Developing Computer-Based Training using the Requirements Engineering Techniques

Hestiasari Rante [1]   Ulrike Erb [2]

1) Multimedia Broadcasting Technology, Electronic Engineering Polytechnic Institute of Surabaya (EEPIS), email: hestiasari@eepis-its.edu

2) Institute of Media and Systems Engineering, University of Applied Sciences Bremerhaven, email: uerb@hs-bremerhaven.de

Abstract

There are several Requirements Engineering (RE) techniques have been developed to assist large projects within the RE process. However, it is still not clear if these frameworks will adequately to be useful in developing e-Learning software.

The purpose of this paper is to show that the RE techniques can also fit for developing e-Learning software such as Computer-Based Training (CBT). In this context, a case study at the Food and Beverages (F&B) Division, Radisson SAS Hotel in Hamburg was taken in order to apply some of the RE techniques. The need to have a CBT for new staff at the division, led the research to focus on identifying the problem and user needs. Using the RE techniques such as Documentation Study, Interviewing, Requirements Workshop, Observation, and Prototyping is becoming a solution that helps developer in developing the CBT as needed by user afterward.

This paper presents the result of using the RE techniques in developing the CBT. The programming skills in developing the CBT will not be discussed in this paper.

Keywords: Computer-Based Training, e-Learning software, Requirements Engineering

1. Introduction

Today's society is subject to various information and technology changes. This condition continuously changing demands of the market and makes it necessary for individuals to continuously develop and advance themselves and their competences. Learning can be seen as an investment for the future [1].

Depart from this phenomenon, many universities, government institutions, and private industry and company as well; begin to develop their human resource's knowledge and skills. Some trainings and lectures as significant educating process are given periodically.

Computer supported solutions are perceived as a possibility to increase the quality of education while simultaneously lowering costs. Increasing interest in education is demonstrated by the rising implementation of computer supported learning and teaching arrangements [2]. Computer supported learning always refers to e-learning term. Web-Based Computer Training (WBT) and Computer-Based Training (CBT) are then labeled as preferred solution for efficiently conducting teaching-learning process.

Designing this kind of e-learning software needs accurate information collected in order to develop a system properly as required by the customer. On the other hand, e-learning software should also be effective, efficient, enjoyable, and easy-to-use for user. The user is, after all, the one whom learning software are designed to assist. The requirements of the user should therefore be the first priority. It needs to understand user capabilities and limitations, to know if there are things that they will find difficult or even impossible. Although it looks simply, but it then could becomes an uneasy work and gives important implications for design.

Most of software engineers and developers unanimously state that designing that complex system is the most difficult task that faces them [3]. It is essential to understand the requirement of a problem before make an attempt to solve the problem.

Requirements Engineering (RE) is probably the only solution to bring developer identifying the user needs. The RE techniques build a bridge to design and construction. The journey across the bridge allowing developer to examine the context of the software work to be performed, the specific needs that design and construction must address, the priorities that guide the order in which work is to be completed, the information functions, and behaviors that will have a profound on the resultant design.

However, applying RE techniques is not easy at all. Several RE techniques and techniques have been developed to assist large projects in their RE process, but so far, it is not clear if/how these frameworks will adequately scale-down to be useful in developing the learning software. Therefore, a case study to develop a CBT at Radisson SAS Hotel in Hamburg was taken in order to apply the RE techniques.

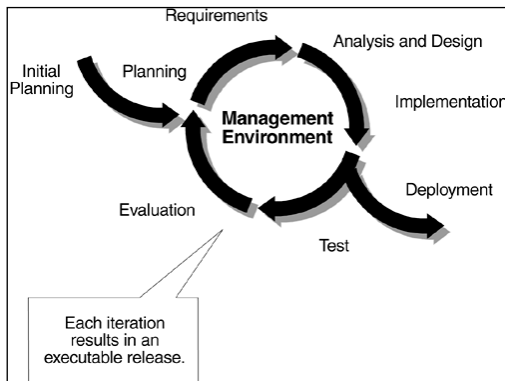## 2. Requirements Engineering

Figure 1. An iterative and incremental process

Understanding the requirements of a problem is among the most difficult tasks that face software engineer or developer. Normally, when we first think about the requirements, they do not seem that hard, but after all, when we have start to work some unpredicted questions are arising: *Doesn't the customer know what is required? Shouldn't the user have a good understanding of the features and functions that will provide benefits?* Surprisingly, in many instances the answers to these questions is NO. And even if customer and user are explicit in describing their needs, those needs will change throughout the development process.

For that reason, then the problem and requirements should be clear from the beginning. Using the RE techniques can help to find the answers. RE provides the appropriate mechanism for understanding what the customer wants, analyzing need, assessing feasibility, negotiating a reasonable solution, specifying the solution unambiguously, validating the specification, and managing the requirements as they are transformed into an operational system.

There are three main tasks of RE for the purpose of developing the learning software: identification, analysis, and modeling. The process is iterative and becomes more details in each iteration. The RE techniques such as Documentation Study, Requirements Workshop, Interviewing, Observation, and Prototyping can be used as part of identification, analysis, and modeling tasks.

2.1. RE Identification

Identifying the requirements is one principle to determine customers and users' behavior and needs in designing the learning software.
As already branded, the golden rule in designing is: know the user. Once the requirements have been identified, the developers are then in a position to make analysis and to design a solution.

2.1.1 Document Study

Documentation study is a common technique consisting of reading and studying available documentation for content that is relevant to and useful on the current endeavor. Reading all available documents related to our domain and thus our problem.

2.1.2 Interviewing

Interviewing is a commonly used technique where users, customers including all stakeholders, and domain experts are questioned to gain information about their needs or requirements in relation to the new system. Interviews are usually semi structured based on a series of fixed questions with scope for the user to expand on their responses.

Interviews on a customer site by representatives from the system development team can be very informative. Seeing the environment also gives a vivid mental picture of how users are working with the existing system and how the new system can support them.

An effective, direct person-to-person interviewing technique requires that developers have prepared a list of questions designed to gain an understanding of the real problems and potential solutions. To get as unbiased answers as possible, the questions to be asked should be context-free. The context-free question is a high-level, abstract question that can be posed early in a project to obtain information about global properties of the user's problem and potential solutions.

2.1.3 Requirements Workshop

Requirements workshop is an organized brainstorming session. If the learning software is complex, the usual technique to use is requirement workshops, where the developer brings the main stakeholders in the system together in order to analyze the system and develop the solution.

Such workshops are ideally carried out off site, so that the stakeholders are not distracted. They usually have a facilitator to keep the process focused, a scribe to document the discussion, and usually make use of a projector and diagramming software. Often multiple workshops are required to bring the process to a successful conclusion.

Requirements workshops are considered to be a very useful technique which can save significant time. However, it can be hard to get all the required stakeholders together at one time.

A more general weakness is that some stakeholders do not contribute forcefully enough in workshops and their requirements will not receive the appropriate attention, and this will inevitably be producing a limited solution. Additionally, while requirement workshops are an excellent technique for gathering the information, sometimes they are not so useful for defining the nature of the solution.

2.1.4 Observation

Observation is intending to show how people do their job and how their behaviors can be transferred into a software system. Observation can be done in this ways: visit the customer location, learn about the work organization, observe user daily working, and it would be great if we could take some pictures of the fields and the activities. All these ways help the development team to more understand the real circumstances and even can give more ideas or better solution.
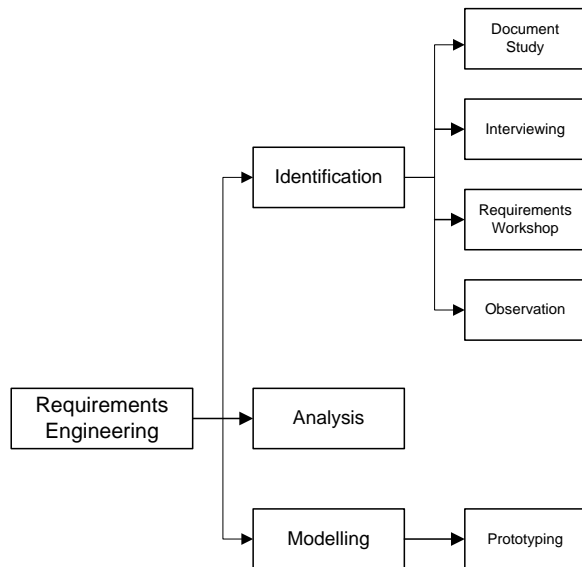

Figure 2. RE Process

2.2. RE Analysis

Requirements analysis techniques will drive the information that is gathered during the requirements identification and will define how it is ultimately analyzed.
It should be noted that requirements identification and requirements analysis techniques go hand in hand [4].

2.3. RE Modeling

Modeling is important because it helps the development team visualize, specify, construct, and document the structure and behavior of a system's architecture. We build models so that we can understand better the system we are modeling; we build models of complex systems because we cannot comprehend such systems in their entirety [5].

2.3.1 Prototyping

In the mid-1980s, prototyping was seen as the solution to the requirements analysis and modeling problem. Prototypes are mock ups of the screens of an application which allow users to visualize the application that is not yet constructed. Prototypes help users get an idea of what the system will look like, and make it easier for users to make design decisions without waiting for the system to be built. When they were first introduced the initial results were considered amazing. Major improvements in communication between users and developers were often seen with the introduction of prototypes. Early views of the screens led to fewer changes later and hence reduced overall costs considerably.

In prototyping the designers or developers create paper or software-based simulations of user interface elements (menus, buttons, icons, windows, dialogue sequences, etc.) in a static or dynamic way. There are now plenty of prototyping tools available which allow the development of such simulation prototypes.

Fig. 2 shows the process of RE techniques that will be adopting for the case study.

3. Results

The result that will be presented revolves around the RE process in developing the CBT prototype for the Food and Beverages (F&B) Division, Radisson SAS Hotel in Hamburg. The CBT was containing a specific topic called Point of Sale (PoS), which is one mandatory subject that should be trained to the new staff (in this context, the new staff is called student or learner). The RE techniques used are as described previously in Chapter 2.

3.1 Problem and User Need Identification

The problem at F&B Division initially occurred by the lack of time and lecturer or tutor to teach the new students who are doing the practicum periodically there. There is only tutor at the division. And the tutor has another role as Supervisor of F&B Division. Working as Supervisor of F&B Division and as tutor for the new students as well, is completely a hard work for him. He sometimes finds that it is not easy to manage the time, mainly for teaching the new students. The worse case is

when he is unable to come, there is no one at the division can replace him. So, this is the major problem that has been identified from the customer.

Second problem is how to make an attractive presentation in the classroom that can encourage student's desires to learn about the topic. Providing an interesting media for teaching is necessary in this case. Frankly, the topic of Point of Sale is the most difficult one and needs total concentration on learning it. Teaching it for just one time is almost ineffective. Most of students need at least two until three times to learn the topic until they understand it and are ready to move forward to the fields for real practice. Thus, it is significant to have well-trained staff that understand the topic well, otherwise the customer could be unsatisfied. Based on these problems, Radisson Hotel then mentioned about their need of learning software.

3.1.1 Document Study

In this case study, document provided was very limited. The only one document given was the material of presentation slides that is used to teach students in the classroom. The presentation contains of 19 slides and in German. It was prepared by the supervisor who wrote the content himself.

The topic itself was not easy to understand. It needed several times talking with the supervisor who explained the content until it could be clearly understood. Explaining one topic to the student over and over again is typical part of the work that will be solved by the learning software. Developer must keep this sequence on his mind. He will get the same experience as he develops the learning software. When he runs to the learning process, he will get to know the possible learning barriers and the complexity of the learning subject.

3.1.2 Interviewing

Holding the interview was the technique that really helpful. The tutor was as the key person from Radisson Hotel helped a lot and gave loads of information. Interviewing was held especially on the need of information regarding the presentation material, machine that will be used, working fields, and detail sequence of the working process.

In fact, there were some informal meetings with the tutor regarding the material of Point of Sale. Since the topic was quite hard to understand, so it was needed more discussion in order to avoid the wrong perceptions. I recommend that it is really essential to have one of the stakeholders as the key person, who can be contacted if any problem arises.

3.1.3 Requirements Workshop

During the process of gathering the customer needs, there were two official requirements workshop that involved the main stakeholders. Both of the requirements workshops gave information about the field and the customer needs.

- F&B Division never have an e-learning system before. There is no LMS.
- The practicum or training in the fields normally takes 1.5-2 hours duration, at time around 14:30-16:30. One training session can be attended by maximum three students as a group. There are 16 students per generation.
- The Micros 8700 runs under UNIX. Until now, Radisson Hotel does not have multimedia tools (speaker, microphone, headset, etc) for practicum purposes.
- The CBT should be not more than one hour and without test. Radisson Hotel already has a testing technique separately.
- The lesson material or content on the CBT must be easy to edit when it is needed.
- CBT must have database of menu list, so Radisson Hotel have the possibility to add, edit, or delete any item on the menu easily.

Requirements workshop is known as a well-organized technique, but it is not always giving a good result – depends on the real situation.

In this case study, the two requirements workshops held are more like a formal meeting where people attended there gave broad answers, not very details. They did not give enough contribution.
So, in this case, I prefer the interviewing as a better technique to gain the deeper information from customer.

3.1.4 Observation

There are five fields involved as part of the learning environment. Visiting the fields at working hours and non-working hours, gave a different perspective. In the working hours, all the staff looked busy as they moved around to serve the guests.

In the non-working hours, the staff looked a bit free and fields were not too crowded. That moment can be treasured to take pictures that will be used for the CBT. These pictures can also help out to memorize some small parts in the fields and this is certainly helpful when writing the storyboard.

Observation sometimes gives unpredictable resource where we can explore questions and gain more detail information.

3.2 Requirements Analysis

Based on the results of the identification above, then analysis was created.

The first thing has been analyzed was the need of multimedia features in order to make the interactive learning course. Then it was found that the CBT content should be written in an easy-to-understand text. And the CBT content also would be consisting of image and animation as well as the video.

A simple test was given at the end of each section. Questions were arranged in different kind of interactions. Some of them are in multiple choice, picture multiple choice, single choice, drag and drop, and true or false. In fact only 10 questions would appear randomly at the end of learning course.

Another important point considered warily was the target group. The target groups were divided into two profiles:

- For new employee, the so-called "New Staff"
- For long-term employee, it is named "Refreshment Staff"

Each profile had different rules.

For the need to flexibility of changing the content, the CBT content should be XML-based. So, the structure and architecture were formed based on XML that later would present the content on the platform.

The next step was to find out what platform best suited to the needs. For that purpose, some technical requirements should also be considered carefully. After some researches and investigation, then it was decided to use Macromedia Flash as the authoring tool for the CBT.

3.3 CBT Modeling/Prototyping

From the problem and user need identification and the requirements analysis, then the CBT prototype was developed. The CBT was developed using the Macromedia Flash.
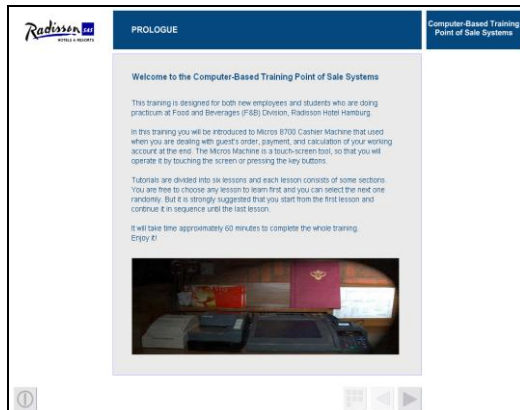

Figure 3. Screenshot Radisson Hotel prototype_1

Figure 4. Screenshot Radisson Hotel prototype_2

4. Conclusion

Based on the fact and subjective interpretation achieved from the research, so it is summarized that it is possible to use the RE techniques for developing the learning software. However, there are lots of RE techniques provided to assist the large project. Thus, it is necessary to adopt (only) the appropriate techniques that could be fit to the specific purpose such as developing the learning software.

From the case study, it was learned that the suitable techniques support for developing a CBT are: document studies, interviewing, requirements workshop, requirements analysis, and prototyping. Bear on mind that technical and didactical aspects are also important parts within the process.

References

[1] P. F. E., Sloane. *Veraenderungen in der Betriebs und Arbeitsorganisation – Konsequenzen fuer die betriebliche Bildungsarbeit*. In: Dehnbostel, P.; Dybowski, G. (eds.): Lernen, Wissensmanagement und berufliche Bildung, pp. 93-109, Bertelsmann Verlag, Bielefeld, 2000.

[2] Christine Frank. *Dissertation: Conceptual Design of the Web-Based Case Technique – A Pedagogical Perspective*. Faculty of Business Administration and Economics, University of Paderborn, 2003.

[3] Roger S. Pressman. *Software Engineering: A Practitioner's Approach*. 6th edition, McGraw Hill, 2005.

[4] Alan Dennis, Barbara Haley Wixom, David Tegarden. *Systems Analysis and Design with UML Version 2.0: An Object-Oriented Approach*. 2nd edition, John Wiley & Son, Inc, 2005.

[5] Philippe Kruchten. *The Rational Unified Process: An Introduction*. 3rd edition, Addison Wesley, 2003.