GOVOPS-PSECO: A Model for Governance of Technology Platform Operations in Proprietary Software Ecosystem

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Abstract. *Proprietary Software Ecosystems (PSECO) are those that concern data and knowledge concentrated on a proprietary software platform with contributions protected by intellectual property rights. The growing number of demands, added to the market pressure for a state-of-the-art solution for every business need in PSECO, causes organizations to work at a highly accelerated pace to deliver results in an increasingly short time. As a consequence, the software projects may be deployed with low quality, provoking financial loss. In this scenario, the central organization (keystone) must establish governance strategies on the technical, business, and social dimensions to ensure a sustainable technological platform. This work aims to develop and evaluate a model involving these dimensions to support the IT management team in the governance of the technological platform operations of PSECO.*

Resumo. *Ecossistemas de Software Proprietário (ECOSP) são aqueles que dizem respeito a dados e conhecimento concentrados em uma plataforma de software proprietário com contribuições protegidas por direitos de propriedade intelectual. O crescente número de demandas, somado à pressão do mercado por uma solução de última geração para cada necessidade de negócio no ECOSP, faz com que as organizações trabalhem em um ritmo altamente acelerado para entregar resultados em um tempo cada vez mais curto. Como consequência, os projetos de software podem ser implantados com baixa qualidade, provocando perdas financeiras. Nesse cenário, a organização central (keystone) deve estabelecer estratégias de governança nas dimensões técnica, de negócio e social para garantir uma plataforma tecnológica sustentável. Este trabalho tem como objetivo desenvolver e avaliar um modelo envolvendo essas dimensões para apoiar a equipe de gestão de TI na governança das operações da plataforma tecnológica de um ECOSP.*

1. Introduction

Organizations have been working cooperatively and competitively to support new products, satisfy customer needs, and eventually incorporate the next round of innovations. So,

increasing attention is being paid to connectivity and dependency in relationships between organizations involving several actors involved (e.g., suppliers, distributors, outsourcing companies, software providers, developers, and managers) (Dahesh et al. 2020).

From this perspective, researchers created a concept to be analyzed in the software industry called software ecosystems (SECO). According to Jansen et al. (2009) , SECO is a set of actors functioning as a unit and interacting in a shared market for software and services, centered on a common technological platform. A proprietary SECO (PSECO) can be characterized by the contributions of several products, technologies, and architectures protected by intellectual property and confidence agreement (e.g., SAP). The central organization in PSECO is called keystone. A keystone must establish governance policies as a critical strategy for ensuring a sustainable platform that aims to resist to natural changes, such as business evolution and technological obsolescence (Dhungana et al. 2010).

The challenge of maintaining a sustainable platform have become a priority for large organizations based on the survey performed by Gartner Group[1]. The software assets (products, applications, and services) that make up the architecture of the PSECO technological platform are built using several technologies combined with dozens of integration points, creating architectural complexities. These complex systems may behave unpredictably (Grieves and Vickers 2017).

Unpredictable behavior and systems downtime are concerns that cause major image and financial upheavals for a keystone. Sustaining the technological platform of the PSECO requires governance mechanisms related to internal and external developers, IT service providers, and IT managers to mitigate the risks of disruptions (Santos and Werner 2012). Some concerns go beyond the technical solutions, such as business and social challenges, to cite a few, revenue increase, knowledge and software asset management, and process optimization for change management.

In a competitive business environment, a keystone can adopt IT operations strategies in technical, business, and social dimensions to face undesired behaviors. IT operations refer to a set of governance practices focused on the technological infrastructure (e.g., software assets, storage, connectivity, and network), standardized software processes (e.g., change management), and people management (Bordoloi et al. 2019).

At the same time, Dittrich (2014) reports that the practices noticed in SECO explore some assumptions of traditional Software Engineering (SE), given that the development of products does not occur around a project, but by the continuous innovation made by different actors of the ecosystem. In this context, one of the critical factors for development is the quality in SECO (Santos and Werner 2012). Quality in PSECO is not easily approachable due to the critical requirements for availability, maintainability, complexity, robustness, security as well reliability practices (Santos et al. 2014).

Therefore, this doctoral thesis proposes to develop and evaluate a model involving technical, business, and social dimensions to support the IT management team in the governance of the technological platform operations of PSECO. This research aims to investigate and answer the main research question (RQ): *"How can a model support the IT management team in the governance of the PSECO technological platform operations?"*.

[1]https://www.gartner.com/en/documents/4006716. Gartner is the world's leading research and advisory company.

As a way to answer the main research question, the following sub-questions were defined:

- (SQ1) - *What are the elements of the technical, business, and social dimensions that contribute to a model for governance of the technological platform operations of a PSECO?*
- (SQ2) - *What are the strategies used for governance of the technological platform operations of a PSECO?*
- (SQ3) - *What are the particularities of a model for governance of the technological platform operations of a PSECO?*

As a contribution to the academic community, this work is intended to carry out a theorization of the evolution of the technological platform, providing ways of understanding the PSECO operations model. As a contribution to the software industry, we address some of the identified challenges in PSECO quality (Santos et al. 2014), such as:

1. Standardized Software Processes - the keystone should review the software processes to improve the experience of PSECO operations and establish appropriate controls for different types of actors;
2. People Management - the intellectual contributions of the actors must be properly leveraged by the keystone through different knowledge capture strategies, such as transferring tacit to explicit knowledge. Additionally, talent people enhance PSECO operations' performance;
3. Governance Strategies - the keystone must establish guidelines for testing activities by developers in order to ensure reliability and security of the software products in a PSECO technological platform, such as release planning; and
4. Reliability Practices - the keystone must incorporates aspects of SE and applies them to the PSECO operations, such as reducing activities duplication effort as much as possible and automating manual tasks.

2. Problem Characterization

A factor influencing the synergy between the business strategy alignment and the PSECO technology platform evolution is market pressure for a state-of-the-art solution for every business need. It causes organizations to work at a highly accelerated pace, passing this anxiety to IT project team, which must deliver results in an increasingly short time (Kappelman et al. 2006).

As a consequence of the growing number of demands added to the lack of flexible processes, some problems emerged, such as: there is not enough time to make a complete requirements specification; time estimates are imprecise; communication failures among clients, IT software providers, developers, and IT managers; late projects; over budget due to rework on software artifacts; and deadlines are prioritized over the quality of the software. The result is a software project delivered with low quality, producing incidents in the productive environment of the organization (Elsayed 2020).

This scenario contributes to the construction of an environment that is complex and vulnerable to failures in PSECO, leaving developers and managers ahead of some challenges, such as: i) building software applications able to achieve success while maintaining the stability of the technological platform; ii) managing PSECO governance relating to the technological platform architecture with several actors; and iii) monitoring

the technological platform architecture of the PSECO in order to ensure the quality of software applications provided to end-users.

Changes in production environment, whether infrastructure or new releases, are always dangerous, as any change can have a negative impact on workload, compromising its stability. The resistance of a change management process in an organization prevents monitoring and auditing the changes (who and when) for quick corrective actions, if necessary (Geada and Anunciação 2020).

The absence of a standardized change management process that supports developers in achieving reliability by protecting services from failures (Beyer et al. 2016) hampers the keystone's management team from driving governance strategies to evaluate the decision making in the PSECO operations. Reliability is closely related to availability, which is typically described as the ability of a component or software to function at a specified moment or interval of time (Geraci 1991). The keystone can use a software engineering approach to IT operations called Site Reliability Engineering (SRE) and apply its principles and practices to the PSECO technological platform to increase reliability and availability (Beyer et al. 2016). SRE teams use software as a tool to manage systems, solve problems, and automate operations tasks.

Moreover, human capital is increasingly considered as one of the main factors responsible for the growth of a company. Concerns about retaining software engineers on the keystone are critical to the success of PSECO software projects. Investing in talent is a way of perpetuating the organization's values to gain a competitive advantage in the software market. However, talent management is a challenge in SE (Gandomani et al. 2021).

Finally, according to previous studies (Manikas 2016; Costa et al. 2021), there is not much research to understand the mentioned behavior in the context of PSECO due to the difficulty of access to data from the organizations. Additionally, as the IT operations in PSECO must ensure the competitive advantage of the technological platform to survive in the market, differentiated governance strategies are necessary in relation to other SECO.

3. Related Work

The way an organization brings development and operations teams closer depends on cultural change and a new mindset to enhance application design patterns, with DevOps and SRE being recent approaches adopted. Leite et al. (2019) investigated and discussed DevOps challenges from the perspective of engineers, IT managers, and researchers. The authors explored the evolution of the operations engineer's role based on SRE strategies. As a result, some of the most relevant DevOps challenges cited in the literature were described and guided SRE practices to achieve application reliability through engineering and operations work.

A framework for SECO management and engineering called ReuseECOS was proposed by Santos and Werner (2012). The approach aims at outlining a set of steps that combine the three dimensions (architectural, business, and social) and draws on different perspectives in SECO literature. As a conclusion, SECO cannot be treated as a pure engineering approach. SECO requires several IT elements to be joined in a technological platform, providing distinct dimensions merged from a management perspective.

The relevant difference to our work is that it has a more concrete approach that de-

signs and promotes a service management strategy that works for a specific PSECO use case towards resilience, availability, and reliability objectives. We also propose several practices integrating the technical, business, and social dimensions to support the IT management team in the governance of the technological platform operations of a PSECO.

4. Solution Proposal

To achieve the general objective of this research, it is intended to achieve the following intermediate results: i) defining a body of knowledge on reliability in PSECO; ii) defining a body of knowledge for the talent retention of developers in PSECO; iii) identifying resilience-focused strategies used for governance of the technological platform operations of a PSECO; and iv) identifying and implementing change management monitoring mechanisms to help PSECO's governance and the IT management team make decisions about the technology platform's operations.

5. Research Methodology

Our work is composed of three phases: ***conception***, ***implementation***, and ***evaluation***. This research followed the methodology shown in Figure 1. The ***conception*** phase is the initial phase of this research project and involves the intellectual process of developing a research idea into a realistic and appropriate research design. The ***implementation*** phase involves applying research results into practice. Finally, the ***evaluation*** phase represents the visions and perspectives of practitioners and is focused on evaluating the PSECO-IM approach. Each step from Figure 1 is described as follows:

- **Ad hoc Literature Review:** this method is an informal approach to understand the main concepts and identify a gap not yet covered on a research topic;
- **Field Study on Talent Retention:** this study aims to identify the strategies used by software development organizations in Brazil to retain talented developers. People management is the basis in our model for the governance of the technological platform operations of PSECO;
- **Studies on Community Smells:** through an industrial research, we are investigating community smells, that is, sub-optimal patterns across the organizational and social structures in a software development community that are precursors of such nasty socio-technical events (Tamburri et al. 2021). The studies aim to identify unforeseen socio-technical events that may result in additional project costs or social debt (e.g., collective employee turnover) and may influence the business pillar in our model of PSECO operations;
- **Studies on SECO Diversity:** this study aims to investigate gender diversity in a SECO in order to comprehend the impact of propagation among software projects, whether positive or negative. For example, if a project has a hostile environment for women, the quality of deliverables may be affected. It may influence the social pillar in our model of PSECO operations;
- **Systematic Mapping Study on Site Reliability Engineering (SRE):** this study aims to investigate in the literature on how the operations model known as SRE proposes the development of automated solutions for operational aspects, monitoring, performance capacity planning, and disaster response. The goal of SRE is to create and maintain software applications that are reliable and scalable in the technical pillar in our model of PSECO operations;

- **Social Network Analysis on Change Management:** through repositories mining techniques, this study aims to investigate the software assets in the changes and to track the quality assurance in the environment of a large international organization. It also contributes to the technical pillar in our model of PSECO operations;
- **Approach for GOVOPS-PSECO Model:** this study aims to address a model to be explored within the relationships in the PSECO, where we have a central organization with concerns on mixed platforms and technologies, internal and external developers, different IT software providers, organization IT managers, and the emergence of new software projects frequently;
- **Focus Group:** this study aims to assess the effectiveness of the GOVOPS-PSECO approach for governance of technology platform operations to support the IT management team in the PSECO based on the experts' opinions;
- **Participative Case Study:** this study aims to evaluate the GOVOPS-PSECO approach for governance of technology platform operations to support the IT management team in the PSECO. The approach will be evaluated in an insurance industry organization as part of the case study; and
- **Refinement:** after the results of the participative case study step, a refinement step is indicated to act on the adjustments identified from the study.

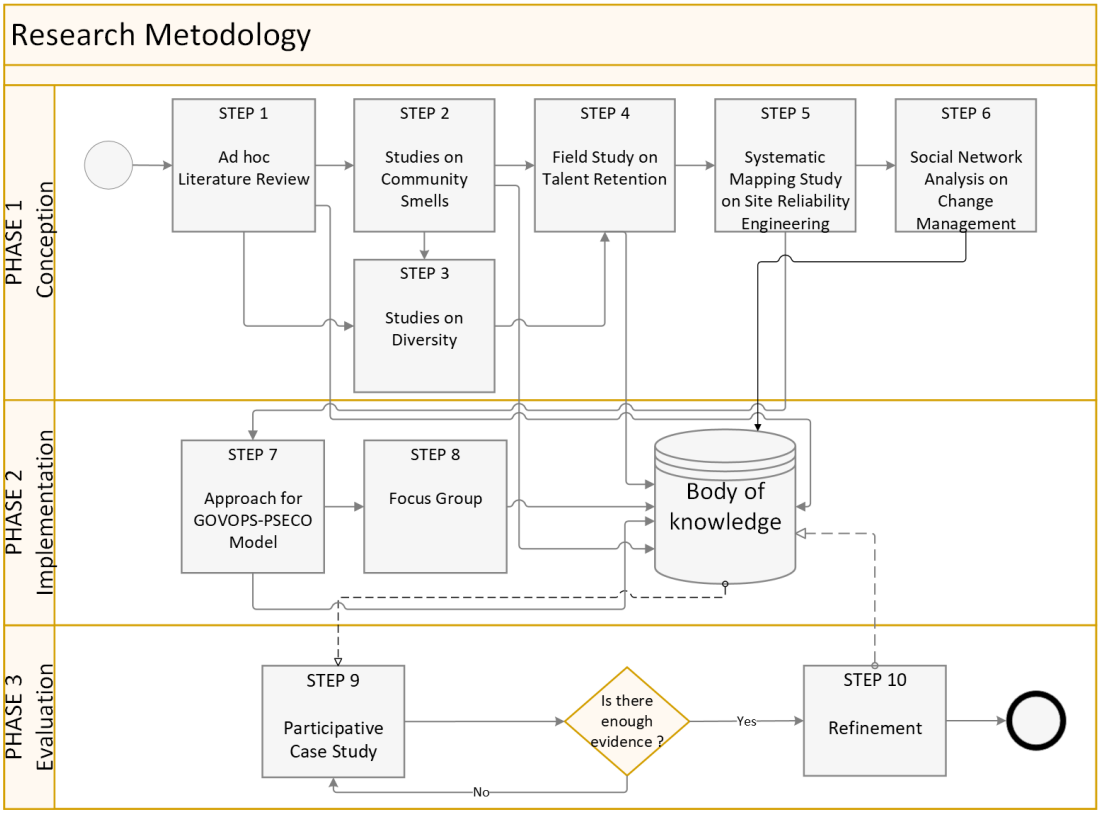

Figure 1. Research methodology.

6. Solution Evaluation

In order to assess the approach's main features, a focus group and a participative case study will be conducted to evaluate the process and the model in a large international

organization. The goal is to understand the evaluation and applicability of a model involving technical, business, and social dimensions to support the IT management team in the governance of the technological platform operations of a PSECO. The research question for this part of the work is: *"Which characteristics of a model should support the IT management team in the governance of the technological platform operations of PSECO?"*.

The evaluation will consider the opinions of industry experts (practitioners such as IT managers, developers, and business analysts). These roles are responsible for decision-making relating to governance strategies and maintaining the IT architecture in the organization's PSECO.

7. Performed Activities

Among the activities proposed for the research and the solution evaluation plans, the following ones are already ongoing: i) **field study on talent retention:** semi-structured interviews are being conducted to gather opinions on the routine of 21 IT managers in order to identify factors that lead talent to remain in organizations as well as identify the factors that are practiced to retain talent; and ii) **systematic mapping study on Site Reliability Engineering (SRE):** identification of which factors influence the adoption of SRE in an IT organizations. To do so, a systematic mapping study is being performed. Currently, we have already analyzed 125 studies from the digital libraries, such as: ACM, IEEE Xplore, Science Direct, Scopus, and Springer Link.

8. Final Remarks

This work presented a doctoral thesis project whose main contributions are: i) a set of strategies used by software development organizations to retain talented software engineers; ii) a set of factors that influence the adoption of SRE by the keystone; iii) an analysis of software asset governance considering change management processes to support governance in PSECO; iv) a set of empirical studies in a large international organization of PSECO; v) a model involving technical, business, and social dimensions to support the IT management team in the governance of the technological platform operations of PSECO; and vi) a set of lessons learned, principles, and practices applied to the governance of the technological platform operations of PSECO.

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