ANALYSIS OF DECISION-MAKING MODELS FOR PROJECT MANAGEMENT

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Abstract

In the present paper an empirical study about the decision-making processes in Project Management areas in valencian SMEs is presented. The work is based on previous studies where it was concluded that:

- the decisions made in Project Management environments are of the type multicriteria, multiexpert and discrete,
- Valencian SMEs do not use any Decision Support System.

The following work is focused on establishing relationships between the companies decision making models and their Maturity Model in Project Management. The methodology used is based on qualitative research techniques, e.g. focus interviews. These relationships obtained will be used as guidelines to propose a Decision Support Methodology based on MCDA techniques to help these companies.

Key words: *Project Management, MCDM, PMMM, decision making*

1. Introduction

A previous survey conducted by the authors of the present work (Poveda et al., 2005; García et al., 2006; García et al., 2005) revealed that the analysis of Project Management decision processes has been mainly based on existing approaches, models and tools for General Management, a field which presents significantly different characteristics from the one under study. Therefore there is a methodological niche and the urgent need for the development of a decision analysis tool that takes into consideration the particular nature of project management. This support tool will allow a more systematic and rigorous decision-making process throughout the project life cycle as well as high excellence in the project management process for successful project implementation.

On the other hand, the need of working with faster and more flexible organizational structures, which forces companies to operate through projects that successfully materialize their objectives, as well as a more competitive business market make it necessary that the

successful results of one project can be extended to future projects through the use of standardized procedures. In this context, new management techniques and tools adapted to project development that allow for systematization and standardization of project management procedures have to be developed to reach acceptable levels of maturity in project management.

Maturity in Project Management consists of developing repeatable processes and systems leading to project success (Kerzner, 2000).

The present study is part of a wider research work on Project Management decision-making processes with the main objective of developing a decision support tool to help Valencian companies in their project management decision process. The tool will allow decision makers to gain a better understanding of the decision problem and to model the main parameters involved in the decision process (alternatives, criteria, criterion weights, utility aggregation procedure …)

The decision support tool must solve decision problems found in Project Management (PM) processes and adapt to the level of maturity of the companies involved in the process. In this sense, the tool should provide a modelling system for solving complex PM problems.

Therefore, it seems reasonable to gain a deeper knowledge on the way decisions are made as well as on the organizational features of the PM processes used in the companies under analysis.

In a previous survey, a questionnaire was used to analyze the typology of the commonest PM decisions and the way companies formulate the decision-making problem. The present work describes the findings of an empirical study conducted on Valencian companies with the aim of classifying these companies according to their PM culture using a model that assesses their level of maturity.

2. Background

A previous survey conducted by the authors showed that the PM decisions made in Valencian companies are of a multiexpert multicriteria and discrete type. Based on the findings of that preliminary survey, in the present work the relationship between the use of conventional decision analysis models and the company's organizational culture in PM is analyzed.

The aim is to gain a deeper understanding both of the formal aspect of the decisions and of the organizational aspect of PM as a general framework for the application of the decision-making processes. For this end, in this work we analyze the level of maturity in PM within the organizational culture of the companies involved in the projects.

It is difficult for most companies to accurately determine the level of application of PM practices. One of the main reasons for classifying Valencian companies according to their level of maturity is to establish an unbiased indicator of the degree of definition of the processes and of the correct application of widely accepted PM practices and tools.

According to Ibbs and Kwak (Ibbs and Kwak, 2002) most companies consider the use of practices and support tools useful in project management processes as they permit them to adapt to changing business environments, yet they need a reference model for the efficient implementation of such tools. Project Management Maturity Models (PMMMs) emerge to provide companies with the necessary mechanisms to allow them to identify the key

opportunity and improvement areas in project management activities. Additionally these models serve to develop comparison indicators for the application of PM practices and techniques across organizations operating in the same business environment or sector.

Recent studies have identified the advantages of applying methodological practices and well-defined procedures in the area of PM. Most of such studies are based on research works conducted in the professional and academic environments. Some studies basically focus on qualitative assessment of PM practices and tools rather than on establishing quantitative indicators (Al-Sedairy, 1994; Boznak, 1988; Bu-Bushait, 1989; Cleland, 1993; Deutsch, 1991; Gross and Price, 1990; Kwak et al., 1995; Ziomek and Meneghin, 1984).

Other works analyze possible improvements in project success through the use of project-oriented organizational structures based only on the analysis of PM practices (Donnelly and Kezsbom, 1993; Gobeli and Larson, 1986; Larson and Gobeli, 1989; Lundin and Soderholm, 1994; McCollum and Sherman, 1991; Might and Fischer, 1985). More recently, Dooley (Dooley, 1998) has studied the impact of maturity and best practices on new product development projects.

In this work we present a new proposal for the quantitative measurement of the level of application of procedural methods and well-defined processes in the companies under study. The measurement procedure is based on Project Management Maturity Models (PMMMs). This will allow the quantitative comparison of the PM organizational culture in Valencian SMEs with the aim of establishing a relationship between this company's culture and the PM decision process.

The results of the analysis will then be used to define adequacy criteria which in future works will be used to develop a PM decision support system adapted to Valencian companies. For this end, our study uses the data from questionnaires sent to the Valencian companies under study. The results of the questionnaires were used to classify the companies according to the decision making model used: well-structured decision models vs ill-structured decision models.

3. Objectives

The objectives of the present work are:

- To classify Valencian companies according to their Project management culture using a model that measures their PM maturity level.
- To study the relationship between the companies' maturity in project management and the decision process. With this objective in mind, the impact of organizational maturity in project management on decision making processes is analyzed.

4. Research methodology

4.1 Stages of the survey

The different stages of the research are

- To review the state of the art in the areas of Project Management and Decision Making.
- To develop a methodology of general analysis of the companies' maturity level and of the use of decision making models.

- To design a questionnaire to identify the decision model used in the company.
- To analyze the data on the basis of how the company structures the decision making process.
- To strategically select the study cases (companies) of the survey.
- To design an interview outline in order to measure the level of maturity in Project Management based on PMMMs.
- To assess the degree of application of methodological practices and well-defined processes in PM (classifying the companies in levels according to PMMMs).
- To analyze the companies' strengths and weaknesses in decision making and PM.
- To establish the relationship between the decision models used and the companies' level of maturity in PM.

4.2. Survey design

The methodological approach is aimed at establishing the relationship between the companies' decision models and their level of maturity in PM. The methodology and survey were based on the Maturity Models proposed by the Software Engineering Institute (SEI) in 1990, Kerzner (Kerzner, 2000) and other renowned authors, as well as on PMMMs used by Project Management practitioners. The PMMMs propose 5 levels of maturity (initial, repeatable, defined, managed and optimizing). The most significant features of the methodology developed are:

Strategic selection of the study cases. Exes	Variables/Factors	Model/Procedure	Research methodology Tools/Analysis	Objective
Company size Decision models	-Project Management -Decision Making process	- PMMM - Decision Model vs. PMMM	-Decision model questionnaire / Statistical analysis -Interview guidelines PMMM / Qualitative analysis	Relationship between decision models & PMMM

Table 1: Methodology for establishing the relationship between decision models and maturity levels (designed by the authors).

The analysis conducted at this stage of the research is the basis for the subsequent development of a decision support tool. An in-depth interview with the decision makers was considered the best way to reach the first objective, i.e. to better understand the relationship between project management decisions and project management maturity.

The purpose was to discuss with the decision makers on key Project management issues: Decision Making Models, and PM methodological practices and standardized procedures; however a discussion on issues as intangible as these is a difficult task. For this reason we decided to focus the analysis on specific situations so that the respondent explained his/her

experiences in more detail. These personal experiences were then used as the basis of the discussion and further interpretation of relevant aspects for the present study.

The survey was devised in such a way that the respondent could analyze the project management processes and activities conducted on a specific decision-making environment. For example, decision makers were asked to describe the procedures for resource allocation followed in a particular project, focusing on how resource allocation decision problems were formulated.

The interviewed decision makers were asked to think about and describe situations according to certain criteria:

- The situations should belong to a well-defined Project: the Project should present well-defined strategic goals, extend over a given time length and be strategic for the company.
- The situations should be complex in the sense that they involve highly-qualified personnel from other departments and/or organizations and areas of knowledge.
- The respondent should have been actively involved in the resolution process.
- The situations should be extrapolable to the overall performance of the company in similar decision problems.

With their descriptions, the respondents were asked additional questions about their organization with the purpose of finding out the company's level of maturity.

Therefore, most of the empirical work focused on the identification of paradigmatic indicators about the companies' level of maturity in project management.

At this stage of the research, therefore, the basic tool was the in-depth interview, in the sense of a non-programmed standardized interview as defined by Vallés (Vallés, 1996), i.e. with certain general guidelines that are adapted to the particular conditions of each specific discussion. Most of the interviews lasted less than one hour and were recorded for further analysis.

4.3. Design of the in-depth interview guidelines

The guidelines of the first part of the survey were based on a questionnaire sent to the companies at an earlier stage of the research work. The results of the questionnaire allowed the classification of the companies into companies that follow a well-structured model and those which follow an ill-structured model in their decision making process. This classification was used in the strategic selection of the study cases (companies) for the present survey.

The second part of the survey focused on questions about how the companies develop their project management activities through standardized procedures. That is, how they structure and systematize project management processes by measuring their level of maturity.

The interview covered the following aspects:

- Detailed description of the selected decision case.
- Description of the stakeholders indicating their responsibilities and roles in the process.
- Questions about the decision making process.
- Questions about the company's degree of orientation towards the project.
- Questions about the status of the project management process. Mechanisms, project plan, monitoring and control tools.
- Questions about the stakeholders' degree of involvement in the project.

Although during the interview, the respondent felt free to express his/her opinions and viewpoints on the different issues, certain elements of the PM theoretical framework were included. Key conceptual categories were included in the interview with the aim of identifying the level of maturity (for example, when the respondents were asked to define "Project Office").

4.4. Strategic selection of the study cases

The selection of the survey sample followed the sampling criteria reported in Vallés (Vallés, 1996) about strategic selection of study cases based on the theoretical sampling approach that consists of generating a typological matrix by crossing two criteria in order to identify cases or situations within each resulting category.

The matrix that collects all the study cases (companies) distributed according to the decision model - company size exes is as follows: the numbers correspond to the companies as listed on the ARDAN Business Database of the IMPIVA (Valencian Institute of Small to Medium Sized Industries).

Size	**Well-Structured**	**Ill-Structured**
Medium	3, 10, 15*, 20, 22*, 33, 44, 51, 59*, 63, 64*, 69*, 74, 79, 80, 82, 83, 87, 90*, 93, 99*, 100*, 105, 107	50*, 70, 73*, 95, 106, 113, 116, 118, 121
Small	2, 4, 5*, 6, 7, 8*, 9, 11*, 14, 16, 17, 18, 19, 23, 25, 26*, 29, 31*, 32, 34, 35*, 36, 37*, 39*, 40, 41, 42, 43, 46, 47*, 48, 49, 52, 53*, 54*, 55, 56, 57, 60*, 61, 62, 67*, 71, 75, 77, 81*, 85, 88, 91*, 97, 98, 103, 108, 109, 110*, 111, 112, 122*, 124, 127	1*, 12*, 13, 21, 24, 27*, 28, 30, 38*, 45, 58*, 65*, 66, 68, 72*, 76, 78, 84, 86, 89, 92, 94, 96, 101*, 102, 104, 114, 115, 117, 119, 120, 123, 125, 126, 128, 129

Table 2: Surveyed companies distributed in the typology matrix. Strategic selection of study cases:*surveyed companies.

The survey was conducted on companies belonging to the four different categories as defined in the matrix. The companies were distributed in the matrix cells according to their answers to the questionnaire that had been sent at an earlier stage of the research and whose data were used to classify the companies on the basis of the decision model used. The survey of the four company groups was as follows:

- Midsize companies with well-structured decision models: a total of 8 interviews were conducted on project managers or heads of department who had actively participated in project management.
- Midsize companies with ill-structured decision models: the respondents belonged to two companies of this group and had profiles similar to the respondents of the above group.
- Small companies with well-structured decision models: subjects with similar profiles from 17 companies belonging to this group were interviewed.

- Small companies with ill-structured decision models: the interviewed subjects belonged to 8 different companies.

Although the strategic selection was determined by the cells in the matrix, the criterion of non-uniformity within each group was taken into consideration for the selection of the companies to interview in order to cover a wider range of companies. Thus, about 20% of the companies that had answered the questionnaire were interviewed. In order to cover a wide spectrum of possibilities, the selection was done on an organizational basis such as type of business organization (familiar, managerial different from ownership, filial-Head), industrial activities and geographical location.

On certain occasions it was not possible to personally interview the subjects in the selected companies. For such cases, a qualitative questionnaire that included the main interview issues was elaborated and sent by e-mail.

4.5. Survey data analysis and interpretation

After the interviews, the recorded material was processed and the interviews were typed and further summarized in the final report of results.

The survey guidelines described in Section 4.3 above helped the analyst to better organize (coding, classification, integration) the survey data.

The analytical processing of the data followed these four steps:

- The transcripts of the interviews were analyzed, and the segments related to key issues were underlined. Notes were taken on the sides to indicate the interview section the fragment belonged to.
- After coding each interview transcript, all fragments belonging to one section were grouped together. This meant separating the fragments from their original interviews and grouping them in the corresponding section.
- Finally, the material collected in each section was re-classified and interpreted, adding sub-sections when necessary.
- After integration, section by section, the next step consisted of the coherent organization of all sections following a narrative coherent sequence.

The analysis of the information collected in the interviews suggested that Valencian companies have different levels of PM maturity mainly due to the great differences in their organizational structure. About 45% of the surveyed companies are at low maturity levels (levels 1 and 2) whereas about 45% are at high or very high maturity levels (levels 4 and 5), although very few companies reach the Optimizing level. The rest of the companies (10%) are at an intermediate maturity level.

However, the objective of the present work was not the accurate characterization of the companies' maturity level; for this goal the definition of indicators difficult to measure would have been necessary. Rather the main objective of this study was to provide a qualitative classification of the organizations in order to find differences in their project management process. Two company groups were identified: companies with high or very high levels of PM maturity (including the companies with an intermediate level of maturity as they were considered to possess a well-defined structure in project management) and companies with low or very low levels of maturity.

In the group of companies with well-structured decision models we found that:

- These companies are project-oriented.
- The Project and the Project chief manager are formally announced and designated.

- They generally use Project management qualitative tools.
- Project management processes are standardized.
- The companies tend to continuous improvement in their Project management processes.

The main conclusion drawn from the interviews and their transcripts was that there is a close relationship between the way the organizations manage their PM decisions and their level of PM maturity. The companies that use well-structured decision models are at high levels of PM maturity, whereas the companies that use ill-structured decision models are at low levels of PM maturity.

No clear relationship was found between maturity levels and company size as high and low levels of PM maturity were found in medium as well as in small companies.

5. Conclusions

From the findings presented and analyzed in the previous section the following conclusions can be drawn:

- There is a close relationship between the company's level of maturity in project management and their decision process. The higher the level of maturity the more they use well-structured decision models.

The statement that the higher the level of maturity the better the company performs in modelling its project management decisions is based on the fact that higher maturity levels bring about benefits to decision models. As an illustration of this we can mention:

- The higher the level of maturity, the greater the availability of well-defined and well-documented projects, which improves the PM decision process.
- A better communication among the stakeholders involved in the project, resulting in a higher satisfaction with and acceptance of the decisions made. This is partly due to the use of a common language at high levels of maturity.
- Alignment and coordination of goals across projects and with the company's strategic goals in aspects such as human resources, purchases, taskforce …
- Definition of a framework for the decision making process and its consequences in the project plan and project change management (this generally takes place at high maturity levels).
- Availability of databases about the company PM capabilities. This will facilitate decision making management.

According to Project Management Process Maturity $(PM)^2$ (Ibss and Kwak, 2002), at maturity levels 4 and 5 there is an integrated planning and control of the company's project portfolio, and complex decisions, like project portfolio selection, are better solved.

Authors like O´Toole and Mikolaitis (O´Toole and Mikolaitis, 2002) identify maturity level 3 with the use of decision models implemented in the company and well-documented project processes, and maturity levels 4 and 5 with assisted decision making and continuous improvement in the decision making process.

- The results of the analysis do not reveal any characteristic PM maturity level in Valencian companies. Certain authors like Andersen and Jessen (Andersen and Jessen, 2003) postulate that the level of maturity of a company is subjective rather than objective. On the other hand, the percentage of Valencian companies at an intermediate maturity level is significant. This consideration is valid only for

companies with high maturity practices. Ibbs and Kwak (Ibbs and Kwak, 2002) in the application of $(PM)^2$ consider that certain companies can be assigned a maturity level N+1, yet they do not possess all the features of level N. This is due to the fact that companies that lie at level N+1 are capable of selecting efficient practices and tools for their projects. For this reason, level-3 companies are included in the group of companies with high maturity levels.

Although we could not establish a typical maturity level in Valencian companies we have drawn some conclusions that help define adequacy criteria for the future development of a decision support tool for these companies:

- In general, level-1 companies do not have a well-structured project plan; in addition, they have no project management information system available. Level-2 companies use support tools and practices for project planning as well as a well-structured organizational project system. Companies at maturity level 3 define and manage formal project management methodologies and models, and possess information systems that collect, review and deliver well-documented processes for project management. Companies at maturity level 4 have integrated or comprehensive well-defined project control processes that are coordinated by the different departments of the company. The project management information system comprises all the company's areas and projects. In companies at maturity level 5 the project management processes are planned and optimized with a focus on continuous improvement.
- High maturity levels are mainly observed in companies that manage projects in which different organizations or departments are involved. These companies need a common PM methodological framework that ensures project success; they also need well-defined management processes to solve conflicts in organizations in which projects are an essential part of the business (Mulder, 1997).
- Certain companies classified as with high maturity levels, however, do not present a well-defined project management training program, i.e. the participants in the project may not have upgraded knowledge.
- Most companies in the groups level 3 and higher, although they have project management teams and departments, the team members also play other roles in the company.

The conclusions presented here suggest that a decision support system adapted to the organizational project management culture of Valencian companies should take into account the following considerations:

- Companies at maturity levels 3 and higher possess project management information systems that allow them to count with valuable data and documents during the decision making process. However, for companies with maturity levels 1 and 2, most of which do not have such information systems available, the decision support tool should help them in structuring and modelling project information.
- For maturity levels 4 and 5, characteristic of companies that develop across-organizations projects, the decision support system should allow remote problem solving and help solve conflicting interests among the stakeholders.
- The decision support system should adapt to interdisciplinary problem solving and help professionals with little knowledge on project management.

6. Future research lines

For future research work we propose to develop a decision support system for project management decision making, based on Multicriteria Decision Analysis techniques, adapted to the maturity level of the Valencian companies. The system may help in the modelling of complex project management problems. In this sense, the support system will help companies at low levels of maturity to structure decision problems.

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