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Multi-criteria performance analysis for decision making in project management

Guillaume Marques [a,*], Didier Gourc [a], Matthieu Lauras [a,b]

[a] Université de Toulouse, Mines Albi, Centre Génie Industriel, Campus Jarlard, Route de Teillet, F-81013 Albi, France
[b] Toulouse Business School/Department of Industrial Organisation, Logistics and Technology, 20 Boulevard Lascrosses, BP 7010, 31068 Toulouse Cedex 7, France

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Abstract

This study is focused on decision support in the context of product and service development projects. Decision support requires the capacity to characterize the current state of the project (performance evaluation) and the decision-maker's point of view. However, the different projects' stakeholders do not have the same needs in terms of performance evaluation to support their decision-making processes. Furthermore, in some cases controlling project performance using the elementary components of the Iron Triangle (Cost, Time and Quality) alone seems inefficient. This paper proposes a new multi-dimensional Project Performance Measurement System that would enable managers to deal with the volume of data. The proposition integrates the only character of each project (tasks, objectives, decision-makers personality and competences), several good practices in terms of universal project management dimensions on the one hand, and in terms of performance analysis on the other hand. Then, we show how an aggregation tool called MACBETH is used to analyze the performance measures according to project managers' own performance interests. A case study illustrates the proposed system.

Keywords: Project performance; Performance measurement system; Project management; Multiple criteria analysis; Decision support systems

1. Introduction

Decision making in a project context is a complex undertaking! "The term complexity is an increasingly important point of reference when we are trying to understand the managerial demands of modern projects in general, and of the various situations encountered in projects" (Kähkönen, 2008). The definition of complexity has been covered by various contributions and research works but does not form the subject of this study. In summary, complexity can appear in different forms and arise from various sources with different levels of intensity according to the industrial sector or object of the project. Intensities can vary over time, and this variation underlines the dynamic aspect of project complexity. A widely accepted approach to describe complexity is the distinction between the uncertainty related to the operational activities, or the environment, and the structural complexity related to project organization (management) (Williams, 2002).

On the one hand, a project is a temporary and transient organization surrounded by inherent uncertainty (Turner and Muller, 2003). The International Organization for Standardization (ISO) (2003) defines a project as "a unique process". In other words, a project is intrinsically unique and strongly subject to its environment (Zwikael et al., 2005). Geraldi (2008) and Geraldi and Adlbrecht (2008) speak of "Complexity of Faith" to describe this kind of project complexity that involves high levels of uncertainty.

On the other hand, the project manager can be confronted with another form of complexity involved in dealing with a large volume of independent information. Geraldi (2008) and Geraldi and Adlbrecht (2008) speak of "complexity of fact" to describe the potentially very great amount of information to analyze and coordinate, linked to the number of people and companies involved.

* Corresponding author.
E-mail addresses: guillaume.marques@mines-albi.fr (G. Marques), didier.gourc@mines-albi.fr (D. Gourc), matthieu.lauras@mines-albi.fr (M. Lauras).

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Both practitioners and academics have difficulties accepting and treating projects as complex systems, and tend to reduce the management of projects to the application of tools such as PERT, WBS, earned value, etc. (Geraldi and Adlbrecht, 2008). When complexity becomes too great, the possibilities and interrelations become so fuzzy that the system has to be assisted by appropriate tools and skills. Consequently, managers facing complex project need access to a decision-making aid model based on relevant performance evaluation. In this situation modeling plays an important role in project management in supporting "complex" decisions. Modeling is often presented as a simplification of reality (Pidd, 1996) and this simplification is a powerful advantage. This enables us to analyze and come to simplified conclusions about the real world which would be impossible to reach if we had to deal with all the complexity of the real world (Williams, 2002). So, the key purpose of modeling is to help decision-makers take a better decision. In a project context, decision making is the point where many management constraints converge from:

- senior management: that define general project objectives and success criteria;
- the quantity of information stemming from the project execution;
- the project manager's own management policy that reflects her/his point of view and the value s/he attributes to each element of information and each objective.

This study is not focused on the objectives definition. For a given project, we suppose they have been defined and adapted to each decisional level (senior managers, project managers, task leaders, etc.). In this paper, we address the problem of modeling project performance in order to support decision making. We face two main questions if we are to achieve this goal: (i) how to build a model that allows a large quantity of information (performance measurements) to be stored and easily available for consultation and/or modification; (ii) which tool or operator to use to analyze data according to decision-maker position/perception. For the first question, we propose to design a Project Performance Measurement System (PPMS) that uses good practices from literature in terms of project performance. Then, data from the PPMS cube are analyzed using a tool called MACBETH in order to propose decision aid; that is examined in the second question.

We will start by detailing the scope of the study and the research methodology we used before presenting our problems statement. Second, we will look at the relevant good practices from the literature concerning the main elements to consider for each problem statement we have identified. Third, we will describe our PPMS and the uses made of MACBETH. The proposed system will be implemented using a case study, before finally drawing some conclusions and discussing the limitations and the various perspectives for further research.

2. Scope and research methodology

In the phrase "decision making in a project context", the term "project" is open to many interpretations. In this study, we pay particular attention to product and service development projects (we refer to the classification proposed by Archibald (2003)). The proposition described in this article draws on the experience of both practitioners and academics. The model we propose is based on real project management practices in the pharmaceutical and aeronautical industries as well as on academic literature. Our model is focused on a complex project. The notion of complexity is related to the size of project, the number of departments involved, the number and type of stakeholders, the location or the form of contract. Furthermore, it is intended for "mature" project organizations since it requires the organization to be capable of carrying out performance measures and of ensuring circulation of this information within the management process.

Through the management of their projects, project managers have to make decisions. The quality of these decisions depends on the capacity of the decision maker to perform a twin evaluation: (i) the current situation of the project versus the initial objectives—What happened until today? and What is the current progression (in a broader sense)?—and (ii) the possible evolution of the project according to the decisions and events (past, present and future)—What will happen and what are the consequences for the project? Performance evaluation appears as a way to design/modify a system, or to control an existing system. It is an essential element of effective planning and control as well as decision making (Bagwat and Sharma, 2007). We refer respectively to *a priori* (i) or *a posteriori* (ii) evaluations, either to assess the current situation or to assess the quality of possible evolutions. Since knowledge of the current situation is a prerequisite to any prospective approach, in this study we focus on an *a posteriori* performance evaluation of a particular system, a project.

These performance evaluations constitute the basis of decision making. However, as stated in the Introduction, the decision-maker's behavior is another important facet of decision making. In this study we propose supporting decision making by focusing the decision-maker's attention on areas of poor performance. The objective consists either in finding the one best solution that respects the perception data, or in comparing different situations that reflect the evaluation sensitivity to the perception data. Nightingale (2008) proposes a dichotomy between the "optimizing" and "skeptical" project managers. Both are compatible with our model but the use is different. Actually, the optimizing project managers will use our model once a time whereas the skeptical project managers who traditionally believe in decision support system where adjustments during the project are possible, will use our model many times (typically at each milestone).

3. Problems statements and background on project performance

Dweiri and Kablan (2006) claim that standard performance management metrics and tools impact the standard performance management methodology, which in turn influence the project success. So, good project management requires a relevant set of performance metrics. However, it is difficult to define a performance measurement that suits each decision. According to Swink et al. (2006), the effectiveness of a project is the degree