DEVELOPING PROJECT MANAGER COMPETENCIES THROUGH SIMULATION MODEL

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ABSTRACT
Companies are increasingly relying on project management to help them complete projects more efficiently and effectively (Cleland & Ireland, 2002; PMI, 2000). Therefore, successful project management requires that Project Managers have a high level of flexibility and understand and use suitably their knowledge and skills in this matter.

The project management area encompasses a large set of specific knowledge, as has been identified in the Project Manager Competency Development Framework (PMI, 2001), therefore, Project Managers must have an understanding of the most relevant aspects of industry and management that most likely will be encountered in projects. It is not enough for the project manager to have conceptual knowledge of project management methods and practices; they require a strong knowledge base and the ability to effectively apply that knowledge base in complex operating environments.

The challenge, then, is to develop more efficient training methods to enhance project management knowledge and to allow that project managers are able to apply and transfer this conceptual knowledge into organizational practices (J. K. McCreery, 2003); due to, that is impossible to learn by simply reading a book or by attending a seminar.

This paper describe how the theories about project management knowledge and practice, the framework of learning, the basis of simulation games, the results obtained in a intervention made in a “pilot” organization and a survey of learning practices in Mexican and Spanish companies who works by project, have been translated into a Simulation Model to develop Project Manager Competencies. The paper also includes some results of a pilot application of the model in a Research & Development organization at the petroleum industry.

RESUMEN
Este documento describe el Modelo de Simulación para desarrollar las competencias de los Directores de Proyectos. Se detalla de forma particular, cómo, las áreas de conocimiento y prácticas de la Dirección de Proyectos; las premisas y fundamentos teóricos que influyen en el aprendizaje y de los juegos de simulación, así como la información obtenida de un Estudio de Campo aplicado en diversas empresas mexicanas y españolas orientadas a trabajar por proyectos y los resultados de una Intervención realizada en una organización de I+D+i, han sido traducidos en elementos del Modelo de Simulación.

Asimismo, se presentan algunos resultados preliminares de la aplicación piloto del Modelo de Simulación, dentro de una organización de I+D+i del sector de la industria petrolera.
INTRODUCTION

Project management has become a well-accepted way to manage organizations. Corporations as AT&T, Microsoft, Bell Atlantic, US West, Motorola, GSK, Novartis, Citibank, Shell, BP, and others, demand that their employees and subcontractors engaged in project management activities should be PMP’s (Alquie N, et al 2005). Therefore, the number of people certified around the world increase every day.

Since 1984, over 89,457 PMP® certificates have been emitted worldwide (PMI, 2004); IPMA has certified 7,318 persons in level C since 1998 (IPMA, 2004); and AIPM has a total number of 880 Registered Project Managers since the beginning of the program in 1976 (AIPM, 2004).

Project Managers must demonstrate that they have enough competencies to manage their projects successfully. They must handle conceptual knowledge of methods, tools and practices in this area, but also they must be able to apply effectively this knowledge in complex operating environments.

In this context efficient learning methods as simulation are necessary to enhance project management knowledge and to allow experimentation; by these means, Project Managers are able to test their conceptual knowledge by applying it into specific situations (McCreery, 2003).

This paper attempts to deal with this topic. It explain how, the theories about project management knowledge and practice, the framework of experiential and organizational learning and the basis of simulation games have been translated into a Simulation Model for a R&D organization at the petroleum industry in order to develop project manager competencies.

1. RESEARCH METHOD

This research has been focused on an empirical study based in three fields: a) theoretical framework of the learning process, simulation games, learning laboratories and the experiential learning; b) general requirements of project management competencies and; c) learning practices used in organizational environments to promote learning.

These concepts are blended to construct a Simulation Model oriented to develop project management competencies and, as well, to create a useful experimentation tool to accelerate the learning process.

1.1 Theoretical framework.

The purpose of this study is to explore the practices and methods for learning. It is based on the analysis of simulation techniques, the procedures which allow the learning process and the elements and mechanisms for fast learning.
The main theories analyzed are: experiential learning (Kolb, 1984), learning style (Kolb 1976, Honey and Mumfords, 2000), creation of knowledge through the interaction and conversion between tacit and explicit knowledge (Nonaka and Takeuchi 1999), and the base of simulation game (Saunders, D. 1995, Greenblat C. 1989). With this framework, the bases of the Simulation Model were established.

1.2. General Requirements of Project Managements Competencies

There are several professional associations devoted to build the body of project management knowledge based on “best practices”, such as the International Project Management Association (IPMA), the Project Management Institute (PMI) and the Australian Institute of Project Management (AIPM).

These associations have schemas for Project Managers certification, as the IPMA’s 4 Level Certification Program, that operates on the basis of its National Competence Baseline (IPMA-2004), The PMI’s Project Management Professional (PMP®) linked with the Project Manager Competency Development (PMI-2002), The AIPM’s Registered Project Manager “RegPM” based on the National Competency Standards of Project Management (NCSPM).

Ones of the main features of these project management certification models are that they have been focused on the essential competencies, skills and knowledge, of a Project Manager (Pinto, 1995). However, competence requirements can be specific for each company, thus the general framework must be aligned to the company’s values, culture, processes and practices. Therefore, organizations should develop their own definitions of Project Manager Competencies, creating a customized framework designed for the specific environment where their projects take place.

Related to this topic, an intervention was made in a R&D organization at the petroleum industry that manage its operations by projects (Aquino Z, 2004-2). The intervention process was based on the theoretical framework of the Action Science (Argyris C. et al, 1985), and its aim was to identify the required competencies for Project Managers in this particular organization in order to develop a customized training tool.

The Management Competencies Model of this organization, gather 25 units of competencies aligned with its core business and strategic activities, such as catalysis, geophysical, chemical, product development, etc., everyone of its employees (about 3.000) belongs in one of these units according to their technical expertise.

In addition to their technical discipline, 387 employees are Project Managers so they also belong to the “project management competence unit”. This unit defines a standard for Project Manager Competence that is aligned with the three dimensions of competencies established by PMI: Project Management Knowledge, Project Management Performance, and Personal Competency. This standard also establish other specific requirements such as proficiency to handle SAP system, subject specific competencies, knowledge in specific legislation, proficiency to manage quality systems and knowledge in business processes.

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1 Subject specific competences are the relevant methods and techniques pertaining to various discipline areas, including skills and knowledge according to the job
This unit of competence has in charge to following up the Project Manager Career prospects and to provide a method to identify the critical aspects of his job, figure 1. These two tasks provide an essential framework to analyze and identify project requirements, to establish performance expectations, to assess career development, and to plan Project Manager's continuing education.

![Project Management Competencies Model](image)

**Figure1. Project Management Competencies Model**

### 1.3 Learning Practices and Project Manager Learning Style

Today is widely accepted that competencies are sustained not only in knowledge, but also in skills, attitudes and behaviours, normally obtained and reinforced through knowledge application and experience. A training process can be a valuable tool to apply knowledge in specific situations, however, in order to be effective, a training programme must consider the learning profile of trainees and their learning methods preferences.

In this context, a survey was carried out in a sample of 74 Project Managers from 24 companies that manage their operations by projects (Aquino Z, 2004-1). The purpose of this study was to investigate about the Project Manager learning styles (Honey & Mumford, 2000), the learning methods preferences CCMD, 1999) and the organizational learning practices. With this information it is possible to assess and select the most suitable learning methods for a particular learning style, such as, analytical reviews, lectures, readings, self study, etc.

In the survey, participants consider that "formal methods" as seminars, courses, congress, conferences, etc., are the most common learning tools in their organization to promote the learning process. However the respondents also believe that “informal methods” are more useful for their learning process. About the learning style of Project Managers, it has been found that the dominant style is clearly the Reflector, followed by the Theorist, the Pragmatist and, finally, the Activist. (Aquino Z, 2004-1)
These data provide ideas about the kind of exercises and the environment that could be developed into the Simulation Model, for example, interaction with colleagues, working sessions, working by doing, visual and audio supports, etc.

2. THE SIMULATION MODEL

The Simulation Model is based on the simulation laboratory for the analysis of change process in industries (Smed R, 1996) and also on the project management simulation laboratory (Sáenz, M.J 2000). The idea of these laboratories is to provide an experimentation environment, where tailored models of processes are applied and data of company are used.

The Simulation Model intends to integrate the requirements for Project Manager Competencies, but also suitable elements that promote an accelerated learning process. Through an experimentation tool, this model expects that Project Managers could apply their knowledge in an organizational environment for a particular project, so they can understand the whole dynamic of the company, see figure 2.

Figure 2. Simulation Model to Develop Project Manger Competencies

The Simulation Model has been designed as a modular system. Each of its four modules has a specific function to support the learning process of project management tools and the best practices in this discipline. The inputs identified in the empirical study are translated, into every module as requirements and specifications to promote rapid learning in project management field. This information is also useful to create a friendly environment that motivates learning (Aquino Z, 2004-1). The next sections describe some details about each ones Model’s module.
2.1 Experimentation Module

The main element of the model is based on an interactive simulation game, named sIMProj©; this game is a customized experimentation tool for the R&D organization. This game incorporates project management competencies (general and organizational requirements), Project Manager learning style and learning methods. The simulation game includes scenarios, a situation booklet and solutions. It also integrate some elements and methods that promote an accelerated learning process as "learning by doing", visual supports, and case study (Lyinn, G.S et al 2003).

It contains the description of several situations showing the key aspects about particular projects for this kind of organization. During the game, the users play the role of Project Manager, they must analyze the booklet information and make the best decision according to their tacit knowledge and experience (Nonaka and Takeuchi, 1999). The simulation game creates opportunities to experience the dynamics of strategic issues normally found in real projects, so that Project Managers can demonstrate and practice their knowledge and behaviours (Riis et al. 1996).

All the situations are grouped in nine fields related to all knowledge areas identified in PMBOK. The topics are explored using various teaching techniques, which include lectures, case study analysis and mini-exercises. With these clusters it can be obtained the performance results in a global report or by fields of knowledge, in order to identify the areas where participants have improved their performance and those where they do not show any progress.

2.2 Implementation Module

This module establishes and defines the didactic mechanisms. It describes how to use the simulation game. It also presents the objectives, the answer sheet, and the scoring key. The simulation game is sustained on the bases of the learning laboratory that provides an experimental environment in which users share their knowledge and obtain insight into project management practice (Sáenz, M.J 2000).

2.3 Assessment Module

In order to measure the learning progress (knowledge and skills acquired), the Simulation Model uses two sources of information: the performance of participants during the simulation game, obtained from their individual score, and the User’s Knowledge Profile, sustained on the results of an assessment test applied to participants before and after the simulation game (Kirkpatrick D.L, 1999).

In order to improve the simulation game, this module also includes its evaluation as a didactic tool. In this matter, participants respond a questionnaire oriented to evaluate its usability, amenity, complexity and educational value.

2.4 Memory Results Module

All the outputs of the simulation process are integrated in this module; this information is analyzed to establish conclusions about the learning process as a whole. With these data the
User Knowledge Profile (UKP) is generated to identify Training Requirements (TR), when contrasting actual knowledge profile with competencies requirements.

2.5 Additional elements

Observers: They monitor the development of the simulation by appraising various performance parameters, previously defined, regarding the behavior of participants during the simulation game such as the group dynamics, communication, and decision making process.

Instructor: He/She facilitates the learning process, by teaching project management theories and giving instructions about the simulation game. He/She usually leads the briefing session (before the simulation game) where instructions and objectives are set, and also leads the debriefing and feedback session.

Participants: Are the core of the Simulation Model, they assume the project manager role during the simulation.

All the elements mentioned above consider different theories and approaches about: knowledge creation, individual and organizational learning, accelerated learning, learning style, simulation, training evaluation, as well as project management.

3. CONCLUSION AND FUTURE WORK

Competencies development for Project Managers requires an appropriate holistic training concept which should include at least two objectives: the acquisition of knowledge and skills required by their organization and by the project management associations, and the understanding about their tasks and responsibilities (Rauch-Geelhaar et al, 2003). The Simulation Model proposed in this paper considers both aspects, so it represents a suitable method to enhance competencies in a fast and efficient way.

This paper explain a Simulation Model that summarize all the aspects of competency development which establish a methodology and practical experimentation tool (sMProj©) to obtain the accurate knowledge and skills in project management and to generate rapid learning in this matter. This kind of tool, properly designed, allows experimentation within a carefully controlled educational framework.

Research about the use of simulation games as a training method, indicates that these tools improve participant knowledge levels as well as their ability to apply that knowledge (John.K. McCreery, 2003). The Simulation Model described in this paper is a customized, and interactive, learning tool which offers the possibility to learn more efficiently than with other didactic methods.

At this moment, experimentation process and model validation is in course. To date, it has been identified a pilot group (27) in the R&D organization in order to probe the model as a whole. However, a few experiments have been conducted with some components, such as the simulation game, obtaining reasonable results about the effectiveness to develop project manager competencies.
REFERENCES


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