# An Approach for Community Smells with Power Relationship Dynamics in Proprietary Software Ecosystems

**Bárbara Beato Ribeiro (Master's student)[1], Luiz Alexandre M. Costa (colaborator)[1],**
**Rodrigo Pereira dos Santos (advisor)[1]**

[1]Programa de Pós-Graduação em Informática (PPGI)
Universidade Federal do Estado do Rio de Janeiro (UNIRIO)
Rio de Janeiro – RJ – Brasil

{barbara.ribeiro,luiz.costa}@edu.unirio.br, rps@uniriotec.br

***Abstract.*** *Community smells refer to unfavorable socio-technical patterns in software development community structures that might exist and lead to a variety of issues, such as loss of key information in any software ecosystem (SECO). These ecosystems also involve power relationships, which have an impact on products and bring challenges. This work proposes to investigate and analyze the relationship between community smells and power relationship dynamics in proprietary software ecosystems (PSECO). By identifying the community smells that may exist in SECO, community members and academics can improve their knowledge and process management, software quality, and the development process, among others.*

***Resumo.*** *Community smells se referem a padrões sociotécnicos desfavoráveis na estrutura das comunidades de desenvolvimento de software, que podem existir e levar a uma variedade de problemas, como perda de informações-chave, em qualquer ecossistema de software (ECOS). Nesses ecossistemas, também existem relações de poder, que têm impacto na produção e nos produtos e trazem desafios. Este trabalho se propõe a investigar e analisar a relação entre community smells e dinâmicas de relações de poder nos ecossistemas de software proprietário (ECOSP). Por meio da identificação dos community smells que podem existir no ECOS, membros da comunidade e acadêmicos podem melhorar seu conhecimento e gestão de processos, qualidade do software, bem como o processo de desenvolvimento, entre outros.*

## 1. Introduction

The understanding that there are social aspects affecting the development of software projects has evolved over the decades [Mens et al. 2019]. According to [Laudon and Laudon 2013], behavioral issues arise during system development and maintenance as in software ecosystems (SECO). SECO is a group of actors that interact in a shared market for software and services that is centered on a common technological platform [Jansen et al. 2009].

In this context, investigating and analyzing social aspects do not imply ignoring technology, but rather recognizing that changes in behavior, organizational policy, management, and other correlates contribute to technological development. Furthermore, [Santos et al. 2014] claimed in their introductory research on software quality for SECO

that social and knowledge management aspects are some of the challenges in this field, requiring "different knowledge capture strategies" to capitalize on the contributions of SECO members.

Proprietary software ecosystem (PSECO) is an ecosystem focused on a proprietary platform with contributions protected by intellectual property. In the software development cycle in PSECO, some interpersonal interactions that cause social events may emerge, including in power relationships. These **power relationships** can be defined, according to [Dahl 1957], as

> *"...all the resources - opportunities, acts, objects etc. - that 'he,she'(someone) can exploit in order to effect the behavior of another."*

The dynamics that provide interventions in software development can be difficult. This is because even if an issue is not apparent right away, it may have long-term effects on the software product [Palomba et al. 2021]. A **community smell** may be a potential issue and is defined by [Tamburri et al. 2021] as

> *"sub-optimal patterns through the organizational and social structure in a software development community that are precursors to unpleasant socio-technical events."*

Community smells are an analogy to code smells [Tamburri et al. 2021], which is a term used to "describe potential problems in the design of software" [Santos et al. 2018]. Although having code smells affects software development and can cause issues such as processing delays and failure risks, it does not necessarily mean that the software will not work. Social debts, which are "to unforeseen project costs connected to a 'suboptimal' development community" [Tamburri et al. 2013], are also correlated to community smells.

Based on this premise, this work aims to identify and verify how the dynamics of power relationships and community smells are correlated in PSECO. Therefore, the main research question (RQ) of this Master's thesis is: *"How are community smells in PSECO related to the dynamics of power relationships?"*. The following sub-questions were developed to answer this RQ:

- (SQ01) *"What connections exist between community smells and power relationship dynamics in PSECO?"*
- (SQ02) *"What PSECO components confirm this connection?"*
- (SQ03) *"What issues does this connection bring to PSECO?"*

The general objective is to find out the existing connections between community smells and power dynamics in PSECO. To accomplish this goal, the strategy includes: (i) conducting research on the topic to provide a theoretical foundation, (ii) proposing a connection between power relationship dynamics and community smells, and (iii) determining whether and how the community perceives this connection.

## 2. Problem Characterization

Teams working on large-scale software development are increasingly looking for ways to support users in a timely and accurate manner. This requires strong cooperation and collaboration among team members as well as all types of development activities

[Mens et al. 2019]. It can lead to delivery or maintenance issues, code smells, community smells, internal competitions, and other social debts that can be an "additional cost in a project", according to [Tamburri et al. 2021]. To cite a few: i) a team with a lack of communication may have duplicate functions in their code; and ii) a developer can take actions that lead to a certain control on the code (which leads to a community smell known as "lone wolf").

In the literature, we find studies such as [Manikas 2016] that bring some social aspects of ecosystems as challenges to overcome. The author performed a systematic mapping study that revealed some studies on this topic. They emphasize that collaboration is an important focus for the software development team, and another aspect of relationships in SECO is the community, which is typically associated with an open source software ecosystem (OSSECO) [Manikas 2016].

As a consequence, analyzing the social aspects present in these ecosystems contributes to the understanding of factors that affect the software development process, its quality delivery, and maintainability. In this context, the goal of this work is to investigate and analyze the relationship between community smells and power relationship dynamics in PSECO.

## 3. Related Work

Using the computational tool "CODEFACE4SMELLS", [Huang et al. 2021] labeled "state of the art" and used the tool to detect some community smells using email list and information about the history of a software repository. The authors suggested a technique based on developer sentiment analysis to predict the occurrence of some community smells.

A previous search on community smells in secondary studies did not return results about a mapping of the community smell field. In terms of power in SECO, some studies, such as [Farias et al. 2021], investigated power relations in open source software ecosystem, whereas [Linåker et al. 2020] investigated OSSECO companies and the influence of stakeholders in the requirements engineering process. Both works did not discuss relationships with community smells.

Regarding PSECO, [Valença and Alves 2016] conducted an exploratory case study on five newly established Brazilian software enterprises (at that time). In this study, power and dependency between companies were assessed from power relationships. However, the analysis neither goes further into the dynamics of the power relationships between these companies and/or the employees, nor addresses community smells.

## 4. Solution Proposal

To achieve the research objective, this proposal intends to: (i) build a body of knowledge on community smells; (ii) define power dynamics for PSECO; (iii) describe the relationship between community smells and power relationship dynamics for PSECO; and (iv) evaluate the findings in order to achieve the overall goal.

In a previous search, it was found that there were no secondary studies referring to community smells. In addition, power relationship dynamics were mapped to OSSECO. Thus, the first step in this study is to gather the necessary knowledge to investigate the

relationship between community smells and power relations dynamics in PSECO. With these questions defined, we aim to develop a framework and evaluate it with academics and experts in the field.

## 5. Research Methodology

This work combines two research phases: **conception**; and **implementation and evaluation** to analyze the relationship between community smells and power relationship dynamics in PSECO. The conception phase entails the process of developing and designing the research idea, while the implementation and evaluation phase focuses on the results, evaluates the work, and refines the findings, as shown in Figure 1.
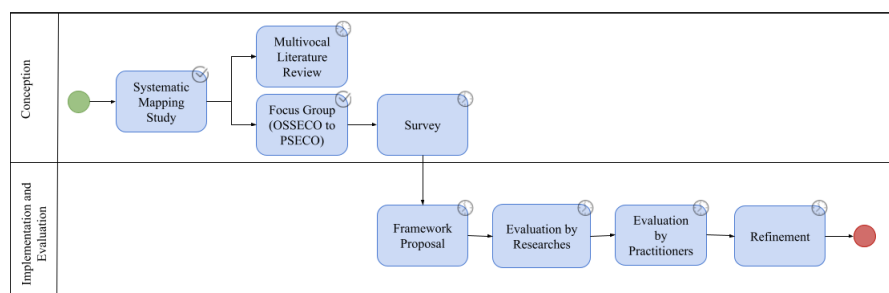


**Figure 1. Methodology adopted in this research**

During the conception phase, a **systematic mapping study** on community smells associated with social debts was conducted. A **focus group** was also conducted to adapt the power relationship dynamics present in OSSECO, identified in [Farias 2022], to PSECO. Furthermore, a **multivocal literature review** on community smells is intended to amplify the research and observations on the subject and verify the "state of practice". Next, a **survey** with IT professionals from a Brazilian organization will be conducted to consolidate the focus group analyses.

A **framework** will be proposed on how community smells and power relationship dynamics are associated in PSECO. An **evaluation by researches** is also planed to revise the framework. To verify the findings, the **evaluation by practitioners** consults senior experts from a PSECO. Finally, a refinement is indicated in order to address the adjustments identified from previous studies.

## 6. Solution Evaluation

To evaluate the proposal, researchers will first develop a framework to structure the proposal according to PSECO. It is proposed planing and execution to collaborate with a large international organization in Brazil for the evaluation. The goal is to verify how the framework is perceived by the community members.

Following this evaluation, additional analyses may be conducted, such as interviews to better understand the perspectives of the community members and the replication of this study in some OSSECO communities to compare the results.

## 7. Performed Activities

Among the proposed activities, the **systematic mapping study** and the **focus group** have already been performed. The first study aimed to contextualize what has been investigated

on community smells so far. The second focused on transposing the dynamics of power relationships from the OSSECO to PSECO.

The systematic mapping allowed us to describe the community smells that had been identified up to this point, their relationships to social debts, and the problems associated with the topic. The search string for this study was defined using the words *"community smells", "social debts" and "software ecosystem"* (and their synonyms). Twenty-three studies were selected, from which four through the snowballing technique. There are fifteen community smells identified, and the most common mitigation techniques involve communication and the developer relationship, particularly the key developer member relationship with other members.

Regarding the focus group, the study was intended to identify which OSSECO power relationship dynamics from [Farias 2022] would be present in PSECO, as well as whether there would be any other existing dynamics. The meeting lasted about an hour and brought together four experts on SECO and power relationships. Sixteen out of nineteen power dynamics were retained, and one new dynamic was added. The ecosystem understand their influence, examine decision-making, manage information and processes, and enhance the quality of the software development process as a result of this identification.

## 8. Final Remarks

This Master's thesis aims to present, as a contribution to the academic community, a research to examine the association between community smells and power relationship dynamics, considering PSECO. As a contribution to the software industry, this work brings a better understanding of how communities smell and power relationships affect PSECO communities, as well as the problems that arise in the results.

Other pertinent contributions include the extension of the body of knowledge about process management and support to decision-making by the IT management team. This work also provides a knowledge base aligned with social aspects and knowledge management for PSECO and increases the number of studies in PSECO.

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