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Platform-based Ecosystems: Leveraging the Two Faces of Business Ecosystems[1]

Thierry Isckia, Denis Lescop, Elena Lescop and Mark De Reuver
Institut Mines-TELECOM
Télécom Ecole de Management
LITEM (Laboratoire en Innovation, Technologies, Economie et Management)

Abstract: In many business ecosystems, the collaboration between participants of open innovation is facilitated by platforms. These socio-technical artifacts support open innovation strategies, facilitating openness and sharing, thus fostering the emergence and development of catalytic reactions between the various participants. Business ecosystems are evolving and dynamic. They typically have two complementary subsystems, the first one relates to the innovation dimension of the ecosystem while the second refers to the commercial development of the ecosystem. However, there is still a lack of understanding of business ecosystems dynamics in general. Existing accounts of ecosystem dynamics are quite scarce in the academic literature and they do not systematically acknowledge these two subsystems. Our contribution fills this gap by developing a conceptual framework to describe and analyze these ecosystem dynamics in different subsystems and their interactions. Four case studies show the applicability of our framework for illustrating the different choices that platform providers make in doing so.

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1. Introduction

Innovation has become a collective activity with its own rules (Gawer, 2011) and its own market (Diener & Piller, 2010). Firms have entered into an era marked by the proliferation of inter-organizational collaborations and systemic innovations (Maula et al, 2006; Teece, 1996). In such context, business ecosystems emerge as a space of opportunities that firms can explore and/or exploit and the crucible of open innovation. Business ecosystems exhibit a flexible and scalable architecture of cooperation that can leverage collective intelligence (Nambisan & Sawhney, 2007; Prandelli et al, 2008). They are cultivating innovation, extending the value proposition and experimenting new business models with the aim of pushing new products and/or services on market spaces which are likely to evolve rapidly (Burger-Helmchen et al, 2011). This network-centric innovation approach is on the verge of becoming a dominant mode of organization for open innovation (Schroll & Mild, 2011, 2012; Sedera et al, 2016; Athanasopoulou et al, 2016). Indeed, in the recent years, platform-based ecosystems (Isckia & Lescop, 2013; Isckia, 2011, 2009; Lescop & Isckia, 2013; Lescop & Lescop, 2013, 2016; Isckia & Lescop, 2015) which are a subset of business ecosystems (Koenig, 2013) became a « recurrent pattern of behaviour » (Allen, 1983) in terms of innovation. For instance, a lot of innomediairies (Sawhney et al, 2002) such as Innocentive, Ninesigma, YourEncore, yet2.com… are using platform-based innovation management principles (Scholten & Scholten, 2012).

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Platforms are foundations upon which unrelated actors can offer complementary services and products (Gawer 2009). They represent a particularly effective architecture of collaboration designed to harness the potential of systemic innovation (Maula et al.,2006; Teece, 1996) activity pursued by various participants or complementors. Platform-based ecosystems implement a set of design rules and governance mechanisms designed to enroll independent actors in the pursuit of distributed, collaborative, and cumulative innovation (Tiwana et al 2010; Wareham et al 2014).

In platform-based ecosystems, platforms are enablers for open innovation activities and make it possible to achieve more effective innovation outcomes (Tan et al, 2015; Kazan, Tan & Lim, 2016; Isckia & Lescop, 2015). In platform-based ecosystems, the pace of innovation is constantly accelerating, driven by the exponentially increasing number of possible combinations of resources and knowledge that flows through the platform. From this point of view, platform-based ecosystems are catalytic attractors and amplifiers of open innovation. Companies are more innovative when they get on the platform because ideas, knowledge and resources can cross-fertilize more easily. The number of possible idea recombinations grows exponentially as new ideas come into the mix, which explains the innovative power of platform-based ecosystems. This positive network effect drives a positive feedback loop for the platform - attracting the best and the brightest players to flock to the platform.

Several case studies have investigated the role of platforms in the emergence and development of ecosystems (Attour and Della Peruta, 2013; De Vogeleer and Lescop, 2011; Isckia, 2009; Isckia, 2011; Isckia and Lescop, 2009; Isckia and Lescop, 2013; Loilier and Malherbe, 2013, Isckia & Lescop, 2015; Lescop & Lescop, 2016) but they do not distinguish between the two sides of the ecosystem neither do they consider their interactions and their consequences on the evolution of the whole ecosystem.

Our paper fills this gap by developing a conceptual framework to describe and analyze ecosystem dynamics in different subsystems and their interactions. We analyze four case studies with this framework to develop a more fine-grained understanding of platform-based ecosystems evolutions. In the first part, we will present our conceptual framework. We will consider an adapted version of the evolutionary model of business ecosystems as defined by Moore (1993) in his seminal work. In the second part, we analyze throughout the platform's lifecycle the key features of the whole system and the implications in terms of strategy, value architecture and platform design. In particular, we will question the role of the focal firm - keystone organization or platform-owner - and the importance of the governance mechanisms in supporting the process of knowledge management (Foss and Michailova, 2009) and value creation. Finally, we present some conclusion and issues associated with the conceptualization of the role of platforms within the context of open innovation or systemic innovation.

2. Conceptual framework

Our work relies on the concept of platform-based ecosystems, a specific subset of business ecosystems (Moore, 1993). After defining the concept (a), we elaborate a bi-dimensional ideal-type (b) exhibiting the links between the two main elements of a platform-based ecosystem: innovation or technology development and business development (Maula et al., 2006). We present the framework used in our case studies to explore the alignment of governance, architecture and strategy throughout (c) the ecosystem life cycle (Moore, 1993).

2a. Platform-based ecosystems

Platform based-ecosystem refers to "a platform-based cohort founded on mutually beneficial cooperative interactions between a platform leader and firms satellites that gravitate towards the platform leader, given that the platform leader is the market creator who exercises control over its satellites and capitalizes on interactions that take place" (Lescop & Lescop, 2013). This definition does not imply that firms and markets coincide. It means that the platform leader supports a part of a market providing other members with resources, knowledge, knowledge objects, boundary resources and other artifacts, interoperability and rules (Isckia & Lescop, 2009). The platform owner provides the whole architecture i.e. the system and the associated governance mechanisms (control), coordination mechanisms and rules (Isckia & Lescop, 2013; De Vogeleer & Lescop, 2011). Platforms are very particular institutional forms (Thomas, Autio & Gann, 2014; Thomas & Autio, 2014; Sharapov Thomas & Autio 2013): they are a locus that facilitates transactions and exchanges between interdependent economic players. In this sense, platforms can take different forms from physical (forum, malls) to virtual technological platforms in the sense of Gawer (2010).

Multi-sided platforms bring together multiple user groups, whereas the value for one group depends on the size of the other (Hagiu, 2014). The term multisided platform is typically used to describe a product, system, service or organization that mediates interaction between two or more groups of agents (Evans et al 2006; Rochet & Tirole 2003). By mediating interactions between the user groups, platforms create network effects. Network effects arise when the desirability or functionality of a product depends on the number of complementary goods available for it (Katz & Shapiro, 1985). Network externalities imply that a technology's usefulness increases as its installed base of users increases (Katz & Shapiro, 1985). Typically, network externalities are direct if the value of the platform depends on the number of users in the same user group. Indirect network effects (inter-side externalities) occur when the value of a platform for a group of users depends on participation of another group of users (e.g., indirect network effects between users of a game console and game developers) (Evans & Schmalensee, 2010; Gawer and Cusumano, 2008; Roson, 2005).

Platforms-based ecosystems rely on the need for intermediation or coordination expressed by two or more groups of agents that stems from the existence of market or industry failures (Lescop & Lescop, 2013). Platform owner (leader) will take this role and create links and relationships between agents through the platform that can be considered as a repository of knowledge, resources and tools for interactions (Isckia & Lescop, 2009). The business model, the profitability and the survival of a platform-based ecosystem relies on a smart and strategic exploitation of these links and relationships (Iansiti & Levien, 2004).

The platform architecture and governance directly influence the value that can be co-created within the system (Tiwana et al., 2010; Staykova & Damsgaard 2015). Technically, the architecture is modular, i.e. made of systems of modules connected through standardized interfaces (Baldwin & Woodard, 2009), scalable and evolutive. Modularity ensures flows of incremental innovation and complements (Brusoni & Fontana, 2004). Interfaces play a key role since they define how modules interact. Interfaces are able to connect a wide variety of components and therefore of contributors. Modularity acts as a coordination device for contributors. Modularity implies interoperability which guarantees diffusion, sharing and access to all improvements, innovation and knowledge in the

system. Contributors can get access to shared resources (SDK, platforms functionalities, software libraries, databases, computing power, storage capabilities, etc.) and create new complements which in turn increase the platform's value both internally and externally (Gawer and Cusumano, 2002). The growth of the internal value improves the loyalty and the adherence of the current partners whereas the gain of external (perceived) value may attract new contributors: modularity strengthens the gravity of the platform both internally and externally (Lescop & Lescop, 2011).

According to Yoo et al (2005) platform-based ecosystems promote a collective maieutic that gives rise to new ideas and concepts that may be embodied in new artifacts. This unlimited generativity is made possible by the very specific nature of these artifacts and by the architecture of collaboration that facilitates their creation i.e. the platform. Generativity means that certain technological artifacts - digital in our case – can be combined in a chaotic or unexpected way into new artifacts to deliver a service radically different from what they were originally designed for (Yoo et al., 2010). Generativity is an essential feature that explains the proliferation of new products or services (Yoo et al., 2010; Boland et al, 2007). According to Yoo et al (2010), the goal of modularity is to control or contain complexity and flexibility while the goal of generativity is to introduce or create variety.

Platforms should provide a certain level of thickness (Roth, 2008): to function well, they need to attract a sufficient proportion of participants to interact with one another. A critical mass of contributors/members is necessary to ensure a sufficient level of indirect network externality. To adapt to the increasing number of participants, platform must be scalable. Scalability protects the platform against congestion that may arise when thickness is increasing. Platforms need to be evolutive to be able to adapt to new markets conditions, new context or new technological conditions (Cusumano, 2010).

Platform creation is a strategic answer to market failures (De Vogeleer & Lescop, 2011; Lescop & Lescop, 2013, 2016). These market failures can arise from information asymmetries, the inabilities of economic agents to interact efficiently, inadequate business models, the lack of knowledge and information circulation, low speed of information circulation, strategic counter-productive behaviors of some firms (patents on the shelf, predation, etc.). These entail losses of mutually profitable interactions between economic agents: the market looses opportunities of development in terms of exchanges (business development) but also in terms of innovation (technology development).

Successful platform leaders are able to identify these opportunities of development and tackle market failures by implementing a business model founded on market functions (Staykova & Damsgaard, 2014; Kazan, Tan & Lim, 2016; Kazan, Wee, Tan & Lim, 2016; Edelman & Geradin, 2015, Lescop & Lescop, 2016).

2b. The two faces of platform-based ecosystems

Platform-based ecosystems display a high degree of heterogeneity in their structure and evolutionary paths. Nevertheless, they usually exhibit two interrelated dimensions: Innovation or technology development and business development or technology commercialization. These two dimensions are in fact the two sides of the same coin. This distinction is quite common in the field of innovation studies, from first generation innovation models up to current models of innovation such as open innovation. Indeed, innovative new products or services will not yield value unless they are commercialized and this commercialization requires a close coupling of the developer of the new

technology to the user (Teece, 1992). Commercially successful innovations require connecting scientific, engineering, entrepreneurial and managerial skills with an intimate understanding of consumer needs. These coupling and feedback mechanisms must operate quickly and efficiently to ensure commercial success of innovation (Kline & Rosenberg, 1986). Figure 1 schematizes the ideal-type of platform-based ecosystem with its two faces or subsystems.

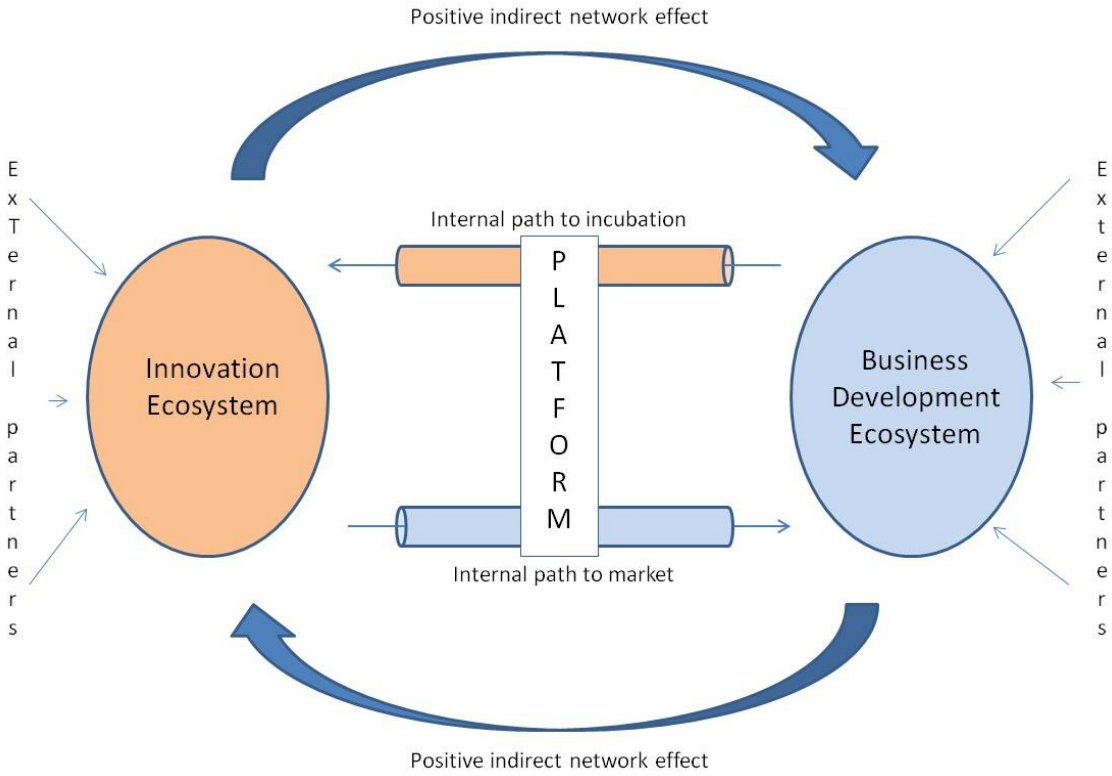

Figure 1: The structure of a platform-based business ecosystem

The right-hand side of the diagram represents the business development side of the ecosystem (BDE). The BDE gives access to the final consumers and is the commercialization part of the whole system. It is the point of entry of the revenue flows. The BDE functioning relies on the platform. The platform provides members of the BDE with tools and functionality to interact with the audience of the platform (consumers or other user groups). Basically, the BDE part contains the user groups that the platform mediates like buyer and sellers. Typical members of the BDE are complementors who will enter the ecosystem to propose via the platform their products and services (the affiliated merchants of Amazon, the developers selling their apps through Apple AppStores or Google Play). The platform owner, the complementors and the consumers interact on the platform and create indirect network effects: the more the consumers, the more the complementors; the more the complementors, the more the consumers.

The platform facilitates these interactions by implementing good market conditions: secured transactions, monitoring of products and services proposed, quality certification if necessary, easy access to the platform for complementors (with eventually different level of commitments). The indirect externalities profit the platform owner by enhancing the net value of the platform (externally by attracting new participants, and internally by reinforcing the loyalty of participants).

The left-hand side represents the innovation ecosystem (IE). The IE part contains user groups that actively use the functionality of the platform to develop complementary functionality. The IE side can be implemented by a collective or an open innovation strategy (Chesbrough, 2003). On the IE side, the platform owner opens part of its knowledge, resources, and skills to the participants; so it means that in the IE side there is an active involvement of the platform owner in developing complementary offerings. The IE side works like an incubator. Some of its main objective is to improve customer experience, knowledge sharing and experimenting new value propositions. From this point of view the IE side can be considered as the antechamber to the BDE side. The path to the market for innovations, ideas or concepts developed within the IE side is tunneled through the platform. This tunneling process can take different form:

1) Connect & Develop: new products or services are developed internally and brought to the BDE by the platform owner,

2) Connect & Support: the platform owner offers various tools to support innovators in testing and experimenting their novelties on the BDE side,

3) Connect & Standardize: the platform owner develops the idea or the concept and creates a standardized functionality on the platform.

The members of the IE come either from outside the business ecosystem or from the BDE. The members coming from the BDE are brought to the IE side by the platform owner. Hence the platforms owner should also scout its BDE for potential ideas of development to be incubated. The whole functioning creates a positive indirect effect between the BDE side and the IE side which reinforce the robustness and the coherence of the whole system. If the BDE grows, then new ideas will benefit from a larger audience: this will attract more innovators on the IE side. Conversely, if the IE side grows and provides the system with lots of innovations, then this will attract more consumers on the BDE side and in return more complementors. The platform is then a multi-dimensional artifact creating positive externalities within the BDE and the IE, and also between them, which means that the indirect network effects (as discussed in section 2.a.) are mediated by the dual function of the ecosystem. Both the BDE and the IE sides require the ability to manage interactions between numerous members of relatively small size. These small actors or niche players (Iansiti & Levien, 2004) are the main drivers of the systems, bringing agility, creativity and diversity. They are usually highly specialized to ensure their survival and their differentiation. Their choice to join a particular platform depends on the nature and the availability of the resources hosted on it.

2c. The business ecosystem life cycle

The nature of the links between the platform owner and the members, the intensity of interactions, the attractiveness of the platform, the architecture of the platform and even the strategy of the members depend on the stage of evolution of the system. Moore (1993, 1996) describes 4 stages of development of a business ecosystem.

Stage 1 corresponds to the birth of the BE. It is by nature an entrepreneurial stage. Everything has to be imagined and put in place. The entrepreneur can be either a small or a big company who wants to project its system in another industry (side competition) just like Microsoft did in the console

manufacturing sector or Apple in the smartphone industry. Platform strategies are surely easier to implement for a dominant actor with a huge market power, especially when it already operates a platform and have developed the associated capabilities (Venkatraman et al, 2014; Tan et al, 2015). However, we believe that the main questions to be addressed do not necessarily depend on the entrepreneurs' identity and their current position. The size and power of the entrepreneur will just help to implement more easily the system.

In stage 2, the platform expands either through its BDE or IE side. Basically, this stage is about attracting outsiders within the system and reaching a critical mass. The expansion phase is crucial: a failure to reach the critical mass will make the whole system collapse[2]. The choice of developing first the BDE or the IE depends on which is the main driver/attractor on the market: is it innovations or transactions? At the end of stage 2, the chosen subsystem (IE or BDE) is developed and the growth of interactions becomes exponential.

In stage 3, the platform tries to reach maturity and full leadership by eventually fully developing its second dimension. External partners are developing as well and may wish to implement their own strategy. Some partners may have reached a critical size. The ecosystem may exhibit internal clusters built around particular partners. Some partners may start to develop their business on other competing platform (multi-homing): value escapes out of the system.

In stage 4, the ecosystem will start to shrink if nothing is done. Multi-homing may be a rule, creating huge outflows of value, skills, competences and capabilities. Some multi-homer may quit the system. At each stage, governance, architecture and strategy must be aligned (Tiwana, 2014). Moore's analysis of the business ecosystem life cycle does not integrate the contribution of the two sides or subsystems nor the way their interactions shape ecosystem's evolution. The next section will address this issue integrating the dual dimension of ecosystems within their evolution analysis.

3. The Life Cycle of Platform-Based Business Ecosystems

This section will first present our methodology (a). Our analysis of the different stage of development of platform-based ecosystems follows from birth (b) to renewal (e).

3a. Methodology

We elaborate our framework with the goal of better understanding how platform-based ecosystems evolve over time and how the interactions between user groups, platform design and keystones' choices explain the different outcomes of generative capacity. We are not following a classical inductive approach in the sense that we do not claim to build a theory from multiple case studies, which would typically require both a theoretical replication logic and a literal replication logic across and within groups of cases in search for external validity and generalisability of ours research findings (Eisenhardt, 1989). We do neither fully adhere to a traditional deductive approach because the framework developed in Section 2 provides a starting point but no full-fledged theoretical model that can be used in deductive approach. Instead, we follow an abductive reasoning strategy based on contextualization (Yin, 2008) that uses inference to the best explanation (IBE) to develop potential

[2] This situation is also known as the ghost town problem (Tiwana, 2013).

explanations for the observed phenomenon (Ketokivi and Mantere, 2010). Inference to the best explanation (IBE) refers to the abductive process of reasoning that takes place when researchers compare potential theoretical explanations of a phenomenon (Lipton, 2004). Within this process, data and theoretical concepts are intertwined and have been examined simultaneously and discussed until we found a plausible explanation. This explanation must satisfy criteria for plausibility, simplicity, novelty and interestingness. Because IBE is a context-dependent reasoning process, we clearly acknowledge a reduced generalizability across time and space in our approach.

We choose to focus our analysis on four cases namely Amazon, eBay, Lawson and Apple for their inherent interest and use in the literature. We collected information over the period 2007-2014 mainly from publications (industry studies, books, articles), Google search, players' publications (press releases, financial reports, activity reports) as well as from writings by experts and consultants, who specialize in the relevant sectors. We capitalize on these case studies merely to elaborate a conceptual framework of platform-based ecosystem evolution. Our sampling plan has been designed to embrace ecosystems heterogeneity and their evolution paths. Following Yin (2009), we are in-between literal replication since we chosen the cases in order to predict similar results, and theoretical replication since these cases also predict contrasting results but for anticipatable reasons.

The cases have been purposively chosen to replicate the situation of each company regarding its original architecture of participation (one-sided platforms vs two or multisided-platforms) and to fill theoretical categories providing examples of polar types (the respective contribution of the two faces of business ecosystems i.e. the innovation side, the ecosystem development side or both in its evolution). Our methodological approach is conceptual-analytic (Järvinen, 2000) since we build on the significant amount of research and experience reported in the academic literature to analyze the complex mechanisms at play in the evolution of platform-based ecosystems. Epistemologically, our position is close to critical realism (Bhaskar, 1978, 1998) since we seek to better understand the mechanisms at work. Following Smith (2006): "The critical realism (CR) notion of generative mechanisms (or tendencies) provides the possibility for scientific explanation that allows for the causal impact of the artifact itself while stressing the importance of the local context and social diversity". We believe that deconstructing such complex mechanisms is a step forward in the development of our understanding of platform-based ecosystems (De Reuver, Sørensen & Basole, 2016).

b. Birth

At this early stage of evolution, the platform, that will serve the potential business opportunities, may not exist yet. The main objective of the platform owner is to identify conditions that may support the creation of a new value proposition that will profit multiple groups of partners. The value proposition should be designed in such a way that it will solve these market failures for a specific group of users or customers. Exploration capabilities are essential (scouting the environment and identifying opportunities). At this stage, the value proposition is not necessarily two-sided as illustrated with our cases (cf.Table 1).

Firms	Amazon	eBay	Lawson	Apple iPhone
Market Failures	The brick and mortar bookshops do not offer enough titles	Second-hand products are not easy to sell since the supply cannot reach a sufficient demand	People in Japan make an extensive huge of cash instead of electronic payments. This entails huge costs for the payment of bills	The mobile Internet is locked by mobile network operators
Value proposition	Offering a large amount of titles and helping the consumers in the discovery procedure of their choices (long tail strategy)	Offering a market place where people can sell their objects with a secured transactions systems and a way to access the quality of members	Offering to the customers of the convenience stores to pay their bills in cash at the counter of the shops; Offering to billers to collect the money of bills and to transform cash into electronic money	Creating a device able to provide customers with ubiquitous Internet
Two-sided platform	No	Yes	Yes	No

Table 1: Market failures and value proposition

In a two-sided context, the platform owner should identify the community that will brings the biggest flows of externalities and consequently which subsystem or face to develop first: IE or BDE. This problem raises the chicken and egg dilemma. When indirect network externalities exist, the participation on one side depends upon the participation on the other side. Some questions arise then: how to attract one side without developing the other? Who should be embarked first? Buyers or sellers (eBay)? Customers or billers?

The case of Lawson is quite straightforward: the customers were already on board since they used the convenience store for shopping purposes. Billers should then be given an incentive to participate. Lawson first identified new partners (electricity and gas companies) who were interested by its customer base and its geographical presence all over Japan. Partners were attracted not only by the value proposition (lower cost of billing) but also by the reputation and the daily flows of customers (several millions of Japanese buy at Lawson every day). Lawson clearly chose to develop its BDE first by creating a collective space in the business development part of its ecosystem. Lawson proposed to its partners to first experiment and to test the concept of paying bills at Lawson. Experimenting gives feed-backs to improve the system and scale it properly (Loilier & Malherbe, 2013). When experiments and tests were conclusive, Lawson launched new partnerships. The possibility of experimenting and testing the system is a key factor of participation. As the Lawson case shows, projecting your previous system into unknown spaces of opportunities requires pivotal capabilities that is ability to refocus/shift/reorient part of your productive system to another strategic space without deconstructing the existing system. This implies a preexisting agility or having the resources of acquiring such a capability.

Thus the platform owner should find a way to motivate potential partners. Free access to all the resources or to a set of resources can create such incentives. However, things are not always that simple: attracting on the platforms the engine-community (the one that will create the more

externality) is not an easy task. The platform owner should find the strategic leverages that will motivate participation, that is, resources or combination of resources coveted by partners or able to generate externalities and value for the whole system. Strategic leverages can be any tangible assets such as user base, functionalities, physical spaces, computing capacities, tool kits, geographical locations, etc. or intangible assets such as patents, SDK, codified knowledge, reputation, trust, economic power, knowledge, etc.. The pricing structure of the access to the platform can play an important role. Subsidizing the participation of some key-partners may help to launch the system: the installed base of partners can finance the entry of new partners.

Key partners can be indentified at a very early stage to collectively support the project of platform. On November 6th 2007, Google led a consortium called Open Handset Alliance (OHA) of 47 members among which HTC, Sony, Dell, Intel, Motorola, Qualcomm, Samsung, LG, T-Mobile and Nvidia to develop an open source mobile phone operating system based on the Linux kernel: Android. OHA was established to create a new mobile platform that will compete with the dominant ones (Symbian of Nokia, iOS of Apple, Microsoft, Blackberry). OHA members are contractually forbidden to produce devices incompatible with Android. In this case, Google chose to create a new IE. Indirect capabilities (coordination capabilities, relational capabilities like trust, reputation, communication skills, and influence) are of great importance.

According to Maula et al (2006), two distinct processes make it possible to manage resource allocation in the context of systemic innovation or open innovation: the foresight process and the shaping process. The first one describes how companies draw information about the evolution of technologies and markets but also about the resource allocation decisions of other firms by linking various actors in their environment. The second process refers to the way companies proactively influence the evolution of technologies (the IE side) and markets (the BDE side) and the resource allocation decision of others in their environment. Shaping can take place through providing actors in the environment with financial incentives (Maula et al., 2006). Such incentives can include sharing of firm proprietary resources, technologies, access to information or participation in standardization processes run by industry associations or standardization organizations.

In a platform-based ecosystem, the platform is the expression of the owner's distinctive capabilities (especially relational capabilities). Firms create platforms in order to access new resources, but also in order to learn and being able to take advantage of new knowledge to develop their own system. Moreover, in a fast-clockspeed environment knowledge is complex and competences are largely dispersed and fragmented, thus the source of competitive advantage and growth relies on a community of partner rather than on a single firm (Fine, 1999). Platforms support both the coordination, the discovery (exploration and experimentation) and the learning processes (exploitation).

During the birth stage, the platform is a technological support that has to be built. Its main function is the coordination of participants in order to strengthen and develop the value proposition of the whole system. This implies to think about how partners will interact with and within the platform. It involves designing interfaces that will act as bridges or exchange zones (Kellogg et al, 2006) between what is done internally and what is entrusted to partners, but also to orchestrate the contributions of these partners. Attour & Della Peruta (2013) emphasized the importance of these exchanges zones in the emergence stage of inter-organizational innovation ecosystem. The design of exchange zones

requires the mobilization of a certain type of architectural knowledge and relational capabilities (Attour & Della Peruta, 2013; Isckia, 2011). These exchanges zones will be developed through an iterative process of exploration/observation, experimentation, feedbacks and reactions. As pointed out by Tiwana (2014), the competitive advantage relies on the evolution speed of the ecosystem: platforms should be able to find continuous flows of temporary competitive advantages. This means that the iterative process implemented on the platform should be as fast as possible as and ideally faster than the potential competitors.

The construction phase of the platform is of tremendous importance (Tiwana, 2014). The way the platform is built imposes choices and hence elimination of some opportunities. Said differently, the elaboration of the platform entails a particular path of development in the future (path dependence). The design of the platform is obviously a key element. However, the spirit of the platform plays also a role. Platform architecture and governance are deeply interrelated. The governance is the expression of the spirit (intent or mindset) of the platform owner in designing its leadership and its attitude towards members. Architecture, in return, allows for the implementation of particular governance: a fully open architecture will not work well with a tough governance aiming at capturing the whole value of the system (Iansiti & Levien, 2004). The same architecture under different forms of governance will lead to different results. Conversely, a particular architecture cannot support all type of governance. These two elements can reinforce each other or not. Hence, governance and architecture must be aligned (Tiwana, 2014) and be in resonance to ensure a good functioning of the system. The platform owner has to co-design these two elements and ensure their co-evolution.

In summary, at the birth stage, the business ecosystem is structured as a closed club with some partners selected by the platform owner. The system appears therefore intentionally closed: entry is discriminatory and under the sole discretion of the owner. This closure is necessary as it ensures secrecy of the project and avoids/limits early imitation. Value creation is the central strategy of the platform owner: it is implemented through a series of exploration, experimentations and tests with the early partners and users. While eBay and Lawson started as two-sided platforms, Amazon and Apple on contrary started as merchant or one-sided platforms.

3c. Expansion

At the beginning of this stage, the platform starts to be known by some happy few (early partners, early adopters, core customers). Technically, the platform is in place and operates normally. The very objective of the expansion stage is to increase thickness and to reach and maintain a critical mass of participants on the platform on one of the subsystems (IE or BDE). The first key challenge is to identify and to focus on the main driver of the whole BE: innovation (IE) or exchanges (BDE). Table 2 exhibits some characteristics found in our cases that illustrate the link between expansion strategy and value proposition and the main driver of the ecosystem expansion for each case (IE or BDE?).

Firms	Amazon	eBay	Lawson	Apple iPhone
Expansion strategy	Reinforcing economies of scope by finding new partners	Reinforcing economies of scope by finding new partners	Reinforcing economies of scope by finding new partners	Some developers create a system (Cydia) to crack the iPhone and to install new apps. This expresses a need for innovation to allow customization of the phone
Value proposition	Offering to partners the access to the audience of the Amazon web site and the possibility to sell their own products using the Amazon system	Authorizing the sale and the visibility of new products and brands through eBay	Offering to the customers of the convenience stores a large array of services, offering to patterns to deliver their products or services at Lawson shops	Creating a virtual place (App Store) where developers can develop and propose their apps to the iPhone owners
Main driver	BDE	BDE	BDE	IE

Table 2: The main driver of BE in the expansion stage

The identification of the subsystem to develop relies on a correct exploration and analysis of the market functioning in the previous stage. For Amazon, eBay or Google, increasing and developing exchanges and transactions in the BDE is a key success factor for their expansion strategy for at least two reasons.

First, it allows for economies of scale as it increases the number of interactions. Improving the depth of the platform (Evans, Hagiu & Schmalensee, 2008) i.e. improving the functionalities and the services provided to existing participants, may also help to reinforce economies of scale (acquisition of Paypal by eBay). Depth strategy attracts new members and at the same time saturates the current needs expressed on the platforms by all participants. Hence, depth also entails higher switching costs on participants leading to more loyalty. Switching costs are reinforced by learning and experience effects: participants learn to use the platform, get familiar with it, seize it and get accustomed to it. The platform owner can develop functionalities aiming at increasing these two effects like customers' recommendations, rating systems, centralized control of quality, search engines, user friendly access to the platform, as Amazon did.

Second, it triggers economies of scope by bringing new partners (hence new products and services) on board. This is often referred as breadth strategy (Evans, Hagiu & Schmalensee, 2008). It means attracting more sides and groups of participants on the platform. Breadth also entails switching costs by creating or fulfilling new needs or opportunities of exchanges (see table 2). Underlying economies of scope and breadth is the idea of making the platform multi-sided or of improving its previous multi-sidedness. Hence at the expansion stage, all platforms become two or multi-sided.

Depth and breadth increase platform's thickness. Moreover, if carefully managed, they can impede or discourage entries in the market by competing platforms. Depth coupled with breadth locks most of the economic spaces that may be available to competitors. They raise barriers to entry (switching costs, technological lock-in of the members, heavy investments in infrastructure, second-mover

disadvantage) and make the strategic spaces created on the platform nearly uncontestable. This pushes competitors to eventually go for head-to-head competition or to enter the system sideways (side competition).

Apple's App Store may now look like a hybrid system mixing innovation and business development (path to market). However, at its beginning (2008), the App Store has been created to allow developers to propose new developments (innovation) on the iPhone. It was hence conceived as an IE with an interface with iPhone users. This allows developers to quickly launch new apps, to test the release candidate (RC), to get feedbacks from early adopters in order to improve QoS (Quality of Service) throughout the software versioning process. Such mechanisms benefit the whole system, thus strengthening innovation flows. Moreover, it attracts new developers very quickly; igniting network effects. The App Store generates positive feedbacks (indirect network externalities) between developers (innovators) and users.

Expansion of the platforms means managing a complex network of partners differing in their size, their business models, their commitment to the platform, their loyalty to the platform, their activity on the platform, etc.. From this point of view, that kind of network cannot be centrally managed. Hence platform's expansion requires some kind of "laissez faire". Said differently, it raises the question of the degree of openness of the system.

The platform owner has to exercise less control on the identity of members as to make entry more fluid and faster. Contracts with members should be standardized and follow a "take it or leave it" rule: potential participants accept the terms of the contract or not. No discussion on the terms of the contract is possible (actually it is not manageable at this stage). Contracts are automated and are most of the time on line. Menus of contracts can be created so as to provide potential participants with different level of commitment or involvement in the BE. This portfolio of contracts provides different levels of access which are often associated with a specific usage of the resources available on the platform. Participants can choose a particular level and eventually upgrade or downgrade it (Affiliated merchants program of Amazon). Every potential participant is given the same opportunity to participate or not to the platform: access becomes non-discriminatory. These contracts also include pricing and hence establish the legal foundations for value capture in a standardized non-discriminatory way.

In order to support the expansion of the BE, the design and the architecture of the platform should evolve. Entry on the platform should be easy, fast and quasi-automatic. Both the shared and new knowledge on the platform have to be fully explicit (API[3],SDK[4]) as to ensure a high circulation and diffusion of information and knowledge sharing within the ecosystem. The design of the innovation process (IE) must integrate the changing characteristics of innovation activities, including the fact that knowledge and external actors now play an important role in the process. In this context, boundary resources (Ghazawneh & Henfridsson 2012) such as SDKs or APIs play an important role. They allow adjusting the participants' knowledge representations in the process of collective innovation and are therefore exchange zones for these actors. Basically, they facilitate knowledge sharing thus facilitating interactions between participants.

[3] Software Development Kit.
[4] Application Programming Interface.

However, the improvement of the thickness may trigger congestion. The fluidity and the quality of exchanges, transactions, information and knowledge sharing should be maintained. The underlying infrastructure should then be highly scalable in order to be adapted quickly and efficiently to the growing number of interactions (traffic). For the platform-owner, anticipating the level of the traffic is an essential capability for scaling the platform properly and at the lowest cost. An underestimation of the traffic may create congestion and decrease the perceived quality of interactions thus jeopardizing platform's expansion. Conversely, overestimated the traffic may increase the cost of the platform and put financial pressure on the owner or focal organization. Moreover, it may cause the waste of financial resources that may have been useful elsewhere (for instance, to improve advertising, communication or control). To facilitate the entry and to ensure a minimal level of depth, the platform owner must enrich the platform with standardized secondary functions. This can be done via two different approaches: either the platform owner creates these functions itself (one-click payment on Amazon) either it acquires them through the BDE (Paypal on eBay, Alexia on Amazon). The latter has to be done cautiously since it may induce uncontrolled effects that can neutralize indirect positive externalities and value creation in the BDE.

During the expansion stage, the platform becomes hence open encouraging niche players to enter the system (Iansiti & Levien, 2004). Niche players are small, specialized players who will complement the products and services provided by the platform. As strategic player thriving for their survival, they may intentionally - or not - affect the shape and the functioning of the platform. Agility is the hallmark of niche players. They participate actively to the expansion of the platform by enlarging the possibility of interactions with other participants, thus pushing outwards the frontier of the BDE. Their ability to explore new business models nurtures the expansion of the system (Chesbrough, 2010; Doz & Kosonen, 2010; Lu & Ramamurthy, 2011). This group of players encompasses start-ups, community of developers, established firms in adjacent markets (side-player), quasi-competitors, spinoffs, etc. Some of them join the platform in order to explore and experiment business opportunities: creating new distribution channels for their products, experimenting new services and business models. Others enter the platform in order to gain knowledge about its functioning in order to develop their own.

Therefore, the platform owner should not consider niche players as second-class players. These actors are strategic players. Most of them act cooperatively and they participate in the survival and the resilience of the system (Iansiti & Levien, 2004). However, others may behave opportunistically to gather huge profits thus jeopardizing the functioning of the platform (crash of the video game industry in 1984). Thus, the platform owner has to develop monitoring capabilities. Control and governance mechanisms are required to support and to secure the position of the platform owner. Nevertheless, it is quite difficult to achieve a total control in such a burgeoning system. Platforms need to be resilient (Tiwana, 2014). Resilience is obviously driven by governance and control mechanisms and the way these processes are implemented on the platform (architecture).

As Evans et al. (2007) pointed out, when the BDE grows, the platform relies more and more on other subsystems created or controlled by participants. Such interdependencies decrease platform's flexibility and the control of the owner. It induces a lower resilience of the whole system. Ensuring resilience is challenging in the expansion stage. The growth of the BDE implies a greater level of complexity within the network because of the interdependencies between participants and between

participants and the platform. The effect of a failure in the system is highly unpredictable and hardly assessable. A small failure can produce dramatic effects in such dynamic systems.

With the transition from the birth stage to the expansion stage the role of the platform owner shifts from a position of project manager to a position of a network orchestrator that addresses a complex and dynamic set of interactions and interdependencies. Of course, dynamic and relational capabilities are still important but are not distinctive any more: any platform owner at the expansion stage has to hold these capabilities. The BDE will need guidance to survive and evolve. This implies leadership in a complex environment and the ability to assess correctly the impacts of central decisions on the system. At this stage, the platform owner really becomes the central player of the BDE: more than the owner, it becomes the leader.

In summary, at the expansion stage, the business ecosystem is structured as an open club with non-discriminatory membership. The system appears therefore intentionally open. This opening increases the number of participants and deepens the complexity of the networks of interactions. Governance and control mechanisms play a central role in the monitoring of the whole system. If value creation is still central to ensure the thickness of the platform, value capture remains important especially to maintain the level of investments in the infrastructure. BDE-focused platforms may more easily start as multi-sided businesses than IE-focused platforms. Apple iPhone started out as a merchant with a one-sided product, and the other side of the ecosystem (developers) came on board only once there is a critical mass of end-users. Clearly, eBay and Lawson started as two-sided platforms in the birth stage. In these cases, the platform was designed as an engine for growth to fuel business development (BDE) since the two groups were already on board. On the contrary, during the expansion stage both Amazon and Apple upgraded their platforms architecture in order to support collective innovation (starting with the developers' side for Apple and with affiliates and later third-party players for Amazon). In the case of Apple, it must be noticed that they opened up their App store in response to jailbreaking by developers. So it was not a conscious strategy to gain a critical mass but rather a response to malicious developers. From this point of view, they had first to get a critical mass of users on one side to attract other groups of players on other sides or their platforms thus igniting network externalities.

d. Maturity & Leadership

At this stage, the platform has reached its critical mass and is supporting a wide and complex network of interactions between members. The growth eventually starts to decelerate. Moreover, as the number of participants increase, the influence of the platform owner on the BE withers. Hence, the main objective of the platform owner is to maintain leadership and to sustain growth. The implementation of these objectives may take different path as shown in our cases (cf. Table 3).

Firms	Amazon	eBay	Lawson	Apple iPhone
Leadership strategy	Sustaining growth and leadership through the creation of a IE and new services	Sustaining growth and leadership through the creation of a IE and new services	Sustaining growth by fully developing depth and breadth of the BDE	Sustaining growth with technological and functional evolution of the platform
Implementation	Developing IE (open source platform) by introducing API and SDK Developing ubiquity (M-Commerce) Developing new services to other firms (e-commerce technologies, cloud computing, etc.)	Developing IE (open source platform) by introducing API and SDK Developing ubiquity (M-Commerce) Developing new services to other firms (e-commerce technologies, CRM, Marketing solutions, etc.)	Increasing the number of shops Leveraging the platform to better understand customer mindset Creating new products in line with customers mindset	Implementing evolutions of iOS to allow for more developments Implementing evolutions of the devices Transforming App Store (IE) into a IE-BDE
BE	BDE+IE	BDE+IE	BDE	BDE+IE

Table 3: Leadership strategy

Lawson pursues a rather traditional growth strategy by fully developing depth and breadth of its BDE keeping innovation internally with a mere Connect and Develop strategy (cf. 2.b) relying on a deep understanding of the customers' mindset , habits and culture. Lawson operates a system that analyzes its customers (sales, location, number of contacts, age, etc.) in a very sophisticated way. It helps Lawson to come up with new products, services, new partnership and new ways to improve its reputation. The whole strategy lies in its motto: "Creating happiness and harmony in our community". Lawson mainly focuses on beating the competitors through geographical competition (more than 500 new shops opened per year), community commitment (sustainable development, green project, health conscious food products, home convenience services, etc.) and partnerships to reinforce platform's value. It maintains its leadership thanks to a strategy that completely sticks to the customers' needs and vision. Amazon and eBay have followed the same strategy, improving their ecosystem by creating and nurturing the IE side of their respective ecosystems. In these cases, the IE side is a digital platform (De Reuver, Soresen & Basole, 2016; Tiwana, 2014; Tiwana *et al*, 2010) that provides developers and partners with access to APIs and SDKs to build on solutions for e-commerce that will improve operations on the platform. eBay more particularly focused on development for the mobile app market (M-commerce). As of 2013, eBay counts 1,8 million active users of its API and SDK in its IE. Once the BDE is created, developing the IE at the leadership stage maintains the flow of innovation in the ecosystem and ensures value creation, diversity and agility of the system. It also attracts new players with new ideas and new business models.

By supporting an IE and a BDE, the platform strengthens its role in the system: the platform is the cornerstone of the business ecosystem (Isckia, 2011; Isckia & Lescop, 2013). As shown in figure 1, there is a positive ripple effect between IE and BDE: innovations on the IE induce more products, services and functionalities on the platform which attract more members on the BDE. In return, the increase of the audience in the BDE attracts more innovators on the IE. To benefit from this effect, the platform owner has to create bridges between the IE and BDE in both directions in order to

ensure a path to market (to the BDE) for innovators in the IE (or eventually outside) and a path to incubation (IE) for participants in the BDE.

The path from the IE to the BDE allows for experimentations and tests via the platform. Innovators may also come from the BDE. The platform owner must be able to identify them building exchange zones (Kellogg et al, 2006) with the IE. It can take the form of boundary objects (API, SDK), innovation contests, business model competitions, App challenges, etc... Communicating on such tools is essential. In the Apple case, the IE evolved progressively in its functions towards operating as a BDE. The IE and the BDE overlap: the App Store is a place for innovators but also a place for merchants (games) which can work and exchange with developers. It is today hard to distinguish at first glance these two parts. By coupling a BDE and an IE through strategic tunneling, the platform owner reinforces its control of the system and the main outputs: innovations and revenues. By doing so, the platform owner develops a real business ecosystem intelligence capability which gives him a strategic advantage over the ecosystem members and competing ecosystems.

However, a business ecosystem is not evolving in a static environment: outsiders and insiders are strategic players. Competitors may be attracted by the success of the platform and enter the market in search of business opportunities. Some leaders in adjacent markets can leverage their own platform to enter very quickly and fiercely (for instance, Microsoft in the game console market, Apple in the mobile device market) changing routines and dominant logic (Prahalad & Bettis, 1986; Bettis & Prahalad, 1995) relationships, architecture and eventually leadership in the market (Lescop & Lescop, 2013). This side-competition is one of the great threats of platform at the leadership stage. Again, dynamic capabilities and especially scouting of adjacent markets are essential to anticipate movements of potential competitors (Tan et al, 2015; Ridder, 2013).

Participants in the BE evolve too. They thrive for their survival and success. Some of them are able to attract other participants and to create subsystems of innovation or business development around their own products, services, developments or even platforms. These subsystems rely on the resources of the central platform and can develop their own resources that they share within their own subsystem. The BE starts to cluster on both sides: IE and BDE. Grapes of interdependent innovations, developments, interactions, services and products grow here and there in the BE. The business ecosystem does not appear anymore as a network centered on the platform of the founding firm. Constellations (nodes) of innovation, services and products are now structuring it. Clustering is not a problem per se. In any growing complex system of interactions, clusters occur. Clustering implies that a part of the survival of the system relies not only on the founder's platform but also on other relatively important ecosystem members. Those players share the fate of the whole ecosystem. Hence, most of them will not try to act negatively on it. Like the platform founder, they fight for the development and survival of the whole ecosystem: they act cooperatively by supporting a part of the system on their own. The platform owner cannot act against clusters without jeopardizing the dynamics of the ecosystem. Clustering is the consequence of the ecosystem expansion. Clusters support many grapes of innovations and business developments that the platform owner may not be able to support by himself. Impeding them will lead to a slower expansion of the system and therefore to weaken it. Instead, the platform owner should use them and integrate them in the governance and control system of the ecosystem. Thus, these institutional mechanisms should be fine-tuned taking into account the clusters as units of control and

governance. From this point of view, clusters impose decentralization and delegation of power in the BE.

However, some players may wish to go further than clustering. They may develop their own system beyond the boundary of the ecosystem: they may multi-home. Multi-homing refers to the situation in which some members of an ecosystem also participate in competing ecosystems to ensure a large audience for their products and services. For instance, in the Apps industry developers often use freemium business models in order to gain a huge audience (Seufert, 2014). Thus, multi-home is a prerequisite for development. Multi-homing has several negative consequences on the ecosystem. If a participant multi-home, its economic activity (products, developments, services) on the original platform is no longer distinctive for this platform. Commoditization then occurs and the relationships of the platform owner with this player change drastically.

Commodities so created do not benefit to any ecosystems, rather they only benefit to their owner. A commodity is not distinctive but rather a must have to remain competitive: no one can imagine an App store without social games like Clash of Clan or Candy Crush. When possible (for instance, if the commodity is a functionality of the platform), the platform owner can envelop it and standardize it (Isckia, 2009). This envelopment strategy (Eisenmann et al., 2011) appears possible only when the commodity is economically and strategically sufficiently closed to the platform and when it will not imply the collapse of a significant part of the ecosystem. Again, no one can envision a situation in which all games are enveloped on the main platform. Whatever the strategy of the platform owner, multi-homing means outflows or destruction of value and innovation in its ecosystem. Multi-homing helps participants to appropriate the value they create and gain economic power both inside and outside the system. In a sense, multi-homing induces contestability of control and governance by the platform owner. Doing so, multi-homers increase the competitive pressure between platforms. As a vector of competition, they appear as a threat.

In summary, during the leadership stage, the business ecosystem is still structured as an open club with non-discriminatory membership. However, clusters appear that may make part of the knowledge more private or dedicated to the clusters. Some parts of the ecosystem can even be fully closed. With clusters also emerges multi-homing strategies and competitive pressure. Multi-homing implies frictions in the ecosystem as multi-homers do not act cooperatively anymore: the platform is just one of their delivery channels and their fate does not rely anymore on one platform in particular. At this stage, attracting and retaining participants is crucial in order to maintain platform's competitiveness. The platform owner should fully embraced its role of leader providing the participants of the BE with vision and guidance for future developments.

e. Renewal

At this stage, if nothing is done, the ecosystem will slowly decay. Some players (among which those who build clusters) will stop investing in the BE, will leave it or will develop their own system by separating their cluster from the rest of the ecosystem. Some other may simply disappear with it. The platform owner may be tempted to use a value dominator strategy (Iansiti & Levien, 2004) draining the whole remaining value from the ecosystem, hence accelerating the attrition process. To avoid this attrition, the platform has to enter a new cycle of development. The renewal stage is the premises of this cycle and looks like a rebirth stage. However, the platform owner can now rely on its

fully functional and mature ecosystem. Table 3 illustrates some renewal strategies found in our cases.

Firms	Amazon	eBay	Lawson	Apple iPhone
Renewal strategies	Finding new ways to deliver products (drone) Creating new devices (FireTV)	Becoming a ubiquitous *digital wallet* for consumers and merchants	Creating Lawson Mart (next-generation convenience store)	Working on new devices, new screen and new design
With Partners	Yes	Yes	No	Yes and No

Table 4: Renewal strategies

The main challenge at this stage is to avoid the disintegration of the interactions forged during the previous stages: renewal is essential to ensure survival of the ecosystem. In the renewal stage, the ecosystem becomes mature. Large parts of it are now stabilized (for instance, Amazon as an online store) delivering comfortable flows of revenue and profits. Renewal stage relies on the leader's capabilities to leverage its own platform to find new paths of development and to project its platform into new markets.

Leveraging a platform can take different forms as shown in table 4. For instance, Amazon chooses to enter the entertainment markets by creating a new line of products and services, among which Fire TV and Amazon Game Studios. Fire TV is a little box connected to HDTV that gives access to a massive selection of TV series and shows, songs and games. It has been built around specialized partners in content diffusion like Netflix, Hulu Plus, VEVO and WatchESPN. In addition, Amazon enters the game development market by launching Amazon Game Studios and its first game Sev Zero running on Fire tablets and Fire TV. These two moves prepare the release of a 3D smartphone for the summer 2014 and the entry in the mobile device market.

eBay follows a more classical renewal strategy by focusing its effort on one part of its ecosystem: payment services. eBay works in the development of Paypal as an ubiquitous digital portfolio for any consumers and merchants in partnership with financial institutions around the world. Paypal expands way beyond eBay ecosystem boundaries. In parallel, eBay improves the Paypal payments network by providing a credit product called Bill Me Later. When a consumer uses Bill Me Later, a chartered financial institution extends credit to the consumer and advances funds to the merchant. The service relies on a bank or any licensed lender to issue the credit. eBay retains most of the receivables and is responsible for servicing functions related to the customer account.

Lawson decides to renew its ecosystem by creating a new concept of shops that combining the functions of a convenience store and of a supermarket: Lawson Mart. These new shops will offer the services of a convenience store - embarking the whole original ecosystem - but will also present larger lines of products. Apple follows its usual strategy of embarking its whole ecosystem in the renewal of the hardware: new screen, new devices, new design and functionalities. In the renewal stage, platform owner's dynamic capabilities are essential to identify and create new opportunities of development for the ecosystem. The renewal stage also depends on the vision provided by the leader during the leadership stage.

The renewal stage is in essence a phase of ideation and exploration. The first challenge is to maintain participants (especially innovators) in the ecosystem by motivating them with new ideas and

challenges. The platform owner should capitalize on existing knowledge and relationships to foster the emergence on new ideas around its vision. The platform owner should break the strategic rigidities created in the expansion stage and gain agility during this process to be able to pivot easily.

As in the birth stage, the platform owner needs to identify and gather the key partners (inside or outside the ecosystem) who will support new projects. This relational strategy can be used to maintain important clusters in the ecosystem: the cluster holder can become a first-tier partner in the ecosystem. Exclusivity contracts can help sealing the relationships. Then, the leader can implement a new structure in the ecosystem: platform of platform (PoP). The original platform can run as a host for other platforms supporting a constellation of clusters or smallest platforms (Tan et al, 2015): clusters will then be able to develop on their own. Being independent entities, these clusters can be used to explore new business opportunities without jeopardizing the whole ecosystem. In this critical phase of renewal, clusters may reinforce the resilience of the system. However, this means rethinking the role of the original platform and, the governance and control mechanisms. All ideas and projects may not lead to major developments. As the leader, the platform owner has to choose the best options for the system to be developed, dynamically reallocating bundles of resources.

In summary, during the renewal stage, the leader leverages its platform to enter new paths of developments. The ecosystem changes its structure and becomes mainly an open club with non discriminatory access, but containing private clubs (clusters of development) managed by the platform leader. The future developments of the platform are nested or embedded in these innovative clusters.

4. Conclusion

In this paper, we developed a framework for modeling dynamics of platform-based ecosystems. Our framework integrates key interrelated dimensions such as platform strategy, platform design (including governance mechanisms) and knowledge management. Our framework is a first to explicitly model the dynamic interplay of two subsystems of the ecosystem: the Innovation Ecosystem and the Business Development Ecosystem. The application of our framework to four illustrative cases shows that platform owners make different choices on how to develop these two interrelated subsystems of the ecosystem over time.

Managing these various dimensions in a coherent approach is tricky for platform owners. Crafting platform-based ecosystem is thus a complex exercise since the scope of strategy is much wider than for normal firms or merchants. Platform owners have to shape their platform's architecture, control mechanisms, value creation mechanisms and the associated knowledge management processes in a coherent and dynamic fashion throughout the platform's development in order to nurture collective or systemic innovation. Strategizing in platform-based ecosystems means that these mechanisms are designed so that they can dialogically handle the tensions between the various ago-antagonistic dimensions of platform-based ecosystems: control/generativity, open/closed, individual/collective. This orchestration process, which refers to the platform owner capability, is the cornerstone of platform leadership in network-centric innovation (Nambisan & Sawhney, 2007).

Our approach embraces all players in the platform-based ecosystems. It gives a detailed view of the dynamics of co-evolution within such a type of business ecosystem. Everything starts with a wannabe

leader that will have to design a flexible system in order to achieve a specific goal (innovation and value creation) while managing interdependence and ago-antagonist tensions. Addressing such interactions requires a set of capabilities that are yet uncommon for traditional companies. Throughout the ecosystem's life cycle, the platform-owner has to think strategically considering the effect of its decision on the ecosystem and the feedbacks or counter-effects created by the strategic move of other players. The platform-owner should thus be both an orchestrator driving the development of its ecosystem and a chess-master that integrate the reactions of others players in its own decision process. As the system develops, its complexity increases which pushes the system to evolve from a centered network to a decentralized structure of platform of platforms (PoP).

Our paper described an ideal-type of platform-based ecosystem evolution. As such, it does not fit perfectly to reality. This evolutionary model is in line with the literature and is in essence theoretical and conceptual. As such, it is an artifact. In the real world, platforms support multiple economic activities, each growing and developing at different pace. Therefore, at a given time, some part of an ecosystem may be in an expansion phase, while another is in a birth phase and so on. Moreover, stages of development may overlap. For instance, the renewal stage can start as early as the expansion stage: some project can take years before emerging (Maula et al., 2006). This is a consequence of the continuous flows of innovation that nurture the ecosystem.

In this paper, we mainly conceptualized our framework. We showed its applicability by analyzing four cases of platform-based ecosystems. Subsequent work will focus on validating the framework with empirical research. We will explore the scope in which the framework can be applied, as well its explanatory power when analyzing ecosystem dynamics.

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