Who Holds the Cards? Managing Power in Software Ecosystems

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Abstract

Software ecosystems (SECO) comprise multiple actors collaborating around a common technological platform, typically governed by a keystone organization. Within these ecosystems, power in inter-organizational relationships define how decisions are made, who holds influence, and how value is created and shared among participants. While SECO enable innovation and collaboration, asymmetric power distributions frequently arise, leading to dependencies on third-party developers and suppliers, increasing risks such as vendor lock-in, governance opacity, and threats to long-term sustainability. Motivated by a real-world problem identified in collaboration with practitioners managing a proprietary SECO (PSECO), this study investigates how power in inter-organizational relationships are managed in SECO and their effects. To address this problem, we conducted a rapid review, synthesizing evidence from empirical studies to provide practice-oriented insights. The results show that power distribution is shaped by a combination of structural factors and that imbalances can significantly affect the ecosystem governance. The findings indicate that unmanaged power imbalances limit flexibility and increase dependency for keystone organizations. In response, the study synthesizes governance practices insights that emphasize transparency, participation, and adaptability as key elements for managing power in inter-organizational relationships and fostering more sustainable SECO.

Keywords

Power, Software Ecosystems, Rapid Review

1 Introduction

Software ecosystems (SECO) are complex socio-technical environments composed of interdependent actors, such as platform owners (keystone organizations), third-party developers, suppliers, clients, and end-users [38]. Although keystone organizations enable distributed value creation through standards and orchestration [20, 28], their central role can generate power asymmetries that limit other actors' autonomy and participation [27, 51]. Thus, the distribution of power among stakeholders within these ecosystems is not always balanced, often leading to critical dependencies on third-party developers and suppliers [4, 26]. This power asymmetry can constrain the decision-making flexibility of keystone organizations, increase the risk of vendor lock-in, and ultimately threaten the sustainability of the ecosystem [3, 42]. Managing such power asymmetries in inter-organizational relationships therefore represents a strategic concern for Information Technology (IT) managers in keystone organizations, who must ensure stability, security, and continuous innovation while navigating complex dependencies and dynamics of influence [12, 17].

Despite the significance of power in inter-organizational relationships, there is a lack of consolidated research that systematically examines how power is exerted, distributed, and managed among different stakeholders. Addressing this gap is essential for developing governance models that mitigate imbalances and promote a more sustainable SECO [13, 37, 39].

Through a rapid review (RR) of the literature, this study investigates how power in inter-organizational relationships is managed in SECO and what effects it produces. Thus, the main research question (RQ) guiding this study is: *How is power in inter-organizational relationships managed in software ecosystems, and what are its effects?* By identifying key power structures, factors influencing power distribution, and governance practices, we seek to provide insights into how organizations can navigate and balance power in inter-organizational relationships. This research contributes to the broader discussion on SECO governance by offering a structured understanding of power in inter-organizational relationships and their implications for SECO sustainability.

The reminder of this paper is organized as follows: Section 2 presents the background and related work; Section 3 explains the research method; Section 4 reports the results of the RR; Section 5 presents a discussion of the results and implications for researchers and practice; Section 6 brings the trustworthiness of this work; and finally, Section 7 concludes the work with some final remarks.

2 Background and Related Work

To contextualize the investigation of power in SECO, this section first introduces the main concepts related to power and then discusses the most relevant related work.

2.1 Background

According to the Cambridge Dictionary [7], the term "power" is defined as the "ability to control people and events". Dahl [11] describes power as a relationship in which "A has power over B to the extent that it gets B to do something that B would not otherwise

do". However, Emerson [13] argues that power should be analyzed from the perspective of relationships rather than being considered an inherent property of an individual or a group. This relational approach aligns with Foucault [15] definition of power relations as asymmetric interactions between two actors, where one possesses something that the other desires, leading the latter to act according to the former's will.

Emerson [13] proposed that dependence is a fundamental element of power, as it arises when one party relies on another. This dynamic is described as a power-dependence relationship, in which "B's dependence on A determines the extent of A's power over B". Since levels of dependence vary among actors, the distribution of power also differs. As a result, relationships can be either balanced or unbalanced, depending on whether one party has a power advantage. This structure suggests that power within a dyadic relationship is not static, allowing for redistributions and shifts, where one actor may gain influence without necessarily reducing the power of the other. In this context, French et al. [16] describes the types of power as follows:

- **Coercive power**: source of power based on a company's belief that another company has the ability to punish the former if it fails to cooperate;
- **Expert power**: source of power based on the belief that one company has knowledge needed by another company;
- **Legalistic power**: source of power based on the belief that one company retains a legitimate right based on formal processes to influence another;
- **Referent power**: source of power based on the identification of one company with another company, or the former's wish for being closely associated with the latter; and
- **Reward power**: source of power based on a company's belief that another company has the ability to mediate rewards and it will bring these rewards if the former complies.

The work of Cutolo and Kenney [10] provides important insights into how keystone organizations can become strategically vulnerable when niche or peripheral players gain disproportionate influence over key technologies or communities. Gawer [18] similarly highlights that power in digital ecosystems is distributed and fluid, challenging hierarchical and static interpretations. While these studies significantly contribute to the theoretical understanding of power asymmetries, they fall short of offering practical tools for diagnosing and mitigating their negative effects.

2.2 Related Work

Farias et al. [14] investigates power relations in open source SECO (OSSECO), showing that power is often decentralized but unevenly distributed, shaped by factors such as repository control, reputation, and community participation. Similar to our study, they show that power relations affect ecosystem interactions. However, their work focuses on OSSECO and mainly maps power forms and dynamics, whereas our study investigates SECO more broadly, synthesizing power distribution, its effects, and governance practices across different contexts.

Alves et al. [1] provides a complementary perspective by examining SECO governance through a secondary study. Their work focuses on the balance between control and autonomy and classifies governance mechanisms into value creation, coordination, and openness and control. In contrast, our study focuses on power in inter-organizational relationships, analyzing how it is established, distributed, and mitigated through governance practices.

Outão et al. [30] focus specifically on proprietary SECO (PSECO) through a systematic mapping study. Their work synthesizes PSECO definitions, actors, characteristics, governance conditioning factors, and challenges, highlighting centralized management, intellectual property protection, restricted contribution processes, dependency monitoring, and transparency mechanisms as relevant aspects of PSECO. While their study frames PSECO and its governance challenges, our work focuses more directly on power in inter-organizational relationships across SECO. Their findings help explain why power imbalances may be particularly relevant in PSECO, while our study synthesizes how power is established, distributed, and mitigated through governance practices.

Overall, these studies provide relevant perspectives on power and governance in SECO. However, our study differs by offering an RR that consolidates empirical evidence across multiple SECO contexts, providing a broader and practice-oriented perspective on how power is established, distributed, and managed to support practitioners facing dependency and governance challenges.

3 Research Method

RR are secondary studies with a strong practice-oriented focus [43, 53]. An RR was appropriate because the main RQ addresses a practical problem raised by practitioners: How is power in inter-organizational relationships managed in software ecosystems, and what are its effects? The RR approach allowed us to synthesize empirical evidence in a structured and timely way, balancing methodological rigor with practical relevance to support decision-making in the investigated context. RR primary objective is to provide practitioners with evidence-based insights to support decision-making while maintaining the reliability of research protocols or addressing challenges encountered in practice [8].

To align with practical time constraints, RR aims to deliver results in significantly shorter time frames compared to systematic literature review (SLR), which often require several months or even years to complete [44]. To achieve this efficiency, RR streamlines or omits certain steps typically included in SLR. For this study, we adhered to the protocol outlined by Cartaxo et al. [8], following a methodology similar to that proposed by Kitchenham et al. [21].

Cartaxo et al. [8] defines the RR process in three main phases: planning, execution, and reporting. In our study, these phases are reflected in Sections 3.1–3.3 (planning), Sections 3.4–3.5 (execution), and Sections 4–5 (reporting). Our approach extends these phases by incorporating actions, ensuring the active involvement of practitioners throughout the process [36]. In our work the practitioners were actively involved across the planning, execution, and reporting phases of the RR. Their contributions included refining RQ based on organizational needs, supporting interpretations during data analysis meetings, and critically reviewing the final results to ensure practical relevance.

3.1 Review Preparation

In this step, we constituted a team made up of five researchers and two practitioners who participated in the review, as described in Table 1. The RR lead researcher presented the overall objective, typical process, timeline, and expected time commitments. Next, the teams agreed on the expectations, level of involvement, and responsibilities of both researchers and practitioners.

The demand for an RR emerged from the alignment of the researcher's work-based and the industry's specific needs in a practical problem: critical dependency on third-party developers and suppliers in SECO, generating an imbalance of power in the ecosystem. The IT manager of a keystone organization is responsible for ensuring the stability, security, and continuous evolution of the ecosystem. However, a critical operational challenge is managing power among key stakeholders, including third-party developers and suppliers, who significantly influence the ecosystem's success. Some third-party developers and suppliers have gained disproportionate influence within the ecosystem due to their control over essential application programming interface (API), core software modules, or specialized knowledge. This imbalance limits the keystone organization's flexibility in decision-making and increases the risk of dependency and lock-in.

Table 1: Characterization of RR participants.

Qty	Profile	Skills
2	IT Manager	Significant experience (10+ years) in software development and IT project management.
1	Research Leader	RR research leader (Master's degree) with several contributions in SE.
1	Research Senior	RR research supervisor (Doctorate degree) with notable publications in SE.
3	Ph.D. Professor	Experienced researcher in Empirical Software Engineering (ESE), responsible for the high-level review of the study.

3.2 Research Questions

To operationalize the main RQ, researchers and practitioners refined four specific RQ (RQ1–RQ4) as the understanding of the practitioners' context improved. In this step, researchers and practitioners refined the RQ as the understanding of the practitioners' context improved. This procedure was performed through an iterative process in which both teams developed an understanding of the terminology and domain concepts. In our case, it did not take much time to develop a consensus on the RQ due to the scope of each one also being grounded in academic references. Once the RQ were sufficiently clear, the research team articulated some decisions, such as the search strategy, inclusion and exclusion criteria, analysis approach (coding process).

In line with our research method, our RQ aimed to allow the researcher to obtain detailed and rich information about power aspects of the topic at hand. The RQ evolved as we collected and examined our data, and they were further revised. The RQ were described in Table 2.

Table 2: RQ rationales to support the RR study.

RQ	Rationale
RQ1. Which are the types of power exercised between organizations in software ecosystems?	Identify the most cited type of power exercised between organizations in SECO in the literature.
RQ2. How are power established and distributed among organizations in software ecosystems?	Explore the factors that define the balance (or imbalance) of power among participating organizations.
RQ3. How does power imbalance affect the keystone organization and the ecosystem?	Investigate how power imbalances influence the keystone organization's ability to sustaine the SECO e and the effects in the ecosystem.
RQ4. What governance practices can be implemented to mitigate power imbalances in third-party developers and suppliers?	Identify practices and mechanisms that reduce the disproportionate influence of external stakeholders and enhance the keystone organization's flexibility in ecosystem management.

3.3 Search Process

We grounded our work on ESE guidelines [40]. We followed a similar SLR protocol and the procedures were described in Section 3.4. Following the RR methodological characteristics [8], we streamlined the search for primary studies and conduct the RR under the agreed time frame. For this purpose, we used the Scopus[1] search engine, which has been similarly adopted in other RR in software engineering, such as Gonçalves et al. [19] and Botelho et al. [5]. It searches in many of the most relevant digital libraries. We tested many different versions of the search string until we found a set that returned relevant studies. Before conducting the search, we present the possible search string to two additional experienced researchers in ESE, and through a feedback loop with them, we refined it, making the string more open so that filtering could be performed in subsequent stages. Thus, we defined the following search string: ("software ecosystem*" AND "power").

The extraction and analysis of data from the selected studies were carried out by two researchers. Several discussion meetings were held to clarify some doubts that required double checking the results. The other researchers validated the final set of studies.

3.4 Inclusion and Exclusion Criteria

We adopted the following inclusion criteria: IC01. Study is written in English; IC02. Study presents evidence based on scientific empirical methods (e.g., interviews, surveys, case studies); and IC03. Study answers at least one RQ. The exclusion criteria adopted in this study were: EC01. Study does not present original empirical evidence (e.g., secondary studies such as SMS and SLR, or other non-full-paper publications); EC02. study is a duplicate report of another study; and EC03. Study does not answer any RQ.

[1] https://www.scopus.com/home.uri

As first step, the literature collection started with 96 studies retrieved from the Scopus digital library. The search process was conducted between January and February, 2026. In the second step, we removed studies that satisfied our exclusion criteria. However, no studies were removed at this stage. In the third step, we excluded studies based on titles and abstracts that did not satisfy our inclusion criteria, obtaining 20 studies. In the fourth step, we read the introduction and conclusion sections of the studies and removed those that could not answer at least one RQ, obtaining 16 studies. In the fifth step, we read the full text and one removed that could not answer at least one RQ, obtaining 15 studies. Finally, in line with RR guidelines [8], the research team adopted a pragmatic quality appraisal over the selected studies, taking the practitioner's perspective and context into consideration. Rather than applying individual quality scores to each study, we considered publication venues as a baseline indicator of rigor, prioritizing peer-reviewed journals and major IEEE/ACM conferences. This decision was aligned with the RR objective of balancing methodological reliability and practical time constraints. We selected the 15 studies for data extraction and the complete list was enumerated from S1 to S15 in Table 3. The RR selection and data extraction steps are shown in Figure 1.

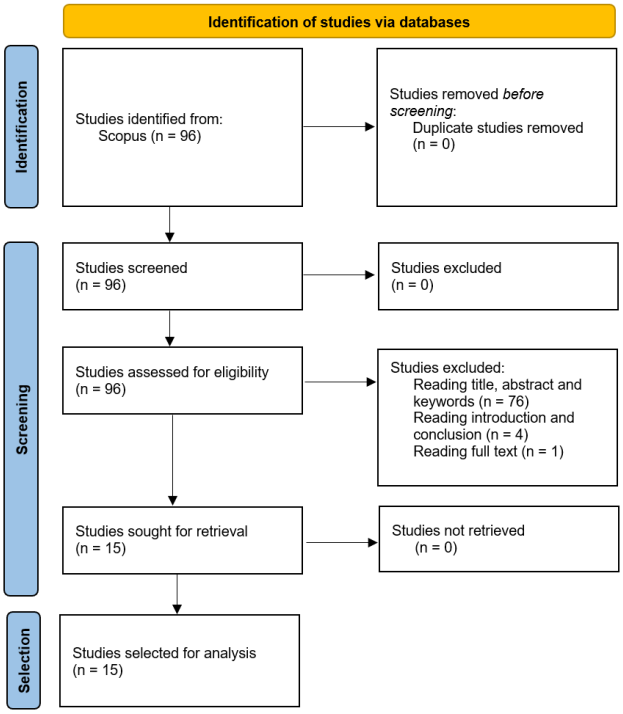

Figure 1: Selection and data extraction steps of the RR.

3.5 Coding Process

Two researchers conducted and coded the selected studies over an average of three iterative cycles. The codes were generated inductively, emerging directly from the data through an open coding process. To ensure a collaborative, comprehensive, and reliable approach, the results were reviewed by each researcher to allow for the exchange of perspectives and consensus on code generation. During the coding process, the points of disagreement between researchers were discussed transparently and resolved through consensus in a new review meeting. The other three more experienced researchers ESE double-checked the results and ensured the compliance of the final dataset.

Two researchers performing the process divided the **transcripts** of the selected studies into coherent units (sentences, paragraphs, keywords, or concepts) and added **preliminary codes** representing the key points related to each RQ rationale. Based on these preliminary codes, **focused codes** were defined to capture the most frequent and relevant elements related to power. Next, axial coding was conducted, as described by Brink et al. [6], to group the codes into core categories. Three iterative cycles were performed, including discussions between the researchers to write memos for the codes and categories and establish relationships among them, forming a higher-level logical network. The coding process is illustrated using excerpts taken verbatim from the primary studies.

In S02, the excerpt "The introduction of ERP app stores brings with it a reconfiguration of the very foundation of the existing ecosystem surrounding an ERP vendor" was initially coded as *Power reconfiguration through platform introduction*, later abstracted to the focused code *Governance mechanisms*, and grouped under the core category *Factor to power establishment and distribution (RQ2)*. Similarly, S03 reports that "Once recognising the business opportunities brought by a specific demand from customers, partners can battle to implement that feature". This transcript unit was coded as *Power disputes over feature implementation*, abstracted to *Strategic positioning*, and mapped to the same core category *Factor to power establishment and distribution (RQ2)*.

4 Results

In an RR, RQ hold the same level of importance as in a SLR [21]. However, there is a subtle distinction between them. While RQ in SLR are designed to identify research gaps and offer broad insights to the academic community, RQ in RR are more focused, aiming to provide targeted answers within a specific practical context [8]. Consequently, once RQ are established, all efforts are directed toward addressing them. In the context of an RR, results are considered valuable when they assist practitioners in solving or mitigating real-world problems [8]. This section presents the results of the RR, organized according to the four RQ that guided the synthesis.

RQ1. Which are the types of power exercised between organizations in software ecosystems? Based on information from the studies, all selected studies were published within the last 15 years. These studies analyze how power is exercised among organizations in SECO, identifying both traditional and emerging type of power that influence intercompany relationships. The traditional power typologies, as *Coercive Power*, *Expert Power*, *Legalistic Power*, *Referent Power*, and *Reward Power*, are widely discussed in the literature, as described in Section 2. These types of power were cited in most studies, which can be observed in Table 4.

Based on the studies, the *coercive power* is observed when companies impose compliance on their partners, as seen in S05: "The coercive power is based on B's perception that A has the ability

Table 3: Selected studies for the RR.

ID	Title	Authors and Reference	Year
S01	The power of propagation: on the role of software operation knowledge within software ecosystems	van der Schuur et al. [52]	2011
S02	Introducing app stores into a packaged software ecosystem: a negotiated order perspective	Magnusson and Nilsson [25]	2013
S03	Competition and collaboration in requirements engineering: A case study of an emerging software ecosystem	Valença et al. [48]	2014
S04	How firms adapt and interact in open source ecosystems: Analyzing stakeholder influence and collaboration patterns	Linåker et al. [24]	2016
S05	Understanding how power influences business and requirements decisions in software ecosystems.	Valença and Alves [46]	2016
S06	A power perspective on software ecosystem partnerships	Valença et al. [45]	2016
S07	Ecosystem ethics: An ethical analysis of orchestrators' ultimate power and the dilemma of ecosystem ruling	Koskinen et al. [22]	2017
S08	Herding cats in a FOSS ecosystem: a tale of communication and coordination for release management	Poo-Caamaño et al. [33]	2017
S09	The dynamics of power in software ecosystems: Insights from a multiple case study	Valença Santos and Alves [50]	2017
S10	A theory of power in emerging software ecosystems formed by small-to-medium enterprises	Valença and Alves [47]	2017
S11	Business as usual? On the nature of relationships in enterprise software platform ecosystems	Molenaar et al. [29]	2018
S12	Strategies for managing power relationships in software ecosystems	Valença et al. [49]	2018
S13	Exercising power in software ecosystems	Alves et al. [2]	2019
S14	Power and privacy in software ecosystems: a study on data breach impact on tech giants	Rebelo et al. [34]	2021
S15	Towards Power Relationship Dynamics and Community Smells in the Proprietary Software Ecosystem	Ribeiro et al. [35]	2023

Table 4: Types of power identified in the selected studies (RQ1).

Type of power	Number of studies	Studies
Referent power	12	S02, S03, S04, S05, S06, S07, S09, S10, S11, S12, S13, and S14
Expert power	12	S01, S03, S04, S05, S06, S07, S09, S10, S12, S13, S14, and S15
Legalistic power	11	S01, S02, S05, S06, S07, S09, S10, S11, S12, S14, and S15
Reward power	11	S03, S05, S06, S07, S09, S10, S11, S12, S13, S14, and S15
Coercive power	8	S03, S05, S06, S07, S09, S10, S13, and S15

to mediate punishments for him". *Expert power* is frequently mentioned, with companies leveraging their specialized knowledge to gain influence, as in S09: "Expert power is an extremely important and effective strategy to influence other companies in a SECO". *Legalistic power* is evident in situations where companies rely on formal processes and governance structures to enforce ecosystem rules. For example, in S10, companies use contractual agreements to establish their authority: "Legitimate power capability provides the firm with greater chances to define technological standards of the integration infrastructure".

Referent power, on the other hand, is based on reputation and the desire of companies to associate with influential players. In S03, referent power arises when a product's strategy enhances its supplier's influence: "Milne and Maiden call this situation referent power, which here consists of the strategic characteristics of one product that increase the power of the product's supplier". Additionally, S05 discusses how referent power is used by keystone organizations to maintain ecosystem loyalty: "By defining this system as a platform, it can oblige partners to follow technical specifications, adapt their systems to maintain the integration and comply with quality standards. This strategy can establish Company D as a keystone by creating a source of referent power". Finally, *reward power* is observed when companies use incentives to encourage compliance and collaboration. S09 highlights that "The exercise of reward power involves the provision of some sort of compensation by a powerholder. Examples include sharing advertising expenses and providing specialized market data". Additionally, S12 states that reward power is commonly perceived in SECO: "Companies expect several advantages when collaborating in a SECO. Players that provide such benefits are exercising reward power, which we perceived in all case studies".

Beyond these well-established categories, some studies adopt a higher-level analytical perspective by grouping traditional power into broader categories. In this sense, *soft power* and *hard power* are not presented as independent power types, but as overarching conceptual lenses that characterize how the previously described power types are exercised. S13 explains that soft power is based on knowledge, rights, and reputation rather than direct enforcement: "Instead of relying on measures of payment or punishment, companies should also explore their knowledge, rights, and respect to apply Expert Power, Legitimate Power, and Referent Power over players. These are examples of what can be called soft power". On the other hand, hard power relies on economic control and coercion,

as seen in the same study: "Coercive and Reward Power are examples of what is called hard power because they involve a significant degree of dependence of companies on the power holder". This distinction provides an integrative view of how traditional power types manifest in practice, rather than introducing new typologies.

Another relevant aspect identified in the studies is the presence of power-changing operations, which are strategies used to modify power. S12 describe four key mechanisms: *withdrawal* (reducing dependence on a partner), *extension of power network* (diversifying relationships to reduce risk), *attachment* (creating incentives to increase dependence), and *coalition formation* (alliances to counteract dominant firms), saying that Emerson [13] introduced four operations to promote structural changes in power: Withdrawal, Extension of Power Network, Attachment, and Coalition Formation.

The studies analyzed indicate that power in SECO are complex and multifaceted. While traditional power types remain relevant, conceptualizations such as soft power, hard power, and power-changing operations provide a deeper understanding of how influence is exerted and contested within these networks. The concentration of research in the mid-to-late 2010s suggests that this is an evolving field, with ongoing discussions on governance, collaboration, and competition within SECO.

RQ2. How are power established and distributed among organizations in software ecosystems? Power in SECO are shaped by factors that influence the balance or imbalance of power among organizations. These factors determine how influence is distributed, whether power remains concentrated in a few dominant companies or is more evenly shared across ecosystem participants. Balance is often achieved when interdependencies create mutual reliance, while imbalances emerge when companies control critical resources or governance mechanisms that force others into subordinate roles. Through the analysis of 15 studies, we identified ten key factors that define power distribution in SECO, each contributing to how organizations establish and maintain influence over their partners. These factors are described in Table 5.

The factors are not exclusive to OSSECO or PSECO. However, the synthesis indicates different emphases across contexts: OSSECO studies more frequently relate power to reputation and status (F07) and coalitions and alliances (F09), while PSECO studies strongly emphasize resource dependency (F01), strategic positioning (F05), market influence (F06), and governance mechanisms (F02).

The establishment and distribution of power in SECO are influenced by a combination of structural, strategic, and behavioral factors. While resource control, governance mechanisms, and market influence tend to favor dominant companies, factors such as interdependence, coalitions, and innovation capacity can balance power in inter-organizational relationships. These findings illustrate that power in SECO is dynamic, constantly evolving as organizations adapt their strategies to maintain influence or challenge existing hierarchies. By understanding these factors, companies can navigate ecosystem dynamics more strategically, fostering sustainable and cooperative partnerships.

RQ3. How does power imbalance affect the keystone organization and the ecosystem? Power imbalances within SECO significantly shape their sustainability, governance, and innovation capacity. The keystone organization plays a central role in maintaining ecosystem health. However, excessive concentration or dispersion of power can lead to risks such as dependency, stagnation, and instability. This analysis explores how power imbalances impact the keystone organization's ability to sustain the SECO and their broader effects, drawing insights from multiple studies, as follows:

- **Power dependency and lock-in risks:** Power within ecosystems can lead to dependency relationships, where actors become overly reliant on the keystone organization. This dependency creates lock-in risks, limiting flexibility and innovation. According to S06, keystone organizations exercise reward power by providing incentives to partners, such as certification programs or financial support, to maintain influence. However, this dependency makes smaller actors vulnerable to governance changes imposed by the keystone organization, as highlighted in S11, where participants expressed concerns about a lack of transparency in governance;
- **Governance strategies and power distribution:** Governance mechanisms play a key role in mitigating power imbalances. S10 emphasizes that an keystone organization can distribute power within the ecosystem by defining governance strategies, ensuring fair participation and reducing the risk of dominance by a single entity. Governance strategies include setting clear participation rules, balancing autonomy among partners, and preventing excessive market concentration. Without proper governance, keystone organizations may impose restrictive policies that limit partner influence, as observed in S06, where some actors had minimal control over platform modifications;
- **Innovation and impact of power asymmetry:** Power asymmetry can foster or limit innovation within an ecosystem. S13 shows that keystone organizations use expert power to define standards and technology directions, which may restrict the autonomy of smaller actors. This effect is especially visible in proprietary SECO (PSECO), where control over product evolution reduces innovation opportunities;
- **Entry barriers and market competition:** Dominant keystone organizations often set high barriers for new entrants, affecting market competition. S08 highlights how power in SECO can create socio-technical challenges that increase entry costs for smaller actors. In some cases, keystone organizations establish preferred partnerships, favoring long-established collaborators over newcomers, as seen in S11, where ecosystem partners criticized biased contract policies;
- **Conflict and ecosystem instability:** Power struggles between ecosystem participants can lead to instability and inefficiencies. S06 discusses how coercive power, when exercised aggressively by the keystone organization, may drive niche players to seek alternative ecosystems, reducing ecosystem robustness. Similarly, S09 explains that conflicts over governance and revenue distribution can lead to fragmentation, where dissatisfied partners exit the ecosystem, further destabilizing the network; and

Table 5: Factors that define power distribution in SECO.

Factor	Factor description	Studies
F01. Resource dependency	Resource dependency refers to the degree to which companies rely on others for essential assets such as technology, infrastructure, or market access. When an organization controls a scarce resource, it gains leverage over dependent companies, creating an imbalance of power.	S01, S04, S06, S07, S09, S11, S12, and S13.
F02. Governance mechanisms	Governance mechanisms, such as platform rules and contractual obligations, establish control over how ecosystem participants interact. Companies that define governance structures often wield power over others by determining entry conditions, standardization processes, and compliance requirements.	S02, S04, S06, S08, S10, S11, and S12.
F03. Interdependence between companies	Power are also influenced by the degree of mutual reliance between companies. In some ecosystems, companies depend on each other for complementary services or shared customer bases, which can prevent extreme power imbalances.	S01, S02, S04, S07, S09, S12, and S13.
F04. Use of coercion	Coercive power is exercised when dominant companies enforce compliance through threats, exclusivity agreements, or resource restrictions. This often leads to an imbalance of power, forcing smaller companies to conform to the rules set by ecosystem leaders.	S03, S04, S05, S06, S09, and S13.
F05. Strategic positioning	Organizations that secure central roles in the ecosystem, such as platform orchestrators or keystone organizations, gain substantial influence over partners and competitors. Companies that position themselves strategically can dictate integration standards and shape market trends.	S03, S04, S06, S09, S10, and S11.
F06. Market influence	Companies that control market access, distribution channels, or industry standards gain significant power over their ecosystem partners. Market dominance enables these companies to set pricing strategies, determine integration requirements, and influence consumer adoption.	S02, S03, S04, S06, S10, and S12.
F07. Reputation and status	Reputation and brand recognition contribute to a company's influence within an ecosystem. Companies with strong reputations attract partners, gain customer trust, and establish themselves as industry leaders.	S01, S04, S07, S09, S12, and S13.
F08. Financial incentives	Financial rewards, such as revenue-sharing agreements or subsidies, can be used to attract and retain partners, reinforcing power in inter-organizational relationships. Companies that provide financial incentives to ecosystem participants often establish long-term influence.	S04, S06, S09, S10, and S11.
F09. Coalitions and alliances	Smaller or less powerful companies form alliances to counterbalance dominant players and negotiate better terms within the ecosystem. By collaborating, these companies can influence governance and resource distribution.	S07, S09, S11, and S12.
F10. Innovation capacity	Companies that consistently innovate and introduce new technologies shape ecosystem dynamics by setting trends and differentiating themselves from competitors. Innovators often establish leadership positions and gain bargaining power over partners.	S04, S06, S07, and S10.

- **Balancing power for long-term sustainability:** To ensure long-term sustainability, keystone organizations must balance power distribution, allowing smaller players to contribute while maintaining overall governance control. S10 suggests that effective governance involves co-regulation mechanisms, where key partners participate in decision-making processes, fostering a sense of shared ownership. This balance prevents excessive centralization while maintaining coherence in ecosystem evolution.

RQ4. What governance practices can be implemented to mitigate power imbalances in third-party developers and suppliers? SECO are dynamic and dominated by keystone organizations that have influence over third-party developers and suppliers. This imbalance can lead to reduced innovation, decreased participation, and unfair dependency structures. To create a more sustainable ecosystem, governance practices can be implemented to balance power among stakeholders and enhance keystone organization's ability to manage the ecosystem (see Table 6).

The practices identified in Table 6 indicate that mitigating power imbalances requires a combination of governance mechanisms rather than a single intervention. Some practices are primarily related to transparency and accountability, such as establishing transparent governance structures (P01), ensuring stakeholder accountability (P12), and monitoring and adapting governance over time (P09). Others focus on distributing influence among ecosystem actors, including decentralized decision-making (P02), open and inclusive participation (P03), and knowledge-sharing forums (P10). A third group addresses dependency reduction by supporting independent developers (P08), limiting keystone organization control over critical resources (P11), defining fair entry and exit rules (P06),

encouraging cross-platform collaboration (P13), and implementing fair revenue distribution models (P14). Finally, conflict resolution mechanisms (P04), collaboration incentives (P05), and regulatory oversight (P07) help manage tensions that may emerge when power is unevenly distributed.

Although we do not rank practices by effectiveness, Table 6 shows that P01 to P04 were the most recurrent, each supported by four studies. Practitioners also highlighted P01 and P02 as the most actionable. Governance practices are important in SECO because they define how influence is exercised across the ecosystem. As Tiwana [42] explains, platform governance concerns the mechanisms through which a platform owner exerts influence over ecosystem participants. Thus, by shaping rules and interactions, governance can help limit dependency and reduce power imbalances.

5 Discussion

The analysis of power in SECO reveals how power imbalances influence keystone organizations and their ability to sustain ecosystem stability, innovation, and governance. The synthesis of findings highlights key mechanisms that reinforce power asymmetries, as well as governance practices to mitigate them.

Power in SECO are complex and multidimensional, involving various stakeholders such as keystone organizations, third-party developers, and suppliers. This RR confirms the presence of traditional power typologies (coercive power, expert power, legalistic power, referent power, and reward power) with referent and expert power appearing as the most frequently cited across studies.

Beyond these traditional power types, emerging power categories such as soft power and hard power introduce a new perspective on how control is exerted in SECO. Alves et al. [2] describes soft power as a mechanism based on knowledge, rights, and reputation, whereas hard power is rooted in economic control and coercion. These findings align with Farias et al. [14], who emphasize that power in OSSECO is often decentralized, yet certain entities manage to establish control by leveraging legal and financial mechanisms.

Another important aspect revealed by this study is the existence of power-changing operations, which allow stakeholders to actively modify power in inter-organizational relationships. Withdrawal (reducing dependence on a partner), extension of power networks (diversifying relationships), attachment (creating incentives for dependence), and coalition formation (alliances to counter dominant companies) were identified as strategies that influence power balance within SECO. These strategies were observed in S12, which discusses how power redistribution can mitigate the risks associated with excessive keystone organization dominance. Moreover, the synthesis suggests different emphases across ecosystem contexts. In OSSECO, power is often linked to reputation, status, and alliances, while in PSECO it tends to be more associated with resource dependency, strategic positioning, market influence, and governance control.

This interpretation is reinforced by Outão et al. [30], who show that PSECO are marked by centralized management, intellectual property protection, restricted contribution processes, and strong keystone coordination. These characteristics help explain why factors such as resource dependency (F01), governance mechanisms (F02), strategic positioning (F05), and market influence (F06) are especially relevant for power concentration in proprietary contexts. Power imbalances significantly impact the sustainability of SECO by introducing risks such as lock-in effects, barriers to entry, and innovation stagnation. The reviewed studies highlight six primary risks associated with power imbalances: (i) power dependency and lock-in risks, (ii) governance strategies and power distribution, (iii) innovation and the impact of power asymmetry, (iv) entry barriers and market competition, (v) conflict and ecosystem instability, and (vi) balancing power for long-term sustainability.

These risks align with the findings of Farias et al. [14], who argue that power relations within OSSECO shape not only developer contributions but also long-term ecosystem health. Furthermore, research by Teixeira et al. [41] on free/libre open source software (FLOSS) ecosystems suggests that decentralized governance models provide a counterbalance to power concentration, enhancing ecosystem sustainability.

To mitigate power imbalances and promote a sustainable SECO, governance practices must address transparency, participation, fairness, dependency reduction, and conflict management. The research identified 14 key governance practices that keystone organizations can implement. The effectiveness of these practices is supported by findings reported in [32], which highlight that governance frameworks based on co-regulation and participative governance improve power balance within SECO. We list some implications for researchers and practitioners.

These findings complement Alves et al. [1], who classify SECO governance mechanisms into value creation, coordination of players, and organizational openness and control. Their study highlights the need to balance orchestrator control and participant autonomy to sustain ecosystem health. Our results extend this perspective by showing how governance practices also operate as mechanisms to mitigate power imbalances. For instance, incentives and fair revenue distribution relate to value creation, conflict resolution and accountability support coordination, and decentralized decision-making, inclusive participation, and limits on keystone control reflect the tension between openness and control.

5.1 Implications for Researchers and Practitioners

This study provides implications for both researchers and practitioners interested in understanding and managing power in SECO. The implications were derived by synthesizing recurring insights across RQ1–RQ4, first summarized by the research leader, refined with the research senior, and peer-reviewed by the Ph.D. professors involved in the study.

From a research perspective, the results reinforce that traditional power typologies remain relevant in SECO, while broader perspectives such as soft power, hard power, and power-changing operations offer useful lenses to understand how influence is exercised and reshaped over time. The findings also highlight the close relationship between power and governance, showing that decentralized governance, participative decision-making, and co-regulation may help balance power, whereas restrictive governance mechanisms can reinforce asymmetries. These issues are directly connected to ecosystem sustainability, since unmanaged power

Table 6: Governance practices to mitigate power imbalances in SECO.

Governance Practice	Practice description	Studies
P01. Establishing transparent governance structures	Implementing well-defined governance models that outline decision-making processes, responsibilities, and accountability mechanisms.	S01, S06, S10, and S12.
P02. Encouraging decentralized decision-making	Distributing decision-making authority among ecosystem participants to reduce keystone organization dominance.	S02, S08, S13, and S15.
P03. Promoting open and inclusive participation	Ensuring that stakeholders have access to participation channels in decision-making and ecosystem strategy.	S04, S06, S08, and S15.
P04. Implementing conflict resolution mechanisms	Establishing structured procedures for mediating disputes among ecosystem participants.	S02, S05, S12, and S14.
P05. Encouraging collaboration through incentives	Providing financial and non-financial rewards to encourage cooperation among developers and reduce dependency on keystone organizations.	S03, S06, and S07.
P06. Defining fair entry and exit rules	Setting clear guidelines for joining or leaving the ecosystem to ensure fair competition.	S10, S11, and S15.
P07. Balancing power with regulatory oversight	Implementing regulations to limit excessive control by keystone organizations.	S07, S10, and S14.
P08. Supporting independent developers through shared resources	Providing technical support, infrastructure, and financial aid to help smaller developers compete.	S01, S06, and S15.
P09. Monitoring and adapting governance over time	Regularly assessing governance mechanisms and making adjustments based on ecosystem evolution	S10, S14, and S15.
P10. Establishing knowledge-sharing and best practices forums	Creating platforms for sharing insights and expertise among stakeholders.	S03, S04, and S12.
P11. Limiting keystone organization control over critical resources	Preventing keystone organizations from monopolizing essential ecosystem infrastructure.	S07, S10, and S11.
P12. Ensuring stakeholder accountability	Implementing performance evaluations and transparency mechanisms.	S03, S06, and S07.
P13. Encouraging cross-platform collaboration	Promoting interoperability between competing ecosystems to reduce reliance on a single keystone.	S08 and S12.
P14. Implementing fair revenue distribution models	Ensuring equitable sharing of profits among contributors.	S06 and S13.

imbalances may affect innovation, stakeholder engagement, and long-term ecosystem evolution.

For practitioners, particularly IT managers, software architects from keystone organizations, the findings provide guidance for managing dependencies and reducing excessive power concentration. Keystone organizations should monitor dependencies on third-party developers and suppliers, especially when these actors control critical API, core software modules, specialized knowledge, or strategic resources. Practices such as transparent governance structures, decentralized decision-making, fair entry and exit rules, conflict resolution mechanisms, knowledge sharing, and ecosystem-wide incentives can help reduce lock-in risks, distribute influence more fairly, and support more sustainable SECO.

5.2 Result Dissemination

The final step in the RR is to disseminate the results. The dissemination actions are designed to communicate the results to practitioners and researchers. According to Cartaxo et al. [8], RR must be reported in a more straight-forward way, focusing on results and recommendations [8]. We follow the guidelines of a novel approach to summarizing research findings from ESE studies called Evidence Briefing (EB) [9], as summarized in Outão et al. [31]. EB are one-paper documents that summarize the main findings of an empirical research, so researchers and practitioners can easily consume the information to support their decision making [9].

The involvement of practitioners played an important role in critically evaluating the final EB artifact derived from our work. Their direct engagement contributed to refining and assessing the artifact through practical expertise, enhancing its relevance and potential applicability within power in the SECO context. Our EB artifact is available at Outão et al. [31].

As part of the result dissemination activities, a follow-up interview was conducted with the same IT managers who had previously participated in the problem identification and RR preparation phases. The main objective of this interview was to present the EB produced from the study and to collect the managers' perceptions regarding its clarity, relevance, and practical applicability. Overall, the feedback was very positive. The managers reported being surprised by the amount of relevant information they were previously unaware of, particularly concerning power-related concepts in SECO and how systematically these aspects were synthesized and presented in the EB.

During the interview, the participants were able to clearly identify several types of power present in their relationships with third-party developers and suppliers, as well as multiple factors influencing power distribution, such as resource dependency (F01), governance mechanisms (F02), strategic positioning (F05), and market influence (F06). In addition, the managers highlighted the usefulness of the governance practices described in the EB, emphasizing their potential to support internal strategic discussions. Among the practices considered most relevant, they emphasized establishing transparent governance structures (P01) and encouraging decentralized decision-making (P02) as concrete mechanisms to mitigate power imbalances. The participants stated their intention to discuss these practices with senior management, reinforcing the role of an EB as a decision-support artifact.

6 Trustworthiness

Given the qualitative and interpretive nature of this study, we do not frame the study limitations using traditional threats to validity. Instead, we discuss the trustworthiness of the study following the framework of Lincoln and Guba [23], focusing on credibility, transferability, and dependability. The main concerns and mitigation strategies are discussed below.

Credibility threats are mainly associated with the RR process. A key concern relates to researcher subjectivity during study selection, coding, and synthesis, as inclusion criteria and code interpretation may introduce bias. To mitigate this threat, two researchers independently conducted study screening and data extraction, followed by consensus meetings. Senior researchers reviewed the synthesized results, reducing interpretation bias. Another credibility threat concerns the pragmatic quality appraisal. Since we relied on publication venues as a baseline indicator of rigor rather than applying formal quality scores to each primary study, methodological differences among studies may not have been fully captured. This choice is consistent with the RR goal of balancing effort and reliability, but should be considered when interpreting the synthesized evidence. Another credibility threat stems from conceptual heterogeneity across primary studies, as definitions of power, dependency, and governance differ.

Transferability is constrained mainly by the scope of the RR. The synthesized evidence is drawn from a limited set of empirical studies selected under time constraints and may not cover all types of SECO or organizational arrangements. Consequently, findings may not be directly transferable to contexts such as startups, OSS-ECO, or ecosystems operating under different conditions. The follow-up interviews reflect the context of a PSECO managed by a keystone organization and capture IT managers' perspectives only. Therefore, results and governance practices should be interpreted as context-sensitive.

Dependability concerns relate to the consistency of the RR process. To enhance dependability, we documented the RR phases, including the search strategy, inclusion criteria, coding procedures, and synthesis decisions. Coding schemes, memos, and records of researcher discussions were maintained as an audit trail. Although qualitative synthesis involves interpretive judgment, documented procedures, multiple reviewers, and senior validation support the dependability of the results.

7 Conclusion and Future Work

This work investigated the role of power in SECO, particularly focusing on how power imbalances influence keystone organizations and ecosystem sustainability. The analysis was motivated by the growing dependency of keystone organizations on third-party developers and suppliers, which can lead to disproportionate influence over essential software components, API, and governance decisions. By conducting an RR and synthesizing insights from literature, related work, and empirical data, the study provided a structured understanding of power typologies, power distribution mechanisms, the effects of power imbalance, and governance practices that can mitigate power asymmetries.

The findings highlight that power asymmetries are not inherently negative, but when left unchecked, they can introduce operational risks, innovation bottlenecks, and governance challenges. Keystone organizations must adopt strategic governance that balance stability, inclusivity, and flexibility to foster sustainable SECO.

Future research should further explore adaptive governance practices and evaluate how governance interventions affect power imbalances in real-world SECO. Building on this RR, we are extending this work through an empirical study with IT managers to examine the relationships between power distribution factors, their effects, and governance practices, as well as how these practices are perceived, prioritized, and applied in practice. By addressing these challenges, the software industry can develop more sustainable ecosystems, where power in inter-organizational relationships are collaborative rather than restrictive, ensuring long-term sustainability for all stakeholders involved.

Artifact Availability

The artifact associated with this study is available as supplementary material in Outão et al. [31]. It includes the rapid review protocol, selected studies, data extraction and synthesis materials, and supporting documentation. The artifact is available through Zenodo and licensed under the Creative Commons Attribution 4.0 International License (CC BY 4.0).

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