A Multimodal Approach to Evaluate Transparency in Software Ecosystem Portals from a Developer Experience Perspective - Extended Abstract – CTDG-SI 2026

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Abstract. *Software ecosystems (SECO) rely on web portals to provide documentation, tools, architectural information, and communication channels for third-party developers, making transparency a key factor for developer experience (DX). However, transparency in SECO portals is often fragmented, increasing cognitive effort and hindering onboarding, coordination, and engagement. This work investigates DX-oriented transparency in SECO portals and proposes SECO-TransP, a framework designed to support the evaluation of transparency in these portals. Following the Design Science Research Methodology, the artifact was refined through expert evaluation and a feasibility study in industry. The results indicate that SECO-TransP makes transparency in SECO portals observable and actionable, enabling practitioners to systematically identify and address barriers that affect developer onboarding, understanding, and engagement. Finally, this work aligns with the information systems field by addressing three pillars: people (third-party developers), processes (developer onboarding and participation), and technology (SECO portals).*

1. Research Overview and Relevance

The growing complexity of modern software development has led organizations to adopt software ecosystems (SECO), where a keystone organization enables third-party developers to build solutions on shared platforms. These ecosystems involve distributed actors and interdependent components, making coordination and access to information critical [Santos et al. 2024]. In this context, SECO portals serve as the primary interface for accessing documentation, tools, and communication mechanisms, directly influencing developer experience (DX) in terms of onboarding, understanding, and engagement [Greiler et al. 2023, Parracho et al. 2024].

Despite their importance, developers often struggle to access and understand portal information [Parracho et al. 2024]. These issues are linked to insufficient transparency, defined as the ability to access, use, and understand ecosystem information [Leite and Cappelli 2010]. However, the literature lacks a DX-oriented understanding of transparency and practical evaluation approaches [Ofem et al. 2022]. To address this gap, this work proposes SECO-TransP, a framework that combines behavioral and perception data to identify transparency gaps and support improvements. This research aligns with

the "I GranDSI-BR 2016-2026" [Nunes et al. 2017], particularly Challenge 7 – Transparency in Information Systems.

2. Objectives and Research Questions

This work aims to investigate transparency in SECO portals from a DX perspective and to provide mechanisms for its evaluation in practice. To achieve this objective, we define two research questions: **RQ1** – What concepts characterize DX-oriented transparency in SECO portals, and how are they related? and **RQ2** – How can transparency in SECO portals be evaluated in practice? To address these questions, we propose a conceptual model (SECO-TransDX) that formalizes the main concepts of DX-oriented transparency (RQ1), and an evaluation framework (SECO-TransP) that operationalizes its assessment through developers' interaction and perception (RQ2).

3. Methodological Procedures

This study adopts the Design Science Research Methodology (DSRM) [Peffers et al. 2007], as follows: (i) *Identify Problem & Motivate* – we conducted exploratory studies, including two systematic mapping studies, a field study and a Delphi study with developers, to characterize transparency and developer experience challenges in SECO [Zacarias et al. 2023, Zacarias et al. 2024, Zacarias et al. 2025a]; (ii) *Design & Development* – we proposed the SECO-TransDX conceptual model and the SECO-TransP framework, integrating transparency and DX concepts in SECO portals [Zacarias et al. 2025b]; (iii) *Demonstration & Evaluation* – the artifacts were assessed through a Delphi study, a focus group, and a feasibility study in an industrial SECO context, focusing on acceptance and applicability; and (iv) *Communication* – the results were disseminated through scientific publications.

4. Main Results and Contributions

The main results of this work include the SECO-TransDX conceptual model, which structures transparency in SECO from a DX perspective [Zacarias et al. 2025b], and the SECO-TransP framework, which supports the evaluation of transparency in SECO portals through developers' interaction and perception. The framework was evaluated through a focus group with experts and a feasibility study in an industrial SECO context, indicating its usefulness, applicability, and ability to reveal transparency issues related to documentation, navigation, and governance.

The results show that SECO-TransP enables the systematic identification of transparency gaps and supports evidence-based improvements in SECO portals, contributing to better onboarding, understanding, and developer engagement. These findings also provide implications for practitioners and researchers by positioning transparency as an experiential and evaluable property in platform-based systems. Future work includes extending the evaluation to different SECO contexts and enhancing support for decision-making and continuous assessment. The complete results are detailed in the thesis [Zacarias 2025], and a related article is currently in the second round of review at *ACM Transactions on Software Engineering and Methodology (TOSEM)* [Zacarias et al. 2025b].

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References

Greiler, M., Storey, M.-A., and Noda, A. (2023). An actionable framework for understanding and improving developer experience. *IEEE Transactions on Software Engineering*, 49(4):1411–1425.

Leite, J. C. S. P. and Cappelli, C. (2010). Software transparency. *Business & Information Systems Engineering*, 2:127–139.

Nunes, V. T., Cappelli, C., and Ralha, C. G. (2017). Transparency in information systems. In Boscarioli, C., Araujo, R. M., and Maciel, R. S. P., editors, *I GrandDSI-BR - Grand Research Challenges in Information Systems in Brazil 2016 - 2026*, chapter 7, pages 73–89. SBC-Sociedade Brasileira de Computação, Porto Alegre.

Ofem, P., Isong, B., and Lugayizi, F. (2022). On the concept of transparency: A systematic literature review. *IEEE Access*, 10:89887–89914.

Parracho, T. d. M., Zacarias, R. O., Seruffo, M. C. d. R., and Santos, R. P. d. (2024). Investigating factors on information consumption by software developers on software ecosystem portals. *iSys - Brazilian Journal of Information Systems*, 17(1):3:1 – 3:46.

Peffers, K., Tuunanen, T., Rothenberger, M., and Chatterjee, S. (2007). A design science research methodology for information systems research. *J. Manage. Inf. Syst.*, 24(3):45–77.

Santos, R., Constantinou, E., Antonino, P., and Bosch, J. (2024). Software engineering for systems-of-systems and software ecosystems. *Information and Software Technology*, 165:107335.

Zacarias, R. O. (2025). *A Framework for Evaluating Transparency in Software Ecosystem Portals from the Developer Experience Perspective*. PhD thesis, Federal University of the State of Rio de Janeiro (UNIRIO), Rio de Janeiro, Brazil.

Zacarias, R. O., Antunes, L. C. R., Barros, M. d. O., Santos, R. P. d., and Lago, P. (2025a). Exploring developer experience factors in software ecosystems. *Journal of Systems and Software*, 230:112549.

Zacarias, R. O., Gonçalves, R. F., and Santos, R. P. d. (2023). Investigating transparency in software ecosystems. In *Proceedings of the XXXVII Brazilian Symposium on Software Engineering*, pages 132–141, New York, NY, USA. Association for Computing Machinery.

Zacarias, R. O., Gonçalves, R. F., Santos, R. P. d., and Lago, P. (2024). Investigating conditioning factors for transparency in software ecosystems. *Journal of Software Engineering Research and Development*, 12(1):14:1 – 14:25.

Zacarias, R. O., Santos, R. P. d., and Lago, P. (2025b). Towards an understanding of developer experience-driven transparency in software ecosystems. Preprint available at: https://arxiv.org/abs/2509.03848.