A PROJECT MANAGEMENT MODEL TO A DISTRIBUTED SOFTWARE ENGINEERING ENVIRONMENT

Lúcia Norie Matsueda Enami,Tania Fatima Calvi Tait, Elisa Hatsue Moriya Huzita
Department of Informatics, State University of Maringá, Colombo Avenue 5790, Maringá-Paraná, Brazil

Keywords: Project Management, Distributed Development, Global Software Development, Virtual Teams, PMBOK, CMMI.

Abstract: This article presents a project management model (PMM) to a distributed environment that will be integrated to the DiSEN (Distributed Software Engineering Environment). The model purpose is to supply to the interested ones in the software project management the pertinent information and treat the aspects of the team member's physical distribution. It was based in PMBOK (Project Management Body of Knowledge) and CMMI (Capability Maturity Model Integration) and the issues treated by the PMM include cultural differences between the members, distribution of knowledge, a tool to facilitate the communication between members, standardization of documents and motivating people geographically dispersed.

1 INTRODUCTION

The evolution of technology and the growing use of Internet has been made possible the distributed development of software (DDS). However, this possibility requires an effective control of activities related to software development that is treated by project management.

Project management benefits organization, high level managers, leaders, team members and clients giving: more productivity, more profits, more capacity in business solutions, better trust and previsibility in the organization's power, and more satisfaction in doing the work (Cleland and Ireland, 2002).

Project management area has barriers, such as: the organizational culture, conflicts, lack of communication and the need of manager's ability. More specifically, in the software project management area there are more difficulties to management, such as: changing technology, turn over of people with specific abilities about the technology and the intangibility of software that makes necessary the creation of artifacts and documentations to evaluate it. With the physical distribution of team members, all of this becomes more complex because of the cultural differences and communication difficulties.

In the construction of DiSEN[1], it becomes clear the needing of a project management model (PMM) to fulfill the lack related to software project management. This article presents a PMM to a distributed software engineering environment.

This article is organized as follows: the section 2 presents DiSEN, the section 3 describes the PMMs found in literature that provides the base to the proposed PMM with a comparison between them. The section 4 presents PMM proposed to DiSEN and the last section the final considerations.

2 DISEN

To treat the DDS giving support to the project management, DIMANAGER tool and a mechanism to aid the selection of human resources were developed to DiSEN.

DIMANAGER aids the project manager to plan and control projects in an environment with DDS. In DIMANAGER, it is possible to register: general information of projects, project activities, the human resources and duration associated to each activity, the effort in man-hour to execute the activity and the technical and organizational problems that can occur in the activities executions (Huzita *et al*., 2004). Besides, it is possible to get managerial information by reports and graphics.

The mechanism developed aids the project

[1] DiSEN = project in execution at Informatics Department of State University of Maringá (HUZITA, 2004).

Norie Matsueda Enami L., Fatima Calvi Tait T. and Hatsue Moriya Huzita E. (2006).
A PROJECT MANAGEMENT MODEL TO A DISTRIBUTED SOFTWARE ENGINEERING ENVIRONMENT.
In *Proceedings of the Eighth International Conference on Enterprise Information Systems - ISAS*, pages 382-387
DOI: 10.5220/0002447903820387

manager to select the person with best ability to develop each activity in project (Huzita *et al*., 2005).

The work, that have been done, will contribute to formalize a PMM to the DDS because they undertake specific functions related to project management such as coordinating, organizing, controlling and leading.

3 PMM

A PMM is a way to represent the project management in a high level of abstraction and according to Cleland and Ireland (2002), it guides the project manager in using a systematic approach to manage projects efficiently.

Among the analyzed models, we considered: the PMBOK (PMI, 2000), the CMMI (SEI, 2002), the PMM based on PMI (Project Management Institute) to a software development environment physically distributed (Zanoni and Audy, 2003) and MuNDDoS (Prikladnicki *et al*., 2004). A brief description about each of them is given next.

3.1 PMBOK

This model is divided in nine knowledge areas (PMI, 2000) composed by processes: 1) Integration Management; 2) Scope Management; 3) Time Management; 4) Cost Management; 5) Quality Management; 6) Human Resource Management; 7) Communication Management; 8) Risk Management; and 9) Acquisition Management.

Each of the processes has inputs, tools and techniques. The processes were categorized again in five groups to get a better visualization of when to execute each process. They are: initialization, planning, executing, controlling and closing.

3.2 PMM Based on PMI

The main characteristics of this model are: 1) The spiral life cycle; 2) The use of OO paradigm, with UML (Unified Modeling Language) and the UP (Unified Process); and 3) Incorporate the PMBOK extending the knowledge areas in more four areas.

The extensions proposed to the PMBOK (PMI, 2000) are: 1) ***Planning Management***: A strategic planning will guide the business to a future-oriented work and a operational management will be responsible by the goals execution; 2) ***Intellectual Property Management***: to care about the legal issues of copyright; 3) ***Learning Management***: to care about the creation of mechanisms to transform the individual knowledge in an organizational knowledge; 4) ***Conflict Management***: to solve the conflicts generated by the cultural differences and the physical distance between the project team members.

3.3 CMMI

It was considered as a PMM because it treats the processes that are related to the development of software, what includes project management. This model aims to evaluate and guide the organizations to get capability and maturity in software development and is composed by five levels of maturity (SEI, 2002). They are: 1) **Initial**: the success depends on the competence of people. The organizations in this level produce products and services that work but exceeds the budget and time of their projects; 2) **Managed**: the processes are planned, executed, measured and controlled. The products and services of work satisfy the requisites, standards and goals specified for them; 3) **Defined**: the processes are documented, standardized, integrated and specified under-measure to the organization; 4) **Quantitatively Managed**: quantitative measures are made, stored and statistically analyzed to give support to decisions fact-based; 5) **Optimized**: the process is improved in a continuous way with the quantitative knowledge of process and using innovated ideas and technologies.

Each of these levels has process areas that have: specific and generic goals and specific and generic practices.

3.4 MuNDDoS

MuNDDoS (Prikladinicki *et al*., 2004), is a reference model to evaluate and guide the organizations to get maturity in the DDS. It is composed by three cycles: 1) Strategic Planning: composed by the following workflows: identification of new project and project´s allocation to the distributed sites; 2) Tactic/operational planning: where the project is developed; and, 3) Knowledge: composed by project's evaluation and feedback workflow.

It presents the processes and issues to be treated in the DDS to the three cycles.

This model like CMMI is divided in four levels: initial, basic, planned and optimized. Each level is a foundation to the next. In the initial level, only the process of reception of new projects exists. In the basic level, to develop projects, all the issues presented by the model are considered. In the planned level, the strategic and tactic/operational planning cycles exist and in the optimized level, the knowledge cycle is included.

3.5 A Comparison Between the Project Management Models

Table 1 shows a brief comparison between the PMMs presented.

PMBOK (PMI, 2000) may be used to all projects and presents: the tools and techniques that are a consensus to the project management community. CMMI (SEI, 2002) may be used to software projects and guides the organizations to get maturity and capability reaching the levels one through five. It presents the goals and practices that must be reached.

The PMM based on PMI to a software development environment physically distributed (Zanoni and Audy, 2003) aims to treat the physical distribution of project team members with the four extensions proposed and it is useful to software projects that intends use UML and UP in a distributed way.

MuNDDoS (Prikladnicki *et al*., 2004) evaluate and guide the organizations to get maturity in the development of software in a distributed way and presents relevant issues that must be considered in a distributed environment.

The four models presented can be used in DiSEN in a different way: PMBOK is more generic and can be used in projects of all areas. CMMI, the PMM based on PMI and MuNDDoS have specific characteristics applicable to the software development and the PMM based on PMI and MuNDDoS are applicable to projects in a distributed environment.

4 THE PROPOSED SOFTWARE PMM

The PMM proposed to DiSEN considered issues related to project management area, software project management area and issues related to physical distribution of team members. Besides this, the model considered the works developed in DiSEN related to project management. The proposed PMM includes: 1) PMBOK (PMI, 2000); 2) the intellectual property management proposed by Zanoni and Audy (2003); and, 3) the strategic workflows proposed by Prikadnicki *et al*. (2004). Besides this, the PMM presents solutions to treat the cultural differences, communication problems, knowledge distribution and standardization in a distributed environment.

4.1 Determinant Elements to the Proposed PMM

The determinant elements to the PMM was: 1) Identify the users of DiSEN and the information required to manage the projects; 2) Determinate a database with project information to each user; 3) Use PMBOK as a reference; 4) Use CMMI to construct a basic structure to allow the organizations achieve level 2; and, 5) Create models of documents to facilitate managing projects.

The users categories and information identified to each one are: a) Clients: that would like information about the project progress; b) Developers that need information about their schedule and the situation of artifacts and material resources; c) Project managers who need information to plan, control, motivate, lead, drive and organize the project; d) General managers that need information about the performance of the project managers and the situation of projects under their supervision; e) Managers who are responsible by the project portfolio management that need information to select, evaluate and prioritize the projects (Reyck *et al*., 2005) and f) Group managers, cited as caretakers (Powell *et al*., 2004), that manage each dispersed group and execute functions that have better results if done face-to-face. This kind of manager needs information to motivate and lead team members.

Each user category in the project will supply and receive the information in a standard way.

PMBOK was used to understand issues related to project management area and identify solutions to DiSEN.

CMMI-Level 2-Defined was used to: develop a basic structure that supports the organizations using DiSEN to get level 2 and to create document models to facilitate the communication between team members and the information searching.

The PMM proposed differs from the models studied in presenting a vision of project management in a distributed software engineering environment that: 1) Emphasizes an initial training to minimize the communication problems; 2) Concerns with the project knowledge distribution; 3) Points out the need of more functionalities in DiSEN; 4) Presents document models to facilitate standardization; 5) Suggests the “group manager” to manage each group geographically dispersed.

Figure 1 shows the DIMANAGER tool provided by DiSEN. Everyone in the organization will receive the information registered in the repository through DIMANAGER. The use of DIMANAGER will standardize the documents provided.

Table 1: Comparison between the PMMs.

Model / Element	PMBOK	CMMI	PMM Based on PMI	MuNDDoS
Goals	Present the "best practices" in Project Management	Evaluate the capacity and maturity of organizations	Present a project management vision to an environment with DDS	Present a reference model to a DDS
Components	9 knowledge areas: 1. Integration, 2. Scope, 3. Time, 4. Cost, 5. Quality, 6. Human Resources, 7. Communication, 8. Risk and 9. Procurement. 5 Groups: 1. Initiation, 2. Planning, 3. Execution, 4. Monitoring and Controlling and 5. Closing. The 9 knowledge areas and the 5 groups are composed by the same processes.	5 levels: Initial, Managed, Defined, Quantitatively Managed and Optimized. Each level has process areas composed by: specific goals with specific practices and generic goals with generic practices.	6 phases: requisite analysis, project, production, evaluation, transition and integration. The 9 knowledge areas of PMBOK and 4 extensions: Planning, Intellectual Property, Learning and Conflict.	5 levels: initial, basic, planned, optimized. Each level has some of the following workflows: (1) identification of new projects; (2) projects allocation in the distributed sites; and , (3) evaluation and feedback To develop projects, 5 categories are considered: Process, Project, Stakeholders, Organization and Dispersion. Each category has relevant aspects to be considered.
Tools, Techniques and Methodo-logies	Each process has tools and techniques suggested to execute the process.	In some practices, there are tools and techniques suggested.	Spiral Life Cycle, UML (Unified Modeling Language), e UP (Unified Process)	-
Outlets	Each process has outlets that usually are the entries to another process.	Each process area presents a list of products to be delivered.	Artifacts specified in UML e UP	A roll of projects: to be developed; candidates to distribution; that can be distributed. Sites that can develop each project.
Developed by	"Consensus" of the project management community	Industry Organizations, Government and SEI (*Software Engineering Institute*)	Zanoni – Study Case	Prikladnicki – Study Case
Coverage	To all projects	To software projects	To projects that intend to use UML and UP in the DDS.	To projects that intend to use DDS.

4.2 Initial Training

An initial training is proposed to be applied to team members to minimize the problems with communications which can arise because of the cultural differences involved. The problems that can occur were related by Carmel *apud* (Olson and Olson, 2004) and include: the way they consider hierarchy and the form they manifest it; their individual goals; the relevance of the job for people; the quantity of risk avoidance; how long they work future-oriented; and, the way they consider deadlines and make deals.

The initial training will be focused in: 1) Communication: how, who, when, how many times, by what mechanism it will be done; 2) DiSEN: It is necessary that team members know DiSEN to use the environment in an appropriate way; 3) Cultural differences: the involved cultural differences may be understood to create a standard way to know the

meaning and avoid or minimize problems; 4) Organizational structure: showing who is responsible and have the authorization in making decisions is important to give direction to team members.

4.3 Knowledge Distribution

The project detailed information may be stored in the local repository of DiSEN where it was created, and the general project information may be stored in the global repository. This type of distribution was presented by Desouza and Evaristo (2004) because the detailed information, such as: timesheets, milestones, meeting minutes and training manuals does not interest to most of people in the organization and, in many cases, needs to be updated daily what can result in high network traffic and irrelevant search results. On the other hand, the general information such as: project team members, deadlines, cost and benefit analysis, customer commitments and expectations and post hoc analysis information interest everyone in organization and doesn't need the daily updating what makes it more useful to be centralized.

The general information of projects can be accessed in a centralized repository that serves as an index and if someone is interested in detailed information, it can be accessed in the local repository where the project was created and updated.

4.4 More Functionality in DiSEN

To control the project information in a distributed environment, it is necessary to register and control more information about the project, such as: the distributed places involved, the human and material resources of each distributed place registered in DiSEN; the responsability/authority of the people involved in the project; knowledge, ability and training of team members; and, cultural issues of everyone in organization.
DiSEN supplies these functionalities giving support to the software project management in a distributed environment. It standardizes the way to store and retry information about the project.

4.5 Motivation

To give the motivation to each team member and reward each one appropriately, the group manager must know what are his/her needs. The people needs in the Maslow Hiearchy are presented in five levels (CLELAND and IRELAND, 2002): 1) Basic and physiologic needs; 2) Security needs; 3) Social needs; 4) Self-esteem and Status needs; and 5) Solemnity-accomplishment needs.

The individuals had values and needs that differ from each other. And to get this information, an initial questionnaire was suggested to be applied.

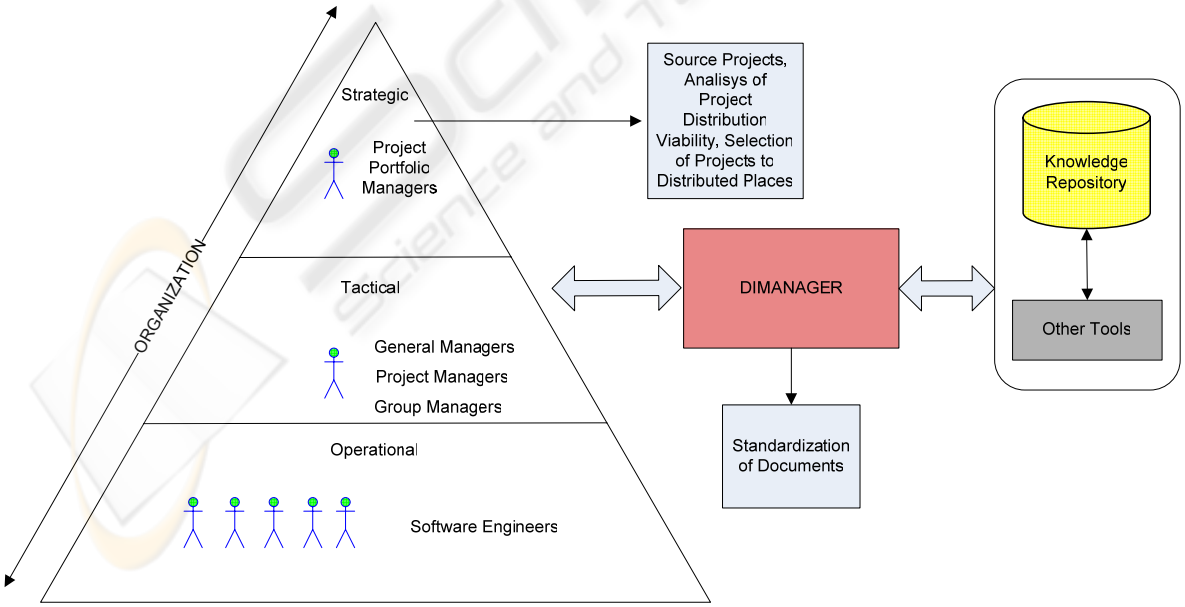

Figure 1: Supply of Information for the Management of Projects in DiSEN.

4.6 Document Models

To facilitate the comprehension of project management, a standardization of document models is supplied. The document models proposed include those that refer to CMMI at level 2-Defined (SEI, 2002): requirements management, project planning, monitoring and control, supplier management, measurement and analysis, product and process quality assurance and configuration management. The document models standardization will contribute to process quality facilitating the search of project information since everyone must know where it will be.

5 FINAL CONSIDERATIONS

To validate the proposed PMM, a prototype will be developed and a questionnaire will be applied to project managers to evaluate issues related to project management and another one will be applied to DiSEN team members to evaluate the accordance with the environment.

Further, the collection and storing of the type of solution given to a specific problem like done by Strafacci (2002) will make possible to generate a specialist system in project management which will help the project manager to make decisions in projects.

ACKNOWLEDGMENTS

Thanks to CNPQ for financial support.

REFERENCES

Cleland D. I.; Ireland L. R., 2002. *Project Manager´s Portable Handbook*, McGraw-Hill. New York.

Desouza, K. C.; Evaristo, J.R., 2004. Managing Knowledge in Distributed Projects. *Communications of the ACM*, 47(4), p.87-91.

Huzita, E.H.M., 2004. Suporte à Reutilização em Ambientes Distribuídos de Desenvolvimento de Software. Projeto de Pesquisa em Desenvolvimento (CNPq) no Departamento de Informática – Universidade Estadual de Maringá. Paraná. Brasil

Huzita, E.H.M. et al., 2004. DIMANAGER: A Tool for Distributed Software Development Management. *In*: ICEIS´04 6th *International Conference on Enterprise Information System Porto-Portugal.* Portugal: ICEIS Press, 659-662.

Huzita, E.H.M. et al., 2005. Um Mecanismo de Suporte ao Gerenciamento de Recursos Humanos no Desenvolvimento Distribuído de Software [CD-ROM]. Concordia-EntreRios-Argentina Available from: CACIC-Congreso Argentino de Ciencias de la Computación.

Olson J.S.; Olson, G.M. 2004. Culture Surprises in Remote Software Development Teams. ACM *Queue,* 1(9), 52-59.

PMI, 2000. *A Guide to the Project Management Body of Knowledge.* Pennsylvania-EUA: Project Management Institute Publications.

Powell, A. et al., 2004. Virtual Teams: A Review of Current Literature and Directions for Future Research. *The DATABASE for Advances in Information Systems*, 35(1), 6-36.

Prikladnicki, R. et al, 2004. A Reference Model for Global Software Development. *In*: PRO-VE at 18th IFIP World Computer Congress, 22-27 August 2004 Toulouse-France. Toulouse-France: Kluwer, 369-378.

Reyck B.D., 2005. The Impact of Project Portfolio Management on Information Technology Projects. *International Journal of Project Management* [online]. 23(7). Available from: http: //www.sciencedirect.com [Accessed 10 Oct 2005].

SEI, 2002. CMU/SEI-2002-TR-011-Capability Maturity Model Integration, version 1.1, Staged Representation [online]. Carnegie Mellon University. Available from: http://www.sei.cmu.edu/ [Accessed 15 Apr 2005].

Strafacci, V. J., 2002. *Uma Metodologia de Gestão para o Desenvolvimento de Software*, Tese (Doutorado). Instituto Tecnológico de Aeronáutica.

Zanoni, R.; AUDY, J.L.N., 2003. Project Management Model for a Physically Distributed Software Development Environment. EMJ Special Issues-Engineering Management Journal [online].Special Issue on Project Management in Information Systems and Technology. Avaiable from: http://csdl.computer.org/comp/proceedings/hicss/2003/1874/08/ [Acessed 20 Jul 2005].