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Diagnostic Techniques in Project Management

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Abstract. Project management practices are critical to improve quality and success of the results. One of the main challenges for project professionals is to identify the characteristics of each project in order to choose a more suitable set of practices and tools that will contribute to greater management performance. In this article, a systematic literature review (SLR) was conducted to identify studies related to diagnose techniques in the project management. Through this review, 22 articles were selected. This paper presents a set of diagnostic tools in order to assist in solving this challenge. Developing a better understanding on how to apply these diagnostic tools, professionals will be able to select management practices that are better suited for different types of projects in their organizations. One main restriction found across the diagnostic tools identified is that they do not indicate how to improve project management performance. From the theory standpoint, scholars could compare how project performance is influenced by different management practices and their combinations.

Keywords. Diagnostic tool, agile project management, hybrid project management, project management.

Introduction

There are different management approaches in the project management theory, including agile and traditional. The traditional or waterfall management approach, is based on methods and practices that follow a sequential series of steps, starting with the definition of requeriments, defining solutions, developing, testing, and delivering [1]. The scope of the project is well defined, the problem is clear, the planning approach follows a detailed process upfront and is minimally revised during the phases, the development is sequencial, driven by task dependencies and critical path, and changes are avoided [2],[3],[4],[5],[6].

There is a lot of criticism from project management practitioners regarding the use of traditional approach in more dynamic and innovative project environment. The answer was the appearance of new theories focused on innovative projects, involving a set of practices, tools and techniques named “agile project management” (APM). Innovative projects are characterized by dynamic, fast-changing environments, where there are constant changes in requirements, uncertaints caused by unknown risks, due to the degree of novelty of the tasks and requirements, causing project conditions never

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faced by the project team before [7]. The main difference, therefore, could be the development of the team's agility and flexibility, which relies on the tacit knowledge of the team members, rather than focusing on creating lots of documentation [2]. It is during the execution of the project that critical decisions are made, that will result in the project success or failure [8].

One potential solution that has been observed in many industry sectors, is the idea of combining management practices from different approaches. The main objective is to use the "best" part or practices from different approaches to improve performance and ultimately have better project results and success. Several authors have dedicated effort to explore the combination of practices and tools in the project environment [9 - 15].

The main challenge for practitioners and scholars is to diagnose what is the appropriate condition to apply a particular approach or combine them, then what practices, techniques and tools are more favorable to use according to a project context and characteristics. One potential solution could be the development of diagnostic methods. This paper investigates the diagnostic techniques in the literature and how they can support in this problem solution, through a systematic literature review.

1. Diagnosis in the field of project management

According to McCulloch and Cronshaw [16] in the organizational improvement perspective, the diagnostics development are highly desirable, if not essential for the development, change and intervention of informed and effective organizations. Diagnoses contribute in the process of improvement, because organizations exist as entities that need to be examined before receiving recommendations for actions [17].

The term "Diagnostic" can be found in several areas of knowledge, as shown in Table 1.

Table 1. The term Diagnostic in different areas of knowledge.

Knowledge area	Goal
Medical	Provides information about the conditions of a patient, orientate patient care through the information analyzed and understand the disease mechanism.
Organizational	Analyzes the organizational environment, identify the organization needs and involves relevant issues to the company, having tactical, strategic and operational consequences.
Environmental	Analyzes the environmental factors of a certain area (country, State, watershed, municipality) to analyze and raise the main elements of the physical, biotic and socioeconomic environment subject to changes with the implementation of an enterprise.
Social	Understand the society reality by identifying and classifying their needs and major problems observed.

It can be concluded that a diagnostic refers to the action and the effect of diagnosing, i.e., collect data and analyze it to evaluate a particular problem. In the project management perspective, diagnostics methods aim to identify characteristics and dysfunctions that may affect the project management performance.

2. Diagnostic tools in project management

The term "tool" comes from the Latin and refers to an instrument used in performing an activity, a job. In addition to this concept related to physical objects, the term "tool" can be related to any procedure which improves and facilitate the ability to perform a specific activity, such as Microsoft Project[2].Thus, the tools are a mean to facilitate and improve the performance of an activity.

In this paper, a tool is defined according to the Project Management Institute (PMI) that describes tool such as: "Something tangible, such as a template or software program, used in performing an activity to produce a product or result" [18].

Diagnostic tool in project management can be described as something tangible used to obtain knowledge about a particular problem, analyzing its characteristics, composition, behavior, or nature, in order to evaluate it and assist in solving different types of issues.

Diagnostic tools can be used to identify project characteristics and environment context factors in order to choose the more appropriate management approach. However, several factors need to be considered in order to identify dysfunctions in projects that are in progress and propose solutions to improve project quality.

An example of a tool to diagnose project characteristics and contextual factors is the Diamond Approach proposed by Shenhar and Dvir [5], which is discussed in section 4, applied to the project of the World Trade Center (WTC). Through the diagnosis, the authors analyzed the particularities of the project and made several considerations regarding its management approach.

3. Research Method

A well-made, effective literature review provides the researcher a solid theoretical basis for the subject and proposed work. Defining a systematic method to search, select and analyze the results will contribute to have a more reliable results and overview of the current "state of art" regarding a specific research topic or area [19].

This study is based on a systematic literature review, which encompasses the process of selecting, understanding, analyzing, synthesizing and evaluating a set of scientific articles with the purpose of creating a scientific-theoretical basis (State of art) on a given topic or subject [19].

The SLR framework used in this study has 3 main phases (input, processing and output). These phases are organized into15 steps (Figure 1).

In the first phase the research problem needs to be clearly and accurately defined. Then, the researcher defines the SLR goals, which should be aligned with the research objectives. Then the primary sources of research are selected (e.g., articles, journals or databases) in order to determine the keywords, authors and relevant studies. Next, the search strings that will be used in databases are defined. It is important to adjust the strings to meet each search engine characteristics and features and ensure that relevant studies will be identified. The inclusion criteria of the articles are defined based on the research objectives. The qualification criteria are critical to evaluate the relevancy of the studies found during the search. The definition of the search method and tools

[2] It is a software program, developed and sold by Microsoft, which is designed to assist in the project and portfolio management.

includes the definition of how the search will be performed, how the results will be documented, and so on. The last step of the first phase is the definition of the SLR schedule to help the researcher control and search progress and results.

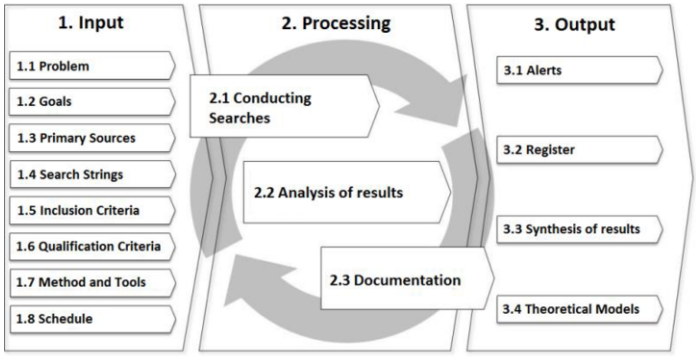


Figure 1. Model for the systematic literature review development [19] (Translated by the author).

In the second phase (Figure 2), the first step involves the search for periodicals, in order to create a list of the most relevant periodicals to the research, based on the primary sources. The search is performed using the previously defined strings. Then the results are submitted to multiple filters. The first filter includes reading of the title, abstract and keywords, which must be in accordance with those used in search strings. The second filter involves reading the introduction and conclusion sections of the article. The third filter consists of a complete reading of the text. It is also recommended to perform cross-search cycles (based on the reference list of articles found in the selected studies in filter 3) to identify relevant studies that were not found during the database screening process in the periodicals and other databases.

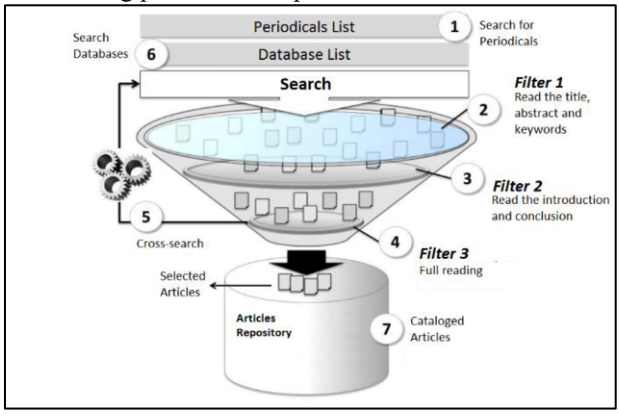


Figure 2. Iterative procedure of processing phase [19] (adapted and translated by the author).

The last phase of the SLR is to create citation alerts using keywords in the relevant databases and periodicals identified during the SLR in order to keep tracking of newly published articles. Articles that were reviewed and selected in the the third filter were included in the repository. Finally, the results are synthesized and the research questions are refined, hypotheses identified and theoretical models are built to support the research development.

The searches that support this study were conducted in the databases Web of Science® and Google Scholar, in the period between October/15 and November/15. The adopted search string is described as follows: "Diagnostic" or "Diagnosis" or "health check" AND "Tool" or "Instrument" or "Test" AND "Project" or "Project performance" or "Engineering project management" or "Project assessment" or "Project management".

The search resulted in 965 articles. During the filtering process, many articles did not come through and were excluded from the database. The set of criteria used to select articles for this study is as follows:

- Presents a model, method, tool or proposals for project diagnostics;
- Describe the development form of diagnostic methods;
- Involve areas of knowledge related to the project management topic.

The 965 articles had their titles and keywordsanalyzed based on these criteria. A sample of 22 articles were identified and submitted to the reading filters. This resulted in 6 articles that were considered aligned with the SLR objectives and were selected for a full reading. These articles were read, analyzed, catalogued and stored in a bibliography management software. From this analysis, it was performed a cross-search in order to identify relevant works that were not previously identified using the search string. Thus, a total of 16 additional studies were identified, summing up 22 articles considered relevant to this study. The results of the systematic literature review are described in the following section.

4. Results

The result of this study consists on the set of diagnostic tools identified in the project management literature. Table 2 shows the list of tools found in the SLR process, as well as their characteristics and objectives.

Through the analysis of Boehm and Turner [3] proposal, we can conclude that professionals carry out an assessment of what is the best approach to be used in a particular project, creating an overall strategy for being implemented, constantly monitored and evaluated. However, the work presented by the authors have as focus the software development, not involving other areas, influencing on the adopted dimensions. The authors do not discuss how to manage the software development project, once adopted a combination of approaches.

In the Wysocki [6] proposal, it is clear that the author focuses the software development projects, not incorporating other areas in their work. The tool presented by the author does not explain why those dimensions were adopted to differentiate the types of project management approaches. Another highlight is that the author does not use the term "agile project management" and does not address a combination of flexible and disciplined practices.

Table 2. Synthesis of existing diagnostic tools in project management.

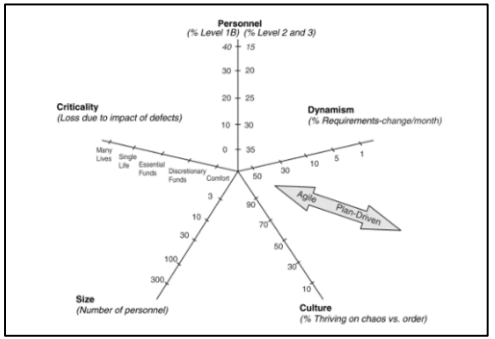
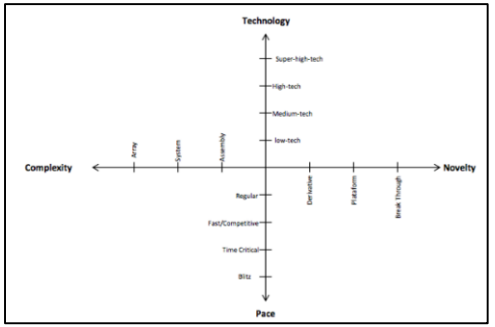
Diagnostic Tools	Graphical Representation	Goal	Dimensions Analyzed
Risk Approach [3]		The authors present a risk-based approach to structuring the projects, incorporating agile and traditional practices, depending on the project needs.	The authors use a classification schema containing five dimensions, which includes conditions where agile and traditional methods are more likely to be successful: People: consists of the different skills required to manage projects; Dynamism: consists on the percentage variation of requirements per month; Culture: analyzes if the organizational culture has well defined rules and procedures or provides greater freedom for those involved; Size: number of people involved in carrying out the project; and Citicality: evaluates the critical level of the project, loss due to the impact os defects.
Diamond Approach [5]		The authors address that a single management style does not fit in all projects, claiming that each project is unique, therefore, must take into account the project characteristics in order to adapt the management form.	The model deals with the variability of the projects, based on four dimensions: Novelty: evaluates how new the product is for the market and its users. This dimension represents the extent to which customers are familiar with this type of product, how to use it, and its benefits. Includes three levels: derivative, platform and breakthrough; Technology: measures the level of technology used in the project and the Organization's knowledge about this technology, encompassing four levels: super-high-tech, high-tech, medium-tech and low-tech; Complexity: assesses the complexity of the project, it's defined using a hierarchical structure of systems and subsystems. Three levels are included in the dimension complexity: assembly, system and array; and Pace: evaluates the time available for the project development. Four levels are part of this dimension: regular, fast/competitive, time-critical and blitz.

Figure 3. Risk Approach [3].

Figure 4. Diamond Approach [5].

Table 2. (Continuation).

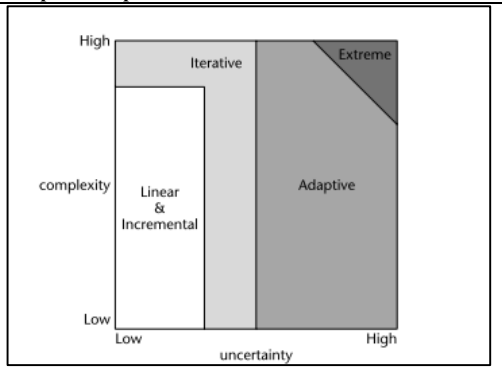
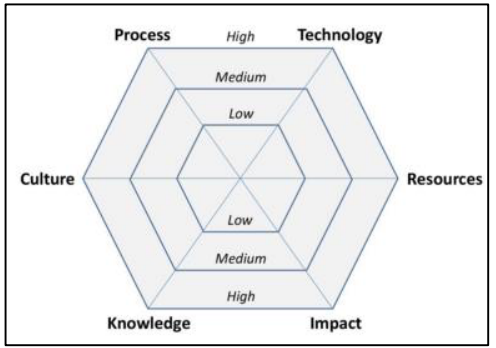
Diagnostic Tools	Graphical Representation	Goal	Dimensions Analyzed
Software Development Project Management [6]		The authors proposed a tool towards the integration of project management with software development for professionals in order that they learn about the best practices to support their projects.	The author presents a schema involving two dimensions to be considered: Complexity and Uncertainty. Through the analysis of these dimensions, five types of approaches to software development are presented: linear, incremental, iterative, adaptive and extreme. Each of the five types of software development approaches can be supported by consistent project management approaches.
Diagnostic Framework and Health Check Tool for Projects [20]		The authors developed a diagnostic tool to assess the health of a project organization. The tool is constituted by an integrated view of project systems.	The tool involves the following dimensions: Processes: encompasses the adoption and implementation of structured procedures and processes-oriented guidelines throughout the project life cycle; Technology: evaluates the information and communication technologies (ICT), and the specific technologies to the project; Resources: involves the necessary infrastructure for the full development of the project, as well as the personnel involved; Impact: involves the general results of the project, including the initial project outputs and the wide range of benefits arising from the delivery of the project; Knowledge: involves data management activities and information that enable the effectiveness of the projects, as well as the planning and control of these; and Culture: relates to the standards of work and behavior patterns, as well as the levels of trust and reciprocity, both in relation to the benefits and risks of the main project stakeholders.

Figure 5. Panorama of the SDPM [6].

Figure 6. Framework for assessing the "health" of the projects [20].

In the Diamond Approach proposed by Shenhar and Dvir [5], each of the dimensions, as well as their respective levels, affects how project management should be conducted. The authors present a graphical tool to demonstrate the gaps between how a project should be managed and how it is currently being managed. They indicate four dimensions and their levels, but not explain how, where or even why they choose such dimensions to be used in the diagnosis.

The Kennedy and Philbin [20] tool aims to contribute on the project performance through the analysis of its "health." However, the authors do not make clear the difference of levels (high, medium and low) presented in the tool and do not explain their relationship with the way in which the project is managed. There is a certain subjectivism on the routes to be followed after using the proposed tool.

We conclude that most of them do not explain about the analysis dimensions choice, as were developed and how they are different in relation to other criteria. Without enough robust constructs to identify the characteristics of the project environment and practices, it will not be possible to perform an analysis to identify the appropriate set of practices, tools and techniques to meet the project needs.

Other restriction found through this research, was the tools limitation to indicate which actions should be carried out after the diagnostic, which may be a challenge for the professionals, given the large number of practices, techniques and tools that can be used.

5. Conclusion

This article presents a set of diagnostic models in project management theory. The result was obtained through a systematic literature review and it shows that there are a few diagnostic methods focused on project management, noting a lack of studies focused on this theme.

The article raised important information about existing forms of diagnosis and the relationship of these diagnoses with project management approaches. The present tools evaluate the characteristics of a project based on the criteria such as personal, dynamism, size, culture, criticality, uncertainty, complexity, novelty, technology, resources, process, impact and knowledge. Although many of these criteria reach the proposal to carry out an analysis of the project characteristics, most of them do not explain why it's used, how they were developed or even how they are different in relation to other criteria, occurring a certain subjectivism.

The tools do not provide patterns or guidelines to interpret the results as common in otherwise organizational diagnosis instruments. Regular instruments in areas as cultural organization, organization climate is frequent the association of the diagnosis tool with guidelines or recommendations for the non-specialist professional. For example, if the result of the diagnosis showed that the project involves a high degree of innovation with many uncertainties and geographically distributed teams, the instrument could indicate a set of most recommended project management practices.

As a future study, we recommend the relationship analysis between the results from the diagnostic and the existing practices in the project management area, linking the best ones for a particular project. The hybrid approach can be involved in this process. Then, the next step would be an observation of this study in real cases.

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