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Highlights

- Analysis of three case studies of software ecosystems formed by SMEs
- Hypotheses explaining the dynamics of power in partnerships in a software ecosystem
- Meta-model integrating constructs from software ecosystems and power theories
- Strategies based on power-changing operations to manage power relationships

Strategies for Managing Power Relationships in Software Ecosystems

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Abstract

Building a software ecosystem provides companies with business benefits as well as share risks and costs with a network of partners. The ability to establish successful partnerships with other companies can influence the success or failure of the ecosystem. Companies use power to build alliances and strengthen their position in the ecosystem. However, the inappropriate use of power may create tensions that threaten partnerships. To explore the dynamics of power and dependence in software ecosystems, we conducted three case studies of ecosystems formed by small-to-medium enterprises. As a result, we present a set of hypotheses that explain the effects of power on software ecosystems. As theoretical contribution, we present a meta-model that integrates concepts from s**o**ftware ecosystems literature with constructs from classical power theories. Our practical contribution is a set of strategies that companies can employ to manage power relationships with partners, so that their ecosystems can evolve in a healthy and prosperous manner. By obtaining an understanding of the occurrence of power and dependence, companies can recognise how to exercise power and deal with the power from partners in order to leverage their relationships.

Keywords: Software Ecosystem, Partnerships, Small-to-Medium Enterprises, Power, Strategies.

1. Introduction

Software ecosystems have become one of the key drivers of innovation and growth in the IT industry. A software ecosystem is a group of interconnected companies that work as a unit and interact with a shared market for software and services (Jansen, Finkelstein and Brinkkemper. 2009). Google Android, Apple iOS and Amazon Web Services are examples of successful platform ecosystems. These platforms heavily rely on the active collaboration and expertise of a diverse developer community. Notably, ecosystems are shifting the rules of competition and collaboration in which companies must operate. To ensure sustainable performance, companies are shifting bilateral partnerships to create ecosystems with different players, such as suppliers, complementors, and clients. The survival and progress of companies depend not only on their own business results, but also on the performance of the companies and the entire ecosystem. The foundation of a software ecosystem is based on the notion of interfirm relationship, with companies that co-create value via technological (e.g. new features for an innovative system), commercial (e.g. relevant pool of customers from different segments) and/or intellectual (e.g. new software development skills) complementation. The participation in a software ecosystem enables firms to integrate activities, assets, and capabilities to deliver complex solutions demanded by the market.

To enable a healthy network, companies must strategically govern the software ecosystem by defining appropriate governance mechanisms that amplify the opportunities to attract new players, share benefits among partners, and align activities among participants with complementary assets (Williamson and De Meyer, 2012). The ability to manage relationships with partners can influence the success or failure of the ecosystem. Frequently, companies disregard the potential for conflict and disastrous effects resulting from misaligned strategic interests (Yoffie and Kwak, 2006). For example, companies may battle to access a profitable niche market or implement a strategic software module.

In this setting, the exercise of power allows companies to share benefits, become more attractive and lead partners in their relationships. Companies holding valuable resources, such as money or expertise, can exercise power over partners that depend on such resources. They can also use power as a means to build alliances and strength their position in the network. However, the excessive use of power may create tensions that threaten the evolution of the ecosystem.

In the last years, we have conducted multiple case studies to explore ecosystem partnerships from a power perspective. We are particularly interested in understanding the dynamics of power in ecosystems formed by Small-to-Medium Enterprises (SMEs). Researchers have extensively studied proprietary ecosystems orchestrated by big players (Manikas, 2016). However, it is quite surprising that very limited

research has analysed the relationships among SMEs forming an ecosystem, as this type of company accounts for around 95% of global business (Colomo-Palacios, Biró and Messnarz, 2015).

The current paper builds upon former studies, as described in Figure 1. In (Valença and Alves, 2017a), we presented a substantive theory on the occurrence of power and dependence in ecosystem partnerships, together with illustrative power models from two exploratory cases studies (CSI and CSII). In another paper published at the 43rd Euromicro Conference on Software Engineering and Advanced Applications in 2017 (Valença and Alves, 2017b), we proposed six hypotheses about power relationships.

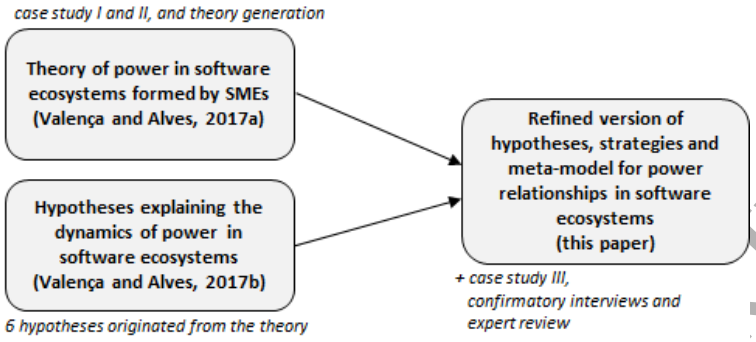

Figure 1. The differences between previous works and this paper.

This paper is an extension of (Valença and Alves, 2017b). Here, we include a refined version of the hypotheses with new evidence gathered from confirmatory interviews. We also add a new case study (CSIII). As novel contributions, we propose a meta-model that integrates concepts of power and software ecosystems. Moreover, we present a set of strategies that companies can employ to establish successful power relationships in software ecosystems. The strategies are based on power-changing operations, which allow a company to adjust power advantage in a partnership. For example, a company may invest on establishing contact with potential partners who can provide it with new clients, reducing its dependence on the customer base of a dominant player. By implementing such power management strategies, companies may improve their own performance and promote the health of the entire software ecosystem. We developed these strategies based on results obtained from multiple case studies. The strategies were created from the analysis of interviews with studied companies and were assessed by means of an expert review. The proposed strategies aim to support companies to obtain a greater understanding on the occurrence of power and dependence, particularly recognising how to exercise power effectively and how to deal with the power from partners in a software ecosystem.

We structured this paper in six sections. Section 2 provides a conceptual background on software ecosystems and power theories. Section 3 details the research method to conduct the case studies. Section 4 illustrates the power model of a case company. In Section 5, we present the meta-model for power relationships in software ecosystems and an extended version of the hypotheses. In this section, we also propose practical strategies to manage power relationships in software ecosystems. Section 6 discusses the results of the expert review. It also analyses research limitations and related studies. Finally, Section 7 presents the contributions for research and practice and proposes directions for future works.

2. Theoretical Foundation

In Section 2.1, we explain relevant concepts of software ecosystems field. In Section 2.2, we describe well-established works on power, which allowed us to examine the dynamics of power relationships among software companies in a comprehensive manner. The ideas introduced by the authors who proposed the classical power theories were widely adopted by researchers from several domains, such as, managerial sciences (e.g. Zhuang and Zhou, 2004; Gaski, 1986) and software engineering (e.g. Milne and Maiden, 2012; Hurni and Huber, 2014).

2.1. Key Concepts in Software Ecosystems

The concept **software ecosystem** establishes a metaphor with natural ecosystems, in which species are part of a food chain and depend on each other. In this setting, a network of actors function as a unit and interact within a shared market for software and services. The relationships among ecosystem participants are generally underpinned by a common technological platform or business opportunities, through the exchange of information, resources and artefacts (Jansen and Cusumano, 2013). In the last

decade, relevant players from the software industry created software ecosystems around their products by opening their platforms via interfaces, allowing external actors to integrate complementary solutions and develop new applications (Che and Perry, 2014). The interactions with external actors allow these players to complement the functionality of existing products as well as expand the offering of systems integration and services (Cusumano, 2004).

Companies in a software ecosystem collaborate and create larger software solutions via integrations of their products in **partnerships**. This intentional strategic relationship between companies enables them to join efforts to achieve goals they could not attain easily in isolation. On the one hand, companies gain access to a myriad of technologies to co-create innovations and enter new markets niches. On the other hand, they strive for common benefits and keep a high level of mutual interdependence.

The network of a software ecosystem is structured on top of business, technical, and social **dimensions** (Manikas and Hanssen, 2013b). The *business* dimension involves elements such as the marketplace, entry barriers and customer base. The *technical* dimension embraces technological and architectural aspects, such as the common software infrastructure and product line. Finally, the *social* dimension considers interfirm relationships, reputation and shared knowledge. In (Valença and Alves, 2017a), we synthesise the core elements of a software ecosystem, which we mapped after performing an exhaustive literature analysis of secondary studies (e.g. systematic literature reviews, mapping studies).

A community of interacting **actors** enables the software ecosystem to create and deliver new solutions (e.g. complete integrations, specific applications) to the market. Such mutually dependent participants often involve a keystone, niche players, value-added resellers, and customers. The *keystone* is a leading actor (in general, a company or independent entity) that guarantees the well-functioning of the network. This player is responsible for running a platform, creating and applying rules, processes and business procedures, setting and monitoring quality standards, and orchestrating actors' relationships. Examples of big keystones are Apple in the iOS ecosystem and Amazon in the Alexa ecosystem. *Niche players* use the central technological infrastructure to produce functionality to address demands from the market. They complement the keystone work and influence ecosystem management. The *value-added resellers* make profit from extending and selling ecosystem solutions to customers, end-users or other vendors. Finally, *users* purchase or obtain an ecosystem solution from a niche player or a vendor to carry out their businesses (Hanssen and Dyba, 2012).

The **health** of a software ecosystem indicates how the ecosystem is evolving and how effective the managerial strategies are to the sustainability of individual players as well as the whole ecosystem. The overall performance of software ecosystems depends on the actions and decisions taken by each individual player. An ecosystem is healthy when it provides mutual benefits for players (Manikas and Hansen, 2013a). The companies acting in the ecosystem are committed to their own health as well as their partners' health. It means that a win-win approach is needed for the ecosystem to thrive. Hence, the ecosystem as a whole must create opportunities for its participants and those who depend on it. According to Hartigh, Tol and Visscher (2006), the health of an ecosystem is a diagnostic of its strength at a given moment. Three measures are commonly used to assess ecosystem health (Iansiti and Levien, 2004). *Productivity* indicates the ecosystem ability to transform inputs into products and services. One possible metric to measure productivity is the number of applications in a marketplace. *Robustness* means the capacity of the ecosystem to deal with interferences and pressure from competitors. To measure this aspect, we can analyse the survival rate of ecosystem members. Finally, *niche creation* denotes the business opportunities available in the ecosystem, which are obtained via valuable resources and market niches expansion. The number of new players around the platform is a way to assess niche creation.

Ecosystems generally evolve during a common lifecycle encompassing the phases of birth, expansion, leadership, and self-renewal (Moore, 1993). In this paper, we focus on the birth phase to understand how actors leverage opportunities to attract new participants to the ecosystem. Potential partners must recognise the benefits of complementing the core of their products or enriching the product line around the platform. During the emergence of an ecosystem, actors will accomplish this goal via partnerships, acting as complementors and combining their solutions. By gradually sharing their pool of customers and accessing new segments, ecosystem participants increase their dependence and need for convergence (Dittrich, 2014). In case the software ecosystem results from the efforts of multiple partners, a keystone can emerge in this initial stage to orchestrate participants and coordinate development efforts.

2.2. Classical Power Theories

Power is a concept that has been investigated exhaustively by social scientists and philosophers. Recently, power has also be subject of study in managerial research, more specifically on firms' alliances and strategies. Power is not a property of an actor or group, but rather a construct that can be analysed more or less systematically from the viewpoint of the relationships around an actor (Dahl, 1957).

Therefore, to say that an actor has power is vacant, unless we specify over whom. It means the exercise of power and the way the relationship occurs in practice is contingent (Isaac, 1987).

The definition of power from Emerson (1962) is a common operationalisation of this construct in inter-organisational studies (Meehan and Wright, 2012). Different areas adopted Emerson's definition along time, with an increased academic interest for his work in recent years. Emerson related power to the notion of **dependence**, introducing the concept of **power relationships**. The author argued that power generally resides in the other's dependence and involves the control of what the other party values. Hence, a potential influence results from the existing dependence between two actors *X* and *Y*. The dependence of an actor *X* upon an actor *Y* is directly proportional to *X*'s motivational investment in goals mediated by *Y*, and inversely proportional to the availability of those goals to *X* outside their relationship. Therefore, we can understand power is a circumstantial and relative concept, whose exercise involves interdependence between parties (i.e. any form of interdependence between parties gives rise to power). In interfirm relationships, Leonidou et al. (2014) define the notion of dependence as the extent to which an actor *X* needs to keep a relationship with another actor *Y* to acquire resources and accomplish his goals.

In light of the previous definitions, we consider power as the ability of a company *X* to exert some sort of influence in the relationship with a company *Y*, and it is based on the dependence of *Y* upon *X*. The power of each both *X* and *Y* evolves along time (Lawler, 1992). It means the total amount of power in their relationship is not fixed, but variable. Shifts in the power of *X* or *Y* generate a redistribution of power, which shows the importance of analysing the process of power exercise. We can perform such analysis by understanding the unique power capabilities of each participant in a structured relationship.

The term **power capability** (PC) expresses an ability of a power holder to exercise power based on specific assets owned by the actor (Gaski, 1986). Examples of power capability are a company's expertise in a novel technology or ability to provide access to a profitable customer market. Each PC represents a potential for power use, as an action where an agent may use its power source(s) (Lawler, 1992) (Kim, Pinkley and Fragale, 2005) (Leonidou et al., 2014). According to Lawler (1992), unions negotiating with management have some structurally based capability to apply leverage (e.g., workers difficult to replace), for instance. These PCs vary among the firms and denote a specific power type.

French and Raven (1959) proposed a taxonomy of **power types**, which is one of the most adopted conceptualisations of power (Elias, 2008). Their power theory is widely adopted across several disciplines due to its loose conceptual framework. The understanding of power as a set of forms is suitable to analyse this construct in several domains. Their work aims to classify power in a precise manner. The proposed power taxonomy comprises five power types, which we describe in light of a relationship between two given companies *X* and *Y*:

- *Coercive power* is the perception of *Y* that *X* has the ability to punish it. For instance, threats by *X* to punish its partner *Y* by reducing profit margins if *Y* fails to comply with requests.
- *Expert power* is the perception of *Y* that *X* has some special knowledge or expertise. For instance, the specialised and unique knowledge possessed by *X*, which is needed by its partner *Y*.
- *Legitimate power* is the perception of *Y* that *X* has the right to prescribe behaviour over Y. For instance, the belief by *Y* that *X* has the right to affect its operation due to internalised values or formal processes in their relationship.
- *Referent power* is the identification of *Y* with *X*, translated in a feeling of oneness of *Y* with *X* or desire for such identity (if *X* is an attractive group, *Y* will have a desire to join in). For instance, *Y* feels pride to define a partnership with *X*, as it admires the status of *X*.
- *Reward power* is the perception of *Y* that *X* has ability to provide rewards in their relationship. For instance, the belief by *Y* that *X* can mediate rewards such as better credit terms or new joint sales.

We highlight that such forms of power may affect each other in a positive or negative manner, as well as transform over time (Wrong, 1980; Williams and Moore, 2007). For instance, once an actor exercises *coercive power*, it may directly cease its *reward power* or no longer hold the same degree of *referent power*. In other situations, the exercise of *expert power* by a firm denotes for its partner that it is able to hold *legitimate power* in their relationship (Gaski, 1986; Valença and Alves, 2017a).

We observed further developments of this taxonomy in the reviews of Raven (1993) and Elias (2008). However, their extensions proposed punctual refinements of the power types instead of presenting novel issues or paradoxes in their structure. Hence, we relied on the original taxonomy and considered relevant advances from recent literature, such as contributions from the IMP Group[1], e.g. Leonidou at al. (2014).

The diverse types of power originate from a **power source**. According to Dahl (1957), this notion is also part of a precise description of a power relationship. Power sources are tangible or intangible resources that an actor can exploit to affect the behaviour of another actor. In business relationships, possible power sources are strong reputation, large customer base or intellectual property. We highlight

[1] Industrial Marketing and Purchasing Group: international group that develops knowledge in B2B marketing and purchasing.

that one shall only consider the two sides of the relationship to identify the power types and respective sources utilised. Although companies operate in a software ecosystem, we must explore each specific partnership between two parties to identify these elements.

In a power relationship, actors may have different levels of dependence, which entails different levels of power. Since the exercise of power is circumstantial and relative, such levels may vary between parties. Emerson (1962) introduced four operations to promote structural changes in power relationships by altering the power advantage between two actors. These **power-changing operations** revolve around the idea of dependence, e.g. increase the degree of dependence of the partner on the company, or decrease the degree of dependence of the company on the partner. Such operations enable a company to deal with the power of a partner by exploring its power capabilities. We propose the power-changing operations with examples as follows, as well as illustrate their impact in Figure 2.

- *Withdrawal* occurs when *X* reduces motivational investment in goals mediated by *Y*. Hence, *X* gains power by absorbing the dependence on *Y* (A. in Figure 2). For instance, *X* neglects the complementation from *Y* by internally building the product feature previously supplied by *Y*.
- *Extension of power network* occurs when *X* cultivates alternative sources for gratification of the goals mediated by *Y*. Hence, *X* gains power by reducing its total dependence on Y and relying on other players (B. in Figure 2). For instance, *X* obtains the technical complementation previously offered by *Y* from one or more partners, which provides *X* with relationships that are more flexible.
- *Attachment* occurs when *X* mediates goals that increase the motivational investment of *Y* in the relationship. Hence, *X* gains power by increasing the dependence that *Y* has on their relationship, given new benefits provided by *X* (C. in Figure 2). For instance, *X* provides *Y* with new commercial benefits such as new customers or a wider profit margin in a joint project.
- *Coalition formation* occurs when *X* establishes coalitions that prevent *Y* from accessing alternative sources of resources to achieve its goals. Hence, *X* gains power by making *Y* more dependent on their relationship, given a reduction in the options for alternative partnerships (D. in Figure 2). For instance, *X* forms coalitions with other companies (including competitors) to deny *Y* to define substitute partners, who could offer similar commercial benefits to *Y*.

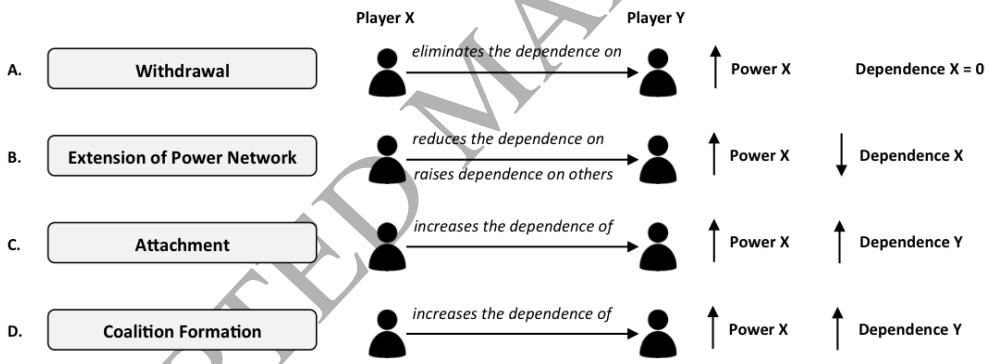

Figure 2. Effects of power-changing operations in a partnership between two software ecosystem partners.

To illustrate the application of power-changing operations, we can consider the same partner companies *X* and *Y*. In their relationship, *X* uses the large dependence of *Y* on its pool of customers to control the relationship. For instance, *X* can specify the roles and duties of suppliers in a joint project, select the strategic requirements that it will implement or establish the percentage of profits that partners will receive (Valença et al., 2014). In this scenario, *Y* can alter the power relationship by considering one or more power-changing operations. For instance, *Y* can apply *withdrawal* operation and neglect the existing dependence on *Y* by strengthening its relationship with customers or prospecting new customers in a new market niche. *Y* could also adopt the *attachment* operation by implementing a new cutting-edge technology in an integrated product, causing *X* to depend on this innovation. In these situations, *Y* can (i) exercise power capabilities that were not used in the relationship with *X* or that can be used in a different manner, or (ii) develop new power capabilities derived from other elements of the software ecosystem used as power sources. Once adopting one or more power-changing operations, *Y* ultimately undermines or changes actions in the relationship. For instance, in light of a new benefit offered to *X* (*attachment* operation), *Y* gradually changes its role in the ecosystem or increases its participation in overall decisions.

Originally, these operations were presented as means to eliminate the power advantage of a given partner by creating an ideal situation of balance, i.e. the degrees of power and mutual dependence are equal. However, Lawler (1992) showed that there is no such perfect correlation between the power capabilities of *X* and *Y*. It means that, by using a power-changing operation, *X* may gain power and *Y* may

keep its power, or *X* and *Y* may both gain power at the same time, for instance. In addition, power is rather variable. At a given point in time, *X* may gain power and balance the relationship. However, all of the sudden, *Y* may gain power and change the alleged balance of the relationship. Therefore, in this paper, we do not discuss the use of these operations as means to necessarily achieve balance, as we believe that such balanced situation is hard to achieve because it is transitory or even unnecessary.

3. Research Method

This research involved four phases, as represented in Figure 3. Between 2012 and 2017, we conducted **three exploratory case studies** with companies in emerging software ecosystems. We describe each case study in Section 3.1. The case studies encompassed the first three phases of the research, whose main results were companies' power models (Phase 1); a theory of power in ecosystems formed by SMEs (Phase 2); hypotheses explaining the dynamics of power in software ecosystems (Phase 2); and strategies to manage power in software ecosystems (Phase 3). In 2018, we concluded the research with an **expert review** to assess the proposed strategies (Phase 4). We detail these phases in Section 3.2.

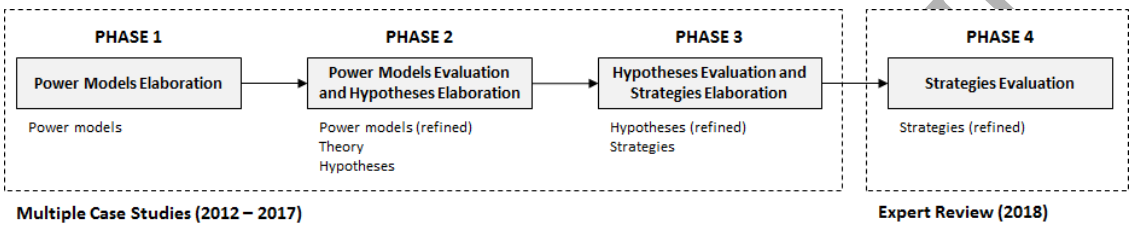

Figure 3. Research phases

3.1 Multiple Case Studies

We conducted three case studies of ecosystems formed by SMEs to investigate the partnerships among participating companies. To select the cases for this research, we considered small-to-medium sized software companies following a market-driven business model and complementing their products via partnerships by creating an emerging software ecosystem. This definition is aligned with the characteristics of a software ecosystem (cf. Section 2.1). It is worth noting that all case studies were undertaken in a sequential manner following the same research protocol. Table 1 gives an overview of CSI, CSII and CSIII, highlighting the companies and respective participants in Phases 1, 2 and 3.

Table 1. Data collection phases and respective participants from CSI, CSII and CSII.

Research phases	Phase 1 – power models elaboration	Phase 2 – power models evaluation and hypotheses elaboration	Phase 3 – hypotheses evaluation and strategies elaboration
CSI	**Company A –** project manager, business analyst, system analyst **Company B –** product manager, project manager, release manager, integration team leader, business analyst, system analyst 1, system analyst 2, tester **Company C –** services manager, project manager, business analyst **Company D –** product manager, project manager, solutions architect, system architect, system analyst **Company E** – operations and deployment director	**Company A** – project manager **Company B** – operations director **Company C** – configuration manager, innovation manager **Company D** – project manager	**Company B** – operations director **Company D** – project manager
CSII	**Company F** – sales director, marketing manager, product owner, business analyst, system analyst **Company G** – marketing manager **Company H** – operations director	**Company F** – sales director	**Company F** – sales director
CSIII	**Company I** – CEO, developer **Company J** – CEO **Company K** – CEO		**Company I** – CEO

In Table 2, we present general information about the companies involved in the case studies, such as domain and solutions developed, as well as age and number of employees.

Table 2. Software companies investigated in the multiple case studies.

Case study companies		Domain and products developed	Age	No. of employees
CSI	**Company A**	ERP with modules focused on retail chains, distributors and wholesalers markets.	32 years	100
	Company B	ERP with modules focused on several market niches.	45 years	180
	Company C	Information system with modules for pharmacies.	28 years	100
	Company D	Information systems for hospitals.	27 years	150
	Company E	Web portal for electronic quotations.	16 years	15
CSII	**Company F**	Information and management solutions with modules for hospitals and laboratories.	30 years	N/A
	Company G	Information systems for laboratories.	34 years	70
	Company H	Tools and services to modernise software systems in diverse markets.	22 years	50
CSIII	**Company I**	Functional modules, toolbox and connectors for Microsoft Dynamics CRM.	18 years	30
	Company J	Accounting and industry system.	33 years	N/A
	Company K	Insurance system.	31 years	180

3.1.1 Case Study I (CSI)

CSI involved 5 software companies based in Recife/Brazil, which are named here as Companies A, B, C, D and E. **Company A** has a portfolio of software solutions for retail chains, distributors and wholesalers markets. It defines integrations around its main product, an ERP with modules for stock supply, inventory management and tax review. In its turn, **Company B** provides around 15 software products, with an emphasis on enterprise information systems. This vendor addresses the needs from market niches such as oil and gas and logistics through an ERP, whose main module involves financial accounting and tax compliance features. **Company C** is specialised in different solutions, such as mobility and cloud computing. One of its main products in an information system for pharmacies, with storefront functionalities. In 2010, a Brazilian leader in retail management software for diverse vertical markets acquired this company. **Company D** offers an extensive product portfolio that embraces radiology and laboratory software solutions. It focuses on developing software systems for hospitals and clinics. A key module of these systems includes an electronic medical record. In 2011, a foreign

		³6RIW 3RZHU DV FRQF *Jonathan Nye, is more sustainable over the long-term especially in fragmented SECOs w* LWK GLIIXVLRQ) RI	Full agreement with the strategy $S_{2.1}$ (which argues companies shall be careful with the application of *coercive power* over partners). **Result**: no changes to perform.
		³7KH GHILQLWLRQ RI *about perception. Exercising this power is then to increase the perception? I would argue that Facebook does this. However, since it is still very attractive, people at least know what they are up to. So, the potential to damage value-co-creation will depend on the point of view. If the exercise of power is in line with the ecosystem goals of X, there should be a positive outcome in the majority of cases (i.e. future partners will better align their value-creation with X, thus increasing the value from* WKHLU SRLQW RI YLHZ	**Result**: we included such argument in future work discussion (Section 7.2). We argued about our interest in investigating whether partners in platform-based and mature ecosystems such as Facebook may accept severe penalties given their dependence on the opportunities within this attractive network. In addition, we altered the title of the strategy to make it clearer ("Avoid using coercive power to apply severe punishments").
$S_{2.2}$ – Anticipate negative actions in contracts and general rules that guide partnerships.	*Disagree* – 16% *Neutral* – 17% *Agree* – 50% *Strongly agree* – 17%	³7UXH EXW LW V OLNH *misuse it, and that's okay. That's part of an evolving ecosystem, and you can take* FRUUHFWLYH PHDVXUH (E10)	**Result**: we improved the description of the strategy $S_{2.2}$ to highlight that some rules can be added or adapted in the course of the relationship, with the evolution of the partnership and the ecosystem.
		³, DP QRW VXUH DERX *orchestrator role will be better in this kind of ecosystems than a controller* UROH(E8)	Full agreement with the strategy $S_{2.2}$ (which proposes the use of orchestration mechanisms to support the exercise of *legitimate power*). **Result**: no changes to perform.
		³7KDW ZRXOG LPSO *punishments are not considered arbitrary. As an academic, I may not have sufficient experience to judge this aspect. I guess a strategy to avoid available punishments lightly might have more success. Having strong contracts plus the reputation to sue everybody will not generate an environment of trustful co-* FUHDWLRQ(E12) I YDOXH	The previous strategy already suggests that companies avoid exercising coercive power with severe punishment ($S_{2.1}$). The goal of the strategy $S_{2.2}$ is to define disciplinary sanctions and punishments that are established in contracts after agreements among partners. However, the observation is relevant and should be included in the text. **Result**: we improved the description of the strategy $S_{2.2}$ by discussing the fact that companies must recognise the importance of a trustful scenario and avoid too strict rules.
		³7KHUH LV D ZLGH YD *arrangements on different types of SECOs among various kinds of stakeholders. So, an overall rule that describes all of that variance may be* FKDOOHQJLQJ(E7) WR FRG	It is clear in the description of the strategy $S_{2.2}$ that we are not proposing general rules for software ecosystems, but rather anticipating specific rules in contracts or similar documents defined with partners. **Result**: no changes to perform.
S_3 – Guarantee that business benefits are shared to maintain the value of partnerships.	*Neutral* – 8% *Agree* – 42% *Strongly agree* – 50%	³2QO\ IRFXV RQ \RXU *model, and allow others to take the crumbs that are left on* WKH (E10)	The suggestion does not recognise the relevance of cooperation in an ecosystem. With no guarantee of a win-win approach, which involves a greater alignment of partners goals, partnerships may not thrive. **Result**: no changes to perform.
		³, GR QRW DJUHH WKD *In addition, certain rewards may generate false collaborative/relationship interests. Finally, I also believe that promoting this kind of force causes a dependence on Y, that is, Y will only cooperate if X gives a* UHZDUG(E13)	In fact, partnerships that involve a great flow of rewards may lead a company to hold high dependence on a partner. However, this is the essence of the ecosystem, which lies over interdependent parties and win-win relationships. It is up to a company to regulate such level of dependence via the power-changing operations discussed here. **Result**: no changes to perform.
		³&RRSHWLWLRQ LV WK LW LV FOHDU WKDW SI *grow the pie and compete to split the* SLH(E7) *Therefore, it is important that all stakeholders are better off as a result of a win-win strategy by the SECO operator and controller wherein everyone is better off by joining a* 6(&2(E7)	Full agreement with the strategy S_3. **Result**: no changes to perform.

$S_{4.1}$ – Define agreements that promote the definition of roles in the ecosystem.	*Neutral* – 8% *Agree* – 50% *Strongly agree* – 42%	³3DUWQHUVKLS PRGH *available, but other models should also be available to avoid that the ecosystem* LV UHVWULFW´ (E4)	Full agreement with the strategy $S_{4.1}$. **Result**: no changes to perform.
		³$JUHHPHQWV PD\ QRW *of sharing a culture and its expectations* WRZDUGV (E12) UROHV´	Full agreement with the strategy $S_{4.1}$. **Result**: no changes to perform.
$S_{4.2}$ – Use authority to reconcile partners' interests and increase their satisfaction.	*Disagree* – 42% *Neutral* – 8% *Agree* – 25% *Strongly agree* – 25%	³, GRQ W WKLQN WKHU *outcomes for ecosystem health. It might have positive outcomes as companies realize that such authority might keep* WKH HFRV\VWHP (E12) XQG	Full agreement with the strategy $S_{4.2}$. **Result**: no changes to perform.
		³,Q D IUDJPHQWHG 6 *diffused authority, it is not straightforward for any stakeholder to exert direct control over all other stakeholders. Thus, authority by itself may be more or less tenable as a tool for reconciliation among divergent stakeholders depending on the level of centralization and consolidation of a* 6(&2(E7)	Full agreement with the strategy $S_{4.2}$. **Result**: no changes to perform.
		³7KH DXWKRULW\ LQ D *difficult to define. It is an implicit characteristic of the main actors in the ecosystem, according to the importance* RI WKH DFWRU (E8) LQ WKH	The respondent confused *legitimate power* with *referent power*, arguing the former is hard to define. However, the description of the strategy S4.2 is clear about that: legitimate power denotes the rights of an actor and may originate in a given leadership position occupied. It is not related to the importance (status or reputation) of a firm. **Result**: no changes to perform.
		³, GR QRW XQGHUVWDQ *strategy. Also, I do not understand how* WKLV VWUDWHJ\ FDQ *power establishes rules and roles in* SDUWQHUVKLSV (E12)¶´	The respondent did not understand the strategy. **Result**: we improved the introductory text of the strategy $S_{4.2}$ to reinforce its link with the hypothesis H_4.
$S_{5.1}$ – Exercise referent power in combination with other power types.	*Neutral* – 25% *Agree* – 58% *Strongly agree* – 17%	³5HIHUHQW SRZHU LV SRZHU ZLOO DOVR E (E10)	Full agreement with the strategy $S_{5.1}$, which highlights that *legitimate power* may grant a company with a position in the ecosystem. **Result**: no changes to perform.
		³0DQ\ H[DPSOHV RI WK *Apple iOS app store and Google Play store where referent power is combined with other types of power to maintain SECO health and sustain its relevance for all stakeholder* V (E7)	Full agreement with the strategy $S_{5.1}$. **Result**: no changes to perform.
		³, FDQQRW XQGHUVWDQ *this strategy and the hypothesis. It also occurs to me that these are rather stratagems. Does one not need to judge an overall strategy and its ability to* JHQHUDWH WKH GH (E12) LU	In fact, the strategies can be seen as stratagems (i.e. artifices used to attain a goal or to gain an advantage over a competitor). Since we built them from interviews, we already observed their outcomes in practice (we cite them in strategy description). **Result**: no changes to perform.
$S_{5.2}$ – Use referent power to influence other companies and orchestrate the software ecosystem.	*Neutral* – 17% *Agree* – 75% *Strongly agree* – 8%	³,Q SURSULHWDU\ *Developed* D *SECOs, referent power may depend on the market position of a particular vendor (e.g., Apple or Google). In open SECOs, referent power may depend on other characteristics of a vendor, such as its reputation for trustworthiness and* JRRG ZLOO (E7) O´	This research focused on proprietary or closed ecosystems. However, this is an interesting observation, which may illustrate how this phenomenon may happen in an open-source scenario. **Result**: we included such examples in the future work discussion (Section 7.2).
		³3HUKDSV MXVW UHIH *remains elusive to me. Why do you suggest this causality? I would think it is the other way around: If I am a keystone, my power is partly referent power (by construction). It may help to attract new partners, but not because I* XVH LW RQ H[(E12) LQJ S	**Result**: we improved the strategy $S_{5.1}$, which also discusses the origins of referent power. We included the possible situation where a given company has to ability to orchestrate players and then emerges as a leader, obtaining *referent power* consequently.
		³,¶P QRW VXUH KRZ µK (E10)	**Result**: in the paragraphs right before the strategies S5.1 and S5.2, we present examples from studied companies that denote the strength of *referent power*.

$S_{6.1}$ – Reinforce capabilities that allow the exercise of diverse power types.	*Neutral* – 25% *Agree* – 42% *Strongly agree* – 33%	³7KLV LV DQ RQJRLQ *SECO members because joining a SECO can benefit a vendor (e.g., give access to clients), but can also lead to vulnerabilities for that vendor (e.g., disclosure of intellectual property). Thus, reinforcing capabilities to exercise diverse power types is important to increase opportunities for advantage* DQG GHFUHDVH FKDQF (E7)	Full agreement with the strategy $S_{6.1}$. **Result**: no changes to perform.
$S_{6.2}$ – Take advantage from both balanced and unbalanced power relationships.	*Neutral* – 8% *Agree* – 67% *Strongly agree* – 25%	³7KH IURQWLHU EHWZ *unbalanced power creates opportunities for technical and managerial innovation such that new value propositions and administrative systems can be developed at the point of confluence of balanced and unbalanced power relationships in* 6(&2Y(E7)	Full agreement with the strategy $S_{6.2}$, which discusses the combination of both balanced and unbalanced power in partnerships. **Result**: no changes to perform.
		³<HV EXW ZLWKRXW D (E10)	Full agreement with the strategy $S_{6.2}$, which remarks that studied companies often "play nicely" with others. **Result**: no changes to perform.

Προφ. Δρ. Γεοργε ςαλεν| α

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Προφ. Δρ. Σλινγερ θανσεν

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