Platform-based Innovation Management: Directing External Innovational Efforts in Complex Self-organizing Platform Ecosystems

(Research Paper)

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Abstract: Modular platforms have become the centerpiece of collaborative value creation in customer-driven platform ecosystems. Platform ecosystems co-create the platform's value proposition and support its market adoption as the more complementors join the ecosystem to supply complementarities, the more valuable the platform becomes to customers due to a greater variety of choice. This poses new requirements on managing innovation in open platform environments. While academic research stresses the relevance of complementary innovation for platform success, it lacks, however, a concrete understanding of how platform operators can direct external innovational efforts in complex self-organizing ecosystems to co-create and deliver value while ensuring the overall quality, reliability, and consistency of the 'whole' product. Based on case study results, this paper presents a categorization of control mechanisms currently applied in platform markets, enabling the platform operator to steer external complementary innovation within the context of a platform strategy. From that an overall platform-based innovation management process is developed.

Key Words: Platforms, Platform Ecosystems, Service Ecosystems, Complementary Innovation, Platform-based Innovation Strategies, Control Mechanisms.

1 Introduction

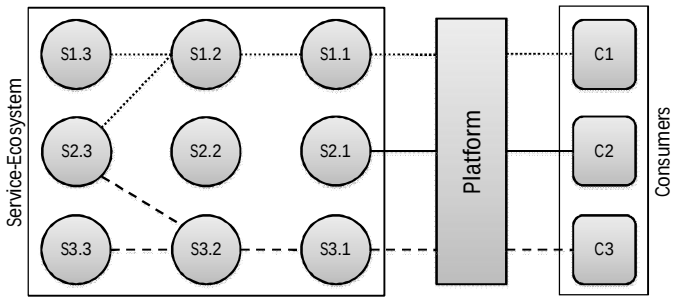
Global economy migrates from vertically integrated enterprises towards specialized enterprises inter-operating to create end-to-end value to customers. Platforms have become the centerpiece of co-opetive value creation. The driving force is the consumers' demand for "product and service customization, speed and high levels of quality of service, all in a seamless fashion and preferably from a single provider. In many instances, consumers will only use and continue using products and services, if their value preferences and criteria are met or exceeded by the services provider"[5]. Preferences change rapidly, driven by demand for innovation, flexibility and shorter time-to-market [6]. Market requirements may even change while the product is still under development [7]. To cope with all this without losing the focus on core competencies, open modular platform concepts enable companies to delegate the process of value generation into a platform ecosystem, limiting themselves to a role of basic value contribution. This process cannot be reduced to a simple outsourcing decision, but is part of renewed strategies of open innovation. Companies are forced to open their business models in order to benefit from the value creation and the resulting pace of innovation outside the company borders [8, 9, 10, 11, 12, 13]. Platform providers often do not have to cope with one layer of service providers only, but with flexible networks of interconnected autonomous services. Innovation management, classically accomplished through hierarchical decision structures and intra-corporate stage gate processes, comes to a point, where external, autonomous innovations have to be included in order to ensure a platform provider's sustainable, goal congruent growth. Although open innovation [8, 9, 12, 13] has become a management buzzword, little light has been shed on the innovation process itself and on the respective management techniques, in particular on its control mechanisms to ensure focus and value capture in open platform environments [14]. In this paper, we aim at closing this gap by introducing a process model of the 'platform-based innovation process'. We focus on platform ecosystems such as those of Salesforce, Netsuite or Facebook and more specifically, on control mechanisms to direct external innovational efforts in self-organizing platform ecosystems congruent to the platform provider's strategic goals. We, therefore, consider the research streams on open

innovation [8, 9, 10, 18], platform leadership [1, 3, 50], network economics [26, 27, 28, 47], and value nets [55, 56]. We begin most fundamentally by introducing our understanding of value creation in a two-sided platform business and identify in section 2 the resulting challenges for innovation management. It is shown that in particular ensuring congruence between the platform ecosystem and the platform provider's strategic innovation goals is of crucial importance for platform success. In section 3, we present the results of our longitudinal studies and categorize the control mechanisms applied in two- or multisided platform businesses. Subsequently, we derive the primary tasks of innovation management in platform companies and introduce the platform-based innovation process. Finally, we draw conclusions and outline our next steps.

1.1 Platform Ecosystems

In line with [50], we conceive platforms as "a building block […] that acts as a foundation upon which other firms can develop complementary products, technologies or services". It "consists of a modular architecture of related standards, controlled by one or more sponsoring firms" [51] and provides leverage for its multiple complementors within the platform ecosystem. Based on web services technologies and service-oriented architectures (SOA), these platform ecosystems allow an entirely new class of business designs, empowering consumers to compose 'on demand' the solutions or service combinations that best suit their needs [51]. These "consumer-driven composite solutions" [15] are built based on loosely coupled chains of services, provided by an "open pool of autonomous service providers" [52], leveraging the platform into different market and price tiers to complement the platform offer [20]. In figure 1, the principle setting of consumer-driven composite solutions is depicted. The platform ecosystem embraces (a) the platform provider, operating the platform and core platform offerings as well as mediating between service consumers and platform providers; (b) the service ecosystem of complementary product and service providers enabling the 'whole' customized solution as offered to (c) the customers.

Figure 1: The Principle Setting of value creation in a platform ecosystem



Within this setting, the platform provider offers its consumers the core platform offer, eventually complemented by core applications and services. In addition, it offers its consumers the flexibility to modify or extend the core offering through complementary services and, therefore, mediates consumer demand between consumers and the service ecosystem. Service ecosystems are understood as that part of the platform ecosystem that takes account of the service providers only [15]. Consumer added value is indirectly determined by the platform provider's capability to provide an appealing core platform offer and a compelling mix of complementary services devoted to the core platform offer. Consequently, "ensuring the integrity of the platform and driving its evolution become strategic imperatives in industries where distributed innovation constantly challenges established relationships of power between suppliers of complementary products" [1]. This poses new challenges on a platform provider's innovation management.

2. Challenges to Innovation Management in Platform Businesses

Innovation management refers to a systematic planning, implementing, directing and controlling an organization's innovation activities for the purpose of an efficient and effective realization of innovative ideas [16]. [17] emphasizes the dispositive modeling of innovation processes as primary task of innovation management, representing a collection of related, structured activities or tasks, embracing the identification and definition of innovation goals and formulating innovation strategies and their implementation, as well as the design of appropriate organizational structures. Multiple

innovation process models have been experimented on in academia and industrial practice to structure innovational activities and tasks for successful transformation of invention into innovation [14]. With the emergence of the open innovation paradigm [8-10], companies are challenged by a new dimension of actively directing external innovation efforts to master open innovation [18]. With regard to open innovation in platform businesses, the platform owner is particularly challenged to continuously evolve the platform's overall value proposition to the customer. Besides innovating the core platform offer, the platform owner has to orchestrate a complex self-organizing web of direct and indirect relationships between independent actors to co-create and deliver value [1, 53], while the value of the total offering is determined and driven by the consumer.

2.1 Systemic Nature of Innovation

Platform ecosystems develop due to the mutual benefits which autonomous partners gain in linking their investments [19]. In doing so, they accept reciprocal dependences, which, in turn, lead to economic value creation and capture. The foundation of value creation represents the platform. Platform concepts are based upon modular architectures, interfaces, and corresponding design rules that allow independent third parties to autonomously innovate and develop different system components, which can, in turn, be flexibly recombined into a variety of configurations to address individual customer demand [20, 21]. Overall, the underlying modular platform architecture is recognized as accelerating innovation through autonomous and modular innovation [22]. Due to accelerated commodization and fierce competition in platform markets, platform systems need to be continuously renewed by incorporating new functions and components, allowing for new functionalities and added value to gain competitive advantage over competitors [20]. Due to the complex systemic character of innovation in platform systems as well as competition between complementors within the platform ecosystem, innovation processes become increasingly co-opetive. This forces platform companies to consider the platform perspective within their innovation management and adopt new modes of control to foster complementary innovation on top of the

platform. Major obstacles in the pursuit of an innovation goal, however, emerge from the peculiarities of service ecosystems, being determined by the non-linear and autonomous behavior of interdependent service providers, striving for profitable growth [43]. Thus, ensuring goal congruence means ensuring that the goals of the participating members within the service ecosystem are consistent with the goals of the platform organization itself is of strategic importance [23].

2.2 Peculiarities of the Platform Business

In platform markets, adoption and, therefore the ROI of platform investments, are determined by network externalities. This means that the consumer utility of the platform and its derivative services depends on the total number of consumers of that platform [24]. Network markets have been widely analyzed throughout the academic literature on network effects, particularly by [24, 25, 26, 27]. These authors provide evidence that the demand for a network good is a function of both its price, and the expected size of the network [24]. Correspondingly, [27] summarizes that networks exhibit positive consumption and production externalities. A positive consumption externality (or network externality) implies that the value of a unit of good increases with the (expected) number of units sold. The key reason for the appearance of network externalities is the complementarity between the components of a network. When opening the platform architecture to external development resources, a second effect becomes relevant: According to [2], the platform's market success, adoption, and profitability is determined by indirect network externalities: Principally, it applies that the more service providers join the ecosystem in order to supply complementary services, the more valuable the platform becomes to consumers, as a greater variety of services attracts more consumers. This dynamic, in turn, causes more consumers to adopt the platform and more complementors to enter the platform ecosystem [3]. However, research conducted by [2] emphasizes the necessity of quality for platform adoption. Consequently, innovation management within platform businesses has to focus strategic attention particularly on balancing the trade-off between the appropriation and diffusion

level of innovations. Therefore, the platform provider has to coordinate innovation efforts with indirect network externalities in mind.

2.3 Open Innovation in Platform Business

Previous sections have shown that steering complementary innovation efforts in complex platform ecosystems has become a critical capability to the platform provider. Indirect network externalities in particular cause a strong impact on a platform's market adoption, where failures in steering external complementary efforts can rapidly lead to reputation damage, financial losses and possibly, even to the ecosystem's decline. However, given the non-linear and autonomous behavior of independent complementors, management techniques in open innovation initiatives significantly differ from the approaches applied within hierarchical organizations [15]. The following chapter analyses in detail mechanisms found in platform businesses.

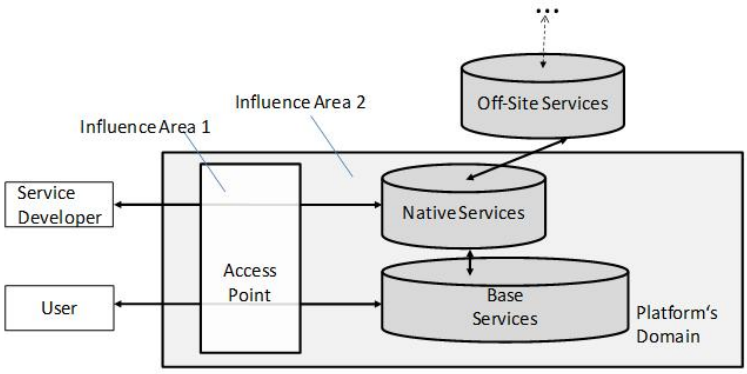
3. Categorization of Control Mechanisms

Given the strategic importance of directing external complementary innovations within the context of a platform strategy, we conducted a longitudinal and an explorative study. We analyzed and grouped implemented control mechanisms. In our explorative study, we looked at the Apple App Store, EBay, Facebook, the Microsoft Windows Mobile Marketplace, Netsuite, Salesforce and StrikeIron. In our longitudinal study, we analyzed and compared platforms for web-services, namely SeekDa, WebServiceList, XMethods, RemoteMethods, eSigma and StrikeIron. The results coincide with findings by [1] on methods for the encouragement of external innovation.

First, we conducted the longitudinal analysis (for details see [29]). Out of 6 Web-service platforms which were analyzed, only 1 was in the position to assert a basic quality level. The selected quality parameter was 'availability' which reached at StrikeIron a level of 99.37% over a period > 6 months. On average however, the 6 platforms only reached an availability of 91.22%, which is far below industry standards [29]. StrikeIron was the only one out of the sample group who was in the position

to exert control over service quality, due to the platform architecture. In contrast to classical e-Markets that simply syndicate external services (influence area 1 of fig. 2), StrikeIron operates all services on its own domain and obliges its service providers to use proprietary programming and interface ("native services). This frameset gives them influencing power on the transactional flow (influence area 1) as well as on the complete runtime environment (influence area 2) and thus allows for a proactive optimization of runtime related quality factors [29].

Fig. 2: Schematic Representation of a control enabled architecture for external services



All successful platforms which we analyzed in our explorative study have this "technical" stakeholding power to actively exert control over the offered 3rd party content and their supply-related quality parameters (e.g. response time, availability, accessibility, successability, conformability, interoperability, observability). On the other hand, platforms lacking these capabilities showed regressive growth rates over the analyzed last 2 years. We can conclude that the first prerequisite for control of external innovation is the actual technical ability to do so (see figure 2). This however depends, apart from a suitable architecture and runtime, on a 2nd prerequisite, which is the service providers' willingness to accept the platform operator's rules and regulations. It is mainly the attractiveness in terms of critical mass of customers along with an expectable profit generation which tips the scales. The great majority of leading 2-sided platform operators like Facebook, the Microsoft WM Market place or Salesforce already came up with a highly attractive existing customer base due to

their own value contribution, when they opened their platforms to 3rd parties. Parties like Salesforce advertise with a customer-base of more than 67,000 [54] and the Apple App store with "a global reach of over 50 million iPhone and iPod users" [30]. The 'argumentum e contrario' also seems valid as none of the analyzed platforms which started off as 2-sided market without significant base value ever managed to reach a significant growth rate or critical mass over the analyzed period.

Based on our longitudinal and explorative studies, we were able to derive 6 categories of control, which are applicable, respectively applied on service ecosystems. They are:

(a) Market Regulative Control: Consumer based service verification and auditing;

(b) Co-regulative Control: Guiding principles of service development, providing development rules or tools for coherent and observable service supply;

(c) Restrictive Control: Platform access regulations;

(d) Sanctional Control: Coercive action up the exclusion of services or service providers;

(e) Motivational Control: Development support, community building, funding, etc.;

(f) Informative Control: Information about consumer behavior, platform evolution, value creation opportunities.

As the introduced mechanisms are not independent, overlaps may occur.

3.1 Market Regulative Control

Through consumer-based service verification and auditing and its respective publication, aspects of the service providers' performance are made publicly visible. This provides "an incentive for good behavior and therefore tends to have a positive effect on market quality" [31]. Many platform operators apply so-called "reputation systems". In these systems, aggregated ratings about a given party are used to derive a trust or reputation score [31]. Whereas some systems are limited to a quantitative scoring approach, others like Amazon or Force.com allow descriptive reviews for services or products offered. At EBay, high-performers, i.e. those who get a 98% score in feedback receive a "power seller" status which increases visibility and perceived trust-worthiness. In a more formalized

approach, some platform operators (e.g., Salesforce) offer paid-for, annual reviews leading to a displayed certification for the offered services. Also Facebook offers a paid-for verification service rewarded with an attractive “badging”, which is an icon, proving that those services meet Facebook’s quality principles. The primary goal of market regulative control is to inform consumers and to put pressure on the service provider, as his performance is made publicly visible and will impact the service provider’s financial success. On top of that, operators like EBay have also established further reactive procedures, where service providers are sanctioned, if their scores are too low. In this case, market regulative control is linked to sanctional control (see 3.4).

3.2 Co-regulative Control

Through the provision of development rules and tools, coherent and observable service quality is ensured through-out the whole life-cycle of a service. Co-regulative control also includes the legal framework. In all of the successful platforms analyzed (e.g. Facebook, Salesforce, Netsuite, MS Windows Mobile Marketplace), platform providers are required to develop products with proprietary tools, interfaces and/or according to development guidelines that allow the platform operator to observe the service’s function and performance in detail. In all stated cases, it also includes the mandatory hosting of services on the platform provider’s own infrastructure (see figure 2). This first of all enables the platform provider to ensure the transactional qualities like availability, sufficient replication or computing performance as it is in their own responsibility. Secondly it further simplifies the monitoring of third party services.

These guidelines always go hand-in-hand with escalation routines, which allow rapid reaction after automated notification on failure, under-performance or disrespect of rules (see 3.4). They are always set in sequence with restrictive control (3.3), meaning that a service is only published if it is compliant to the rules.

3.3 Restrictive Control

These mechanisms apply pro-actively prior to the supply of a service. Most of the platform operators regulate platform access in accordance with rules set in co-regulative control (see 3.2). This way, initial coherence with the platform provider's goals is ensured. In our research we saw that all leading platforms require automated entrance assessment methods where each platform provider has to run through an automated link-in procedure and is only published in the service ecosystem once the assessment has been successfully accomplished. In general, basic quality and interoperability-features but also conformity to rules and policies are verified. Microsoft applies rigorous testing mechanisms for quality and suitability of "user experience" [32]. Apple even shows a strategy-driven restrictive product range management to avoid conflicts with its own base value contribution or with its own products. Products like Google Voice were refused in July 2009 as it seemed to be in conflict with Apple's business model on mobile communication [33]. Unauthorized products are technically blocked in the iPhone-environment.

With respect to security-sensitivity, restrictive control in the financial service industry is rigorous. Certification is a must for platform providers in the credit card industry. Participation in the ecosystem of the leading credit card suppliers is exclusive for platform providers which are "Payment Card Industry's Data Security Standards certified" [34]. A company processing, storing, or transmitting cardholder data must be PCI DSS compliant, including secure networks, data protection systems, vulnerability management programs, strong access control, regular monitoring and testing procedures and an information security policy [34, 35].

3.4 Sanctional Control

Exceeding the commercial and psychological pressure, exerted in market regulative methods, sanctional control acts directly on the services and their providers. Many platform operators apply sanctional procedures, including the removal of an offering from the platform, if specific rules or guidelines are not met. In EBay's Verified Rights Owners program for instance, the platform operator

enables rights owners "to easily report and request removal of listings offering items or containing materials that infringe their intellectual property rights"[36]. EBay has also established policies and rules [36] for vendors including prohibition and restrictions of items and listing practices and performance guidelines. Violation will lead to sanctions, i.e. listing cancellation, forfeit of eBay fees on cancelled listings, limits on account privileges, loss of power seller status or account suspension.

The PCI DSS standard for data security in credit card services defines detailed sets of rules and bodies for the "enforcement of compliance" [34] ranging from fines to exclusion.

In Facebook's statements of rights and responsibilities, Facebook explicitly reserves the right to analyze and audit 3rd party applications, content, as well as data for any purpose, to limit developers' and operators' access to data and to stop providing all or part of Facebook in case of violation of rules and policies [37].

3.5 Motivational Control

This control approach includes measures to indirectly control the service ecosystem through incentives. The scope ranges from development support, community building or even funding. All leading platform providers set focal activities on community building as they are highly scalable through automation and self-paced by the community itself. Netsuite offers technical and marketing support to their "Select" and "Premier" development partners [38]. Only few platform providers also try to pursue goal congruence through targeted incentives. Facebook for instance offers seed funding of $25k to $100k per approved idea [39]. In addition, through 'Facebook Connect', Facebook loosely ties market players to the platform and tries to establish first relationships with non-allied complementors through offering service providers added value. We term this strategic approach 'contextualization of the environment', which means, that the platform provider motivates complementary service providers to loosely connect with the core platform offer as non-allied partners represent a large potential for the platform provider to unlock in order to tie them closer to

the platform, gain influence over their behavior, and, finally, benefit from indirect network externalities.

3.6 Informative Control

In this approach, information on consumer behavior, platform evolution and value creation opportunities are communicated to the service providers. Many platform operators today provide basic direct feedback e.g. on errors to their service-providers. Statistical feedback as provided by StrikeIron is rare. Netsuite has just launched a premier partnership approach, where "Premier Partners" have access to sales leads or even have access to joint roadmap-planning. The latter promises lean development activities in the ecosystem, meaning complementary developments to those of the platform operator [38].

According to [15, 40, 41], this kind of information could stimulate the self-regulatory processes and emergence within the ecosystem, as service providers suffer information asymmetry [42]: Being positioned in a dyadic relation in the shadow of the platform operator (or the next tier platform provider) constitutes a significant limitation of accessible market and end customer information (information asymmetry). In consequence, services may run out of phase with the actual market demand, risks of bull-whip effects are high. Provided with suitable information on unsatisfied consumer demand or required steps for better response to consumer utility would drive them towards optimized solutions, if this promises a sustainable increase of the expected profits due the intrinsic goal for "profitable growth" [43].

3.7 Addressing the void

Summarizing the applied control mechanisms in the analyzed platforms, we can state that a majority of platforms is focusing on transactional quality parameters, defined in the rules and regulations (co-regulative control) and enforced through restrictive and sanctional control. This goes mostly in hand with the application of reputation mechanisms (market regulative control) to allow for a market-

driven influence on the business value quality [29] of the offered services. During the current period of market penetration, this soft control could be explained with the pursuit of reaching or maintaining a critical mass of services, but also with the fact that the required control technologies are readily available and mature. However, parameters, reflecting the specific functional features and their respective quality to a consumer (functional utility), are undervalued and underexploited. Reputation mechanisms can only evaluate actually provided service quality. None of these mechanisms give insight into aspects of undersupply of service demand or a goal incongruent development of the ecosystem as a whole. The effects of this are currently visible in Apple's app store through a bias towards "games" of low technical quality [44].

A platform's long-term success however depends on continuous innovation and renewal of the platform ecosystem [45] embracing continuous services portfolio optimization and provision of superior customer value. This embraces the handling of two primary risk factors with respect to a robust evolution of such an ecosystem: a) information asymmetry (as service providers lack a comprehensive market view) [46, 28, 47] and b) goal incongruence with the platform provider's objectives. For this, 2 courses of action need to be followed: First, co-regulative control needs to exceed basic regulation of legal and transactional issues. In sequence with restrictive and sanctional control loops, it needs to expand to verification of actual functional quality. This requires more sophisticated monitoring and analysis of actual service demand, offering and consumption. Further research on these conceptual and technical aspects and respective implementation is done by [40, 41].

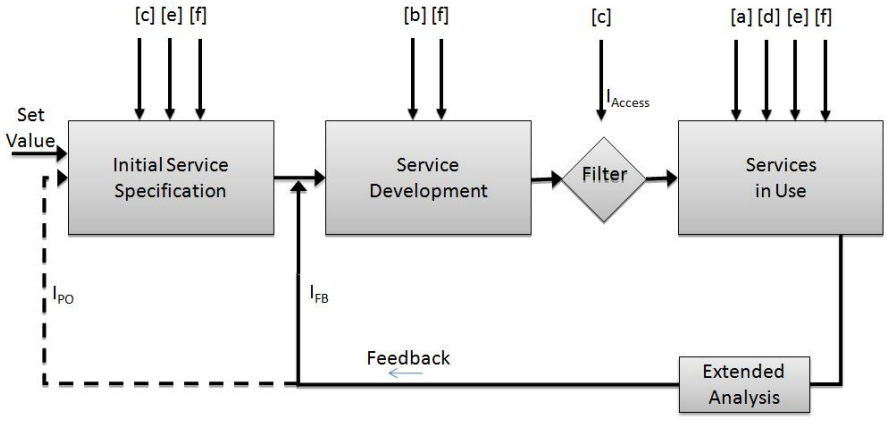
In addition to these rather reactive patterns of control, platform providers need to improve their pro-active influence towards satisfaction of undersupplied consumer demand and on a macroscopic perspective to ensure goal congruence. Motivational action, as exemplified by Facebook and Netsuite is one step to address this void. More scalable however would be information-driven methods. According to [15, 40, 41] automatically generated information, specifically customized per service

provider, could stimulate targeted self-regulatory processes and emergence within the ecosystem [42]. Details on reference architectures on monitoring and analysis can be found in [41].

4. Tasks and Concerns of Open Innovation Management in Platform Business

Sequencing the control mechanisms identified in chapter 3 provides us with a fundamental understanding of the major control flows currently applied in industry practice. In a simplified manner, figure 3, depicts the three major phases of the platform-based open innovation process from the complementors' perspective: (a) initial service specification, (b) service development, and (c) the consumption of services. While this process can either be initiated by an external innovational impulse or explicitly by the platform provider, it is finally the platform operator deciding whom to grant platform access. The letters in brackets indicate the control mechanisms as categorized earlier.

Fig. 3: Sequenced control mechanisms



[a] Market Regulative Control
[b] Co-regulative Control
[c] Restrictive Control
[d] Sanctional Control
[e] Motivational Control
[f] Informative Control

In a next step, we combine this simplified process perspective with the challenges the platform operator faces with regard to managing innovation in platform business, as identified in chapter 2. We are now able to draw conclusions concerning the tasks of open innovation management, which will lead us in the sequel to an integrated process model, targeted at addressing the peculiarities of

innovation management in platform environments: Most fundamentally, we perceive that it is of crucial importance to the platform provider to develop a coherent vision of the platform's and platform ecosystems evolution in order to successfully drive internal and external innovation in a consistent manner. Therefore, the platform operator is required to have a clear understanding of its core competencies and the new capabilities that are needed to be developed in order to satisfy individual customer demand. In particular, companies have to decide which capabilities can be provided in-house and which will be complemented by platform providers in order to provide the 'whole product' [1, 4]. At root, the platform operator needs to ensure that the consumer-perceived value of the composite solution is greater than the sum of its parts [48]. Consequently, it is particularly the systemic nature inherent to innovation in platform context that requires the platform operator to direct the evolution of both the core platform offer as well as its complementary services [1]. Therefore, the platform operator has to implement dedicated mechanisms to ensure strategic goal congruence. Particular attention has to be turned to the strategic goals of an appropriate variety and quality of complementary services as key drivers of platform adoption in multisided platform markets. Hence, innovation management in open platform environments differs significantly from innovation management in closed environments within the company. Explicitly, strategic planning as well as managerial control needs to consider internal and external innovation efforts in a coherent, interdependent manner to successfully drive innovation.

In the sequel, we consider innovation management in platform businesses as an ongoing process that (a) systematically identifies, evaluates, and defines the strategic innovation goals of platform and ecosystem evolution; (b) implements innovation strategy both within the company and within the platform ecosystem, and, finally, monitors and controls strategy implementation. In particular, strategy implementation is targeted at exploiting innovation opportunities, while offering service providers sufficient benefits from participating in the platform's ecosystem. Therefore, it embraces both the management of internal innovational efforts targeted at evolving the platform architecture and core complementary offerings as well as related activities to steer complementary innovation on

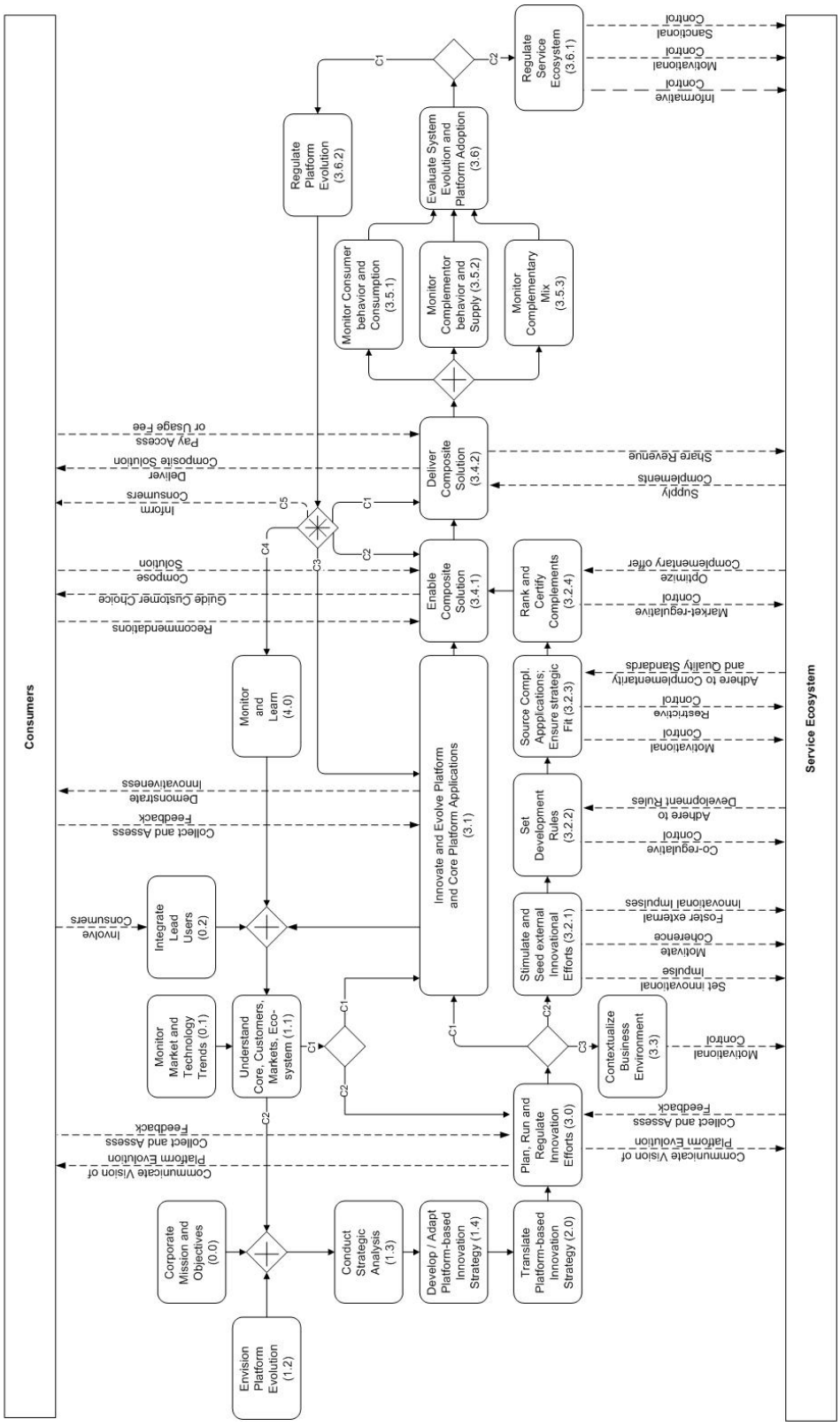
top of the platform. It does not only foster the realization of new ideas, but also the recombination and optimization of existing services to benefit from commonality and reuse of components to satisfy and create consumer demand. Primary tasks of innovation management in platform businesses embrace:

- Envisioning and leading overall platform and ecosystem evolution.
- Empowering and stimulating economic value creation activities of autonomous parties to enhance the platform's overall value proposition.
- Encouraging goal congruence of autonomous partners.
- Evaluating information about the overall system evolution as well as about emerging opportunities and threats within the ecosystem.
- Ensuring strategic coherence and appropriability of returns by maintaining control over platform and ecosystem evolution.

5. Modeling the Platform-based Innovation Process

In correspondence to the tasks of platform-based innovation management, the business process can be modeled. The Business Process Diagram depicted in figure 4 represents the process model of the "platform-based innovation process". It is modeled in Business Process Modeling Notation (BPMN), describing from the platform provider's perspective the flow of internal activities, control mechanisms as well as interactions with consumers and complementors guiding the platform company to drive innovation within the context of their platform strategy. Each of the activities depicted by a rounded rectangle represents a high-level process, containing further sub-processes and tasks. Service complementors and consumers are represented as rectangles. For the ease of understanding, the process model does not consider the parallelism of sub-processes. Further, we have structured the following sections along the management cycle [60]: (5.1) Develop / adapt platform-based innovation strategy; (5.2) Translate Strategy; (5.3) Implement strategy, and, finally, (5.4) Monitor and Learn. The relating numbers in brackets guide the reader through the process model.

Fig. 4: A business process model of the "platform-based innovation process"



5.1 Formulate and Adapt Platform-based Innovation Strategy

The sub-processes and tasks of this phase represent the innovation managerial tasks of systematically identifying opportunities for platform evolution. Further, they include deciding on and formulating the innovation strategy by setting respective goals for both the internal evolution of the core platform offer as well as the overall evolution of external innovations, complementing the core platform offering. We consider it as an ongoing process of developing and revising strategic goals, which allows the platform organization to achieve its objectives, while taking into account its capabilities, constraints, and the environment in which it operates.

Fundamentally, the platform owner's innovation assumptions, platform competition, customer requirements, market and technology trends as well as the platform ecosystem's capabilities are reexamined in a strategic analysis (see 1.3 in fig. 4), while considering existing corporate mission and objectives (see 0.0 in fig. 4). Key to this phase is the envisioning of the future platform evolution (see 1.2 in fig. 4). Mirrored against an assessment of both the platform operator's internal capabilities and performance as well as the platform ecosystem's, the platform vision allows the platform owner to define the platform's future customer value proposition and to decide, which innovational efforts to pursuit in-house and which to stimulate within the platform ecosystem. This decision is based on a classic SWOT analysis, reflecting the platform owner's strengths and weaknesses in pursuing emerging innovation opportunities, while explicitly considering internal and external threats in platform competition or in platform ecosystem evolution. This analysis reveals numerous innovation issues to be addressed within the platform-based innovation strategy, e.g.: which new innovation fields to be explored, which complementary innovation efforts to be stimulated, which innovation capabilities to develop in-house or within the platform ecosystem. Finally, the platform owner has to decide which complementary markets to develop or to enter, and has to behave accordingly towards third party companies who are complementing the platform's value proposition to the customer. In considering the platform's multisided market's peculiarities, the essential target that should guide platform owners in this decision is not primarily whether an invention maximizes their own ROI, but

whether an invention maximizes the value of the overall system, and, therefore, maximizes its profits indirectly. Finally, the platform-based innovation strategy is formulated and approved by the platform-owner's executive management. In the pursuit, the platform-based innovation strategy provides the frame for decisions to be taken in operational innovation activity.

5.2 Translate Platform-based Innovation Strategy

Once the platform-based innovation strategy has been formulated and approved, it needs to be translated into dedicated innovation objectives and platform-based innovation strategies, detailing targets and tactics in the light of a multisided market's peculiarities. Due to the systemic character of innovation and the autonomy of independent service providers, implementing the innovation strategy is particularly challenging for platform organizations. The platform provider is, thus, required to translate the platform-based innovation strategy (see 2.0 in fig. 4) into dedicated closed (see 3.1 in fig. 4) and open (see 3.2 in fig. 4) innovation initiatives, taking into account the degree of control the platform operator is able to exert to implement its strategic goals. In addition, the platform provider might consider innovation initiatives to 'contextualize the business environment' (see 3.3 in fig. 4) as a dedicated means of motivational control (see section 3.5).

5.3 Implement Platform-based Innovation Strategy

While closed innovation initiatives can be implemented within the company through traditional means of hierarchical control, open innovation initiatives require dedicated control mechanisms as identified in chapter 3. However, as innovation in platforms tends to be generated through the interplay of loosely coupled network participants, it becomes evident that with an increasing number of platform providers, complexity rises rapidly to a degree, which is difficult to be centrally controlled by the platform provider. To handle this, platform operators have introduced degrees of de-centralized control, and autonomy to the platform providers, respectively [15, 40]. For comparison consider a Web shop owner in Ebay or Amazon, who is to a great extent the master of his product-mix

and pricing and who is fully responsible for the choice of his sub-supply chain. With regards to the above introduced formula, the reduction of nodes and transactions in the influence sphere of Ebay or Amazon drastically reduces their handling complexity [15]. In consequence, directing the development of external complementary innovations, regulating platform access as well as ensuring the complementary services' congruence to strategic platform goals such as quality and integrity, moves into the center of the platform provider's attention. This embraces stimulating external innovational efforts, setting dedicated development rules for guiding the service provider's development efforts, the targeted absorption and tying of external complementary innovations, as well as rankings and certification. Explicitly, these sub-processes represent the corresponding internal process perspective to figure 3, representing the platform-based open innovation process from the complementors' perspective.

- Stimulate and Seed external innovation efforts (3.2.1 in fig. 4): Based on the strategic innovation goals cascaded from platform-based innovation strategy, the platform operator sets innovational impulses within the platform ecosystem to motivate service providers to initially specify complementary services. Relevant control mechanisms refer to motivational and informative means of control.
- Set Development Rules (3.2.2 in fig. 4): In order to ensure the integration of complementary services, the platform provider sets guiding principles of service development, providing development rules or tools for coherent and observable service supply. Co-regulative, restrictive and informative controls can be applied.
- Source Complementary Applications (3.2.3 in fig. 4): Sourcing complementary applications is primarily achieved by regulating platform access. Granting platform access by deciding, which complementary innovations to absorb and which to foster or deny due to e.g. the missing congruence with strategic platform goals such as quality is of crucial importance. Granting or denying platform access is, therefore, the strongest means of the platform provider's mechanisms of control. It represents a restrictive control mechanism.

- Rank and Certify Complements (3.2.4 in fig. 4): Ensuring strategic goal congruence of complementary innovations has been identified as one of the primary tasks in platform-based innovation management. Corresponding control mechanisms are market regulative and motivational control mechanisms to motive complementors to become goal congruent and regularly optimize their services in accordance to current consumer demand.
- Enable Composite Solution (3.4.1 in fig. 4): Enabling consumer-driven composite solutions represents the core of value creation in platform ecosystems (see chapter 1). Therefore, the platform operator mediates services complementing the core platform offer. Based on the ranking and certification of services achieved in sub-process (see 3.2.4 in fig. 4), the platform operator is able to guide customer choice to compose the whole solution that best suits their needs. As the platform operator remains the single point of contact to the consumer, restrictive means of control apply.
- Deliver Composite Solution (3.4.2 in fig. 4): This process entails the transactions on top of the platform. While the platform provider delivers the whole solution to the consumer and receives its access or usage fees, it is up to the platform provider's stakeholding power, how it shares revenue with complementary service providers. In particular, the impact of indirect network externalities has to be considered (see chapter 2). Thus, market-regulative and restrictive controls apply.

As already indicated, platform regulation plays a crucial role in implementing strategy and managing open innovation efforts. Platform regulation embraces the platform provider's efforts and activities to ensure that (a) the behavior of the service ecosystem and the decisions made by autonomous service providers are consistent with the overall objectives and strategies set by the platform operator, and (b) that the platform provider strategically responds to important opportunities and threats emerging from the service ecosystem, resulting in emergent platform-based innovation strategies. The decisions taken to regulate both platform and service ecosystem evolution are based upon the information provided by platform intelligence (see section 5.4).

- Regulate Service Ecosystem (see 3.6.1 in fig. 4): In order to enforce and stimulate service optimization, the platform provider feeds back dedicated information to the service providers. Thereby, enforcement is accomplished through sanctional control of concerned complementors. As described in the eBay example (chapter 3), sanctional control is mostly a staged process, starting with a request for improvement and leading to exclusion in case of unsatisfactory reaction. Stimulation, on the one hand, can be accomplished through motivational control as seen in the Facebook example, where promising complementors are financially supported. A strong and scalable approach however is the application of informative control, feeding back customized information, stimulating self-optimization of each service provider.
- Regulate Platform Evolution (see 3.6.2 in fig. 4): In order to allow for a reactive strategic platform-based innovation management, opportunities and threads from the ecosystem are fed back to the platform provider's operational platform development process as well as into the strategic planning process of the platform-based innovation strategy. An illustrative example for emergent strategy and reactivity on disruptive ecosystem innovation is Apple's reaction on the emergence of PodCasts.

5.4 Monitor and Learn

Characteristically for a thriving platform ecosystem is that innovative strategies might emerge within the platform ecosystem. While not all trends are worth pursuing, the platform operator, however, has to decide which trends to pursue and when to adapt strategy. In this context, we consider platform intelligence as an ongoing process to provide the platform provider with information relevant for strategic innovation planning and managerial decisions for platform regulation throughout the innovation process (see 3.6 in fig. 4). It, therefore, collects, analyses, and applies information for the purpose of decision support. According to [41], platform intelligence targeted at the needs of platform-based innovation management has to collect data on consumer preference patterns and the related composite service choreography (see 3.5.1 until 3.5.3 in fig. 4). The data then needs to be

aggregated and analyzed (see 3.6 in fig. 4). Through these procedures, the platform provider gains information on consumers, important consumption clusters, service provision and the ecosystem's capacity to respond on important needs, opportunities and threats. Further the platform operator is enabled to locate goal incongruence as well as under- or oversupplied service segments. With regard to the large amount of data that is to be analyzed, data needs to be automatically collected, interpreted and customized. The procedural design is based on feedback loops and motivated with system theory [41]. Tools and technologies for improved choreography of services in the frame of platform management and service value nets are the subject of current state of related research. To quote some, [41, 57] do research related platform intelligence, [58] do research on suitable service network notations (SNN) and enlarge the Business Process Management Notation to include choreography. Further, [59] provides a stack for services provided in platform contexts and, thus, provide a basis for a better classification of applied services.

6. Conclusion

Within this paper, we emphasize that platform businesses require distinct control mechanisms to actively co-evolve the service ecosystem to succeed in platform competition. We, therefore, identified the primary challenges the platform provider faces when managing innovation in open platform environments. Merging these findings with our case study results enabled us to categorize control mechanisms applied in platform industry to co-evolve the service ecosystem and to derive major tasks of innovation management in platform businesses. Finally, we introduced the platform-based innovation process and applied the identified control mechanisms to various sub-processes, addressing the platform provider's needs to purposefully exert corrective measures in the pursuit of goal congruence with respect to the ecosystem's evolution.

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