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OPEN INNOVATION MODEL FOR A LARGE COMPANY IN THE ICT INDUSTRY

Case Ericsson LMF

Master´s Thesis
in International Business

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In my view, open innovation is a mindset; value is created by collaborating and sharing knowledge. I hope the readers enjoy this work and that it delivers value to them. I leave the readers with a quote which hopefully encourage them to seek new opportunities and get out of their comfort zone.

"If you're not prepared to be wrong, you'll never come up with anything original." – Sir Ken Robinson

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API: Application programming interface.
BLISS: Business Lab Innovation System (Suomi).
DCP: Device Connection Platform.
FRAND: Fair, reasonable, and non-discriminatory.
ICT: Information and Telecommunication technologies.
IoT: Internet of Things.
IP: Intellectual Property or Internet Protocol.
IT: Information Technology.
LMF: Refers to Ericsson subsidiary in Finland.
M2M: Machine-to-machine.
NBD: New Business Development.
OI: Open Innovation.
PDP: Aalto's product development project.
RECA: Region Europe & Central Asia.
ROI: Return on investment.
R&D: Research and Development.
SDK: Software Development Kit.
SME: Small and Medium Enterprises.
TEKES: Tekniikan edistämiskeskus. Finnish funding agency for technology and innovation.
3GPP: 3rd Generation Partnership Project; involves six telecommunication standards development organizations.

1 INTRODUCTION

In the last century, the prevailing innovation paradigm was characterized by firms investing in huge R&D departments, working secretly and in isolation from the environment. Knowledge was created and sold in-house; having the smarter people in the field developing new products and services, and using own distribution and sales channels to commercialize them in their market. However, during the last decades of the century, things slowly started to change as new and smaller competitors overcome the bigger corporations; with examples, from giants like IBM, losing market in major product lines such as PC, Workstations, Memory Storage, Databases, and Operating System; to modern cases like Wikipedia overcoming Encyclopedia Britannica in just a few years. The knowledge landscape has changed and with it the rules of competition. A new paradigm, Open Innovation, is becoming the standard innovation process, and has been adopted by firms and organizations across several industries, from high tech firms to low tech firms and from huge corporations to SME's. But what is open innovation? Are phenomena like crowdsourcing, open source software, and user innovation part of open innovation? What about more traditional business activities like business partner-ship, mergers and acquisitions, and research collaboration? Moreover, how could companies implement open innovation into their organizations when they have several ongoing collaborations? What is the relationship between open innovation and other domains like business strategy? This research tries to solve some of these questions taking a holistic approach towards open innovation and exploring the factors influencing how it is pursued in organizations.

1.1 Background for the research

The Open Innovation paradigm, a term which has been used for more than a decade, has gained importance both in academics and among business practitioners due to the potential benefits in firms' innovation practices. The benefits of following an effective open innovation process include: access to sources of knowledge outside the firm's boundary, reduced time to market product and services, maximization of intellectual property, expansion of the firm's knowledge base, among others. Firms such as Procter & Gamble, Philips, Siemens (Enkel, Gassmann & Chesbrough 2009; Whelan, Parise, de Valk & Aalbers 2011), IBM, Xerox, Intel (Chesbrough 2003; Whelan et al 2011), Lego (Antorini, Muñiz & Askildsen 2012), and others; have successfully implemented open innovation practices with positive outcomes. The successful examples of these firms suggest that open innovation may be a sustainable trend that provides the basis for achieving competitive advantage (Huston & Sakkab, 2006). Nevertheless, implementing

a successful open innovation process can be complex: as it involves several domains of management; and its term, classification, scope, and practices have not totally been agreed (Elmquist, Fredberg & Ollila 2009). Raising question about what really is open innovation, and how could open innovation be implemented.

1.1.1 Management challenges

Open innovation could cover several areas of business and management; depending on the extent of its practices within an organization. Some of the areas covered include: strategic management, inter-firm collaboration, management of intellectual property, entrepreneurship, and culture and organizational change. Thus, to employ it effectively; open innovation requires rethinking several aspects of the business (Chesbrough & Brunswicker 2013).

To begin with, there should be an alignment of the firm's main strategy and the innovation strategy, and of the innovation strategy and open innovation. This could be a challenging task as the forms and combinations how open innovation could be approached are manifold: e.g. strategic alliance, collaboration with research institutions, crowdsourcing, establishing a platform to co-create with users, corporate venture capital, spin-offs, acquisitions, licensing, free revealing, to mention a few. Furthermore, decisions about what mode to choose, which partner to select, and what is required to do so; are not very clear for most organizations, especially for those that handle multiple collaborations.

In addition, from an open innovation perspective, intellectual property should be used as a strategic asset to generate value, especially from new markets. However, opening everything to outsiders can be fatal for a firm. Raising questions about, what should be shared with external parties, how the company maintains its competitive advantage after sharing some of its intellectual property, or to what extent it is appropriate to be open. Also, exposing innovations to the environment requires further work in convincing the external party about the value of the unused intellectual property.

As products and services reach market maturity, firms need to search for new businesses and technology areas. Entrepreneurial behavior can help them in their internal search. However, not all ideas can be taken forward inside the company and, thus, forms like spin-offs and investing in startups can be a way to benefit from entrepreneurship outside the organization. Unfortunately, it is not an easy task to fulfill, involving tough decisions, like for example: assessing and selecting promising ventures in which to invest, forms of collaboration to be established, assessment of the risks involved, coping with technological and market uncertainty, finding and selecting means to capture value, among others.

Also, one of the main barriers for implementing open innovation is organizational and cultural change. From the previous examples, it becomes clear that the organization needs to establish new procedures and structures to handle new activities. However, introducing change is hard as established organizational units may perceive this change as a threat for their survival (Chiaroni, Chiesa, Frattini & Terruzzi 2013), creating internal resistance. Moreover, change also affects partners and their business activities. These issues lead to the challenge of how to balance the tension between normal and new activities when implementing open innovation.

1.1.2 Previous research on open innovation

There have been several contributions to the field of open innovation during the past decade. To illustrate the multiple approaches taken just in the field of open innovation, previous research are listed: frameworks to categorize and explore the open innovation processes (Elmquist et al 2009; Lazzaroti & Manzini 2009); categorization of different modes of collaboration (Lazzaroti & Manzini 2009; Schroll & Mild 2011; Bigliardi, Dormio & Galati 2012); open innovation phenomenon (Elmquist et al 2009; Enkel, et al 2009); taxonomy of open innovation (Duarte & Sarkar 2011); adoption of open innovation in different regions or industries (Gassman & Enkel 2004; Laursen & Salter 2006; Chesbrough & Crowther 2006; Van der Meer 2007; Lichtenthaler 2008; Campbell-Smith 2008; Lazzaroti & Manzini 2009; Faems, Visser, Andries, & Van Looy 2010; Lazzarotti, Manzini, Pellegrini 2010; Schroll & Mild 2011; Chesbrough & Brunswicker 2013); the impact of open innovation on firms' performance (Berchicci 2013), and the impact of networking on innovation capacity (Pittaway, Robertson, Munir, Denyer & Neely 2004); the role of absorptive capacity (Lazzarotti et al 2010; West & Gallagher 2006); external collaboration at different stages of the innovation process, such as ideation, development and commercialization; user innovations (Hienerth & Lettl 2011; Bogers & West 2012); managing online/virtual communities (Antorini, et al 2012; Grundström, Rosenfall & Öberg 2012) adoption of open innovation modes in practice (Lazzarotti, et al 2010), review of the topic open innovation, and planning of future agendas for research (Gassman & Enkel 2004); and others studied the topic from the point of view of other theories such as transaction cost economies (Remneland-Wikhamn & Knights 2012), resource based view (Hage & Hollingsworth 2000), dynamic capabilities (Cheng & Chen 2013), among others.

Despite all these and many other valuable contributions to the field of studies, there still is a research gap to approach open innovations from a holistic (West & Bogers 2013, Gassman, Enkel, Chesbrough 2010) and integrative perspective (Chieroni et al 2013). Pinoargote (2014) made an analysis of open innovation contributions including

work by Elmquist et al (2009) and Gassman et al (2010). This analysis is also presented on the literature review on open innovation. The findings suggest that open innovation needs to combine research from other domains like strategy, business models, innovation, and knowledge management, among others.

1.2 Research Purpose

As it has been discussed in the previous subchapter, there have been several contributions to the field of open innovation during the last decade. However, most of the work have taken a partial view of open innovation, focusing on few areas like the outside-in process, obtaining innovations from external sources (West & Bogers 2013), virtual communities, absorptive capacity, to mention a few. In addition, there have been few cases that analyzed how a single firm manages multiple open innovation practices, like in the case study of Deutsche Telekom (Rohrbeck, Hölzle & Gemünden 2009) and in those cases the link between open innovation practices and strategy is not very clear.

These issues, taken from the perspective of a firm practicing open innovation, like the case company; raise questions about how the company could incorporate a complete view of open innovation. Moreover, how to do this when they have several projects with different collaboration characteristics. Other questions that serve as background for the research are: How can companies applying open innovation practices maximize its benefits? And, what guidelines can help companies achieve this?

Therefore, one of the aims of this research is to study how open innovation can be addressed inside a big company when they handle multiple projects and partners. Moreover, how to do so when collaboration forms and partners characteristics differ from each other? This research tries to reduce that gap by understanding the factors that influence the adoption of open innovation practices and later propose a conceptual framework for successfully addressing open innovation according to the different possible open innovation modes the company can pursue. The aim is to construct a model which incorporates the lessons learned from literature review on open innovation and other fields such as strategy, business modeling, collaboration modes, knowledge sharing, and capabilities; which serves as a guideline for companies coping with multiple projects that involves collaboration with external parties.

1.2.1 Research Questions

This study is an extension of a previous study that explored the state of open innovation research (Pinoargote 2014). That study suggested incorporating research contributions

from strategy, business models, innovation, and knowledge management. Thus, this study falls into the broader disciplines of innovation management and strategy. Open innovation should be an integral part of the innovation process of an organization and support firm strategy. However, extending open innovation to those aforementioned domains adds more choices, like: how to apply open innovation, innovate the business models, work as a startup, apply startup methodologies, incorporate design thinking or a user centered approach, and, many others. And thus, it is required to assess in which cases it is better to employ one approach instead of another. It is a question that the case company and the literature are trying to answer. Keeping this under consideration, this study will focus on the modes of external collaboration which are part of the innovation process; and thus, the following research question is formulated:

How could Ericsson LMF assess which open innovation mode to select depending on the attributes of the project at hand?

1.2.2 Sub-questions

From the main research question, the following sub-questions were formulated:

- How do strategy, innovation, business modeling, and knowledge management relate to open innovation?
- What factors influence the selection of open innovation mode inside LMF?

The first sub-question derives from previous research on open innovation (Pinoargote 2014). The research suggested that further developments should incorporate those domains if they seek to integrate multiple perspectives and have a holistic approach. By integrating these domains, it would be possible to have a broad view of open innovation inside an organization. The second sub-question aims to identify the factors that influence the selection of modes inside Ericsson LMF. And, by doing that, it would be possible to link the factors with literature contributions. These factors will support constructing a model to assess open innovation modes and approach open innovation.

Table 1: Operationalization Table

Main Research Question	Sub-questions	Contributions	Methods	Document
How could Ericsson LMF assess which open innovation mode to select depending on the attributes of the project at hand?	How do strategy, innovation, business modeling, and knowledge management relate to open innovation?	Previous research on open innovation	Literature Review Analysis	Chapter 2.5 Chapter 2.6
		Open Innovation models	Literature Review Analysis	Chapter 2.6.5
		Open Innovation modes	Literature Review Analysis	Chapter 2.6.6
		External Sources of Knowledge	Literature Review	Chapter 2.6.4
		Relationship between open innovation, innovation, strategy, and knowledge management	Model Construct based on literature review and data collection	Chapter 5
	What factors influence the selection of open innovation mode inside LMF?	How is LMF applying open innovation at the moment?	Observations, cases and insights	Chapter 4
		Factors behind mode selection	Case interviews + insights	Chapter 4.4
		Factors behind initiatives not been taken forward	Case interviews + insights	Chapter 4.4

Table 1 provides the research operationalization linking the research questions and the contributions with their corresponding sources. The two sub-questions serve as a basis for the model construct. The first question is strongly supported by literature review and modelling; whereas, the second questions on empirical data and the factors behind mode selection inside the organization. By linking both perspectives it is possible to build a construct that answers the main research question.

1.3 Research Justification

The reasons behind this research relate to the following factors: the increased adoption of open innovation (Chesbrough & Brunswicker 2013); the uncertainty in generating profit and limited number of companies who had benefited from these initiatives (Enkel et al 2009; Cheng & Chen 2013); the challenges of implementing open innovation practices, which can be a complex process (Enkel et al 2009; Cheng and Cheng 2013; Dittrich & Duyster 2007); and suggestions that future research should incorporate different streams (Van de Vrande, Lemmens & Vanhaverbeke 2006, Chiaroni et al 2013) and take a holistic perspective (West & Bogers 2013). Therefore, the author's interest in studying open innovation from an organizational perspective, trying to understanding how a company could plan and implement multiple open innovation practices, and thus, gain its benefits.

The practice of open innovation has increased in the last decade. As the paradigm has gained popularity among academics and practitioners, and after the success cases of some companies; more organizations have adopted open innovation in their innovation process (Chesbrough & Brunswicker 2013). Moreover, this phenomenon is not happening only in high tech industries but in other industries such as consumer packed goods, medical devices and chemicals (Chesbrough & Crowther, 2006), to mention a few. Also, factors eroding the old innovation paradigm has grown in magnitude, new development in ICT is supporting online communities, social media, closer interaction with users, empowerment of uses; and the growth of phenomena such as crowdsourcing, co-creation, crowd-equity, distributed innovation, to mention a few; which suggest higher flows of knowledge between parties.

Despite the fact that open innovation is being practiced more, not all companies have successfully exploited its benefits (Enkel et al 2009; Cheng & Chen 2013), or in other words, they are not taking its full potential. Also, it is reflected in the wider adoption of the outside-in open innovation process and its partial focus of study from academics. Thus, there are plenty of opportunities to explore the inside-out perspective of open innovation.

In addition, implementing open innovation can be a complex process. Collaborating with external parties brings challenges such as identifying and selecting the appropriate partners, the type of collaboration structure to be used, and the competences required by the assigned team (Enkel et al 2009; Cheng & Chen 2013; Dittrich & Duyster 2007). This complexity increases with the number of collaborations and interdisciplinary areas, especially when developing radical innovations where technological and market uncertainty can be high. As Chesbrough and Brunswicker (2013) explains about open innovation: ‘‘*"Is a systemic shift that requires re-thinking many aspects of one's business to utilize it effectively.*" Chesbrough & Brunswicker 2013, 37

Finally, some authors (Van de Vrande et al 2006, Elmquist et al 2009; Chiaroni et al 2013) suggest that research on open innovation should integrate multiple research perspectives. These reasons justify the effort and interest in exploring more about this topic, in particular in integrating multiple perspectives and addressing it from an organizational point of view. In addition, the case company interest in understanding more about these phenomena and use tools that supports approaching open innovation.

1.4 Methodology

The methodology used could be characterized as constructive research approach. The main idea behind constructive research is on solving a domain specific problem. In order to do so, it constructs an artifact (models, diagrams, plans, organization charts, etc.) that solves the problem and from which theoretical contributions can be made. Thus, the construction involves a process of innovation in which the artifact is built. Constructive research has been compared to consulting activities with the major difference that constructive research needs to show the theoretical connections and research contributions. According to Kasanen, Lukka & Siitonen (1993), the steps to create a successful construction are as follow:

- Find a practically relevant problem, which also has a research potential.
- Obtain general and comprehensive understanding of the topic.
- Innovate, i.e., construct a solution idea
- Demonstrate that the solution works
- Show the theoretical connections and the research contributions of the solution concept
- Examine the scope of applicability of the solution

The methodology selected is based on qualitative research methods. Qualitative methods were selected as they provide a much richer explanations to particular phenomenon, in this particular case; it provides explanations behind the reasons to choose particular modes of collaboration. This research approach was selected as seems appropriate to address the challenges encountered, contribute to the literature on the topic, and at the same time, provide a model that could support a company decision making process and validate the construction. More information about the methodology, the sampling, collection, and analysis techniques are presented in the third chapter.

1.5 Case company

The case company is the Finnish subsidiary of Ericsson, a large global telecommunications company. Worldwide, the company has more than a hundred thousand employees and operations in over 180 countries. Expressed in initial conversations with representatives from the company, the organization is handling several collaboration projects with multiple external parties. They saw potential in learning more about open innovation in their organization setting. However, several factors, like those mentioned in the previous chapter, could lead to confusion about how to approach the practice. Thus, there was a mutual interest in pursuing this research inside the organization; which led to integrate the researcher into the organization.

Within the company, there are several project and initiatives related to open innovation. For the purposes of this research, a few initiatives were selected as case study units. The reason behind this selection was to explore multiple different cases of open innovation within a single company and understand the factors behind the selection of those cases over others. More details about the case company and the multiple cases are presented in chapter 4.

1.6 Research scope and limitations

The current study has the following scope and limitations. To begin with, it will be focused in the ICT industry. The industry environment perfectly fits this research as it is a highly competitive industry and some of the actors are applying open innovation at certain extent. Moreover, it has experienced radical transformation during the last years (Grøtnes 2009). Secondly, the case company operates globally but the scope will be limited to the reach of the Finland subsidiary, with a focus mostly on research and development functions.

Another factor limiting the scope of the research relates to the breadth of concepts related to open innovation and other domains. This study presents a general view but cannot go into details explaining all topics and contributions in these fields. For example, the research will consider topics such as crowdsourcing, user innovations, and metrics but will not go into details in these areas as they are too broad topics to be addressed in this study. Thus, it could be recommended for readers not familiarized with these topics to explore them if some concepts are not very clear.

Finally, there could be a risk of bias as the researcher joined the organization to work on the thesis and have participative observation; however, it is worth to clarify that the researcher has had complete freedom to choose the topic and scope of his work and it has been reviewed by university peers and supervisors.

1.7 Overview

The document is divided into six chapters. The first chapter gives a brief introduction about the topic, provides the research purpose, including research questions, sub-questions, methodology and planned content. The second chapter reviews the concept and earlier studies related to Open Innovation Paradigm, and important contributions related to Strategy, Business Models, Innovation and Knowledge Management. Details about the methodology and methods are presented in the third chapter. The case company is reviewed in details in the fourth chapter. Also, the cases studied within the case company are reviewed in that chapter. In addition, it presents a review of open innovation inside the company. The model constructed to address open innovation is presented in the fifth chapter. The last chapter, details the findings and conclusions. Finally, the last part of this document provides a list of the references used in this research.

2 LITERATURE REVIEW

The main focus of this study is on open innovation which could be seen as the inflows and outflows of knowledge used to create value. The literature reviewed relates to this basic concept but involves several domains like strategy, business models, innovation, knowledge management and other similar concepts. As it was mentioned in the previous chapter, open innovation could be addressed from multiple perspectives and dimensions. Therefore, before exploring the literature related to open innovation and discussing about collaboration modes, types of open innovation, processes, and others; it is required to review the common underlying elements that bind open innovation with other domains. Pinoargote (2014) suggested a conceptual framework that links open innovation and strategy (See figure 1).

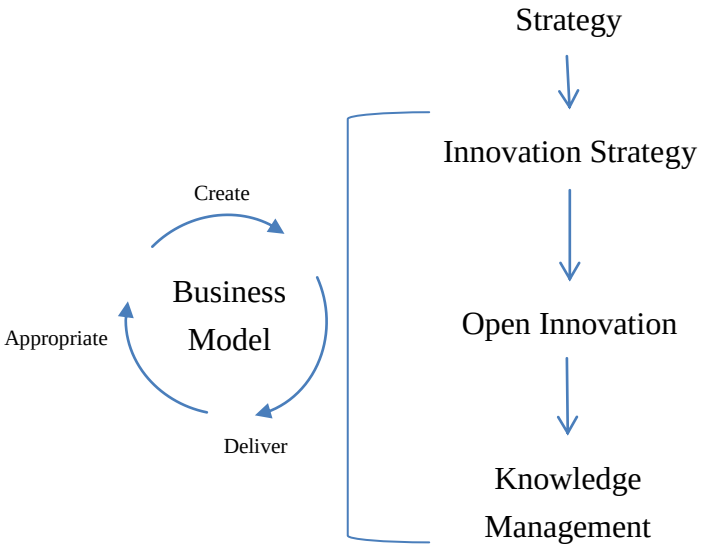


Figure 1: Open Innovation Conceptual Framework (Pinoargote 2014, 36)

Pursuing a complete literature review of the aforementioned areas falls out of the scope of this research. Yet, it is required to address these topics, covering the basic elements and their relationship before continuing exploring the open innovation phenomenon. This does not imply a scarce literature review but on the other hand, it has been selective on the areas that support a holistic view on open innovation. As Maxwell (1996) claims when talking about conceptual context:

> *The relevant studies may only be a small subset of the research in a defined field, and they may range across a number of different disciplines and approaches. In fact, the most productive ways of constructing a conceptual context are often those that integrate different approaches, lines*

> *of investigation, or theories that no one had previously connected. Maxwell (1996, 26)*

From the multiple perspectives related to open innovation, one common aspect found in the literature involves several dilemmas of balancing opposing points of view. According to the domain, they are referred as balancing: open and close innovation; short and long term goals; incremental and radical innovation; the notion of exploitation and exploration activities; low and high levels of uncertainty and risks; and current organization form and changing the organization‘s status quo. This remark is important as the organizational characteristic required for one perspective is fundamentally different from the characteristics required by the opposite (Tushman, Smith, Wood, Westerman, O'Reilly 2002); and is one of the main issues that should be considered in order to have a holistic view of open innovation. For example, closed, exploitative, incremental innovation requires tight controls, fixed structures, a type of culture aiming at efficiency and control, and established processes; whereas open, explorative, radical innovations could require the opposite. In the end, the approach will be subject to the firm’s goals and capabilities.

Moreover, it is believed that business units can operate in multiple time frames and develop streams of innovation by designing organizations that are both tightly and loosely coupled, in what is known as ambidextrous organizations.

This chapter presents a literature review related to open innovation at different levels. First it will start with an overview of open innovation and the several contributions to the domain, including: process view, capabilities, organizational forms or governance, modes of collaboration, external sources of knowledge and some cases on the ITC sector where open innovation has been applied. Later, it will review aspects of knowledge management as open innovation involves knowledge flows with and into the environment. After that, it will expand the view towards innovation to gain a broader perspective of open innovation. Afterwards, notions of strategy and business model are presented to bind all the previous elements. The logic behind presenting the literature review in this bottom-up form is similar to how this study was approached by the researcher. It required expanding the scope of open innovation into other domains and at the same time defining the concepts utilized.

All the elements reviewed served as basis for the construct. Once all these elements have been considered and integrated into a construct, it is possible to suggest to firms how to approach open innovation. This offers more possibilities to explore new opportunities or exploit current certainties in new forms. However, in the end, it depends on the firm’s decision makers to decide how to exploit the benefits from open innovation.

2.1 Open Innovation Paradigm

Open Innovation paradigm, a term which has been used for more than a decade, has gained importance both on academics as in business practitioners (Chesbrough & Brunswicker 2013; Schroll & Mild 2011) due its huge potential in firms' innovation practices. The benefits of following a successful open innovation process include: access to sources of knowledge outside the firm's boundary, reduced time to market of new products and services, maximization of intellectual property, expansion of the firm's knowledge base, among others. Firms such as Procter and Gamble, Philips, Siemens (Enkel et al 2009), IBM, Xerox, Intel (Chesbrough 2003), Lego (Antorini et al 2012), and others; have successfully implemented open innovation practices with positive outcomes. The successful examples of these firms suggest that open innovation may be a sustainable trend that provides the basis for achieving competitive advantage (Huston & Sakkab, 2006). Nevertheless, implementing a successful open innovation process can be complex: as it involves several functional areas of management; and its term, classification, scope, and practices have not totally been agreed (Elmquist et al 2009).

This chapter introduces the concept of open innovation and the initial contributions. Afterwards, it describes how the scope of the term has broadened over the last ten years. Finally, it concludes with a call for a new scope that includes multiple perspectives and contributions to the domain.

2.1.1 Origins of Open Innovation Paradigm

The term, Open Innovation, was coined by Henry Chesbrough (Chesbrough 2003) in *Open Innovation: The New Imperative for Creating and Profiting from Technology*. In his initial work the author described this new paradigm; mentioning the reasons behind the shift from the old innovation process, the basic principles contrasting both paradigms, and providing some case examples of how firms could harness the potential of open innovation. Chesbrough contributions had great impact in the field of innovation management, becoming very popular among academics and practitioners.

The author defined open innovation as follows:

> *"Open Innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology. Open Innovation combines internal and external ideas into architectures and systems whose requirements are defined by a business model" Chesbrough (2003, xxiv)*

The basic notion of open innovation states that ideas could come from inside or outside the organization and could be taken to market inside and outside as well. In several of his contributions, Chesbrough (2003) emphasizes a shift from a closed innovation paradigm, characterized by companies with huge R&D centers, vertically integrated industries, where knowledge is created and exploited within the firm boundaries (see figure 2), and few firms have monopolized the industry's knowledge; towards a contrasting open innovation paradigm, where boundaries of the firm are permeable, allowing ideas and, in more concrete terms innovations; to flow inside and outside the firm (see figure 3).

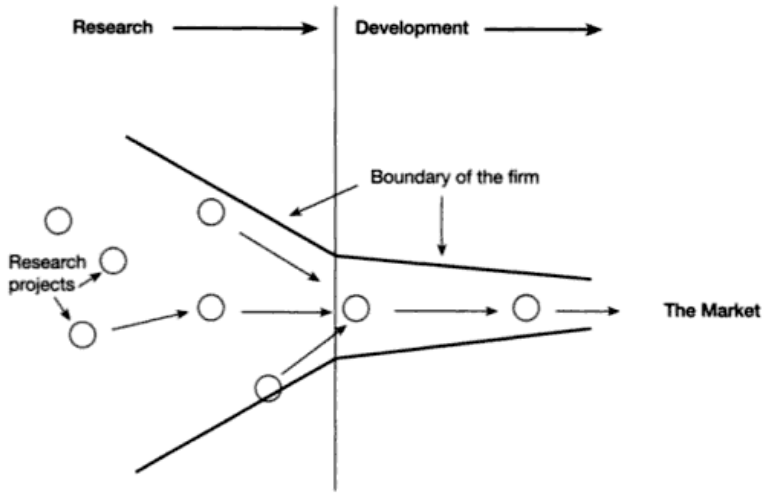


Figure 2: Old Paradigm for Managing Industrial R&D (Chesbrough 2003, xxii)

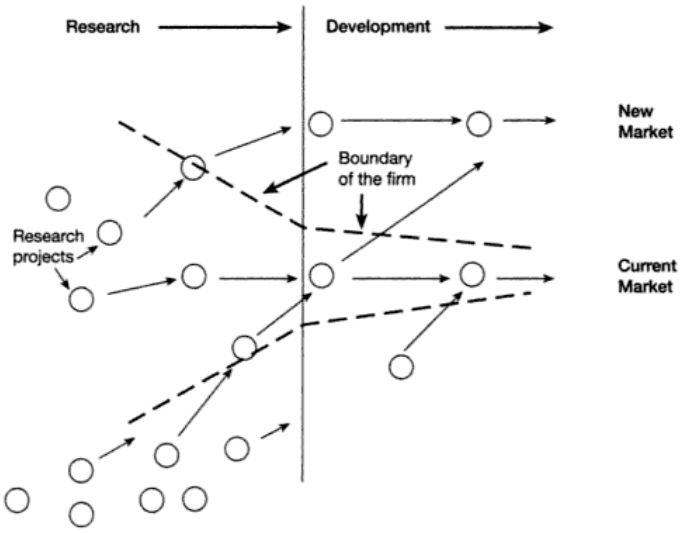


Figure 3: Open Innovation Paradigm (Chesbrough 2003, xxi)

The author attributed the change of paradigm to several factors that affected the knowledge landscape. These factors are: availability and mobility of skilled workforce, growth of venture capital market, external options, and increased capability of external suppliers (See table 2 for a description of the factors). Altogether, the factors have affected how knowledge is created, distributed, and transformed in processes for developing new product and services; and thus, have changed the rules of competition.

Table 2: Factors affecting the knowledge landscape (Chesbrough 2003)

Factors	Description
Availability and mobility of skilled workforce	With the increased access to sources of knowledge and improvement of communications; knowledge was distributed to other sources out of traditional R&D units. In addition with globalization, the mobility of employees increased.
Growth of venture capital market	During the late 80's and 90's the venture capital market growth to support new ventures.
External options	Unused Intellectual property could be taken to external paths in forms of spin-offs, startup companies.
Increased capability of external suppliers.	The number of specialized suppliers has increased in the last decades.

In addition, Chesbrough contrasts the core principles of closed and open innovation (see table 3). The principles contrast the sources of innovations and the forms how they could be exploited. These principles are still relevant despite the fact that was mentioned more than a decade ago. Moreover, they seem to cover more industries and domains; as the factors eroding the old paradigm have increased in magnitude.

Table 3: Contrasting Principles of Closed and Open Innovation (Chesbrough 2003, xxvi)

Contrasting Principles of Closed and Open Innovation	
Closed Innovation Principles	Open Innovation Principles
The smart people in our field work for us	Not all the smart people work for us. We need to work with smart people inside and outside our company
To profit from R&D, we must discover it, develop it, and ship it ourselves.	External R&D can create significant values; internal R&D is needed to claim some portion of that value.
If we discover it ourselves, we will get it to market first.	We don't have to originate the research to profit from it.
The company that gets an innovation to market first will win.	Building a better business model is better than getting to market first.
If we create the most and the best ideas in the industry, we will win.	If we make the best use of internal and external ideas, we will win.
We should control our IP so that our competitors don't profit from our ideas.	We should profit from other's use of our IP, and we should buy other's IP whenever it advances our own business model.

Chesbrough's initial work described cases of companies that integrated knowledge from the external environment and exploit unused knowledge in new forms. An example of the former case comes from Intel Corporation. Intel, utilized knowledge from basic research created by other research institutions; and focused their resources on developing their development facilities. With that approach, they were able to capture value from existing knowledge and focused their resources on developing operational excellence. However, when they could not capture more value from the basic research done by other organizations in the domain, Intel started investing some resources on R&D. By smartly co-investing on certain Universities and Research Centers; Intel benefited from access to early developments and investments of other institutions. A different example where unused knowledge of firms found new opportunities outside the parent company, could be seen from Xerox Palo Alto Resesearch Center (PARC) spin-offs. Xerox allowed several people inside the company to take unused technology into spin-offs. These small spin-offs found their way in the market by forming a new organization structure, experimenting and developing the technology, and building a new business model. According to the author (Chesbrough 2006) the collective value generated by eleven of the spin-offs had twice the market value of the parent company. Xerox could have tried new means to capture value by taking unused knowledge outside the organization boundaries; however, that would have required changes in the business model or the creation of a new organizational form.

These examples illustrate how open innovation could be implemented inside an organization. However, from these examples and according to the Open Innovation definition and core concepts, other traditional forms of collaboration like alliances, partner-

ships, joint ventures, etc. could be seen as open innovation. Thus, raising questions about what is the difference between forms of partnership and open innovation? In addition, new forms of knowledge creation and sharing like crowdsourcing, open source software, and co-creation has expanded the scope of open innovation. The next subchapter will describe the evolution of the concept during the last decade.

2.1.2 Evolution of the term

It is important to begin by clarifying that open innovation has been practiced for many decades before the term was initially coined by Chesbrough (Lazzarotti & Manzini 2009; Duarte & Sarkar 2011). For example, there is clear evidence of formal business activities occurring during the past decades that involves processes of acquisitions, divestments, licensing, partnerships, and others. Still, when it was introduced as a new paradigm; open innovation had an impact on the mindset of how collaboration with external actors could be fostered and leveraged. Nowadays, open innovation covers more areas than it did before (Muller, Hutchins, & Cardoso Pinto 2012); and in some way, it could be said that the concept has been evolving. Evidence supporting this claim includes: authors' variable definition of the term, used to expand its scope; higher impact from the eroding factors affecting the knowledge landscape; and multiple ways how academics have been approaching and exploring the term. Thus, there should be a distinction regarding what open innovation covered when it was first coined over ten years ago, compared to what it does today. This subchapter will review the evolution of the term, what it meant in the past and how it is used nowadays, including current trends.

The definition of open innovation has not totally being agreed upon. As it is a complex evolving topic, different authors have slightly different views on it (See table 4 for a list of some definitions of Open Innovation). The original definition of Open Innovation states that ideas can come from inside and outside the firm and can be taken to market inside or outside the firm (Chesbrough 2003). In this definition it is implied the value from access and usage of an idea over ownership and control of it. A later definition by Chesbrough, Vanhaverbeke, and West (2006) expands the notion of ideas into knowledge; which may be embodied in ideas, technology, products, and others. West's and Gallagher's (2006) perspective includes a systemic process of exploration, integration, and exploitation of both internal and external sources. Lichtenthaler's (2008) definition of open innovation focuses on internal and external technology management by using a firm's dynamic capabilities. In later work, Lichtenthaler (2011) refined its definition by addressing knowledge instead of technology and, similarly to West and Gallagher: incorporating the phases of exploration, retention, and exploitation. From the previous definitions of the most prominent researchers in the field, is possible to ob-

serve a wider scope of the term open innovation. It involves a process view of identifying opportunities, integration with the innovation process, and knowledge exploration and exploration processes. In addition, they mention capabilities as an important element. Finally, knowledge becomes the basic element as it contains ideas, technology, know-how, intellectual property, etc.; and could be embodied in people, processes, products, services, and others.

Table 4: Definition of Open Innovation by most prominent authors.

Author	Definition
Chesbrough (2003)	"Open Innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology. Open Innovation combines internal and external ideas into architectures and systems whose requirements are defined by a business model." (Chesbrough 2003, xxiv)
Chesbrough, Vanhaverbeke, West (2006)	"The use of inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively." (Chesbrough, et al 2006, 1)
West & Gallagher (2006)	"Systematically encouraging and exploring a wide range of internal and external sources for innovation opportunities, consciously integrating that exploration with firm capabilities and resources, and broadly exploiting those opportunities through multiple channels" (West & Gallagher 2006, 320)
Lichtenthaler (2008)	"An open innovation approach refers to systematically relying on a firm's dynamic capabilities of internally and externally carrying out the major technology management tasks, i.e., technology acquisition and technology exploitation, along the innovation process. Thus, open innovation processes involve a wide range of internal and external technology sources, and a wide range of internal and external technology commercialization channels." (Lichtenthaler 2008, 148)
Lichtenthaler (2011)	"Open innovation is defined as systematically performing knowledge exploration, retention, and exploitation inside and outside an organization's boundaries throughout the innovation process." (Lichtenthaler 2011, 77)

In addition, if we review the factors that have affected the knowledge landscape, we can observe they have increased in magnitude (see table 5) due the continuous improvements done in the field of information and telecommunication technologies. For instance, the availability and mobility of skilled workers has been enhanced by access to knowledge sources such as Massive Open Online Courses (MOOC), remote working, specialized communities, do it yourself sites, and access to hardware and specialized components like 3D printing, Arduino hardware, open hardware, and others. Similarly, venture capital markets have expanded and new methods of raising capital such as crowd funding or crowd equity are more common these days. Also, external options for

unused ideas have broadened, with the possibility to access public and private funds, in addition, of receiving influence from the previous mentioned factors. Finally, the capability, and reach of external suppliers has growth, with highly specialized suppliers of global reach.

Table 5: Factors affecting the knowledge landscape (updated).

Factors	Status a decade ago (2003)	Current status (2014)
Availability and mobility of skilled workforce	Knowledge distributed to other sources out of traditional R&D units. Universities, research institutions and new channels such as internet are distributing knowledge. Also, mobility of workers and trends such as outsourcing has changed the knowledge landscape.	Developments of Massive Open Online courses, creation of communities, development of open hardware, open office.
Growth of venture capital market	A mature VC market since the 90's.	Expanded to Peer funding, Crowd funding, Crowd equity, and others.
External options	Unused Intellectual property can be taken to external paths in forms of spin-offs, startup companies.	Not just through startups and VC funding. New options like innovation markets or using innovation intermediaries.
Increased capability of external suppliers.	The number of specialized suppliers has increased in the last decades.	New smaller highly specialized suppliers have appeared. Due to the small size of internal market they tend to operate globally to reach a specific but distributed market segment.

2.1.3 Need for new scope of Open Innovation

Since the introduction of the term, the scope of open innovation has broadened. Academics have been discussing about the term and what it should cover (Elmquist et al 2009; Gasman et al) without reaching consensus. Also, the development of ICT and new forms of collaboration have expanded the scope of open innovation into areas like crowdsourcing, crowd funding, citizens' collaboration, *prosumers*[1], co-creation, and platforms ecosystems, to mentioned a few. These new phenomena are not explicitly pointed out in the aforementioned principles and definitions but still need to be consid-

[1] A portmanteau formed by words professional/producer and consumer.

ered in current open innovation practices. Moreover, the number of activities related to open innovation and the complexity for managing it; are expanding as the factors that influenced the change of paradigm have increased in intensity. Finally, some authors (Curley & Samelin 2013, Dittrich & Duysters 2007; Laursen & Salter 2006; Campbell Smith 2008) recognize that the practice of open innovation is subjective to organizations and their environment; and they could change according to project characteristics and require different organizational forms. With all these changes its important to recognize that open innovation scope has broadened and it needs to be seen in a different perspective from how it was initially introduced.

Gassman, et al (2010) identified trends related to open innovation (see table 6) which suggest the paradigm has matured. With these new trends and advancements in the field, it is important to agree on what is meant by open innovation in the present.

Table 6: Current trends in Open Innovation (Gassman et al 2010).

Category	Initial status	Current trend	Details
Industry penetration	Pioneers	Mainstream	Growing trend towards the adoption of Open Innovation. It has also gone from few leading firms to multiple firms across industries.
R&D intensity	High tech	Low tech	Shift from high tech industries to low tech. Nowadays it also incorporates users, customers, universities and others; at different stages of the innovation process.
Size	Large	SME's	From large multinational companies to smaller companies. This also links to the born global phenomenon.
Innovation process	Stage-gate	Probe and learn	From step wise processes to iterative and agile/ lean processes.
Structure	Standalone	Alliances	Development of alliances for value creation as in the case of innovation networks
Universities	Ivory towers	Knowledge brokers	Increased cooperation between industry and academia.
Internal processes	Amateurs	Professionals	Internal process to manage open innovation has gone from amateurs to experts in the field. There are new positions like open innovation managers, consultants in the field and the increase of open innovation intermediaries.
Content	Product	Services	Shift towards servitization of products
Intellectual Property	Protection	Tradable goods	Shift towards a trade market for intellectual property. Increased phenomenon of patent wars, patent trolls, and others.

Some authors are even discussing about Open Innovation 2.0. For instance, Curley and Samelin (2013) say the following:

> *Our observations indicate that we are indeed witnessing a strategic inflection point in the practice and impact of innovation. OI2 is enabled by the collision of three mega trends digitization, mass collaboration, and sustainability. Across the world, Moore's law is colliding with virtually every domain. Industries that have taken centuries to mature have been dramatically reshaped in less than a decade (e.g. music, books). Many more industries are ready for this atoms-to-bits transformation with energy distribution and the emergence of smart electrical grids as prime examples. (Curley & Samelin 2013, 5)*

Also, is important to consider that the scope of open innovation inside an organization might change according to the time and project characteristics. Dittrich & Duysters (2007) support this claim:

> *There are many different modes of innovation processes- such as outsourcing, spin-offs, and spin-ins- which may be viable in different innovation projects and circumstances. Thus, an Open innovation system may result in a complex network of relationships (with other organizations), serving different purposes in different periods. (Dittrich & Duysters 2007, 512)*

The idea of having different organizational forms is also mentioned by Laursen & Salter (2006).

> *Our approach sees each of these channels as a separate search space, encompassing different institutional norms, habits, and rules, often requiring different organizational practices in order to render the search processes effective within a particular knowledge domain (Laursen & Salter 2006, 133)*

In addition, Campbell-Smith (2008) says that Open Innovation is about collaboration with external parties for the development of new products and services. He emphasizes that the way of collaborating will differ according to the project. Nevertheless, the general objective is to harness ideas and expertise across a wider reach than an organization could ever do by itself.

> *The essence of OI is an acceptance of the need to collaborate with other parties—suppliers, academic researchers, industry partners and perhaps above all customers—on the development of new products and services. How this collaboration will work differs from one project to the next and needs constant reappraisal. But the objective in every case is to harness ideas and expertise across a wider horizon than even the largest company could contemplate on its own. (Campbell-Smith 2008, 4)*

All these different issues raise questions about what Open Innovation really is and how it could be applied inside an organization? From this author's point of view, the novelty in the Open Innovation paradigm is on strategically managing knowledge by establishing an appropriate business model that fully captures value from collaboration. Thus, the author wants to emphasize the distinctive use of Open Innovation concept, more as a mindset than on some of those previously mentioned activities which are included in the open innovation practices, i.e. partnership, licensing, acquisitions, to mention a few. In order to explore these issues more, past research of open innovation will be reviewed and fit under the scope of this study. The next subchapter will take an overview of past research related to open innovation.

2.2 Literature Review on Open Innovation

There are two main contributions that analyze previous literature review on open innovation and propose a way forward. The first contribution was done by Elmquist et al (2009); they examined the field of studies of open innovation by reviewing academic papers published before November 2007, and interviewing several key researchers. The second contribution was done by Gassman et al (2010) and they provide multiple perspectives on how to organize the fields of research related to open innovation.

Elmquist et al (2009) identified the following key themes from the literature review: the notion of open innovation, business models, organizational design and boundaries of the firm, leadership and culture, tools and technologies, Intellectual Property (IP), patenting and appropriation, industrial dynamics and manufacturing. In addition to the literature review; the authors interviewed several prominent researchers of the field; identifying these themes: Open innovation as a model for innovation, contingency perspective of open innovation, implementing and using open innovation, and the role of management in open innovation. By comparing both sources; the authors identified these characteristics:

- Open innovation as a collaborative process rather than a market for ideas.
- Definitions diverge, including many more aspects that those first introduced by Chesbrough.
- Acknowledgment of negative sides of open innovation, identifying situations and circumstances when it is more beneficial than others.
- Proof of several practitioners and empirical case studies. There is a call for more systematic studies and research on specific parts of a model.
- The role of leaders in changing organizations that adopt open innovation and understanding the individuals that participate in open innovation.

Finally, they suggested a bi-dimensional model with the locus on the innovation process in one axis and the extent of collaboration partners on the other (reviewed in chapter 2.2.1).

On the other hand, Gassman et al (2010) described nine perspectives needed to develop an open innovation theory more fully. These perspectives are:

- Spatial: Geographical location and virtualization.
- Structural: Decentralization of innovation and collaboration
- User: Co-creation, lead users, toolkits, mass customization, user innovation.
- Supplier: Supplier co-creation.
- Leveraging: Business model thinking into expanding markets / industries.
- Process: Three processes view: outside-in, inside-out and coupled.
- Tools: Co-creation tools.
- Institutional: Change of institutions in the innovation model. Spillovers

- Cultural: Mindset, values, incentives systems.

Their article finishes recognizing some gaps for future research including the need for a holist model of open innovation (Gassman et al 2010).

This research recognizes the valuable contributions of the aforementioned authors; however, argues that the field has developed further and other perspectives and areas need to be reviewed and integrated. Thus, the researcher has reviewed other contributions to the domain. Some of these contributions relate to perspectives described by Elmquist et al (2009) and Gassman et al (2010); but there were others, including: taxonomy of open innovation (Duarte & Sarkar 2011); adoption of open innovation in different regions or industries (Gassman & Enkel 2004; Laursen & Salter 2006; Chesbrough & Crowther 2006; Van der Meer 2007; Lichtenthaler 2008; Campbell-Smith 2008; Lazzaroti & Manzini 2009; Faems et al. 2010; Lazzarotti, et al. 2010; Schroll & Mild 2011; Chesbrough & Brunswicker 2013); the impact of open innovation on firms performance (Berchicci 2013), and the impact of networking on innovation capacity (Pittaway et al. 2004); the role of absorptive capacity (Lazzarotti et al 2010; West & Gallagher 2006); external collaboration at different stages of the innovation process, such as ideation, development and commercialization; user innovations (Hienerth & Lettl 2011; Bogers & West 2012); managing online/virtual communities (Antorini, et al 2012; Grundström et al 2012) adoption of open innovation modes in practice (Lazzarotti, et al 2010), review of the topic open innovation, and planning of future agendas for research (Gassman & Enkel 2004); and others studied the topic from the point of view of other theories such as transaction cost economies (Remneland-Wikhamn & Knights 2012), resource based view (Hage & Hollingsworth 2000), dynamic capabilities (Cheng & Chen 2013), among others. These contributions are useful but somehow could be seen as fragmented; they need to be integrated and analyzed based on some factors that allow having a holistic view.

The next subchapter will review the most prominent contributions relevant for this work. The literature related to open innovation is broader than presented and all the literature reviewed will not be mentioned in this chapter. The main domains presented relate to processes and frameworks, capabilities, and governance or organizational forms. In addition, it will review the multiple open innovation modes and external sources of knowledge. Finally, some uses cases of open innovation in the ICT industry are presented, mainly because of their linkage to the case company industry.

2.2.1 Processes

Gassman & Enkel (2004) studied the practice of open innovation in firms and identified three core process archetypes: The outside-in, the inside-out and the coupled process

(see figure 4). Since then, these archetypes have been used and referred by others researchers (for example, Bigliardi et al 2012; Grøtnes 2009) as a basis of open innovation processes.

In addition, their study discussed different capabilities required to implement open innovation effectively; and associate them with the aforementioned archetypes processes. The absorptive capability, which is firm's ability to identify, assimilate, and exploit knowledge from the environment (Cohen & Levinthal 1989); relates to the outside-in process. The multiplicative capability referred by the authors as the ability to multiply and transfer its knowledge to the external environment; relates to the inside-out process. Lichtenthaler (2011) refers to this ability as desorptive capacity, with a different connotation for multiplicative capability. Finally, relational capability which is firm's capability to build and maintain relationships with partners; relates to the coupled process.

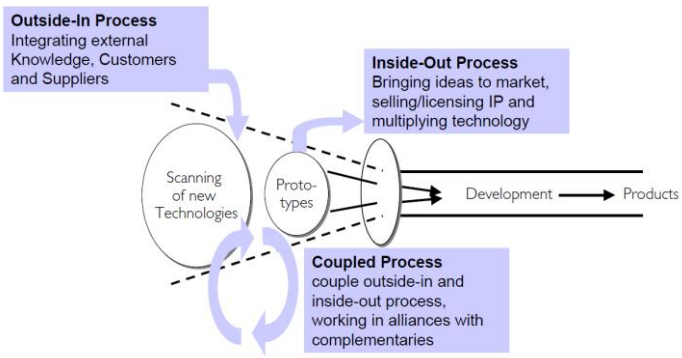


Figure 4: Three archetypes of open innovation process (Gassman & Enkel 2004, 7)

In a different study, Lichtenthaler (2008) analyzed strategic approaches to technology transactions, namely technological acquisition and exploitation. Based on a questionnaire sent to more than 150 SME's, the author identified several groups or clusters following similar strategies (Figure 5). These clusters followed different innovation strategies: close, balanced, open; and two new types: desorbing and absorbing. Closed innovators are characterized by very limited external technology acquisition and exploitation. They follow traditional in-house development within their normal business activities. Another cluster, balanced innovators, has opened up their innovation processes to some degree. This cluster has a mixture of technological acquisition and exploitation activities; required to perform regular business. One example from this cluster mentioned in their study, comes from a semi-conductor firm that relies on licensing and cross-licensing, in order to operate the business. Another cluster, the open innovators clusters, is characterized by having opened their innovation activities to a great extent. Firms within this cluster pursued external technology acquisitions and exploitation transactions to a great extent. One common mentioned example that fits in this cluster is

a pharmaceutical company. The desorbing innovators clusters are focused on internally developing new technologies and actively commercializing technology assets in addition to their product business. Thus, some knowledge is absorbed from external sources but a great deal of knowledge is desorbed from the firm's technological portfolio, e.g. through licensing agreements. An example is chemical companies. On the other hand, absorptive innovators rely strongly on external technology acquisition but are reserved when commercializing technological knowledge. An example of this type is the automotive companies. From a process perspective, this study resembles Gassman & Enkel (2004) archetypes. Moreover, it can be inferred that these innovators needs absorptive and desorptive capacity in different degrees. Although these types of studies are useful for identifying adoption of open innovation in industries and associating different strategies to certain groups; they are still missing a holistic approach to open innovation (i.e. mentioning the multiple forms of collaboration or organizational forms), or describing how one company can balance between multiple modes according to the projects.

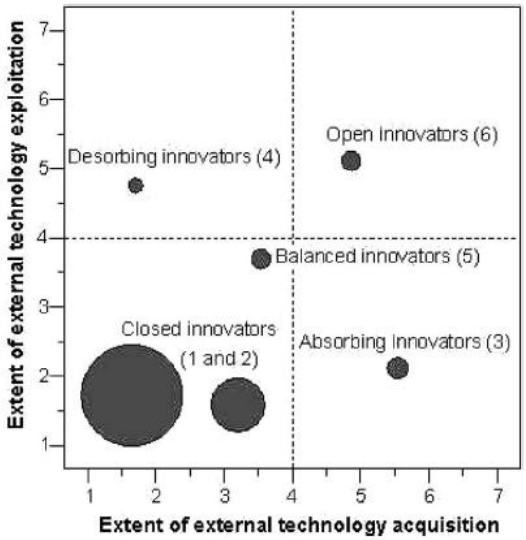


Figure 5: Open Innovation Cluster analysis (Lichtenthaler 2008, 150)

A slightly different framework was proposed by Elmquist, et al (2009). As was mentioned before, the authors examined the field of studies of open innovation by reviewing academic papers published to November 2007, and interviewing several key researchers. Based on the combination of sources and themes discovered; they suggested a bi-dimensional model with the locus of the innovation process on one axis and the extent of collaboration partners on the other. Their framework has four quadrants of collaboration: internal R&D, internal cross functional collaboration, R&D alliances, and mass collaboration (see figure 6). The framework has been used by other researchers to categorize companies strategies and actions towards open innovation. For example, Bigliardi et al (2012) studied the type of open innovation adopted by firms in

the ICT industry in Italy. It was a case study of three companies that pursue different strategies towards open innovation and have multiple types of collaboration both on number of collaborating partners and phases of the innovation process.

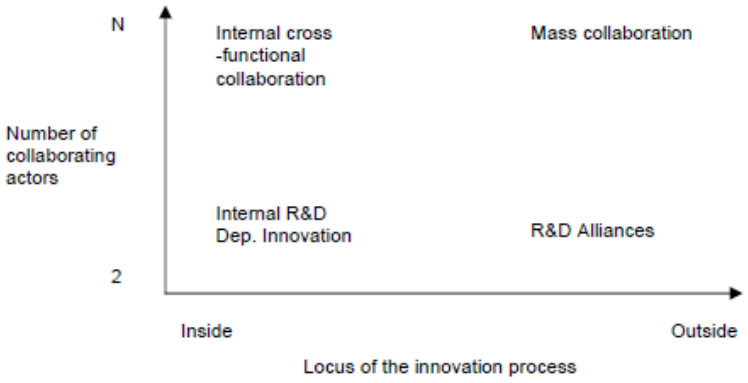


Figure 6: Model of open innovation alternatives (Elmquist et al 2009, 341)

Similarly to Elmquist et al (2009), Lazzarotti & Manzini (2009) integrated several conceptual and empirical studies and proposed a bi-dimensional framework with number/type of partners on one axis and the number/phases of innovation process that is open to external collaborators on the other axis. Based on these elements, they form a 2x2 matrix with four modes: closed innovators, integrated collaborators, specialized collaborators, and open innovators (See figure 7). Like previous approaches, closed innovators have low intensity in both axes; meaning there is not much interaction with the external environment. On the opposite diagonal quadrant are the open innovators which, according to the authors, engage with multiple partners across the different stages of new business development. Then, there is the integrated collaborators quadrant which means they open more parts of the innovation funnel to a few external contributors, i.e., by integrating a few partners with complementary assets to R&D functions. And finally, in the last quadrant are the specialized collaborators, which integrate multiple parties on specific phases of the innovation funnel. Some examples include companies running ideation workshops with multiple actors to gain insights used to develop new products and/or services.

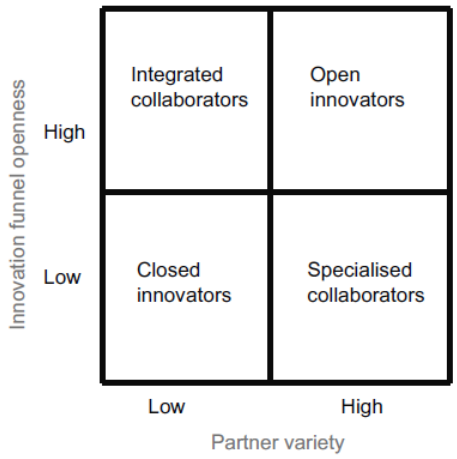


Figure 7: Different modes of open innovation (Lazzarotti & Manzini 2009, 623)

In another research, Lazzarotti, et al (2010) studied the adoption of open innovation by Italian companies and used their framework to cluster different groups of companies. In addition to their previous findings, they linked innovative performance to the clusters, showing that open innovators have higher innovative performance.

Both frameworks reflect a similar view towards open innovation. Although it could be a useful tool, the author considers is not appropriate for this study as it simplifies the type of open innovation modes a big company has, when in reality they could have multiple heterogeneous collaborations. To illustrate this claim, a case company can have several types of collaborations with different characteristics. For example, for one type of collaboration, say a consortia; the number of partners might be quite high. At the same time, for other type of collaboration like strategic partnership they might have just one partner to develop a technology. In addition, the author questions the matter that in these studies, openness is measured according to the number of partners and phases where it collaborates; and not on the degree of value created and captured.

In a separate study, Bogers & West (2010) proposed a similar 2x2 matrix of open innovation with the difference on the locus of innovation creation and commercialization, both internally and externally (see figure 8). For both internal perspectives, the company follows a vertical integrated innovation, which is pretty similar to the closed innovation clusters mentioned by previous authors. From the outside creation and inside commercialization; it is the open innovation inbound (or outside-in according to Gassman & Enkel 2004). In addition, in this quadrant there is also user generated content and crowdsourcing. On the opposite diagonal quadrant is the inside creation and external commercialization; also referred as the Open Innovation outbound (or inside-out), with some examples such as out-licensing, free revealing, selling Intellectual Property, among others. Somewhere in the middle could be considered a mixed or coupled process. The last remaining quadrant represents a user

creation and commercialization approach. Some examples can be seen from business ecosystem (platforms), open source software, innovation communities, amongs others. This last quadrant shows that it is possible to capture some of the value creation and commercialization by establishing a compelling business model.

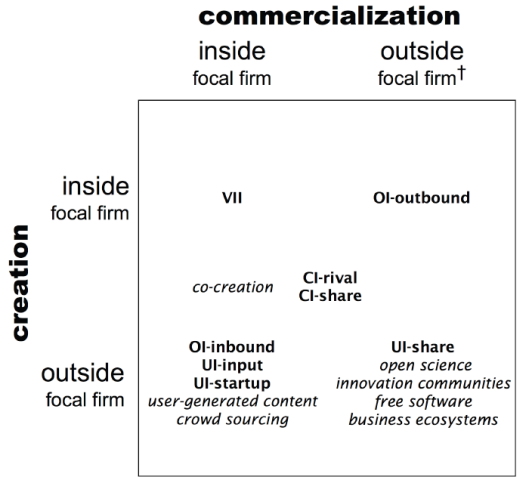


Figure 8: Locus on innovation creation and commercialization (Bogers & West 2010, 36)

A subsequent work by Schroll & Mild (2011) studied the adoption of open innovation in Europe. Using Bogers & West (2010) matrix they categorize different clusters of companies that fall into the previously mentioned categories. They also associate R&D intensity to the type of innovation strategy. Their findings suggests that outside-in perspective has been adopted higher than the inside-out perspective, and that R&D intensity is higher when commercializing external innovations. Moreover, they suggest than open innovation acts as a complement of R&D instead of a substitute, as suggested by Laursen & Salter (2006).

2.2.2 Capabilities

Lichtenthaler & Lichtenthaler (2009) proposed a conceptual framework based on organizational capabilities for open innovation. It considers both internal and external perspectives in three processes of knowledge management: exploration, retention, and exploitation (see figure 9). In this context, knowledge exploration refers to the process of generating new knowledge and adding it to the organizational knowledge base. This could happen internally; by means of researching new technology, testing and experimenting, developing products and services; and/or by means of incorporating knowledge from the outside through modes such as licensing, acquiring, sourcing,

among others. Knowledge retention refers to the process how the knowledge is maintained over time inside the firm. It could also be seen from an internal perspective, how a company keeps the knowledge base active; or by means of keeping access to external sources of knowledge without yet exploiting them, for instance by maintaining networks and alliances. And knowledge exploitation refers to the commercialization of technology either internally or externally. Based on these aspects, the authors identified six capabilities that form the open innovation dynamic capabilities: inventive capacity, absorptive capacity, transformative capacity, connective capacity, innovative capacity, and desorptive capacity. Inventive capacity is the internal generation of new knowledge. Absorptive capacity refers to ability to explore external knowledge. In this context, the use of the term has a shorter scope than Cohen's & Levinthal's (1989) definition; however, the authors' reconceptualization is adopted in order to differentiate between individual processes, and its limitation is complemented by the knowledge exploitation process. Transformative capacity refers to the ability to internally maintain knowledge over time, whereas, connective capacity, refers to the ability to keep the access to knowledge from external sources; i.e. alliances, networks, etc. Innovative capacity refers to the ability to commercialize internal innovations. Finally, desorptive capacity is the ability to transfer innovations to the external environment.

	Knowledge exploration	**Knowledge retention**	**Knowledge exploitation**
Internal (Intrafirm)	Inventive capacity	Transformative capacity	Innovative capacity
External (Interfirm)	Absorptive capacity	Connective capacity	Desorptive capacity

Figure 9: Capability based Framework (Lichtenthaler & Lichtenthaler 2009, 1318)

In a subsequent study, Lichtenthaler (2011) incorporated more elements to the aforementioned framework (see figure 10) by including two more levels in addition to the organizational level: the project and individual level. In addition to the aforementioned capacities, on the knowledge exploration process there are the make or buy decision; and at the project level are the not invented here and buy-in attitude. On the knowledge retention process are integrate or relate decisions and the not-connected here or relate out attitudes. On the knowledge exploration process are the keep or sell decisions and the not-sold here and sell out attitudes.

		Knowledge exploration	Knowledge retention	Knowledge exploitation
Internal	Organizational level	Inventive capacity	Transformative capacity	Innovative capacity
	Project level	Make decision	Integrate decision	Keep decision
	Individual level	Not-invented-here attitude	Not-connected-here attitude	Not-sold-here attitude
External	Organizational level	Absorptive capacity	Connective capacity	Desorptive capacity
	Project level	Buy decision	Relate decision	Sell decision
	Individual level	Buy-in attitude	Relate-out attitude	Sell-out attitude

Figure 10: Open Innovation Conceptual Framework suggested by Lichtenthaler (Lichtenthaler 2011, 80)

In other article, Braun & Bockelmann (2013) integrates Lichtenthaler & Lichtenthaler (2009) capabilities framework to the culinary innovation process. Based on several interviews they identify how the *haute cuisine chefs* use the different capabilities in open innovation. Their study contributes to understanding open innovation at the individual level in creative industries and advance on open innovation capability concept.

2.2.3 Governance or Structure

Van de Vrande et al (2006) reviewed different governance modes for external technology sourcing (see figure 11). By integrating perspectives from transaction cost economies and real options literature, they argue that in environments of high uncertainty, both market and/or technological; it is recommended to use flexible governance modes of low commitment that allow reversibility. Once uncertainty decreases, it is suggested to invert the governance modes. Thus, they recommend real options as a mean to explore external environments of high uncertainty. The advantages of real options from an open innovation perspective have also been discussed by Vanhaverbeke, Van de Vrande and Chesbrough (2008). Real options give the investing firm the flexibility to reverse (pull out) current investment options. On the other hand, once the level of uncertainty decreases, the level of commitment and investment could increase if wanted.

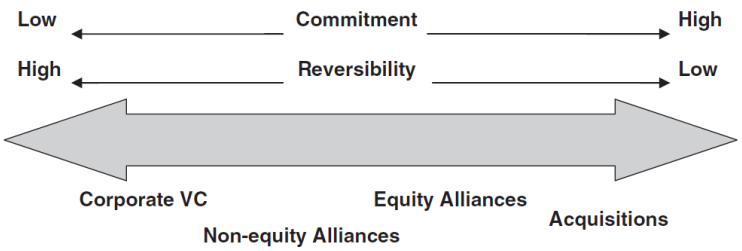


Figure 11: External corporate venturing modes (Van de Vrande et al 2006, 355).

In a different approach towards open innovation, Bröring & Herzog (2008) analyzed multiple organizational tools of business development. In their research, they addressed the questions of how an organization can shift from exploration to exploitation while balancing their open and closed innovation tools. In other words, how they deal with ambidexterity in new business development. In order to do that, they studied how Creavis - the venturing arm of Degussa, managed multiple new business development tools. Explorative and exploitative units require different organizational setup (see figure 12), and thus, it is hard to shift from exploratory to exploitative. To overcome this challenge, Creavis put in place different channels like business ventures units and exploration and validation sections; and then established different entities running as corporate funded projects, project houses, and science to business centers. These entities are established according to the size of competence gap and degree of openness. Corporate funded projects are characterized by a mix of operational (exploitative) and explorative projects. The projects are generated by internal open call where individuals in business units can submit proposals. Later, the proposals are evaluated by an internal committee and the selected projects are funded for two years by the business units and Creavis. The projects are selected mainly by the short term commercialization of R&D. Thus, has a strong exploitative character. In addition it does not require external competences, thus, could be seen as closed innovation in nature. Project houses combine knowledge and competences from different business units. It consists of interdisciplinary team of 20-30 scientists brought together for three years. It has a joint funding between business units and Creavis venture unit. In addition, the project houses work together with universities, research centers, and customers. The output is transferred back to the business units or also by the foundation of new internal start-up. Regarding the incentives systems, they have a venture bonus plan, allowing employees to invest part of their remuneration to internal start-ups. Finally, there is the Science to business centers, or S2B, which involves corporate and public funding. Their focus is on emerging markets with high growth potential outside existing portfolio. They have high technological and market competence gaps. They integrate internal and external knowledge under the same roof of the S2B centers. These centers join basic research, applied research, development of products, and pilot production. The nature is also of multidisciplinary and functional project teams. They integrates scientist from universities and research institutions, and SME's. They provide infrastructure like lab facilities and pilot plan equipment. In addition, allow partnership of capital investments, Joint Ventures or acquisitions.

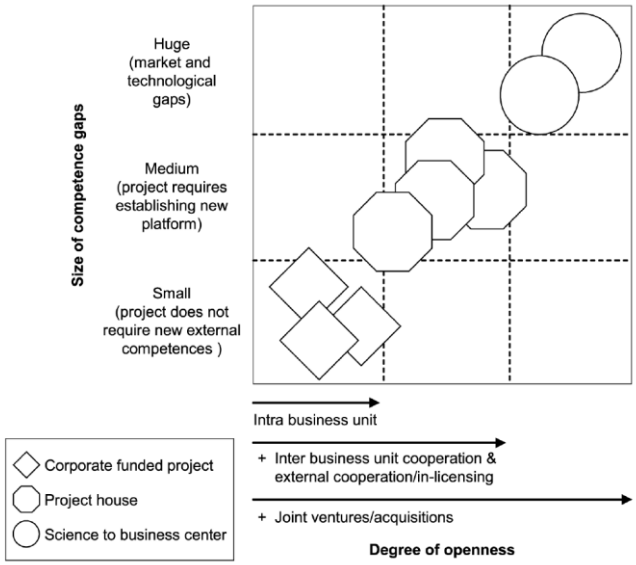


Figure 12: Different New Business Development tools at Degussa (Bröring & Herzog 2008, 343)

This research case is important as shows that firms could use new organizational forms to explore open innovation. The case of Degussa, illustrate how a firm balances the dilemma of exploiting current competences with exploring new opportunities. By creating new independent organizational forms, it is possible to explore new markets, take risky decisions, and experiment new business models that would not be possible through the parent organization.

2.2.4 External sources of knowledge

Kruse (2012) identified external sources of knowledge that could be used for open innovation initiatives (see figure 13). The authors not only consider external parties but goes further to explore sources containing knowledge embodied in patents, regulations, standards, etc. The sources are categorized in groups including: institutions, customers, business partners, media, employees, networks/alliances and competitors. The list of sources includes: academic institutions, nonacademic institutions, governmental institutions, user/consumer, customers, suppliers, innovators, companies within venture capital, other companies, markets, R&D alliances, network alliances, industry networks, others types of networks, competitors, scientific employees, business employees, patents/licenses, standards/regulations, mass media and multiple events. This is not an exhaustive complete list of sources of knowledge but provides good input to identify, search, and distill possible knowledge sources and further explore new opportunities.

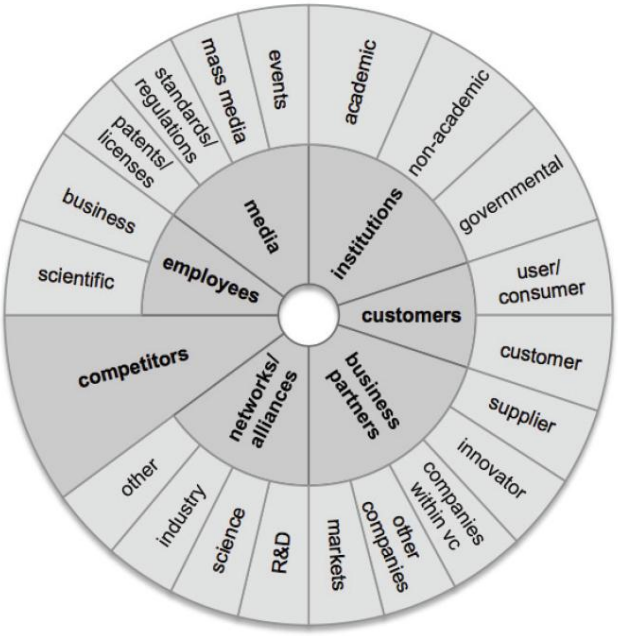


Figure 13: External Sources of Knowledge (Kruse 2012, 5).

2.2.5 Open innovation modes

A collaboration mode could be seen as the way, manner, or method of cooperation between two or more parties. In the context of open innovation, the collaboration modes are forms established to transfer knowledge between the firm and external parties. It could occur at all phases of the innovation process; and from the outside-in, inside-out, and coupled process perspectives. In this research, they are referred as open innovation modes.

Modes vary on goal, scope, complexity, governance, number and type of partners, and extent of participation of their members. The selection criteria could depend on the firm strategy, goals, resources, and capabilities; and could be influenced by the nature of the firm (e.g. culture, structure, governance, processes) and the dynamics of the environment (e.g. competition, industry, regulations).. Therefore, in some situations some modes would be preferred over others.

The following lists contain some of the most frequent types of collaboration modes and processes related to open innovation. They have been grouped according to the phases of the innovation process where they are most prominent; although, some of these modes could also be used in other phases. Also, some modes could overlap as they are not mutually exclusive; for instance, free-revealing, co-creation, crowdsourcing, and user innovation have much in common and could be mixed, or they can be addressed independently.

Creation modes

- Idea generation: Involves a process of gathering ideas and insights from external parties such as suppliers, customers, competitors, and universities. This could happen by multiple collaboration activities such as partnerships, workshops, insight sessions, co-creation activities, and executive forums. For example, Deutsche Telekom (Rohrbeck et al 2009) gathers customer insight using ethnographic methods such as empathic design and day-in-the-life visit. These insights helped identify unarticulated needs and develop better services for their customers.
- Scouting: A process of searching for new ideas and technologies by scanning the environment and external parties such as scientists, venture capitalist, entrepreneurs, startup firms, idea scouts, among others. For example, Beta one of the Italian case companies in Bigliardi et al (2012) research; established an internal laboratory for scouting and monitoring technological and business trends. In addition, the laboratory collaborates with incubators, business angels, and startups for idea generator activities.
- Academic and research institution collaboration: There are multiple types of collaboration with universities and research institutes such as joint research, funding research projects, government funding research, endowed chairs, and public projects research consortium. For example: Deutsche Telekom (Rohrbeck et al 2009) uses an organizational form called T-Labs to manage industry-research center. They have four endowed chairs, over 80 post-doctoral researchers and over 100 employees working on technology and customer driven innovation. When collaborating with academics, it is important to remember their goals and motivations. In most cases their aim is to create and diffuse knowledge which could be an issue in collaborations where the output of the research is intended to be kept in secret or protected.
- Customer Integration: It is one of the most used modes of collaboration (Campbell-Smith 2008). It involves integrating customers into different phases of the innovation process, usually in the initial phases of ideation, problem statement, early prototype evaluation, and co-design, among others; but also at later stages of development, and commercialization. A few examples: Google is constantly launching new products at early stages to get feedback from lead users and improve the products before launching to wider crowds; threadless.com, allow users to submit designs for their t-shirts, vote for the most popular, and finally buy them on their website; and Telefonica sponsors Campus party in Valencia, where thousands of participants exchange ideas on technologies and innovations.

- Corporate Venturing: Refers to the act of investing in a new internal venture that is distant from the core business. Corporate venturing surges as a mean for corporate growth in new areas or markets of higher risk and uncertainty. The term internal corporate venturing is used for investments within the company, as new units. It is different to external corporate venturing or corporate venture capital, which involves investments in ventures outside the organization, such as other companies, startups, investment funds, and others. Corporate venturing overcomes issues like bias towards existing products, markets, organizational structures, and lower risks tolerance. It is a mean to explore new opportunities. Some companies are already taking advantage of entrepreneurial behavior both inside and outside their boundaries. These companies have units responsible to take unused ideas into a new organizational form or investing in startups. Some examples include: Google Ventures, Intel Capital, Motorola Solutions Venture Capital, Siemens Venture Capital, Cisco System and Qualcomm Ventures, to mention a few. As an interest example: Degussa uses a venturing arm for their investments. They have investments across multiple horizons and in new domains.
- Spin-ins: It involves the act of integrating a startup or business unit into the corporate business. Sometimes this happens for already spin-out companies of the parent company which are later reintegrated; this allowed the startup to work in the proper environment without the boundaries set by the parent company.
- Acquisitions: Refers to the action of acquiring another firm, a business area, a technology, people or intellectual property to gain access to knowledge, resources, or customer base. Acquisitions are easier to manage when the knowledge acquired is in explicit form (patents, technology, documents, products, etc.). Acquisition is a rigorous process involving, strategic analysis, thoughtful evaluations, due diligence; and, thus requires investing time and resources. One company that has successfully developed an acquisition process is Cisco. With over hundred acquisitions, the process is part of their strategy and competitive capability.
- In-licensing: The transfer of a license by agreement from another organization in order to use it for the innovation process. There could be licenses of technology, intellectual property, product, brand, process, and others. Licensing is common for big pharmaceutical companies like Pfizer, Novartis, etc.; who license from smaller bio-tech companies. There could also be licensing of intellectual property such as music, movies, art, and others.

Development modes

- Transactional development: Refers to the type of development made by contractual agreement. This could happen in several forms such as broker function,

challenges, or posting a technical problem for solvers. In addition, could be made through interaction with communities like in the case of open source software. This mode of collaboration is very useful when the problem or issue can be modularized and diffused to a big number of solvers like in Internet competitions. Some examples include: Idea contest, technical challenges, posting needs/wants, crowdsourcing, among others. These initiatives could be initiated by the firm or via brokers or innovation intermediaries. Most common examples come from innovation intermediaries' activities, competitions and challenges posted by some companies, or a few companies adopting these initiatives into their business model, like Procter & Gamble Connect + Develop program and their co-creation channel.

Commercialization modes

- Spin-outs: A spin-out is a newly formed company in which the parent firm holds an equity stake. A spin-out is a viable form to take unused knowledge to the external environment in situations of high risk and uncertainty, or when the parent firm cannot exploit the knowledge internally.
- Out-licensing: The transfer of a license by commercial agreement to another organization. IBM is one of the top patent holders with billions of revenues from license fees.
- Divestures: Selling a business unit, technology, or intellectual property; a firm decides not to focus anymore.

Others modes

- Strategic Alliances: Involves different types of collaboration between firms to gain mutual benefits by using complementary assets. They can be separated as equity and non-equity forms. Non-equity forms include: collaboration, joint research, working with suppliers, licensing, sharing Intellectual Property Rights, R&D consortia, industry clusters, and networks, among others. Equity forms include: joint venture, mergers, acquisitions, investments, cross shareholding, etc. There is a distinction with joint venture as it forms a new independent entity.
- Standardization: is a process for developing and implementing technical standards. The aims of standardization vary from having compatible technologies in a fragmented industry (e.g. computer hardware and networks), to improve quality and safety (e.g. ISO 9000, OSHA, etc.), and to diffuse and promote a new technology (e.g. the case of Blu-ray disc technology), among others. According to Grøtnes (2009), standardization has been essential for innovation in the mobile industry and this model suits very well the telecom industry. Also, standardization is good to develop new technologies like in the case of new generation of telecommunications, M2M, and Internet of Things. This has also been referred as up-front standardization.

- Innovation Intermediaries: Intermediaries perform multiple roles such as facilitators, brokers of knowledge, marketplace for innovations, bridge domains, and change agents. Some popular innovation intermediaries include: Innocentive, NineSigma, Yet2com. These intermediaries leverage their networks of scientist, problem solvers, and entrepreneurs, to match problem seekers with solvers. In addition, they support the firms to formulate their problems, handle intellectual property rights between solvers and seekers, among other services. Some of them function as a technology and innovation broker agent whereas others offer personalized services and consultancy services for corporate open innovation. Using innovation intermediaries could be a way to learn about open innovation.
- Co-creation platforms (API, Toolkits, etc.): Commonly referred under multiple names such as Internet platform, community platform, innovation platforms, etc.; co-creation platforms are physical and virtual environments that involve multiple parties to create value together. Lego offers a great example of customer integration and co-creation. They have several tools to engage with users. For example, in Lego's CUUSOO platform, users can create and submit a concept, which if backed up by at least ten thousand people, gets a chance to become an official product. For other user group, Lego offers a toolkit which allows them to code to operate Lego's Mindstorm. These are a few examples of toolkits that allow co-creation. Other firms that are exposing assets to user groups include telecom operators such as Deutsche Telekom and South Korea Telekom; both offer developers API's, SDK, and other resources.
- Free Revealing: According to Von Hippel & von Krogh (2006) free revealing of information constitutes the act in which all intellectual property rights of that information are voluntarily given up by the innovator, and all parties are given equal access to it, in other words the information becomes a public good. Free revealing could be profitable when there is a business model in place that could capture value from revealing. For example by offering complementary products or services; by gaining reputation of by diffusing the innovation and having it adopted (Von Hippel 2006); or like in the cases of open source software.
- Crowdsourcing: Could be seen as an extrapolation of open innovation (Sloane 2011). Jeff Howe, who coined the term, defines crowdsourcing as a "company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call" (Howe 2012). One remark is that in order to be crowdsourcing, the outcome of the open call needs to be implemented by the firm. Crowdsourcing can take many forms such as in ideas generation, solving challenges, giving tools to co-create with the crowd and other forms. In addition to crowdsourcing, there are new forms of collaboration related to crowds such as crowd-funding, crowd-

equity, crowd-solving. Some examples include: Wikipedia, Facebook (languages), X prize, among others. Moreover, the potential of crowdsourcing will depend on the business model designed for it; for example: Waze utilizes user generated input to bring value to the platform, Fold.it build a game interface to attract users to contribute to the research of curing diseases such as HIV/AIDS, Cancer, Alzheimer's among others; and Dualingo captures value by using a learning platform that enables crowdsourcing professional translations.

- Joint Ventures: Is a new entity formed by the equity of two or more partners. Joint ventures are useful when there is high partner complementarity and good relationship between the partners. Joint Ventures could have diverse goals like develop new products and services, research center for parent companies, or commercializing goods and services in new markets.
- User driven innovation: This term will be used to include three aspects of user driven innovations. First, user innovation as the act of lead users bringing innovation by themselves (see, for example: Euchner 2013, interviewing Eric Von Hippel). Firms could benefit from these types of users and from collaborating with them. Second, firms benefiting from incorporating users/customers into the innovation process (Henala, Parjanen & Uotila 2011). In addition, to lead users, other users/customers can support the innovation process by providing ideas, insights, knowledge, evaluating prototypes, giving feedback, acting as testers, and by diffusing and promoting the innovation. Last but not the least, the growing trend of firms employing toolkits to co-create with users. Firms can provide toolkits in form of tools, API's, free revealing code, among others; engaging with users and encouraging them to co-create. It is important to remark that in order to capture value from the co-creation; firms need to have a supporting business model.

These are some of the most used modes and activities related to open innovation. However, this is not a complete list, as some modes could contain other modes and activities, and new modes could appear in the future.

2.2.6 Open Innovation Models

Open innovation literature offer several contributions of use cases and frameworks like those seen in the previous chapters. However, models that include a broader perspective and guidelines for implementing open innovation are limited. This chapter will present a few contributions worth reviewing; namely Slowinsky (2005) Want, Find, Get, Manage model; West and Bogers (2013) four phase model; and an inside-out perspective by Collins (2014). These tools provide guidelines for innovation processes.

One popular tool to identify and manage opportunities from the environment is the: Want, Find, Get, Manage model proposed by Slowinski (2005). The tool is centered on the following questions: What external resources do we need to succeed in our mission? (Want); what mechanism will we use to find these resources? (Find); what processes will we use to plan, structure and negotiate an agreement to access the resources (Get); what tools, metrics and management techniques will we use to implement the relationship? (Manage).

In a similar way, West & Bogers (2013) suggest a four phase model to leverage external sources of innovation: obtaining, integrating, commercializing, and the interactions between the firm and its collaboration. The obtaining phase involves sub-phases of searching, enabling/filtering, and acquiring that have some similarities with this step. These previous examples focus on the outside-in perspective.

Collins (2014) analyses the other side of the coin with the case of Beijing Genomics Institute practicing inside-out open innovation. He formulates two questions to explore how companies can implement this process: The first questions tries to discover how the knowledge can be packaged and presented (converted to be easily transferred) in a way that others might find useful? And second, what win-win situation is envisioned? In other words, how could value be created or captured by the openness initiative?

These tools could be useful; however, in the end it depends on the firm and how they want to approach open innovation. For example P&G's famous Connect and Develop program (Huston and Sakkab 2006) has processes for scanning new technology developments via internal and external networks (based on similar criteria from previous steps) and screening criteria based on matching needs with opportunities and other factors such as partner negotiations, feasibility, ability to integrate to current operations, among others. P&G combines internal and external networks (Open Innovation intermediaries) to specify technology briefs (wants) and scanned possible solutions & technologies. They have a separate process for evaluation. In addition they have built an IT solution to manage their internal networks, and support the screening process by matching needs with opportunities.

2.2.7 Use cases in the ICT sector

There have been multiple case studies of open innovation. This research will review particular examples from the ICT sector. First, Rohrbeck et al (2009) studied how Deutsche Telekom created an open innovation ecosystem. The researchers separate several of the companies initiatives based on the innovation process phases and the intensity level, composed of budget, time, and resources (see figure 14). The company employed several tools like foresight workshop, executive forums, endowed chairs, cus-

tomer integration, consortia projects, Corporate Venture Capital, Internet platforms, joined development, strategic alliances, spin-outs, test markets. His study brings valuable contributions as it provides an overview of different open innovation initiatives within a company. Nevertheless, elements related to managing capabilities are missing.

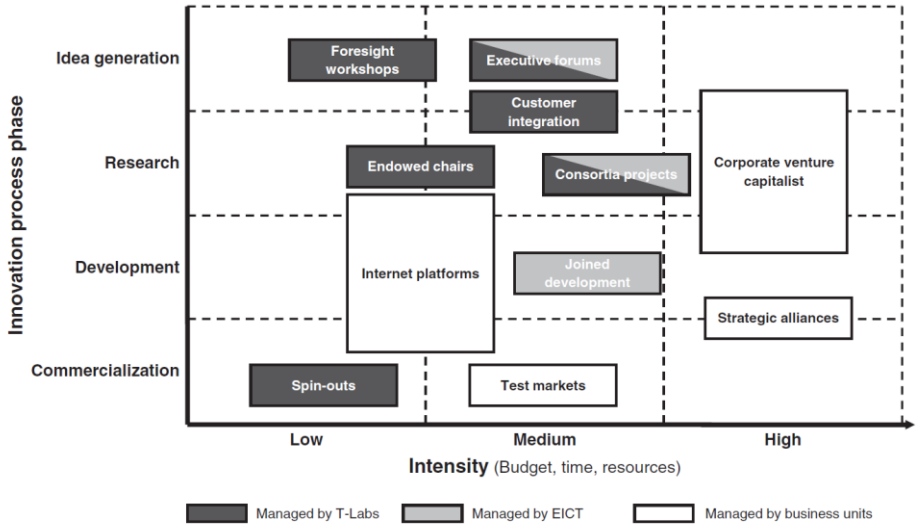


Figure 14: Open Innovation Ecosystem at Deutsche Telekom (Rohrbeck et al 2009, 425)

Bigliardi et al (2012), studied the case of three big companies in the ICT sector in Italy. They studied the open innovation approach adopted by these companies and the collaboration and dynamics that characterize them. Some examples from these companies include research centers for new business opportunities with multicultural and interdisciplinary networks; having external development or acquiring already establish solutions, integrating them into their current offering; creating boards, processes, and professional roles that enable to maintain and nurture the collaboration relationships. These companies collaborated mostly with university and research centers, suppliers and actors within the value chain. They also found out that organizational and cultural issues are the main barriers to implement open innovation. Finally, they used Elmquist et al (2009) matrix to position the case companies. This example reinforces the notion that open innovation is a continumm, and that multiple activities can be practiced by firms and in different ways.

Grøtnes (2009) analyses how different policies towards membership in standardization initiatives lead to different open innovation processes. He analysed two cases: the open mobile alliance, involving several actors of the telecommunication industry and whose goal is to create a platform to develop new mobile services; and the open handset alliance, led by Google, and whose goal was the creation of a mobile operating system, Android. The cases differ in how membership and intellectual property rights were handled.

The development of Android was limited to selected members including operators, handheld manufacturers and some service providers. It followed both: an inside-out and outside-in open innovation process but at different stages. First, the outside-in process ocurred when Google acquires a startup, Android, and then created the alliance to develop and diffuse the android platform. In addition, the architecture consist of open source components like linux kernel, libraries, and android runtime environment. Secondly, they used an inside-out process by sharing android as open source, provided a software development kit for third party developers to create apps (bringing value to the platform ecosystem), and provided a marketplace to freely publish and distritute apps.

On the other hand the open mobile alliance membership is open for all. The platform especifies new functionality and services for mobile devices. In this case, a coupled open innovation process predominated, as inflows and outflows of intellectual property rights between members and other standarization organizations were needed for the standardization process. The standards are available to anyone by licensing on reasonable and non-discriminatory terms. The standards could be implemented, commercialized, and taken to the market in multiple ways. This case study is important for this research as it provides examples of how an open innovation mode such as standardization can have differences according to the goals, processes, and business model implemented; and how they impact on control and Intellectual Property rights issues.

In a different contribution, Dittrich & Duysters (2007) made a longitudinal study of Nokia's R&D alliances during the period of 1985 – 2002. They analyzed the differences between exploration and exploitation strategies by means of observed capabilities of the partner. They argue that the type of alliance will vary depending its nature; exploration had more flexible legal structures, whereas exploitation activities have formal structures; leading to distinct international innovation networks. During Nokia's product development, exploitation was mostly used during first two generations of mobile telephony, where Nokia had most of the required capabilities in-house; and exploration was mainly used for the third generation, where new software capabilities were needed to offer new producs and services. The decision criteria for Nokia's collaboration was: will the company be able to produce it alone fast enough? Followed by a second question: Does the company has necessary competencies to produce it in short time period? If the answer was no to both questions, then they would decide forms of collaboration or outsourcing.

An Economist Intelligence Unit Report (Campbell-Smith 2008): Opening up - How R&D is changing in the telecommunications sector today, analyzed how technology and telecommunication firms are dealing with the process of innovation. The author conducted a wide-range survey to over 300 senior executives in the technology and telecom industry and follow up in-depth interviews. The findings suggest that the

internet has transformed the process of innovation in telecoms, going from Telco to Softco during the last years. Majority of respondents (74%) agree's that innovation approach has changed significantly compared how it was a decade ago. The number of collaboration with external partners has increased (just 30% of respondents choose the option develop new products or services entirely in-house) and most of the cases are with customers; two out of three respondents said they involve customers in the innovation process. Some examples of what companies have been doing include: internal incubation through corporate venture, scanning startup business, invest and acquire, collaborate with academic research, and strategic partnerships not only with telco companies but also with companies from other sectors.

The study mentioned that open innovation is helping telcos: find new ideas, accelerate new business development, and strengthen the links with the customer through differentiated customer experiences. Furthermore, it gave some examples of how some operators are employing open innovation. For instance, Telefonica has a campus party were they bring together companies, consulting firms, universities, and start-ups. Also, British Telecom taps into external expertise with *hothouse* discussions, and in other examples, inviting schools teenagers to contribute with their ideas.

2.3 Knowledge Management

Knowledge management plays a major role in Open Innovation as it involves inflows and outflows of knowledge in multiple forms. But accessing or exposing sources of knowledge would not necessarily mean that the firms' will be able to integrate and exploit the new knowledge. For example, access to knowledge from universities and partners in its basic form (know-how, people, process, technology, etc.) needs some kind of process to integrate and to develop it into something that could generate revenues. Therefore, it is important to understand knowledge characteristics and the firms' routines, tools, and processes to explore, integrate, and exploit knowledge.

Knowledge management could be seen as the formal processes and structures firms employ to collect, interpret, and internalize knowledge (Storey & Kahn 2010). The processes need to consider between two types of knowledge: explicit knowledge and tacit knowledge. Explicit knowledge is easier to codify and transfer. On the other hand, tacit knowledge is harder to codify and transfer. Also, explicit knowledge is revealed by communication whereas tacit knowledge is revealed by its application.

Knowledge management has to consider aspects such as transferability, aggregation, and appropriation. Transferability refers on the ability to transfer knowledge from one source to the other. It will depend of the type of knowledge and its embodiment. Aggregation refers to how knowledge is integrated to the previous knowledge base. Aggregation is enhanced when it can be expressed in terms of common language (and knowledge base). Appropriation refers to the ability of an owner of a resource to receive an equal return of value from his resource. Tacit knowledge is appropriated through its application to productive activity; e.g. a medic applying his knowledge in surgery. Explicit knowledge might have some issues with appropriation, in particular of public good as they can be acquired and resold without losing it.

Figure 15 illustrates an example of knowledge management. It is separated in three processes of exploration, integration, and exploitation. In the example a firm possesses knowledge base of domain A and B. In the first step, new sources of knowledge of domain C and D are identified. In the second step, it is shown that with its current knowledge base, the firm is able to integrate knowledge of domain C but not of knowledge domain D. This could happen because variable reasons, for example: the knowledge base is not sufficient to integrate D; because it is too costly; require more time and effort; or because the firm do not want to integrate D as it does not fit its operations (strategic reasons). In the last step, the firm exploits its knowledge base to create new products and services.

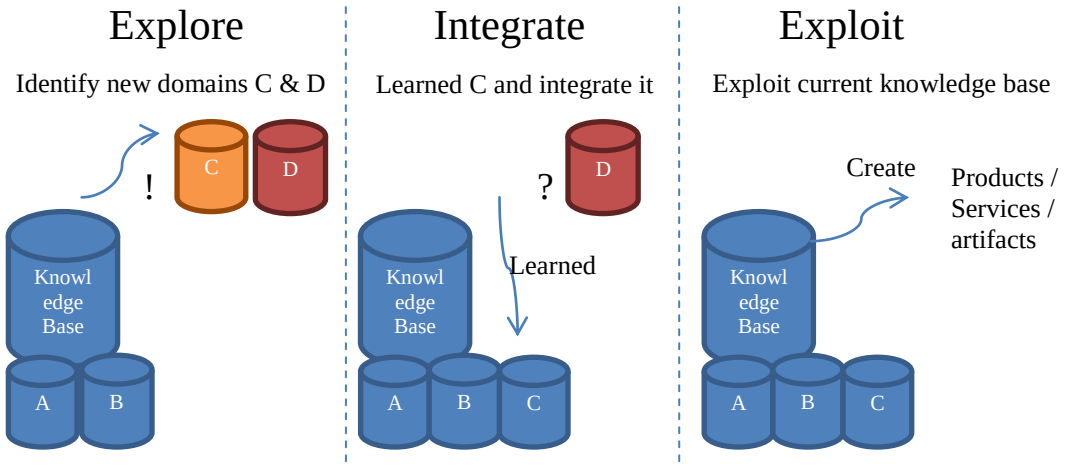


Figure 15: Example of knowledge management process.

The differences of knowledge type, aspects, and embodiment have important implications for knowledge management process, for example: if tacit knowledge cannot be codified, can only be observed through its application, and acquired through practice, its transfer between people is slow, costly, and uncertain.

In addition, The Organisation for Economic Co-operation and Development or O.E.C.D. (Bogers 2011) categorized four stages of knowledge found in collaborations: background knowledge, foreground knowledge, sideground knowledge, and postground knowledge. Background knowledge is the existing knowledge put into the collaboration, Foreground is the knowledge created as outcome of the collaboration, sideground is knowledge relevant to the collaboration, developed in-house in parallel to the collaboration and postground knowledge is knowledge relevant for the collaboration developed in-house after the collaboration (Bogers 2011). This type of knowledge categorization helps handle the knowledge management collaboration process between the firm and external parties.

2.4 Innovation

It is on the authors' opinion that the term *Innovation* have been misused and overused. Nowadays, the term is being employed to denote any degree of novelty, to the level that communicates that anything new is an innovation. Although novelty is an important element in order to have an innovation, there are other requirements; namely, usefulness and market acceptance/adoption. The first element, novelty, conditions the innovation to introduce something new; a novel idea, concept, product, development, service, process,

or other. Novelty does not necessary means it need to be completely new to the world (as invention) but must be new in the context where it is applied. Second, it must create or deliver value to someone; let it be a new product or service that satisfies a customer need, a process improvement that reduces costs or maximizes output, or other. Last but not the least; the innovation must be adopted by a market, diffusing its novelty and value to a broader audience.

Innovation differs from invention in the sense that an invention has novelty and value but not necessarily has been adopted by the market. A huge number of innovations have been old inventions, existing products, or services; taken into a new context. For instance, centuries before being used by arms, gunpowder was used for fireworks and the treatment of ailments.

There are different categories for innovations such as process, product, organizational, to mention a few. This work will consider all types of innovation but will make a distinction based on the degree of novelty between two main types: incremental and radical. Incremental innovations are used to denote small or minor change with less degree of novelty, i.e. improvements in product line, new functionalities in an existing product, etc. Radical or disruptive innovations are often associated with bigger changes, not just in the innovation itself but on people's behavior, i.e. the introduction of the first iPhone and its impact on people's (and companies) behavior regarding mobile communications. Radical innovations can be disruptive, meaning that they change the status quo of a market, industry or even create new ones.

These two categories are relevant for management, as these types of innovations demand different styles, organizational structure, culture, and processes. In addition, the benefits deriving from the types of innovation differ; the more radical, the greater benefits a company could obtain (Küpper, Lorenz, Maurer & Wagner 2013).

Innovations can affect firms' growth in both positive and negative way. The lifecycle of technologies resemble an S-Curve (as seen in picture 16). Companies need to be aware of the disruptions in technologies as it could affect their competitive advantage.

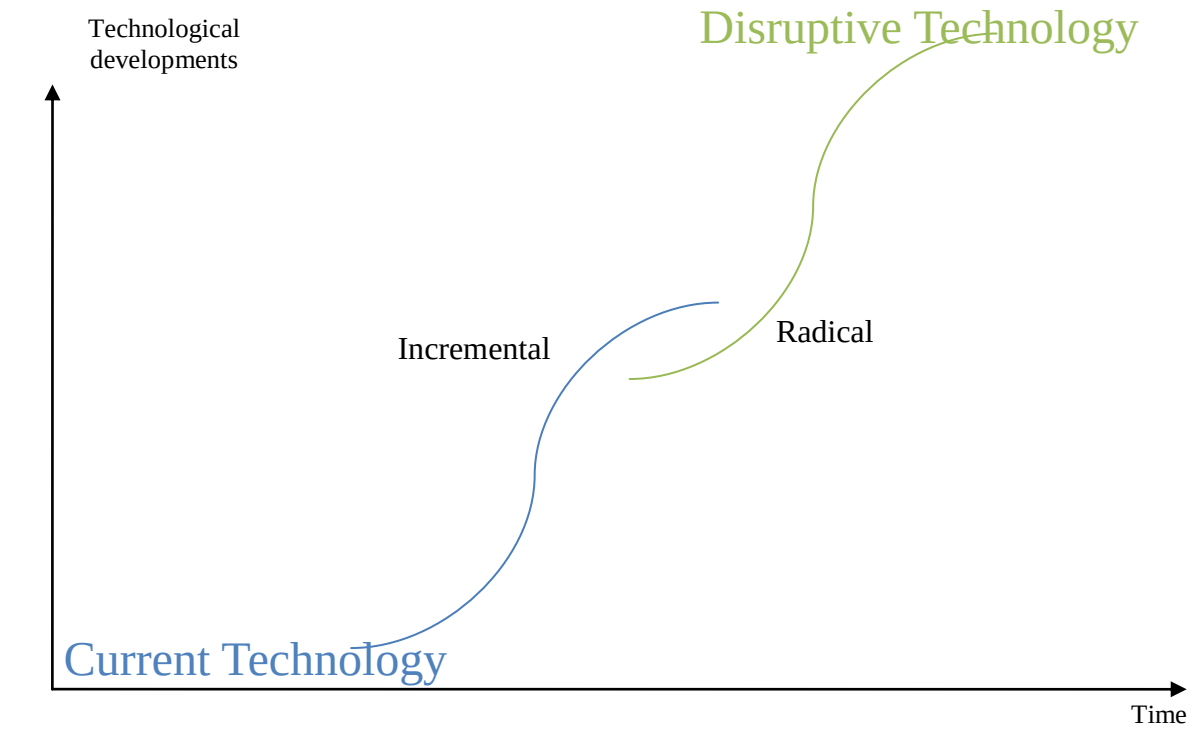


Figure 16: Technology S-curves and disruptive technology

Academics have address product development by explaining its process through linear models, such as stage-gate model or the product development funnel (See figure 17) that starts with an idea, develops into a concept/prototype, and finishes as product or service that (in most cases) could be sold in a market.

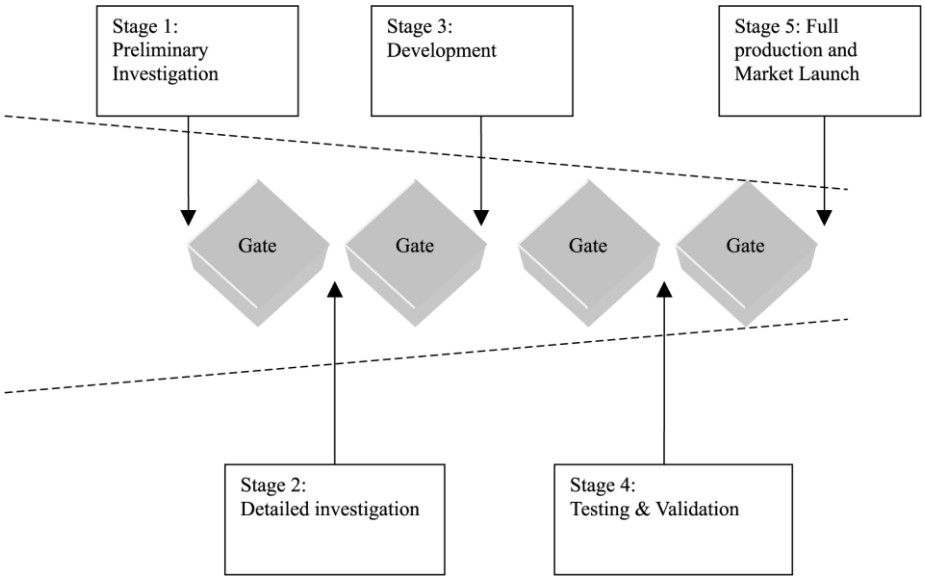


Figure 17: NPD funnel model (Harkema 2003, 341).

Innovation process has several sub-steps which vary according to authors; however, it is possible to generalize three main processes: idea creation, development, and commercialization. This model simplifies the path an idea can take towards being materialized into a product or service; though, in reality, this process does not always follow a linear path, as there could be plenty iterations until the idea reaches the end of the process (see double side arrows in figure 18). Moreover, most of these ideas do not reach the end of the path.

Figure 18: Basic elements of the innovation process.

Finally, managing innovation is like playing poker (Chesbrough 2004). There is lot of uncertainty, in particular in radical and disruptive innovations, which is reduced step by step as time passes. Thus, the game is changing after each turn and company needs to make new decisions based on these changes.

After reviewing some of the general elements of innovation, it is possible to agree on the scope this concept will have within this study. Thus, this work will consider innovation as the successful commercialization of an invention. Also, it will use the funnel and stage-gate model as a reference for the innovation process, in addition, to other perspectives. And, it will consider innovation of all kinds (product, service, organizational, process, etc.) but will separate them into incremental and radical.

2.5 Firm strategy

A strategy is a contingent plan that formulates a set of actions and decisions taken in order to achieve one or more goals, usually firms' vision. In business, it defines a set of actions that will impact firm's growth (and survival). According to Porter (1996) a strategy defines firm's position, selection of choices and trade-offs, and fitting of operational activities. Strategy formulation needs to consider factors such as changes in the environment, uncertainty, competition, risks, and others. These factors change with time and are influenced by the system dynamics in which they operate. The reason behind reviewing contributions in this domain is that open innovation should be part of firms' overall strategy (Vanhaverbeke 2013; Chesbrough & Brunswicker 2013).

2.5.1 Multiple Strategies

Firms could follow multiple strategies at different levels. For example: Porter (1980) defines three general business strategies: cost leadership, market segmentation, and product differentiation; Kim & Maugborne (2005) argue that a differentiation and cost efficiency strategy can be achieved at the same time, proposing a Blue Ocean Strategy which has value innovation in its core; Guiltinan (1999) discusses new product development launch strategies, differentiating between lead and follow strategy; and on a different level, Kaplan (1999) discusses discontinuous innovation strategies; including: radical cannibalism, competitive displacement, market invention, and industry genesis. The domains where strategy could be applied seem never-ending; with broad literature covering specific domains such as corporate strategy, internationalization strategy, innovation strategy, technological strategy, to mention a few. Thus, firms could pursue multiple and heterogeneous strategies at a given time, aligning resources, and capabilities to obtain the goals planned.

2.5.2 Balancing time dimension and uncertainty

Developing a strategy requires that firms make decisions considering factors that could change in short and long term future. As future is uncertain, managers make predictions of what could happen. Furthermore, uncertainty tends to be higher as the time frame and dynamics of the system increases.

In addition, the factors that provide competitive advantage in the presents might not be sufficient to compete in the future. There are plenty of cases that illustrate this claim, in particular with incumbent firms missing an opportunity and being displaced by new entrants and technologies; for example when Kodak did not invested sufficient in developing the digital camera market, and continue investing in film market. However, there is a risk of investing all resources in developing products and services for the future without generating profit to sustain those investments. Firms need to find a balance between surviving the present without losing competitiveness in the future. Day & Wensley (1988) considered this issue when referred to strategy:

> *"Strategy is about seeking new edges in a market while slowing the erosion of present advantages." Day & Wensley (1988, 1)*

Also, there is uncertainty about new technology developments and market reaction to those technologies. Some management perspectives consider control and prediction as the focus of strategy (Wiltbank, Dew, Read & Sarasvathy 2006). Taking these consideration, there are different strategies that work better depending the circumstances. For example, a careful planning strategy works best when the changes in the environment

are minimal and the level of uncertainty is low. On the other hand, in conditions of high uncertainty and dynamic environment, an adaptive strategy could be more appropriate.

One way to deal with time and uncertainty is to have multiple strategies that balance firms operations of the present with the requirements of the future according to factors such as risk, uncertainty, and time.

2.5.3 Strategies across multiple horizons

Beikenhocker (1999) argues that firms should manage a portfolio of strategies across multiple horizons. The authors propose using Baghai, Coley & White (1999), three horizons of growth (See figure 19) and populate them with multiple strategies. The three horizons of growth are: Defend and extend current business, drive growth in emerging new businesses, and seed options for future growth businesses.

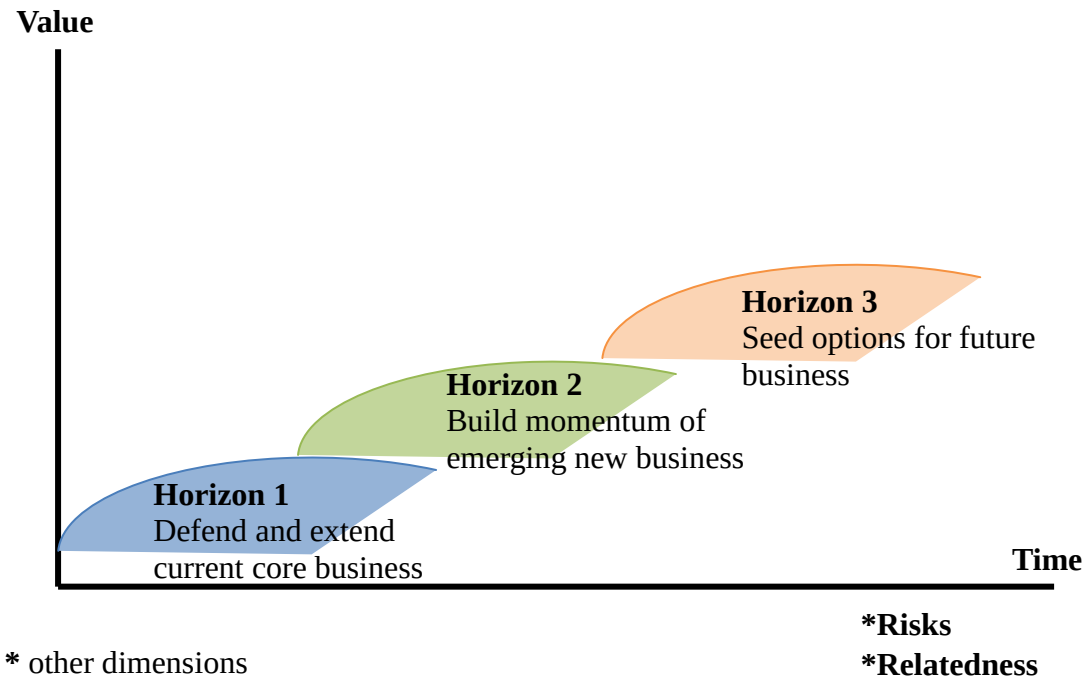


Figure 19: Three Horizons of Growth adapted from Baghai et al (1999, 5)

The first horizon: Defend and extend current core business; aims at exploiting current capabilities in order to grow in the core business and develop further the existing market. Most companies focus on the first horizon, with examples such as developing new product and services for existing markets, and bringing existing products and services to adjacent markets. The second horizon: build momentum of merging new business; is concerned in using current capabilities to find new growth opportunities in new

markets or developing new capabilities in order to offer new products and services, like in the case of Amazon's web services. Finally, the third horizon, seed options for the future business; involves higher level of uncertainty in which the firm could not really foresee what is going to happen. Still, it is possible to invest in developing future options which are expected to be centric for future business. For example, oil companies, making different types of investments in renewable energy technologies.

The three horizons have two axes: value and time. In addition to time, there are other dimensions that could be used, such as risks and relatedness to business. These dimensions are usually correlated, but are not always the case, e.g.; firm can make risky investments or can diversify in a completely unrelated business in the first horizon. The further the horizon, the bigger the gap from current capabilities and longer time it takes to develop, however; the payoffs tend to be higher.

The notion of multiple horizons and the dilemma of managing two contrasting perspectives have been addressed by other authors. For example: March (1991), talks about exploitation of old certainties and exploration of new possibilities. March characterizes exploitation with terms such as: refinement, choice, production, efficiency, selection, implementation, and execution. On the other hand, exploration is characterized by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation. Both exploration and exploitation are essential for organizations; however, their activities are limited by, and compete for, the resources of the firm.

Innovation management literature discuss about incremental and radical innovation. Incremental innovation demands minor organizational changes and efficiency, whereas radical innovation demand changes in the organization. In network theory it can be seen from the weak and strong ties perspectives. Nokia used strong ties to develop the first two generations of mobile telephony but in order to explore new opportunities, it require to explore new technology domains and used weak ties on the development of the third generation (Dittrich & Duysters 2007). Like Baghai et al (1999) three horizons, exploration is usually correlated with increase in time, uncertainty and risk but that is not always the case. Companies that manage to balance between the multiple horizons and exploration and exploitation activities are commonly referred to ambidextrous organizations.

Beikenhocker (1999) argues that in areas of uncertainty is recommended to have a population of multiple strategies that evolve over time. Some of his arguments are that adapting to the changes of the future require running several experiments; and the factors that fit today competitive environment may not fit tomorrows'; hence, it is recommended to experiment with multiple strategies.

This research will adopt these notions of strategy across multiple horizons to address dilemma's related to exploitation and exploration, incremental and radical innovation,

and managing risk, uncertainty, and capabilities; together with current and new business opportunities.

2.6 Business Model

Authors have not completely agreed on what constitutes a business model (Berglund & Sandström 2013). There are several definitions, and views of what a business model entails; however, there is a consensus that business model describes how firms: create, deliver, and appropriate value through interaction with the environment.

A business model defines a set of components and their interrelationships, transcending the boundaries of a firm. For example, *the business model canvas* (Osterwalder & Pigneur 2010), one of the most popular business model frameworks; analyses the following components and their interrelationships: value proposition, customer segment, customer relationships, sales channels, suppliers, key partners, key activities, key resources, costs structure and revenues systems (see figure 20). This model has gain popularity as it helps to understand the logic of the firm by visualizing the main components of a business and their interrelationship; furthermore, allowing to change variables to experiment with a new business model.

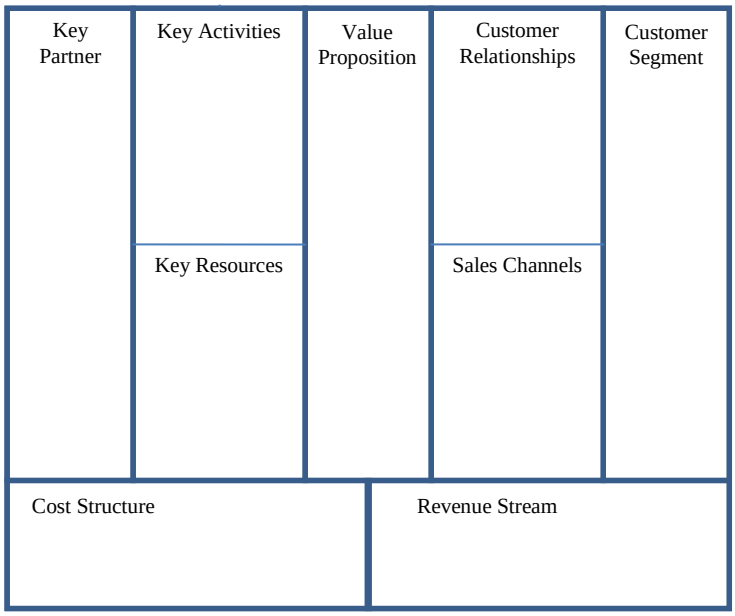
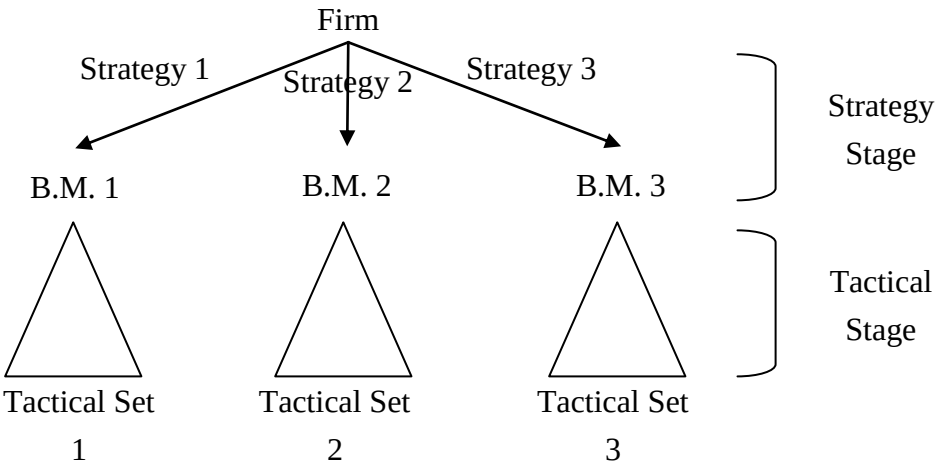


Figure 20: Business Model Canvas (Osterwalder & Pigneur 2010, 25)

Business model could be seen as the implementation of a strategy (Casadesus-Masanell & Ricart 2010). The main difference between both could be appreciated with the occurrence of a contingent action; e.g. when a new competitor enters the market,

launches a new product/service, etc. In that case the company could adapt/change the business model as part of its strategy (see figure 21).



B.M. = Business Model

Figure 21: Strategy, Business Model and tactics. Adapted from Casadesus-Masanell & Ricart (2010, 204).

Firms can change their business models to a new one; referred in the literature as business model innovation. Business model innovation carries significant challenges related to organizational change (Berglund & Sandström 2013); in particular, those encountered on ambidextrous organizations:

- Resource inertia due conflicts between old and new model
- Cognitive inertia due influence of an existing dominant business logic
- Lack of management leadership capabilities
- Lack of firm-internal organizational structures and processes needed to manage dual business model.

In some cases, it is necessary to make changes or update the business model. But is not always the case as there other means to exploit opportunities without major changes to the business models. This could happen forming new organization forms, like partnership, spinoffs, corporate venturing, among others; that have its own business model. Nevertheless, for disruptive innovations, especially those introduced by emergent firms, it is important to adapt the business model and refocus the strategy if it has not been done.

Chesbrough discussed about the importance of business model in his first book of Open Innovation (Chesbrough 2003). In his second book: Open Business Models (Chesbrough 2006), he discussed about open business model; how the business model can be adapted or changed to gain the benefits of open innovation. His third book:

Open Services Innovation (Chesbrough 2011), gives another focus to creating value in terms of services instead of selling products. Much like his previous works, he emphasizes on the importance of business model but with a focus on services. The business model still needs to change but towards servitization of products, like changing the revenue model (charging per hour of usage instead of per product), internal competences, partnerships, and expand customers segments, to mention a few. The developments in his work, gives hints on the evolving link between business models and open innovation.

This research adopts the notion of business model; how firms create, deliver, and capture value. It will not go into details explaining tools for modelling business. In addition, it will have a stronger focus on capturing value. Even if access to a particular resource is given it will depend on how firm is able to capture value to exploit that opportunity. For example, a patent of unused technology by itself would not produce much value but by licensing the patented technology the firm will be able to profit, other mean will be not to patent the technology but free reveal it and offer complementary products or services to profit. Thus, it will depend on the firm business model how it will create, deliver and capture value.

3 METHODOLOGY

This research uses the constructive research approach. The main idea behind constructive research is on solving a domain specific problem. In order to do so, it constructs an artifact (models, diagrams, plans, organization charts, etc.) that solves the problem and from which theoretical contributions can be made. The steps taken into this research context are derived from Kasanen et al (1993) and goes as follow:

- Find a practically relevant problem. The application of open innovation has generated several research approaches and challenges. The problems this research is trying to solve were presented in the first chapter but it could be narrowed down to support firms approach open innovation.
- Obtain general and comprehensive understanding of the topic. This is done theoretically through extensive review of open innovation and related topics seen in the literature review chapter; and through empirical data collection inside the case company. Data collection process is described later in this chapter.
- Innovate by constructing a solution idea. The description of this step is simple and straightforward: Build a solution that addresses the problem by developing a construct. The actual implementation of building the construct involves iteration of the previous steps of finding the problem (and sub-problems), gaining more theoretical and empirical understanding, and making small contributions to the construct. Thus, the construct is based on strong theoretical contributions and supported by empirical data. The construct is presented in chapter 5.
- Demonstrate that the solution works. This step involves the implementation of the solution inside the case company. However, successfully implementing open innovation and measuring its benefits could take several years. Therefore, the implementation and validation of the solution falls out of the scope of this thesis work. Nevertheless, by modifying this step to fit the scope of this work, it is possible to validate the construct by comparing the factors used in the model with those from the selected cases.
- Show the theoretical connections and the research contributions of the solution concept. This step involves making the theoretical contributions of the construct. Also, a research contribution will be the construct itself. As stated in constructive research (Kasanen et al 1993, 246), innovation is an essential part of the constructive research; if the author is not able to produce a new solution, there is no point in going forward with the study. In addition to the construct, it is possible to draw links to other theoretical contributions. This step is presented in the conclusion chapter.
- Examine the scope of applicability of the solution. The final step associates to relevance of the solution inside the case company and in other organizations. Be-

cause of the highly competitive and changing environment in which the case company competes; it is expected that the construct will fit other settings, meaning that it could be used in other companies and industries with similar characteristics. This last step is also presented in the conclusions.

The methodology selected is based on qualitative research methods. These methods were selected because they provide richer explanations to particular phenomenon; in this case, exploring the factors behind the selection of modes of collaboration.

3.1 Data Collection

The data collection is done in three parts. First, the basis for empirical data collection was formed by reviewing the extensive literature contributions on open innovations and others field of studies related, namely: strategy, business models, innovation, and knowledge management. The second part involves immersing in the environment of the case company and observing their operational and innovation processes; to understand their relationship with open innovation. This is made possible by getting involved in multiple projects and initiatives, reading internal information, and observing daily routines. The third part of data collection is done by interviewing key people in charge of particular open innovation initiatives, discovering the factors that influence the selection of certain modes, and how they have been implemented. The aim of the last part is to validate the core elements of the construct inside the organization.

The extensive and multi-domain literature reviewed provided diverse views of open innovation inside organizations. During this first part of data collection, there were identified multiple insights and factors affecting open innovation. This process followed snowballing of literature review by looking at the most prominent contributions and identifying themes and sources that are relevant for a holistic perspective inside this research. In the end, it was possible to form a framework that defines concepts, link insights, and aligns the field of studies.

The second part involved observation of the case company environment, which served as a complement for the literature review. Insights derived from observations were registered in personal notes. Notes were also made when there was a link between the literature and observations. By observing similarities (and differences) with literature contributions, it was possible to start forming the construct. The first and second parts and forming the construct; followed an iterative process. With some iteration, it was possible to identify factors that seem to guide the adoption of modes. These factors guided the first categories/themes for empirical validation.

The third step, involve conducting semi-structured interviews with key people involved in open innovation initiatives. The sampling was based on the selection of cases

relevant in exploring how open innovation is followed inside the organization. The cases selected relate to external technology acquisition and exposing assets; research collaboration consortium following a coupled process (both inflows and outflows of knowledge); customer insights by collaborating and involving customers; and forming a business partner's ecosystem. The selection of cases follow the goals of purposeful sampling described by Maxwell (1996): Representativeness, heterogeneity (in cases with diverse open innovation modes), critical for theory development, and allows comparison between different modes settings.

The persons selected for the first set of interviews, have a high role within the activity/initiative and in the organization; being either chapter/program managers or leaders. The participants were contacted one week before the interviews took place via e-mail (See appendix 1 for a sample e-mail). After confirming their participation, an interview meeting was arranged with them.

The interview questions were based on themes derived from the literature review and observations inside the company. These themes are:

- Respondent background information and experience
- Knowledge about initiative including the story behind and how value is captured
- Factors influencing the decision to select the initiative
- Knowledge about collaboration with external parties
- Problems or issues encountered with the initiative or the partners
- Open for the participant to add insights or comments valuable for the research

The themes aim to explore the different open innovation modes pursued, their characteristics, and the reasons behind their selection. Nevertheless, questions vary according to the flow of the case interview. This is strength of semi-structured interviews as they leave space to dig into issues that are important for the research which were not initially considered.

The interviews were recorded with consent of the participants using a recording application from a modern mobile phone (iPhone 5S). The recording application was tested before in the same room where the interviews were carried out; resulting in good audio quality. The phone was left on the table with the purpose of minimizing its presence and reducing discomfort from participant side. Before having the interviews, it was checked that there was enough battery and that the phone was in optimal conditions. The interviews were carried out in a private and quiet room, with comfortable and friendly environment. (Couch, windows, whiteboards); in an area the interviewees felt comfortable. All interviews were conducted face to face directly by the researcher with the exception of one interview done by teleconference system and sharing some slides by the participant to assist in explaining the initiative.

The questions were reviewed by peer academics and colleagues not involved as participants. In addition, to test the structure of the interview, physical environment, quality of audio recording, and validity of the answers; the questions were tested in a pilot case of research collaboration. The pilot test was positive in all means.

After the first interviews, another set of interviews were conducted in cases were the initiatives were not taken forward. The decision was made to complement the research by identifying factors that inhibited or restricted other initiatives (not necessarily from open innovation). The process was the same as with the previous interviews but the questions were derived from slightly different themes:

- Respondent relationship with the case
- Knowledge about initiative including the story behind and how value is captured
- Factors explaining why the initiative did not go forward
- Thoughts related to how the initiative could have been driven forward
- Problems or issues encountered with the initiative and how they solve them
- Open for the participant to add insights or comments valuable for the research

Also, in the case of PDP, most of the participants have a trainee role. The decision to select them as participants is that they had been involved as students and later as responsible from the company engaging with other students; this offered a double perspective about the case. The second set of interviews complemented the previous interview to confirm factors influencing the decision making and to incorporate them in the construct.

The interviews lasted on average 35:45 minutes with the shortest interview lasting 20 minutes and the longest over 77 minutes. Information related to the interviews can be seen in table 7.

Table 7: Interviews information

Interviews	Date	Duration of Interview	Case	Participant (s)
Pilot	19.03.2014	22 Min.	Pilot Interview	Participant 1
1	26.03.2014	22 Min.	Bliss	Participant 2
2	28.03.2014	25 Min.	DCP	Participant 3
3	31.03.2014	20 Min.	IoT	Participant 4
4	04.04.2014	39 Min.	Oulu Ecosys-tem	Participant 5
5	16.04.2014	34 Min	PDP[2]	Participant 6
6	17.04.2014	47 Min		Participant 1, Participant 7, Participant 8
7	17.04.2014	77 Min.	Liquid Cool	Participant 9

Finally, the digital recordings were transcribed to text by the researcher, with several reviews to check the accuracy of the interview. After the whole interview was transcribed, the researcher reviewed the recording and text to double check consistency.

The selection of participants was based on their involvement with the case. They have an active role in all initial cases. In the last two cases they were involved as drivers of the idea or project; thus, it is worth mentioning that the answers given could have some biased based on their personal experience with the initiatives, in particular in cases were the initiatives were not taken forward. A list of the participants and their experience within the company is provided in table 8.

[2] PDP case was done in two parts due to the participants' time conflict. It involved several participants as the initiative had different stakeholders but it was difficult to identify the initiative owner.

Table 8: Participants information

Participants	Years inside the company	Current Role	Previous roles and experience
Participant 1	28	Operational Planning Manager	Several task and functions related to Innovation and New Business Development Product development on different technologies
Participant 2	29	Program Manager	Innovation Advisor Product Management in Sweden. Several customer units and customer account projects Several R&D positions Line Management Tester Coder
Participant 3	20	Section Manager	Section Manager Project Manager Team Leader Administration R&D IT Department
Participant 4	13	Senior Developer	Research areas Design functions
Participant 5	2	Program Leader	Wide business experience in other company of the same industry
Participant 6	2	Trainee	New Business Development & Innovation PDP Project
Participant 7	4	Project Manager	New Business Development & Innovation
Participant 8	23	Section Manager	Technical Manager Innovation Coach Involved in multiple tasks and areas
Participant 9	1	Trainee	New Business Development & Innovation PDP Project

The data collection served as input for building and refining the construct. It cannot be said the process was linear but rather iterative as more information was gathered, the construct was refined.

3.2 Data Analysis

Data analysis includes reducing, organizing, structuring, interpreting and displaying the data collected. There are several tools for qualitative research analysis; this research mostly uses thematic coding from the different collection method mentioned in the previous chapter. The data analysis is connected to the steps of data collection (see table 9).

Table 9: Data Analysis approach

Data Collection Step	Data analysis method	Themes	Description
First	Thematic analysis	Processes Capabilities Governance External Sources of Knowledge Modes Strategy Business Model Innovation Knowledge Management	These themes were derived from literature review on open innovation. In addition, they were evaluated against other research domains described in the literature review to make associations.
Second	Thematic analysis	Core business New business Incremental innovation Radical innovation	These themes derive from observations of the environment and links to literature contributions.
Third	Thematic analysis	Strategy Goals Capturing Value Resource Gaps Partner Selection Respondent profile Issues encountered	These themes are derived from empirical data from the interviews.

This method was used to define general variables underlying many factors, to be able to select issues that could contribute to the solution. The first sets of themes are: Processes, capabilities, governance, external sources of knowledge and modes. These themes derive mainly from literature related to open innovation. After reviewing these

themes it was necessary to expand the scope and cover other domains; thus, other themes were added: strategy, business model, innovation, and knowledge management. These new themes derived from linking previous themes with other domains related to open innovation. The second set of themes derived from observations of the case company and links to literature, they contain: core business, new business, incremental innovation, and radical innovation. These themes were used to identify elements that need to be considered by the construct; for example, balancing incremental and radical innovation. The last set of themes derived from the interviews analysis, and served to validate elements of the construct. This type of analysis method supports the constructive approach as it makes easier to connect the theoretical contributions.

3.3 Validity and Trustworthiness

The research's validity and trustworthiness are supported by the selected methodology. To begin with, the construction approach follows a process that ensures the construct is built on theoretical grounds, solves a practical problem, and associates the contributions to the literature. Thus, this research followed a step by step procedure specified in the framework. It also offers the possibility to check every step and phase of the construction. Finally, it is goal oriented; the construct is built with a specific purpose.

The construct is built on extensive literature review. The focus centers on open innovation and the emerging factors that influence it; including first contributions from the original work of Chesbrough but also contributions linked to other theories and domains like strategy and knowledge management.

In addition, the researcher has been involved in the case company for more than 10 months, which could be seen as prolonged engagement. The researcher forms part of the unit involved with fostering innovation culture and searching for new business opportunities. Being immersed in this setting allowed the researcher observe various elements related to innovation culture, processes, initiatives, programs, collaboration; in addition to access to internal documents and other resources.

The selection of cases was made considering multiple cases that represent heterogeneous approaches related to open innovation, including: different processes view, outside-in, inside-out, and coupled processes; support the innovation process at different stages, ideation, development, and commercialization; knowledge embodied in multiple forms: technology, insights, ways of working, ideas, concepts, people, intellectual property, API, among others. Moreover, the decision to add other cases, where ideas/innovations were not taken forward; was made to corroborate the validity of the factors from a different perspective.

Finally, there are some possible risks with the validity and trustworthiness of the results, which need to be considered. First, most of the interviews involved a single participant representing the case[3]. Moreover, the participants were highly involved in the initiative; thus, there could be some bias, especially in the cases were the initiative did not proceed. This flaw was compensated by having other sources of information and analyzing several cases. Having multiple and heterogeneous cases exploring similar factors, provided a variety of sources with alternative views on these issues; thus, this could be seen as data triangulation, combining data collected from several interviews. In addition, the researcher has been involved in the organization close to a year which brings many benefits but also the disadvantage of possible conflict with neutrality of the research. Last but not the least, the constructive research approach is relatively new and still lacks some recognition and acceptance.

[3] With the exception of PDP case.

4 CASE COMPANY: ERICSSON LMF

4.1 Parent Company Information: Ericsson

Ericsson was founded in 1876 in Stockholm, Sweden; by Lars Magnus Ericsson. Since its beginnings, operating as a mechanical engineering workshop that repaired telegraph machines; the company has been developing new products and services in the communications fields, becoming one of the global leaders in the ICT sector. Nowadays, the company has over 114,000 employees worldwide and operations in over 180 countries (Ericsson History 2014). At corporate level, the company is divided into the following divisions: networks, services, support solutions, and modems. In addition to these divisions, there are global functions like strategic management, research, patents, and others (Ericsson 2014a).

The company has the vision of a networked society where people and devices will be connected. The networked society brings new challenges as it demands connectivity everywhere, flexibility of networks due constant data and huge volume traffic and development of new products and services. Therefore, Ericsson is investing in innovation and in new markets areas related to machine-to-machine (M2M) communications.

4.1.1 Innovation at Ericsson

Innovation is at the core of Ericsson's business, being stated in the company's mission:

> *Innovating to empower people, business and society in order to shape lives and shape worlds (Ericsson 2014b, 12)*

During its long history, the company has been innovating in the ICT field; since its beginnings on telegraphs and telephones, to the latest generation technology on telecommunications solutions and services. Some of the company's innovations are shown in table 10. These innovations are just a few of the multiple contributions of the company to the industry and society.

Table 10: History of Innovations in Ericsson. (Ericsson 2014c)

Year	Innovation
1878	Telegraph to telephone
1923	Manual switching to automatic switching
1968	Electro mechanics to computer control
1981	Fixed communications to mobile communication
1991	Analog (1G) to digital (2G) mobile technology
1998	Integration of voice and data in mobile networks
2001	Launch of WCDMA/3G networks in Western Europe
2006	Launch of HSPA mobile broadband globally
2009	First commercial LTE network launched
2010	New world record, 84Mbps HSPA technology
2011	Launched Smart Services Router (SSR)
2012	Ericsson launched a Telco Grade, OpenStack Telecom Cloud solution
2013	Launch of Ericsson Radio Dot System which enables operators deliver high performance service in dense areas like business and public spaces.

The company has invested in R&D activities across the world in many ways; for instance in their own R&D units, with partners, research institutions, and public institutions. Therefore, Ericsson is one of the largest patent holders with over 35,000 granted patents and the largest holder of standards for mobile telecommunications (Ericsson 2014d). The focus of research is on the following areas: Radio access technologies, broadband technologies, electromagnetic fields safety and sustainability, multimedia technologies, security, services & software, wireless access network, packet technologies and global services. (Ericsson 2014e)

4.1.2 Open Innovation at Ericsson

According to open innovation definition used in this work, Ericsson has been active on several open innovation modes during decades. Some examples included: Joint ventures and divestures (Sony Ericsson and ST Ericsson), acquisition (Telcordia, Microsoft Media Room, Azuki Systems.), standardizations (3GPP, OMA, etc.), free revealing (standards, open source, Erlang), and others forms. Moreover, from the new or modern modes of collaboration, Ericsson has initiatives that involve customers and user co-creation, collaborations, and exposing assets, like the following:

- **Application developers:** The Company has recognized the value of applications ecosystem and the input of users into new ideas. As Bert Nordberg, former president of Sony Ericsson, said:

  > *"When we talk applications, we are talking innovation and that is where listening to the consumer is important. We try to sponsor innovative ideas, but it is also important to have open innovation. We've started coop-*

eration with smaller companies that have the innovation we want to invest in and bring to our solution. ''Bert Nordberg (Ericsson 2010)

- **Exposing Assets on Ericsson Labs:** In Ericsson Labs, Ericsson was opening telecom capabilities to researchers and developers on early stage developments, allowing instant feedback and improvements from end users on Internet. Some of the applications included: Photo caching service, a meeting organizing service and Mobile Map Services (Ericsson 2009). Nowadays, they have stopped exposing certain assets through Ericsson Lab. This shows that certain types of open innovation initiatives could be run as experiments to discover new opportunities; however, it does not guarantee the initiative will be permanent.
- **Competitions by Ericsson Applications Awards:** the application awards are a global app competition that addresses a yearly theme, like network society, working life, etc. It has two main categories, one for students and one for companies. A Jury selects the best apps addressing the themes and categories. Former head of Ericsson Research describes the interest behind this type of competition:

  "We want to encourage open innovation and attract developers, and get in contact with them. We want their feedback on our APIs and what is needed to get developers to use the functionality in our systems. And to get this going, we decided to start an application competition." Jan Färjh Former Head of Ericsson Research (Ericsson 2012)
- **Innovation Lab:** A Joint Innovation Lab was formed together with Facebook. The goal of the lab is to provide developers the possibility to simulate various network conditions in which they can develop, test, and optimize apps targeted at emerging markets. This joint initiative supports the main goals of Internet.org: bring Internet to the remaining two thirds of the world population.

Other examples related to open innovation includes open source development, standardization, licensing under FRAND terms, and co-creation with selected customers. These cases exemplify getting consumer insights, exposing assets, and in concrete words applying open innovation. Thus, it could be seen that globally, the company is using multiple forms of open innovation like the previous mentioned cases.

Nevertheless, the scope of this research will be in the Finnish subsidiary of the company, which focused mostly on R&D activities. Like the parent company, the subsidiary is also involved in similar open innovation activities, as in other types of collaboration activities. This research will use the subsidiary as case company. The reasons behind this decision are manifold: First, it offers sufficient number of collaboration projects to have a variety of cases where to explore open innovation. In addition, it offers a reasonable level of complexity in terms of number of people, projects, and magnitude of initia-

tives. Last but not the least, it offered direct access for the researcher as he got involved in a team that works with new business development and innovation.

4.2 Ericsson LMF

Oy LM Ericsson Ab. or LMF is the company's Finnish subsidiary. The company has had operations for more than 90 years in the country. The main site in Jorvas was established in the early 1970's and was the first R&D site outside Sweden. In addition to the main site in Jorvas, there are sites in the cities of Oulu and Turku. The main areas of R&D include: Media Gateway, Security, CPI, Device Connection Platform (DCP), Radio Base Stations (RBS), WCDMA Radio Access Network (RAN), and RAN Transmission. In addition, LMF works in areas such as Cloud, M2M, Security, and Radio in synergy with other organizational areas and regions like R&D, Business Unit Global Services (BUGS), and Region Europe and Central Asia (RECA). In addition to R&D, LMF also has operations in Regional, IT, and others areas. Nowadays, it has close to 950 employees from over 41 nationalities.

LMF has several initiatives both in current business and in new business development. From a strategy point of view, LMF is doing research and development focused on core business. However, new business growth is driven by M2M business opportunities, guiding the company towards the vision of networked society. For this research, the scope of analysis will be in Ericsson LMF R&D unit, with particular focus on Business Unit Networks, Development Unit Core Networks. Therefore, there could be differences between initiatives and processes described in this work and those followed in other units, sites, or regions.

4.2.1 Innovation at LMF

LMF has good reputation as an R&D site due its continuous contributions in research and development; excellence in ways of working; and implementing innovations, like in the Mobile Media Gateway. Like many other big organizations, LMF is configured in a complex way; there are areas from different business units, regions, and product lines. In general, most of the innovation efforts and development go to improve current products and services. Thus, there has been a strong focus on developing the ways of working towards lean and agile development transformation, and nowadays, towards continuous integration and deployment. In addition to the lean and agile transformation, there have been investments in fostering the collaboration and innovation culture. Before, there were initiatives including innovation coaches, idea boxes, competitions, and also

changes in the infrastructure. Nowadays, going a step forward, there is a bottom up approach of innovation, creating spaces and channels that support the culture; and thus, enable ideas to go forward. During an event called Café Friday, anyone at LMF can pitch their ideas in front of colleagues to receive feedback and develop their ideas. Some of those ideas are later taken to other event that has a hackthon style, Jack Bauer Challenge, where participants can develop their ideas during 24 hours into early prototypes or demos that are presented at the end of the event. A few of the ideas reach maturity and are presented to customers inside the business lab. In addition, the organization formed a reference group involving multiple key stakeholders to assess mature ideas, help them go forward, and distribute them to the most appropriate channels. Other initiatives improve the working culture like having learning sessions, training, presentations, discussions, etc. A new initiative called the learning lifestyle has a bottom-up, community driven approach towards learning and improving the work culture.

It is worth mentioning that there are different innovation focuses inside the organization. In general, from LMF site's strategy point of view, the aim is towards incremental innovations, the focus should be on product line innovations, providing new features and in process efficiency by lean and agile ways of working, which translates into incremental product innovations. However, everyone in the organization has the opportunity to take their ideas forward independently if it is incremental or radical. Moreover, they are encouraged to participate in the multiple activities and initiatives previously mentioned. In addition, there is a small unit in charge of seeking new business opportunities and enabling radical innovation across the organization. Its innovation approach leans towards radical innovation; both in technology and market domains. However, this unit also searches new business opportunities for existing products. Then, from the regional strategy point of view, one of the goals related to innovation is to expand into new areas. It is important to distinguish between these focuses, as by nature, they are not the same and require different mindset.

4.2.2 Open Innovation at LMF

From direct observations and searching in internal documents, it was not possible to find evidence of any formal open innovation program at the time of this research. Nevertheless, there is abundant evidence, both formal and informal, of open innovation practices inside LMF. According to the open innovation definition, LMF has been using open innovation in several forms; such as being part of research collaborations, participating in standardization for 3GPP, being active in open source communities, collaborating with universities and research institutions, integrating customers into the innova-

tion process, collaborating with partners, SME´s, Startups, conferences and much others forms. The next chapter, reviews the cases of open innovation inside LMF

4.3 Open Innovation Cases at LMF

The researcher selected six cases to study open innovation[4]. Each case itself is interesting enough to have an individual research focus on a particular theme of open innovation. Nevertheless, this research tries to take a holistic approach, and therefore they were selected to offer a diverse and complementary view of open innovation.

The first four cases involve: a business lab for co-creation with customers, a complex service that involves collaboration with third parties and which originally was bought and integrated from an external party, in addition it offers an API to customers; a leading huge national research consortium with over fifty external parties; and forming an ecosystem of external parties in a particular physical location with the goal of developing new products and services. Similar to what has been seen in the literature, the cases reflect that most of the activities involve an outside-in process perspective, but some of them involve a coupled process, and inside-out process perspective by exposing assets like API's. Most of the cases have a focus on M2M development.

On the other hand, it was required to have other view of cases that have not been taken forward entirely; and identify the reasons behind it. Two more cases were explored: A collaboration initiative with a university that involve developing projects together with students in a co-creation manner; and a case of internal innovation that could not continue forward.

The cases are: Ericsson Device Connection Platform, BLISS Lab, Oulu Ecosystem, Internet of Things research consortium, PDP Project, and liquid cooling. All the cases are described with more details in the following subchapters.

4.3.1 Ericsson Device Connection Platform

Device Connection Platform also referred as DCP offers operators an end to end solution for managing M2M connectivity. DCP includes the following functionalities: subscription management; rating, billing, and policy control; provisioning and order management; Internet Protocol (IP) control and policy enforcement; connectivity monitor-

[4] A separate case was conducted during the pilot interview which involve research collaboration. Some of learnings from the case were also incorporated in the findings.

ing; device management; device access enablement; and to integrate with operation support solutions (OSS) and business support solution (BSS) systems. With this offering, DCP allows operators, to focus on their customer operations. In addition, the service offers a self-service portal to manage business related process with API capabilities for customization and extend self-service to their customers. Because it is offered as a service, DCP gives operators flexibility and opportunities to scale-up whenever they want; and as part of the offerings (see figure 22) includes: Initial setup, training, solution analysis, among others.

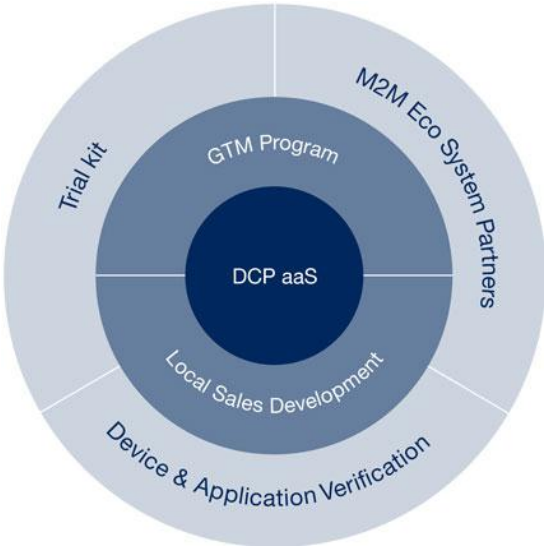


Figure 22: Ericsson Device Connection Platform offering (Ericsson 2014f)

The story and interest behind DCP starts with the acquisition of valuable technology of M2M platform from Telenor Connexion in 2011. The acquisition included integrating personal from Telenor Connexion into Ericsson. Since then, DCP has been refined and sold as a service to customers. Nowadays, managing DCP includes integration of 3rd parties' tools and other collaboration with external parties such as consultancy and additional services. In addition, DCP offers an API that allows customers to customize part of the self-service portal and extend this capability to their customers. DCP is an example of outside-in open innovation, in terms of acquisition of key technology and key people with knowledge of the technology and later an inside-out exposing some capabilities by offering an API on the self-service portal.

4.3.2 BLISS Lab

Ericsson Business Labs focuses on creating and developing sustainable businesses for Ericsson and their customers, across multiple industries related to the field of M2M.

The approach used involves engaging with customers and partners at early phase of development process to gain insights and drive business innovations altogether; a sort of co-creation with customers and partners. The Business Labs concept is based on four cornerstones (Ericsson 2014g):

- Proof-of-Business – evaluating the business potential of new opportunities and innovating business models together with customers and business partners
- Proof-of-Concept – prove that an implementation of the solution is technically feasible using Ericsson and partner products and services
- Global scale – network of local labs to share results within Ericsson to enable re-use and business on a global scale
- Partners and Ecosystem growth – actively engage with customers and potential partners to grow existing and create new ecosystems

LMF Business Lab also known as BLISS (Business Lab Innovation System Suomi) has the same general goals and cornerstones but also allows innovations in other fields than M2M. Using the LMF R&D powerhouse to engage with customers, validate early prototypes, expand business opportunities to a global scale and develop ecosystem growth. The BLISS Lab is an example of outside-in perspective but from the customer co-creation approach. Therefore, this case was selected as it is an important and relevant part of open innovation.

4.3.3 Oulu Ecosystem

Ericsson's vision is toward a networked society, where not only people but devices are connected. As part of that vision, Ericsson needed to develop small cell radio networks that could handle huge loads of traffic in densely populated areas like buildings and public open spaces (like stadiums, concerts, parks, etc.) Therefore, Ericsson decided to establish a new R&D site in Oulu as the regional ecosystem offers one of the world top places to develop this technology.

The regional ecosystem offers talented people, experts in the field of radio access networks, universities with top quality, an active public sector, small companies, startups, and business development clusters. Tapping into this ecosystem allows Ericsson to leverage internal competence and knowledge with external sources of knowledge (Oulu New Tech 2013).

What is really interesting from this case is that they use a model of collaboration with external parties that leverages internal and external competencies. The setup established uses a model where a very small percentage of the persons involved in a collaboration project comes from Ericsson and the remaining comes from external parties; mainly

consortium of partners. From an open innovation perspective, it could be seen mainly as outside-in perspective.

4.3.4 Internet of Things (IoT) consortium

This research program is funded by TEKES and steered by DIGILE. The program focuses on development related to M2M and internet of things. DIGILE, as part of Finland's Strategic Centers for Science Technology and Innovation (SHOKS), aims to lead Finland on this domains. The program involves more than 35 partners representing large companies, SME's, research organizations, and other institutions. Ericsson is actively involved in the IoT research program being the main industrial driver.

Internets of things involve a multitude of diverse devices communicating among themselves (and us) to improve the quality of our lives. This is made possible by having information produced and consumed by machines. These processes involve multiple domains related to ICT like smart sensors, big data analysis, telecommunication technology, and complex standardization of multiple communication protocols and technologies. In addition to the communication, there is a need to have common foundations that address issues related to efficiency, reliability, security, scalability; and building a partner ecosystem to experiment with new business models.

This case was selected mainly because it is a coupled process. In addition, it is quite interesting due to the magnitude of the project, as it involves a large number of partners and multitude of collaboration forms and outputs. In addition, this case study is relevant due the magnitude of investment in the program and the impact it will have on the partners and Finnish society.

4.3.5 PDP Project

Product development project, also referred as PDP is a course taught at Aalto University Design Factory. As the name implies, the course consists of assigning a group of students a real product development project given by a sponsoring company. The novelty and strength of the course is that it puts together a team of students of diverse background, including, engineering, designers, and business; and mentoring and assistance from tutors of design factory and the sponsoring companies. On the other side, the sponsoring companies benefit from the work of the students and the outcome of the project which could be technical studies, prototypes, products, intellectual property, documents, and others (Aalto 2014).

Ericsson LMF participated four times in the PDP. The goal behind participating in PDP courses was to collaborate with Design Factory and learn how to drive ideas forward, create an innovation and collaboration culture. In addition, they could gain benefits from the particular projects. Some of the outcomes of the projects include: technology concepts, early prototypes of products, documentation regarding the project, hiring of promising and capable students, among others. After four years, the company decided not to continue in PDP.

In general PDP could be seen as an outside in process, or co-creation with external party; the project is given and steered by the company but the students do most of the work with supervision and coaching from the University. This case was selected because the author believes than some of the projects and their outcome could have been channeled through other forms to capture additional value.

4.3.6 Liquid Cooling

Liquid Cooling is not exactly an open innovation initiative but the author argues that perhaps it could have been taken outside in a new collaboration form. Thus, this case could be considered for study as a possible inside-out process.

The initiative consisted on replacing the air cooling system of certain products by a liquid cooling system. The idea sounds simple but it involved plenty of work and experimentation to get the prototype working, and later great effort to drive and push the idea forward internally.

First the idea was put in the idea box tool by one of LMF employees. After a few comments and suggestion, the ideator and a colleague, which was the main driver started working on the concept and develop it. The idea was really pushed forward by them trying to build the business case and developing all sort of technical analysis. They met internally with several people and presented the idea and prototype to different stakeholders. There was interest on the idea but for multiple reasons it could not find an internal channel. After some time and several phases of development, it finally faded and left the initiative halted or *sitting on the shelf*.

This case was selected as reflects the event when some ideas cannot reach the end of the funnel. It is intended to learn from this case to identify the factors that influence in channeling the ideas forward.

4.4 Results

The results are categorized on themes derived from the interviews. The themes associate to reasons behind the selection (or development) of an open innovation mode instead of another. In most of the cases, the initiatives were driven by formal request or decision at corporate level. Thus, the decision why it was done in that particular form could not be officially obtained. Nevertheless, it was possible to infer based on respondent answers and their beliefs.

In general, the decision to start with these initiatives is based on the need of something that could be supplied better, cheaper, or faster by the external environment; for example: access to technology, complementary assets, know-how, learnings, doing something in a different way of how it is done before, among others. There are several factors influencing the selection of modes; however, three main factors have stronger influence: strategy, business model or internal exploitation channels, and internal resource gaps.

First, it is a matter of strategic relevance; either in existing business areas or new areas where the company wants to competes. This was evident from the cases related to M2M; independently of how concrete the type of initiative was it fitted strategic goals at corporate level. One participant could not provide detailed information related to decisions but the answer given justifies strategic relevance.

> *"Yeah, actually, I have to say I don't know much about those details, why was that? But how we see today, Ericsson wants to enter this M2M area and see lot of business potential there. I think Ericsson, to really enter this are, decided to have [the technology] as an own product or service." Participant 3*

Another case related to core business and the existing market. And the reason behind that particular selection of collaboration mode clearly derives from strategy; developing technology outside while keeping control of the development and intellectual property rights.

> *"[…] so it's simply thinking, that ok, do we think that somebody else can do it? Secondly, do we want to give our, kind of crown jewels, to third party kind of dilemma? And, that has been one of the things. […] " Participant 5*

The second reason relates to the alignment with the business model; as if it is part of the product portfolio, or that could strengthen the product portfolio. This was more evident with initiatives that did not continue forward due these reasons. For example from the PDP courses, the outcome of one project could not be channeled internally as it did not fit the portfolio, core business, and business model.

> *”It didn’t fit the product lines or portfolio. People didn’t see a way to work on it. I´d say it was a concept that was radical for the company and there wasn’t a structure how to handle that. “Participant 6*

In a similar way, the Liquid Cooling project faced challenges as it involved changing the cooling system of products and that required changing the value chain of the product; thus, meeting internal resistance or lack of support to develop it further. The reasons are not very clear, it could have been for strategic reasons, like the future products tend to be smaller and thus, liquid cooling is not needed; but it also appears that how the organization is structured and the value chain influenced in the decision.

A third reason relates the gap between available resources, like knowledge or competences, and those intended to explore and integrate. It has been seen in the previous cases that it is required to develop new ways of working to integrate knowledge; or integrating complementary assets is based on existing knowledge and competences; among others. This also, suggests that some initiatives would be needed at certain point, but not always. One case illustrates this notion:

> *“I would see that the whole three PDP courses should be looked into the context of this Innovation and collaboration thinking. We, at least I, didn’t saw it as a course. I saw it as a way to learn how to drive ideas, and build the ideas in a new way; and somehow that was the point with it. In parallel, we try to have innovation coaches that had the responsibility to coach any ideator. We have all this culture and there were more or less successful or unsuccessful, whatever you can say about it but from that perspective, I would argue that the main reason why we didn’t continue with the [Fifth] PDP course is that this culture has already gained all that information. We are aware how to drive ideas in the way PDP does, is not new for us.” Participant 1*

In addition to these factors, the selection of particular initiatives varies by case as there are other influencing factors. As one participant describes the decision to participate in the initiative, it was the best option.

> *“But at the moment it is the strongest channel, or where we invest more from Ericsson Finland. From Finland only, not from Ericsson” Participant 4*

Figure 23 illustrates the relationship between the main factors previously described and others that influence the selection of modes. As was mentioned before, the three main factors appear to have higher influence; and thus, in the figure they have been color coded to show the relationship of the connections.

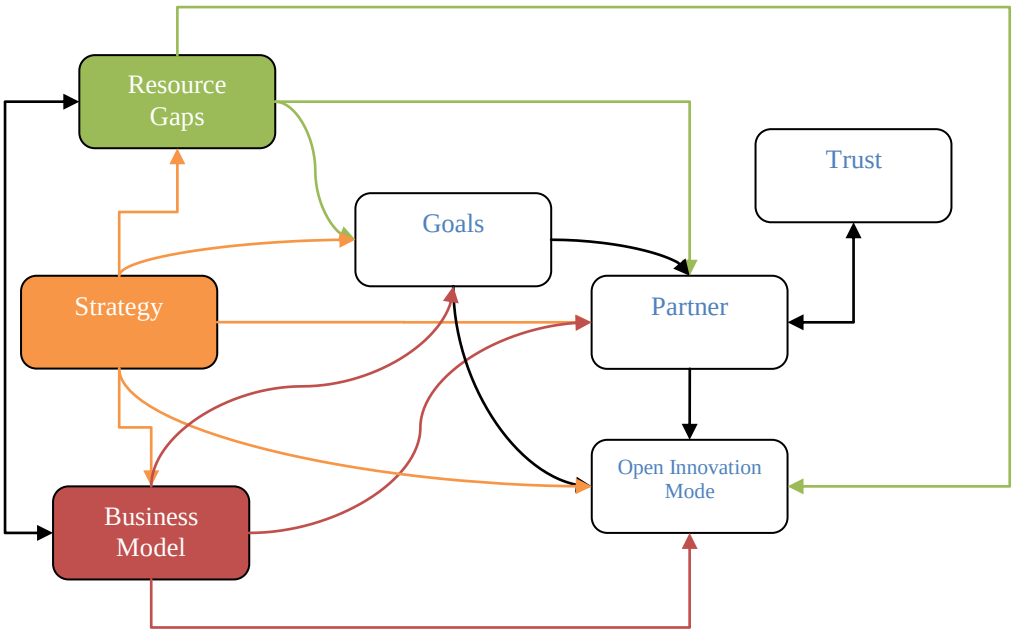


Figure 23: Factors influencing the selection of open innovation modes

It is possible to analyze these factors in detail and their relationship with others by expanding them to: strategy, goals, capturing value, resources gaps, partner selection, respondent's profile, and issues encountered. They are presented in logical order instead of how the interviews were carried out.

4.4.1 Strategy

Most of these initiatives are related to bring value to the M2M market and some of them to existing core business or extension of core business. For example, DCP and IoT consortium and BLISS Lab are strongly connected to M2M. However, some are also using the initiative as an opportunity to develop new capabilities and learnings. For example, the Business Lab is also developing capabilities by collaborating with customers to develop new products or services which could be seen as value co-creation. Similarly, in the business ecosystem case, although the market is based on existing product portfolio on core technology; the ways how the product is being developed together with external parties could be seen as something new in the organization. This initiative in addition of having strategic fit, is improving the ways of working with third parties and developing and supporting an ecosystem.

> *"At the same time, when you understand that the company is not the most advanced in using competence outside the company. This will be a good opportunity to test and develop that kind of model." Participant 5*

It is important to have a broader view of strategy, not only on markets but also on developing skills, technology, competences and others. Imagine if the two last cases that did not go forward could have been seen from the perspective of different strategic horizons. For example, despite there was no proper channel to drive these cases forward, a new channel could have been tried out to gain new ways of working or test the technology.

4.4.2 Goals

When discussing about goals, the researcher mainly refers to two aspects. First, what are the goals or aims of the collaboration? And second, the notion, that clear goals support maximizing the collaboration. As it was expected the goals vary depending the initiatives and their respective collaborations, the business model of the company, and how formalized the initiative is. For example, the general goal for DCP is clearly aligned with the strategy; to support the company competing in the expanding market of M2M. The decisions related to the acquisition of technology were to integrate external technology into the current offering to customers. And the decision to expose the API, is to offer flexibility and customization to customers. For other initiatives like the IoT research program there are other goals. Some of the goals include: Improve brand image or visibility, being seen as a strong leader in the market; access to state of the art research and possibility to partner with strong players; networking with new players; in addition to obtain benefits like utilize financial incentives from the government. All these goals can be achieved as the research program is aligned with the strategy and have clear channels or paths. In the case of the business lab, the goals are different. By offering a permanent showroom of new prototypes and innovations, the aim is to gain early feedback from the customers, collaborate with them, and co-create with them. In addition, the creations that reach the innovation stage and are sold to customers in the Finnish market could then be taken to global market. Lastly, this type of fast and early development requires cross organizational work, that improves internal collaboration between areas. Finally, the Oulu ecosystem has a clear aim to develop a new product. In addition, it develops new ways of working, and develops the ecosystem for future collaborations.

There is the notion that open innovation initiatives should have clear goals in order to capture more value. This was evident in some way, in the form that clearer goals that are related to the business model have a path were to channel those initiatives. Clear

goals help the collaboration materialize into concrete actions. On the other hand, having fuzzy goals carry the risk of inefficiency, misalignment of efforts, and the inability to exploit the outcomes; this could result in losing opportunities to capture value, frustration, and harming relationships. This could have been the case with one of the student projects:

> *"It felt like a waste of time, why did you want to create a radical concept if you are not willing or capable of dealing with, but maybe it served as a wakening call, hey we need to have a structure how to deal with it." Participant 6*

From the previous quote it also seems that goals depend of internal paths, channels and structures or in other words how the outcomes of the collaboration could be exploited. However, there are also other considerations like business evaluation and strategic fit. Moreover, from a previous quote it seems that the goal of this initiative was not necessarily to exploit the outcome of the projects but to learn from it. Nevertheless, in a different student project there was a similar internal project ongoing at the same time; thus, it was possible to capture value from the student project as the internal paths, channels, and structures enabled it.

4.4.3 Capturing Value

The idea behind value capture relates to the business model of the company. The business model extends to creating, delivering, and appropriating (or exploiting) value. In this context, capturing value refers to what is integrated inside the organization from the collaboration and how it is done. Capturing value from collaboration varies according to project. It could be explored from direct gains in technology to integrate into current products or services, or to intangible gains like reputation, networking, incentives, funding from governmental organizations, insights from users and customers, gaining access to information, knowledge, publications, etc. In most cases capturing value will be channeled through processes and routines in which the company has experience and competences; in other words through what it is used to do, like partnership, research collaboration, registering patents, etc. Therefore, capturing value depends strongly on the structures and channels the organization has in place but it is also a matter of mindset; of seeing new opportunities and trying out new forms to incorporate value.

How the company is able to capture value influences selection of partners, goals, and finally the selection of modes. It is important to be aware of this matter, as it could limit selecting a mode over another. In some cases like in the business lab and the business ecosystem, it was required to develop new configurations or structures to capture value. It could be seen as there was a need of creating a new form to capture value that other

activities or initiatives could not fulfill. When discussing about forming the business lab instead of other forms, like having fairs or seminars to show products to customers, the participant replied:

> *"What I'm trying to do or we try to achieve over here is trying to capture new business outside of normal Ericsson core business which is to sell telecom equipment to the operators. This requires constant dialogue, not only to wait for the certain fairs; and really engage with the customers from the beginning to work together with us in certain things. So it's like, not everything is done by us but together with the customer or together with the customer and some partners. And this is something which you don't wait for the fair, is better to have [it] more permanent." Participant 2*

This notion together with the fact that open innovation modes could be used in forms that leverage costs, risks, and uncertainty act as a strong option for exploring new opportunities, especially if seen from the horizons perspectives. This is best demonstrated in one of the cases:

> *"[…] And also you have to remember that this kind small cell segment three or four years ago when this whole thing has started, it was far from being a secure business opportunity. It was also that at that time, many were thinking most likely it will never realize as a commercial product. Then once again, would you invest heavily by yourself direct for something that you are not even sure it will every fly. In some things you want to minimize risks therefore using 3rd party that you use if it fly, but then if it doesn't fly, then go." Participant 5*

The business model of the company or how they capture value strongly influences in the selection of modes. In some of these cases it was observed that is possible to have means to capture value on different horizons that do not conflict with the core business model or internal structures.

4.4.4 Resources Gap

When referring to resources the focus is on knowledge and competences. The ability to exploit new knowledge depends strongly on existing knowledge of the company. This is discussed in the literature on topics of knowledge management, knowledge base, and absorptive capacity, among others. Knowledge and competences also influence in the selection of modes and partners. For example, when discussing the selection of one partner, the argument was the closeness to internal existing technology and the ability to integrate.

> *"There are many others using other technology. And, in a way, the argument or the only reason we are not using any other technology, is that we don't have the competence or we don't have the time. So we go forward with this one, as far as we could go." Participant 1*

The information from the participants suggests that some of them have experience in running projects, developing products, researching, forming partnership, and developing knowledge in their technology domains but in other forms such as acquisition, partnering with smaller companies, investing externally, user driven interaction, and others; they are learning more. This is good because it involves a learning process required to gain access to new knowledge domains and forms of collaboration. Nevertheless, the sample of participants does not reflect all the competences from LMF nor to say corporate level. Still, it could be said that there are some gaps in certain domains that are being developed; at least from the participant's point of view. These notions of newness and learning were mentioned on some occasions, for example when discussing about maximizing capacity with partners in the ecosystem:

> *"[…] this is something that we are not there yet, of course we are relatively new and we are trying to get of course more work which is partially happening as well." Participant 5*

Or when discussing about partnership assessments:

> *"So we have to go to Sweden and check out, ok, Ericsson Sweden or let's say Ericsson corporate is doing acquisition and partnership deals all the time but we over here haven't done so many locally so for us is like learning, at the moment, but it is interesting. " Participant 2*

Other knowledge gaps are associated to industry domain specific knowledge. This is important to keep in mind as new business development requires deep understanding of the new business domains.

From a knowledge management perspective; there have been knowledge flows from both directions. Some of the decisions of selecting a collaboration mode or partner have been influenced by knowledge domains, for example, could the technology be integrated? Whereas in other cases it did not matter much due other factors, like strategy and goals dictated the type of mode selected. Later, contingent actions like recruiting personnel with those capabilities, training sessions, consulting services, partnership, etc.; supported reducing the gaps.

In addition, in some cases there is access to new knowledge but it has been decided not to explore it because it does not fit the goals or strategy. Like in the examples of last two cases of PDP and Liquid Cool.

In summary, the data suggest that forming new modes involved learning about domain specific aspects. In addition, the selection of mode and partners are influenced by the gaps between knowledge base and external knowledge. Therefore, it could be said

that new collaboration modes or partners could be selected in order to develop other competences or access to sources of knowledge. At the same time, gaps between existing knowledge and competences and those required, will influence in the selection of collaboration modes and partners.

4.4.5 Partner selection

The selection of modes is also influenced by selection of partners and the selection of partners depends on certain factors. First is worth clarifying that the notion of partner could be extended to external parties, meaning they could also refer to research organizations, people, users or in general external sources of knowledge. However, they differ in many aspects like type of partner, number of persons involve, competences, goals, etc.

In most the cases, it was mentioned that partners should have complementary assets. Complementary assets vary according to the goal of the initiative and within a particular collaboration. It is easier to approach a partner that has stronger evidence of the value of their assets, this includes steady and provable technology, have an existing customer base, brand, etc. However, complementary assets is one factor, other important factors are alignment of goals and trust, in addition to the cost of collaboration. The following quote support this claim:

> *"On the partner side that is trickier. Ok if we find a good company, we believe has a good technology; they show some steady, how should I say, performance on whatever they do; and they have a plan, they can show a plan to do their business in the future." Participant 2*

Trust was also mentioned several times as an important factor. There are several aspects of trust involved including fulfilling agreements (both formal and informal); respecting intellectual property and confidentiality; and having a positive attitude towards the partner.

Partner selection is also influenced by other aforementioned factors, like means to capture value and knowledge gaps. For example, in one of the cases it was inferred that the selection of partner was driven by lower technology gap, meaning that it was easier to integrate that type of technology in comparison of others and also to exploit that technology as it would not affect much the business model:

> *"Our interest in [PARTNER A], primary is [that] they use technology that utilizes existing infrastructure and its only software. It's an addition to the software that you [already] bring. In the long end, you should be able to port the Software into the terminal, and by that the terminal could*

utilize the same service; it is not affecting the infrastructure hardware. So, that's a good thing." Participant 1

From this quote a couple of thoughts are developed. First, that the lower the knowledge gap the easier and faster it is to assimilate the external technology. Second, if it is more aligned to current business model or portfolio then it is easier to implement. Thus, again, the notion of how value is captured influences the selection of partners. It is rational and appropriate thought but it is worth adding that there should be a balance between the gaps of knowledge, competences, business model; and exploring other in other horizons where the gap could be higher.

4.4.6 Respondent previous experience

Questions related to this theme aimed to learn more about the participant, their background experience, and time working inside the company. This served to confirm if they were the proper persons to be interviewed and also, as a side track to explore a little more about the relationship between people involved in open innovation and their profile. The participants have lot of experience in the industry and most of them within the company. Most of them are section managers or program managers and have been involved in areas of IT Design, Coding, Testing, and Project Management. A few of them have been involved with customers units and accounts. From the interview it was corroborated that they have an important role in the initiative and thus, were appropriate participants for the interviews.

This theme didn't dig much on the competences of the participants, although literature suggests open innovation teams and responsible possess certain capabilities like ability to integrate multiple domains, interpersonal and communications skills, and networking could be favorable for open innovation initiatives. This is greatly illustrated in the case of Oulu Ecosystem, where it was mentioned to have multidisciplinary teams focus on coordination and support of multiple parties.

"And the team that we have currently is roughly 30 people, is growing slightly up to 45 people in the coming two months, but anyway nevertheless, a small team where we have competences from different areas of the business mostly in product development area. But one common denominator for all of them is that all of the team members are experienced. The reason has been that this team will be paved kind of coordinator or coach; defining the case for the business, what we are doing here, and also coordinating between different Ericsson sites and the local ecosystem." Participant 5

Other participant mentioned some personal skills needed to push the initiative forward.

> *"The thing is that, [the initiative] is like a small startup within the corporate. Is a challenge to change, let's say, the attitude to this kind of behavior. You need to be really flexible. If you are getting frustrating easily [then] don't do this because you will probably get frustrated. It takes long time to get an acceptance that this is a valuable business. Myself I'm really fast in my normal mood. For me this could be a bit frustrating at the moment when nothing happens but on the other hand when you see things moving, they could move really fast. And that is rewarding." Participant 2*

However, this wasn't the focus for this research, and thus contributions to this theme are limited.

4.4.7 Issues

The participants were also asked about issues related to particular case collaborations. These issues could be associated to partners, internal challenges, and exploring new business domains. Partner issues depend mostly on the type of partner, alignment of goals, and fulfilling expectations. For example, most startup companies are short-lived; thus, collaboration should be focused and at fast speed. Then, certain partners have a different agenda or goals; hence, aligning interest and work flow is very important, especially when unforeseen issues could happen. Expectations are based on potential gains and what it is actually obtained from the partner. But this also happens with particular modes; for example, when discussing about benefits of acquisition of external technology instead of internal development, there were some unforeseen challenges related to scalability.

Other issues with partners relate to aligning interests, coordination and responsibilities. For example, in the case of unforeseen problems; how to balance the challenges and compensation with partners. How to balance the gains, pains, and different business interest? Especially, in new initiatives like the Oulu ecosystem:

> *The big question here still is and remains. How do we make a setup? And is not a kind of organizational structure, [it] also involves the mental philosophy, different kind of people behavior, and principles. How could we make this kind of setup, where we have different parties whereas Ericsson, or partner A, or partner B, or partner C or whoever; in which everybody would have a common goal to get the job done? Secondly, everybody has the common goal to make sure that all of us are treating*

> *in fair manner, without having a huge monitoring, coordination, and management mechanism around. And that may sound [simple], just agreeing in something like that but it's a very complicated topic and multidimensional. You need to think how you can get your personal interest fulfilled through fulfilling the common interest. Participant 5*

It is believed that it is a matter of establishing high level of trust to balance coordination, control, and align business interest.

In the case of internal issues, some of them are linked to aspects previously mentioned like knowledge and competence gaps but also in the internal channels how to capturing value, which could create barriers and frustrations to the main drivers. This was more evident with the initiatives that did not go forward:

> *Maybe, I'm being kind of naive not understanding how business work. You don't start a project [Pause]. You don't actually get this how could I say [Sight]. I feel basically, we have so many, kind of, silos. Because we were contacting this radio product management guys about these issues. And you know the discussion was always the same, no interest. Participant 9*

As it was mentioned before, there could be plenty of reasons why the initiatives did not continue forward, like misalignment with strategy, market, internal channels. It is suggested to communicate these reasons to the drivers to prevent frustrations and utilize the resources in other initiatives.

When talking about new business opportunities, there are common issues related to learning and resource gaps; but there were some particular challenges related to addressing prospect customers and finding a business case. First, relating to the prospect customer or partners. It is important to learn about their business and communicate the value they can gain:

> *[Addressing] Prospect customers, is also, let's say, challenging. Here we see the fact that the field of industry is so different, when talking about the telecommunications and, then let say, the manufacturing. They don't really see any connection point. That means that we, at Ericsson, we don't really know what the manufacturing is all about while they don't know what they could get from us. Participant 2*

Other issue is on who should be approached inside the organization

> *[…] when we explain to them, what they could do, for example, with mobile technology like 4G or LTE; all the sudden the interest raises but then the challenge is, who to talk inside the company that is doing manufacturing? So, should we talk to manufacturing department or should we talk to the CEO of the company, who should we talk to? It is not always easy to find the right person. Participant 2*

Other major challenge is in finding a business model to exploit the new opportunity. It could be a little constraining by wanting to have a new business model but limiting to existing structures, channels, and markets. In particular there is a strong bias towards targeting operators or trying new offers but via operators. It is expected that exploration activities will bring new challenges and issues. Therefore, it is important to pass the learnings from some domains to others.

5 OPEN INNOVATION MODEL

The process started with an extensive literature review of open innovation. There have been several contributions to the field of open innovation since its introduction by Chesbrough in 2003. Open innovation could be approached from many perspectives including strategic planning, organizational modes, corporate venturing, innovation, knowledge management, user driven innovations, crowdsourcing, among others. After reviewing several of the contributions, it was difficult to integrate these multiple and (sometimes) fragmented perspectives into a model that could be used by an organization seeking to implement open innovation. Therefore, it was necessary to take a broader view and explore the relationship between innovation and open innovation. After exploring the domain of innovation, the researcher gained a better understanding of how open innovation could support the innovation process and analyzed in more details the knowledge flow processes. That step increased the complexity as open innovation could be used to support innovation in broader contexts than new product or services development, and for incremental and radical innovations. In addition, the decisions of which mode to use, the selection of partners, and the criteria that would suit better an organizational setting, goals, capabilities, and strategy was missing. Thus, it was necessary to again take a broader view and analyze the links between open innovation, innovation, strategy, business model, and knowledge management. In addition from literature review on these domains, the model considered observations from the case company and data validated by the cases interviews. Thus, the factors found from the empirical data were considered in the model. These main considerations act as a starting point for constructing the model.

5.1 General Model

The model was constructed to align corporate strategy, innovation, open innovation, and knowledge management. Figure 1 served as a framework for building the model. The alignment is supported by a business model which includes multiple processes how companies create, deliver, and appropriate value. In addition, the model considers multiple growth horizons to address several dilemmas including: exploitation vs. exploration, closed vs. open innovation, and incremental vs. radical innovation. By using several horizons of growth is possible to balance the tensions and conflicts usually seen in ambidextrous organizations.

It consists of a layered model (see figure 24) that includes the three horizons of growth. At the core are the building block of open innovation, composed by set of strategies, company’s business model, and resource base that includes knowledge base and

capabilities. The next layer includes processes for discovering and evaluating the open innovation opportunities. These processes could include exploration of new sources of knowledge through networking, scanning, and scouting, among others; and processes for evaluating, screening, and connecting opportunities. The next layer includes the possible modes of collaboration with external parties. These modes are referred as open innovation mode or collaboration modes; and include a variety of forms such as venture capital, strategic partnership, and free revealing. Finally, the last layer describes an instance of the open innovation mode, defining the organizational structure established, the internal team, and the external parties involved. These are the different layers of the general model.

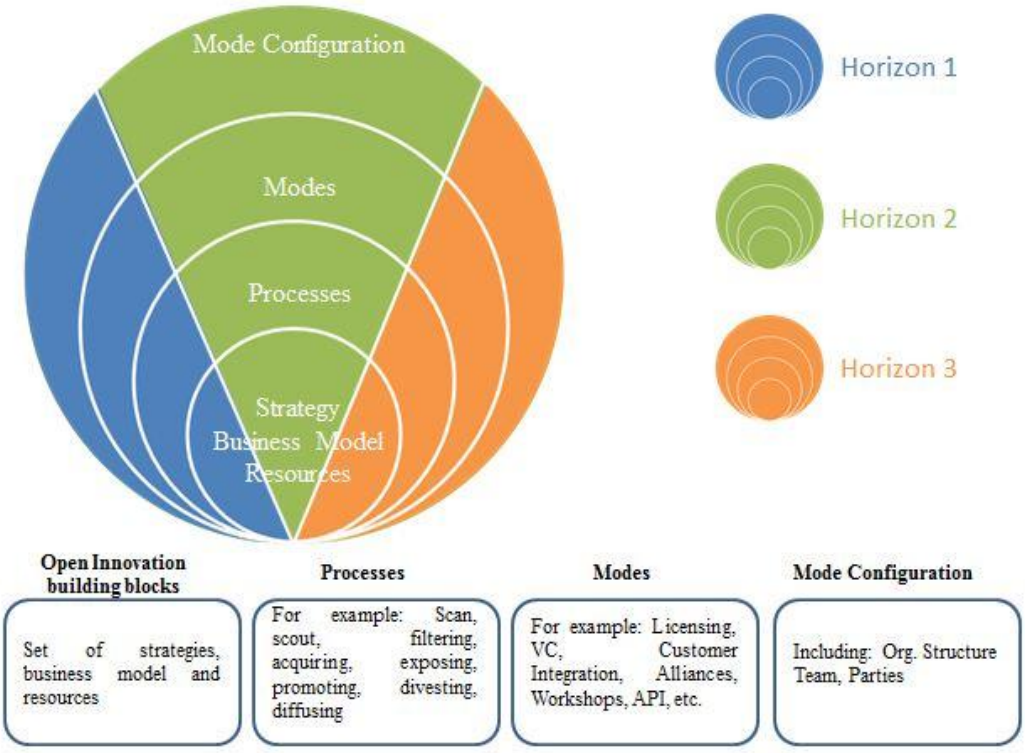


Figure 24: Open Innovation Model

The model starts by defining strategies across multiple horizons using as a reference the three horizons of growth. This view is implemented in the model to have a balance between short and long term dimensions; balancing the risks and benefits of exploiting current assets and markets, and developing and experimenting new opportunities. Afterwards, the business model is reviewed and compared to the strategies searching for gaps and inconsistencies. It is important to fully understand and communicate the business model to the organization. Next, the resource base is analyzed, including knowledge domains and capabilities; and they are assessed according to strategic goals,

defining wanted levels of knowledge and capabilities, and identifying those in which the company excels. Once these steps have been completed, the innovation process is opened by scanning and exploring the environment to identify and select opportunities. There are several forms to establish exploration and screening of opportunities. After that, the model suggests matching opportunities with the strategic, business model, and resources criteria. The model provides a table suggesting actions at general-level: buy, sell, build, keep and ignore. Later, the business model is reviewed again to identify forms to capture value from the possible collaboration. This is more relevant with initiatives in horizons two and three. Finally, the open innovation activity is implemented by establishing the collaboration, forming a team, selecting partners, among others. All these steps reflect the model from figure 24. However, there is another phase of learning and improvements. That last phase involve two more steps which involve all initiatives: Reviewing the alignment of strategy and open innovation and learning and improvement process for the whole model. The flow of all steps is presented in figure 25. For simplicity, the model is presented in steps or linear form; however, there are some steps than interact with the others in cycles. For example: the external knowledge exploration, connection, and mode selection need interaction between each step and could be seen as a bi-directional flow.

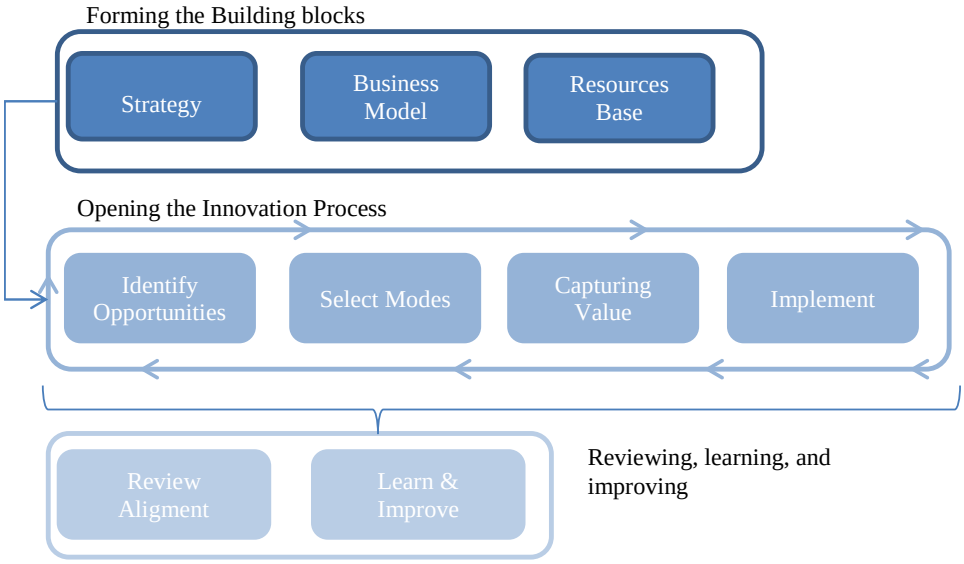


Figure 25: Open Innovation Model Step by Step.

5.2 Forming the Building Blocks

The first phase consists in evaluating strategy, the business model, and the resource base across multiple horizons. These three core elements form the building blocks to approach open innovation (See figure 26). Details about each step are described in the next subchapters.

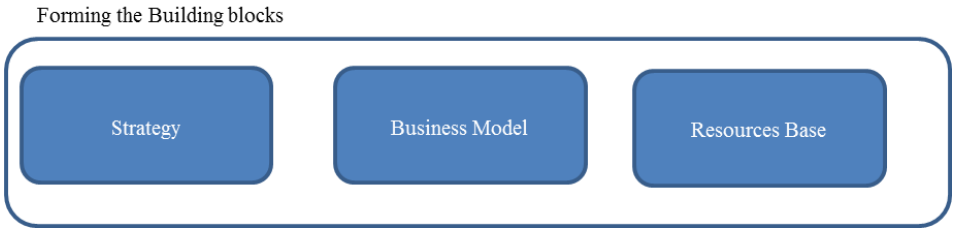


Figure 26: Forming the building blocks

5.2.1 Strategies across multiple horizons

The first step of the model suggests defining strategies across multiple growth horizons, in particular, across the three horizons of growth (Baghai et al 1999), similar to Beinhocker (1999) adaptive robust strategies. Figure 27 shows several strategies across the three horizons (represented as a central node) and possible paths they could take (represented by the emerging nodes with arrows). This view supports a holistic and integrative perspective of open innovation; exploiting its potential and bridging gaps between current situation and the desired position. For example, it could be possible to have an open innovation mode which is relevant for strategies in the first horizon and another to explore strategies in the second or third horizons.

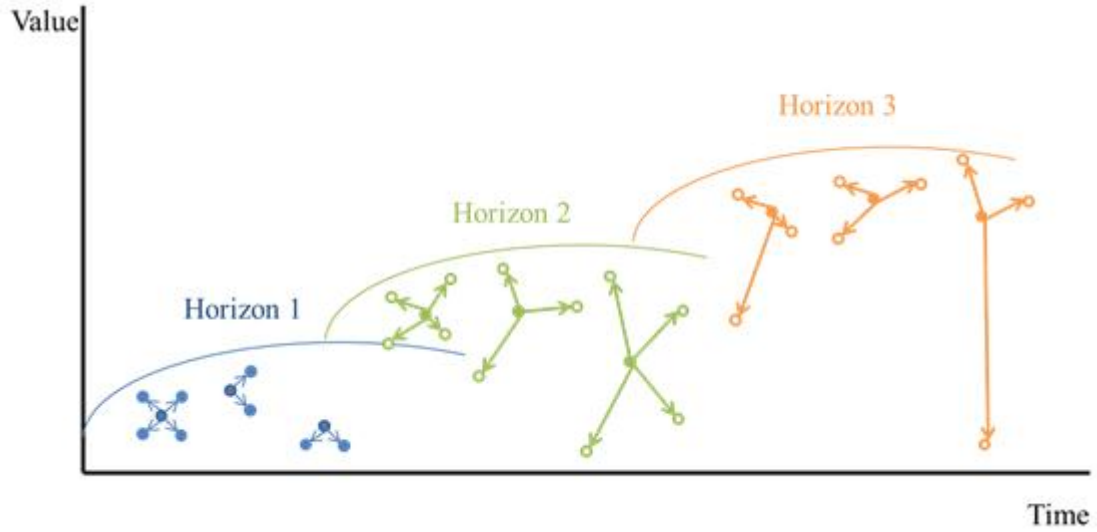


Figure 27: Three growth horizons adapted from Baghai et al (1999) and Beinhocker (1999, 101).

In order to do so, firms should use their current strategy as a reference, and then: analyze in which markets they are competing (first horizon), where they should invest to expand to new markets (second horizon) and plant seeds for the future (third horizon). Most firms are focusing on activities in the first horizon but not much on others (Beinhocker 1999). The others horizons tend to correlate with longer time frame, higher uncertainty, and risk levels.

Having the view of multiple horizons for growth is a strategic decision, not necessarily a condition for open innovation. However, the innovation process could involve several dilemmas (incremental vs. radical, closed vs. open, exploitation vs. exploration, weak vs. strong ties, etc.) and, open innovation adds more complexity to the topic; with multiple collaboration modes, partners, and decisions to make. Therefore, this vision supports handling conflicts and/or tensions that could surface by integrating open innovation into the organization, in particular when addressing a new collaboration mode, partner, organizational form, or market.

To summarize this step, it will use as a starting point the corporate strategy of the company. It will formalize set of strategies, goals, and objectives across the three horizons of growth. The next step involves analyzing the business model and its alignment with these strategies.

5.2.2 Analyzing the Business Model

The second step involves analyzing company's business model. It is important to understand the role of the business model and how is supporting the strategies; in other words

understand the logic of the company. As was mentioned in the literature review, a business model could be seen as the materialization of a strategy. At a general level, the business model explains how the organization creates, delivers, and captures value (see figure 28). It includes: processes; organizational form; internal structures, revenue model; interface with customers, suppliers, and other external parties; activities; and others.

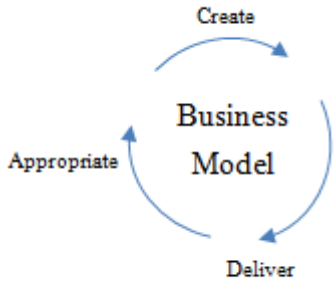


Figure 28: Business Model Value Cycle

To analyze the business model, it is recommended to have a holistic view of the company's operations and interactions. This could be done by tools like business process modelling, system analysis, business model canvas, among others. Once the business model is understood, it could be possible to analyze how the innovation process supports the strategy. Moreover, it could be possible to observe if the business model is aligned to the strategy, identifying issues, inefficiencies, and/or contradictions; for example, a company following a technology leadership strategy that has higher investments in marketing than in R&D operations seems to have some sort of misalignment.

Having a complete understanding of the business model supports the company at later phases of exploring open innovation initiatives. Companies could consider how initiatives fit with current business model by asking at least the following three questions: How would the company create value? How would the company deliver value (and to whom)? And how would the company appropriate value? For example, in the case of collaborating to develop a new technology, the company could ask the following questions: could the new technology be patented? Who will have access to the technology and how will the patent be filled (ownership)? Does the company have in place the process, know-how and internal structure supporting efficient licensing activities (legal department, efficient patenting process, etc.)? On other cases, like in free revealing, it could ask the following questions: does the company has in place complementary products or services from which it could capture value (consulting services, premium products, etc.)? Or could it capture value in other forms by increased reputation (like becom-

ing an expert in the field)? Understanding the business model helps aligning open innovation decisions with the strategy

However, in some cases, company's business model could not fit open innovation initiatives. These could happen due organizational culture, lack of competences or experiences, risk aversion, market gap, among others. In these cases companies would need to change their existing business model or develop one new to integrate open innovation. This is exactly what Procter & Gamble has done by integrating open innovation into their business model, having a major organizational shift. With their Connect and Develop program, P&G has integrated open innovation to their daily routine. It involves several changes like creating processes that matches external sources of knowledge to internal needs; creating a culture of openness; providing incentives supporting these changes both to external collaborators and internal employees; among others changes. Companies could take an active approach similar to P&G, be a little less active with incremental steps, or balance both approaches. However, they do not need to make major changes to the business model to explore opportunities in the second or third horizons. One company that managed to successfully implement this is Degussa. Degussa created a new organizational entity, Creavis, to handle different organizational forms like spinoffs, investing in corporate venturing, and others (Bröring & Herzog 2008). These new forms could experiment with new technologies, business models, partners and deal with uncertainty and risk issues. Thus, forming new organizational forms to experiment with new modes, partners, markets, and technologies could be an alternative to adapting the business model. Moreover, together with the view of multiple horizons of growth strengthens the model for open innovation.

In this step companies need to analyze their business model with focus on value creation, delivery, and appropriation. Sometimes the business model and strategy are aligned and allow exploring open innovation initiatives, whereas in other cases it is required to adapt the business model or change it. In addition, it is possible to have new organizational forms with a different business model to explore some of the open innovation initiatives. This tends to be the case in the second and third horizons of growth. The next step involves analyzing the resource base, in particular the knowledge base and capabilities.

5.2.3 Exploring Resource Base

In this step, it is required to explore the possessed (or accessible) key resources including knowledge base and capabilities. There are two main reasons behind it: access to the required knowledge to develop innovations and transfer unused knowledge to external markets. The former is achieved by assessing the knowledge domains in which collabo-

ration with external parties could increase the knowledge base or knowledge in new domains. The latter is achieved by identifying opportunities where owned knowledge could be transferred to external environment. In addition to knowledge, this step extends to capabilities (like know how or ways of working) and physical resources (like infrastructure, economies of scale and scope).

This step could resemble an S.W.O.T. analysis based on knowledge base, capabilities, and resources. It is suggested to explore the domains required to achieve the strategic goals of the company. At the end of the day, exploring the resource base needs to answer two questions: do we have the required knowledge base to produce the desired innovation internally? If so, do we possess the capabilities to do so?

In addition, it is suggested to explore the knowledge management process of the company. Improving the knowledge management process could support company's open innovation initiatives. This process seen from Lichthentaler (2008) framework will depend on capacities related to knowledge exploration, retention and exploitation processes. Enhancing these capacities[5] increases the probability to access knowledge, integrate, and appropriate it; and thus, support effective open innovation. Nevertheless, access to new knowledge does not necessarily mean more value for the company; it will depend on the business model to successfully capture value from the knowledge management and innovation processes. Hence, this model suggests aligning strategies, business model, innovation processes, and knowledge management.

After this step, companies should be able to identify what knowledge areas and capabilities are required to support the strategic goals. Also, in what knowledge areas and capabilities the company excels and which of them could be transferred to the environment. Both would serve as input for the next step of exploring open innovation opportunities.

These first three steps form the core of the model, or open innovation building blocks. These elements serve as the starting point to explore future open innovation initiatives. The next phase involves opening the innovation process of the company by identifying opportunities, selecting them, and implementing them.

5.3 Opening the innovation process

This phase describes steps to open the innovation process. It is an iterative process that involves identifying opportunities, selecting the most appropriate, planning how to create, deliver, and capture value from the collaboration, and implement it. Opening the

[5] More about this topic on chapter 2.3.

innovation process (see figure 29) involves receiving inflows of knowledge from the environment (outside-in process), taking unused knowledge to the outside (inside-out process), and/or both of them (coupled process).

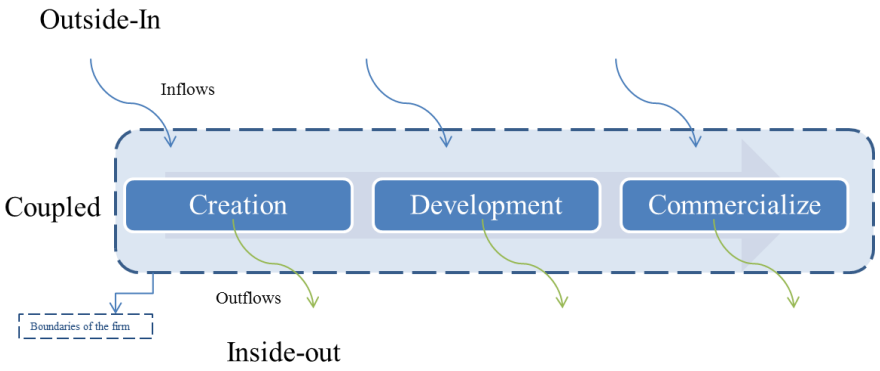


Figure 29: Opening the innovation process

In order to enhance the inflows and outflows of knowledge, it is important to have processes that use the knowledge exploration, integration, and exploitation capabilities[6]; and identify how external sources of knowledge could reinforce parts of the innovation process. This phase has the following steps: identify opportunities, selecting them, reviewing value capture, and implementing them. To simplify the steps, they are presented linearly; however, they could go in both directions and through iterations (See figure 30).

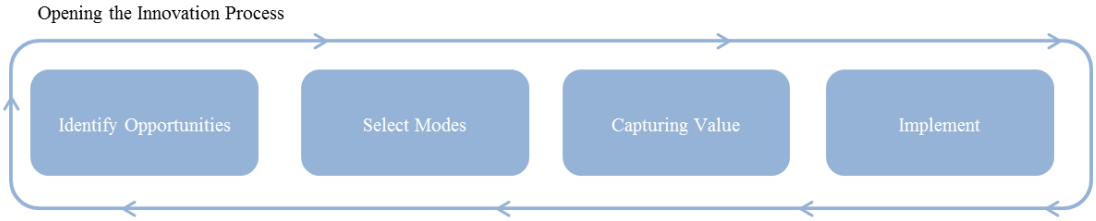


Figure 30: Opening the Innovation Process

5.3.1 Identifying Open Innovation Opportunities

This step involves exploring opportunities for open innovation initiatives mainly scanning the environment for potential external sources of knowledge[7] and being receptive of initiatives started by external collaborators. These opportunities could be sought to match needs of the resources identified from the previous phase but they could also sur-

[6] As described in chapter 2.2.2

[7] For a list of external sources of knowledge see chapter 2.4.4

face from unknown needs discovered through interaction with partners and/or the environment. Thus, it is suggested to search for open innovation opportunities initiated by partners and other organizations.

With the (theoretical) limitless potential sources of knowledge available to interact with, it could be difficult to decide which partner to choose and by which mode to collaborate, however; before engaging with external parties it is suggested to consider, at least, the following aspects and their implications: partner complementarity, partner goals and motivation, partner business model, organizational form, and size and number of partners (see table 11).

Table 11: Factors influencing the selection of external parties

Factors	Description
Partner Complementarity	It is important that the selected partner(s) complement company's resources. These resources could be knowledge, intellectual property, capabilities, skills, infrastructure, financial, among others.
Partner goals and motivation	Companies should analyze and consider partner(s) goals and motivations to participate in the collaboration. This is an important issue that should be considered as there could be conflicts that lead to negative consequences. For example, a university aims at producing knowledge in order to diffuse it, which could conflict with the company's interest in keeping the knowledge in secret. In other case, a possible collaboration partner could access information that could be used to compete with the company in the future. In the case of multiple user collaborations, like open source or idea competition; they should be aware that users are motivated by different factors. Thus, is suggested to offer a balance between extrinsic and intrinsic motivators.
Partner business model	From the previous factors, it becomes clear that partners should aim for a win-win situation. Thus, it is suggested to have aligned business models. This could require investing time and resources; as in some cases the collaboration and how each partner can capture part of the value is not that clear. Especially for activities in the second and third horizons.
Organizational form	Organizational form, collaboration mode, and governance could influence the collaboration with partners. In some cases, flexible modes with less restricting rules (agreements based on trust rather than non-disclosure agreements) could be more appropriate whereas in others more strict rules are suggested. It is important to have clear rules and expectations of the collaboration. Organizational form and culture could support or create conflicts between partners; this is more common with higher cultural and spatial distance.
Size and number of partners	Size and number of partners could be a factor that affects the aforementioned factors. In addition, with higher number of partners/participants, the complexity expands.

Successfully exploiting open innovation opportunities reinforce the innovation process or allow taking innovations to new markets. Companies could reinforce the innovation process by exploring, integrating, or exploiting knowledge at the three phases of the innovation process. Similarly, they could "package" unused knowledge in forms that becomes easier to transfer to external parties. The model suggests that both actions are considered across the three horizons of growth.

One important remark is that companies need to perform a double role (Whelan et al 2011): first, of idea/knowledge scout; and second of internal connector of knowledge with opportunity. They could establish multiple processes to identify external sources

of knowledge, evaluate and select them, and implement the collaborations; for example: scanning the environment including, customers, suppliers, startups, venture capitalist, etc., and screening these opportunities based on defined criteria. At the same time, they could establish processes for selecting the unused knowledge, diffusing it to external parties and profit from it; for example: processes to promote and "package" an existing technology to external parties.

This model will not propose particular processes for exploring and assessing opportunities but suggest companies to define their own processes or use others processes as references, such as suggested by Slowinsky (2005), West & Bogers (2013), Collins (2014) or others. Nevertheless, as a starting point, the model will use an opportunity, whereas it was carefully sought internally or proposed by a partner. Once they have been identified, is up to the decision makers to see which mode is more convenient. This decision is strongly influenced by the company's business model and how it is able to create and capture value from these interactions. For that action, the model proposes guidelines based on strategic fit, resource ownership, and ability to appropriate value; more details are presented in the next step.

5.3.2 Selecting Open Innovation Modes

The previous step identified opportunities to engage in open innovation activities with external parties. Once companies have identified opportunities, they need to decide which ones to pursue and what mode to select[8]. The decision criterion differs between companies due specific characteristics of the company and its environment (Bigliardi et al 2012). This step introduces a tool to guide the selection of opportunities, suggesting which ones to explore and how, and which to omit or ignore.

The tool was inspired by a combination of Dunning's (1995) Eclectic Paradigm which considers factors that influence the decision towards internationalization mode; the open innovation literature; and empirical data. Open innovation modes are dependent on certain factors that influence company's selection criteria. These factors, the open innovation building blocks, were reviewed on the previous phase. The first factor, strategic relevance is associated to how the opportunity aligns to the strategic goals. For the first horizons is clear about if it supports or not the strategy. For the other two horizons if could be less clear. The second factor is the business model and how the company could appropriate value from the opportunity. Value creation and delivery are important parts of the business model; however, in the end, having means to capture value will

[8] For a list of some open innovation modes see chapter 2.6.5.

have greater impact in selecting an opportunity. Finally, ownership of knowledge and capability will influence on the selection, together with the gaps between them and those intended to integrate.

In order to select open innovation opportunities, companies need to answer the following three questions: Is the opportunity a source of strategic advantage in any of the three horizons? Does the company have a business model to capture value from it? Do they have the sufficient knowledge base and capabilities to develop it? According to the answers, table 12 gives general suggestion about what decisions take at a macro or high level.

Table 12: Modes selection framework

Strategic Relevance	Business Model (create and capture value)	Resources, knowledge & capabilities	Suggested decision
Yes	Yes	Yes	Make
Yes	No	Yes	Keep. Or Experiment. e.g. Corporate Venturing, Joint Ventures, others
Yes	Yes	No	Buy
Yes	No	No	Buy/Make (depends). Or Experiment. e.g. Corporate Venturing, Joint Ventures, others
No	Yes	Yes	Sell. e.g. Divest, License
No	Yes	No	Ignore
No	No	Yes	Sell. e.g. Divest, License
No	No	No	Ignore

At a high level the suggestions are associated to make or develop the innovation internally or buy it from external sources; and keep the innovation internally or sell it. In addition to, ignore the initiative. The make decision refers to internally developing the innovation. This does not necessarily mean from idea to final product, existing collaboration from suppliers and outsourcing can be maintained and fostered. For example:

improving value chain, outsourcing manufacturing, etc. Thus, it relates more to developing internally or keeping the core elements related to intellectual property, knowledge and capabilities. The keep decision refers to maintaining the knowledge inside the company. Knowledge could be exploited in new forms but it is not easily exposed to the external environment. The buy decision refers to sourcing the knowledge or capabilities by different means such as idea scouting, transactional development, venture capital, acquisition and or in-licensing, among others. It will depend of the stage of the innovation process and the type of knowledge needed. Selling decisions refers to exposing the knowledge or capabilities to the outside by different means such as divesting, free revealing, out-licensing, among others. Ignore decisions refer to not investing time and resources in the opportunities if they are not linked to the strategy or adds value significantly. It is suggested to reallocate the resources to other opportunities.

The tool supports companies exploring different open innovation opportunities. At the low level, decisions will depend on their goals and approach towards open innovation and vary according to type of knowledge, the type of partners, their risk appetite, and collaboration particularities. If the goal is to exploit current capabilities and knowledge then select the mode and collaboration that is more aligned with current business model. For example Cisco has developed an acquisition and development strategy with a specific unit Acquire and Develop (A&D) in charge of these actions. They even have developed a standard process for acquisition and integration. Therefore, acquisitions, external corporate venturing, and other similar actions are easier to implement by Cisco because are aligned with their business model and internal structure. In a similar manner, although with different modes and capabilities; software company SAP, has enabled a platform that gives developers the opportunity to contribute with third party applications; engaging and supporting a community of developers that share and build new knowledge. This implies that some modes would fit better organization's culture, capabilities, and processes than others. However, this does not mean companies cannot use other modes. If the goal is to explore new opportunities and develop new capacities, then it is possible to explore and experiment with a new mode of collaboration. Companies' should consider experimenting with new modes to develop capabilities and test new business models.

The previous tool presented suggestions on a high level. These aspects depend on the companies and there is not a solution that would fit all of them. Nevertheless, to complement previous tool, a lower level general mode suggestion is presented in table 13. These suggestions would depend on the horizon the companies want to drive the initiative. Thus, the modes are a generalization based on the three horizons and the level of commitment and reversibility of them; for instance, a collaboration agreement requires less commitment and reversibility than a company acquisition.

Table 13: General level suggestion of modes selection across horizons

Horizon	General characteristics	General modes examples:
1	Involves exploitation of current knowledge and capabilities. Knowledge tends to be simpler to assimilate, the sources are centralized, and its form is explicit and easily codified.	In-licensing, acquisition of technology, out-licensing of technology, divesting units, transactional development, use of innovation intermediaries, informal community engagement, free revealing, co-creation, among others.
2	Involves a mixture of exploration and exploitation: Tends to explore the adjacencies to expand in new close markets and invest in new technologies.	Internal corporate venturing, joint ventures, external corporate venturing, platforms, formal community engagement, providing tools like API, company acquisitions.
3	Involves exploration of new domains, organizational forms and business models. Knowledge tends to be complex; it is distributed among multiple sources and domains. Knowledge is tacit and is difficult and costly to codify and transfer. There are experimentation and risk-taking activities.	Forming new organizational forms, investing in distant technologies of high technological and market uncertainty, research clusters or ecosystems, among others.

This tool provides rationales for open innovation decision making. It is based under the assumption that the company could influence and establish a collaboration mode. However, in some cases, the mode would be given by the partner or as a condition (for example in consortia collaboration) and it is up to the company to decide whether to collaborate or not. These tools support the decision making process but should carefully considered based on the company business model and experience.

To summarize, this step involves deciding whether to collaborate or not, and suggest some modes over others for particular circumstances. Companies need to decide based on different criteria (such as partners, risks, resources, etc.) and their approach towards the collaboration.

5.3.3 Capturing Value through Business Model

In this step the selected opportunities are compared with the business model of the company. A business model reflects the logic of the company. It should clearly define how the value is created, delivered, and captured. It could happen at any phase of the innovation process and through interaction with other open innovation modes and part-

ners. It is assumed that there is a business model for the first horizon, which is where the company is competing. In the case of misalignment or gaps it might be required to form new organizational forms, re-structure current organization or adjust the means to capture value. If the selected opportunities are in the second or third horizon it is also suggested to align current business model to the adjustments or new organizational forms. For example, if a new form like external venturing unit is created to explore non-core business or technology opportunities (horizon 2 or 3), there should be a plan that considers when the small investments are integrated as part of the core business, integrated to current technology or on the other hand halted or divested.

5.3.4 Implementation of open innovation opportunity

Details for implementing specific open innovation opportunity through a mode like those described in chapter 2.6.5.; falls out of the scope of this thesis work. However, there are some general guidelines or considerations when implementing modes:

- Allocate resources. As any other formal business activity, open innovation initiatives demand resources. Thus, before starting to implement the activity have management support and assign the required resources.
- Form a team in charge of the mode. A formal team or responsible for the initiative should be assigned. The team should act as interface between collaboration parties and the organization. It suggested that the team is multidisciplinary and have good communication and coordination skills; then, according to the type of mode additional skills and knowledge will be required (domain specific).
- Define clear goals, expectations, and rules. This serves both for internal stakeholders and to the external parties with whom the company will engage.
- Balance control and trust. This point could be challenging as it needs to define the boundaries of control between organization and external parties.
- Balance intrinsic and extrinsic incentives. It is important to have a mixture of intrinsic and extrinsic rewards. This applies for internal and external stakeholders. There is no recipe as it would depend on the type of mode; for example, online competitions tend to have some type of monetary reward but are not the main driver for collaborators whereas in plenty of cases of open source, intrinsic rewards have more predominance. Thus, is important to keep in mind the motivation of the persons involved.
- Use non-traditional measurement for tracking success. Traditional measures like R.O.I. might not be the most appropriate metrics to measure success. Therefore, it is important to analyze the business model of the company and

see how value could be captured. With this view, it is possible to define better metrics for the collaboration.

- Keep an open mindset. Be open to explore new opportunities, learn from the collaboration and external parties, and see new exploitation potential. Humbleness is required to recognize that we do not know everything and there is space to learn.

In addition, it is important to highlight that external collaborations involve three types of alignments (Mailman, Uribe-Saucedo, Taylor, Slowinsky, Carreras, Arena 2010). Figure 31 illustrates this claim in the cases of alliances.

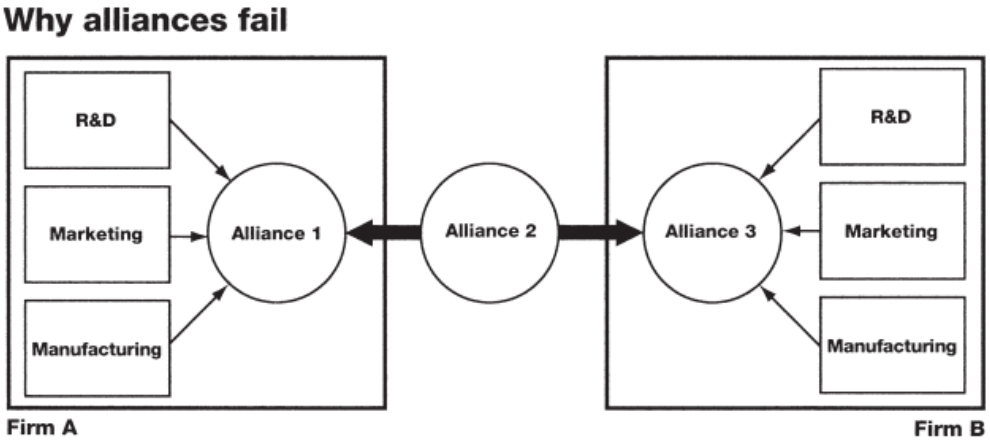


Figure 31: Why alliances fail. (Mehlman et al. 2010, 59)

5.4 Reviewing, learning and improving

The final phase of the model involves looking back at what have been done and reviewing alignment of strategy and open innovation. This phase includes steps of reviewing the alignment of strategy, business model, open innovation and knowledge management and finally a step of learning and improving (figure 32). These steps are described with more details in the next subchapter.

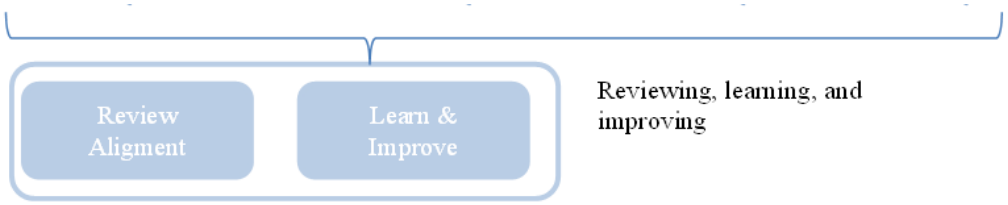


Figure 32: Reviewing, learning and improving phase

5.4.1 Reviewing Aligning Strategy and Open Innovation

After having multiple strategies across multiple horizons, it is suggested to align them with the business model, open innovation and the modes of collaboration. It is important that the selected modes support open innovation, that a business model allows to create and capture value and that it supports company's strategy. There are processes for opening the innovation process and become aware of the multiple opportunities. This can happen at any phase of the innovation process from the outside-in, inside-out or coupled process. Thus, it is recommended to review the alignment between strategy and open innovation once again. (See figure 33).

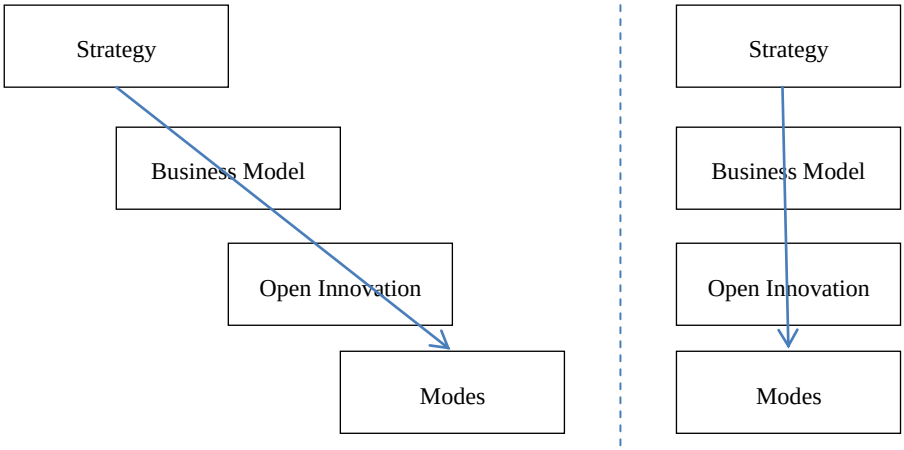


Figure 33: Reviewing aligning

The following questions could serve to assess and review alignment of strategy and open innovation.

- What are the main goals, areas, and activities that the strategy defines?
- Do we have a proper setting (organizational structure, culture, incentives, processes, partnership, etc.)
- What is the innovation approach taken? Is it aligned with the strategy?
- Does the business model support the innovation initiatives?
- What open innovation modes are we pursuing?
- How are the modes supporting the innovation process?
- How are we creating value from these modes?
- How are we capturing value from these modes?
- Are the selected modes the most appropriate considering our goals, methods to capture value and partners?
- Do we have the necessary resources (including proper team) to implement the open innovation activity?
- How do we measure success with a particular collaboration?

5.4.2 Learnings and Improvements

This model would be incomplete without having notion of learning and improving. These concerns all parts of the model, including: defining strategies, goals, and processes; scouting new knowledge and connecting it to internal organizational needs; selecting modes; improving modes efficiency (joint ventures, acquisition processes, etc.) and reinforcing networks; establishing partners profiles (strengths and weaknesses); defining internal open innovation teams and required capabilities; etc. Moreover, the model needs to be adapted to companies' environment, considering internal resources, and the industry's system dynamics. Thus, it should be used as reference and adapted to the needs of the organization. There are learning opportunities from every collaboration, modes, implementation, and iterations. It is important to share the learnings inside the organization but also with potential collaborators.

6 CONCLUSIONS

The last chapter of this research discusses theoretical connections, implications for the case company, further research, and final considerations. First, the researcher describes contributions made to open innovation literature and other domains including: strategy, business model, innovation, and knowledge management. After that, the researcher presents implications for the case company, including: general understanding about open innovation; enhancing capabilities; other recommendations; and possible next steps. Later, possibilities for further research are discussed, including: best practices for modes, competences required in open innovation; and defining metrics. Lastly, the document ends with some final considerations from the researcher.

6.1 Theoretical contributions

6.1.1 Open Innovation Literature

This research contributes to open innovation literature by integrating multiple perspectives, domains, and elements; including strategy, business model, innovation, knowledge management, capabilities, organizational forms, assessments of modes, and uncertainty, risk and time dimensions. Previous contributions have emphasized certain perspectives, provided case examples of companies applying certain modes of open innovation, or even provide guidelines or frameworks to approach open innovation but with certain limitations and focused on particular aspects, for example: outside-in process, engaging with online communities, idea competition, among others. Therefore, this research contributes with a broader view of open innovation which has been missing.

This research emphasizes that certain modes of collaboration are more appropriate to organizations depending internal factors including strategy, business model, and their resources; and external factors including industry dynamics and partners. Thus, the selection of modes depends on several factors. Moreover, it justifies that it would not be appropriate to recommend one mode over another without considering these factors. In other words, it could be said there is no magic bullet or perfect recipe to approach open innovation.

In addition, this research suggests that open innovation should not be categorized or measured by degree of openness in number of partners or extent of collaboration in the innovation process; like some previous contributions or frameworks suggests (for example see Elmquist et al, 2009 or Lazzarotti & Manzini, 2009). Organizations could be

more open to certain partners and domains but closed to others. Implying that how open innovation is handled could differ. Thus, a single organization could have multiple open innovation initiatives that are handled completely different.

Also, companies do not need to open all their processes or try all possible modes of collaboration to maximize open innovation potential. On the contrary, they could benefit more from existing collaboration by enhancing certain capabilities, like those described by Lichtenthaler & Lichtenthaler (2009). This is suggested for the case company in chapter 6.2.2.

Open innovation initiatives can be leveraged according to internal competences and external opportunities. Moreover, new organizational forms could support the leverage in cases of conflict or tensions with existing business model, strategy, or competences. Thus, the selection of mode could also be seen from a strategic point of view.

Finally, the model was constructed considering issues and challenges such as balancing: open vs. closed innovation, incremental vs. radical innovation, exploration vs. exploitation; and overcome those integrating different forms to balance them such as different horizons, forming new organizational forms, leveraging risks with opportunities, among others.

6.1.2 Strategy

It has been mentioned several times in the literature that open innovation should be aligned with the firms' strategy. However, literature contributions describing how this could be done has been limited. This research contributes to the link of open innovation and strategy by describing an alignment of strategic goals and innovation strategy of the firm, and how it reflects on open innovation initiative. Moreover, by integrating contributions like the multiple horizons of growth (Baghai, Coley & White 1999) and adaptive robust strategies (Beikenhocker 1999); the model was strengthened, providing a strategic approach to open innovation. In addition, this research suggest that open innovation could be used to leverage knowledge and/or resource constrains by using external sources and appropriate modes. Furthermore, this could be made in second or third horizons were uncertainty and risks are higher.

6.1.3 Business Model

Business model have a very important role in open innovation. Business model could be seen as how the firms, creates, delivers, appropriate value. This research contributes to the business model literature in several forms. First, describing the linkage between

open innovation and business model. In addition, the research emphasizes that the business model depends on the internal structures, channels, and paths of the firm, and that they could be aligned to exploit particular external opportunities. Finally, the research encourages practitioners to experiment with new business models by leveraging external opportunities and internal competences.

6.1.4 Innovation

Most research on open innovation focuses on certain parts of the innovation process but is missing a holistic view of it. This research contributes to the domain of innovation by linking open innovation to a broader view of innovation concept including: different forms of innovation, like product services, organizational, processes, etc.; types of innovation, like incremental and radical; across the different stages of innovation, ideation, development, and commercialization. In addition, this research tries to associate and align multiple open innovation modes with particular phases of the innovation process (see chapter 2.2.5). Also, the research considers issues and challenges found in the innovation literature, such as balancing incremental and radical innovation, dealing with change and resistance; and address them in the model by integrating the multiple horizons perspective.

6.1.5 Knowledge Management

Contributions to knowledge management literature are limited. The main contributions are to acknowledge the important role of knowledge management to open innovation; connect this domain to capabilities; and to associate and describe knowledge management role in exploring external sources of knowledge. Despite the fact that open innovation definitions explicitly mention knowledge, previous research has been limited in detailing how knowledge and open innovation are connected; for instance, describing the embodiment of knowledge, processes, aspects, and others. This research tried to align these elements with notions of capabilities and different modes. It is an initial contribution to the domain of knowledge management; however, more work needs to be done.

6.2 Implications for the case company

This research provided the case company with a model to approach open innovation, tools to assess the selection of modes, and other recommendations. The findings of this study together with the following recommendations are planned to be presented to a group of key stakeholders. The model would need to be tailored to the organization based on their strategies, goals, business model, and knowledge base; thus, some workshops are required to have this internal evaluation. In addition, the research brings the following implications for the case company.

6.2.1 General understanding about Open Innovation

This work contributes to the general understanding of open innovation, and in particular how LMF could benefit from the new paradigm. Before this study, there were some persons inside the organization aware of some aspects of open innovation. A few others have wide knowledge and experience in many activities including collaboration, research programs, bringing users or customers' insights, among others. Even in a few cases, the researcher has heard of discussion about bringing outside-in knowledge. Nevertheless, there is considerable number of people unaware of what open innovation really is and how the organization could maximize its potential. Also, as in many other institutions the outside-in perspective is dominant, leaving small room for inside-out perspective; thus, there are opportunities to foster and implement this view. To share the learnings about open innovation, there are plans to have an internal public presentation for the rest of the organization.

6.2.2 Enhancing Capacities

Independent of the new open innovation opportunities, it is possible to capture more value from current open innovation activities by enhancing the knowledge management process and the corresponding dynamic capabilities[9]. Based on Lichtenthaler & Lichtenthaler framework (2009), this research separates absorptive capacity into different capacities (figure 34). In order to capture value from current and new opportunities, it is suggested to enhance the capacities.

[9] For more information review chapter 2.2.2.

	Knowledge Exploration	Knowledge Retention	Knowledge Exploitation
Internal	Inventive Capacity	Transformative Capacity	Innovative Capacity
External	Absorptive Capacity	Connective Capacity	Desorptive Capacity

Figure 34: Capability based framework by (Lichtenthaler & Lichtenthaler 2009, 1318)

Inventive capacity involves processes to generate new knowledge inside the organization and integrate it to the knowledge base. Absorptive capacity involves integrating knowledge generated from external sources. Thus, both capacities are dependent of the knowledge base of the firm and processes that increases it. Knowledge base could be increased by formal methods of training, experimenting, researching, learning, etc., but also by informal methods of socializing, enabling informal communications, among others. Both are supported by a culture that stimulates learning, sharing knowledge, experimenting, training, tolerance to failure, among others. It has been positive to see that the company's culture and environment support these aspects; for example, with initiatives like Café Friday, Jack Bauer challenge, and learning lifestyle. In addition, the premises and infrastructure possess favorable conditions to exchange knowledge; offering comfortable meeting places, socializing rooms with coffee areas, couches, guitars, cafeteria, and gym room, among others. For many of these reasons LMF was selected among the top three best places to work in Finland during 2013. What could be suggested is to keep working in these activities and initiatives; support other forms of learning and experimenting; and if possible try to connect them with internal or external channels to increase knowledge exploitation. In addition, it is also suggested to increase the access and communications with external sources. There have been discussions about getting access to physical location close to the startup hub. The author believes this would be favorable for absorptive capacity of LMF.

Transformative capacity involves processes for maintaining and reactivating knowledge base. Transformative capacity could be enhanced by several means like codifying knowledge, establishing processes, routines, and training. LMF has excelled in these activities. Besides having access and contributing to official sources of knowledge and information from corporate intranet; LMF has been codifying knowledge of other less formal practices such as some innovation related activities. For example, they have been documenting most of the public presentations given during Café Friday, Jack Bauer Challenge, seminars, and other knowledge sharing activities. Nowadays, it is possible to access video footage of almost every Café Friday pitch and Jack Bauer challenge presentation. In addition, teams are using internal wiki's to document routines; processes; and share artifacts like code, documents, and other. Therefore, LMF has been very good at codifying knowledge. However, there could be a future challenge as the amount of information from formal and informal channels increases. One suggestion is to offer

easy interfaces to access and select the required information from all these multiple sources. Another suggestion is to transfer know-how, of new activities and collaborations; like how to engage with new partners, collaborating with multiple parties, third-party development, among others.

Connective capacity refers to the ability to retain knowledge through their networks but it does not imply its exploiting that knowledge. It is possible to enhance connective capacity by building new networks and social ties. Some examples include participating in seminars and fairs, especially in new areas or domains. For example, recently LMF organized a two day Machine-to-machine conference. This channel offered a great networking opportunity to build and strengthen ties with customers, partners, and other units and sites. It is worth mentioning that LMF is already using other channels that give great networking possibilities, including several TEKES and DIGILE research collaborations, including Internet of Things and Need for Speed programs. In addition, it is possible to form new ties using social networks like LinkedIn, Twitter, and others. In order to build trust relationships it may be required to invest in social capital, attending events, participating in meetings, and sharing knowledge with external parties. It is suggested to seek for a win-win scenario and be open to dialogue and discussions. Besides the possibility to network, it is recommended to foster competences related to social skills and have a consistent message that communicates the interests of the company. These suggestions are already in practice inside the organization, but are more evident in some units involved with customers and partners, like for example RECA. However, it is possible to foster this notion to any person inside the organization, as any of them could be able to contribute with the connective capacity of the firm.

Innovative capacity refers to forms of converting existing knowledge into means to deliver and capture value; for example, products, services, intellectual property, etc. Suggestions to enhance this capacity involve aligning internal knowledge to existing exploitation channels and expanding them. The former could be achieved by aligning ideas to products, services, or technology that matches current portfolio. For example, pitch customer problems in Café Friday or Jack Bauer challenge. The latter could be achieved by experimenting with new channels of exploitation or finding proper channels. For example, one of the aims of the reference group is to guide mature ideas to the most appropriate channels. Other suggestion is to communicate the customer and business perspective in events like Café Friday, Jack Bauer Challenge, and others.

Finally, increasing desorptive capacity involves communicating the benefits of a particular technology or intellectual property and being able to package and modularize it. This could be reinforced by experimenting taking current assets into other domains or new channels; for example, licensing technology to new domains, exposing API's, free revealing, and others.

6.2.3 Other recommendations

- **Improving internal collaboration.**

Another suggestion is continue improving collaboration between different areas and sites; in a way, to *break the silos.* Some activities are trying to involve other parts of the organization to participate and contribute with their knowledge and perspectives. For example, the reference group involves stakeholders representing different areas of the organization. Lately, Café Friday and Jack Bauer challenge initiatives have had participants of other units like RECA and research; in addition to sites in other countries like Sweden, Croatia, Hungary, and Canada. Similarly, the learning lifestyle community is trying to involve more stakeholders from multiple areas in the weekly planning discussions. There is a plan to have a sort of "road-tour" to Oulu and Turku sites with the aim of promoting activities like Café Friday, Jack Bauer Challenge, Coaching, learning lifestyle, and others, The goal is to integrate the sites, encourage them to participate, and empower to drive ideas and initiatives forward.

Open innovation activities demand collaboration of multiple departments and functions of the organization. As was described before, collaboration with external parties involves three alignments; and one of them is internal alignment. Thus, it is important to involve several stakeholders of the organization. By improving the communication and collaboration of the organization, it is possible to enhance connecting external ideas to internal exploitation channels. This could be reinforced by having functions or process for idea seekers and idea connectors; and assuring that both of them are connected inside the organization. The chances of exploring and exploiting external opportunities increase by channeling the wants/needs between the organization and the external environment. This could be made by a function, a process, IT tool, and/ or a combination of them.

- **Experiment with new modes of collaboration**

Another recommendation is to utilize opportunities that local environment offers. Finland offers a pool of highly educated and talented people, support from public institutions, and favorable and growing startup ecosystems in Helsinki, Tampere, Turku, and Oulu regions. At different levels, the organization is already exploiting opportunities, for example, participating in several research programs, developing the Oulu ecosystem, involved in the IT HUB in Turku, among others. Nevertheless, LMF could take the opportunity to expand collaboration in new forms, like experimenting with new modes to develop new capabilities. For example, LMF could take advantage of experimenting with spin-offs or investing in startups, leveraging available external founding offered by public organizations, accelerator programs, mentoring, knowledge, etc. and leveraging with internal resources such as networks, technology, know-how, etc. Moreover, this

could serve as an opportunity to experiment new approaches like Lean Startup methodology or Design driven Innovation.

- **Create an open innovation function**

Final suggestion is to formalize a function or unit in charge of steering open innovation activities. An open innovation program would probably fail unless it counts with proper management support and resources needed to drive initiatives forward. Thus it is recommended to form a team consisting of stakeholders representing multiple functions and areas. It is suggested that it involves multidisciplinary members. They should be responsible, together with other stakeholders; of defining, planning, and executing processes and initiatives like scanning of external technology, screening of opportunities, assigning them to the proper channels, driving new channels forward, and coordinating with other functions and internal departments.

6.2.4 Possible next steps

First, as it was mentioned before, the model needs to be tested inside the organization. The initial planned at the moment is coordinating a meeting with participants of the research and other stakeholders that could contribute with feedback and insights into what could be used in their daily work. After that, it could be plan how to test the model in the organization.

In addition, there is an ongoing national research program *Need for speed* in which the company is involved. There are many aspects from this study that could be shared in that research; for example, assessment of internal resources, finding new forms to exploit internal knowledge and capabilities; and looking and possible new internal or external paths.

Finally, if the results from the previous steps are positive, the researcher has the intention to extend this study at corporate level. It was not possible to find a formal model or open innovation program; however, it is quite plausible that key stakeholders are considering similar factors to make their decisions. It is also possible that these decisions are handled in privacy; and thus, the internal information was not available to the researcher.

6.3 Further Research

This research provided contributions to the domain of open innovation; presenting a broader view by integrating other domains. Nevertheless, there are more opportunities to extend the research to study other elements that could complement the model and

benefit practitioners. Some of these elements were considered at the beginning of this study but the researcher decided not to pursue them as it would expand the scope of the research in great magnitude. Thus, the researcher suggests further research in the following topics: best practices for open innovation modes, competences requires in open innovation teams, and metrics for open innovation.

6.3.1 Best practices for open innovation modes

This research introduced some of the open innovation modes found in various organizations. Some of them have been studied with more details like user innovations (see for example, Euchner 2013) whereas new phenomenon like crowd funding requires further research. Therefore, the researcher suggests exploring the different open innovation modes [10] and investigate their best practices.

6.3.2 Competences required in open innovation teams.

During the interviews, the researcher noticed the importance of particular competences of participants involved on open innovation activities. However, they were not explored in details. Thus, the researcher suggests investigating more about this domain and link them to particular open innovation modes. There are already some contributions like those of du Chatenier, Verstegen, Biemans, Mulder& Omta (2010). However, more research is needed, especially linking competences with open innovation modes.

6.3.3 Define metrics for open innovation.

Other research opportunity is to explore useful metrics for open innovation. The researcher suggests taking a broader view in the process of defining the metrics. For example, number of partners with whom the company is collaborating would not communicate much unless it is placed into other contexts, like in co-creation, standardization, research consortium, etc. In addition, the researcher suggests using metrics that could lead to quantify how value is being captured. For instance, percentage of ideas from idea contest that lead to a product/service improvement. Of course, this would

[10] Some of them were presented in chapter 2.2.5

depend on the business model of the firm, as it has frequently been mentioned. Defining metrics for open innovation is a very complex topic worth investigating.

6.4 Final considerations

This research started with several questions around how to approach open innovation inside a large organization. It combined several views of open innovation and other domains to construct a model that supports approaching open innovation. The model could be used as a reference by any organization regardless their strategies, business model, position towards innovation, resources, and industry in which it operates. It provides guidelines to approach open innovation and a step-by-step process showing how to go forward. Nevertheless, the model could be tested in different types of organizations settings like small companies, public institutions, companies in other industries, etc. In addition, the model could be iterated to include more elements like those mentioned in further research.

Open innovation requires management support and aligning the whole organization to work together. Without management support the organization could encounter barriers and limitations, including: lack of resources, cultural issues, resistance, and misalignment, among others. The organization should work together across multiple units. Therefore, they should invest on improving internal communication and awareness of what other units inside the organization are working on.

In addition, implementing open innovation takes time and involves learning and adapting process. It took several years and iterations to P&G, one of the early adopters of open innovation, until they could obtain the full benefits of this new paradigm. Thus, it is possible to approach open innovation by starting from existing practices and taking incremental steps to new practices. Also, firms should consider that initiatives in distant horizons will take more time to measure.

The researcher considers the case company has extensive experience with some open innovation initiatives. Moreover, it has been surprising to identify how many aspects of open innovation are already being practiced. Some of them with higher level of maturity than others but, of course, there is always room for improvement. Nevertheless, the general impression is that the case company is mature and has in place the elements required to capture the benefits of open innovation.

Other consideration involves discussions on similar topics being done in an online community MOOI (Managing & Organizing Open Innovation) which includes some prominent researchers in the field like Chesbrough, Vanhaverbeke, and others. Even though the researcher became aware of this initiative during the research, he decided not to participate or get involved on it. The decision was made because of the level of de-

velopment of this work at the time he discovered about the forum. In addition, it was worth to have an independent research that contributes to the field of study. Nevertheless, practitioners and researchers could explore the forum to improve their understanding of open innovation.

Finally, open innovation could give companies the possibility to develop products and services faster and cheaper while adapting to the changes of the environment. The knowledge landscape has been changing in the last decades, influencing how value is created, distributed, and captured across the value ecosystems. In the future, technology disruption will not be originated only by other companies but also by end users and customers. The researcher sees open innovation more as a mindset. Thus, how organization captures the benefits of open innovation depends on what internal structures, processes, and culture the organization selects and how they align them with opportunities from the environment. In the new competition landscape the winners will be those that adapt to the changes and enable to co-create and co-capture value with anyone.

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APPENDICES

Appendix 1: Sample Interview Request by e-mail

Dear [RECIPIENT],

I'm Juan Pinoargote. I work at [UNIT], the unit involved with New Business Development and Innovation. For my master thesis, I'm doing research on the topic of Open Innovations, which is how firms could integrate and share knowledge from (and into) the external environment. The research tries to understand decisions related to knowledge flows between Ericsson LMF and external parties. I'm interested in collaboration with external parties, characteristics, processes, and others. As part of my case analysis, I plan to learn about [CASE] and how is the external collaboration.

I have been referred to you by [COLLEAGUE] as someone who could help me with this research. I would very much appreciate the opportunity to talk with you about your knowledge and experience in [CASE]. The interview should take around 20-40 minutes.

This research is part of my academic studies but benefit the whole organization.

If you agree to participate, we could arrange a meeting when it suits your schedule.

Any questions or doubts please let me know.

Thank you very much in advance,

All the best,

Juan C.

Appendix 2: Sample Interview Questions

Theme 1: Respondent background Information

1. Could you please tell your name and role in the company?
2. Could you talk a little bit about your background experience and your particular role in this program?

Theme 2: "Case" story

1. Could you please tell me the story behind the "CASE"?
2. What its main goal?
3. How was it formed?
4. How is the company benefiting from the collaboration or capturing value?

Theme 3: Decisions behind selecting this CASE (Why this initiative instead of others)

1. When it was decided to form (CASE), were there other forms to achieving the same goal considered?
2. Do you think there are other ways how to achieve the same goal?
    a. Examples: Acquisitions, Customer Workshop, Fairs, etc.
3. Why this type of collaboration instead of other types?

Theme 4: Collaboration with external parties

1. Could you mention the external parties with whom you collaborate?
2. What is being done with these parties?
3. Why these parties? How do you select them? What is the criterion for selection?
4. Is there a process to find and select parties?
5. Can you explain a little bit about the collaboration process?

Theme 5: Problems or Issues encountered / How solve them

1. Do you recall any particular issues when forming this collaborative initiative? Would you care to share some of those?

Theme 6: Open for respondent (Any other thing you wish to add to this conversation?)