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Aligning Innovation Ecosystem Strategies With Internal R&D

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Abstract - Innovation based on external cooperation is becoming more and more relevant for many firms. We focus primarily on the innovation ecosystem in which firms live in a symbiotic relationship for co-evolution around a particular technological platform. Literature in this field often focuses on the external strategy, but neglects aligning the ecosystem with the internal R&D strategy. We define three ecosystem types with different engagement models. With help of four case studies we study four different innovation ecosystem strategies. In addition we use an analysis framework ESTO (ecosystem, strategy, technology platform, organizing) to discuss alignment between the internal and external perspectives of the firm.

Keywords - **Innovation, Ecosystem Alignment, R&D**

I. INTRODUCTION

Open innovation has been important for firms to gain new insights for R&D. However, the term ‘open’ is interpreted differently per firm [1]. One type of open innovation is the focus on the ecosystem. An ecosystem is defined as an economic community supported by a foundation of interacting organizations and individuals, which can also be perceived as the organisms of the business world [2]. Such an ecosystem consists of a symbiotic relationship for mutual survival, co-evolution of partners capabilities and the ecosystem is often based on a particular platform or product [2, 3, 4, 5, 6, 7]. There are different types of ecosystems discussed in literature, i.e., business ecosystems or innovation ecosystems. We focus primarily on the innovation ecosystem, which is defined as a collaborative arrangement through which firms combine their individual offerings into a coherent customer-facing solution [8, 9]. The ecosystem literature has been popular in software engineering as software ecosystems [10, 11]. The primary focus of ecosystem literature has been on the external environment, the different roles in the ecosystem and how firms adjust to their ecosystem. However, few studies discuss how the ecosystem is aligned to the internal innovation strategy and way of performing R&D. Strategic management and R&D literature have primarily looked at the internal firm, but have neglected the impact of the ecosystem concerning innovation. Many firms know rather well how to work within an established ecosystem concerning the day-to-day operation, i.e., supplier ecosystem. But in innovation ecosystems research the alignment between

their internal and external innovation strategies is often not discussed.

In this paper we contribute with the following (1) we apply an analysis model that aligns the ecosystem with the internal strategy, technology platform and way of organizing (ESTO) on four different case studies. (2) We define four innovation ecosystem strategies. Our work primarily focuses on the software intensive industry. The article first discusses relevant literature and the analysis framework of the study. Thereafter we discuss the methodology of the study and qualitative data collection. In the findings section we discuss four case studies with help of the analysis framework earlier defined. The findings are analyzed and discussed in the discussion section and finally concluded in the final section.

II. LITERATURE

In this paper, we focus primarily on the innovation ecosystem. The innovation ecosystem focuses primarily on collaborative approaches concerning innovation, such as the open innovation paradigm. Although open innovation is for all types of organizations – our research indicates that ecosystems are primarily built around a technology platform, which provides the anchoring function for the ecosystem [8]. In contrast to open innovation and innovation ecosystem literature, business ecosystems can have both a collaborative as well as a competitive approach [12] and often creatively combine these approaches.

In ecosystem literature particular roles and firms are discussed, i.e., key stone firm, suppliers, customers, and complementor roles [1, 2, 6, 8]. Others discuss how flows of activities are bundled in relation to the focal product. Authors distinguish between component elements like upstream suppliers who support a firm, and complement elements consisting of the firm’s product in combination with complements as input for the customer [8]. Although different activities and roles are distinguished, studies do not look into different types of ecosystems, but cluster all elements together in one large and complex ecosystem.

In our studies we have identified that companies operate in at least three types of ecosystems for which they apply different engagement models, i.e. operational, product development and innovation ecosystems. However, companies do not always distinguish carefully between the different types, and often different partners are called by a single name, e.g., suppliers, competitors, partners even though the partner may play a different role

in each type of ecosystem. The *Operational ecosystem* is concerned with day-to-day operation such as manufacturing and customer support where part of the business processes are outsourced and where suppliers and logistics companies operate part of the value network. Any successful firm is by necessity familiar with these ecosystem companies and works well within its ecosystem. The *Product development ecosystem* is concerned with development of products, both newly developed and periodically released upgrades to existing products. Especially for high-tech products including mechanics, electronics and software, OEMs (Original Equipment Manufacturers) typically use an elaborate ecosystem of partners including suppliers, customers, and complementers (firms who build on top of a product) to support product development. Finally, the *innovation ecosystem* [8, 9] focuses primarily how firms relate to their ecosystem in terms of innovation of new ideas, technology, and markets.

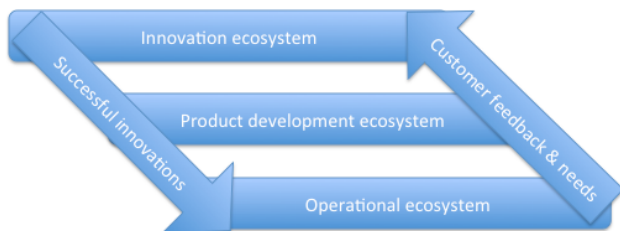


Fig. 1. Ecosystem Types and Flows

Although we explicitly recognize three types of ecosystems, there are dependencies and connections between these. The innovations resulting from the innovation ecosystem become requirements for product development or R&D that, in due time, need to be manufactured, sold and supported for customers. In the opposite direction, customer feedback and data flows back to the R&D and innovation ecosystems. Successful companies manage to align their different ecosystem types and exploit the innovation and feedback flows to their benefit. In figure 1, we illustrate the types of ecosystems and the discussed flows. In this paper we primarily focus on the innovation ecosystem.

From innovation literature there are a number of phases of an innovation process. In our article we focus on the following innovation phases: (a) ideation and prioritization phase, (b) prototyping and testing, validation phase and (c) the scaling and testing of an innovation towards a larger customer base. We exclude the product exploitation since this focuses on a different ecosystem, i.e., product development. For each of those steps firms can decide to work with different strategies either with the support of the ecosystem or mainly internally. Below we discuss the analysis framework that aligns the internal and external strategic choices.

A. ESTO Model

In order to align the ecosystem with the internal organization, we have developed the ESTO (Ecosystem, Strategy, Technology platform and Organizing) model [13]. This model consists of six interdependent and interconnected dimensions that are important to take into account for R&D. The six dimensions of the ‘ESTO’ model concern both an internal company and an external company perspective. In the remainder of this section, we first describe the internal perspective and subsequently discuss the ecosystem or external perspective.

The *internal perspective* consists of three main dimensions, i.e. strategy, technology platform and organizing. Below, each of these dimensions is defined in more detail.

1. *Internal Company Strategy*: The strategy of the company lays down the basis for the future path of the firm concerning the business. In particular, the strategy is concerned with how the company generates revenue now and in the future. The company strategy is relevant for the internal prioritizations and decisions made within an organization and is closely related to the technology platform strategy. The internal business model development is part of the internal strategy. The business model defines how the firm creates and delivers value to customers and then converts payments received to profits.

2. *Internal Technology platform*: The technology platform comprises the technical structure to build the technology platform as well as the technology choices. The company strategy defines which aspects of the business are prioritized and which can be deprioritized. This is important input for the technology platform decisions as it allows effective management of future evolution cost.

3. *Internal Organizing*: The ways of working, roles, responsibilities, processes and tools within R&D are important and closely related to the architecture and strategy of the firm.

External dimension: In the ESTO model, we use the same three dimensions discussed above for the external ecosystem.

4. *Ecosystem Strategy*: The external strategy of a company is related to the business and platform ecosystem of the firm and the strategic options that it has available in its current role in the ecosystem. Depending on the strategic choices made by the company, there are significant implications on the system and software development of the firm.

5. *Ecosystem Technology*: The ecosystem technological platform or architecture defines the strategy and interface between the internal technology platform and the solutions that are provided by ecosystem partners. In addition to the focus on interfaces, the focus is also on the technology strategy.

3. *Ecosystem Organizing*: Deals with how firms work with their customers, suppliers, and ecosystem partners in

terms of processes, tools used, ways of working, and ways of organizing the collaboration.

III. METHODOLOGY

We apply a comparative case study analysis [14] of four cases in Northern Europe and Northern America. The four cases all have a different approach to how they align their internal R&D strategy with their ecosystem strategy concerning innovation. Based on long-term experience in this particular area these cases are a selection of rather typical types of approaches in the software and software intensive industry. We apply the ESTO model introduced above to structure the case findings. In the four cases we have held semi-structured and group interviews, and in three of the cases one of the authors was a participant observer. For case Alpha we held 14 group interviews with an average number of participants of 5 to 10 people per group (in total 50 people). During the group interviews, interview questions were asked around the group and were directed to every individual. In case Beta we held 13 interviews. Case Gamma and Delta were in one large global firm in which two different strategies were applied. For the two last cases we held 20 interviews. All companies work in the software intensive industry. The analysis of the cases was first done within each separate case and later on the cases were compared with each other. Below we discuss the four cases in more detail.

IV. FINDINGS

From the case we find four types of approaches how firms can work with their ecosystem and align this with their internal firm. Below we discuss the four cases and their particular innovation ecosystem strategy. We apply the ESTO model as an analysis framework to the four cases, in order to gain more insight in the alignment between the external and internal company strategy. However, due to lack of space we primarily discuss the *External* and *Internal* perspective and discuss in these the strategy, architecture/technology platform and organizing elements.

A. Case study Alpha

The case company Alpha is a large global company in the embedded systems domain. The unit that we studied works with OEM customers (Original Equipment Manufacturers) to provide one of the major sub-systems in their product. The case starts their innovation process with ideation and prioritization fully internally in their R&D department. Once the firm has developed a tested and proven innovation, the company starts to collaborate with ecosystem parties and continues collaboration for scaling the innovation.

External perspective: the company primarily drives its internal innovation processes due to Intellectual

Property (IP) reasons and its historical approach towards innovation. The company primarily looks externally to identify mega-trends and technological developments in particular areas and to perform competitive analysis. Consequently, it will not adjust itself to externally driven architecture/ platforms or ways of working, instead it will only start to work with its customers and suppliers once it has developed and tested an innovation that it knows provides a value to its customers. However, once it has achieved that state of innovation, it engages its customers and suppliers in joint scaling of the innovation. It primarily collaborates with its ecosystem partners to test the innovation in pilot products of its customers.

Internal perspective: the company is a technology driven innovation player, which causes the firm to define its competitive advantage by providing superior technical quality in its products. With this internal R&D strategy it primarily focuses on advances in relevant technologies as a source of product innovation. Based on past experience, it has divided its innovation in three major categories: mechanics, hardware/software, and domain specific technology. In these three areas components of products of the company are developed and innovated upon, independently of each other. The integration between the three categories takes place very late in the product derivation process. The business units that take in the internally developed innovation from the three categories, collaboratively and jointly innovate with their lead customers to test the scalability of innovations with customers and in the field.

The case study company employs an internally driven innovation strategy and starts working collaboratively with its ecosystem after it collected validated proof of their innovation. The collaboration with the ecosystem primarily focused on scaling the validated innovation to a large set of customers.

B. Case study Beta

Company Beta is a Fortune 1000 company developing software products and services operating primarily on personal computers. The company's products address both consumer and business markets and the company releases several products per year, including new releases of existing products and completely new products. The case starts the innovation process externally in its ecosystem in the ideation and prioritization phase as well as in the prototyping phase and only in the phase in which the product is scaled, the case collaborates with these ecosystem parties for new features and products.

External perspective: The firm organized periodic events where it invited the most promising start-ups that had developed successful innovations and had validated these with customers. During these events, senior leaders selected some of these start-ups for scaling experiments with one of their leading products that typically served customers counted in the millions. The externally driven innovations were combined in the scaling phase with the internally driven innovation activities of the firm. After

external start-ups had been selected, there was deep collaboration between the internal feature team and the start-up staff to test the scalability of the innovation content.

Internal perspective: innovation ready for scaling coming from the outside, was prioritized together with innovations that were developed by internal innovation teams. The company developed strategies where it identified areas where it was looking for innovations, in particular for their market leading products. This was based on extensive customer research and defined by product management. The collaboration with external ecosystem parties on innovation was based on particular selection criteria. One of the selection criteria was the ease or complexity of integrating the external innovation with the core product - the platform or architecture. For instance, promising innovations that were architecturally incompatible with the core product were often not selected. The collaboration with the start-up team also provided a very fruitful testing environment to determine if the culture and ways of working of the start-up matched those of the case study company. In case of a successful test, the better architecture, ways of working and culture matched, the more likely the case study company was to integrate the innovation.

This case employs an externally or ecosystem driven and collaborative approach to innovation. The case study company only became involved with the external partners once the external partner provided validated proof of the customer interest in their innovation. The case study company then used its market penetration as a mechanism to scale the innovation with the case study firm's large set of customers.

C. Case study Gamma

Case Gamma is a Fortune 100 company developing embedded products, i.e. products that include mechanical, hardware and software parts. The company had both an internal R&D and external innovation process (see case Delta), but did not work collaboratively in the innovation process. The company operates in a business domain that is very strongly intellectual property (IP) driven. This means that patents are very important and the industry is riving with patent trolls. Consequently, the company paid a significant amount of money in license fees to a wide variety of players, including legitimate players and more exploitive players.

External perspective: for the innovations in its primary product portfolio, the company relied virtually entirely on its internal R&D labs. Consequently, it used its external ecosystem primarily for identifying mega-trends, interesting technology innovations and competitor analysis. Once the firm had identified a technology where customer interest had been proven and validated, it reached out to its external ecosystem of suppliers of technology providers to introduce the innovation in its products. The company would always reach out to multiple potential providers in order to negotiate the best

deal for itself. In addition, the company strictly adopted a dual-supplier strategy, causing a situation that no supplier would be able to develop a lock-in position in the company.

Internal perspective: based on the trends, technology innovations and competitor innovations resulting from the ecosystem strategy, the company developed an internal strategy to innovate in its product portfolio. The innovations ranged widely. At the one end the company sought to drive down the cost of its mass-market product to the lowest possible point. At the other end, the company aspired to place as many innovative technologies in its high-end products, while maintaining or even increasing the product price. Developing innovations in its high-end and high-margin products allowed the company to effectively scale down the innovations to mid-range and low-end products over time. The company architected its products explicitly so that it would be as easy as possible to transition innovations from high-end to mid-range and low-end products. Because the innovation pushed by the company was internally focused, the company was highly secretive, sometimes even requiring individual teams to maintain secrecy towards their colleagues.

The case study firm worked with an internally driven innovation strategy and only followed trends, competitors and new developments in the ecosystem. Furthermore, once internally a new innovation was proven they reached out to suppliers for to introduce the innovation in their product development through a competitive approach.

D. Case study Delta

The company is the same company as discussed in case study Gamma. Over time the company achieved massive market penetration with its range of products. This caused a situation that many third parties were requesting the ability of developing additional functionality on top of the products developed internally by the case study company, in order to serve segments of the market.

External perspective: the company accepted the external development and developed a set of APIs (Application Programming Interfaces - set of programming instructions and standards for software development), a certification process, and a rudimentary app-store through which third party applications could be found and acquired by its customers. The company took part of the revenue of the sales of third party applications, but it did not constrain which third parties could provide what functionality. Instead, it actively encouraged competition between different third parties as a way to spur innovation and to avoid the risk of any third party becoming too large and a potential disrupter for its business.

Internal perspective: initially the company was primarily driven by internal innovation processes, over time, it started to use external innovations as a source of inspiration for its internal innovation activities. For

instance, the functionality of successful third party applications would often appear in the base product after a period of time, affectively putting the third party out of business if the third party had not already moved on to the next innovation. Also, the company designed its product portfolio such that the APIs accessible by third party developers were highly limited and allowed the company to innovate in areas where it did not want competition from its ecosystem. As the company was primarily internally focused, it worked competitively with its third party innovators and to the largest extent possible drove its own innovation path without including important third parties.

The case worked with externally driven innovation in a competitive and controlled way, in which ecosystem parties followed strict APIs, certification procedures and contracts.

TABLE I
INNOVATION ECOSYSTEM ANALYSIS

Case/ ESAO	Alpha	Beta	Gamma	Delta
Eco-system	With proven internal innovation, select ecosystem partners for scaling innovation to market	Inviting proven innovation externally. Collaborate in scaling with own internal product	Identify trends, new technology. Competitive approach for product development (dual supplier)	Third parties involvement controlled by API, certification, app-store and shared profit
Strategy	Technology driven innovation internally	Identify ideas from customers. External and internal innovation combined	Insights of ecosystem support internal development of product portfolio strategy	Internally driven innovation, but external innovation inspiration for new products
Technology platform	Specific domain technology development	selection criteria: Ease and complexity of integration	Technology developed for easy transitioning throughout product portfolio	Restricted APIs to withheld competition
Organizing	Business units collaborate with lead customers to scale innovation	Collaboration with partners is testing environment for good match	High level of secrecy, even amongst internal teams	Very competitive approach towards third party ecosystem members
Context	Complex fragmented ecosystem with very many players	Keystone and market leader in this product. Few competitors	One of keystone players, highly competitive market, IP driven	One of keystone players, highly competitive market, IP driven

V. DISCUSSION

In this paper we applied the ESTO framework to analyze four different cases of innovation ecosystems strategies [13].

Based on the four cases discussed above we find that firms can have either an internal innovation driver, like case Alpha and Gamma, or an external ecosystem driver for innovation, like case Beta and Delta (see table I).

In the internally driven innovation strategy, the cases work with an innovation strategy in-house either based on technology driven research or on customer input. With an externally driven innovation focus, firms rely on innovations that have been developed and proven on the market as a basis for the innovation strategy within the firm.

Another element important in the case studies was the difference in a collaborative or a competitive approach for innovation with the ecosystem. In contemporary literature, innovation ecosystems are primarily perceived as collaborative or open innovation approaches [8, 9]. Although open innovation research discusses different forms of openness [1], the main idea is to gain input or work jointly towards innovation. However, from business ecosystems literature, it is clear that firms can have either a competitive or a collaborative approach [12] in how they work within their ecosystem. Based on these two categories: driver and ecosystem strategy, we define four different innovation ecosystem strategies for software intensive firms (see table II).

These strategies are the following:

1. *Benevolent orchestrator strategy*: This strategy focuses on internally driven innovation. Once the internal innovation is proven as a concept, the firm selects partners within its innovation ecosystem with whom it can share and collaborate in order to scale the innovation and test it with customers. The firm orchestrates the innovation, but works generously and collaboratively with its ecosystem in scaling the innovation towards customers. Case Alpha had a fragmented and complex ecosystem in which they were one of the players, the case therefore focused on internal innovation, and once proven they went out to collaborate with selected partners to maintain their place in the ecosystem.

2. *Thousand flowers strategy*: This strategy focuses on a large set of customer-validated ideas and proven innovations from its ecosystem parties, i.e., thousand flowers. The firm selects only a few of these ‘flowers’ or potential parties as collaborators for scaling innovation with their own customer base. The selection process of selecting a few of the flowers focuses on technology integration with the firm’s internal R&D, as well as potential matches for suitable collaboration partner. Case Beta was market leader and keystone firm in their industry with few real competitors and chose to focus on external innovation to lower innovation costs and gain

more input from their 3rd party developers and customers.

3. *Let them compete strategy*: This strategy is adopted by firms that primarily focus on internal innovation and is not open for innovation from its ecosystem parties. The ecosystem is mainly used for gaining insight in competition, new developments and trends. Once the firm has a customer-proven innovation and reaches out towards external suppliers or developers to introduce the innovation, i.e. its product development ecosystem. The firm does this in a competitive fashion and lets ecosystem parties compete to get the best possible deal. Case Gamma is one of the keystone players in a highly competitive market primarily driven by IP and therefore chose a competitive ecosystem strategy.

4. *Play inside the box strategy*: This strategy is performed by firms that are open for innovations from the ecosystem, but only when the ecosystem parties play by the rules, i.e., within the box, of the firm. These rules can be placed down in certification procedures, APIs, and other contractual agreements like sharing revenue. The firm applies a competitive approach concerning innovation, but is able to take in new ideas and suggestions. Case Delta also works in a highly competitive market driven by IP, but is one of the larger players. Therefore, they have chosen to work with a competitive innovation strategy based on their rules.

In our cases it became clear that industries that are more driven by Intellectual Property and patents, like case Gamma and Delta, are less open for a collaborative approach in ecosystem innovation and are more afraid for knowledge disclosure. These firms focus more on a competitive innovation ecosystem strategy. The telecom space is an example of such an industry.

TABLE II
INNOVATION ECOSYSTEM STRATEGIES

Strategy	Collaborative	Competitive
Internally driven innovation	Benevolent orchestrator	Let them compete
Externally driven innovation	Thousand flowers	Play inside the box

The four different strategies discussed in table II also have implications for the elements discussed in the ESTO model. The innovation ecosystem strategy needs to be aligned with the internal R&D strategy, the technological platform or architecture choices as well as the way of working or organizing. From the four case studies there are clear implications of the selected innovation ecosystem strategy for the internal choices.

As a final observation, especially the most internally focused case study companies had a tendency to open up to more external innovation impulses as they saw the value that ecosystem partners could provide. Interestingly, the companies started from collaborating in the operational ecosystem, then engaged with ecosystem

partners in their product development ecosystem and over time brought partners into their innovation processes, creating an innovation ecosystem.

VI. CONCLUSION

Our study focuses on the innovation ecosystem. Ecosystem literature has studied primarily the external environment and particular roles in an ecosystem, while innovation and R&D literature has focused more on the internal factors concerning innovation. However, few studies discuss how the ecosystem is aligned to the internal innovation strategy, the technology platform and the way of working. Therefore, in this paper we apply an analysis framework that aligns all these elements and discusses four different types of innovation ecosystem strategies. Our paper contributes with the following. First, we illustrate that firms work in different types of ecosystems with different engagement models; these different ecosystems are however perceived as one in current literature. Secondly, we apply the aforementioned ESTO model as an analysis framework in order to align the external ecosystem strategy with the internal strategy. Third, we define four different types of innovation ecosystem strategies, based on the driver of innovation, i.e., internal or external, and the strategic approach for working with the ecosystem, i.e., collaborative or competitive approach.

Future work will study the different types of ecosystems and their respective engagement models in more detail. Furthermore, a deeper insight in the influence of the context as well as the role a firms plays in their ecosystem in relation to the four different innovation ecosystem strategies is needed to support firms in aligning their internal R&D with their ecosystem strategies.

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