REPORT 14

Speculative Design for Transparency in Software Ecosystem Portals

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Abstract

Software ecosystem (SECO) developer portals are Web interfaces that allow a developer to participate, consume information, and communicate with other actors within a software ecosystem. Improving developer engagement is an important concern to keep a SECO sustainable in the market over time. Developer Experience (DX) is an important quality, since negative experiences during interaction with the SECO may result in developer disengagement. Difficulties faced during interaction with a SECO portal affect engagement and may cause developers to abandon the portal and, consequently, the ecosystem. The objective of this work is to verify how transparency has been explored in SECO portals for greater satisfaction in DX and, consequently, contributing to engagement. To this end, a bibliographic survey was conducted in the Scopus database and, in the end, 4 articles were selected for result extraction. After that, speculative design was used regarding the investigated theme to identify trends and propose a technological solution for the coming years. This work aims to support developer engagement in SECO portals by identifying ways to explore transparency, which may contribute to the improvement of portals and, consequently, to greater satisfaction in DX.

1. Introduction

To meet new market demands, advances in software development strategies and approaches have emerged. For this reason, some companies are investing in opening their architectures to allow external developers to collaborate in the production of their components around a common technological platform. In this way, the concept of software ecosystem (SECO) is defined [Santos 2016].

In this context, Social Web interfaces (e.g., forums, social networks, and Web portals) have played an important role within the SECO. These interfaces comprise the so-called SECO portals (e.g., Android portal[1] and iOS portal[2]) [Meireles et al. 2019] and are essential for a central organization (platform owner) to keep its ecosystem sustainable in the market over time. One of them is the developer portal, and it is through it that developers will consume official information about the technology that composes the common technological platform and learn about its processes.

Maintaining developer engagement should be a priority for the central organization, as it is a decisive factor in keeping a SECO sustainable in the market. Engagement, which can be understood as a quality resulting from user experiences [O'Brien and Toms 2008], contributes to developers accessing the portal again. Engagement is directly related to Developer Experience (DX), which can be defined as a set of experiences lived during the development process.

Under the aegis of the Social Media Engagement Theory [Di Gangi and Wasko 2016], which establishes the relationship between engagement and user experience in social interactions between users and technical resources of the platform, it is possible to understand, in the scope of SECOs, users as developers who seek knowledge about the technological platform. In this case, transparency in SECO portals is a fundamental requirement for interaction and information consumption to occur satisfactorily.

Developers encounter barriers when using SECO portals, whether due to usability problems, difficulty of access, or low content quality. These barriers may contribute to a lack of engagement, which may occur due to lack of motivation, unpleasant aesthetics, or negative feelings generated during interaction with a SECO portal [O'Brien and Toms 2008]. Thus, understanding which aspects influence engagement makes it possible to improve SECO portals, enabling developers to remain connected longer, interacting and consuming official information.

One of these aspects is DX, which can directly influence engagement. A pleasant interaction experience may cause developers to access the SECO portal again and continue developing for its platform. Another aspect that may influence

developer engagement is information transparency, which can be understood as a characteristic that enables developers to access quality information in environments that are easy to use and understand and in which information can be audited [Leite and Cappelli 2010].

The objective of this work is to verify how transparency has been explored in software ecosystem portals to achieve greater satisfaction in developer experience (DX) and, consequently, contribute to engagement. To this end, the following research question (RQ) was formulated: *"How has transparency been explored in software ecosystem portals?"* A bibliographic survey was conducted in the Scopus database, whose results indicate that the topic has been explored in a very limited way. In the end, 4 articles were selected for data extraction. After that, a speculative design process was initiated to identify trends related to the investigated topic and propose a technological solution for the future.

This work aims to contribute to design practices, transparency, and knowledge organization in SECO portals. To this end, in addition to conducting the bibliographic survey, the speculative design method was used to identify new ways to explore the theme and apply them in Information Systems (IS), providing a basis for discussion and allowing theory and practice to be related. The remaining sections of this article are organized as follows: Section 2 presents the theoretical background; Section 3 describes the research method; Section 4 presents the results; Section 5 discusses the results; and, finally, Section 6 concludes the work.

2. Theoretical Background

2.1. Transparency in Software Ecosystems

According to Manikas [Manikas 2016], software ecosystems (SECOs) can be classified into three types: proprietary, open source, and hybrid. The proprietary SECO has its value creation based on proprietary contributions (e.g., SAP and Amazon). The open-source SECO allows contributions from different actors (e.g., Eclipse and Apache). Finally, the hybrid SECO supports both

proprietary and open-source contributions (e.g., Android and iOS).

In this context of multiple actors, three main roles can be identified: (i) central organization (keystone): organization or group that leads the development of the common technological platform; (ii) end users: customers who need the solutions provided by the platform to conduct their business; and (iii) external developers (third parties): they use the platform technology as a basis to develop new products and solutions [Hanssen and Dybå 2012].

Leite and Cappelli [Leite and Cappelli 2010] define the concept of transparency as the condition that allows individuals access, ease of use, content quality, understanding, and auditing of information of interest. Table 1 presents a set of characteristics and subcharacteristics that contribute to transparency.

Table 1. Characteristics and subcharacteristics that contribute to transparency
[Leite and Cappelli 2010].

- Accessibility: Portability, availability, publicity
- Usability: Uniformity, intuitiveness, simplicity, ambiguity, operability, performance, adaptability
- Informativeness: Clarity, accuracy, completeness, correctness, consistency, integrity, comparability, timeliness
- Understandability: Composability, conciseness, divisibility, detailing, dependency
- Auditability: Explanation, traceability, verifiability, validity, controllability

In the context of SECOs, transparency allows stakeholders to know and understand their elements, as well as the processes used for software development on their common technological platforms [Cataldo and Herbsleb 2010a]. SECO portals are one of the main interfaces that provide information about the common technological platform to the community [Meireles et al. 2019]. In this sense, central organizations responsible for managing

these portals need to maintain them with transparency levels appropriate to their niche of external developers, creating an environment conducive to information consumption and interaction among actors.

One of the main benefits of transparency for a SECO is its central role in coordinating its members, since it allows stakeholders to follow the evolution of activities within the SECO [Cataldo and Herbsleb 2010a]. In this sense, to extend the concept of transparency in the SECO context, it is necessary to implement its characteristics in the products and processes contained in the ecosystem [Santos et al. 2016].

2.2. Speculative Design

Speculative design is a way of speculating how things should be. In this form of design, imagination is the central tool and allows new perspectives on so-called "wicked problems," as well as stimulating debates and alternative ways of being, inspiring and encouraging people's imagination to flow freely [Dunne and Fiona 2013].

The authors of the term "speculative design" also coined the term "critical design" in the mid-1990s to highlight the importance of critical thinking in the face of technological advancement, since at that time technology was always considered good and capable of solving any problem. Thus, they defined that "critical design uses speculative design proposals to challenge narrow assumptions, preconceptions, and data about the role products play in everyday life" [Dunne and Fiona 2013].

One can think of the fictional objects of speculative design in relation to Kendall L. Walton's theory of make-believe, in which props are objects that "prescribe imaginings" and "generate fictional truths." Being "engaged in a story" means "participating psychologically in a game in which the story (or play or painting) is a prop." The props used in speculative design help stimulate imagination and facilitate ideas that may not be obvious. In addition, they allow thinking about alternative possibilities, favoring the challenge of ideals, values, and beliefs of our society [Dunne and Fiona 2013].

3. Research Method

The research method consists of two phases: (i) bibliographic survey; and (ii) speculative design for the researched theme. Phase (i) consisted of five stages: (1) definition of the research protocol; (2) execution of the research; (3) study selection; (4) data extraction; and (5) analysis and discussion of results. Phase (ii) also consisted of five stages: (1) research on news related to the theme; (2) reading on speculative design; (3) attempt to use speculative design tools; (4) use of notebooks to describe signals and trends, elaborate a set of cause-and-effect relationships unfolding into a set of implications, and design a technological solution for the future involving the theme; and (5) discussion of the obtained results relating them to some speculative design tools.

3.1. Bibliographic Survey

3.1.1. Protocol

At this stage, the research question was elaborated and the PICOC structure (Population, Intervention, Comparison, Outcomes, and Context), suggested by Kitchenham and Charters [Kitchenham and Charters 2007], was used to identify keywords and define a search string. In addition, the Scopus database was chosen to conduct the research, as it indexes works from other databases. The following search string was used:

("portal*" OR "interactive system*" OR "site*" OR "website*" OR "interface*" OR "platform*")

AND ("SECO" OR "SECOs" OR "software ecosystem*")

AND ("transparency" OR "translucence")

The inclusion criterion (IC) and exclusion criteria (EC) used for study selection were:

- IC: The study explores the concept of transparency in SECO portals
- EC1: Duplicate studies or studies presenting the same results as a previous study

- EC2: Study not openly available or accessible via institutional IP
- EC3: Study does not meet at least one inclusion criterion
- EC4: Study not peer-reviewed

3.1.2. Execution

The search was conducted in June 2024 and, after executing the string, 12 articles were found and a filtering process began. The filtering process had two stages: (1) preliminary selection, in which titles, abstracts, and keywords were read and checked against inclusion and exclusion criteria; and (2) additional selection, in which introductions and conclusions were read. Finally, the full texts of the accepted studies were read and results were extracted.

3.2. Speculative Design for the Researched Theme

After the literature search to identify the state of the art, speculative design was used to identify trends and project the evolution of the explored theme. This process began with research on news related to the theme on Google and Google Trends. However, no news related to the theme was found, as it is a complex and little-explored topic.

Subsequently, materials on speculative design were read and tools that could assist in the speculation process were used. The Innovation Map tool was initially explored, but no technologies related to the proposed theme were found. The Futures Wheel tool was studied but not used. Instead, a creative process based on existing knowledge of the theme was initiated.

The three notebooks provided for speculative design creation were completed. Afterwards, the Future Scenario Maker tool was used with the following inputs: product/service = “transparency in software ecosystem portals”; industry = “software ecosystem”; year = “2029.” The responses obtained and their discussion are presented in Section 5. Finally, the Tarot Cards of Tech were used to support the discussion involving the results in Section 4.

4. Results

4.1. Bibliographic Survey Results

The selected studies were published in symposia (2 studies), conference (1 study), and workshop (1 study), from the years 2010, 2017, 2020, and 2023. Figure 1 presents the distribution of studies by country.

Figure 1. Number of studies by country.

Table 2 presents the selected studies and the approaches used to explore transparency in software ecosystem portals.

Regarding the state of the art, Table 2 shows that studies explored transparency by listing interface translucency practices in software ecosystems and software development (E1); using a multimodal capture tool to evaluate developer experience during portal interaction (E3); applying a questionnaire with transparency evaluation guidelines (E2); and conducting an opinion survey to understand developers' perceptions during portal interaction (E4).

Table 2. Selected studies and approaches to transparency in SECO portals

ID	Reference	Year	Publication venue	Approach
E1	Cataldo and Herbsleb	2010	Symposium	Lists interface translucency practices in software ecosystems and software development
E2	Santos et al.	2017	Conference	Applies a questionnaire with transparency evaluation guidelines
E3	Meireles et al.	2020	Workshop	Uses a multimodal capture tool to evaluate developer experience during interaction with SECO portals

ID	Reference	Year	Publication venue	Approach
E4	Santos et al.	2023	Symposium	Conducts an opinion survey to understand developers' perceptions during interaction with SECO portals

The results demonstrate that transparency in SECO portals has been explored in a limited way and from different perspectives. Most studies focus on evaluating transparency through instruments such as questionnaires, surveys, and analysis of interface practices, but none of them propose concrete technological solutions to enhance transparency in SECO portals.

5. Discussion

5.1. Future Scenario Maker

Based on the Future Scenario Maker tool, three future scenarios were generated: Transparency Utopia, Transparency Wars, and Transparency Dystopia. Each scenario presents a different perspective on how transparency in software ecosystem portals may evolve over time.

The Transparency Utopia scenario presents a future in which transparency is a central value in software ecosystem portals. In this scenario, platforms prioritize openness, clarity, and accessibility of information, enabling developers to fully understand processes, rules, and changes within the ecosystem. Automated tools based on artificial intelligence support developers by translating complex technical documentation into plain language adapted to different profiles. This scenario promotes trust, collaboration, and engagement, strengthening the relationship between developers and platform owners.

The Transparency Wars scenario describes a future marked by disputes over control of information and transparency levels. In this context, organizations selectively disclose information to gain competitive advantage, while developers demand greater openness. Conflicts arise between platform owners and external

developers regarding data access, governance, and accountability. Transparency becomes a strategic asset, used both as a differentiator and as a source of tension within software ecosystems.

The Transparency Dystopia scenario portrays a future in which transparency is undermined by excessive control, misinformation, and lack of accountability. In this scenario, portals provide limited or misleading information, making it difficult for developers to understand platform policies and technical requirements. The absence of transparency leads to frustration, disengagement, and erosion of trust, ultimately threatening the sustainability of software ecosystems.

These scenarios highlight that transparency is not a static attribute but a dynamic and contested concept. The future of transparency in SECO portals will depend on organizational values, regulatory frameworks, technological advances, and the ability of stakeholders to negotiate shared expectations.

5.2. The Tarot Cards of Tech

The Tarot Cards of Tech were used as a speculative design tool to support reflection on the social, ethical, and cultural implications of the future scenarios discussed. The cards selected encouraged analysis of themes such as accessibility, power relations, inclusion, and unintended consequences of technological solutions.

One of the cards emphasized the importance of accessibility, reinforcing the need for SECO portals to present information in formats that can be understood by developers with different levels of expertise, cultural backgrounds, and language proficiencies. This aligns with the transparency characteristics of usability and understandability discussed earlier in this work.

Another card addressed power and control, prompting reflection on who benefits from transparency and who may be disadvantaged by it. While increased transparency can empower developers, it may also expose sensitive strategic information of platform owners, leading to tensions that must be carefully managed.

The cards also raised concerns about standardization and homogenization, suggesting that excessive reliance on automated tools for transparency—such as AI-driven content simplification—could unintentionally suppress diversity of perspectives or oversimplify complex technical concepts. This reinforces the need for balance between clarity and completeness.

Finally, the Tarot Cards of Tech encouraged consideration of long-term societal impacts, such as how transparency practices in SECO portals may influence norms of collaboration, trust, and participation in digital ecosystems. These reflections support the idea that transparency should be designed not only as a technical feature but as a socio-technical value embedded in platform governance.

6. Conclusion

From this speculative design process, it was possible to envision a tool that uses an artificial intelligence model and dictionaries of words and terms for different user profiles to translate texts into Plain Language, supporting information and software transparency. This idea is not new and had already been considered for a dissertation project, but it remains a promising contribution to society.

This work contributes to the challenge proposed by Nunes et al. (2017) by envisioning ways to enhance transparency in Information Systems and reflecting on future trends involving the area and the research theme. The speculative design process allowed discussion of possible futures and identification of opportunities and risks related to transparency in software ecosystem portals.

As future work, it is intended to document requirements, develop the artificial intelligence model, create dictionaries of terms for different user profiles, train the model, design the interface, validate the solution through testing, and apply it in real scenarios. These steps may enable the proposed solution

to be evaluated in practice and contribute to improving developer experience and engagement in software ecosystems.

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