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Process Mining for IS Project Success Factors Management: A proposal

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Research-in-progress

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Abstract

Research on Success Factors (SF) of Information Systems (IS) projects carried out over the last decades has resulted in a vast literature. However, extant studies typically aim to identify and list generic SF for projects, denoting a static perspective, with few concerns of practical nature regarding their use as management tools to support decisions throughout the projects' lifecycle. On the other hand, process mining has been used to discover, analyze, and improve project management processes. In this paper, we propose a new approach that involves relating the performance of those processes with SF in IS projects. By using process mining, the aim is to automatically extract and manage SF in projects, measure processes performance, and provide project managers with information on how SF correlate with performance. This will provide managers with enhanced information regarding status and improvement opportunities for current and future projects. The main purpose is to contribute to the project management theory and practice by providing a decision support system that can associate performance with IS projects' SF automatically obtained from internal and external data sources.

Keywords Information System, Process Decision Support System, Process Mining, Project Success, Success Factors.

1 Introduction

Organizations resort to Information Technologies (IT) and Information Systems (IS) to provide an agile response to the ever-changing ecosystem. Many of the business processes that companies used to execute manually are now performed through digital means that encompass the entire organization, providing quicker and better information for decision-making (Bharadwaj et al. 2013; van der Aalst 2021). Companies with extensive use of IT/IS in their business processes are becoming fully digital firms since most of their commercial links with customers/suppliers are interceded digitally (Laudon and Laudon 2020).

The success of IT/IS projects is a major concern, given their impact on the organization, the high costs involved, and the risk of failure in implementations. Notwithstanding, the evaluation of success is many times informal (Varajão 2018; Pereira et al. 2021), without the definition of the evaluation process or the identification of success factors (Keith and Vega 2017).

Success factors (SF) are essential aspects that have an impact directly or indirectly on the success of projects (Takagi and Varajão 2019). Examples of success factors include, among others, top management support, internal communication, alignment of IT with business objectives. Typically, SF are identified through various listings available in the literature. Nevertheless, given the extensive literature related to this topic (Iriarte and Bayona 2020), it is difficult to know which factors are pertinent and most relevant for a given organization.

The quantity and diversity of SF and the lack of formal processes in the management of the success of projects (Varajão and Álvaro Carvalho 2018) limit the project manager's capability of identifying threats to success as well as the underlying reasons for those threats.

Process Mining (PM) emerges as a non-intrusive research area that aims to extract knowledge through the logs that an IS produces on the control-flow, data, and resources perspectives of the execution of an organization's business processes (Van Der Aalst et al. 2012). Process mining has been used to discover, analyze, and improve project management processes (Van der Aalst 2016), but to the best of our knowledge, currently, there is no work that uses process mining to associate the performance of these processes with success-specific aspects such as SF, configuring a research opportunity.

This paper proposes a new approach that involves associating the performance of IS project management processes with SF. It starts with the application of process mining techniques to discover the underlying IS project management practices (focusing processes) and the identification of the SF. Then, it aims to correlate those SF against performance indicators of the identified processes to provide project managers with evidence on which and how the performance of these processes influences project success along the project's lifecycle.

This paper is organized as follows: the next section introduces the main concepts related to project success and process mining. In section 3, we describe the new approach, and section 4 refers to related work. Finally, section 5 discusses the main contributions and presents further work.

2 Background

This section briefly presents important concepts related to project success and process mining, including its relationship with success factors, techniques, and main uses.

2.1 Project Success

For Sudhakar (2012), a project is composed of specific properties, such as the start and end date, well-defined objectives, a set of tasks, and a budget.

There are several definitions for project success (Iriarte and Bayona 2020). Overall, a project is considered successful if it meets all the technical performance parameters and/or its objectives. A project can also be said to have been successful if there is a high level of stakeholders' satisfaction (Agarwal and Rathod 2006).

Success can be described and divided into two components (Baccarini 1999): the success of project management and the success of the deliverables. The success of project management indicates whether the project was carried out successfully according mainly to three dimensions: scope, cost, and time. The success of the deliverables, on the other hand, corresponds to the impact of a project's product/service on the customer business; that is, it focuses on the efficacy of the project, such as, for example, the commercial benefits (Varajão and Álvaro Carvalho 2018).

Given that different factors and criteria can influence the success of projects, there is the need to identify them in each project in particular, allowing to focus management efforts on what is really important for the success of a project (Varajão and Trigo 2016). In IS projects, there are several SF related to success, including the most mentioned in the literature, such as user's involvement in the project, knowledge and technical expertise of the consultants, and effective planning (Iriarte and Bayona 2020), to name a few.

2.2 Process Mining

A business process can be defined as a set of interrelated tasks and behaviors that organizations develop over time to generate results (Laudon and Laudon 2020). Chfouka et al. (2013) define a business process as a collection of activities within organizations that allow them to reach a specific goal.

According to the Process Mining Manifesto (Van Der Aalst et al. 2012), process mining can be defined as an important bridge between data mining, business process modeling, and analysis. It is a discipline whose focus is on discovering, monitoring, and improving real business processes. The process mining techniques enable the extraction of knowledge from business processes through ad-hoc stored data or events supplied by the organizational IS (Gupta 2014). These records are commonly known as *event logs*, and quite often, there are numerous of several business processes, often loose and unrelated. Considering IS project management processes, these logs are gathered in particular (project management) tools/repositories, including Jira, Trello, text files, and commit code updates and documentation.

In the case of IS project management processes, process mining essentially focuses on extracting knowledge from a large amount of data stored in event logs that organizations use to track the development of an IS (Arias et al. 2018). From the knowledge extracted from these logs, process discovery allows the respective process models' construction (Chfouka et al. 2013).

There are three types of process mining (Van der Aalst 2016): discovery, conformance checking, and improvement. Discovery consists of building a process model based only on an event log. The second type, conformance checking, compares processes and checks whether a certain process is conformant or not with another (model or ideal) process and vice versa (Van Der Aalst et al. 2012). Conformance checking enables identifying existing deviations from the process model to be followed and determining how faithfully the model is implemented in relation to its official definition (Keith and Vega 2017). The third and last type of process mining essentially refers to process improvement. That is, it uses the results of the previous tasks to generate a (new) improved process model. In other words, it uses the information about the real process registered in the event logs.

3 Process Mining for IS Project Success Factors Management

Given the importance that SF have for project management, it is crucial that the project management bodies can analyze and understand which SF applies to a particular project so that current and future projects can be better organized and managed.

In this way, this work proposes an approach whose objective is to provide management with information on SF, including alarms regarding threats and deviations to the planning, towards a maximized probability of project success. The approach comprises the use of business logic to correlate historical data between project management processes (discovered and measured through process mining) and SF registered or retrieved automatically from a knowledge base.

The approach is depicted in Figure 1 and accounts for two main phases: 1) diagnosis; and 2) prognosis. In the first phase, process mining will be used to discover project management processes (such as scope management, resource management, time management, among others), tasks, control-flows (sequencing, parallel, branching, loops, decision nodes), resources (human, material), events, and associated data (artifacts, documents).

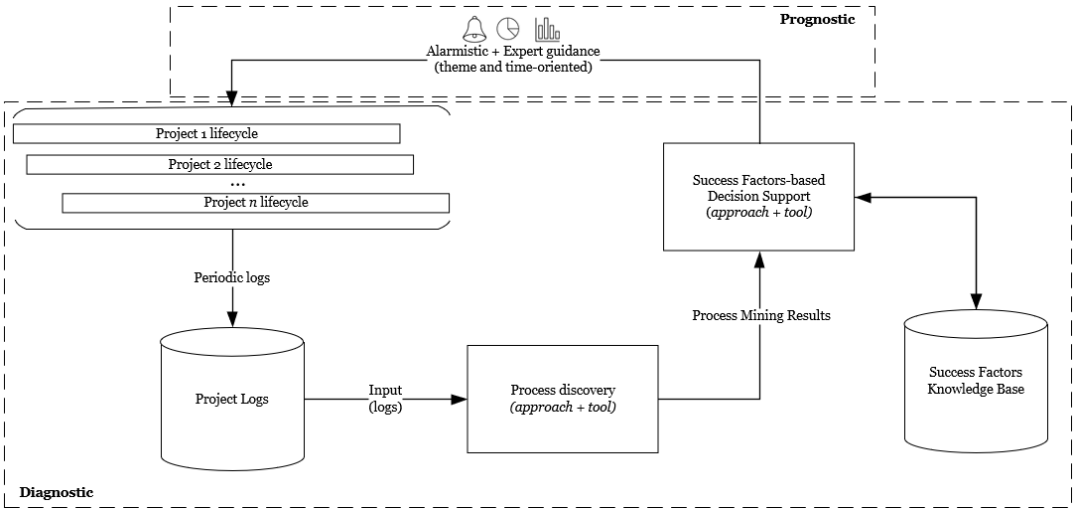

Figure 1 - A new process mining approach for IS project success factors management.

For instance, throughout an IS project lifecycle, several events and produced data are explicitly and implicitly registered through documents, Kanban boards, code repositories, and other project management tools. These refer, generally, to three time periods: 1) ante-project endeavors; 2) project management tasks during IS development, such as system specification, design, development, testing, and deployment; and 3) post-project activities such as IS operation, monitoring, corrective and evolutive maintenance, and, at the end of the lifecycle, discharge/conversion/migration of the IS.

The approach foresees the collection of these data in a centralized database (Project Logs), formatted already in an event-based schema (such as, for instance, the eXtensible Event Stream (XES) standard[1]). From here, discovery and analysis process mining techniques applied to these events will produce the most common performance metrics for these processes, including, for instance, average lead, service, waiting and synchronization times, as well as fitness, precision, generalization, and simplicity – see, for instance, Van der Aalst (2016). Still, in the diagnosis phase, the focus is comparing project management practices with the organization's SF knowledge base to help project managers determine how to improve project success.

To achieve this goal, we foresee a decision support system to derive a business logic that can correlate the results of process mining (discovering and conformance checking) with registered SF. This correlation should be configurable and dynamic so that it can be adapted to new SF for a certain organization or kind of IS projects. Also, the proposed approach to be supported by this system will also include a knowledge base to register SF records consistently and automatically regarding the success of IS projects.

For instance, this logic should be able to map the relation between not performing (skipping) a certain project management task (as deviation from a normal management process, detected by conformance checking), and known SF, either as a quantitative or qualitative metric (e.g., did it affect positively or negatively the importance of those SF). An example for this kind of logic can be the application of decision mining (Rozinat and Aalst 2006) to find rules explaining such relation in terms of characteristics of the particular project, where a classification technique like decision tree learning can be used to find rules.

After acquiring this knowledge and concluding the diagnosis phase, there will be the second phase of prognosis. The objective of this phase is to predict the course of a specific IS project regarding its SF (based on its historical data and/or of other similar projects) and to propose adjustments to its current and future project management tasks, which can maximize the identified SF and project success. In this way, data visualization and alarmistic information can be provided to IS project managers (e.g., in the form of a dashboard), essentially based on potential deviations in IS project management processes towards a less efficient result for project success.

[1] https://xes-standard.org/

4 Discussion

To the best of our knowledge, there is no specific research that applies process mining for managing SF. Nevertheless, there are approaches for predicting project success. For instance, in Cheng et al. (2010), the authors present a model that dynamically predicts project success by applying Artificial Intelligence (AI) and other factor analysis and multiple regressions techniques. The authors also refer to developing a predictive model of project success that uses neural networks to predict the project budget's performance.

Rubin et al. (2014) present an approach that describes how to apply process mining techniques in the agile software development processes. This approach and process mining techniques, namely process discovery and expert analysis of results, aim to improve the functional specification for the remaining sprints. Also, Caldeira et al. (2019) state that the discovery of software development processes allows evaluating the efficiency of teams, comparing the processes in terms of efficiency and effectiveness.

In another approach presented by Poncin et al. (2011), a prototype that pre-processes the repository logs for later process mining applications is presented. For Astromskis et al. (2015), process mining can help understand possible improvements after analyzing users' interaction with the software. It aims to improve the user interface, considering the activities they perform. Smit & Mens (2019) purpose is to identify SF by applying process mining in the railway industry. Wisnuwardhana et al. (2020) present a systematic literature review for identifying SF in the application of data mining.

Although not directly related to project management and project success, Valle et al. (2017) work in process mining focuses on the evaluation of software processes, namely with the aim of mitigating inefficiencies in ticket resolution processes.

Furthermore, several works correlate the success of projects with the critical SF, namely the work of Hasan et al. (2019), which aims to identify the SF that impact the success of ERP post-implementation stage. Also, Tam et al. (2020) build a model of factors that influence the success of agile software development projects. Alongside this, there is also the need to understand how the evaluation of success is carried out in organizations. Here, the works of Özturan et al. (2019); Pereira et al. (2021); Teixeira et al. (2019); Varajão and Álvaro Carvalho (2018); and Varajão and Trigo (2016) debate this theme, based on surveys and case studies.

5 Conclusion

This paper presents a new approach to improve project success by extracting and managing SF through process mining. The purpose is to enhance project managers' decisions towards providing SF information to reduce risks and failures in IS projects execution. This is achieved by first discovering and analyzing the processes behind IS project management through process mining. By considering a decision support system that will include specific business logic to correlate each SF with process mining results, we aim to provide project managers with useful monitoring, and decision-making information towards improving IS projects' success.

With this approach, organizations will also formally register, in a knowledge base, the most relevant SF and their correlation with IS project management processes. Besides presenting an innovative approach to diagnose and forecast a certain IS project's success through process mining, additional contributions include enriching IS project management process logs with SF information that can be mined by process mining techniques, as well as a decision-making platform that will support the business logic behind the correlation of process mining results and SF.

The defined method for carrying out further work is based on Design Science Research. Following Kuechler and Vaishnavi (2008)'s work, the research will comprise the stages: awareness of the problem; suggestion; development; evaluation; and conclusion. By now, the awareness of the problem and suggestion are completed (first iteration); some of the planned activities for development and evaluation are as follows: 1) identification of IS project management data of event logs, to fed process mining algorithms; 2) applying multiple-perspective process mining algorithms to discover and check the conformance of IS project management processes, towards identifying project success deviations; 3) identify heuristics for the mapping of process mining results and SF, and generate corresponding alarmistic (decision support system); and, 4) validate the solution through simulated and real project management data.

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