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Modeling the leadership – project performance relation: radial basis function, Gaussian and Kriging methods as alternatives to linear regression

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ABSTRACT

The purpose of this paper is to analyze alternative forecasting methods that produce results at least similar to or better than linear regression (MLR) that can be used in the modeling of social systems. While organizations may be considered as typically non-linear systems, the common feature of most models found in literature continues to be the use of linear regression techniques. From a case study, advanced statistical methods of Gaussian and Kriging are evaluated, as well as an artificial intelligence (AI) tool, the radial basis function (RBF). The results show the best performance of the suggested methods compared to MLR, especially RBF, because of its uniform prediction behavior throughout all ranges of evaluation. These techniques, although somewhat unconventional in social systems modeling, present a potential contribution in increasing the accuracy and precision of the predictions allowing a more accurate assessment of the impact of certain strategies on the project performance to be made before the allocation of material, human and financial resources.

1. Introduction

Much has been said about the need for understanding the influence of human contribution to the success of organizations. There is an increasing concern with the provision of services, the performance of people, and their effectiveness. Increasingly, the term "do more with fewer resources" gains strength. This approach has been proven to be valid in many situations but does not always yield the expected results. Many of these unsatisfactory results are only realized after the implementation of a project involving a large allocation of human and material resources and financial support (investments) for its execution.

Large companies typically present corporate structures, and as such, they must be flexible. The corporation also has to be agile to cope with market competition, anticipate the competition, minimize the threats to its survival, and turn such threats into opportunities (Borgatti & Foster, 2003; Vega & Vokurka, 2000). The interaction between leadership, agility and flexibility, and organizational factors contribute to these results, making a tool for predicting project performance essential to ensure the assertiveness of the process (Petri, 2004; Singh & et al., 2000). This environment has motivated researchers and managers to search for prediction models that allow the assessment of the impact of the people factor in organizations' performances. Simulation models are powerful analysis tools for the development of research on the behavior of complex systems (Gilbert, 2007; Gilbert & Troitzsch, 1999). However, the reliability of the predictions depends on the proper specification of the model variables and the choice of an appropriate modeling tool (Nikolopoulos & Assimakopoulos, 2003).

While organizations may be considered to be typically non-linear systems, the basic feature common to most models in the social system field continues to be the use of traditional statistical techniques, such as multiple linear regression (MLR). This is due to its easiness to implement and broad dissemination of the field of social research and science management. It is also due to the mentioned fields' scholars and their lack of understanding of the use of more sophisticated alternative methods (Harrison & et al., 2007; Somers & Casal, 2009). Nevertheless, the introduction of these analysis methods, whether they are more elaborate statistical methods or even artificial intelligence tools, aims to overcome the limitations found in conventional statistical techniques. These restrictions are associated with the assumption that there is a linear relationship amongst the system variables - in other words, the effect of a dependent variable is proportional to the sum of a set of independent variables (Gilbert & Terna, 2000).

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The purpose of this paper is to analyze alternative forecasting methods that produce results at least similar to or better than linear regression methods, and that can be more frequently used in the modeling of social systems. Three groups of tools are evaluated and compared so that, by the end of this study, it is possible to describe the impact of the used technique in the accuracy of the results obtained through simulation. The first group concerns with the traditional regression techniques, while the others are related to the introduction of advanced statistical methods and artificial intelligence (AI) tools. Section 2, which follows after this introduction, describes the proposed method, where the variables of the research are presented, the modeling tools used, and the method of analysis. Section 3 deals with the empirical study, starting with certain considerations about the sample used and a discussion of the results. The conclusions of the study are found in Section 4.

2. The proposed method

The proposed construct for the system under analysis in this study is shown on Fig. 1. It consists of four blocks – project leadership, agility, organizational factors, and performance. Project leaders influence people's attitudes and behaviors and affect teamwork. The influence of this leadership over teams and collaborators is manifested in terms of agility factors, which in turn affects organizational performance. Organizational factors refer to the organizational structure and can influence both the agility factors as well as organizational performance. Resources are shared amongst various projects, with team members subject to different leaders simultaneously.

2.1. Research variables

Table 1 describes the relation of the agility and flexibility variables (Baker, 1996) with the organization components (Albrecht, 1988). Agility is related to the organization's strategic level and its business network, with reflexes on the organizational structure, more specifically on the strategy, people, and customers. Flexibility refers to processes and resources and it is related to people and to hardware and software components. Agility always affects the range and response dimensions whereas flexibility affects either one or the other or both. The range dimension refers to the range of products and strategies while the response dimension is related to the ease of transition between them. On this wise, flexibility is a component of agility.

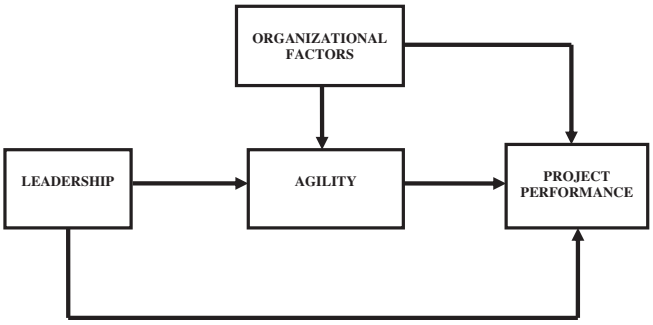

Fig. 1. Proposed framework.

Table 1
Relation between the agility and flexibility with the organization components; adaptation from Baker (1996) and Albrecht (1988).

Organizational structure (ALBRECHT, 1988)	Agility and flexibility (BAKER, 1996)		
	Organization level	Dimension	
		Range	Response
Business strategy + people + customer	Business (network)	Agility	
Hardware and software	Organization Processes	Flexibility	Flexibility
Hardware & software + people	Resources		

2.1.1. Leadership factors

For Northouse (2007), leadership refers to the influence exercised by leaders over the collaborators in order to execute a common objective. It's a process inherent to all organizations. When considering the concept of adopted leadership in this work, only the "people" factor will be considered, as related to its interaction with the leadership variable. Transformational leadership is considered in this study.

Transformational leadership is made of charisma (idealized influence), inspirational motivation, intellectual stimulation, and individualized consideration (Bass & Steildmeier, 1999). Idealized influence can be noticed in the leader's capacity to establish relationships and influence the organization, leading by example, building a sense of pride and purpose, and communicating effectively. Inspirational motivation includes incentives to change and improvement (empowerment), development of team agility, inspiration to achieve extraordinary results, and sharing of corporate vision and direction. Decision-making and focus on solutions via the acceptance of trials and errors are representative of the intellectual stimulation component. Individualized consideration means true interest in the employees' well-being, demonstrated by treating them as human beings as well as identifying and meeting individual and group needs and investing in their personal development, training, and instruction.

2.1.2. Agility factors

The first agility factor related to people is team maturity. This practice contemplates collaborative and self-organized teams. Collaborative teams work with great aptitude for improvisation, fostering brainstorming and a problem-solving environment, which increases the levels of individual and group performance (Cockburn & Highsmith, 2001). In self-organized teams a formal management is responsible for the organizational context and group performance as related to staff allocation, task distribution, and resource availability. Team members are responsible for managing processes inherent to the project and executing associated tasks, as well as team performance (Evans & Davis, 2005).

Another component of organizational agility is communication. According to Ring (2007), communication is efficient when used in all organizational levels as means to share and align information and project results, leveraging team commitment.

Continuous delivery is another important factor pertaining to agility and represents the organization's capacity to deliver results with time. Terziovski (2002) associates this variable to productivity. From this standpoint results are obtained through people. Continuous delivery is associated to organizational performance and reflects the results reached through actions over the processes.

Continuous improvement contributes to agility through the learning and implementation of best practices, resulting in organizational growth (De Waal, 2007). This practice includes the production and sharing of knowledge, education, and training. These characteristics are fundamental in the development, introduction, and management of agile businesses and in the development, improvement, or implementation of new or existing technologies.

Another factor that has direct influence on the levels of agility in an organization is people flexibility. This means their capacity to participate in multiple tasks simultaneously consequently resulting in change in roles. This practice can be evaluated through