REQUIREMENTS SPECIFICATION MODEL IN A SOFTWARE DEVELOPMENT PROCESS INSIDE A PHYSICALLY DISTRIBUTED ENVIRONMENT[i]

Minimizing the communication difficulties and incorporating a planning view to the software development life cylce

Rafael Prikladnicki, Fernando Peres, Jorge Audy, Michael da Costa Móra e Antônio Perdigoto
DELL/PUCRS E-Business Research Center, Computer Science School, Pontifícia Universidade Católica do Rio Grande do Sul, Av. Ipiranga 6681, Porto Alegre, Rio Grande do Sul, Brazil
Email: [rafael_prikladnicki, fernando_peres, jorge_audy, michael_mora]@dell.pucrs.br, antonio_perdigoto@dell.com

Keywords: Information Systems, e-Business, Software Development Process

Abstract: The purpose of this paper is to propose a software development model, centered in the requirements specification phase, adapted to the research and development characteristics in the e-business area, where the users and development teams are found in a physically distributed environment (United States and Brazil). The results of a case study are also presented here, in development of a specific software for DELL Computers e-business website. This research is classified as an explanatory study, where the main research method was the case study. As result, the proposed model is presented and described, adding a planning phase to the software development process, based on the concept proposed by the Unified Process and the UML language. Some aspects are also discussed, such as the partnership of a great worldwide company in computing (DELL Computers) and a great Brazilian university (PUCRS), in the research and development conjoined project context.

1. INTRODUCTION

Several studies have considered the software development process as a technical and dissociated activity of the organizational sphere (Valacich et al., 2001; Martin and O'Dell, 1998). It is possible to identify many efforts towards the definition, stabilization and diffusion of the system development approaches that guarantee greater dedication to the specifications and user's requirements, which should be aligned to the organization's business strategy.

This research is focused on defining a software development model adapted to the characteristics of a research and development environment in the e-business area. The objective is to propose a model that contemplates the interfaces to the planning activities as an initial phase of the system development process, adapted to the present situation of an organization that has its research and software development center physically located far away from its head office, its program managers and its users. Besides the presentation of the proposed model, focused on the requirements specification phases and having UML and UP for basis, the results of study cases are presented, in developing of specific software for the organization's e-business site.

The research is led in the software engineering area in order to create its own software development model, based on a coherent conceptual framework, the object oriented (OO). The providing of models accepted by the scientific community by the conceptual basis of OO has been assumed as requirements of which extensions and adjustments are proposed to help answering the proposed research purpose.

This paper has the following structure: item 2 presents the theoretical basis, item 3 discuss the research method used, item 4 describes the case study analyzed, item 5 presents the proposed model and item 6 describes the application of the proposed model. Finally, item 7 presents the final considerations, leading to future studies and research limitations.

2. THEORETICAL BASIS

2.1 IS Planning

Information Systems Planning (ISP) is the process of identifying an application portfolio that is based on a computer to support the organization's business plans and to help the concretization of the organizational objectives. (Lederer e Sethi, 1988). Many researches have been guided to improve the IS planning process. The studies in this area have investigated the IS and business strategy alignment (King, 1988; Boar, 1993; Venkatraman, 1997; Reich and Benbasat, 1996); the identification of the opportunities to take competitive advantage using IT (Porter and Millar, 1995; Service et al., 2000; Kearns, 2000); the implementability of plans (Lederer and Salmela, 1996; Gottschalk, 1997 e 1998; Reponen, 1998); and the relation with the software development process (Valacich et al., 2001; Sprague and McNurlin, 1999; Laudon and Laudon, 2000).

2.2 Unified Modeling Language

The Unified Modeling Language (UML) is the successor of the object modeling languages, unifying Booch (Grady Booch), OMT (James Rumbaugh) and OOSE (Ivar Jacobson), according to (Fowler, 2000).

It is by definition a language used to specify, visualize and document the artifacts of a system based object oriented, along the development process. Besides, it is a tentative to standardize the analysis and design artifacts: semantic models, syntactic notation and diagrams (Quatrani, 2001).

2.3 Rational Unified Process

The Rational Unified Process is a software engineering process (Kruchten, 2001) that supports the incremental and interactive life cycle, based on a spiral model for software development. It has a horizontal dimension, representing the time. This dimension is characterized by 4 well-defined phases (*Conception, Elaboration, Construction and Transition*) and its interactions. Each phase is concluded with well-defined *milestones*.

On the other hand, the RUP also contain a vertical dimension, representing the components of the process, like the activities involved along the period, where the spent effort varies according to the phase of development.

It is a generic methodology based on processes that provides organized scenarios, which assign tasks and responsibilities inside an organization. One of the most interesting aspects of RUP is the fact that it can be adapted and extended according to the organization's requirement and settings. Its main authors are the ones in charged of drawing attention towards it. The objective is to increase the software production quality that faces final user's requirements (Quatrani, 2001; Kruchten, 2001).

Different companies have utilized the RUP since 1999, applying it to several applications contexts (e-business, corporative systems, etc.) and different project areas. (Kruchten, 2001) points out that this methodology is versatile and has more than 50% of its usage focused on e-business and planning.

3. RESEARCH METHOD

This research is characterized as a study mostly explanatory, since the main research method was the case study. In this study, it is possible to justify the usage of qualitative methods since it involves the study of the system development process in its real context, with description and the comprehension of the art state in those situations where practice precedes theory (Yin, 1994).

4. CASE STUDY

4.1 The Organization

The Research Center (RC) in e-business of DELL Computers in Porto Alegre was created in the second semester of 2000, being created using incentives of the Brazilian Law on Information Technology that stimulates companies located in the country to invest part of their earnings on research and development institutions providing tax exemption on manufactured products (IPI). The RC aims to perform scientific research and technological development in the e-business area, making usage of professional of DELL and the excellence of the researchers of PUCRS on areas that may solve problems and attend needs existent nowadays in systems of this area. This way, the objective is to foment the scientific research and promote technological development from scientific results, generating advanced prototypes, integrating systems and creating new electronic commerce systems specifically for the e-business site of DELL Computers.

5. PROPOSED MODEL

5.1 Phase 0 - Planning

As we expand the focus of the software development process, and try to adopt a more strategic position in relation to the process, we identify the planning stage as the first one to take place. Thus, the planning stage basically involves the definition of the strategies, which will lead the development the whole process.

It is possible to consider the planning stage as a former cycle of many project cycles derived from the planning process.

In relation to the identified projects, we may consider that many of them (most of them) involve specific software development projects, which will follow their own development methodology, and will be based on the RUP generic proposal. The reference model for the development process is the spiral model, with all of its implications, especially in relation to the interaction between its phases and resources.

5.2 Phase 1 - Conception

The main objective of this phase is to obtain the user needs (requirements), changing informal requirements to formal ones, aiming the formalization and the reduction of risks specially concerning the project's comprehension. This way, the demandant team must create a document called **Development Intention (DI).** It must contain the overview of the project from the user's point of view.

As a result of the conception phase, a document called **Project Preliminary Specification (PPS)** must be created. It must define the logic of domain of the application for the project and its scope (characteristics and restrictions), that is, the purpose of the project, detailing the document of development intention. At this point, the sponsor agrees only on continuing the studies, aiming to better specify the project and to build the team, required competences, beginning of the contacts looking for a specification of the requirements for building of the chronogram and necessary resources.

This phase tends to be fast concerning the estimate time, since it can happen one day after receiving the conception document. It is expected a period of 5% of the total time of the project for this phase.

5.3 Phase 2 - Elaboration

The basic objective of this phase is top develop an requirements analysis that goes deep enough in order to clearly identify the project's objectives, as well as its functional and non-functional aspects, defining the scope, the architecture and to manager possible risks.

This way, the PPS (Project Preliminary Specification) is a prerequisite of the phase, previously elaborated. From this moment on the work team is outlined, beginning a deep process of studies of the requirements of the system. In relation to the execution process of this phase, the project manager will intensely interact with the product team, looking for the comprehension of the project. The efforts must be guided towards the following activities: *Complementation of the requirements analysis, Potential Risks, Definition of the Essential Architecture and Chronogram and stated period estimation.* The figure 1 gives us an idea of how is the architecture evolution in the whole process.

Figure 1: the Architecture evolution in the process

Use the *Use Cases* and *Conceptual Model Domain* diagrams defined in the UML in order to complement the activities of this phase. The system will start its production phase (construction phase) from the acceptance of the project on (end of the elaboration phase. As result of this elaboration phase, it must be created a document called **System Project Plan (SPP)** of the system to be developed, containing functional and non-functional specification, all diagrams generated, chronograms and critical path identified, besides of the test plan and a well-defined architecture. In relation to the stated period for this phase, it depends on the agility of the process of obtaining information by the users involved and the internal work team. This phase must use an average of 15% of the total stated period of the project we believe.

6. CASE STUDY: APPLYING THE PROPOSED MODEL

Aiming to validate the proposed model in item 5, it is being used in the project in course in the e-Business Research Center DELL/PUCRS. To exemplify the applying of the proposed model, it is presented next the process regarding the

development of a specific tool for DELL e-business site.

6.1 Process Description

Coherently to the planning phase, the product manager of Dell (Austin, USA) has manifested the intention of developing a tool of e-mail marketing (E-mail Blitz). Immediately, the coordinators of the partner institutions verified the adherence to this demand in relation to the Strategic Planning of RC. The subsequent moment has involved a interaction between the ones responsible of the beginning of the project (Porto Alegre, Brazil) and the product manager (Austin, TX, USA) where the scope of the project was preliminarily defined and information were collected aiming a preparation of the document of Development Intention (DI).

It has been requested the sending of the DI by DELL (Austin, TX, USA) containing an overview of the tool, as well as the general objectives and the risks involved. After receiving this document, the idea of developing the software was presented to the leaders. In this meeting, the PM was assigned and the General Work Plan was adjusted.

A meeting with the PM was held to pass on the documentation of the existent project until the present moment, becoming the PM responsible of the interaction with the PM in Austin on every subject concerning this new project. It is important to say that the PM was supervised by two members of the group responsible for the RC, chosen in the same meeting, which role was simply supervision and help when needed (characterizing the tactical planning).

From the designation of the Project Manager, the process of refining requirements preliminarily identified has initiated, aiming to formalized the requirements colleted in the DI. The beginning of the analysis process of the requirements has tried to create a convergence in the view of the team from Austin and Porto Alegre. When a consensus was set, the conception phase was finished, creating a document of preliminary specification (PPS). This document has established a determinant milestone of this phase conclusion.

Concluded the conception phase, the elaboration phase takes place. The PM has focused efforts on outlining the work team, aiming to initiate a deepen process of studying the system requirements. This team yet in formation, was constituted of a system architect (ARCH) and a quality assurance analyst (QA). Since then, project team meeting were held to develop a more including analysis of the requirements, refining whatever is needed, creating Use Cases and Domain Model instanced through a class diagram. Figure 2 demonstrates one of the generated Use Cases Diagrams and Domain Models.

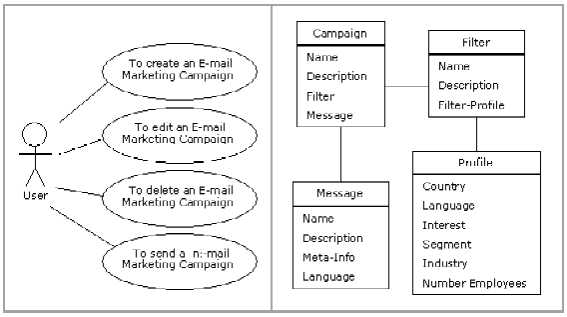

Figure 2: Use Cases Diagram and Domain Model

During the detailing of the requirements analysis, the supervisors of the project perform a significant role when tracing and critically analyzing the proposed directions, as much in the organization sphere as in the technical sphere, with special attention to the aspects involving the communication between the participants of Austin and of Porto Alegre. This role was performed through meeting and group dynamics involving all or part of the team engaged. It is clear that these communication aspects and the cultural differences existent were somehow significative in these stages and in the subsequent ones, reinforcing the perception of the importance of a stricter rigor in the communication process between the teams.

From the formal point of view, during the requirements analysis, were developed use case diagrams, domain diagrams, a risk management plan, preliminary test plan and essential architecture, as described in the proposed model. Other activities involved non-functional aspects, such as the migration aspects analysis, interface project etc.

Close to the ending of the elaboration phase, there was an adequate notion of the functional and non-functional requirements of the system, enabling possible the definitive set up of the work team that would be in charged of the phases of construction and transition of the proposed model. Aiming to level the acquired knowledge in the initial phases of the project, meetings were held in order to present all the existent material so far.

Only after feeling itself confident, the team was able to identify the activities and elaborate a comfortable chronogram for the project execution. This way, reinforcing the theoretical aspects of project management, the determination of the stated periods proposed and its execution was source of constant tension between Austin and RC teams.

Ending this elaboration phase, a document called System Project Plan (SPP), containing a functional and non-functional specification, the generated diagrams, identified critical path and chronograms,

besides the test plan and the architectural basis generated. The SPP was the milestone that marked elaboration phase conclusion. Its acceptance by the Austin team characterized the transition between the phases of elaboration and construction. As an example, the figure 3 shows the essential architecture generated.

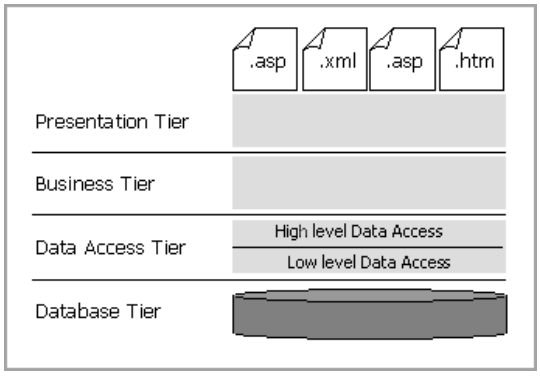

Figure 3: the generated Essential Architecture

Regarding the objectives of this paper, the use case has been focused only in the planning, conception and elaboration phases. The support tools used were Rational Rose and MS-Project.

7. FINAL CONSIDERATIONS

The proposed model resulted from the necessity to find answers to a critical problem presented to us by our work environment. This problem is centered on communication difficulties derived from physical and cultural distances between users and developers groups. In these manner, an answer was searched in the formalization of a communication and specification process, having roles well defined to the participants, besides adopting patterns universally accepted in the software engineering area, such as Object Orientation, UML Language and the Unified Process of software development and requirements engineering.

Great potential is identified in advancing these research line, where the high points evolve a partnership between academy and industry, creating unique experimentation and learning conditions, recurrent from a positive synergy between partners.

REFERENCES:

Kruchten, P., 2001. *The Rational Unified Process an Introduction*, 2nd edition.

Fowler, M., Scott, K., 2000. *UML distilled: applying the standard object modeling language*, 2nd edition.

Larman, C., 2000. *Using UML and standards: an introduction to the analysis and to the object oriented project (in Portuguese)*.

Cantor, M., 1998. *Object-oriented management with UML*.

Jacobson, I., Booch, G., Rumbaugh, J., 1999. *The unified software development process*.

Quatrani, T., 2001. *Visual Modeling with Rational rose and UML (in Portuguese)*.

Lederer, A.L. and Sethi, V. The implementation of strategic information system planning methodologies. *MIS Quarterly* (12:3), September 1988.

King, W.R. How effective is your IS planning?. *Long Range Planning* (21:2), 1988.

Boar, B. *The Art of Strategic Planning for Information Technology*. New York, John Wiley and Sons, 1993.

Venkatraman, N. Beyond Outsourcing: Managing IT Resources as a Value Center. *Sloan Management Review*, spring 1997.

Reich, B. and Benbasat, I. Measuring the linkage between business and information technology objectives. *MIS Quarterly*, March 1996.

Porter, M. E. and Millar, V. E. How Information gives you competitive advantage. *Harvard Business Review*, Boston, Jul/1995.

Service, R. and Boockholdt, J. Employing information systems for competitive advantage. *Proceedings of AMCIS*, Long Beach, CA, 2000.

Kearns, G. and Lederer, A. Alignment of IS plans with business plan: the impact on competitive advantage. *Proceedings of AIS 97*, Indianapolis, USA, 1997.

Lederer, A. and Salmeia, H. Toward a theory of strategic information system planning. *Journal of Strategic Information System*, 1996.

Gottschalk, P. Strategic information system planning: the implementation challenge. *Proceedings of AIS 97*, Indianapolis, USA, 1997.

Gottschalk, P. *Content characteristics of formal information technology strategy as implementation predictors*. Ph.D. Dissertation. Henley Management College, Brunel University, 1998.

Reponen, T. The Role of Learning in Information System Planning and Implementation. In: GALLIERS, H. e BAETS, R. *Information Technology and Organizational Transformation.* Chichester, England, John Wiley and Sons, 1998.

Sprague, R.H. and McNurlin, B.C. *Information Systems Management in Practice.* Canada, Prentice Hall, 1999.

Valacich, J., George, J. e Hoffer, J. Essentials of Systems Analysis e Design. Prentice-Hall, NJ, 2001.

Martin, J. and O'Dell, J. Object Oriented Methods: A Foundation. Prentice-Hall, NJ, 1998.

[i] Article developed in the E-business Research Center DELL/PUCRS, sponsored by DELL Computers, through the Brazilian Law on Information Technology.