kimse bunu güncelleyemez. Bir daha yapmak zorunda kalır. …. İlk başta sonuçta buna benzer bir proje tekrar yapılabilir, yaparken ilk başta en azından bunun da eklenmesi. Bir yıl en azından bir yıl mesela düzeltmeleri yapacak ya da kaynaklarını verecek ya da duruma göre öyle bir madde de eklenmesi lazım.

4.5.3. Integration layer issues

In the integration layer, especially, training and style guideline related findings were gathered.

Training

Training conducted at the beginning of the project was considered helpful by the interviewees (CD4, CD5, CD6, CD7 and SD3). It provided examples and showed the direction to the developers. SD3 mentioned about its benefits as

> Those trainings were planned well. I already knew the things that were given as handouts that include the criteria like how is an online course developed, what is considered. It was good to have them done. Because nobody has to know programming or instructional material development [AP3 - I1_1-SD3_E5].
>
> Şeyler falan güzel planlanmıştı eğitimler falan. İşte online ders nasıl hazırlanır, nelere dikkat edilir, o tür kriterler yazılı olarak verilmişti zaten biliyordum. Onların yapılmış olması güzel. Çünkü hiç kimse programlama bilmek zorunda değil, hiç kimse öğretim materyali hazırlama bilmek zorunda değil.

Training related to the use of the technical platform was also helpful to especially the software developers in the project. The given information related to how to upload the materials as well as at what points possible problems might be faced was adequate (SD4). CD5 pointed out that more trainings could be given and defined the structure of the tarinings given as

> What was that training like? That training was planned and given by the people who previously developed courses in the project. It was like for the ones who knew some before. It would be hard for me if I was there as someone that had no previous knowledge about it. I would prefere it to include more examples [AP3 - I1_1-CD5_E11&12].
>
> O eğitim nasıldı? O eğitim daha önceden vermiş olanların daha önceden böyle bir projeyi hazırlamış olanların hazırladığı bir eğitimdi. Biraz sanki bilene yönelikti, sanki ben sıfır sadece bir hoca olarak oraya gitsem beni biraz zorlardı. Biraz daha içerikli biraz daha örnekli olmasını tercih ederdim.

Style guidelines

Determination of the style guideline was tried to be established in this project. However, it could not be provided since the presentation types of courses were different from each other (CD4). Two different presentation styles were used for the courses. One of the courses used the HTML-based web pages for the presentation of its content while the others used videos synchronized with slides for the presentation style.

There were different ideas among the interviewees for the determination of style guideline. CD6 proposed that "it was strictly needed especially to enable the wholeness and ease the quality audits" [AP3 - I2- CD6_E13&15]. On the other hand, SD3 suggested that would make the lessons boring for the students. . It was also mentioned to have a style guideline at least up to some point would be helpful but it was not necessary (CD4, CD5 and CD7).

> "Kesin lazım. Bütünlük sağlaması açısından artı kalite denetiminin daha kolay yapılabilmesi açısından şart."

4.5.4. Micro layer issues

Course content determination, prototyping and review meetings, their advantages and frequency related issues were gathered from the findings at this layer.

Course content determination

There was a ready content for all the courses developed in the scope of this project. Some additional materials were gathered to support this content (CD4, CD7). None of the development teams used concept maps for the development of their courses but CD6 proposed the need to use concept maps was necessary.

Prototyping

All course development teams used prototyping for their course development. For the video included lessons, test recordings were done and these were integrated to

the web interface to show the look of the presentation and then reviewed by the teams (CD4, CD5, SD3, SD4). Final decision was given after working on the prototypes.

Review meetings, their advantages and frequency

The regular review meetings were concerned as helpful by all the team members. The benefits were listed as seeing the progress of each team (CD4, CD5, SD5), giving feedback to each other (CD6, CD7), motivation of work (SD3), sharing experiences and finding solutions to problems (CD6, CD7, SD5), and providing a control mechanism (CD5, CD7). The two week frequency was also considered adequate by the team members. On the other hand, conducting more frequent meetings at the beginning of the project when there were many things to decide and then decreasing the frequency later in the process was another idea proposed for the frequency of the meetings (CD6, SD3 and SD5).

Development process

Project was planned to be conducted in iterative fixed duration intervals based on the development methodlogy. Coordination mechanism was also provided to guide the flow of the process. In spiet of these, slippage occurred in the project schedule.This might be due to several reasons that the schedule could not be updated throughout the project. One of the course developers decided to record his courses in their real-time environment so that team had to wait for the actual schedule of the courses. For the other two courses, schedule of the place where the videos were planned to be recorded could not be accommodated whenever needed. These could not be reflected in the project schedule. In addition, course development was not the primary responsibility of all the team members. They had other duties such as offering other courses as a faculty or taking courses as a student.

4.5.5. Summary of the interviews

The positive and negative issues of this project at each layer were revealed and summarized as in Table 4.9, as said by the interviewees reporting.

Table 4.9: Summary of the issues in Case 4 – AP-3

Management Layer	Positive issues	Supportive project management
		Guiding coordination
		Detailed project schedule
	Negative issues	Missing technical expert in the project
		No consideration for course maintenance
		Not updated project schedule
Integration Layer	Positive issues	Conducting trainings
	Negative issues	No implementation of style guidelines
Micro Layer	Positive issues	Regular reviews for the evaluationof the courses
		Use of prototypes
	Negative issues	No use of concept maps

4.5.6. Document Examination

In addition to the interviews, the courses developed by the interviewed developers were examined. The developed courses were uploaded to Plei@d platform. Although the general structure of each course looked similar based on the use of content management sytem some slight differences in the interface were seen. The presentation structure of the courses was very different from the previous phases of the project. There were two types of courses. One of them was regular web pages that present content and provide some interactions and the other included video recordings supported with the slide shows of the content. The courses were E-Business Environment and Architecture (e-business), High-tech Entrepreneurship (HTE), Information Technology Management and Governance (ITMG) and Sytems Engineering (SE). In all these courses content was divided into chapters and these were accessed through the use of left menu. Top-menu

was used to access the different materials related to the courses such as the lecture notes, printable version of lecture notes, review questions or practice tests, glossary and video-lectures. However, since the use of video presentation was used for three of the courses, there were differences among the courses. These can be listed as follows and can be seen in Figures 4.17, 4.18, 4.19 and 4.20:

- Only for one of the courses (e-business), regular web site presentation format was used. In that course, additional navigation bar was used to access the inner pages of the content.

- In all the video lessons, lecturer describes the content of the slides. This description was only put in one of the courses (HTE) directly at the bottom of the slides. On the other hand, slides were provided in a printable version in addition to the additional reading materials related to the content.

- Only in one of the video-based courses (HTE), navigation was provided to access to the sub-sections of the chapters.

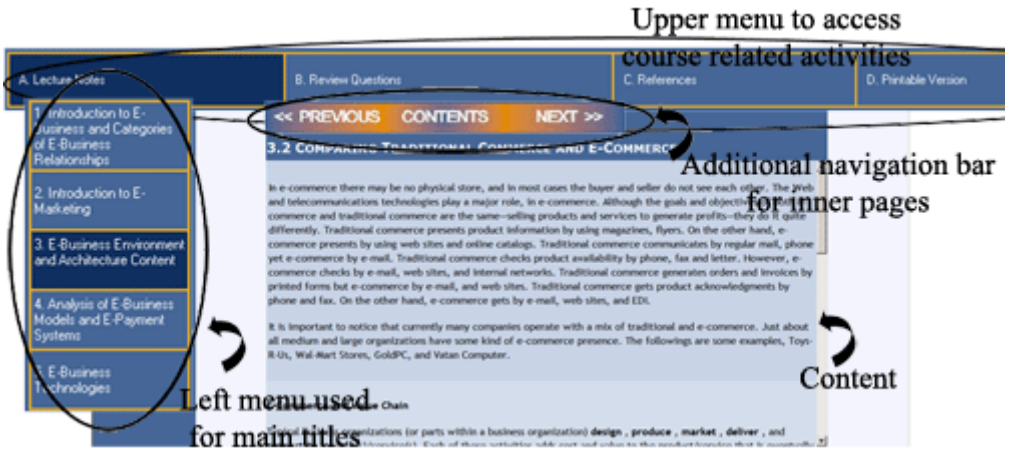

Figure 4.17: Screenshot of E-business Course

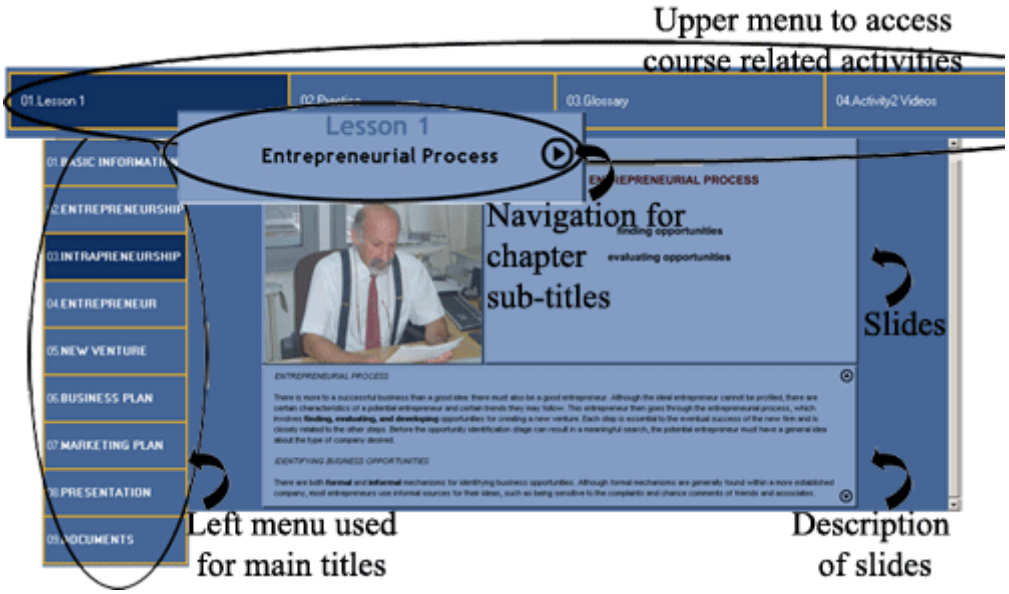

Figure 4.18: Screenshot of HTE Course

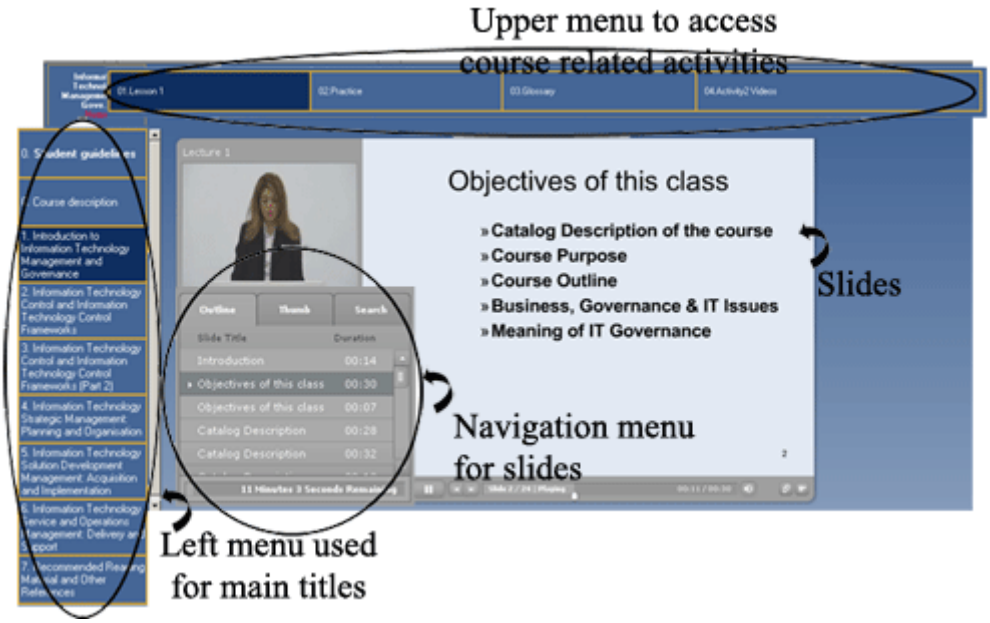

Figure 4.19: Screenshot of ITMG Course

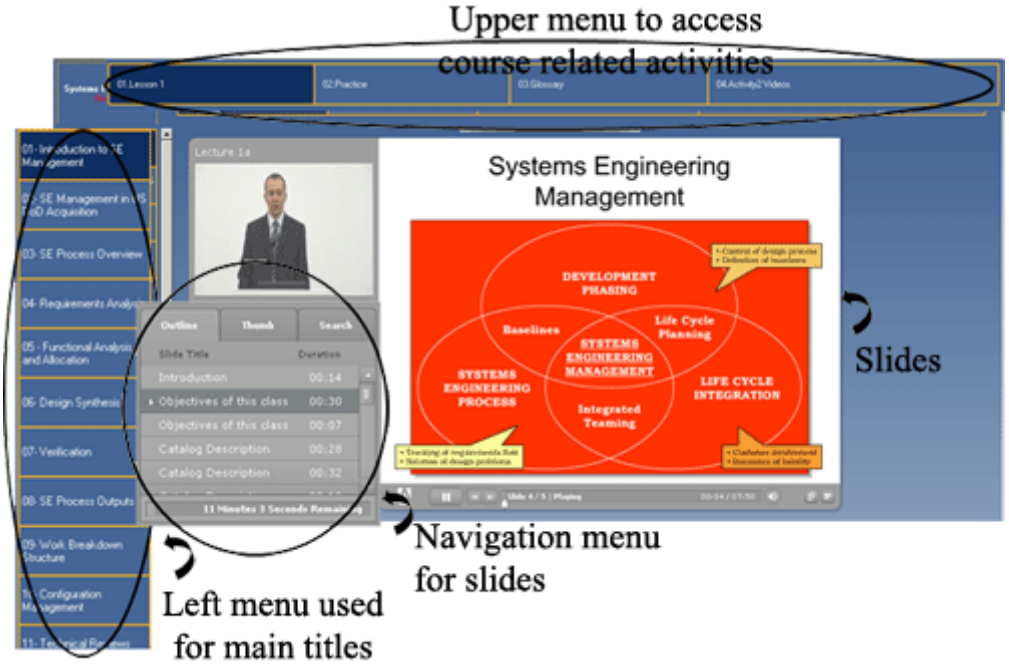

Figure 4.20: Screenshot of SE Course

The reason for not being successful for establishing a style guideline was defined by SD5 as follows

> Actually, this was discussed in the previous term. However, deciding on a style guideline and the development of all the courses according to it was not accepted since the content of courses were different. Some courses require more animations, some requires more tests. Some courses for instance this term's include more videos. If there was a common guideline it would limit the developers or it might guide the others to include these kind of things. [AP3- I2- SD5_E6].

> Aslında ilk dönem tartışılmıştı bu herkes ortak bir style guideline hazırlayıp onun üzerinde mi yapsın diye ama genelde çok sıcak bakılmadı çünkü her dersin içeriği çok farklı oluyor. Bazı dersin içeriğinde çok fazla animasyon olması gerekiyor, çok fazla test olması gerekiyor. Bazıları mesela bu dönem daha önce yapılmayan çok farklı bir şey yapıldı videoya çok ağırlık verildi. Ortak bir şey oluşturulmuş olsaydı bence bu kısıtlardı ya da diğerlerini de buna benzer şeyler koymaya teşvik ederdi

4.5.7. Outcomes of the AP-3 Case

- *Providing an involved project manager:* Supportive, directive and concerning project management is essential especially for the motivation of the team members (AP-3_M1).

- *Provide a technical expert in project management team:* Project management team should better include people who have required skilss such a technical expert so that responsibility can be divided appropriately (AP-3_M1_1).

- *Providing a project schedule*: Providing a project plan will show the way to follow to the developers. However, since the prediction of the later events clearly is not possible at the beginning of the project, ability to update the plan is essential. In thisproject this could not provided and so caused the slippage in the schedule (AP-3_M2).

- *Providing technical support*: technical support may be needed at any point in the project and it cannot be the responsibility of project manager. Therefore some exerts that will be responsible for this should be included in the project management team. This is also something related to the motivation of the developers since it may cause to frustration (AP-3_M1_1 & AP-3_M3).

- *Providing trainings*: People in the development teams may not have the same level of knowledge or experience about online course development. Therefore, providing training to them will be useful for them to develop effective courses. These trainings may include the issues related to online course development, instructional development or some technical information about tools or programs to be used. These training can be helpful to provide motivation to the developers (AP-3_I1 & AP-3_I1_1)

- *Providing style guidelines*: Style guideline determinations should be considered carefully. Style guideline should be provided for the unity of

the courses that will be served in the same curriculum. This will enable the assessment of quality of the courses easily. Prevention of creativity should be avoided while applying some guideline (AP-3_I2).

- *Regular review meetings*: Review meetings enable the control of the project flow. In addition, this will increase the quality of materials by enabling teams to review each others's materials and to see ther progress. This also affects the motivation. More frequent review meeting are especially required at the beginning of the project but the number can be decreased at the later stages based on the needs of the project. The intervals can be determined based on the total project duration but two weeks itartions can be adequate generally (AP-3_m3).

4.6. SUMMARY OF THE OUTCOMES OF ALL CASES

The investigation of all these cases revealed some essential principles that should be included in a developmet model. These principles especially could be grouped in management or integration layer since thet were dealt with management, planning or strategic decision making level activities. Table 4.10 summarizes all the principles and also shows from which cases they were gathered.

Table 4.10: Summary of the outcomes of all cases

MANAGEMENT LAYER	Provide a good project management team	AP-1_M5_2, SBS_M7&M11, AP-3_M1_1
	Provide a good project manager	SBS_M3, AP-3_M1
	Provide a project plan which is continuously updateable	SBS_M4&M5, AP3_M2
	Collaborative decision making	EPPICC_M1&M3
	Formation of adequate teams	SBS_M7
	Enable appropriate division of responsibilities in teams	EPPICC_M1&M6_1
	Provide a good technical support	AP-1_M4 & M4_1, AP-3_M1_1
	Providing a risk plan	EPPICC_M5
	Provide mechanisms to enhance communication and active participation	AP-1_M5_1, SBS_M8_1&M8_2 &M8_3&M10_1
	Provide comprehensive requirements analysis at each level	SBS_M2&M12& m1, EPPICC_M2
	Provide configuration and change management mechanisms	SBS_M10_3
	Include Quality Checks into the process	SBS-m5
	Regular review meetings	AP3_m3
	Create a common understanding among all the team members	AP-1_M5_3
INTEGRATION LAYER	Provide training mechanisms for the developers	AP-1_I2&I2_1, SBS_I1, EPPICC_I1, AP3_I1
	Provide capable LMS	AP-1_I1
	Careful consideration of recruitment / retention	EPPICC_I2
	Providing style guidelines	AP-3_I2
MICRO LAYER	Provide detailed content (requirements) analysis	SBS_ m1, EPPICC_G2
	Provide sound pedagogical approaches for the implementation of the courses	AP-1_m2, SBS_m4
	Provide adequate evaluation for the quality of course materials	AP-1_m3, SBS_m5, EPPICC_m3_2
DEVELOPMENT PROCESS	Follow an iterative/incremental development model	AP-1_P1, SBS_P1, EPPICC_P1

4.7. CHARACTERISTICS OF DESIGN PROCESS AND DISTRIBUTED DEVELOPMENT MODEL

In this section, answers to the two main research questions posed in Section 1.2 will be elaborated. These answers are based on the relevant literature as well as the findings of the case studies carried out. The distinctive characteristics that are required for the successful implementation of the design process can be listed as:

- Following an iterative and incremental development process supported by prototyping is the most important characteristic revealed from the cases. This approach responds to the needs such as fast, on-time, within budget and in scope development effectively.
- Providing effective project manager or management team is also a crucial characteristic for the development model. There is a need for a collaborative, supportive and knowledgeable project management for the successful implementation of the project as well as for enabling the motivation of the development teams
- Scheduling a project plan which is flexible and continuously updateable is another necessary characteristic since is not possible to predict everything at the beginning of the project. All team members are needed to be aware of this and agree on the plan and accept to accomplish it as much as possible.
- Providing effective communication mechanism is essential since the development teams may be geographically separated. There is a need for a communication infrastructure that will provide team members to share and disseminate project knowledge including various forms of communication tools. In addition to the infrastructure there is also need for other mechanisms that define the type and way of communication among all the team members in terms of rules of engagement.
- Including quality checks into the process is another critical element since the quality of the developed learning materials is vital for the effectiveness of these materials. Continuous evaluation of the process as well as the

developed materials are needed to be done through the use of review meetings and quality checks performed based on the pre-determined quality criteria of the project.

- Conducting adequate requirements analysis at all levels is also important since all the planning is done based on the determined requirements of the project as well as the individual courses.
- Training mechanisms will be helpful for establishing a common understanding among the team members on the project requirements and each others' needs. This also helps to increase the motivation of the team members
- Style guideline determination is also crucial for the developed courses since they will be considered in the scope of a curriculum. A style guideline will provide unity among the courses. In addition this will help to ensure the assessment of the quality of the materials
- There is a need for application of sound instructional design strategies and approaches for the effective course materials that will aid learning.
- Attracting students for the developed courses is also essential since the online course market becomes highly competent based on the increase in the number of online courses. Keeping the students is also essential issue to be considered.

CHAPTER 5

DONC^2 DEVELOPMENT MODEL

In this chapter, a comprehensive model for online curriculum and courseware development is proposed by making use of all the findings discussed in the previous chapters. Throughout this chapter, first, a general overview and the principles underlying the model will be handled. Subsequently, the model and its essential elements will be discussed in detail.

5.1. THE STRUCTURE AND VISUAL REPRESENTATION OF DONC^2 DEVELOPMENT MODEL

5.1.1. The Adopted Approach

The DONC^2 development model was developed based on the related literature and principles gathered by the investigation of the reported cases in the previous section. Although the main goal was to provide a model for the process of developing learning environments which would be used in online curriculum, it was realized that it had similarities with the software development process. Therefore the model mainly integrated instructional design principles and strategies with current software development models.

DONC^2 development model primarily has its foundation in adaptive software development (ASD) (Highsmith, 2000) which is considered as one of the agile

development methodologies. Therefore, it includes iterative and concurrent development in its nature. This development approach is also supported by the investigated cases. It was seen that, linear development models could not be followed in none of the online course development projects investigated (AP-1_P1, SBS_P1, EPPICC_P1). Rather, iterative development supported by the use of prototyping technique was applied. This kind of development approach responds to the needs of online curriculum and courseware development environments which involve the similar kind of problems that can be seen in software development projects such as the need for fast, on-time, within budget and in scope development. In addition, since the requirements of the courses in the curriculum may not be determined completely at the beginning of the project, instructional strategies planned to be applied or the technology that is used for the development or the implementation of the courses may change, as in software engineering.

Since time is an essential element for the development effort, time-based phases are chosen for the process flow rather than a task based approach. In other words, these time-boxed iterations are adapted from the ASD, as can be seen in Figure 5.1. Short and fixed durations are applied to the iterations. This will enable the developers to focus on conducting most critical issues at first as well as making trade-offs in areas such as features and resources. Moreover, the quality of the materials is enabled to be increased at the end of these short time boxed iterations. The numbers of iterations as well as the duration of these iterations are determined based on the duration given for the project. Keeping phases short as much as possible, like one or two weeks, can be used as a rule depending on the problems (Highsmith, 2000). The tasks are assigned to these time-boxed phases throughout the project and if any extensions occur new phases can be added at the end of the project rather than extending the duration of the phases.

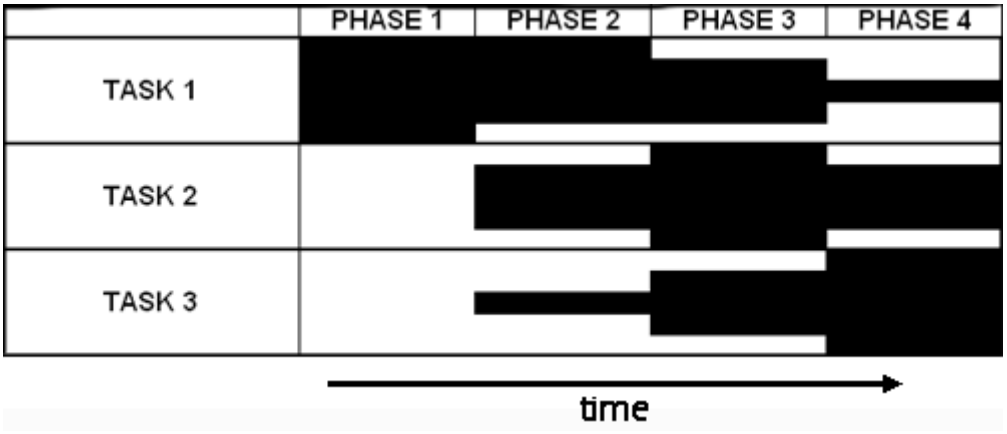

Figure 5.1: Time-boxed approach of DONC[2] development model (Adapted from Highsmith, 2000)

In addition, the model also has a concurrent nature as it was stated above. However, this does not mean that every task is done at the same time. Overlapping for the tasks is enabled as much as possible depending on the relationships of the tasks as well as the resources at hand.

The tasks are assigned to phases, not all tasks are expected to be finished at the end of an iteration. Any task may take long more than one phase. For instance, since the whole requirements may not be gathered at one phase, this activity can be continued in several phases with different workloads like heavy at the start and then lighter at the following phases. This can also be seen in Figure 5.1. The black bars show the density or loads of the tasks in different phases.

The model includes all the components required for the effective curriculum and courseware development in addition to all the components required for the management of the development effort. Therefore, the components are divided into three main categories. These are management, integration and micro layer processes. Management layer components mainly deal with the project management as well as strategic decision making issues. Integration layer components generally deal with curriculum development issues. Finally micro layer components deal with courseware development issues. In the model, the processes are listed in a circular form in order not to emphasize any order for their sequence, as in Figure 5.2.

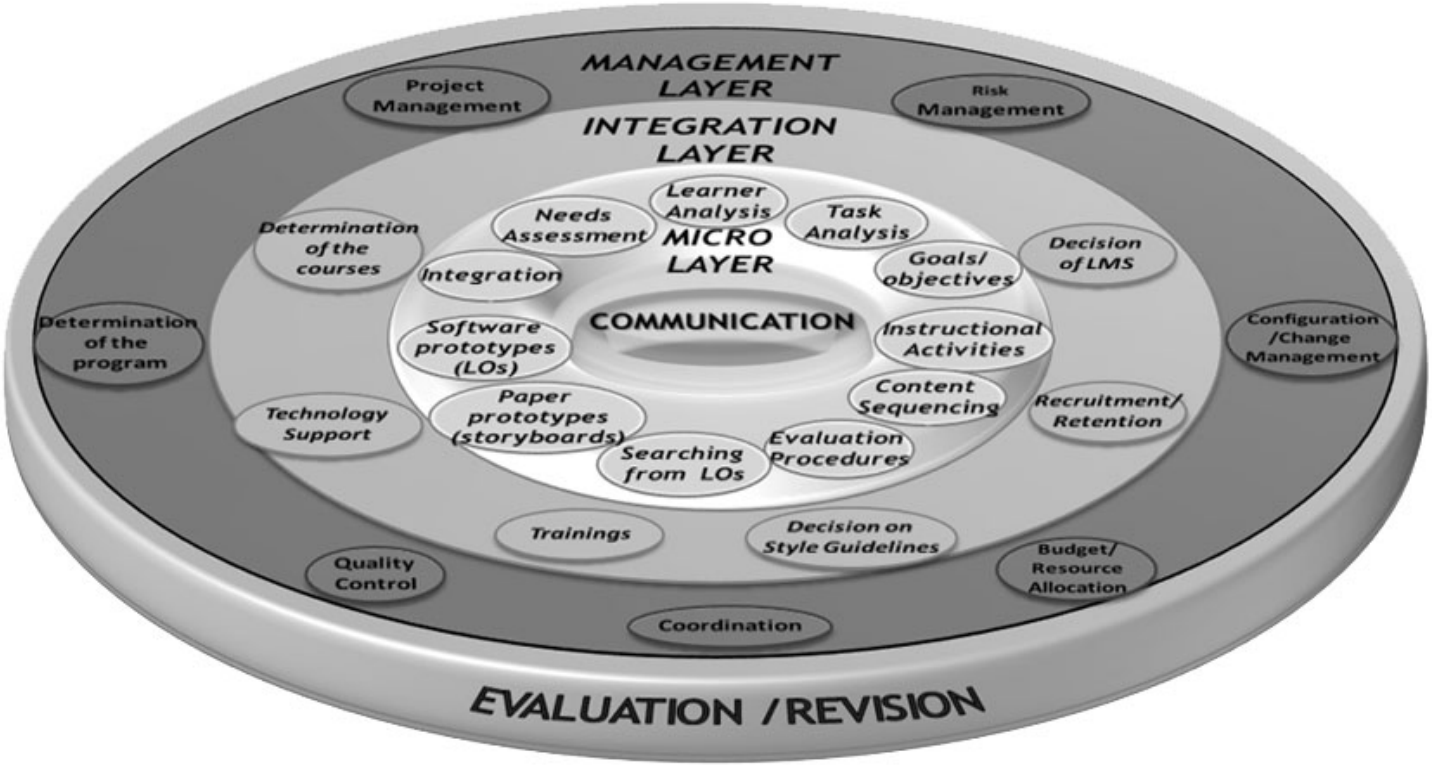

Figure 5.2: The DONC^2 Development Model

The model also emphasizes feedback and collaboration. These features are also supported by the findings of the cases (EPPICC_G1&G3, AP-1_G5_1, SBS_G8_1&G8_2 &G8_3&G10_1). Each component can give feedback to any other related component by continuous evaluation and revision component (SBS-m5, AP3_m3). This is enabled by communication component which provide continuous communication and collaboration among the components in all layers. These two components can be considered as supportive interlayer compoenents.

All the components are conducted in time-boxed phases throughout the development process, as can be seen in Figure 5.3. Especially the management layer components are performed heavily at the beginning phases of the project but some of them continue to the end of the project with descending loads. On the other hand, some of the integration layer components start from the beginning but their load changes throughout the project. Finally micro layer components cannot begin at the initial phases of the project since they are related to the development of individual courses which may not be determined at the beginning of the project.

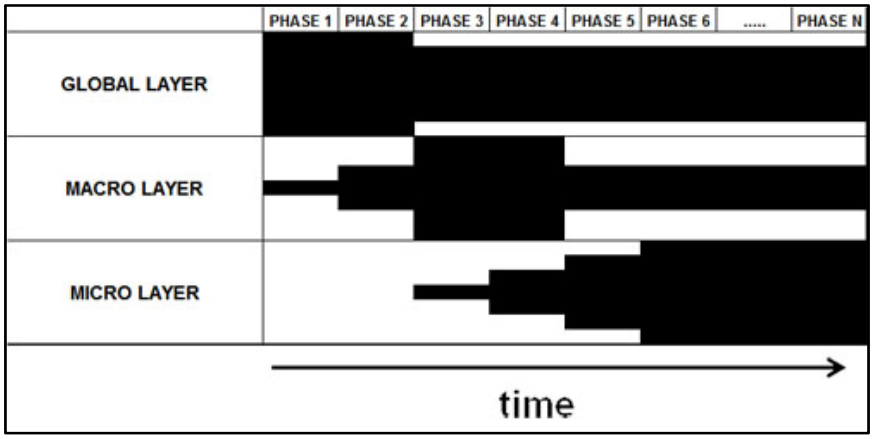

Figure 5.3: Workloads of the layers in time-boxed phases of the DONC^2

5.1.2. Main characteristics of the model

Discussion in section 5.1.1 leads to the following main characteristics of DONC^2

- Iterative and concurrent development

- Short and time-boxed phases
- Consideration of all the components required for the effective curriculum and courseware development equally.
- Continuous collaboration through the use of communication mechanism
- Continuous evaluation and feedback through conducting regular review meetings
- No pre-determined sequence among the components

5.2. COMPONENTS OF DONC^2 DEVELOPMENT MODEL

5.2.1. Overview

Component based approach is used as in ASD rather than providing to-do lists in the form of list of tasks or processes, in this model. Providing a list of tasks may be helpful to the developers but this also generally results in the team members to be lost in the long list of required tasks without the acknowledgement of what is really expected them to develop. On the other hand, components are group of features that are planned to be implemented together. Development through the use of components provides project teams focus on the results rather than the details of processes. Therefore, they can understand their objectives better and achieve the results in their own way (Highsmith, 2000). For that reason, components, rather than processes, that are necessary for the implementation of this kind of development effort are defined and then they are assigned to the iterative phases of the development effort.

The components of the model are gathered from mainly the outcomes of the cases as well as the related literature. Some components directly come from the literature while some others are based on the cases. In addition some of the components are both based on the cases and literature together. The details of the components and their relationship with the cases and literature can be seen in Table 5.1.

Table 5.1: Components of the model vs Cases/Literature Matrix

	Components	Their relations with cases and literature
Management Layer	Project Management	AP-1, SBS, EPPICC, AP-3, Highsmith (2000)
	Budget/Resource Allocation	AP-1, SBS, Highsmith (2000), Phillips (1998), Rosenau & Githens (2005).
	Configuration / Change Management	SBS, Phillips (1998)
	Coordination	AP-1, SBS, Rosenau & Githens (2005).
	Determination of the program	SBS, EPPICC, Yang & Liu (2007), Perrie (2003)
	Quality Control	SBS, AP-3, Wang (2006), McLoughlin & Visser (2003)
	Risk Management	EPPICC, Chapman & Ward (1997), Karolak (1995), Rosenau & Githens (2005)
Integration Layer	Determination of Courses	SBS
	Determination of LMS	AP-1, Yildirim, Temur, Kocaman & Göktaş (2004)
	Recruitment/Retention	EPPICC
	Trainings	AP-1, SBS, EPPICC, AP-3
	Style Guidelines	AP-3, Xu & Morris (2007),
	Technology support	AP-3
Micro Layer	Needs Assessment	Smith & Ragan (1999)
	Task Analysis	Smith & Ragan (1999), Kemp, Morrison&Ross (2004)
	Learner Analysis	Kemp, Morrison & Ross (2004), Novak (2006)
	Goals/objectives	Smith & Ragan (1999)
	Instructional Activities	AP-1, SBS, Dick & Carey (2005)
	Evaluation Procedures	Kemp, Morrison & Ross (2004)
	Sequencing the content	Kemp, Morrison & Ross (2004)
	Searching from LOs	AP-1, SBS
	Paper prototype	AP-3, Tripp & Bichelmeyer (1990)
	Software prototype	AP-3, Tripp & Bichelmeyer (1990)
	Integration	
Interlayer	Communication	AP-1, SBS, EPPICC, AP-3, Bafoutsou & Mentzas (2002), Poltrock & Engelbeck (1997), Corkill (1991)
	Evaluation/Revision	AP-1, EPPICC, Nielsen (1993),Nielsen & Mack (1994)

All the components of the model are assigned to phases in a flowchart like figure, as can be seen in Figure 5.4. Although the figure looks like a process flow, it only shows the possible implementation of the components based on their workload distribution throughout the project as shown in Figure 5.3 above. More iterative phases than seen in the figure can be conducted according to the needs of the project. Moreover, figure shows the feedback association among the related components. More detailed version of this figure also can be seen in Appendix E.

The model integrates all the necessary components from the planning activities, to the individual learning object development to provide a detailed guideline for the developers. Components were grouped into three layers as discussed before. There are also some supportive interlayer components included in the model such as communication and evaluation-revision. The details of all these components will be described in the following section.

Additionally a web site was developed for the detailed description of the model at http://www.ii.metu.edu.tr/~doncc. This web site includes descriptive information about the model from two different perspectives which are component-based and role-based. It can be used as a guideline to determine a path for the development of any courseware by the development teams. Sample project implementation plan is given in addition to the sample document forms such as quality checklists that can be used during development. Screenshots of the web site can be seen in Appendix F.

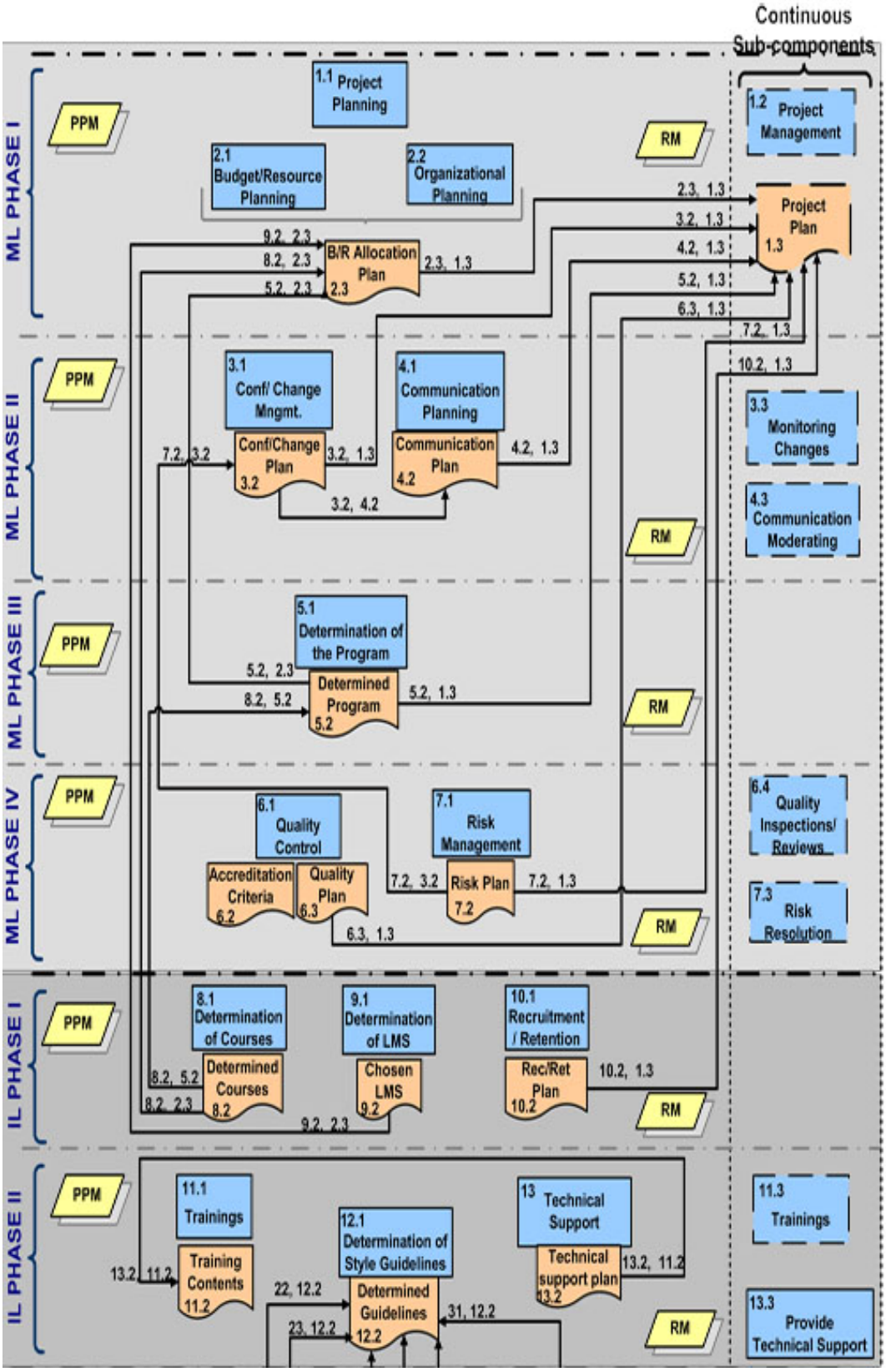

Figure 5.4: Overview of the model

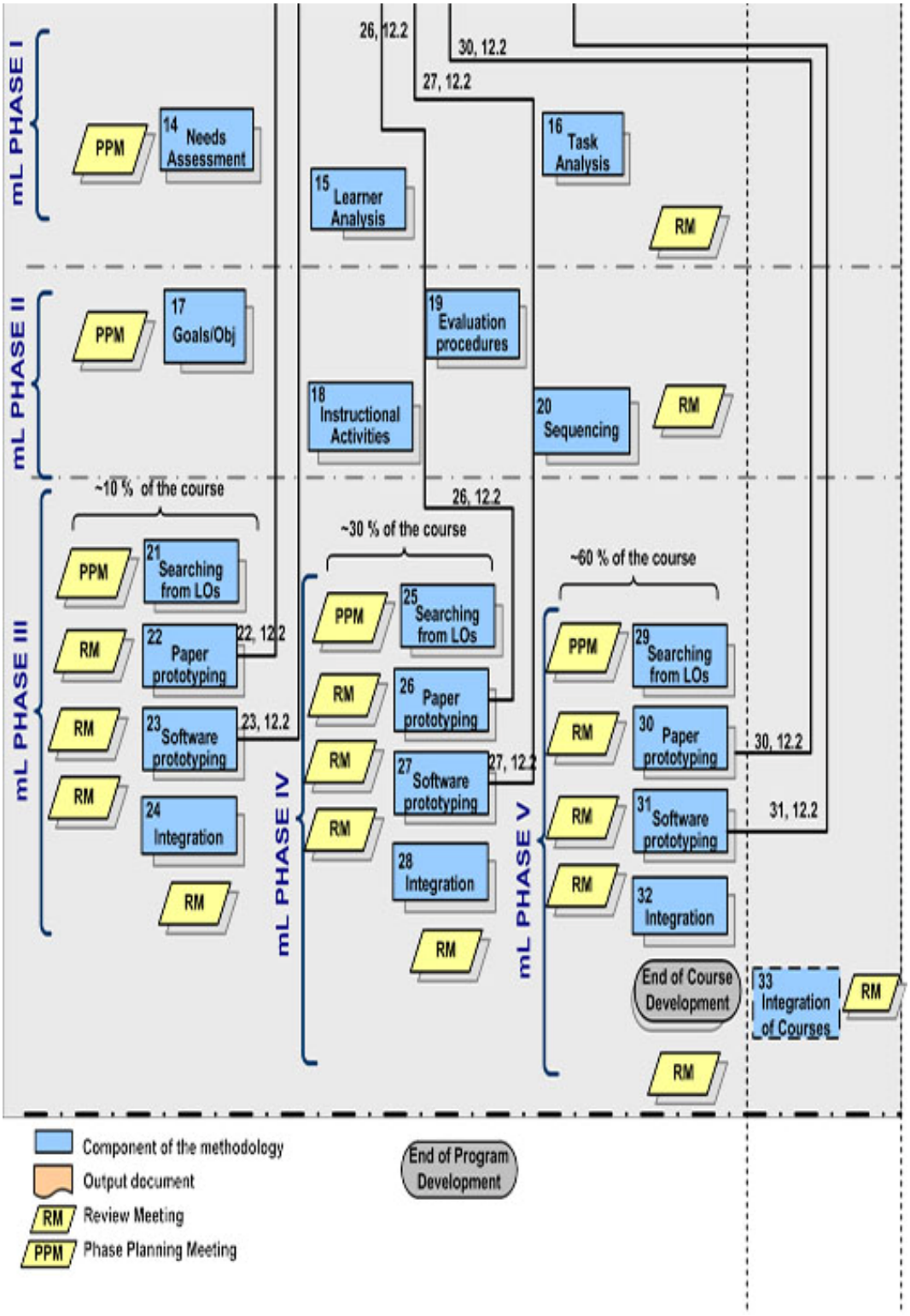

Figure 5.4 : (Cont.)

5.2.2. Components of the Management Layer

The management layer deals with the strategic decision making as well as planning activities of the project management team. These project management activities are adapted from the standard developed by Project Management Institute (2000). In their guide, there are about nine areas of project management knowledge, but in this model six of them (time, cost, quality, human resource, risk and communications management) were adapted using the ASD's project management approach and the specific requirements of this model.

In the implementation, there is no pre-determined sequence among the components. They can be conducted concurrently as well as iteratively throughout the entire project based on their relationships and the resources available. They also gather feedback from each other as well as the components of other layers whenever necessary. All management layer components can be seen in Figure 5.5.

Figure 5.5: Components of the Management Layer

Management layer components, especially the ones dealing with planning activities, are conducted heavily at the beginning of the project while the others, which are related to the execution of the plans, continue with different workloads throughout the project. The possible assignment of the components to the iterative phases can be seen in Figure 5.6.

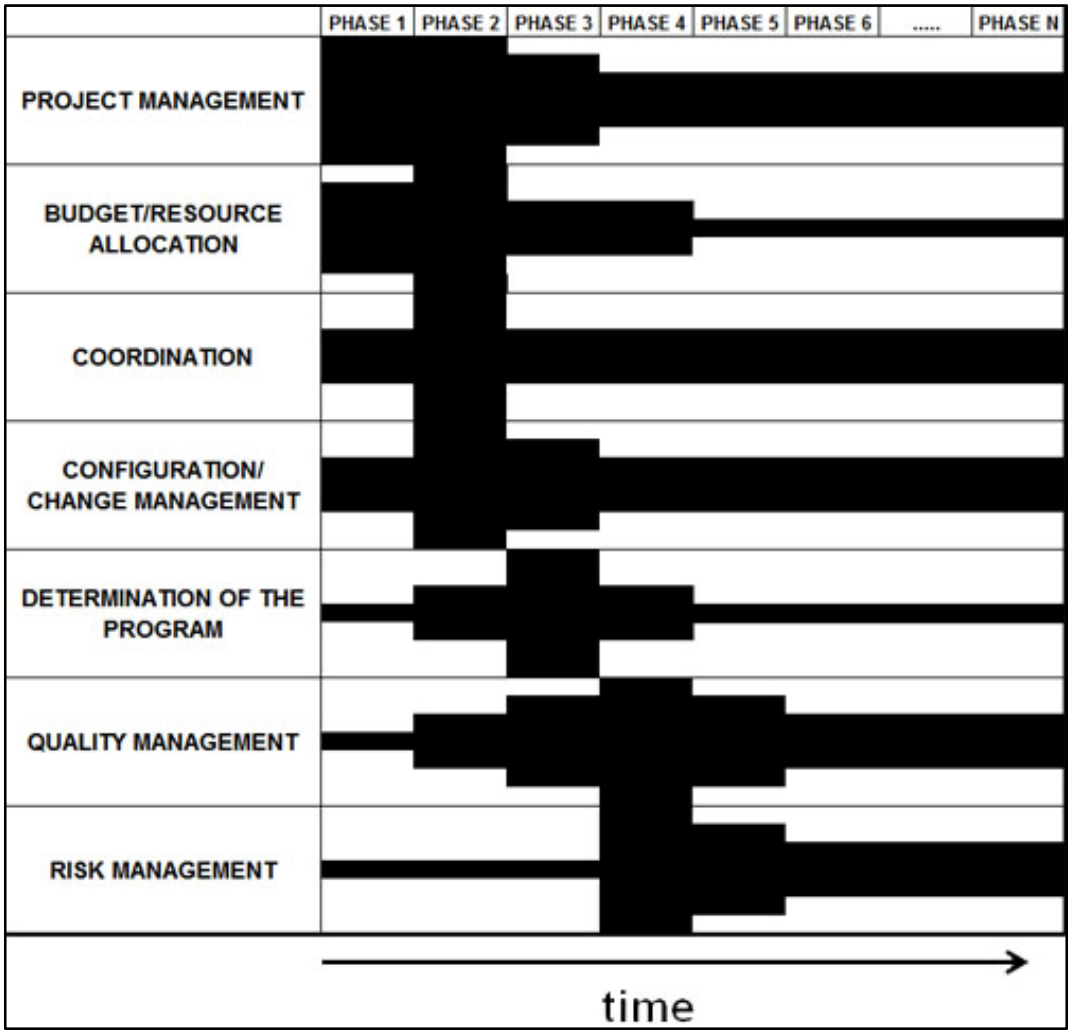

Figure 5.6: Assignment of management layer components into the time-boxed phases

5.2.2.1 Project Management

Project management is one of the main components of the management layer. The outcomes of this component may result in success or failure of the project, as can also be seen from the results of the investigated cases (AP-1_G5_2, SBS_G7&G11, AP-3_G1_1, SBS_G3, AP-3_G1, SBS_G4&G5, AP3_G2, EPPICC_G1&G3). Careful consideration for all the project management issues is essential in order to respond to the desired features defined in this model. The requirement of an effective project management was strongly emphasized by the investigated cases.

Project management approach used was also adapted from ASD. Its leadership and collaboration rather than command and control mechanism was integrated. Command is replaced by leadership which enables participative or human-centered management. This is also supported with the collaboration feature. This type of management environment defines the direction to go, provide guidance to achieve the direction and enable people and teams work in collaboration. As a result of this, creativity and innovation is enhanced in the development environment. (Highsmith, 2000). This is also supported with the other components like coordination or evaluation and revision components of the model.

Activities of project management component start at the beginning of the project and continue heavily till the end of the project. Project management involves two major sub-components:

- ***Plan development***: This involves the determination of the scope as well as the schedule that provide a complete guide for the execution of the project. This activity is iterated for several times, as it uses the outputs of the other processes of the management layer and it cannot be completed before the planning activities of other management layer components are ended.

  Since the prediction of all elements at the start of the project is not possible, speculation is used for scheduling and a general plan which is not very detailed is prepared. All the components of the model assigned to the time-boxed iterative phases. The duration of the iterations is determined based on the time given for the completion of the project as well as the human resources but keeping them short is essential. The plan developed at the beginning is flexible and open to changes due to the variances in the requirements. Therefore, evaluation of the project process is done at the end of every iteration. Then, next phase is planned in detail based on the accomplishment and performance level of the previous phase. The tasks that could not be performed in the previous phase can be transferred to the

following phase based on its importance for the accomplishment of the component. This feature seems causing schedule extension however at this point trade-offs occur among the most important requirements that the critical requirements can be performed early in the process. On the other hand, extensions may be required for the completion of the project. These extensions can be added as extra phases at the end of the schedule if necessary. Therefore, unallocated time buffers are also included at the end of schedule for the unexpected events. However, the main goal of the development teams is to achieve the original schedule and use the buffers whenever really necessary. Schedule update is a continuous activity that takes throughout the project. This is also supported by an interlayer component which is continuous evaluation and revision.

- ***Management***: This activity of the project management component also starts from the beginning of the project and ends only when the project is finalized. It involves the control of the execution of the plan. It is not possible for the management team to achieve success without achieving consensus on the plans and schedules (SBS_G5) as well as without establishing mutual trust (SBS_G3) among all the team members. In this model, "distributed governance" (Highsmith, 2000, p.214) which emphasizes collaboration is favored rather than strict control. Project manager acts as a leader rather than a single authority for decision making. This is also required by the nature of distributed development environments since there is a need for decentralized, distributed or parallel decision making. In participative management, leader assigns components to team members and makes them accountable of their performance. S/he empowers them make their own decisions to achieve the component. On the other hand, leaders consult team members as well in decision making but it is not always possible to consult everyone every time. For those times, team members also empower the leader since respect and trust are established among them (Highsmith, 2000). All the collaboration and

shared decision making of this component are enabled by the support of some other components such as communication, and evaluation and revision. The success of this component mainly depends on the skills and abilities of the project manager or leader. These skills and abilities will be explained in section 5.2.6 in more detail.

Main Characteristics of Project Management Component

- Management based on leadership rather than an authoritative mode
- Collaborative trust-based decision making/ empowerment among team members
- Flexible planning based on time-boxed iterations
- Continuous schedule updates

5.2.2.2 Budget\Resource Allocation

This kind of project requires a considerable amount of capital and human resources. All the resources need to be planned carefully by the project management team. While deciding on these issues management team gets feedback from other teams in the project. Two major activities in this process are as follows:

- ***Organizational Planning***: Having teams involving adequate number of personnel (AP-1_G5_4) is necessary since the team members may have additional responsibilities other than this in their institutions such as working in other projects or giving lectures. Their extra duties may degrade the team performance if supporting personnel is not satisfactory in quality and quantities (SBS_G7). “Cross-functional teams” (Highsmith, 2000, p.252) rather than functional teams are formed. Personnel are allocated based on different required skills rather than forming functional teams like visual design teams or programming teams. A project management team which consists of team members who have different

expertise in areas such as project management, instructional design, software engineering or graphical design is formed. Under that project management team course development teams which again consist of people who have various skills are formed. The number of these teams depends on the needs of the project, number of courses to be developed. To sum up, having people who have necessary skills and motivation to do their best is the critical asset for this kind of project (Phillips, 1998). Required roles and responsibilities for the project are discussed in section 5.2.6 in more detail.

All the members of the teams should be considered as important stakeholders of the project. Organization of people is also essential for making efficient use of other resources (Rosenau & Githens, 2005). Requirements of the project are ranked and the personnel are assigned for the high priority requirements in iterative phases. It may also not be possible to have the people who have necessary skills every time or sometimes having the best people may not result in success in the project. Therefore, acquiring the right people as well as acquiring them right depends on the abilities of the project leader. For that reason this sub-activity of this component is also supported by the project management component.

Since there is the requirement of collaboration in the model, ability to work collaboratively is another important skill to be considered during team formation other than the technical capabilities. Project teams are better formed of small number since this will enable team members to blend to each other easily so they can perform better (Highsmith, 2000).

Since change is considered an inherent feature of this kind of development effort, human resource requirements may also change throughout the process due to several reasons such as the addition of new requirements or to prevent schedule slippages. Therefore, allocation of resources can be

repeated during the project for several times according to the availability and workload of the people when performing integration or micro layer components. The results of this activity are also updated in the project plan, as can be seen in Figure 5.4.

- ***Budget/Resource Planning*:** This involves the estimation of the project costs and then controlling this by budgeting. In addition to the planned personnel in the organizational planning activity defined above, other cost issues are determined. These are generally non-labor elements such as purchases like an LMS, other software or hardware and travel expenses. All of these are priced. The estimate for the human resources is generally calculated based on the historical data. Then a total project cost is determined and this estimate is used as a baseline to track the progress of the project. Change may occur, and this will also result in change in the budget. This must be managed by project manager. The results of this activity are also given as feedback to the project plan, as can be seen in Figure 5.4.

Main characteristics of Budget/Resource Allocation Component

- Recruiting adequate number of personnel in teams
- Recruiting team members with adequate skills
- Forming cross_functional teams rather than functional ones
- Small numbered collaborative teams
- Tracking the progress based on the determined labor and non-labor costs

5.2.2.3 Configuration\Change Management

Change may occur throughout the project due to unpredicted requirements or problems in addition to the result of continuous evaluation and feedback. If the management of change is not considered at the beginning of the project, data losses or rework due to data losses may occur (SBS_G10_3). Therefore there is a

need to plan for the identification mechanisms for the developed products or documents specific to the project. In other words, versioning mechanisms defined so anybody in the development teams will know whether the document or program that s/he is working on is the final updated version of it. Providing this type of identification schemes will ease the work of developers that they will not need to invent their own identification mechanisms which may not match to others as well (Phillips, 1998).

Any change will affect many other components at the same time since there is continuous communication and feedback mechanisms exist among all layers as well as all components of the model. Therefore, planning of configuration and change is required. Generally, configuration or change management processes are considered as unwanted activities since they are believed to result in bureaucracy or slow down the process (Phillips, 1998). The aim of configuration and change management in this model is not mainly control the change in a way that would prevent it as in traditional sense. Rather it allows adapting to changes.

Change and its management are established by the leadership of the project manager but this is also a collaborative activity performed together with the team members. This is enabled in the evaluation meetings conducted at the end of iterative phases in collaboration with all the team members. Re-planning can be done for the next phases based on the requested and accepted changes. The result of these change decisions is also disseminated to all stakeholders who do not participate in the meeting through the use of determined communication mechanisms. Sometimes changes can be postponed to some later phases based on their criticality.

To make a configuration change management plan at the beginning of the project is essential, since having it later may require the rework of some project documents (Phillips, 1998). Therefore, this component is assigned to the early phases of the development model. The results of this activity are also given as

feedback to the communication planning activity of coordination component, as can be seen in Figure 5.4.

Main Characteristics of Configuration/Change Management Component

- Change is considered as an indispensable feature since continuous evaluation and revision is emphasized in the model
- Having identification mechanisms for the developed products or documents specific to the project to respond to the change
- Change management is enabled by all the team members with the leadership of project manager collaboratively.

5.2.2.4 Coordination

Coordination component mainly related with the communication and coordination of the stakeholders of the project. The main aim is to generate, collect, store and disseminate the project information among the team members. There is a need for mechanisms especially in distributed collaborative development environments (AP-1_G5_1, SBS_G8_1&G8_2 &G8_3&G10_1) where the project stakeholders or team members has different communication needs (Rosenau & Githens, 2005). This component mainly involves planning activities which are done at the beginning and moderation activities which are done continuously throughout the project.

- ***Communication Planning***: This involves determining the information and communication needs of the people involved in the project as well as information distribution mechanisms, which enable the required information available to people in a timely manner. Although communication component begin to be implemented from the beginning of the project, the actual planning can begin after the organizational structure of the development teams are determined. When the structure of the teams as well as their members are determined, their individual needs can be defined more clearly. Since many of the teams may have the possibility of working geographically separated so may not have a chance to conduct face to face meetings, well-defined mechanisms and rules are

needed to be developed for the effective collaboration (SBS_G8_1). Therefore, this plan defines who will communicate with whom, what kind of information will be communicated among whom, when these communications will take place and how this will take place (SBS_G8_2&G8_3). If this planning cannot be provided, misunderstandings or conflicts among the stakeholders may occur. This results in decreases in performance as well as waste of time while dealing these.

In addition to providing content information such as the documents, or developed parts of the courses, context information is also needed for the effective communication of distributed teams. The contextual information is related to interpersonal issues such as respect and trust, participation, commitment and responsibility of the individuals and informational issues such as identification, revision, state and relationships (Highsmith, 2000).

This activity gathers the outcomes of the configuration change management component as a feedback while planning the contextual information that is going to be used. Moreover, this plan is also coherent with the schedule as well. After the determination of this component, updates to project plan or schedule are done if necessary, as can be seen in Figure 5.4.

- ***Communication Moderating***: This is an essential activity done by a coordinator or facilitator who is also a member of the project management team because the need for a facilitator is essential for the virtual teams. The communication moderating activity of this component is also supported and implemented by an interlayer component which is the communication component since the continuous communication is one of the indispensable principles of this model. Therefore this activity will be discussed in more detail in section 5.2.4.

Main Characteristics of Coordination Component

- Determination of rules of who will communicate with whom, what kind of information will be communicated among whom, when these communications will take place and how this will take place
- Providing context information in addition to content information to support the understanding in virtual communication environment
- Providing moderation by a coordinator/facilitator role

5.2.2.5 Determination of the program

The determination of the program or in other words the scope of the curriculum is the most strategic component of this model since all the development will take place based on the results of this. This can also be considered as the requirements analysis component of this model. The main scope, goals and targets of the curriculum is defined in this phase and then the courses to be developed and the pedagogical strategies or instructional design approaches will be based on these. Although if there is any requirement analysis conducted before, the actual development teams are needed to conduct their own analysis to make better decisions (SBS_G2&G12& M1, EPPICC_G2). How well these decisions are made will affect the success of the program to be delivered.

Project management team is responsible for the decision of which degree program or curriculum is to be developed. This process involves the needs assessment activity before making the decision of the program. This required collaboration with different groups such as subject matter experts, designers, technical specialist, administrators and learners is needed. Some of these actors can be found in the project management team as well but some of them may not especially at the early phases of the project but consultation to them is essential. Actual needs are needed to be determined to attract more students. Therefore, techniques such as surveys or interviews can be performed among the targeted students to reveal their exact needs clearly to form a curriculum.

There is a need for awareness of the limitations as well as opportunities to be provided by the online delivery since it has different features than traditional learning environment. The limitations can be summarized as having no direct teacher expression or guidance since the interacted materials are text or graphics or videos, possible mismatch between the online courseware and the other learning materials provided, lack of contextual understanding for feedback and interactions (Yang & Liu, 2007). On the other hand, the advantages can be listed as ability to use various forms of material formats, student-student as well as student-teacher interactions provided and ability to include different instructional strategies for different type of learners (Perrie, 2003). The possible ways to overcome the limitations and at what point these can hinder the successful delivery of the selected curriculum as well as the advantages provided are considered carefully while making the curriculum decision. The curriculum which offers appropriate experiences and information which are suited to the delivery through virtual learning environments is designed.

The workload in this component is heavier at the beginning while it is less at the later stages of the project but continues until the end as small modifications may be needed for the scope of the program. The result affects many of the management layer components such as project management, budget/resource allocation, quality management and risk management, as can be seen in Figure 5.4.

Main characteristics of Determination of the Program Component

- Conducting own requirements analysis for the determination of the program by the use of techniques such as surveys or interviews
- Collaboration with different groups
- Careful consideration of limitations as well as opportunities of virtual learning environments

5.2.2.6 Quality control

Today's students expect more services from the educational institutions. They require better service, lower price, higher quality and various forms of products that will satisfy their needs. Therefore, quality assurance of any degree program is very important for its success (SBS-m5, AP3_m3). However, quality assurance is an issue that should be considered in all three levels. First of all project management team determine the quality criteria as well as an accreditation criteria for the degree program as well as the courses in the program at the management layer. Then according to these guidelines and plans quality and accreditation is controlled in the following layers' processes (integration and micro layers) supported by the continuous evaluation and revision process which has affect on all the layers. The quality assurance process involves the following activities:

- ***Preparation of Quality Assurance Plan***: This involves determination of accreditation and quality policy, standards and regulations to be followed during the project and preparation of quality checklists for the evaluation of the developed curriculum and courseware. The following key areas adapted from Wang (2006, pp. 268-269) are considered as criteria for the accreditation and quality policy of an online degree program:

1. *Institutional commitment*: It requires whole institutional commitment including administrative, technological and organizational support to ensure quality for an online degree program. In addition, well-defined procedures for developing and teaching online courses should have been set
2. *Curriculum and instructional development*: This involves the assurance of each course in the degree program results students that accomplish appropriate level of learning outcomes recognized by the institute. In order to maintain this, team approach, ongoing course evaluation, using online learning pedagogy and applying appropriate student assessment techniques are required for the course design and development. In addition the

following attributes (McLoughlin & Visser, 2003, p. 5) are also essential to consider during the development for the quality of online courses

- Engage students in active, experiential learning.
- Build and sustain motivation by providing prompt and regular feedback.
- Make expectations explicit and cultivate self-directed learners.
- Provide interaction with others which allows negotiation and construction of knowledge.
- Provide activities that allow for practice of new skills and foster transfer of new knowledge.
- Allow time and space for reflection on learning.
- Balance individual and collaborative tasks for learning so that interpersonal and social elements are well integrated.
- Align assessment processes with learning outcomes.
- Provide accessible and structured support for student learning.
- Ensure that teacher-student and student-student interaction are provided.

Based on these course-level attributes, checklists for the evaluation or accreditation of the courses can be determined.

Moreover, usability requirements of the learners are needed to be gathered since the effectiveness and quality of the courseware will be affected by bad usability. In this component general usability goals are defined

3. *Faculty support:* This addresses issues of faculty development, ongoing technical support and institutional rewards. As online course development is different than traditional course development in its requirements, faculty needs some educational design support and production support. In addition to teaching resources they also require technical support throughout the process. In addition, generally, faculty, involved in online course development activities in institutions, also continue their regular workload. Therefore they should find this experience as professionally beneficial and

satisfying. To provide this their institutions can provide them recognition or some rewards.

4. *Student support*: To support online students, full range of academic and administrative services such as online admission or registration services, online course schedules, online library access are required. In addition to these, adequate interaction with faculty and peers is needed, tutoring should be provided. Full time technical support for students is also essential.

The output of this activity is given as feedback to the project plan development activity, as can be seen in Figure 5.4.

- ***Quality Inspections and Reviews:*** This is a continuous activity that takes place many times throughout the whole process. It is supported by the continuous evaluation and revision component. This is done according to the criteria and goals determined during the quality assurance planning and this activity takes place either as self-reviews plus peer reviews or external reviews based on the checklists. Moreover, these are conducted in virtual environment provided in communication component and by the facilitation of the coordinator. The details are given in section 5.2.5.

Main characteristics of Quality Control Component

- The need for continuous evaluation and revision in the form of review meetings
- Consideration of the needs of institutional commitment with support provided for the faculty
- Consideration of the attributes specific to online courses and needs of online learners

5.2.2.7 Risk Management

If the possible risks are not considered, extensions in the project schedules may occur (EPPICC_G5). Moreover these late deliveries may also result in budget overruns or out of scope products. These are generally based on the factors based on unexpected events in other words risks that are not considered in the project plan and whose impact on project performance is significant (Chapman & Ward, 1997). Risks consisted in this kind of development effort occurs in market, financial, personnel or production areas as in software development (Karolak, 1995). Market risks are related to whether the developed curriculum and courses will attract its target users at an expected level. Financial, personnel and production risks are related with the profit gathered by the development effort and occur when the development cannot be finalized at the predetermined time with the allocated resources. Therefore risk management is an essential component to be considered early in the life cycle of the project for the success of the project (Chapman & Ward, 1997). It is provided by planning and resolution activities in the model.

- ***Risk management planning***: This involves deciding how to approach and plan the risk management activities for the project. Before developing responses for the risks, they are identified and analyzed in detail. General types of risks associated with this model are defined above. However, the model involves well-proven risk identification methods such as reviews, use of prototyping and concurrent development which are also applied to software development (Karolak, 1995). The possible risks are defined at the beginning and strategies. At the end of iterative phases, during evaluation of the phases, the risks are also evaluated and required actions are taken to respond to them and identification of new risk issues are updated in the plan. This is also a collaborative activity that needs to be performed as a team. Rosenau and Githens' (2005) ten steps of collaborative risk management is adapted and applied in the risk management planning meetings. The steps can be listed as follows

1. Be prepared for the meeting by identifying the needs of all stakeholders, examining past projects' learnings and communicating the purpose of the meeting well to the team members
2. Establish common language for the risk related concepts among all the members
3. Determine the threats to success by the use of common identification techniques such as assumption analysis, brainstorming, or checklists and prepare a list
4. Classify the risks into technical, logistic, programmatic or commercial risk sources. For this model, another classification is also added as instructional or pedagogical risk sources.
5. Analyze the impacts of these risks as low, medium or high.
6. Prioritize the risks since there may be many risks in a project and it may not be possible to try to manage.
7. Plan the risk responses by the use of strategies which are risk avoidance, risk mitigation, risk transference or risk acceptance
8. Integrate the risk responses to the project plan based on priority levels.
9. Execute the plan by the leadership of project manager in collaboration with the team members
10. Review, reflect and capture the results for future projects.

- ***Risk Resolution:*** In addition to prevention strategies, contingency planning is also conducted and whenever any risk occurs, its requirements are performed to overcome the risks.

The outcomes of this component are also given as feedback to project management component. In addition it gives and gathers feedback from change and configuration management component, as can be seen in Figure 5.4 and it is supported by the continuous evaluation and revision component.

Main characteristics of Risk Management Component

- Consideration of unexpected events as in software development
- The use of risk identification techniques such as reviews, use of prototyping and concurrent development

5.2.3. Components of the Integration Layer

The integration layer deals with the curriculum level development activities. There is also no pre-determined sequence among these components. They can be conducted concurrently and gather feedback from each other as well as the components of other layers whenever necessary. They also provide feedback to the upper layer components. All integration layer components can be seen in Figure 5.7.

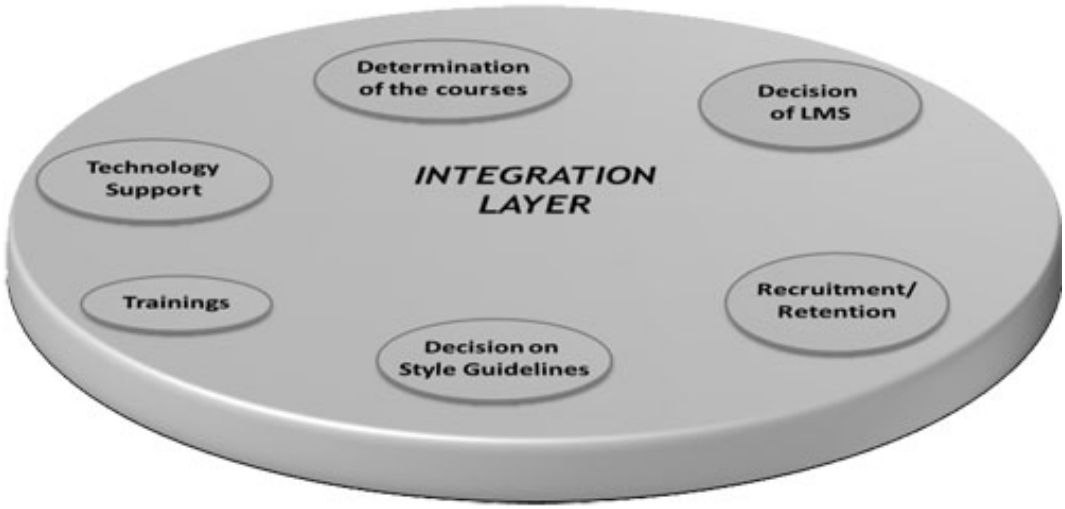

Figure 5.7: Components of the Integration Layer

Some of the integration layer components are begun to be considered from the beginning of the project and some others can begin in later phases but their heavy implementation takes place in the middle phases. Because they require the outcomes of some of the management layer components such that in order to begin the determination of the courses component, determination of the program component should be started. Some of the components of this layer may end in few phases whereas some others implemented with different workloads

throughout the project. The possible assignment of the components to the iterative phases can be seen in Figure 5.8.

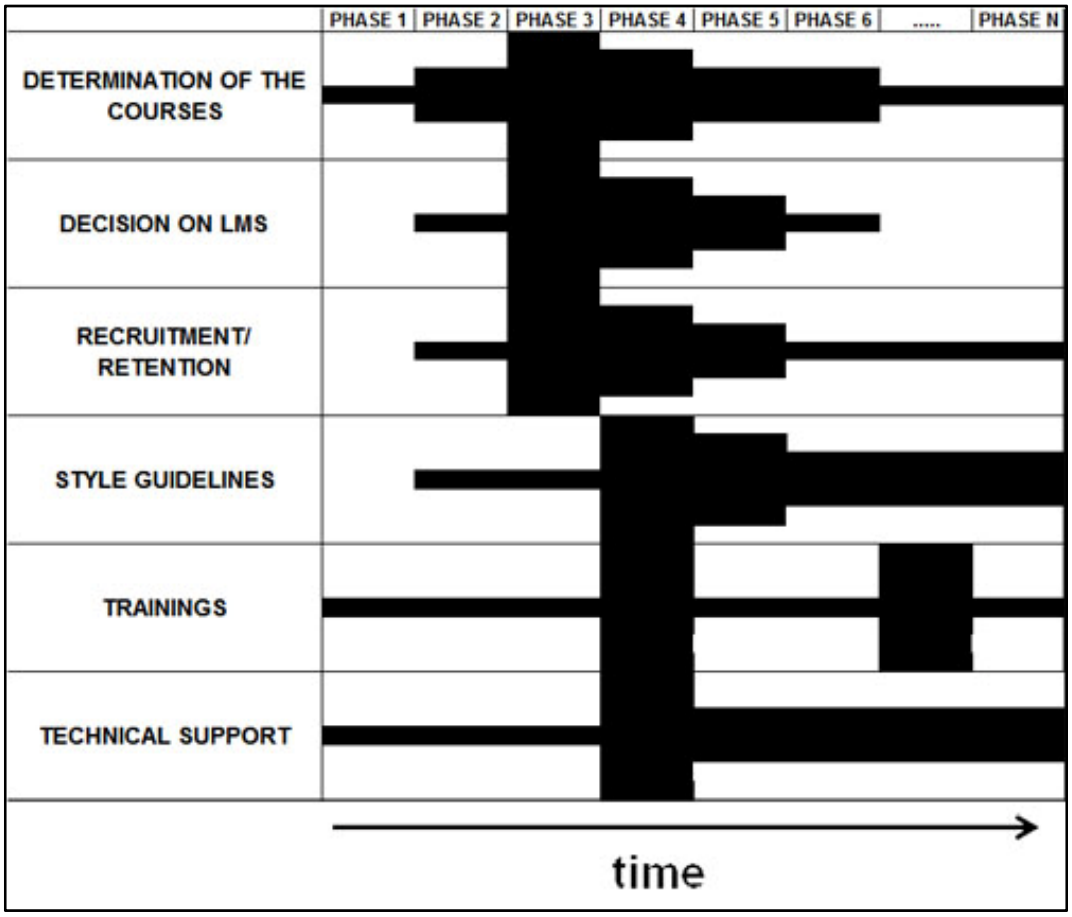

Figure 5.8: Assignment of integration layer components into the time-boxed phases

5.2.3.1 Determination of the courses

Curriculum consists of courses which are related by themes and skill development. The related courses from introductory to advanced levels are combined to form a degree program. They are selected based on the scope and goals determined. They are also decided by collaborative effort of the specialists mentioned in the determination of the program component. Development of the courses that are appropriate to online delivery or developing them by making use of the online opportunities needed for the effective learning is important. Their general purpose or goal is determined and their actual development will be

performed in micro layer components based on the instructional as well as developmental requirements defined in this component.

The implementation of this component may start concurrently with the determination of the program component and this may follow for several phases. The outcomes give feedback to all the components of the management layer.

Main Characteristics of Determination of the Courses Component

- Collaboration with different groups
- Careful consideration on whether the course is applicable to online delivery, such as the consideration of lab facilities for technical courses.

5.2.3.2 Decision on LMS

The determination of LMS is actually a strategic level decision but this is considered in this layer since it is mostly related about the curriculum related activities like it is going to be used for the delivery of the curriculum and can be determined based on the needs of the determined curriculum and courses. The decision on LMS that will be used to offer the courses is an important activity both for the course developers as they will use this system to deliver their courses and for the students since this will provide the main interaction point for the students to access the system. The LMS that is easy to use and handled by the course developers as well as that have many interactive features for the students is to be selected since it will provide the main interface for course delivery (AP-1_M1).

The main goal of LMS can be defined as providing administrative and learner management functions such as keeping track of users' information and tracking their performance (Oakes, 2002). Since all learning activities take place through the LMS, the following key issues are considered for the selection of LMS (Yildirim, Temur, Kocaman & Göktaş, 2004)

- Features related to the general features and functionality such as usability concerns like accessibility, organization, navigation and aesthetic issues; the ability to use standards such as learning object standards and appropriateness to the needs of the curriculum determined
- Features related to the content to be delivered such as the easy update of the objectives and goals or the content of the courses and design issues which is related to the navigation, interface and legibility structure provided.
- Features provided for the support of learners, such as providing them adequate synchronous or asynchronous discussion platforms to exchange their thoughts and ideas; the support of instructors such as providing them infrastructure to monitor and manage their learners and courses or support for the course delivery such as providing tools including multimedia sources, e-mail services, newsgroups, chat environments, whiteboards, tele or video conferencing or help-desk facilities
- Features provided for the technical infrastructure such as adequate server that respond to the needs of the courses, easy access without technical problems; security to access the courses and cost-effectiveness.

Main Characteristics of Decision in LMS Component

- Selection of easy to use LMS for developers
- Selection of an LMS that includes interactive features for students

5.2.3.3 Style guidelines

Complete consensus cannot be achieved for the determination of style guidelines for the courses since some faculty believed that it reduces creativity while the others proposed it to form unity for the quality assessment of the materials (AP-3_M2). This debate on the lesson templates including what to include in every lesson or whether everything has to be put in identical categories in every lesson is also seen in the literature as well (Xu & Morris, 2007). However, providing

similar structure for the courses that form a degree program is essential for students to transfer their skills they learned in one course to another is essential feature to be provided (Porter, 2004). Style guidelines are helpful to provide standard structure in all courses. These guidelines are decided based on the determined quality issues as well as the usability goals determined in the management layer. The guideline consists of information related to the navigation structure, the types of color use, screen arrangement, type of synchronous or asynchronous communication tools and types of instructional activities to be used at least at a minimum level in each course.

This component is conducted by first investigating the courseware developed by the use of different presentation styles such as video-based materials or html-based materials. Next after defining common needs specific to the project, a prototype is developed and evaluated in review meetings by a collaborative effort. The determined guidelines are disseminated to all the development teams. This is a continuous activity that may needed to be updated throughout the project since new requirements may be added in the later phases of the development especially when the micro layer activities are begun to be conducted.

Main Characteristics of Style Guidelines Component

- Providing common style guideline for the presentation of the courses for the unity in the program
- Collaborative decision making
- Use of prototyping for the determination of style guidelines
- Continuous update throughout the project

5.2.3.4 Training

Staff development through the use of training is required for all people who work in any of these processes. This will provide a common insight to distributed development teams on the requirements as well as the development strategies of online materials (AP-1_M2&M2_1, SBS_M1, EPPICC_M1, AP3_M1).

Moreover, the trainings will also provide help for the establishment of motivation of the team members (AP3_M1).

Team members who have diverse skills are involved in these development projects. They can bring three different views one of which generally influences more on the development of e-learning environments that are "available technology, the pedagogical approach and the learning market" (Hughes & Hay, 2001). These trainings mainly will provide them knowledge to better understand each others' views and needs. In addition this will prevent the dominant influence of one of these views by enabling everybody to speak common language for the common goals.

Trainings is especially required in two dimensions which are pedagogical and technological issues. Pedagogy trainings include the following subject areas

- Online curriculum development,
- Online courseware development which focuses on the application of appropriate pedagogy;
- Online teaching strategies
- Providing electronic interaction among students, instructors and content for the virtual learning environments.

Especially the implementation of the micro layer components that will be used in this development model are discussed in them. Technical trainings include the subject areas as follows

- Tools or software to be used during the development
- Selected LMS or CMS

These training primarily conducted at the beginning of the project. However they can be conducted throughout the process whenever necessary.

Main Characteristics of Training Component

- Required both for providing common understanding and motivation for team members

- The need for both technological and pedagogical trainings for all the stakeholders of the project
- Providing trainings for several times throughout the project

5.2.3.5 Recruitment & Retention

There is a challenge of marketing the online programs as the number of online courseware increases. Therefore, attracting the students to register to the curriculum or courses developed has become an issue to be considered before the development. This component seems to be included in management layer since it is related to some sort of strategic decision. But it is included in the integration layer as for determining the activities to publicize the curriculum can be conducted after the determination of the curriculum. In addition to recruitment of students, retention is also essential and required to be planned (EPPICC_M2). This is related more with the satisfaction of the students with the curriculum or courseware and supports provided. The result of this component affects the instructional strategies to be chosen such as the use of collaborative strategies or the planning of feedback strategy. This component is added to the model in this final version after gathering the results of Case 3.

Main Characteristics of Recruitment/Retention Component

- Consideration of recruitment by effective announcement strategies
- Consideration of retention of students by enabling their satisfaction by the use of appropriate instructional as well as support strategies.

5.2.3.6 Technology Support

Technology needs of the development teams are needed to be dealt since problems based on them degrade the performance of the project as well as the motivation of the teams as they create frustration (AP-3_G1_1). This need arises after the actual development of courseware begins but this is considered in

integration layer since it has relationship with the LMS chosen in this layer. Therefore, it affects the scope of technical trainings provided to the developers.

Moreover, technical infrastructure which determines the hardware needs for the development as well as the delivery of courseware is also considered and planned in this component. Since the model involves the distributed online development of courseware through virtual teams, hardware equipment is needed to be determined based on the number of project members especially the developers and end-users. Determining the hardware has a close relationship with the budget/resource allocation component of the management layer. Therefore, the hardware specification is made based on the budget as well as the requirements of the project. This component is also added to the model in this final version.

Main Characteristics of Technology Support Component

- Providing continuous support for development teams in their technological issues in a timely manner.

5.2.4. Components of the Micro Layer

The micro layer deals with the courseware development level activities. There is also no pre-determined sequence among these components as previously. They can be conducted concurrently and gather feedback from each other as well as the components of other layers whenever necessary. They also provide feedback to the upper layer components. All micro layer components can be seen in Figure 5.9.

Figure 5.9: Components of the Micro Layer

Micro layer components begin to be considered after the determination of the program in the management layer and determination of the courses component in the integration layer begins to be performed. Some of the components of the micro layer can be conducted concurrently at the beginning and then concurrent development begins to be conducted heavily just after the first course of the curriculum is developed. Concurrency is possible as much as possible the resources make it available and the components of this layer ends when all the courses of the curriculum is developed. The possible assignment of the components to the iterative phases can be seen in Figure 5.10. All the components are continuously as well as concurrently repeated until all the courses are developed after the components are conducted for the first course. Therefore it looks like that there are two columns in the figure.

Many of the components of this layer are adapted from the instructional design models in the literature (Kemp, Morrison & Ross, 2004; Dick & Carey, 2005; Smith & Ragan, 1999, Tripp & Bichelmeyer, 1990) but their implementation is changed based on the model. Some new components are also added based on the requirements of current online courseware development environments as well as the outcomes of the investigated cases (SBS_ m1, EPPICC_G2, AP-1_m2, SBS_m4, EPPICC, AP-1_m3, SBS_m5, EPPICC_m3_2). In the following part, these components are identified in detail.

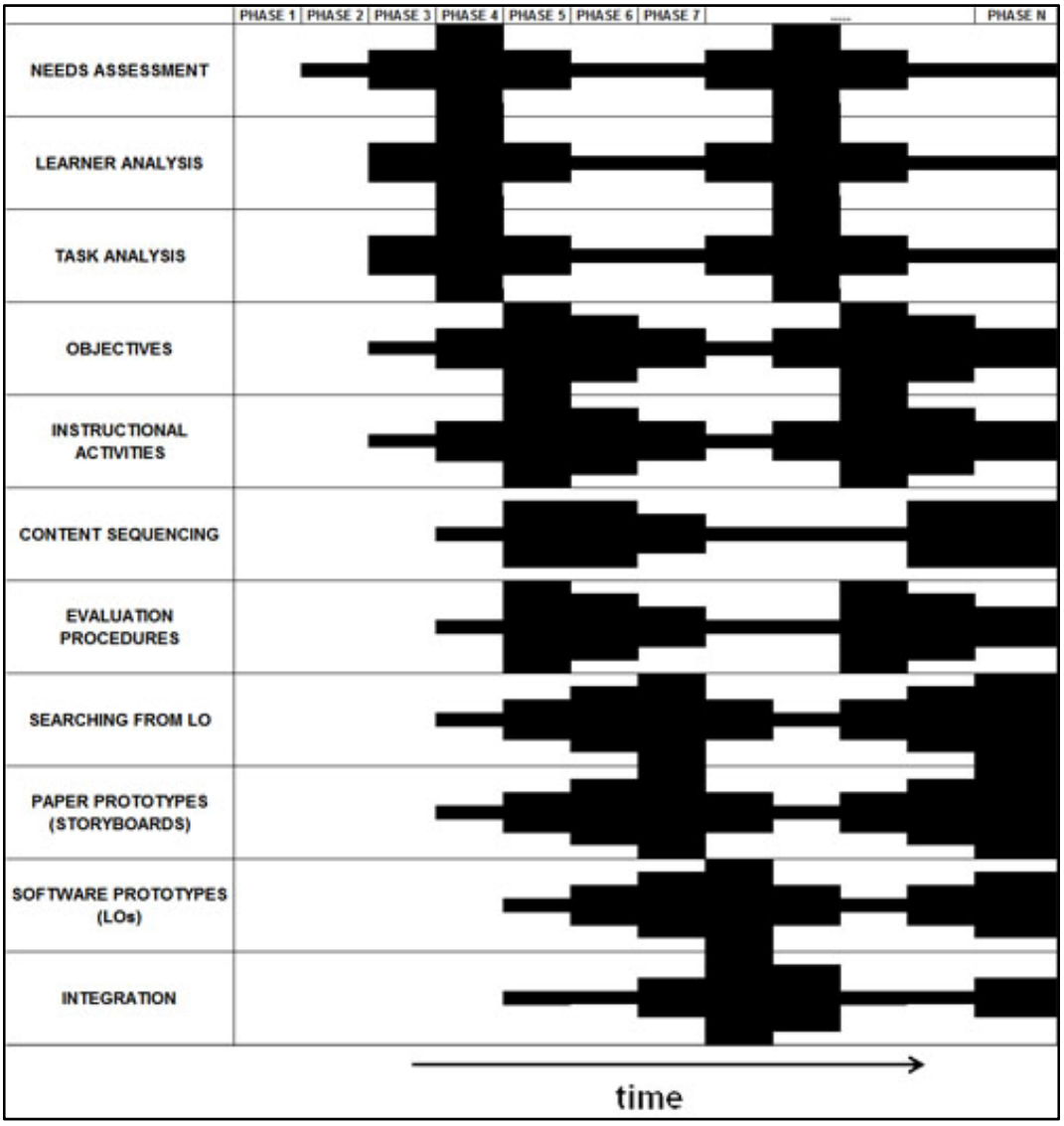

Figure 5.10: Assignment of micro layer components into the time-boxed phases

5.2.4.1 Needs Assessment

This component is partially performed when the courses in the curriculum is defined in the integration layer as the courses to be included in the curriculum is selected in the determination of the courses component. Here the activity left is to determine the gaps and missing needs among the topics. This can be done by examining the target audience of the courses by either working with them directly or with the experts who might have previous experience with them or with

managers or supervisors in a job setting. Data can be gathered by the use of techniques such as interviews, questionnaires or observations. After all the needs are revealed they are prioritized and the needs that can be responded with the course design are determined (Smith & Ragan, 1999). In addition the goals for the course in a general sense are also identified based on the determined needs. This component can be conducted concurrently with the task analysis and learner analysis and also continuous interchange can occur among these three. For instance, during the task analysis or learner analysis where the detailed examination takes place, additional needs can be realized.

Main Characteristics of Needs Assessment Component

- Detection of gaps in subjects
- Investigation of target audience by the use of techniques such as interviews or observations to obtain this
- Determination of general goals of the courses

5.2.4.2 Learner Analysis

Since self-learning will take place as learning will take place in the virtual learning environment, consideration of different learning characteristics is essential (Smith & Ragan, 1999). Target audience's general characteristics such as age, cultural background; their entry skills and their learning styles are points that are considered. The possibility of delivering courses to various different cultures on virtual learning environments is needed to be considered. Target groups' characteristics create an impact on the outcomes of the program. These characteristics can be gathered by the use of observation, interviews and questionnaires. In addition to this, the environment in which the student interacts with the courseware is also required to be considered, such as the hardware that the users can have or their connection speed (Kemp, Morrison, & Ross, 2004). This will especially affect the determination of the types of activities provided as they will determine the limitations.

Main Characteristics of Learner Analysis Component

- Investigation of learning characteristics of target audience
- Consideration of interaction environment

5.2.4.3 Task Analysis

This is one of the critical components of instructional design since this determines the content of the material that is going to be developed. The prerequisite knowledge required for the content is also determined (Kemp, Morrison, & Ross, 2004). In this component work with subject matter experts (SME) who are knowledgeable about the content is essential to provide accurate and adequate information. Concept based analysis is favored than a topic based one. This will be enabled by the preparation of concept maps which are "graphical tools for organizing and representing knowledge" (Novak & Canas, 2006, p.1) in our situation the content. Concept maps show the concepts with their relationships to other concepts generally in a hierarchical manner (Novak and Canas, 2006). The use of concept maps will provide an easier way for the development of learning objects and they can also be used as learning tools in the courseware.

Main Characteristics of Task Analysis Component

- Determination of the content that will respond to the needs of the target audience
- Consideration of prerequisite knowledge.
- Organizing content by the use of concept maps

5.2.4.4 Course Objectives

General goals of the courses are determined during the needs analysis component. More specific learning outcomes are determined in form of objectives here. The objectives define what the learner would know or perform at the end of the

instruction. They are defined in both observable and measurable way (Smith & Ragan, 1999). There are various schemes for designing objectives such that "Bloom's (1956) taxonomy of objectives, … Merrill's (1983) two dimensional classification, …. and Gagne's (1985) type of learning outcomes" (Smith & Ragan, 1999, p.67). A design scheme based on the goals of curriculum as well as the course is chosen and applied here in this component. The objectives list is used by courseware developers during development but it can also be used as learning tools in the courseware (Kemp, Morrison & Ross, 2004).

Main Characteristics of Objectives Component

- Determination of specific learning outcomes based on the goals of the courses
- Use of a design scheme based on the needs

5.2.4.5 Instructional Activities

This component involves determination of activities to be included in the virtual learning environment to enable learners to achieve the determined objectives. These provide ways for the interaction of the learners with the material, instructor and each other. Instructional strategies can be grouped into five types of activities that are "pre-instructional, content presentation, learner participation, assessment and follow-through activities" (Dick & Carey, 2005, p.190). The following guideline which is seen in Table 5.1 is applied for the determination of the activities for a typical course.

Table 5.2: Guidelines for Instructional Strategy Selection (Dick & Carey, 2005, p208)

Learning Components of an Instructional Strategy	Guidelines for Designing Constructivist Learning Environments
1. Preinstructional Activities • Motivate learners • Describe objectives • Recall prerequisites	Foster motivation through "ownership" by giving students choices in the content they explore and control of the methods they use for exploration. Situate problem scenarios in meaningful (authentic) contexts that contain necessary elements for inquiry and are rich in the context of interest. Learning environments should require reflexive thought, looking back to incorporate foundational knowledge in construction of new knowledge.
2. Content Presentation with Examples	Learning environments should emphasize constructing process over finding answers; for example, the aim is for students to think like mathematicians rather than to compute a correct answer. Learning environments must be generative rather than prescriptive; that is, students construct their own, active investigation and knowledge acquisition rather than following steps in a prescribed process. Encourage group participation for negotiating new knowledge and process.
3. Learner Participation • Practice	Use cooperative learning so that students can negotiate the meaning of what they are learning. Design learning environments of high complexity requiring use of multiple process strategies and knowledge and tool skills. Encourage multiple perspectives and interpretations of the same knowledge. Situate problem scenarios in authentic contexts.
• Feedback	Balance the potential frustration of aimless exploration with just enough facilitation to ensure progress (suggested facilitation techniques include modeling, scaffolding, coaching, and collaborating), but fade the facilitation as students become more skillful. Facilitate group interaction as needed to ensure peer review of knowledge and process.

Table 5.1: (Cont.)

Learning Components of an Instructional Strategy	Guidelines for Designing Constructivist Learning Environments
4. Assessment	Suggest tools that students can use to monitor their own construction of knowledge and process; learning should be reflexive, encouraging review and critique of previous learning and newly constructed positions. Standards for evaluation cannot be absolute, but must be referenced to the students' unique goals, construction of knowledge, and past achievement.
5. Follow-Through Activities	The ultimate measure of success is transfer of learning to new, previously unencountered, authentic environments. Students should have opportunities to explore multiple, parallel problem scenarios where they will find application in a new scenario of information and processes that they have previously constructed.

Main Characteristics of Instructional Activities Component

- Determination of activities to be included in the virtual learning environment
- Use of a Guideline for Instructional Strategy Selection (Dick & Carey, 2005

5.2.4.6. Evaluation Procedures

Evaluation component primarily deals with the strategies that will be used for deciding whether the course results in the expected outcomes for the learners. Evaluation procedures can be grouped in two, one of which is called formative and the other is summative. Formative evaluation takes place throughout the instruction to follow the progress of the students. On the other hand summative evaluation is conducted at the end in order to see whether the students achieve the determined objectives. The evaluation procedures are directly related with the determined objectives since they are the procedures to test them. This is also a

critical component since the learning takes place in the virtual learning environment and the assessment of actual progress of the students is difficult. Therefore, many forms of assessment techniques are integrated into the course. For instance, multiple choice, true false, completion type, short or long essay or problem solving techniques are integrated for assessing the knowledge based on the needs of the course (Kemp, Morrison & Ross, 2004).

Main Characteristic of Evaluation Procedures Component

- Determination of strategies that will be used for the assessment of students' achievement in virtual learning environments

5.2.4.7 Content Sequencing

This component deals with the sequencing of concepts that are determined in the task analysis component. Sequencing decision is also affected by the determined strategies in the instructional activities and evaluation activities component (Kemp, Morrison & Ross, 2004).

Main Characteristic of Content Sequencing Component

- Sequencing the concepts prepared in concept maps and activities

5.2.4.8 Searching from learning objects

This component deals with searching for suitable materials in existing learning object repositories which may be commercially available or established during the development of previous courses. This is done before starting to develop new materials to accelerate the process as well as to reduce redundant efforts.

Main Characteristic of Searching from Learning Objects Component

- Searching for learning objects to reduce rework

5.2.4.9 Paper prototypes (storyboards)

Storyboards are the paper prototypes of learning materials. Storyboards show the organization of the material in a page in sketch forms. They will provide to evaluate the learning objects formatively before developing its software version (Tripp & Bichelmeyer, 1990). Based on their evaluation, changes may be required in the previously conducted components, especially in the style guideline component of the integration layer so feedback is given. In the development model, paper prototyping begins by first developing a sample module that is about 10 % of the whole course. After the evaluation of these prototypes and development of software versions in the software prototype component, the rest of the concepts are also developed in two iterations as first preparing 40 % and then the remaining 50 %. This will enable the early realization of missing points that may occur.

Main Characteristics of Paper Prototypes (storyboards) Component

- Evaluation of learning objects in the form of paper prototypes (storyboards)
- Development of about 10 % of the course in order to continue after the evaluation of it to reduce errors early
- Development of the rest incrementally by supporting continuous evaluation.

5.2.4.10 Software prototypes (learning objects)

All the sequenced concepts are developed as learning objects according to a determined learning object standard. This provides to re-use them whenever necessary so reduce the redundant efforts. In addition, this also enables the marketing of these objects individually if it is required. This component begins just after the preparation of the storyboards of the first 10 % of the course and then continue iteratively as the storyboards are prepared.

Main Characteristics of Software Prototypes (Learning Objects) Component

- Evaluation of learning objects in the form of software prototypes
- Developing software version of about 10 % of the course in order to continue after the evaluation of it to reduce errors early
- Development of the rest incrementally by supporting continuous evaluation.

5.2.4.11 Integration

Integration involves the incorporation of developed learning objects according to the determined content sequence. This component starts to be conducted as the software prototypes of the learning objects are developed one by one. All these learning objects are integrated and form a complete course and then all the courses developed are integrated and form a complete degree program. This component is heavily conducted until the end of the whole development is ended.

Main Characteristic of Integration Component

- Incremental incorporation of developed learning objects according to the determined content sequence

5.2.5. Communication

Communication is the essential and necessary process required for all level components and for all team members in this development model since the collaboration and evaluation and revision are at the heart of this model which mainly targets the distributed development environments. The planning of this component is mainly done in the coordination component of the management layer and the implementation of this is done here.

Collaboration infrastructure is needed and this can be enabled by realizing the needs of virtual teams and providing them necessary mechanisms to enhance

effective and efficient communication to ensure timely and appropriate generation, collection, dissemination, and storage of the project information. Collaborative services that could be included in a communication mechanism can be listed as bulletin boards, discussion boards, e-mail, e-mail notifications, online paging/messaging, chat, white board, audio/video conferencing, task lists, contact management, screen sharing, surveys/polling, meeting minutes/records, meeting scheduling tools, presentation capability, project management, file and document sharing, document management, synchronous work on files/documents (Bafoutsou & Mentzas, 2002).

All these collaboration tools are to be provided in a "shared workspace" (Poltrock & Engelbeck, 1997) environment or "collaboration service layer" (Highsmith, 2000) in order to provide the critical links among people, ideas, and information necessary for success in the model. This component is formed of combination of technology infrastructure and human facilitation. Technology infrastructure is provided as a shared memory as in the blackboard systems used in artificial intelligence (Corkill, 1991) which aim to find a solution to a common problem by different specialists. This way, each party can post a solution and apply their own expertise to any part of the problem and contribute to the overall solution. This can be provided through a web-based shared workspace infrastructure called communication blackboard. The infrastructure will contain specific areas in each layer of the model for different teams and team members can access several of these areas according to their responsibilities to contribute to others while solving problems. The communication process is continuously supported by the communication moderating activity of the coordination component of the management layer. Moreover, this component interchanges feedback with many of the components of the model, since it will provide the dissemination of the outcomes of them to the project stakeholders. A coordinator is responsible for the human facilitation of this component and his/her responsibilities will be described in section 5.2.6 in detail.

Main Characteristics of Communication Component

- Realization of the needs of virtual development teams
- Incorporation of collaboration services as many as possible based on the determined needs of the development teams
- Use of shared workspace
- Providing human facilitation for moderation of the communication

5.2.6. Evaluation\Revision

Continuous evaluation and revision are also essential elements and conducted at all layers. The processes at all layers are continuously tested and evaluated and revisions take place as a result of these evaluations. Evaluations can be either formative or summative. As a part of formative evaluation a series of usability tests are conducted. Revisions are conducted as peer reviews or expert reviews in any of the processes. This process is supported by the quality inspections/reviews activity of the quality control component of the management layer and takes place in the form of review meetings at the end of each phase. Based on the results, feedback is given to the related components when necessary. Review meetings are conducted in various forms based on the needs of the project progress as follows

- Review meetings for component evaluation: These meetings are conducted at the end of fixed-time iterative phases such that in every week or every two weeks which are determined specifically for the project workers. Their main goal is to evaluate the progress of the component by determining whether the planned activities to be finalized in that phase can be completed, which of the activities cannot be completed and their reason. In addition, the planning of the next phase is done in these meetings by assigning components or previously undone activities.

- Review meetings for the evaluation of the developed course: These are the meetings conducted during the micro layer components. These also include the activities stated for the component evaluation review meetings

like checking whether the required activities can be completed in the previous phase. This can be conducted by controlling the developed material based on checklists which was prepared based on the requirements defined for the courses. These checklists are implemented before the meetings. Their results are discussed during the meetings to resolve the problems if there are any. Furthermore, the evaluation of the developed materials are conducted in three ways

- Usability reviews: These reviews assess the material based on the human computer interaction principles for the ease of use of the materials. They can be conducted from the very beginning of the courseware development. This can be done by determining the general usability goals by using the techniques of ethnographic interviews or natural group observation in the natural setting of the learners. Low or high fidelity prototyping or usability walkthroughs can be conducted when beginning to develop concepts for the courses. In this model low fidelity prototyping is applied to the paper prototypes or storyboards. On the other hand, high fidelity prototyping, usability walkthroughs or heuristics evaluation are applied to the software prototypes of the contents individually as well as their integrated or final version of them (Nielsen, 1993,Nielsen & Mack, 1994).

- Quality reviews: These reviews are conducted in order to assess whether all the micro layer components are conducted as well as the developed courseware is based on the quality criteria determined in the quality control component of the management layer.

- Accreditation reviews: These reviews are conducted at the end of each course development process and at the end of curriculum

development process as a whole. Whether the course or curriculum conforms to the accreditation criteria is assessed.

Main Characteristics of Evaluation/Revision Component

- Providing evaluation ad revision continuously by the use of periodic review meetings
- Implementation of formative evaluations in addition to summative evaluation
- Use of usability testing techniques in the review meetings for the developed course materials.

5.2.7. Personnel Requirements

Applying the DONC^2 model to an online curriculum and courseware development effort requires many roles each corresponding to a different expertise. Although all of these roles are required, it may not be possible to allocate one full time individual for each role in many of the cases. Rather any team member is generally responsible for different roles during the progress of the project. The roles necessary for the implementation of this model can be summarized as follows

Project Manager (PM) is responsible for the entire implementation of the project. S/he works as a leading agent to provide collaboration in the development environment in order to provide smooth flow of the project.

Team Managers (TM) are responsible for the work of each team at each level activity. They also should have the similar skills with project manager and they should serve and help to the PM for the implementation

DONC^2 emphasizes more human centered skills for project or team managers. Therefore, leadership and collaboration approach replaces command and control approach of traditional development models. In other words, project or team managers are considered as leaders in the model. The necessary skills are summarized as follows (Highsmith, 2000; Rosenau & Githens, 2005; Kouzes & Posner, 1987; Smith & Imbre, 2007)

- Influence rather than being authoritative
- Being familiar with motivation theories
- Provide direction and guidance to team members by understanding the requirements or needs of the project as well as the individuals rather than dictating the things to be done.
- Challenge the process by searching for opportunities and taking risks
- Inspire a shared vision by envisioning the future
- Enhance collaboration among the team members to connect them to each other as well as to enable emergence of the solutions.
- Create both friendly and trust-based development environments
- Put empowerment into practice among the team members.
- Recognize individual contributions and appreciate them in concrete ways
- Be optimist while being pragmatist at the same time. In other words, acknowledge the risks and manage them.
- Know the conflict resolution strategies which are compromise, withdrawal, forcing, smoothing, confrontation and negotiation among the team members.

Coordinator/Facilitator (C) is one of the new project roles that is required for collaborative development models. S/he is responsible for the communication and enabling collaboration among all the team members. This role is more important for the projects based on virtual teams since they need more guidance in order to become closer. S/he has the right to enforce even the project managers to enable the effective communication skills whenever required. The detailed responsibilities can be summarized (Highsmith, 2000) as

- setting up and maintaining the collaboration structure,
- conducting and facilitating online meetings by enabling the adequate support with the right tools for the needs of the type of meeting,

- moderating online discussions going on other online media such as e-mail or discussion groups by filtering the information flow whenever necessary
- maintaining both content and contextual information by enabling opportunities such as face to face meetings especially for the interpersonal elements of contextual information

Technical Expert (TE) is responsible for the technical support of the development teams. Throughout the development effort, development teams may face with some technical problems with the development tools or environments that are used for the courseware development or they may need additional tools. In addition they may also have some other technology related problems due to the communication infrastructure provided. To satisfy these kinds of needs of the team members is the main responsibility of the TE. In addition TE is responsible for providing the trainings related to the technology based issues.

Pedagogical Expert (PE) is primarily responsible for the selection of pedagogical approaches that are going to be implemented in the courseware. PE provides support to the development teams on pedagogical issues such as helping how to structure the course material that is appropriate for the effective web delivery, the learning strategies that are better to apply to a specific content or the interaction styles to be used in the course or the drawing of concept maps throughout the project. Moreover, PE provides and organizes training on these issues.

Subject Matter Expert (SME) is the specialist on the content of the course. SME provides the content required for the subject and responsible for the accurateness of the information used for the course. SME also works with PE in concept map drawings, activity selection and creating text and scripts for these activities as a writer or an editor.

Visual Designer (VD) is mainly responsible for the style guideline defined in the project as well as the usability issues of the user-interface. GD ensures the

consistency of the general look and feel of the developed materials and supports the development teams in ensuring this.

Multimedia Designer (MD) works in the design and development of multimedia materials used in the courseware. MD

Audio/Video Director (AVD) is responsible for the creation as well as the preparation of video elements that will be used in the courseware especially in the video based lessons.

Software Programmer (SD) is responsible for the development of software versions of the courseware in the form of learning objects with the integration of them as a complete courseware.

These roles can be matched with the components of the model, as in Figure 5.11. Marked intersections show the role which is primarily responsible in those components. Some additional responsibilities can be given to these roles or they can act as feedback agents in other components. In addition to this responsibility matrix, more detailed version of the responsibility divisions can also be seen on the website of the model (http://www.ii.metu.edu.tr/~doncc). Each role is described separately by showing the primary responsibilities of the team members on a flow-chart like figure, as can be seen in Figure 5.12. In the figure, primary responsibilities are represented in colors while the others are in gray-scale and the detailed version of each component in the figure can be examined by placing cursor on it.

	PROCESSES / ROLES	PM	TM	C	TE	PE	SME	VD	MD	AVD	SD
MANAGEMENT LAYER PHASE I	**1.Project Management**										
	1.1 Plan Development										
	1.2 Project Plan										
	1.3 Management										
	2. Budget/Resource Allocation										
	2.1 Budget/Resource Planning										
	Determination of resources										
	Cost estimation										
	Cost budgeting										
	2.2 Organizational Planning										
	Staff Acquisition										
	Team development										
	2.3 Budget Resource Allocation Plan										
MANAGEMENT LAYER PHASE II	**3.1 Configuration / Change Management**										
	Determination of Change Control System										
	3.2 Configuration/Change Plan										
	3.3 Monitoring Changes										
	4. Coordination										
	4.1 Communication Planning										
	Communication Needs										
	Mechanisms										
	4.2 Communication Plan										
	4.3 Communication Moderating										
MANAGEMENT LAYER PHASE III	**5.1 Determination of the program**										
	Needs analysis for the program										
	5.2 Determined Program										
MANAGEMENT LAYER PHASE IV	**6.1 Quality Control**										
	Determination of Accreditation criteria										
	Determination of Quality Issues										
	6.2 Accrediatation Criteria										
	6.3 Quality Plan										
	6.4Quality Inspections/ Reviews										
	7.1 Risk Management										
	Identification of Risks										
	Identification of Solutions										
	7.2 Risk Plan										
	7.3 Risk Resolution										

Figure 5.11: Roles and Responsibilities Matrix

	PROCESSES / ROLES	PM	TM	C	TE	PE	SME	VD	MD	AVD	SD
INTEGRATION LAYER PHASE I	**8.1 Determination of Courses**										
	Needs analysis on courses										
	8.2 Determined Courses										
	9.1 Determination of LMS										
	Investigation of LMSs										
	9.2 Chosen LMS										
	10.1 Recruitment/Retention										
	Identifictaion of Rec/Ret strategies										
	10.2 Rec/Ret Plan										
INTEGRATION LAYER PHASE II	**11.1 Trainings**										
	Preparation of Trainings										
	11.2 Training contents										
	11.3 Continuous trainings										
	12.1 Determination of Style Guidelines										
	Examination of Style Guidelines										
	12.2 Determined guidelines										
	13.1 Technology support										
	Determination of responsibilities										
	13.2 Technical support plan										
	13.3 Technical support										
MICRO LAYER PHASE I	**14 Needs Assessment**										
	15 Task Analysis										
	16 Learner Analysis										
MICRO LAYER PHASE II	**17 Determination of goals/objectives of courses**										
	18 Determination of Instructional Activities										
	19 Determination of Evaluation Procedures										
	20 Sequencing the content										
MICRO LAYER PHASE III	**21 Searching from LOs**										
	22 Paper prototype preparation of 10 % of the course										
	23 Software prototype preparation of 10 % of the course										
	24 Integration										
MICRO LAYER PHASE IV	**25 Searching from LOs**										
	26 Paper prototype preparation of 30 % of the course										
	27 Software prototype preparation of 30 % of the course										
	28 Integration of 40 %										
MICRO LAYER PHASE V	**29 Searching from LOs**										
	30 Paper prototype preparation of 60 % of the course										
	31 Software prototype preparation of 60 % of the course										
	32 Integration of 100 %										
	End of course development										
	33 Integration of Courses for the Program										
	End of program development										

Figure 5.11 : (Cont)

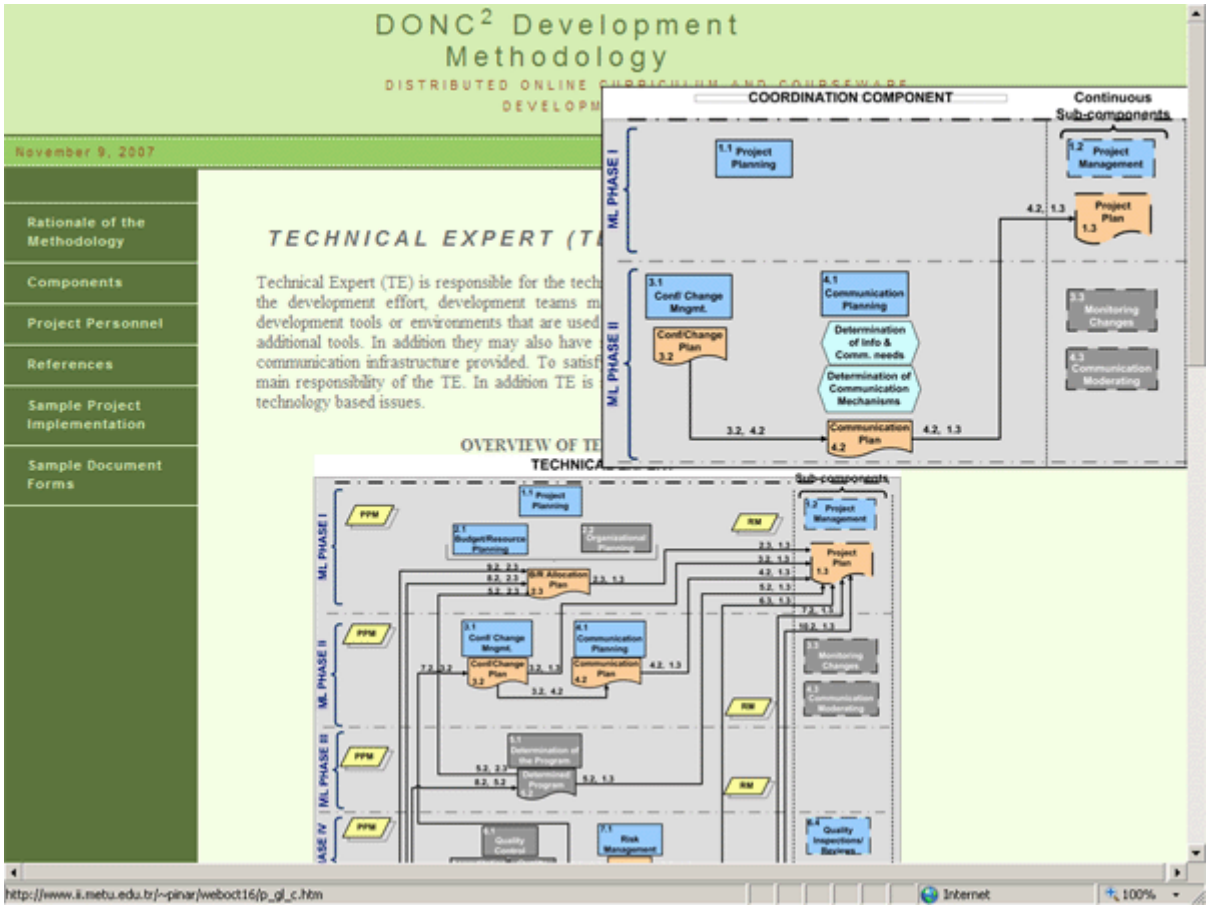

Figure 5.12: Screen-shot of the website showing the primary responsibility of the team members

CHAPTER 6

CONCLUSIONS

In this chapter, summaries of the study and the designed distributed online curriculum and courseware development model are given. Subsequently, the major contributions of the model and its limitations will be discussed. Finally, the chapter concludes with recommendations for further research.

6.1. SUMMARY OF THE WORK DONE

Online distance education has been emerged and its popularity kept increasing for about the last 10 years. Virtual learning environments (VLE) are provided by these online distance education initiatives. The features of VLEs are different from the traditional learning environments since there is no direct interaction among the students and the instructors. This issue reveals the need for careful considerations in their design and development process as the online students deserve at least the same level of quality with their traditional counterparts. A distributed online curriculum and courseware development model ($DONC^2$) was developed in this study to fulfill the aforementioned needs.

When the literature was examined, it was seen that many instructional design models existed. However, these models are especially for the design and development of traditional learning environments. These instructional models also lack many issues related to the development of software part of the courseware.

There were also some attempts to integrate software development models with the instructional design models but these are generally direct adaptations of the software models, so instructional issues are not satisfactory. Besides, human computer interaction (HCI), reusability or standardization issues are missing in many. Furthermore, the collaboration issue is not considered in most. DONC^2 is a comprehensive model that responds to all these issues.

DONC^2 is developed by the investigation of related disciplines as well as the investigation of online courseware development projects. The related disciplines that some of the principles of the model were gathered were instructional design, software engineering especially the adaptive software development (ASD) model, HCI as well as reusability and standardization concepts such as learning objects. In addition to the literature investigation, four different online course material development cases were examined. Interviews were conducted with the developers who took part in those projects and the course materials developed in those projects were also investigated. The model was first formulated after the investigation of the first case. Then it was applied as an evaluation framework in one of the cases and it was applied as a development framework in another case. Based on the findings gathered from these cases, the essential principles for the model were revealed and integrated into the model.

6.2. SUMMARY OF THE DONC^2 DEVELOPMENT MODEL

The DONC^2 development model is a model developed for the distributed online curriculum and courseware development. The following can be listed as the main characteristics of the model

- It is primarily an iterative development model which is supported by the use of prototyping
- There is no pre-determined sequence among the components and concurrency is allowed as much as the resources are available

- Continuous communication is at the heart of the model so determination of rules of who will communicate with whom, what kind of information will be communicated among whom, when these communications will take place and how this will take place are needed to be well-planned
- The model defines the necessary components required for the effective curriculum and courseware development rather than the tasks. All these components are grouped into three layers as management, integration and micro layers
- The model uses short and time-boxed iterative phases. All the components are assigned to these phases.
- Management based on leadership rather than an authoritative mode is emphasized for effective collaboration
- Flexible planning based on time-boxed iterations is applied for project scheduling
- Change is considered an indispensable feature so continuous updates are applied to plan
- Cross-functional teams rather than function-based are formed for the development teams. Moreover, recruiting adequate number of personnel who have adequate skills is tried to be achieved for team formation
- Continuous evaluation and revision in the form of review meetings is implemented

In the model, the required personnel roles for this kind of development effort are also determined by defining their responsibilities. The project manager, team leaders, coordinator/facilitator are determined as the three important roles that will affect the success of the development effort.

6.3. CONTRIBUTIONS OF THE DONC^2 DEVELOPMENT MODEL

The DONC^2 is different from former models mainly in that it provides an approach that can be used to develop a complete online program or curriculum

rather than developing individual courseware. It integrates best practices from the software engineering field and also emphasizes instructional design issues. It also incorporates reusability and interoperability in itself to respond to the requirements of high change environments.

DONC^2 is a comprehensive model that investigates the development effort components in different layers. These components can be used in three layers as a whole or some layers can be adapted to the needs of the organization. It includes the important components that should be considered for the success of the development effort.

DONC^2 deals with all the components from project management to individual learning object development, all of which are necessary for this kind of effort. This will provide a guideline for all team members that will enable them to be aware of all the issues to be considered. In addition, this will provide a common understanding for the needs of the project among the instructional designers who generally do not know much about project management or software development and software developers or project managers who generally do not know much about pedagogical issues.

DONC^2 is a flexible model that does not attempt to impose rigid prescriptions to developers. It emphasizes short time-boxed iterations, collaboration at all levels among stakeholders, continuous evaluation and revision. Collaboration is essential for success and it can be achieved by effective communication which can be ensured by a coordinator who has effective communication and facilitating skills.

The prepared web site (http://www.ii.metu.edu.tr/~doncc) for the DONC^2 development model can be used as a comprehensive guideline for the development teams. It provides practical information which can be easily accessible. It presents the model in two different perspectives which are component-based and role-based. This enables any team member to know his/her responsibilities in each phase of the project in addition to its scope.

6.4. LIMITATIONS OF THE DONC^2 DEVELOPMENT MODEL

Despite all these contributions, there are also some limitations of the model. The model defines the major principles to apply based on the investigated cases and the literature. It was also applied as an evaluation framework in one of the cases and development framework in another one. However, the validity of the model is still questionable since it could not be applied as a whole. Only some components of management and integration layer could be implemented with the micro layer components. All the components and principles could not be tested.

Another limitation can be considered based of the personnel needs of the model. The model defines the roles for the development and also requires involving adequate number of personnel who can take these responsibilities in the development teams. This may be difficult to achieve especially in some of the institutions in which people has other responsibilities other than the development of the courseware such as lecturing courses in other degree programs. Their workloads are needed to be adjusted in order them to fully contribute to the project.

The model includes the components directly related to the design and development of courseware and tries to enable this development on time within budget and at the required quality level. However, there is a need to support and maintain these courseware after their deployment. They need to be revised and updated after students use them based on the gathered feedback from them. Therefore, the detailed components related to the maintenance of the developed courseware are missing although components that can make this maintenance easy are included in the model such as the developing the concepts of the course contents in terms of learning object structure.

The flexible scheduling approach based on time-boxed iterations is used for the planning of the project in the model. This implies to make a general plan at the beginning for the whole process and continuosly make detailed plans for every iterations at their beginnin. If the components or jobs cannot be accomplished at

that layer then they can be planned to be done in the following interation based on their criticality for the project. This does not show that schedule slippages will occur or will be allowed. Rather this will provide to accomplish the really critical tasks early and eliminate the project risks. However, this kind of scheduling approach may be confusing especially for the novice team members until they get accustom to it. This can be eliminated by the trainings provided to them as well as a project manager who is competent enough about approach.

There is also a methodological limitation for the developed model since the adopted research method was case study. Generalizability is an issue since only four cases were investigated during this study. Furthermore, while all four cases had different features like three of them were online courseware development project while one of them was a computer-aided courseware development project, only one of them truly includes global development or none of them had an aim of degree program or curriculum development. These also limited the generalizability of the model.

6.5. FURTHER RESEARCH

Recommendations for future research in this area are closely connected to the limitations mentioned above. First of all since there is a need to test all the components and principles of the model, the whole model can be implemented fully to a complete program development case to investigate whether all determined components are working effectively.

There is also a need to support and maintain the developed courseware to keep their quality. Therefore new courseware development cases can also be investigated to determine additional components related with the support and maintenance of the developed courseware or curriculum. In addition, these new cases also can provide support for the previously gathered principles and strengthen them.

In the model, the communication infrastructure was determined and its requirements were defined. However, it was not implemented in the scope of this study. Therefore, realization of this communication infrastructure which will provide a shared workspace for the development teams can be another area of research.

This development model can also be elaborated as a "distributed online collaboration approach" and can be implemented for other kind of development projects other than curriculum or courseware development since there is a communication component at the heart of the development model. This will provide effective communication for team members who can be geographically separated. Moreover, this elaboration can be accomplished by adapting the components which are directly related to curriculum and courseware development based on the needs of the other development efforts such as software or information systems development.

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APPENDICES

APPENDIX A. INT_1 Question set for the investigation of online course development projects

A.1 Turkish version of Interview Set 1
Genel Sorular (Proje ile ilgili genel bilgi amaçlı sorular)

1. Yer aldığınız projenin adı nedir??
2. Projenin ana amacı nedir?
3. Sizin bu projede aldığınız görev nedir?
4. Şu an proje hangi aşamada? Bitti mi devam ediyor mu?

Yönetim Düzey Sorulari (Yönetim Düzeyi proje yönetimi ile ilgili aktivitelerin yapıldığı seviye ile ilgili sorular)

5. Çevrimiçi derece programları verilmesi/ Çevrimiçi derslerin hazırlanması projesine nasıl karar veriliyor?
   a. Karar verme mekanizmasında yer alan kişi ve kurumlar nelerdir? Bunların projedeki rolleri ve katkıları nelerdir?
   b. İhtiyaç analizi yapılmış mıdır?Sonuçları nedir?
6. Hangi programların/derslerin hazırlanacağına nasıl karar veriliyor??
7. Projenin bütçesi nasıl bulunuyor?
8. Projenin yönetim yapısı nasıl?
9. Projenizde oluşan çeşitli problemler (soft ve hard) nasıl gideriliyor?
   a. Teknoloji ile ilgili problemler
   b. Projede yönetimde yer alan kişilerin iletişimiyle ilgili problemler
   c. Farklı bakış açılarından doğan problemler
   d. Çıkan çeşitli anlaşmazlıklar nasıl çözülüyor (Conflict resolution konusunda neler yapılıyor)?
10. Açılacak programların müfredatının(curriculum) oluşturulması sırasında
    e. Müfredatın amacı nasıl belirlendi
    f. Amacı belirleyen kişiler ya da kurumlar kimlerdir
    g. Bu aşamada sorunlar varsa bunlar nelerdir

h. Programın hedef kitlesi nasıl belirlendi? Hedef kitle kimlerdir

Entegrasyon Düzey Sorulari (Entagrasyon Düzeyi müfredat belirlenmesi ile ilgili aktivitelerin yapıldığı düzey ile ilgili sorular)

11. Herhangibir ÖYS (öğrenme yönetim sistemi) kullandınız mı?
    a. Bunu kim ve nasıl belirledi?
    b. Projede kullandığınız bu ÖYS nin performansı hakkındaki düşünceleriniz neler?
12. Süreçte yer alacak kişilere müfredat geliştirme ile ilgili eğitim veriliyor mu?
    a. Bunun sağladığı faydalar neler?
    b. Eğer böyle bir eğitim sağlanmıyorsa sizce bu bir zorluk yaratır mı? Bunlar neler olabilir?
13. Süreçte yer alacak kişilere online/çevrimiçi ders geliştirme ile ilgili eğitim veriliyor mu?
    a. Bunun sağladığı faydalar neler?
    b. Eğer böyle bir eğitim sağlanmıyorsa sizce bu bir zorluk yaratır mı? Bunlar neler olabilir
14. Farklı yerlerde bulunan takım elemanlarının iletişiminin sağlanması için oluşturulan mekanizmalar nelerdir?
    a. İletişimde karşılaşılan zorluklar varsa bunlar hangi noktalarda yoğunluk kazanıyor
    b. Bunların çözümlenebilmesi için ne gibi mekanizmalar sağlanabilir?
15. Programda yer alacak derslerin geliştirilmesine hangi sıra ile başlanacağı konusunda nasıl karar veriliyor? Derslerin hiyerarşik yapısı var mi? Bunun sıralamada rolü var mı?

Micro Düzey Sorulari (Micro Düzey ders materyali geliştirme aktivitelerinin yapıldığı seviye ile ilgili sorular)

16. Dersler kendi başlarına bağımsız olarak mı geliştiriliyor? Yoksa derslerin konuları ya da derslerde yer alan konseptler çıkartılıp konseptler/kavramlar bazında geliştirilip sonrasında mı bir araya getiriliyor?
17. Öğrenme nesneleri kavramından yararlanılıyor mu? Derslerde ortak kullanılabilecek materyallere ya da konulara dikkat ediliyor mu
18. Dersler geliştirilirken LOM (Learning Object Metadata) ya da SCORM (Sharable Courseware Object Reference Model) gibi standartların kullanımından yararlanılıyor mu?
    a. Bu standartları kullanmanın avantajları ve dezavantajları neler olabilir?
    b. Standardları geliştirmek için neler yapılabilir?
19. Dersler geliştirilirken öğretim tasarımı modellerinden ya da öğretim stratejilerinden (pedagojik yöntemlerden) faydalanılıyor mu?
20. Derslerde çoklu ortam öğelerinden faydalanıldı mı?
    a. Ders içeriği ve derslerde de kullanılacak çoklu ortam (multimedya) öğelerinin geliştirilmesi nasıl gerçekleşiyor? Sıralı mı yoksa paralel mi

b. Bunların kalitesi nasıl test ediliyor?

21. Derslerin hedefleri gerçekleştirip gerçekleştirilmediği nasıl test ediliyor?
22. Program ya da derslerin akreditasyonu nasıl sağlanıyor? Bunun için var olan mekanizma nasıl çalışıyor ya da henüz yoksa bu nasıl sağlanmalı?
23. Hazırlanan materyali kullanılabilirlik (usability) açısından test ediyor musunuz?
24. Programın tamamı içerisindeki tüm derslerin hazırlanmasından sonra mı öğrencilere sunuluyor ?
25. Materyallerin öğrenciler tarafından test edilmesini sağlayacak mekanizmalar var mı?
26. Dersler öğrenciler tarafından kullanıldıktan sonra onlar tarafından değerlendirilecek mi?
    a. Bunu nasıl sağlayacaksınız?
    b. Değerlendirme sonucunda yeniden bir revizyona/yenileme gidilecek mi??

Kullanılan geliştirme metodolojisi ve genel değerledirme soruları

27. Tüm süreç boyunca izlediğiniz yolu yazılım geliştirme modellerinden hangisine daha uygun buluyorsunuz
    a. Analiz, tasarım, geliştirme, uygulama ve değerlendirme adımları kendi içlerinde sırayla mı gerçekleştiriliyor (çağlayan modelindeki gibi). Paralel gerçekleştirilen adımlar var
    b. Adımlar arasındaki geçişler nasıl sağlanıyor
28. Süreçte yaşadığınız en büyük problemler hangi noktalarda? Bunları kısaca açıklayabilir misiniz? Geriye dönmek mümkün olsaydı neleri farklı yapardınız?
29. Eklemek istediğiniz başka noktalar var mı?

A.2 English version of Interview Set2

General Questions

1. What is the name of the project you are involved in?
2. What is the goal of the project?
3. What is your assignment in the project?
4. Do you have any previous experience on online courseware development?

Management Layer Questions (Management Layer is where project management level activities are carried out)

5. How was it decided to carry out this project, which involves developing online courses?
    c. What kind of people or organizations are involved in the decision making process? What are their roles, job descriptions and contributions to the project?
    d. Was any requirements analysis conducted before the project was started? What was the result?
6. How was it decided on the course modules to be developed?
7. Who determined the budget and how?

8. How is the managerial structure of the project?
9. How the project related issues (soft or hard) are handled?
    a. Problems related to technology
    b. Problems related to the communication of the people in the project management
    c. Problems related to different viewpoints
    d. How is the conflict resolution handled?
10. While developing the curriculum of the courses
    a. How the curriculum was decided?
    b. Who was involved in the determination of the curriculum?
    c. Who was the target group? How was it determined?
    d. Was there any problem at the curriculum determination point?

Integration Layer Questions (Integration layer is where curriculum development level activities are done)

11. Did you use any LMS (learning management system)?
    a. Who determined it and how?
    b. What do you think about the performance of the LMS you have used in the project?
12. Was there any training related to curriculum development provided for the developers?
    i. If there was, what were the advantages?
    ii. If there was not, do you think this causes any problems? What can be some potential problems?
13. Was there any training related to online course development provided to the developers?
    i. If there was, what are the advantages?
    ii. If there was not, do you think this causes any problems? What can be some potential problems?
14. What are the communication mechanisms provided for the team members who are physically separated?
    i. If there are communication problems, at what points do they encounter them most?
    i. How these problems are eliminated?
15. How was the development sequence of the modules determined? Do the courses have any hierarchical order among them? Does that affect the development sequence?

Micro Layer Questions (Micro layer is where course material development level activities are carried out)

16. Is each module developed independently from others or developed together, following certain guidelines. For example developing concepts first and then consolidating them or each module is independent in itself?
17. Is the learning objects concept used?

18. Are any industrial standards such as LOM (Learning Object Metadata) or SCORM (Sharable Courseware Object Reference Model) taken into consideration while developing modules?
    c. What are the advantages and disadvantages of using standards?
    d. What can be done to develop common standards?
19. Are any instructional design methods or instructional strategies (pedagogical principles) applied while developing modules?
20. Have you used any multimedia materials in the courses?
    c. Are multimedia materials used in the courses determined during the development of the content of the courses, or are they developed after finishing the development of the content?
    d. How is the quality of multimedia materials tested?
21. How is the extent to which the course has achieved their objectives determined?
22. How are the courses accredited? How does the accreditation mechanism work?
23. Do you test the material according to the usability criteria?
24. Are the courses offered to the students after the whole course development is over?
25. Are there any mechanisms that enable students to test the materials?
26. Will students evaluate the courses after they take them?
    c. How are you going to achieve that?
    d. Are you going to make revisions after getting feedback from the students?

Questions for Model and Overall Evaluation

27. How do you classify your development methodology as compared to the software development methodologies?
    a. Is it like the traditional software development methodologies in which the development stages are done sequentially or are there any parallel stages?
    b. How the transitions between stages are handled?
28. What are the biggest problems you have faced throughout the project? Can you define them briefly? If it was possible to go back to the start, what would you do differently?
29. Are there any more comments you would like to add?

APPENDIX B. INT_2 Evaluation matrices for the evaluation of online courseware development project (EPPICC)

	MANAGEMENT LAYER	ALWAYS	OFTEN	RARE	NEVER	NA
#	***Project Management***					
1	Project has a detailed project plan at the beginning of the project	**X**				
2	Project plan is revised throughout the project		**X**			
3	Project plan includes a project schedule	**X**				
4	Project lasts in planned duration/ is ended at the planned date			**X**		
5	Project schedule includes the major milestones and target dates	**X**				
6	Determined milestones can never be finished at their pre-determined dates		**X**			
7	Project schedule is never revised			**X**		
8	Project has a full-time manager / management team				**X**	
9	Project has a pre-determined manager / management team	**X**				
10	Project management give continuous effort during the whole project	**X**				
#	***Project Management***					
11	Project management has good skills of leadership, communicating and negotiating		**X**			
12	Project management gets feedback from the lower layers throughout the project	**X**				
13	Project status review meetings with all project stakeholders are held regularly to exchange information	**x**				
14	Project management team meets regularly.	**x**				

	MANAGEMENT LAYER	ALWAYS	OFTEN	RARE	NEVER	NA
#	***Budget\Resource Allocation***					
1	Project plan includes a project budget/resource section	**x**				
2	The required human resources are determined at the beginning of the project	**x**				
3	The required equipment resources are determined at the beginning of the project	**x**				
4	Cost estimation and budgeting is done at the beginning of the project	**x**				
5	Revisions are never required for the cost and budgeting issues throughout the project			**x**		
#	***Determination of the course (Curriculum/program)***					
1	Needs assessment is conducted at the beginning of the project	**x**				
#	***Coordination***					
1	Project manager is responsible for the coordination among all the teams as well as team members			**x**		
2	Project has a full-time personnel for the coordination	**x**				
3	Project communication is continuously moderated	**x**				
4	Project has a pre-determined communication mechanism which determined how the data will be disseminated in a timely manner		**x**			
5	Project has performance-reporting mechanisms for collecting and disseminating performance information such as status reporting	**x**				
#	***Quality control***					
1	Project plan includes a quality planning section				**x**	
2	The project management determines a quality policy for the project				**x**	
3	There are standards and regulations that have to be considered for the project	**x**				
4	Checklists are prepared for quality reviews	**x**				
5	Quality reviews/inspections are done regularly throughout the project	**x**				
6	Quality review/inspection is done at the end of the project	**x**				

	MANAGEMENT LAYER	ALWAYS	OFTEN	RARE	NEVER	NA
#	***Configuration\Change Management***					
1	There are configuration and change management plans that defines the exact procedure	**x**				
2	Revisions and changes required throughout the project		**x**			
3	Revisions and changes done successfully throughout the project		**x**			
#	***Risk Management***					
1	Project plan includes a risk management section				**x**	
2	Possible risks are identified and analyzed				**x**	
3	Possible solutions are determined				**x**	
4	Pre-determined risks are resolved smoothly based on the determined solutions	**x**				
5	Unexpected risks are never encountered		**x**			

	INTEGRATION LAYER	ALWAYS	OFTEN	RARE	NEVER	NA
#	***Determination of the modules (courses)***					
1	Modules are identified according to the results of the need analysis	**x**				
2	The modules are combined from introductory to advanced levels.	**x**				
#	***Decision on LMS***					
1	LMS is used for the course					**x**
2	Available LMSs are investigated and analyzed					**x**
3	LMS is chosen after matching the requirements with the features of the investigated LMSs					**x**
#	***Style guidelines***					
1	Style guidelines and user interface features are determined before the development of modules	**x**				
2	Prototyping of the guidelines are done before making final decision	**x**				
3	Revisions done to the prototypes for several times before the final decision		**x**			
4	All modules have a standard structure	**x**				
	Training					
1	Trainings are planned for all people who work in any of these processes				**x**	
2	Trainings related to the curriculum development are given				**x**	
3	Trainings related to the courseware development are given				**x**	
4	Trainings are also conducted several times during the project				**x**	

	MICRO LAYER	ALWAYS	OFTEN	RARE	NEVER	NA
#	***Needs Assessment***					
1	Modules are decided by first determining the required changes in students' knowledge	**x**				
#	***Task Analysis***					
1	The content and the tasks necessary for the modules are determined.	**x**				
#	***Learner Analysis***					
1	Target group's general characteristics are determined	**x**				
2	Target group's prior knowledge are determined	**x**				
3	Target group's motivation level and attitudes are determined		**x**			
#	***Goals\Objectives***					
1	Goals (general statements) and objectives (more specific statements) what an instruction will provide to learners are determined.	**x**				
2	Goals and objectives of the modules are never needed to be revised throughout the development of the project	**x**				
#	***Instructional Activities***					
1	The instructional activities to be included in the learning environment are determined based on the determined goals and objectives	**x**				
2	Interactive instructional activities are planned	**x**				
3	Revisions are done throughout the project		**x**			
#	***Content Sequencing***					
1	The sequence of the content of instruction is decided according to the results of the task analysis which are combined with the goals and objectives of the instruction as well as instructional activities determined.	**x**				

	MICRO LAYER	ALWAYS	OFTEN	RARE	NEVER	NA
2	Revisions are done throughout the project		**x**			
#	***Evaluation Procedures***					
1	The evaluation procedures that are going to be applied for the instruction are determined based on the determined goals and objectives.	**x**				
2	Formative evaluation is planned for the learners	**x**				
3	Summative evaluation is planned for the learners	**x**				
#	***Searching from learning objects***					
1	Existing learning object repositories are searched for suitable materials					**x**
#	***Paper prototypes (storyboards)***					
1	Learning materials are developed as paper prototypes first	**x**				
2	Prototypes are evaluated formatively	**x**				
#	***Software prototypes (learning objects)***					
1	All learning materials are developed as learning objects					**x**
2	Software prototypes are evaluated formatively	**x**				
3	Developed prototypes of modules are evaluated formatively	**x**				
#	***Integration***					
1	Developed learning objects are integrated according to the determined content sequence					**x**

	INTERLAYERS	ALWAYS	OFTEN	RARE	NEVER	NA
#	***COMMUNICATION***					
1	A procedure is defined for communication for all stakeholders	**x**				
2	An infrastructure is provided for effective communication	**x**				
3	An infrastructure is provided for sharing project data		**x**			
#	***EVALUATION\REVISION***					
1	Continuous evaluation and revision takes place throughout the project	**x**				
2	Regular review meetings are done	**x**				
3	Revisions are conducted to the developed course modules as peer reviews	**x**				
4	Revisions are conducted to the developed course modules as expert reviews	**x**				
5	Usability testing is done for the developed modules	**x**				

APPENDIX C. INT_3 Question set for the evaluation of the results of the project (AP-3)

Öncelikle bu proje kapsamındaki görev tanımınızı kısaca özetleyebilir misiniz?

PROJE YÖNETİMİ (PROJECT MANAGEMENT)

1. Proje yönetimi konusundaki düşünceleriniz nelerdir?
2. Projenin bir proje planı (project schedule) var mıydı?
    a. Bu plana uyabildiniz mi?
    b. Proje öngörülen zamanda tamamlanabildi mi?
    c. Sizce proje planındaki problemler nelerdi?
    d. Bunlar nasıl giderilebilirdi?
    e. Plan süreç boyunca güncellenebildi mi?

EĞİTİM (TRAINING)

3. Projenin başında verilen eğitim konusunda ne düşünüyorsunuz?
    a. Eğitim yeterli miydi? Proje kapsamında nasıl ders geliştirilmesi gerektiği ile ilgili yeterli bir bakış açısı sağlayabildi mi?
    b. Daha fazla ne yapılabilir?

ORTAK BİÇİM KILAVUZU

4. Hazırlanacak dersler için ortak bir biçim kılavuzu (style guideline) oluşturulması konusunda ne düşünüyorsunuz?
    a. Sizce bu projede bu sağlanabildi mi?
    b. Neler yapılabilir?

DERS GELİŞTİRME SÜRECİ

5. Hazırladığınız derslerin içeriklerinin hazırlanması ve de derslerin geliştirilmesi sırasında nasıl bir yol izlediniz?
    a. Bu proje planındaki yoldan hangi noktalarda farklıydı?
    b. Onu uygulayamama nedenleriniz nelerdi?
6. Dersleri geliştirirken kavram haritaları kullandınız mı?
    a. Kullandıysanız ders geliştirme süreci için sizce katkıları nelerdir?
    b. Dersleri geliştirirken prototip kullandınız mı (Paper ya da software)

SÜREKLİ DEĞERLENDİRME (EVALUATION/REVISION)

7. Derslerin geliştirilmesi süresince yapılan değerlendirme toplantıları faydalı oldu mu?

KOORDİNASYON / İLETİŞİM

8. İletişimde karşılaşılan zorluklar varsa bunlar hangi noktalarda yoğunluk kazanıyor?
    a. Bunlar nasıl çözüldü ya da çözülebilir?

9. Projenizde oluşan çeşitli problemler (soft ve hard) nasıl gideriliyor?
    a. Teknoloji ile ilgili problemler
    b. Projede yönetimde yer alan kişilerin iletişimiyle ilgili problemler.
    c. Farklı bakış açılarından doğan problemler
    d. Çıkan çeşitli anlaşmazlıklar nasıl çözülüyor (Conflict resolution konusunda neler yapılıyor)
10. Motivasyonunuzu etkileyen faktörler
11. Bundan sonra böyle projelere sıcak bakıyor musunuz?
12. Eklemek istedikleriniz?

APPENDIX D. Project schedule used for AP-3 case

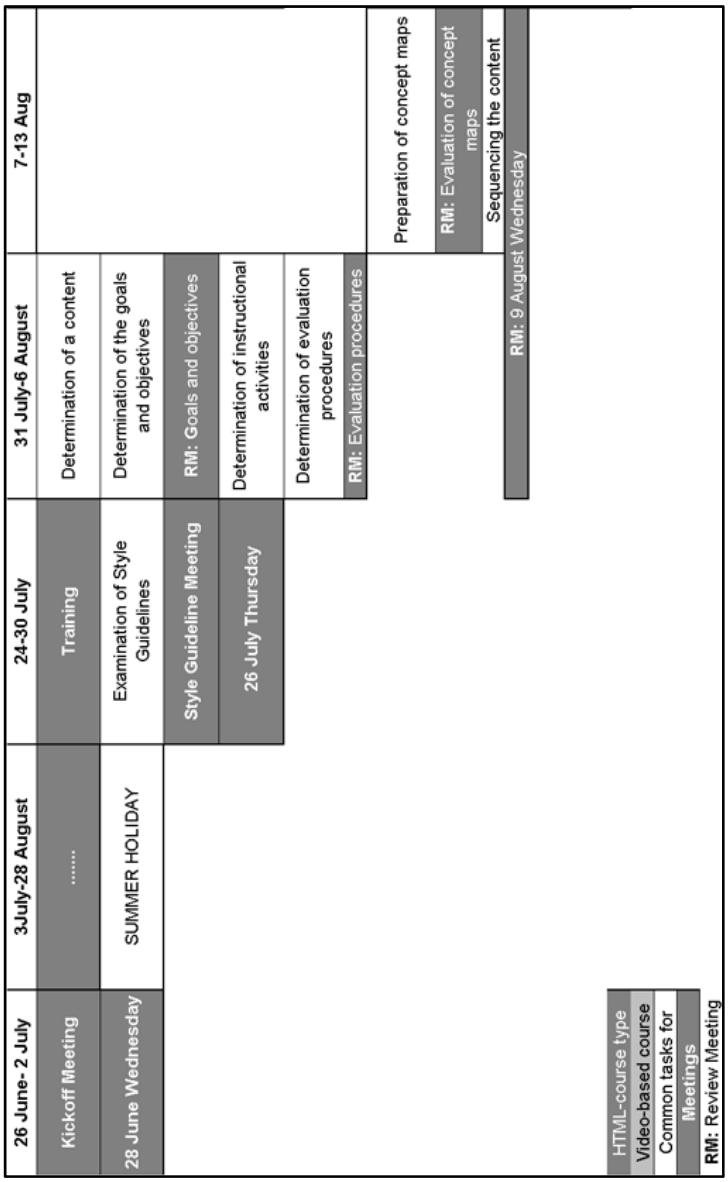


Figure App D1: Project schedule prepared for the AP-3 Case at the beginning of the project

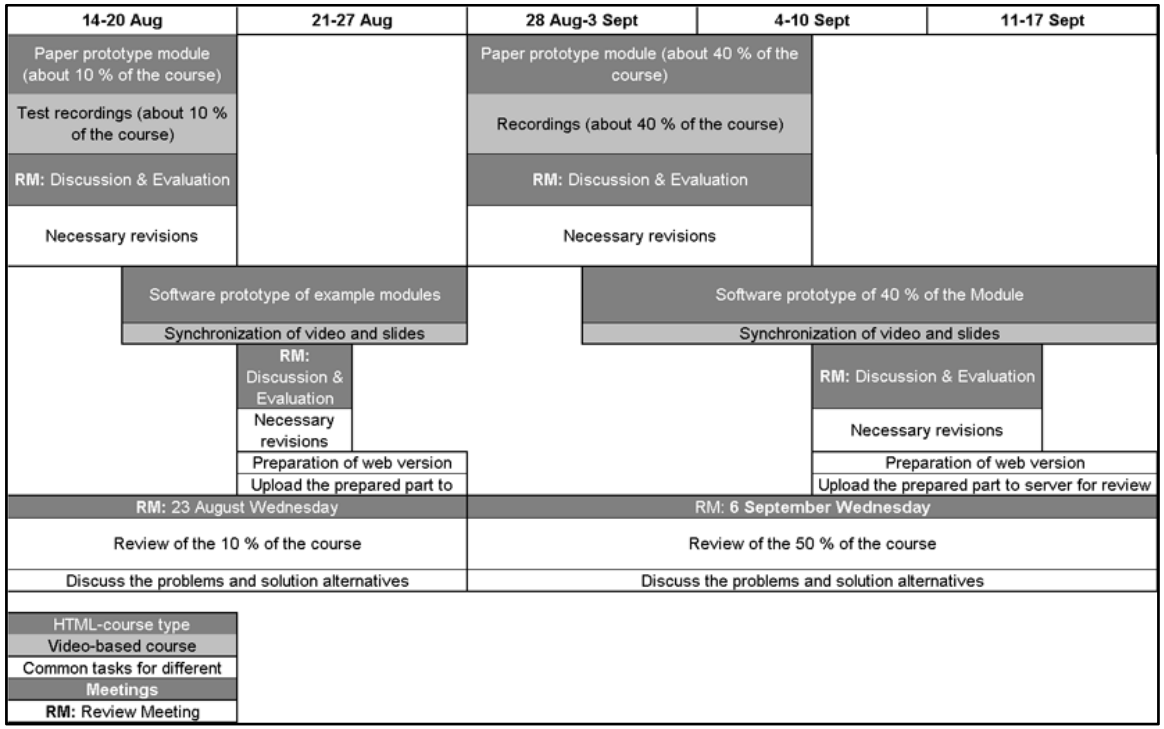


Figure App D1: (Cont.)

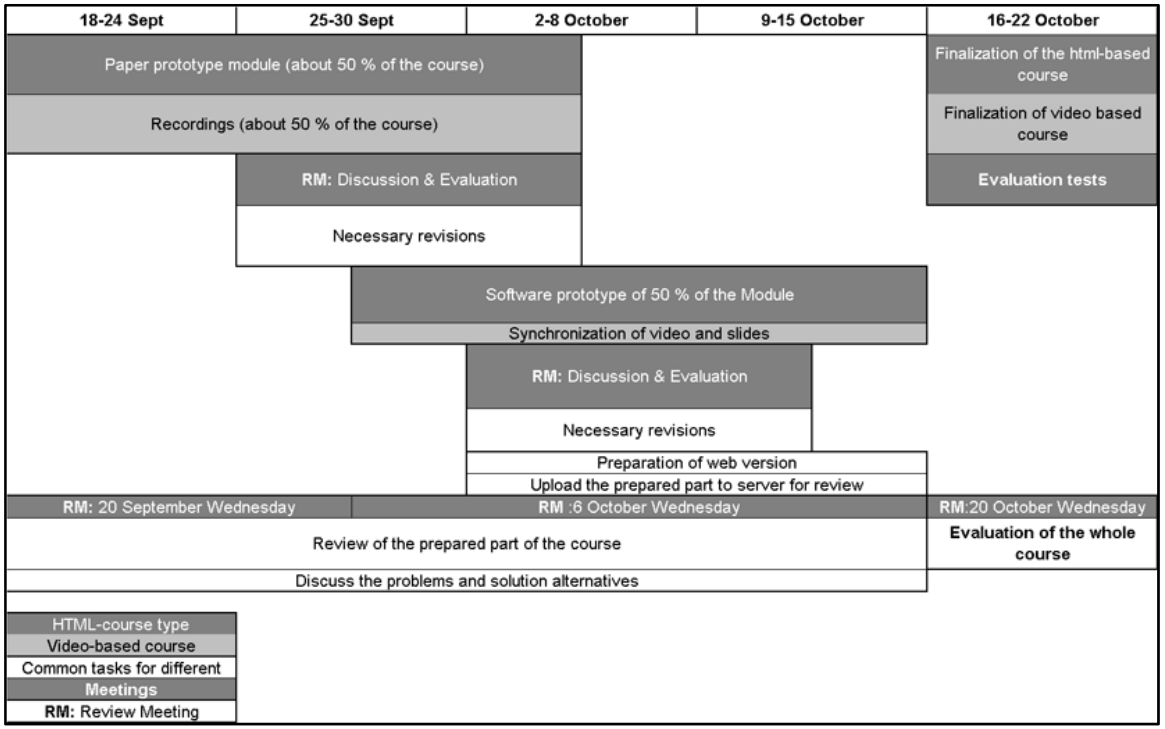
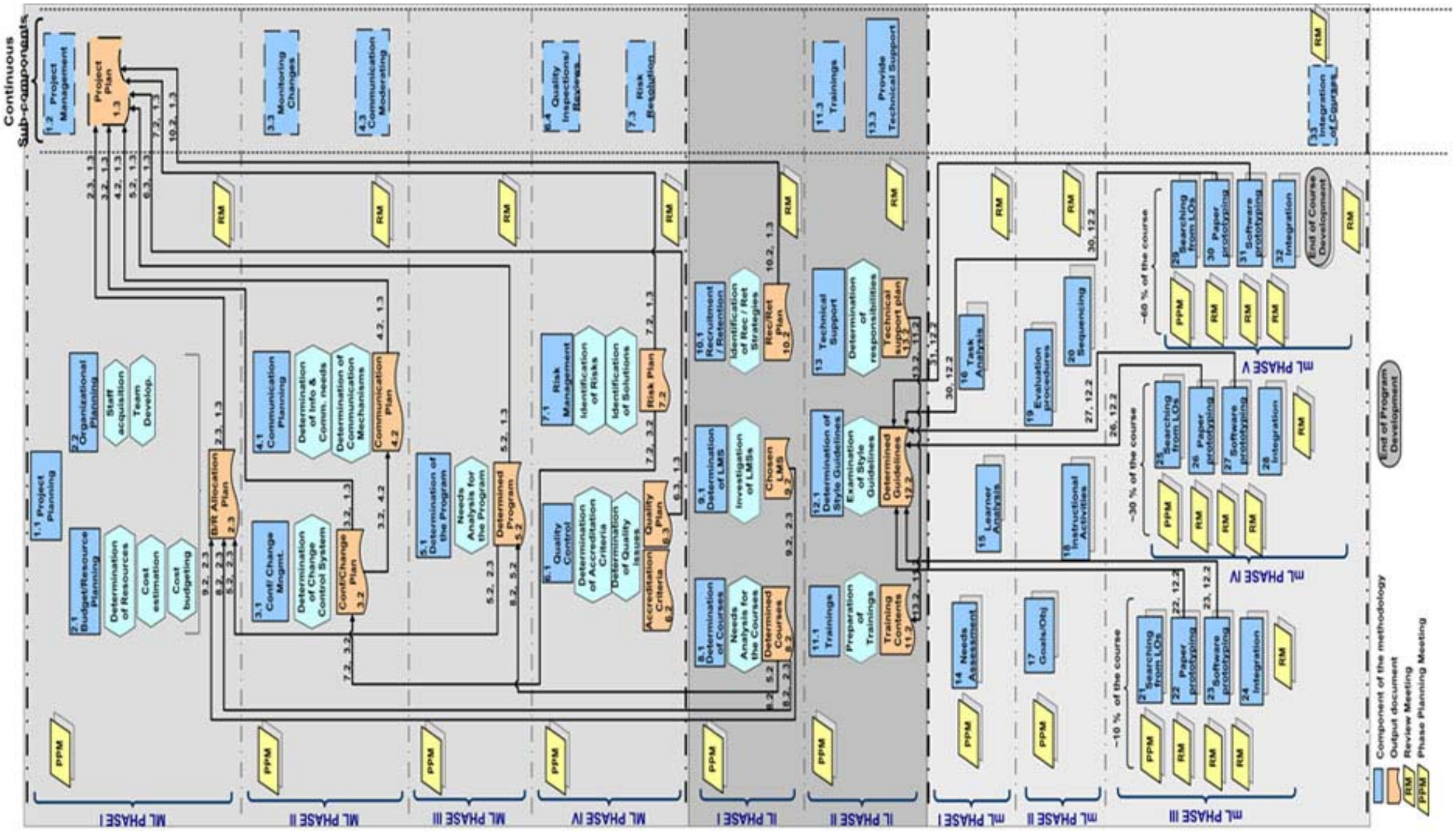


Figure App D1: (Cont.)

APPENDIX E. Detailed Overview of the model



APPENDIX F. Screenshots from the model web site

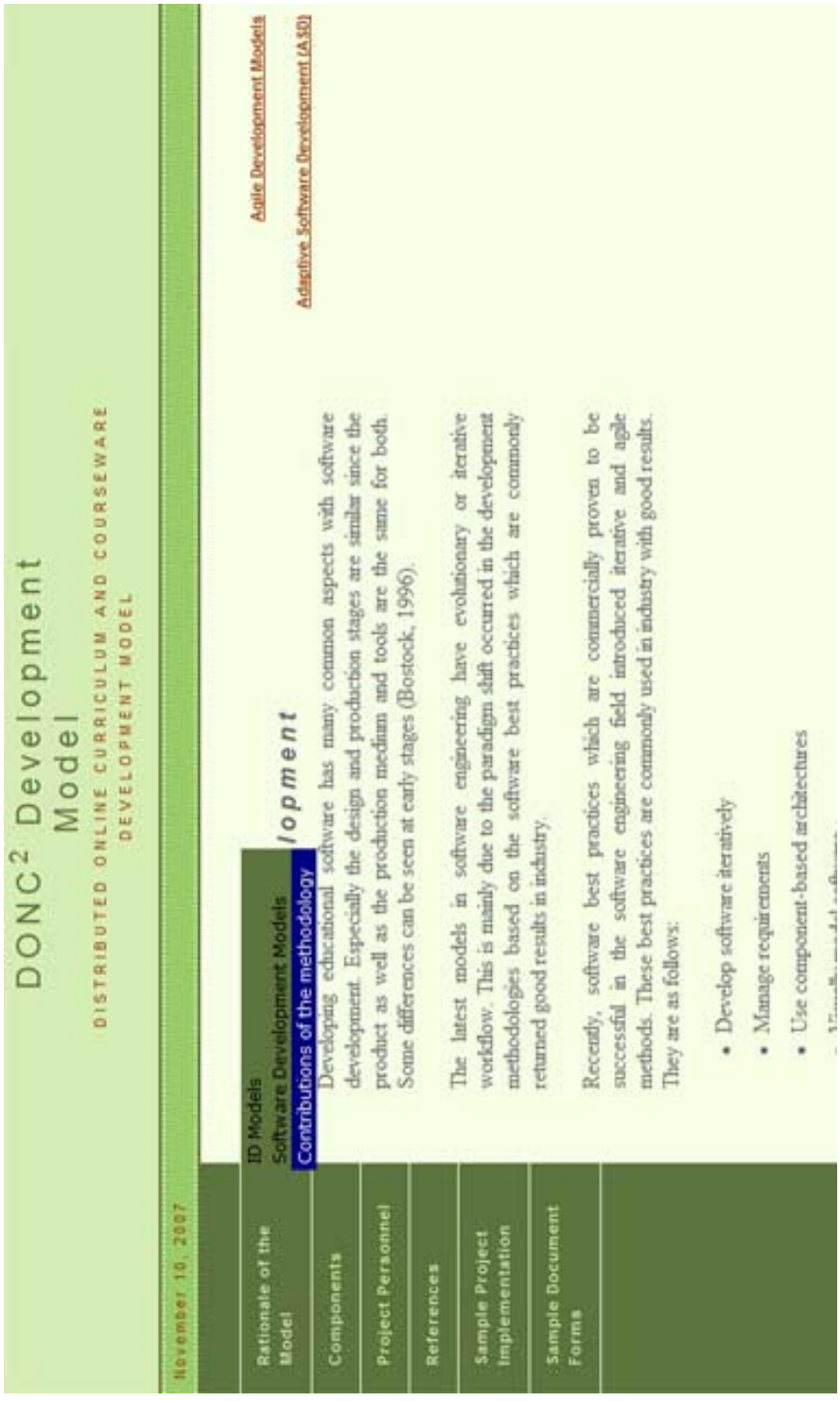


Figure App F1: Screenshot of ID Models page

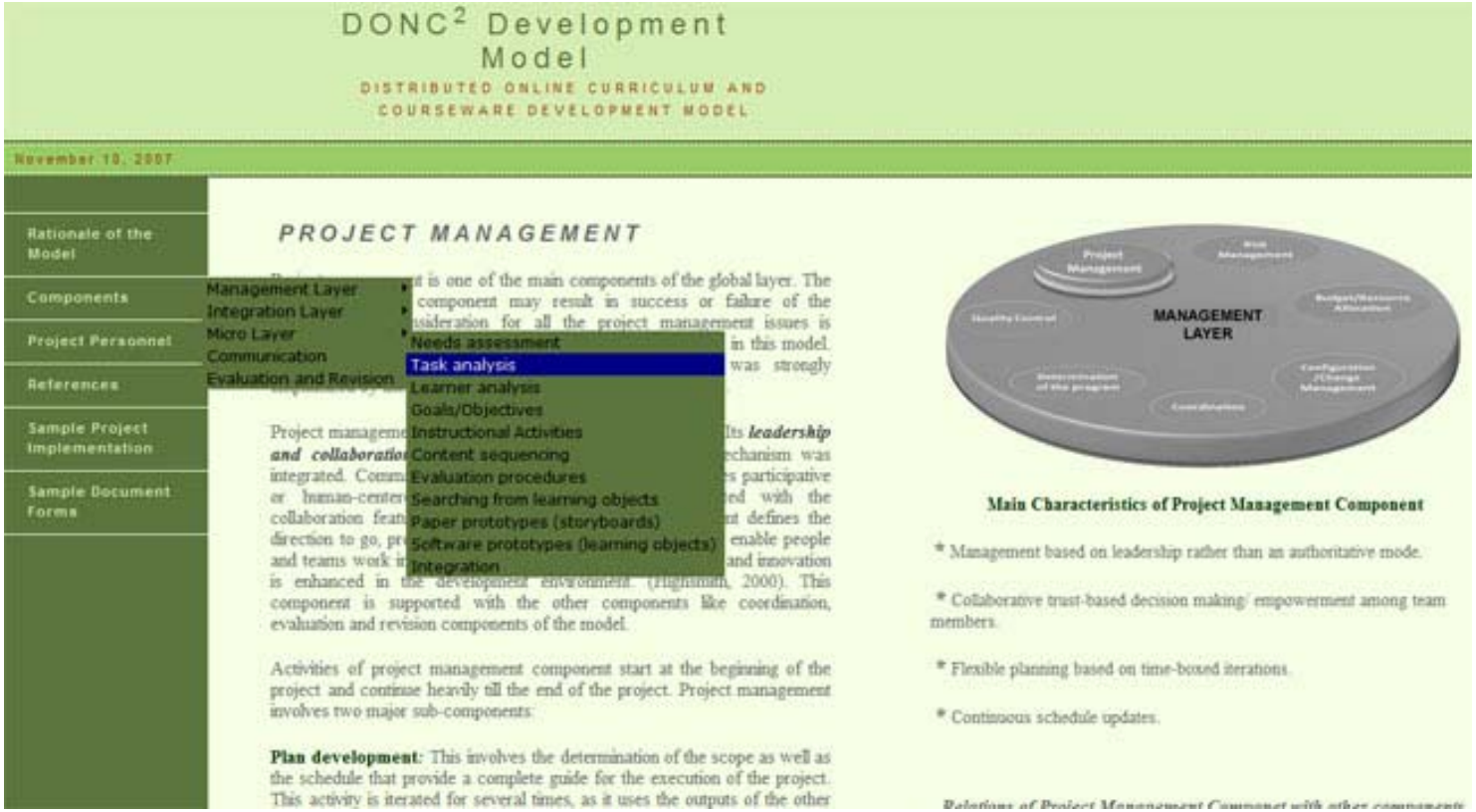


Figure App F2: Screenshot of Components of the Model (Project Management)

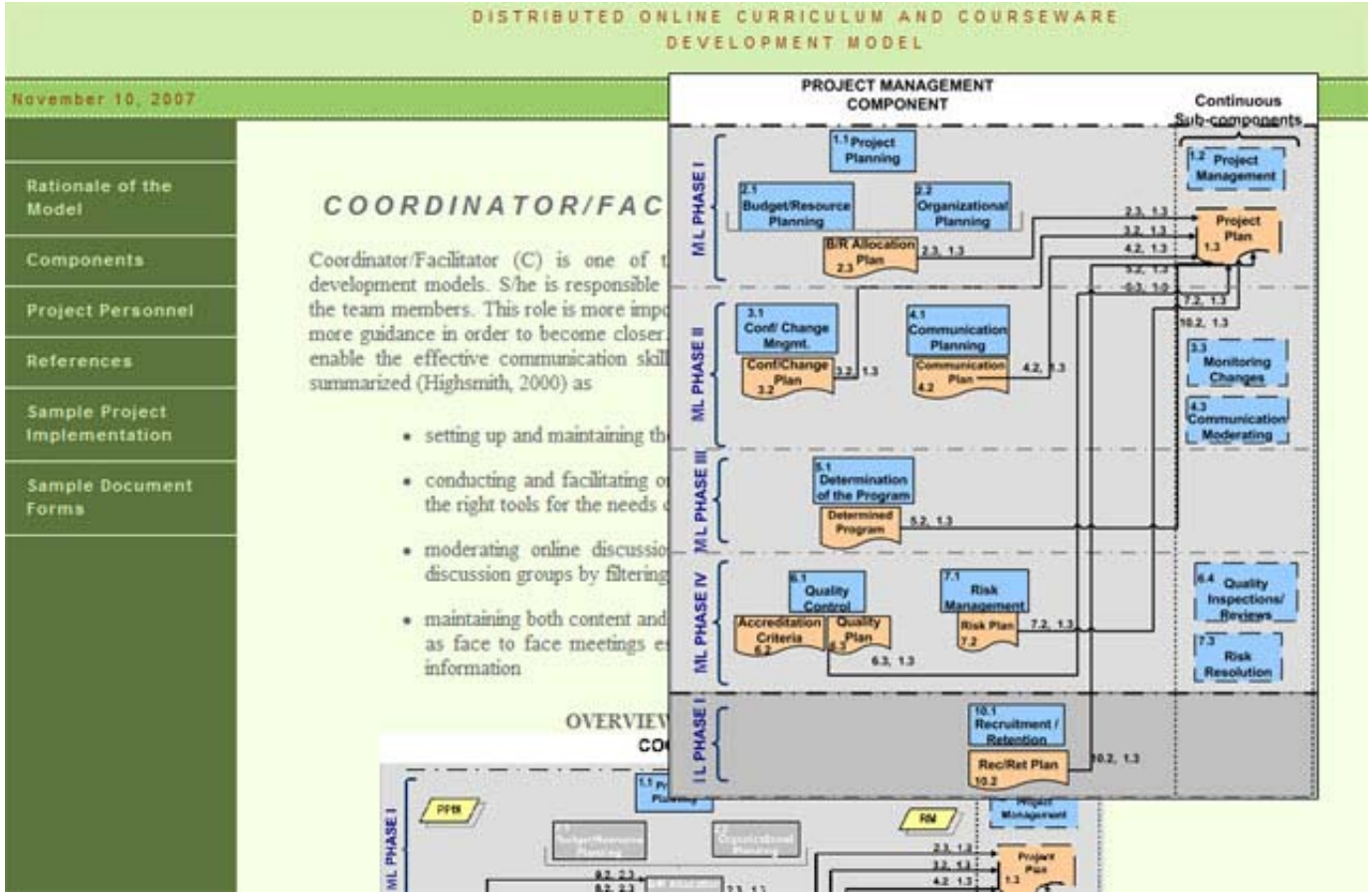


Figure App F3: Screenshot of Coordinator page

VITA

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WORK EXPERIENCE

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PUBLICATIONS

1. **Onay-Durdu, P.** & Çağıltay, K. (2006). Investigation of Simulator Sickness in A Driving Simulator", *Traffic and Road Safety Third International Congress*, Gazi University, Ankara, May 2006.

2. **Onay Durdu, P.,** Yalabik, N. & Köksal, G. (2005) e-Kampus-IS: Information System for a Virtual University Consortium. In Proceedings of the *6th International Conference on Information Technology Based Higher Education and Training*, Santo Domingo, Dominican Republic, 7-9 July.

3. **Onay, P.** & Yıldırım, Z. (2005). Evaluation Of Computer And Instructional Technology Education Programs: Students' And Faculty Members' Perspective. *The Eurasian Journal of Educational Research 19 (2),* pp.77-88.

4. **Onay Durdu, P**., Çağıltay, K. & Hotomaroğlu, A. (2005). A Case study Between METU and Gazi University Students: Game Playing Characteristics and Game Preferences. *The Eurasian Journal of Educational Research, 19 (2)*, pp.66-76.

5. **Onay Durdu, P**., Çağıltay, K. & Hotomaroğlu, A. (2004). A Case study Between METU and Gazi University Students: Game Playing Characteristics and Game Preferences. *In proceedings of the Bilişim Teknolojileri Işığında Eğitim Conference and Exhibition 2004*, Ankara, TURKEY

6. **Onay, P**. & Çağıltay, K. (2004). Students' game play characteristics at a Turkish university. *American Educational Research Association 2004 Annual Meeting*, San Diego, CA, USA, 12-16 April.

7. Yalabik, N., **Onay, P.** & Çağıltay, K. (2004). Sanal Üniversite Sanal mı Gerçek mi? *TMMOB Elektrik Mühendisleri Odası Dergisi*, Sayı:419

8. **Onay, P.** (2003). Evaluation of Computer and Instructional Technology Education Programs: Students' And Faculty Members' Perspective. *Unpublished Master's Thesis. Middle East Technical University*.

RESEARCH INTERESTS

Design and Development of Information Systems, Distance Education, Human Computer Interaction, Electronic Games