

UNIVERSIDAD DE NAVARRA
ESCUELA SUPERIOR DE INGENIEROS
SAN SEBASTIÁN



**Relevant factors in the implementation of
open innovation practices: Application to the
case of SMEs in the automotive sector**

MEMORIA

que para optar al Grado de Doctor
presenta

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bajo la dirección de
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Donostia - San Sebastián, Noviembre 2014

*Este tesis está dedicada a mi marido,
por ser el mejor compañero en este
largo camino, a mis peques por su
alegría y cariño incondicional, y a
mis padres por ser un ejemplo de
apoyo y esfuerzo que espero ser capaz
de transmitir a mis hijos, como ellos
me lo han transmitido a mí.*

“Everything you can imagine is real” Pablo Picasso

AGRADECIMIENTOS

“De bien nacidos es ser agradecidos” dice un tradicional refrán que todos conocemos, pero la realidad de nuestra vida es que pocas veces tenemos tiempo de pararnos a pensar a quién y por qué queremos dar las gracias. Así que aprovechando esta oportunidad, empezaré por mi familia porque son los que siempre han estado ahí, apoyándome en todas mis decisiones, incluso en esta aventura de volver a la universidad que emprendí hace casi dos años.

A mi marido Nacho, con su cariño y paciencia sin límites y un sentido del humor que es el antídoto perfecto para sobrevivir a la locura de mantener el equilibrio entre familia, casa, docencia, las mil y una actividades que se impulsan desde el grado de Diseño Industrial de Tecnun y el desarrollo de esta tesis.

A mis hijos, Marina e Iñigo, que son nuestros mejores proyectos en común, y que desde su visión sincera e inocente de la vida siempre tienen esa pregunta o ese comentario que pone en orden los valores en los momentos de mayor desorden, que nos devuelven la claridad mental para no olvidarnos de lo que realmente importa.

A mis padres y a mi hermana, tres buenos ejemplos de cómo cada uno hacemos nuestro camino en la vida, que nos podemos encontrar con un camino más o más difícil pero que la ilusión por seguir adelante y el esfuerzo para superar las limitaciones siempre son la opción que no defrauda, que antes o después compensa. Al resto de la familia que siempre han tenido una palabra de ánimo o un gesto de cariño que lo dicen todo.

Pasando al terreno profesional a mi mentora en Tecnun, Paz Morer, gracias a ella he tenido la oportunidad de dar este cambio en mi rumbo profesional gracias al cual cada día vengo feliz a trabajar, y soy consciente de que esto es un privilegio que debo a su confianza en mí y a su empeño en hacer del Grado de Diseño Industrial de Tecnun una experiencia premium, tanto para los alumnos como para todo el equipo docente. Al resto del equipo de Tecnun Design, Aitor, Diego, Itziar, Jon, Luis, y a todos nuestros profesores asociados (Adrián, Ane, Juan Luis, Ignacio, Marcelo y María), por compartir nuestras aventuras para lograr hacer de nuestros alumnos los más motivados y preparados del mundo. Esa es la meta y en el camino estamos todos juntos. Al resto de

compañeros del edificio Multiusos y de Tecnun en general porque todos ellos con su amabilidad y respeto contribuyen a crear en Tecnun un ambiente de trabajo muy especial.

A José Antonio Alfaro, director de esta tesis, porque sin él no hubiera sido posible, por su generosidad al considerar que este trabajo podría tener interés para la Cátedra de Empresa Volkswagen Navarra – Universidad de Navarra y porque siempre ha tenido una palabra de ánimo para impulsarme a seguir avanzando hasta llegar a este momento. A Francesco Sandulli, co-director de esta tesis, por aceptar participar en este proyecto y ser un contrapunto crítico-constructivo aportando siempre buenas ideas para enriquecerlo. A Javi Santos, porque fue él quien me hizo a llegar a José Antonio Alfaro, y siempre ha estado dispuesto a ayudarnos a sobrevivir en la burocracia y papeleos.

A todo el equipo de Volkswagen Navarra que ha colaborado conmigo en la fase empírica de esta tesis, por su interés y amabilidad, y en especial a Juan Gómez que nos ha abierto las puertas del Grupo de Innovación que está haciendo una gran labor impulsando interna y externamente la cultura de la Innovación Abierta. A todas las PYMEs proveedoras de Volkswagen que hemos entrevistado, y en especial al equipo de la SME5, por compartir conmigo sus inquietudes, sus éxitos y sus fracasos en este apasionante ámbito de la Innovación Abierta.

A mi ex Director en Bantec, Miguel Isaacs, porque como los maestros artesanos me enseñó paso a paso la profesionalidad necesaria para acompañar a nuestros clientes en esta aventura de la gestión de la innovación, y siempre confió en mis capacidades y me dio un voto de confianza en todas las iniciativas que le propuse. A mis compañeros de Bantec porque ha sido un placer compartir esa fase de mi carrera profesional con vosotros y de todos y cada uno he aprendido algo, y especialmente a Macarena, Iranzu e Iñigo porque lo que empezó siendo una relación profesional se convirtió en una amistad que espero que nos dure muchísimos años.

A mis alumnos y asesoradas en Tecnun, sí puede parecer exagerado, pero yo considero que tengo una deuda con todos los profesores que a lo largo de mis años de colegio, instituto y universidad se esforzaron por hacerme crecer personal e intelectualmente, y por eso cada uno de mis alumnos es un nuevo proyecto en el que pongo toda la ilusión por conseguir hacerles avanzar en su formación universitaria, tanto personal como académica.

Finalmente a los compañeros y al mentor del grupo de trabajo del Doctoral Colloquium del Congreso Internacional EURAM 2014, Hagen Habicht Executive del Center for Leading Innovation and Cooperation (CLIC) de la HHL (Leipzig Graduate School of Management), por ser el primer congreso internacional en el que contrasté los objetivos y metodología de esta tesis y que me terminó de convencer de que era un trabajo necesario en el ámbito de la Innovación Abierta hoy en día.

Mabel Rodríguez

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ABSTRACT

The research field of Open Innovation (OI) has grown exponentially since Chesbrough coined the term in 2003. But after more than a decade of research, some essential areas of research in the OI literature, such as OI practices and the context factors relevant to their implementation, are still fragmented and uncompleted, as noted in the reviews of the OI literature in recent years. In this thesis, I aim to enrich the literature on OI by analysing two specific issues: taxonomy of OI practices; and identifying the relevant context factors that most influence in the implementation of OI practices.

Accordingly, the first objective of this research is to conduct a comprehensive literature review of OI practices, which is necessary in order to clarify the concept and propose more precise terminology. This review includes the identification of the different typologies of OI practices defined in the literature and the dimensions used by authors to describe these practices. Secondly, we propose the identification, also based on the literature review methodology, of the internal and external factors that influence the implementation of these practices and the analysis of their relation with each OI practice typology. Then, according to the conclusions of the literature review, we propose a theoretical framework for establishing relations among different typologies of OI practices and the internal and external factors (firm-specific and contextual) relevant for their implementation. The empirical work of this thesis consists of an experimental contrast of the proposed theoretical framework, particularized for OI practices in SMEs in the automotive industry. This empirical work includes two steps, the first is a multiple case study of SMEs in the automotive sector and the second one is a retrospective case study of an SME from the automotive sector that has successfully implemented OI practices over a long period of time.

From the academic point of view, this thesis contributes to the OI literature with two main results. The first one is a classification of OI practices typologies, according to their main dimensions, which helps to establish a taxonomy in this research stream. The second one is a theoretical framework for establishing relations among different typologies of OI practices and context factors.

From the managerial point of view, the empirical research developed in this thesis, also yields some interesting results. In relation to OI practices typologies, we have shown that the studied SMEs have implemented the following OI practices typologies, which are identified in the theoretical framework: Innovation contest, Inward licensing of IP, Joined development, Joint venture, Lead user method, Outsourcing R&D, Outwards licensing of IP and Regional innovation clusters. Moreover, some specific typologies of these practices are more commonly used by the SMEs from the sample, such as Joined development. When using the theoretical framework developed in the theoretical section to look for relations between the implementation of the OI practices and the context factors, some interesting contributions arise from the multiple case study in relation to the relevance of specific context factors. We identify some relevant factors, from the internal and external contexts that facilitate OI practices implementation, such as absorptive capacity, IP management, Corporate culture, Technological turbulence, Proximities and Intermediaries, along with one factor from the internal context that hinders, namely Ambidexterity. Furthermore, the retrospective case study provides experimental evidence for the substitution effect between the absorptive capacity internal factor and the Intermediaries external factor when implementing a specific OI practice, Innovation contest. This contribution opens up an interesting stream for research and also for application issues. This contribution is a significant advance in the state of the art of current research in the field of OI, not only in general but also, particularly in OI in SMEs.

Finally our work is a door to open future research directions in the OI field that, if based in the proposed theoretical framework, could contribute to the strengthening of the theoretical foundations of this innovation management paradigm.

GLOSSARY

ACAP: Absorptive Capacity

IPRs: Intellectual Property Rights

ICT: Information and Communication Technology

IPS: Innovation Process Stage

NPD: New Product Development

OEM: Original Equipment Manufacturer

OI: Open Innovation

OIP: Open Innovation Practices

R&D: Research and Development

RQ: Research Question

SF/FS: Shared Facilities / Facilities Sharing

SME: Small and Medium Enterprise

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

The research field of Open Innovation (OI) has grown exponentially since Chesbrough coined in 2003 the term as “the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation”.

This OI model has been widely reported in the literature on innovation management research, but after more than a decade, some under-researched areas still remain, as has been noted in published reviews of the OI literature in recent years (Dhalander and Gann, 2010; Huizing, 2011; Remneland-Wikhamn and Wikhamn, 2013).

Some essential areas of research, areas that could help managers better understand the most suitable times for implementing OI in their companies and how to do it, such as OI practices and context factors that could have influence on their implementation, are still fragmented and uncompleted.

Figure 1.1. represents the Closed Innovation Model, where a company generates, develops and commercializes its own ideas. This philosophy of self-reliance dominated the R&D operations of many leading industrial corporations for most of the 20th century.

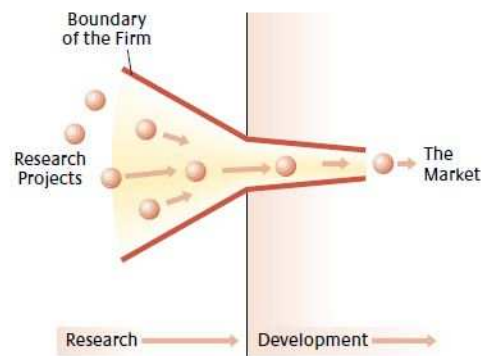


Figure 1.1. Closed Innovation Model (Chesbrough, 2003b)

In the new OI model, as shown in Figure 1.2., a company commercializes both its own ideas as well as innovations from other firms and seeks ways to bring its in-house ideas to market by deploying pathways outside its current business. In this model the boundary between the company and its surrounding environment is porous, represented by a dashed line, enabling innovations to move more easily between the two.

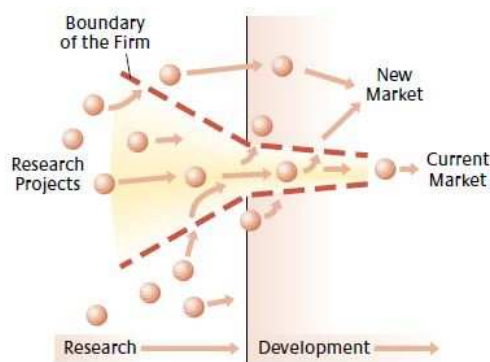


Figure 1.2. OI Model (Chesbrough, 2003b)

Table 1.1. below compares the principles of both models of innovation (Chesbrough, 2003b).

Closed Innovation Principles	Open Innovation Principles
The smart people in our field work for us	Not all the smart people work for us so we must find and tap into the knowledge and expertise of bright individuals outside our company.
To profit from R&D, we must discover, develop and ship it ourselves.	External R&D can create significant value; 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 in order to profit from it.
If we create the most and 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 intellectual property (IP) so that our competitors don't profit from our ideas.	We should profit from others' use of our IP, and we should buy others' IP whenever it advances our own business model.

Table 1.1. Comparison between principles of Closed VS Open Innovation models

Critical voices from the research community around the OI paradigm are increasingly louder, claiming the need for further research on issues that may contribute to the reinforcement of the theoretical foundations of the OI paradigm, as can be seen in Table 1.2:

Reference	Quotations
Dhalander and Gann, 2010	In spite of rising interest in using the openness construct, systematic studies of openness remain cumbersome because of conceptual ambiguity.
Elmqvist et al. 2009	Developing a more precise terminology in the OI field is considered important by many researchers
Lichtenthaler 2011	There is a need for a clearer understanding of the characteristics of OI. In this regard, we need further

	insights into practices and tools for managing OI processes
Penin et al. 2011	Future research will have to develop a coherent typology of OI modalities, according to their level of openness and interactivity among others
Dhalander and Gann, 2010	There is a fundamental question on which there is surprisingly limited evidence: Why are some firms profiting more than others from openness?
Elmqvist et al. 2009;	A contingency approach is needed that focuses on the context characteristics determining OI effectiveness. The context in this sense can be characterized by both the internal and external environment
Huizingh 2011	The importance of context factors can be studied in multiple ways, they can be related to the adoption level of OI, or can be related to the application of particular OI practices. This implies that some OI practices are more effective in one context than in another
Dhalander and Gann, 2010	While firms have always relied on some degree of openness, there may be new ways to work with external actors, suggesting qualitative change of OI practices along time
Gassmann et al. 2010	While most of the firms described in early works on OI are large multinational firms, it has become apparent that SMEs are also opening up their innovation process. SMEs are the largest number of companies in an economy, but they are under-researched in the OI literature. A crucial question for SMEs is how they can manage OI despite the liability due to their smallness. This is especially relevant when a firm is dependent on a few strong customers, such as the automotive sector.
Gassman et al. 2010	The internal process by which companies manage OI is still more trial and error than a professionally managed process. These authors state that what is missing is a decent cookbook, an integrated framework that helps

managers to decide when and how to deploy which OI practices. In what stage of the innovation process is collaboration most effective? With which parties to collaborate, and how to find and select them? What is the best way to capture value in collaborative networks, especially when formal protection methods are less feasible?

Table 1.2. Research gaps identified in the literature in relation to OI practices and relevant context factors

All these references help us to understand that OI research is a work in progress (Trott and Hartmann, 2009) that requires a more systematic approach, such as the one proposed in this dissertation, which will lead to advance in the theory of OI in relation to most of these research gaps: OI practices terminology, the relevance of context factors for OI practices implementation and OI practices for SMEs.

Many references from the literature emphasize the importance of research on how firms can implement OI (Chesbrough and Crowther, 2006; Dahlander and Gann, 2010; Pisano and Verganti, 2008; Raasch et al., 2008; Bilgram et al., 2008), stressing the importance of the “right conditions” for implementing any open approach successfully (Lazzarotti and Manzini, 2009).

Moreover, when analysing the state of the art in OI in depth, we see that most of the references and case studies are relative to large companies, leading many researchers to argue that OI in SMEs has been scarcely analysed and to emphasize the need for developing a theoretical framework in which SME managers can answer the question that arises: When and how to open their innovation?

A crucial question for SMEs is how they can manage OI despite the liability due to their smallness. This is especially relevant when an SME is dependent on a few strong customers, such as normally happens in the automotive sector (Gassmann et al. 2010). Some authors that have explored recently the field of OI in the automotive sector, found that OI is appropriate for the automotive industry, and that it will be a crucial factor in the next years (Ili et al. 2010). However the situation of SME suppliers in relation to the implementation of OI practices with their main customers in the automotive sector, the Original

Equipment Manufacturers (OEMs), still remains unexplored. This is one of the main reasons, as is detailed explained in section 3.3, why we decided to focus the empirical research of this dissertation in SMEs from the automotive sector.

1.2 RESEARCH QUESTIONS AND OBJECTIVES

Having presented the needs that motivate this thesis in previous section, we now present the research questions that have guided our research work. We propose a total of seven research questions, which are divided into two groups: the first three questions are general questions that arise from the theoretical framework of this thesis and the following four questions are particular questions for the research context focused on SMEs in the automotive sector.

General research questions:

- Research question 1: Can contextual factors be used by managers to decide what OI practices typologies to use to open their innovation process?
- Research question 2: Are some OI practices typologies more effective in one context than in another?
- Research question 3: Are there any complementarity or substitution effects among some of these context factors that have to be taken into account when implementing open innovation practices?

Specific research questions for SMEs from the automotive sector:

- Research question 4: Is the OI model appropriate to foster and reinforce innovation activities between OEMs and SME suppliers in the automotive sector?
- Research question 5: Which OI practices are currently implemented by automotive SME suppliers and what benefits do they obtain from these OI practices?
- Research question 6: Which barriers and enablers can result from SMEs automotive suppliers adopting OI practices?

- Research question 7: What are the context factors (internal and/or external) that can facilitate or hinder OI practices between OEMs and SME suppliers in the automotive sector?

To answer these seven research questions we have defined the following objectives:

- Objective 1: Identify and characterize the different typologies of OI practices.
- Objective 2: Identify the internal and external factors that influence the implementation of OI practices.
- Objective 3: Propose a theoretical framework that would help to establish relationships among different OI practice typologies and the influence of the internal and external factors for their successful implementation.
- Objective 4: Contrast and empirically particularize the proposed framework for the case of SMEs by identifying which OI practices seem to be most suitable for SMEs and their main challenges.
- Objective 5: Finally, as a consequence of the design of our empirical research, we have the opportunity to deepen in the understanding of implementing of OI practices between automotive OEMs and their SME suppliers.

Objectives 1, 2 and 3 are relevant from an academic perspective, while objectives 4 and 5 are more focus on managerial issues.

1.3 THESIS STRUCTURE AND RESEARCH METHODOLOGY

The structure of the contents of this dissertation and the research methodology, are shown in Figure 1.3. The objectives detailed in section 1.2, have been pursued from a theoretical point of view in Chapter 2, using a literature review methodology. This literature review followed a systematic methodology that is described in depth in Chapter 2, which includes the construction of a database with 122 articles related to the particular OI topic this is of interest for this thesis, and a classification, analysis and discussion of all these articles.

This methodology gives us a solid theoretical foundation on which to build our contributions to the paradigm of OI and it will also certainly contribute to future works by other researchers, in which some of our results can be used, such as the classification of OI practices typologies.

For the empirical contrast to our theoretical framework, we have used qualitative research methods. Qualitative research is a more exploratory and inductive method, in which researchers use words rather than numbers to generate theory through observations and descriptions (Bryman and Bell, 2011). Furthermore according to Yin (2003), a case study research strategy should be followed when researchers want to describe, explain, illustrate and explore conditions related to their research topic; therefore, it is consistent with Siggelkow (2007), providing a rich illustration of the phenomenon under analysis.

Among the different types of qualitative research methodology, we have decided to apply two different methods. In Chapter 3, we performed a multiple case study with a sample of SMEs from the automotive sector. As a result of this research we arrived at a first contrast with our theoretical framework, particularized for SMEs in the automotive sector. The development of this empirical research offered us the opportunity to collaborate with the Cátedra de Empresa Volkswagen Navarra – Universidad de Navarra. This collaboration will be explained further in Chapter 3.

In Chapter 4 we present a retrospective case study, which not only provided a second opportunity to contrast our theoretical framework, but also delved into a case with a journey of eight years, which shed light on key factors in designing a strategy for implementing OI practices in SMEs.

CHAPTER 1: INTRODUCTION	RESEARCH METHODOLOGIES
<ul style="list-style-type: none"> • Background to the research • Research propositions and objectives • Dissertation structure and methodology • Scope and limitations 	
CHAPTER 2: FRAMEWORK FOR OPEN INNOVATION PRACTICES	
<ul style="list-style-type: none"> • Literature review • OI practices typologies • Characterisation of OI practices: dimensions • Context factors that influence adoption of OI practices • Theoretical framework relating OI practices typologies and context factors • Research propositions 	LITERATURE REVIEW
CHAPTER 3: MULTIPLE CASE STUDY IN THE AUTOMOTIVE SECTOR	
<ul style="list-style-type: none"> • Empirical research strategy and design • OI in SMEs from the automotive sector • Case studies description • Findings and implications for theoretical framework 	MULTIPLE CASE STUDY
CHAPTER 4: RETROSPECTIVE CASE STUDY	
<ul style="list-style-type: none"> • Case selection • Research strategy and data collection process • Case study description • Findings and implications for theoretical framework 	RETROSPECTIVE CASE STUDY
CHAPTER 5: CONCLUSIONS AND FUTURE WORKS	
<ul style="list-style-type: none"> • Conclusions • Limitations • Future works 	

Figure 1.3. Structure of contents of the dissertation and associated research methodologies

1.4 SCOPE AND LIMITATIONS

To describe the scope of this thesis it is important to take into account that OI is such a broad concept that trying to cover it would have been an impossible challenge for this study. As a result, the topic has been narrowed to considering just two issues in OI which are OI practices and the context factors that affects their implementation.

The main limitations come from the methodological side of this thesis. First, our decision to use qualitative research methods, which mean that the generalization of the results beyond the cases studied, is one of the inherent difficulties in this research method. We decided to use semi-structured interviews for the case studies because in applying this method to data collection participants have the opportunity to respond in their own words, rather than being forced to choose from fixed responses, as quantitative methods do.

Qualitative methods are particularly useful for getting detailed information about a participant's thoughts and behaviours or experiences (Boyce & Neale, 2006). In-depth, semi-structured interviews have the ability to evoke responses that are unanticipated by the researcher and rich and explanatory in nature. And finally, interviews are particularly useful for testing what people's responses might be to a particular issue and they reveal completely new issues that the interviewer had not previously considered (Wimmer and Dominick, 1997).

Moreover for the case studies in Chapter 3 and 4, we decided to focus on a specific sector, the automotive sector. This choice is not trivial, because the automotive sector has a huge direct and indirect economic impact on the European Economy. The European Automobile Manufacturers' Association (ACEA) reports that in 2013 the turnover generated by the automotive sector represents 6.9% of the EU's GDP and a total of 12.9 million Europeans are employed in the sector. It is also worth nothing that the automotive industry is the largest private investor in R&D in Europe, investing over €32 billion into R&D and applying for 9,500 patents per year.

Finally, we think that by limiting the empirical research to a single industry, we are able to avoid unnecessary "noise" due to industry factors (Westerberg et al. 1997; Parida et al. 2012), which could hinder researchers arriving at valuable conclusions.

CHAPTER 2

OPEN INNOVATION PRACTICES AND CONTEXT FACTORS

2.1 INTRODUCTION: OBJECTIVES AND STRUCTURE OF THE CHAPTER

2.1.1 OBJECTIVES

After more than ten years of the emergence of the OI paradigm (Chesbrough, 2003a), this is still a broad concept that has become increasingly important both in practices and in research. In spite of the growing literature on openness, there is a lack of clarity and some dissatisfaction in the research community with the evolution of the concept. An obvious consequence of this situation is that literature is fragmented and therefore comparing findings achieved by different researchers becomes difficult (Dahlander and Gann, 2010).

According to Huizingh (2011), OI practices are “the processes that managers start when deciding ‘when, how, with whom, with what purpose, and in what way should they cooperate with external partners’”. In recent years an extensive body of literature has reported results from qualitative and quantitative research in relation to OI practices. In Table 2.1, we show the main statements of six papers that have highlighted the inexistence of an exhaustive inventory of OI practices.

References	Statements
Van de Vrande et al. 2009	Future attempts to survey OI in broad samples of enterprises should delineate the several practices in a more detailed and accurate way.
Lee et al. 2010	One of the conclusions of this research is that the several terms used to describe collaboration modes, such as strategic alliance, collaboration, co-operation, networking, and so. – which are used together to point the same or different patterns and thus are quite confusing – need to be clearly defined in future research.
Lichtenthaler 2011	First, we need a clearer understanding of the characteristics of OI. In this regard, we also need further insights into practices and tools for managing OI processes. A recent study provides interesting insights (van de Vrande et al., 2009), but further work is needed to fully capture OI initiatives (Helfat, 2006). While the conceptual framework highlights knowledge exploration, retention, and exploitation as critical processes, a better understanding of the activities and tools underlying these processes is needed.
Bellantuono et al. 2013	The existence of different innovation modes determines the problem of the mode selection. Key issues in such a problem are clarifying what OI practices are and supporting organisations in the adoption of such practices. Yet, to our knowledge, no studies address such issues.
Rass et al. 2013	The authors refer to OI instruments as concrete means to implement OI and highlight the inexistence of a conclusive list of OI instruments in the literature.
Wynarczyk 2013	Although OI is widely researched, there is no unified definition of OI practices.

Table 2.1. Summary of recent research publications calling for a unified definition and classification of OI practices

As a conclusion, we observe that there is a gap in the literature about the need of classifying in a structured way the myriad of OI practices that can be found

in OI literature. As it will be shown later, there are different references that have used heterogeneous typologies of OI practices in their publications and this greatly hinders the correlation and comparison between results of different studies and consequently the advance in the OI research field.

Moreover, from the managerial point of view, managers that want to open their innovation process, usually look in the literature to identify specific OI practices, and through previous experiences of other firms, to deepen the characteristics of each type of practice in order to consider the tradeoffs of each and assess the organisational capabilities, structure, and assets required to manage the challenges developing the initiative (Pisano and Verganti, 2008). Moving from a set of ad hoc processes to clearly define OI practices, systems, roles, and responsibilities can help to ensure successful adoption of the OI paradigm across the organisation (Chesbrough and Crowther, 2006).

Therefore the first objective related to this chapter is to construct a framework for the homogenisation of OI practices typologies that permits clarifying the use of OI practice and also helping managers to know better what kind of practices they can implement to impel OI in their firms.

On the other hand, obviously there is not one single best approach to managing a firm's OI activities, which depends on internal and external factors (Lichtenthaler & Lichtenthaler, 2009). The context in this sense may moderate the relationship between OI and performance. This implies that OI practices can be more effective in one context than in another (Huizingh, 2011). Therefore the second objective related to this chapter is to analyse the context factors that can be related to the application of particular OI practices and construct a theoretical framework including our findings in this subject.

Within this context, we formulate our research questions as follows:

Research question 1: Can contextual factors be used by managers to decide what OI practices typologies to use for opening their innovation process?

Research question 2: Are there some OI practices typologies more effective in one context than in another?

Research question 3: Are there any complementarity or substitution effects among some of these context factors to take into account when implementing open innovation practices?

In the following section we explain the methodology that we applied for answering these questions.

2.1.2 RESEARCH METHODOLOGY AND STRUCTURE OF THE CHAPTER

This chapter is structured according with the research methodology based on a sequence of different literature reviews and a content analysis of each of them.

The Figures 2.1, 2.2 and 2.3 summarize the steps followed in this methodology and the results of each step that will be developed in detail throughout the chapter.

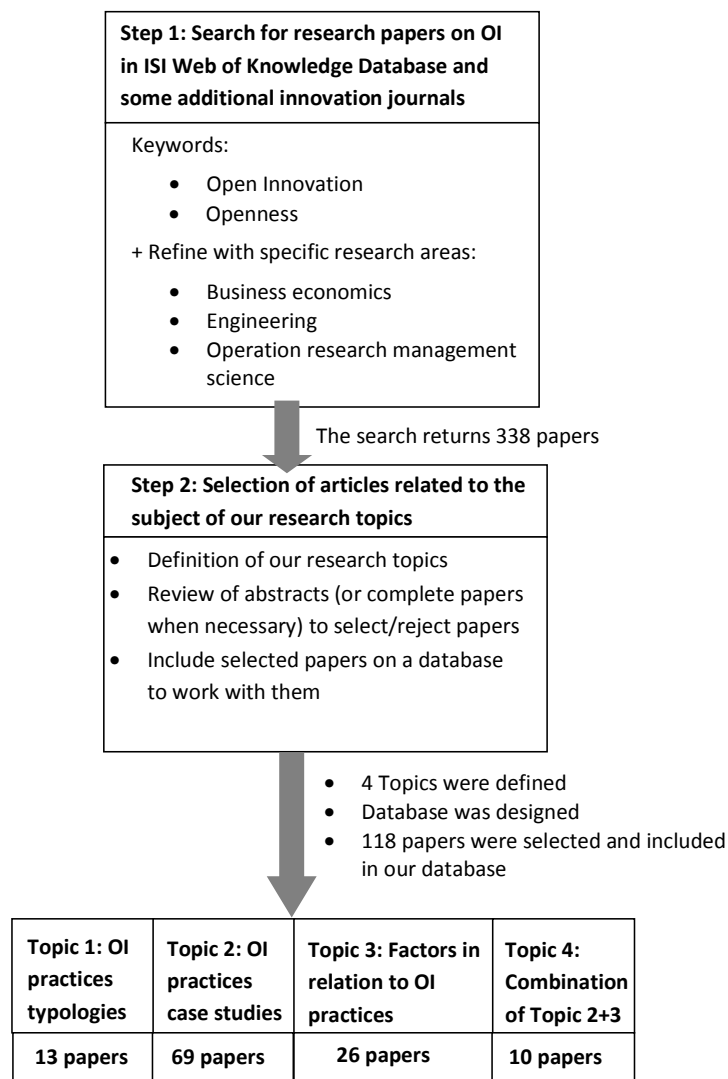


Figure 2.1. Construction of database

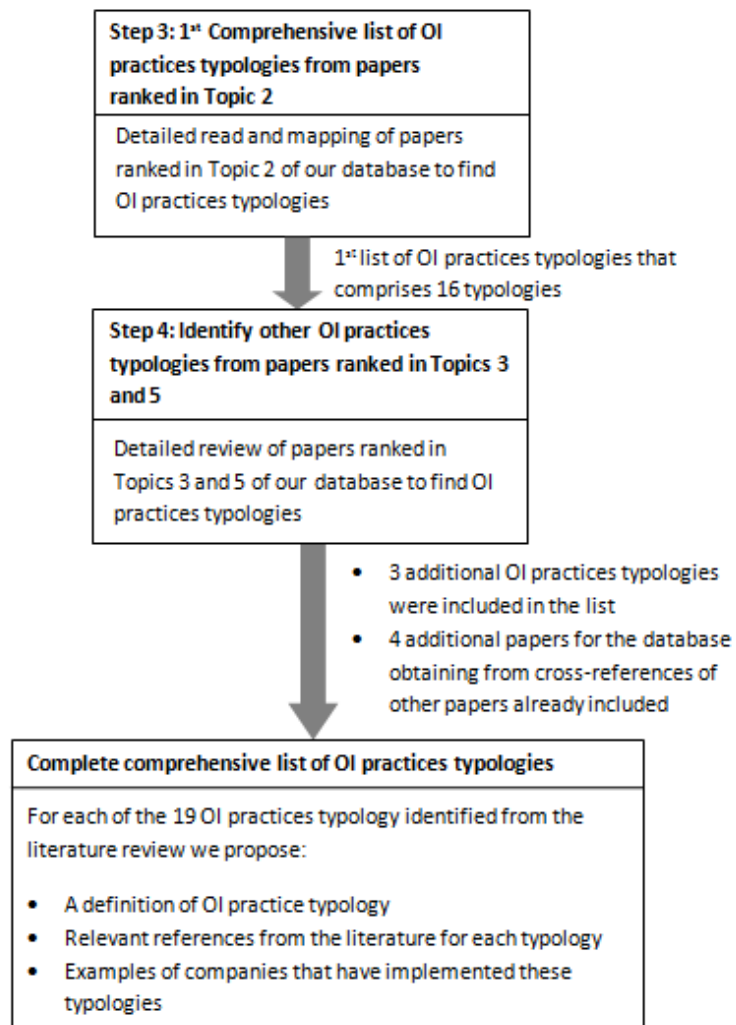


Figure 2.2. Methodology for development of a list of OI practices typologies

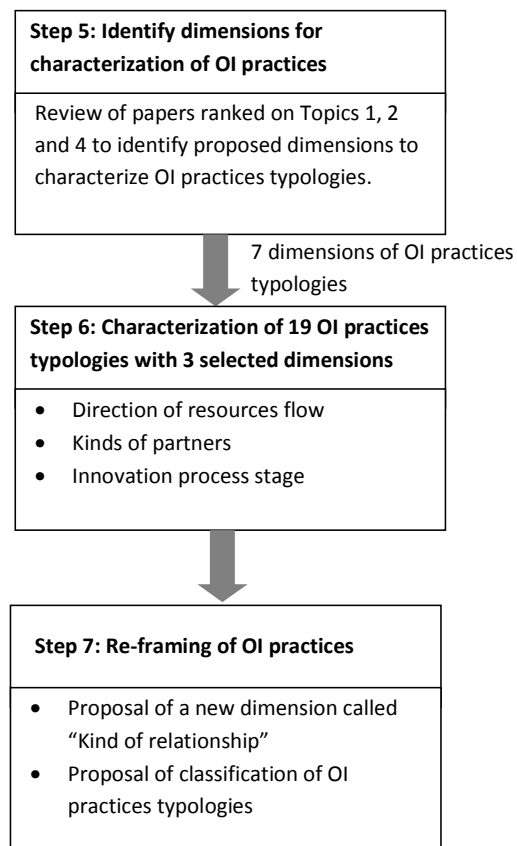


Figure 2.3. Characterization of OI practices typologies

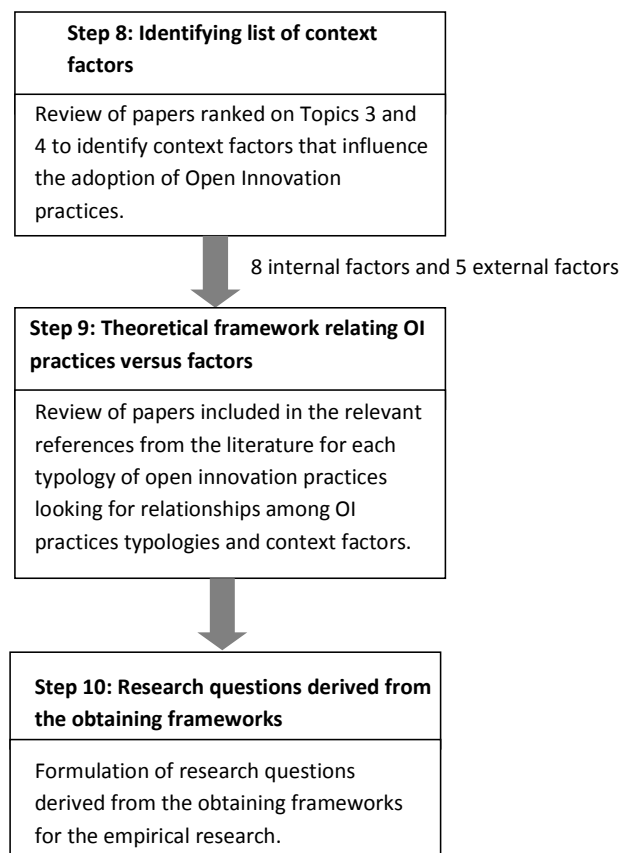


Figure 2.4. Characterization of OI practices typologies

The structure of this Chapter is associated to the ten steps that appear in Figures 2.1, 2.2, 2.3 and 2.4. To clarify this, the Table 2.2 shows the relationship between the sections of the Chapter and the methodological steps.

Steps of the methodology	Sections of chapter 2
Step 1: Search for research papers on OI in ISI Web of Knowledge Database Step 2: Selection of articles related to the subject of our research topics	2.2. Literature review and construction of database
Step 3: 1st Comprehensive list of OI practices typologies from papers ranked in Topic 1 Step 4: Identify other OI practices typologies from papers ranked in Topics 2 and 4	2.3. Development of OI practices typologies
Step 5: Identify dimensions for characterization of OI practices Step 6: Characterization of 19 OI practices typologies with 3 selected dimensions	2.4. Characterization of OI practices: dimensions and findings
Step 7: Re-framing of OI practices	2.5. Proposed framework for OI practices
Step 8: Identifying list of context factors	2.6. Identifying and classifying factors that influence the adoption of OI practices
Step 9: Theoretical framework relating OI practices versus factors	2.7. Theoretical framework relating OI practices and factors
Step 10: Research questions derived from the obtaining frameworks	2.8. Research questions.

Table 2.2. Relationship between methodological steps and sections of this Chapter

2.2 LITERATURE REVIEW AND CONSTRUCTION OF DATABASE

2.2.1 METHODOLOGY FOR CONSTRUCTION OF THE LITERATURE REVIEW DATABASE

According to Figure 2.1., we have made three steps in order to obtain a database to make the content analysis:

- Step 1: The author reviewed the literature by an analysis of papers published on OI in Thomson's ISI Web of Knowledge and some additional innovation journals not covered by these databases but relevant in the OI literature. The search criteria used were the selection of items that contain the terms "open innovation" or "openness" in the fields of topic or title. Naturally, there are publications closely related to OI without using these terms, but this lies outside the scope. Further, to refine the search in Thomson's ISI Web of Knowledge, the following areas of knowledge were selected: Business economics; Engineering; Operations research and management science. This search returns a total number of 331 papers.
- Step 2: The author manually reviewed abstracts for each of the 331 publications in the sample, to determine whether each was related to the study, and the part of our investigation that was more related with it. When an abstract was inconclusive, the full paper was examined (in particular the introduction and discussion sections). Some of the papers were rejected because their content was not relevant for this research and the rest were classified on the following topics:
 - Topic 1: Proposals of classification of OI practices typologies.
 - Topic 2: Specific OI practices research
 - Topic 3: Factors in relation to OI practices implementation and performance.

It is interesting to highlight that 10 of the papers included information in relation to Topic 2 and Topic 3. Because of this, we introduced an additional topic, Topic 4, for those papers.

Finally we obtain the articles classification shown in Table 2.3 for the 118 selected papers:

Topic 1: OI practices typologies	Topic 2: OI practices	Topic 3: Factors in relation to OI practices	Topic 4: OI practices + Factor in relation to OI practices
13 papers	69 papers	26 papers	10 papers

Table 2.3. Classification of papers from the database by topic

The review of the literature has been repeated twice, one in December 2013 and it was updated in April 2014. From the first to the second search, just two new papers were identified to be included in the database. The author considers that the conclusions of this research will not change substantially in the short period of time between the close of the database on April 2014 and the publication of the conclusions of this work.

- Step 3: The author built a database to store all relevant information of each selected article that could be helpful to store along the research for working with them more easily.

The fields that the database contains are the following:

- Field 1: Reference
- Field 2: Year of publication
- Field 3: Journal
- Field 4: Topic in relation to our research
- Field 5: OI practices
- Field 6: Factors in relation to OI practices

- Field 7: SMEs (identify if the papers refers to OI practices implemented by SMEs)
- Field 8: Research methodology
- Field 9: Comments

Then, the full papers were examined to complete fields 1, 2, 3, 4, 7 and 8 of the database. Fields 5 and 6 will be completed later on in the research work.

Next, in the following section some descriptive results obtained from the analysis of the database are presented.

2.2.2 SOME DESCRIPTIVE RESULTS

From the analysis of the items included in our database, the author obtains information that helps to understand the evolution that research on OI in relation to this dissertation's research Topics has had in the last decade.

As can be seen in figure 2.5, from 2003 to 2006, in the early research on the concept of OI, the authors focused their activity on the analysis of case studies on OI practices.

From 2006 onwards authors interested in analysing the factors influencing the implementation of OI practices emerge.

From 2009, articles proposing typologies of OI practices increase, and also those that analyse factors in relation to OI practices implementation. We observe that in 2013 there is an increase in this topic, which indicates that it is still an unsolved issue in the literature and that arouses the interest of researchers.

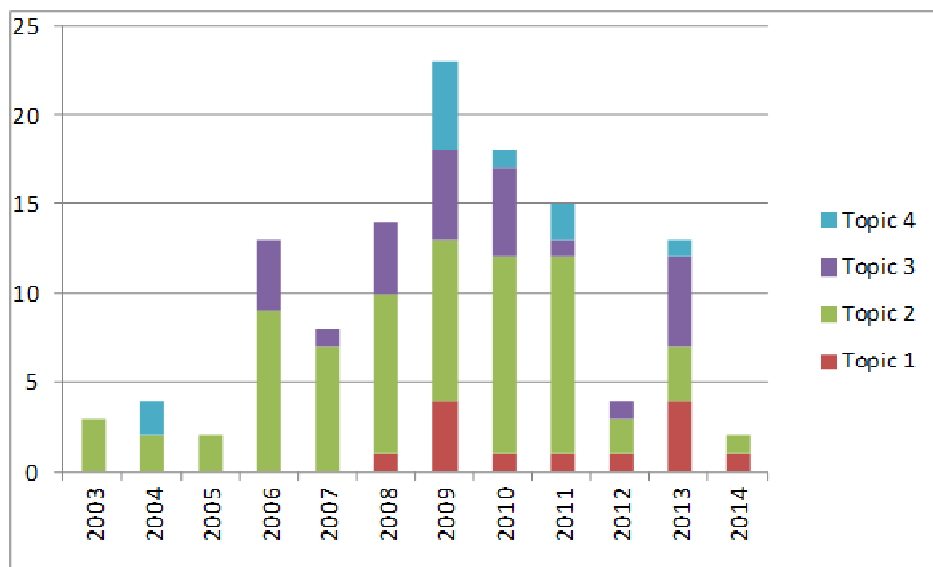


Figure 2.5. Distribution of publications by year and by topic

The distribution of articles included in our database among journals, is presented on Table 2.4. Almost half of the articles in our database are concentrated in 8 magazines and the rest are widely distributed among a wide range of publications, indicating that the topics included in our literature review arouse the interest of many publications.

Journals	N° of papers	Indexed	Impact Factor (2012)
R&D Management	16	Yes	1.58
Technovation	15	Yes	3.177
Research Technology Management	12	Yes	0.712
Research policy	8	Yes	2.850
Creativity and innovation management	5	Yes	0.855
International Journal of Innovation Management	4	No	-

California Management Review	4	Yes	1.667
Other publications (with less than 4 papers in the database)	54	-	-
Total	118	-	-

Table 2.4. Distribution of publications by journal and information about each journal

Other interesting information that can be deduced from the analysis of the articles in our database, is the attention that research in OI has been paid to SMEs. In figure 2.6, we show the number of articles from our database that includes explicit information about OI in SMEs. Until 2009 the literature in this area was very scarce and it is from this year on that it increases significantly, although still it is scarcer than that from large companies.

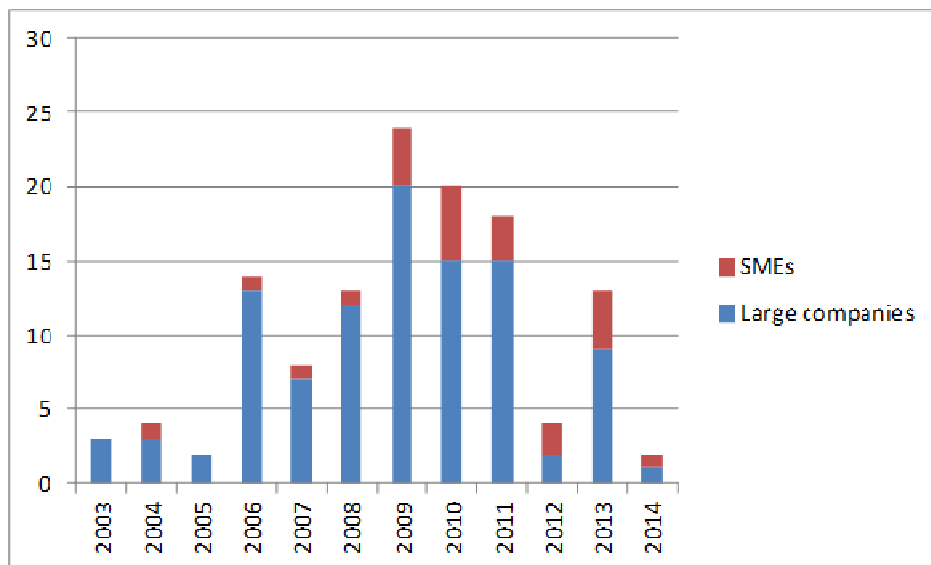


Figure 2.6. Publications about OI by year and by type of companies

Other interesting fact, which can be drawn from our database analysis, is about the type of research methodologies on our research topics. As we can see in

Table 2.5 qualitative research methods are predominant, assuming almost twice as references to quantitative methods.

This difference can be explained by the difficulties encountered by researchers in collecting quantitative data in a field of research where the basis on which to build their studies continues to be confused.

Methodology	Number of papers
Qualitative	60
Quantitative	38
Combination of both	8
Review of literature	12
Total	118

Table 2.5. Distribution of publications by research methodology

As a conclusion of this analysis the author states that the main topics of this research, OI practices and factors in relation to OI implementation, are unsolved topics that attract the attention of researchers in the OI field from 2008 to now. This also adds to a growing body of the literature relative to OI in SMEs. Moreover, as can be seen in Table 2.1 there are some gaps in knowledge with growing interest in the community of researchers on OI issues, such as a clear definition of OI practices typologies, and therefore the author considers that this thesis can contribute to the advancement of knowledge in this field.

2.3 DEVELOPMENT OF OI PRACTICES TYPOLOGIES

From the performed review of the literature we found a total of 13 articles that proposed OI practices classifications that are detailed in Table 2.6.

A result that it is still pretty amazing, despite being expected, is that each author proposes a different list of OI practices typologies and even the dimensions used to describe or classify the OI practices are also diverse.

It is also surprising that several of these publications indicate that the list of OI practices is based on a review of the literature but the authors have not

included details on the methodology and sources used to produce them (Van de Vrande et al. 2009; Remneland-Wikhamn and Wikhamn, 2013; De Araújo et al. 2014).

Authors (Year of publications)	Pisano and Verganti (2008)	Journal	Harvard Business Review
References for OI practices identification	<p>The authors propose that there are two basic issues that executives should consider when deciding how to collaborate on a given innovation project:</p> <ul style="list-style-type: none"> - Open or closed collaboration - Flat or hierarchical governance structure. <p>According with these two dimensions they propose a framework that reveals four basic modes of collaboration.</p>		
OI practices	<p>The authors propose four basic modes of collaboration:</p> <ol style="list-style-type: none"> (1) Elite circle: A closed and hierarchical network (2) An innovation mall: an open and hierarchical network (3) Innovation community: an open and flat network (4) A consortium: A closed and flat network 		
Comments	<p>The authors suggest that figuring out which mode is most appropriate for a given innovation initiative, a firm could consider the tradeoffs of each and asses the organisational capabilities, structure, and assets required to manage the challenges developing the initiative.</p>		
Authors (Year of publications)	Van de Vrande et al. (2009)	Journal	Technovation
References for OI practices identification	<p>The selection of practices was generated from a literature review.</p>		
OI practices	<p>Technology exploitation activities:</p> <ol style="list-style-type: none"> (1) Venturing (2) Outward licensing of intellectual property (IP) (3) Involvement of non-R&D workers in innovation initiatives (4) Technology exploration activities: 		

	<p>(5) Customer involvement</p> <p>(6) External networking</p> <p>(7) External participation</p> <p>(8) Outsourcing R&D</p> <p>(9) Inward licensing of IP</p>		
Comments	<p>Future attempts to survey OI in broad samples of enterprises should delineate the several practices in a more detailed and accurate way.</p> <p>Next, the list of OI indicators is probably not a complete list. Past studies have proposed other practices that were not included in the survey.</p>		
Authors (Year of publications)	Poot et al. (2009)	Journal	International Journal of Innovation Management
References for OI practices identification	<p>The authors constructed four different modes of collaboration according to the different kinds of partners with whom a firm has engaged in a formal collaboration.</p>		
OI practices	<p>(1) Internal collaboration: Collaboration with other enterprises within the enterprise group.</p> <p>(2) Horizontal collaboration: Collaboration with competitors.</p> <p>(3) Vertical collaboration: Collaboration with suppliers of equipment, materials, components, or software and clients or customers.</p> <p>(4) Knowledge-intensive collaboration: Collaboration with consultancies, universities, other research institutes</p>		
Comments	<p>The authors just rely in inflows of knowledge not considering outflows. Moreover they just consider one of the possible dimensions for identifying OI practices, the type of partner.</p>		
Authors (Year of publications)	Leimester et al. (2009)	Journal	Journal of Management Information Systems
References for OI practices identification	<p>In literature and in practice, there are three core practices for integrating customers into the early stages of the innovation process.</p>		
OI practices	<p>(1) Lead-User Method</p>		

	(2) Internet Toolkits (3) Ideas Competitions		
Comments	The authors only refer to OI practices for integrating customers into early stages of the innovation process.		
Authors (Year of publications)	Rohrbeck et al. (2009)	Journal	R&D Management
References for OI practices identification	<p>Combining two dimensions:</p> <ul style="list-style-type: none"> - Innovation process stage (according to Deutsche Telekom innovation process) - Types of OI processes (according to Gassmann and Enkel (2006) archetypes) <p>The authors identified 11 OI instruments at the case study of Deutsche Telekom.</p>		
OI practices	<ul style="list-style-type: none"> (1) Foresight workshops (2) Executive Forums (3) Customer integration (4) Endowed chairs (5) Consortia projects (6) Corporate Venture Capitalist (7) Internet platforms (8) Joined development (9) Strategic alliances (10) Spin-outs (11) Test market 		
Comments	The authors' classification of OI instruments in relation to the proposed two dimensions provides an interesting reference for a systematic approach to OI.		
Authors (Year of publications)	Lee et al. (2010)	Journal	Research Policy
References for OI	The author refers to the identified OI practices such as "collaboration		

practices identification	modes”.		
OI practices	<p>(1) Customer provider: Exploration: Funding, licensing, outsourcing, etc. Exploitation: Outsourcing, etc.</p> <p>(2) Strategic alliance Exploration: R&D partnership, joint-ventures, etc. Exploitation: Partnership, etc.</p> <p>(3) Inter-firm alliance Exploration: Network, etc. Exploitation: Network, etc.</p>		
Comments	One of the conclusions of this research is that the several terms used to describe collaboration modes, such as strategic alliance, collaboration, co-operation, networking, etc. – which are used together to point the same or different patterns and thus are quite confusing – need to be clearly defined in future research.		
Authors (Year of publications)	Hilgers (2011)	Journal	International Journal of Business Research
References for OI practices identification	The author refers to the identified OI practices such as “typical instruments of OI”.		
OI practices	<p>(1) Lead user method</p> <p>(2) OI communities</p> <p>(3) Online toolkits</p> <p>(4) Innovation contests</p>		
Comments	The author does not specify the references used for identifying of these practices.		
Authors (Year of publications)	Parida et al. (2012)	Journal	Journal of Small Business
References for OI practices identification	Based on and inspired by the study by Van De Vrande et al. (2009), we measured four inbound OI activities.		
OI practices	Inbound OI activities:		

	<ul style="list-style-type: none"> (1) Technology scouting (2) Horizontal technology collaboration (3) Vertical technology collaboration (4) Technology sourcing 		
Comments	<p>The authors include a definition of each typology of OI activity. It is surprising that the authors claim to be based on Van de Vrande et al. (2009) for identifying the types of activities but these activities are not explicitly mentioned in that reference.</p>		
Authors (Year of publications)	Mina et al (2013)	Journal	Research policy
References for OI practices identification	<p>The authors refers to 15 types of OI activities performed by firms that take into account both formal (contractual) and informal (non-contractual) activities. No clear reference to how they construct this list of activities is provided.</p>		
OI practices	<p>Informal (non-contractual) activities:</p> <ul style="list-style-type: none"> (1) Engaging directly with lead users and early adopters (2) Participating in open source software development (3) Exchanging ideas through submission websites and idea “jams”, idea competitions (4) Participating in or setting up innovation networks/hubs with other firms (5) Sharing facilities with other organisations, inventors, researchers, etc. <p>Formal (contractual) activities:</p> <ul style="list-style-type: none"> (6) Joint R&D (7) Joint purchasing of materials or inputs (8) Joint production of goods or services (9) Joint marketing/co-branding (10) Participating in research consortia (11) Joint university research (12) Licensing in externally developed technologies (13) Outsourcing or contracting out R&D projects 		

	(14) Providing contract research to others (15) Joint ventures, acquisitions and incubations		
Comments	The authors suggest that further theoretical work on the purpose and nature of OI activities with different partners is a potentially fruitful area for research. So too is the nature of the link between OI activities and the choice between informal and formal modes of mediating such activities.		
Authors (Year of publications)	Rass et al. (2013)	Journal	Creativity and innovation management
References for OI practices identification	<p>The literature does not provide a conclusive list of OI instruments, but there are some categorisations of OI activities that help to structure existing instruments along different dimensions:</p> <ul style="list-style-type: none"> - Direction of resource flows (Gassmann and Enkel, 2004) - Modes of governance (Fey & Birkinshaw, 2005) <p>Combination of these dimensions by Dahlander and Gann (2010) provides a categorisation of OI instruments in 4 categories: Acquiring, sourcing, selling and revealing.</p>		
OI practices	<p>Acquiring:</p> <ul style="list-style-type: none"> (1) Innovation marketplaces (2) Intermediaries <p>Sourcing:</p> <ul style="list-style-type: none"> (3) Innovation contests <p>Selling:</p> <ul style="list-style-type: none"> (4) Licensing activities <p>Revealing:</p> <ul style="list-style-type: none"> (5) Open source communities 		
Comments	The authors refer to OI instruments as concrete means to implement OI and highlight the inexistence of a conclusive list of OI instruments in the literature.		
Authors (Year of publications)	Remneland-Wikhamn and Wikhamn (2013)	Journal	Journal of Technology Management & Innovation

References for OI practices identification	The selection of OI activities was generated from a literature review.		
OI practices	<ul style="list-style-type: none"> (1) Lead user (2) Open source development (3) Innovation communities (4) Innovation contests (5) Crowdsourcing (6) Innovation intermediaries 		
Comments	The authors state that this paper aims to initiate a critical discussion about which activities can/should be called “open innovation”, but also how different notions under the umbrella of OI are related to each other. Further research is suggested to continue this quest.		
Authors (Year of publications)	Theyel (2013)	Journal	International Small Business Journal
References for OI practices identification	The analysed OI practices are focused on collaboration with customers and suppliers.		
OI practices	<p>Technology development:</p> <ul style="list-style-type: none"> (1) Joint technology development with customers (2) Joint technology development with suppliers <p>Product development:</p> <ul style="list-style-type: none"> (3) Joint product development with customers (4) Joint product development with suppliers <p>Manufacturing:</p> <ul style="list-style-type: none"> (5) Share equipment with customers (6) Share equipment with suppliers (7) Joint manufacturing with customers (8) Joint manufacturing with suppliers <p>Commercialization:</p> <ul style="list-style-type: none"> (9) Serving new markets with customers (10) Serving new markets with suppliers (11) Joint bidding for new contracts customers (12) Joint bidding for new contracts suppliers 		

Comments	<p>This study sheds some further light to the benefits and challenges of the adoption of OI practices, according the nature of firm's product and process innovations. Prior research on OI has concentrated to the analysis of external knowledge channels instead of researching specific practices. The author's state that the reasons from firms to adopt some OI practices more frequently than others remains a question. Therefore they ask for further longitudinal, quantitative and experimental large-scale research designs that should shed more light to the causal factors affecting the adoption of OI practices along the value chain.</p>		
Authors (Year of publications)	De Araújo et al. (2014)	Journal	Technovation
References for OI practices identification	<p>The selection of practices was generated from a literature review. After screening research addressing OI topics (Bahemia and Squire,2010; Chesbrough and Garman,2009; Van deVrande et al.,2009), a comprehensive list of 11 practices was identified, with the aim of building an extensive rather than a compressed list of practices.</p>		
OI practices	<p>(Does not include a Table with definition for each OI practice)</p> <p>Inbound:</p> <ol style="list-style-type: none"> (1) Employed the internet to search for new trends or technology (2) Reading technical magazines (3) Used information from trade organisations (4) Participated in innovation related fairs or shows (5) Purchased R&D work from others (6) Purchased licenses, patents or know-how (7) Worked with lead users (8) Used innovation brokers <p>Outbound:</p> <ol style="list-style-type: none"> (9) Actively participated in other's innovation projects (10) Sold patents, licenses or know-how 		

	(11) Made own innovations available to others for free
Comments	<p>This article states that proposed a new approach to measure OI, on the basis of a practice perspective, to offer a more comprehensive approach than the general actor-based measures currently available, which rely on inter-organisational relationships as a proxy for openness.</p> <p>Practices such as Used the internet to search for new trends or technology, Reading technical magazines, Used information from trade organisations, Participated in innovation related fairs or shows, are OI practices really?</p>

Table 2.6. Summary of papers related to Topic 1: typologies of OI practices

Main conclusions of this review are the following. First, we realize that researchers use different terms to refer to OI practices: modes (Pisano and Verganti, 2008; Poot et al. 2009; Lee et al. 2010); activities (Van de Vrande et al. 2009; Parida et al. 2012; Mina et al. 2013; Remneland-Wikhamn and Wikhamn 2013); practices (Leimester et al. 2009; Theyel 2013; De Araújo et al. 2014); instruments (Rohrbeck et al. 2009; Hilgers 2011; Rass et al. 2013;). We may observe as there is not a predominant concept, which is a fact that clearly adds confusion to this research stream.

Second, there is a diversity of proposals in the literature both for typologies of OI practices and for dimensions that can be used to characterize and classify such practices.

Third, these findings confirm the interest of our investigation to provide to researchers and practitioners a more solid and clear base to deepen on the OI from a practice perspective.

I want to emphasize that we decided to exclude the following practices that appear as OIP in Table 2.5:

- Involvement of non-R&D workers and Collaboration with other enterprises within the enterprises group: Where to place the boundaries of the firm is an open issue in the OI literature, in this point we decide to restrict our research to OI practices in which the firm collaborators are totally external agents, that means, from

outside of the firms or even of the enterprises group that the firm belongs to.

- Internet toolkits or on-line toolkits: In the literature the use of IT toolkits appears as a tool used to facilitate the interaction with external agents in more than one OI practice such as Crowdsourcing (OIP2) (Leimester et al. 2009) or Idea competition (OIP4) (Piller and Walcher 2006; Adamczyk et al. 2012). Therefore in this dissertation we consider that these are tools that can be used to implement different typologies of OI practices but are not OI practices in themselves.
- Spin-outs: We consider that this is one of the forms that corporate venture capitalist can take, and therefore we do not separate it as a different OI practice.
- Test market: This is a stage of innovation process but not an OI practice as far as it can be developed in a close or open way, and therefore cannot be considered OI practices.
- Used the internet to search for new trends or technology, Reading technical magazines, Used information from trade organisations and Participated in innovation related fairs or shows: We consider that these are practices for market and technology intelligence that can be developed in a close or open way and therefore cannot be considered OI practices.

In next steps of this research, papers ranked in Topics 2 and 4 will be deeply analyzed to look for additional OI practices identification, to verify that these decisions were right as far as those practices are not considered OI practices in no one of these 79 papers.

To sum up, the Table 2.7 shows the 16 OI practices that we have identified, and the references where they appear on our database.

OI practices	Pisano and Verganti 2008	Van de Vrande et al. 2009	Poot et al. 2009	Laimester et al. 2009	Rohrbeck et al. 2009	Lee et al. 2010	Hilgers 2011	Parida et al. 2012	Mina et al. 2013	Rass et al. 2013	Remneland-Wikhamn and Wikhamn 2013	Theyel 2013	De Araújo et al. 2014
Corporate venture capitalist		√			√								
Crowdsourcing											√		
Endowed chairs					√								
Innovation contests		√		√			√		√	√	√		
Innovation marketplaces					√					√	√		√
Innovation networks	√	√				√			√				
Inward licensing of IP		√				√			√	√			√
Joined development			√		√			√	√				√
Joint venture					√	√			√			√	
Lead user method		√	√	√	√		√	√	√		√	√	√
Made own innovation available to others for free									√	√	√		√
OI communities	√						√		√		√		
Outward licensing of IP		√											√
R&D partnership		√	√		√	√		√	√				√
Shared facilities/facilities									√			√	
Technology scouting					√			√					

Table 2.7. First version of OI practices typologies and relation with literature reference

From this initial list of typologies of OI practices, we proceeded to a thorough analysis of the rest of publications included in our database as publications (Topics 2 and 4) related to OI practices. The objectives of this analysis were the following:

- Check if all the OI practices exposed in these articles were already included in this list or not, in order to identify new typologies. New OI practices can appear in case study based articles because, due to the time gap between the practice and the research, emerging OI practices that are still not included in previously proposed typologies.
- Complete the rest of the fields from our database that were:
 - Field 5: OI practices: Identify which practices included in our list of typologies are included on each publication or new practices that were not identified.
 - Field 6: Factors: Identify which factors in relation to internal or external context are mentioned on each publication in relation to OI practices implementation and success.
 - Field 7: SMEs: Indicate if each article includes information about implementation of OI practices in SMEs or not.
 - Field 8: Comments: Any relevant information that can be useful to highlight for later analysis.
- Identify articles of reference in relation to each typology of practice to look for detailed definitions of each practices and examples of their use in firms.

And main results from this review were:

- The inclusion of three new typologies of OI practices that were not included in our first list: Regional innovation clusters, Staff exchanges and Scientific committee.

- This detailed review of publications included in Topic 2 and 4 of the database, confirms our decision of excluding some practices from the first list, because after this review our assumptions do not change.
- The identification of 4 new articles in the database of literature review, that do not refer explicitly to OI but that are focused in some of the typologies of OI practices included in our list: Von Hippel 1986 (Lead users); Narula 2004 (Outsourcing R&D) and Howe 2006 (Crowdsourcing).
- The identification of definitions that serve to explain each OI practice typology and publications of reference for each typology, where are deeply analyzed or/and illustrative examples of application of each OI practice were included.

In Table 2.8 we present our final proposal of inventory of OI practices typologies, a definition for each OI practice, the references in the literature that we found more interesting in relation to each typology of OI practices (chronologically ordered) and examples of their application in firms.

OI practices (other terms used for same practices)	OIP 1	Corporate venture capitalist	Recommended references from the literature	Kirschbaum 2005; Vanhaverbeke et al. 2008; Van De Vrande et al. 2009; Mortara and Minshall 2011
Definition	Venture capital initiatives where a parent organisation provides support (finance, human capital, networking, etc.) to external partners (typically start-ups, spin-offs or spin-outs) aligned with a portfolio of specific technologies, of interest for the parent company, for exploring new business opportunities. In exchange of this support the parent organisation may lead either to further value creation, strategic alliances or to the "spinning-in" of a successful initiative (adapted from Van de Vrande et al. 2009)			
Examples	DSM Venturing & Business Development; T-Venture from Deutsche Telekom; Panasonic Venture Group; Samsung venture investment; Dell Ventures; Cisco Investments; Intel Capital			
OI practices (other terms used for same practices)	OIP2	Crowdsourcing	Recommended references from the literature	Kleemann et al. 2008; Enkel et al. 2009; Sandulli and Chesbrough 2009; Bartl et al. 2010; Howe 2010; Baldwin and von Hippel 2011; Schroll and Mild 2011; Poetz and Schreier 2012
Definition	Crowdsourcing is the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call (Howe, 2010).			
Examples	Fiat 500 and Fiat Mio initiatives from Fiat; Dell's "Idea Storm"; Threadless.com; IBM Innovation Jam; Bamed/ MAM Group;			
OI practices (other terms used for same practices)	OIP3	Endowed chairs	Recommended references from the literature	Perkmann and Walsh 2007; Buganza and Verganti 2009; Rohrbeck

practices)				et al. 2009
Definition	Research undertaken mainly in universities and/or research centers, using financial support from companies that will benefit from the exploitation of this knowledge in medium-long term (own construction).			
Examples	Deutsche Telekom			
OI practices (other terms used for same practices)	OIP4	Innovation contests (Idea competition; Idea prizes)	Recommended references from the literature	Piller and Walcher 2006; Terwiesch and Xu 2008; Ebner et al. 2009; Leimester et al. 2009; Hutter et al. 2011; Adamczyk et al. 2012; Rass et al. 2013
Definition	Time-limited competitions arranged by an organisation, calling on the general public or a specific target group, to make use of their expertise, skills or creativity in order to submit a solution for a particular task previously defined by the organizer who strives for an innovative solution and offer some incentives for participants (prices can be cash, nonmonetary or mix of both types) (adapted from Terwiesch and Xu, 2008)			
Examples	P&G's YET2.com; Salomon Design Contest; BMW's Urban Driving Experience Challenge design competition; Miadidas from Adidas; SAPIens from SAP; Initiative D21 from Siemens; Motorola: Motofwrdr; Fujitsu Siemens: Innovation; Henkel Innovation Challenge; "Emotionalize your light" from Osram; Swarovski's jewellery design competition; BMW's Urban Driving Experience Challenge			
OI practices (other terms used for same practices)	OIP5	Innovation marketplaces (Intermediaries; Markets for ideas)	Recommended references from the literature	Wallin and Von Krogh 2010; Sieg et al. 2010; Rass et al. 2013; Natalicchio et al. 2014
Definition	IT marketplaces that act as middlemen between searchers (i.e.,			

	organisations or individuals who look for a specific solution) and solvers (i.e., organisations or individuals who possess relevant capabilities to solve a certain problem) (Sieg et al. 2010)			
Examples	Innocentive; Ideacrossing; NineSigma; yet2.com; IdeaConnection; YourEncore			
OI practices (other terms used for same practices)	OIP6	Innovation networks (Networks of creation)	Recommended references from the literature	Gassmann and Enkel 2004; Brown and Hagel 2006; Dittrich and Duyster 2007; Pisano and Verganti 2008; Tether and Tajar 2008; Chiaroni et al. 2011; Van de Vrande et al. 2009; Di Minin et al. 2010; Lambert and Schaeffer 2010; Lee et al. 2010; Brunswicker and Vanhaverbeke 2011; Mortara and Minshall 2011; Rondani et al. 2013;
Definition	Participants from diverse institutional settings collaborate over longer periods of time to create new knowledge, to learn from one another, and to appropriate and build on one another's work-all under the guidance of a network organizer (adapted from Brown and Hagel 2006, Dittrich and Duysters 2007)			
Examples	PortalPlayer; Nokia; TXActive club from Italcementi; Fiat; BMW car control mechanism – iDrive			
OI practices (other terms used for same)	OIP7	Inward licensing of IP (Purchased licenses; IP in-	Recommended references from the literature	Tao and Magnotta 2006; Chesbrough 2007a; Van de Vrande et al. 2009;

practices)		licensing; Licensing-in)		Spithoven et al. 2010; Bianchi et al. 2011; Parida et al. 2012; De Araújo et al. 2014
Definition	Buying or using intellectual property, such as patents, copyrights or trademarks, of other organisations to benefit from external knowledge (Van de Vrande et al. 2009)			
Examples	Spin Brush from P&G			
OI practices (other terms used for same practices)	OIP8	Joined development (Joint research; Joint R&D)	Recommended references from the literature	Chesbrough 2007a; Dittrich and Duyster 2007; Tether and Tajar 2008; Rohrbeck et al. 2009; Spithoven et al. 2010; Mina et al. 2013; Theyel 2013;
Definition	Collaborations along the value chain, targeted at a certain product or market that can be joint research projects, consortia or programs with an exchange of knowledge, people and resources (adapted from Rohrbeck et al. 2009).			
Examples	IBM's Microelectronics Joint Development Alliance consortia; Nokia joint development agreement with Nordea Bank and Visa International			
OI practices (other terms used for same practices)	OIP9	Joint venture	Recommended references from the literature	Gassmann and Enkel 2004; Tao and Magnotta 2006; Chesbrough and Schwartz 2007; Lazzarotti et al. 2013;
Definition	A joint venture is used for the transfer of organisationally embedded knowledge which cannot be easily blueprinted or packaged through licensing or market transactions and normally are chosen only for high-relevant long-term projects (Lazzarotti et al. 2013).			
Examples	Joint venture of P&G with Clorox one of its oldest competitors; Joint			

	venture of Pininfarina and Webasto to develop convertible roofs; Joint venture of Bosch with MAHLE GmbH to develop exhaust gas turbochargers for gasoline and diesel engines; Joint venture of Bosch with Samsung for the development of lithium-ion batteries;			
OI practices (other terms used for same practices)	OIP10	Lead user method (User co-creation)	Recommended references from the literature	von Hippel 1986; Lüthje and Herstatt 2004; Piller and Walcher 2006; Bilgram et al. 2008; Leimester et al. 2009; Wallin and von Krogh 2010; Bartl et al. 2010; Parida et al. 2012;
Definition	This method consists on systematic identification and collaboration with lead users in new product development (Bart et al. 2010). Lead users are characterized by two fundamental criteria: First, they experience certain needs significantly earlier than the bulk of the market and thus serve as a "need-forecasting laboratory". Second, they are positioned to benefit notably from innovative solutions (von Hippel, 1986; Lüthje and Herstatt, 2004).			
Examples	3M; Johnson & Johnson Medical; Hilti; Phillips			
OI practices (other terms used for same practices)	OIP11	Made own innovation available to others for free (Free revealing; Donation to commons or nonprofits; Open source communities)	Recommended references from the literature	von Hippel and von Krogh 2006; Chesbrough 2007a; Dahlander and Magnusson 2008; Brunswicker and Vanhaverbeke 2011;

Definition	The category of revealing captures attempts of companies to reveal innovative resources to the environment in exchange for indirect benefits as opposed to financial rewards (adapted from von Hippel and von Krogh 2003).			
Examples	Hewlett Packard, IBM, Sun, MySQL.			
OI practices (other terms used for same practices)	OIP12	OI communities (User community; Community for Innovations)	Recommended references from the literature	Fuller et al 2004; Dahlander and Wallin 2006; West and Lakhani, 2008; Dahlander and Magnusson 2008; Di Gangi and Wasko 2009; Ebner et al. 2009; Wallin and von Krogh 2010; Rass et al. 2013;
Definition	Voluntary association of actors, typically lacking in a priori common organisational affiliation (i.e. not working for the same firm) but united by a shared instrumental goal—in this case, creating, adapting, adopting or disseminating innovations (West and Lakhani 2008)			
Examples	Harley-Owners-Group; developersvillage of Siemens; womensnet of Henkel; Advisory community of Procter and Gamble; Dell's "Idea Storm"; Garage Maemo project from Nokia; Propellerhead;			
OI practices (other terms used for same practices)	OIP13	Outsourcing R&D (R&D subcontracting)	Recommended references from the literature	Gassmann and Enkel 2004; Narula 2004; Cassiman and Valentini 2009; Mortara and Minshall 2011; De Araújo et al. 2014;
Definition	Buying R&D services from other organisations, such as universities, public research organisations, commercial engineers or suppliers. There is			

	generally a clear customer–supplier relationship between the innovation creator and a firm seeking innovations from external sources (adapted from Van de Vrande et al. 2009)			
Examples	German MTU Aero Engines and the American engine manufacturer Pratt & Whitney; DaimlerChrysler outsourcing with BASF for varnishing products			
OI practices (other terms used for same practices)	OIP14	Outward licensing of IP (Licensing-out; Out-licensing)	Recommended references from the literature	Gassmann and Enkel 2004; Chesbrough 2007a; Bianchi et al. 2011; Lichtenthaler 2010; Wallin and von Krogh 2010; Lazzarotti et al. 2013; De Araújo et al. 2014;
Definition	Selling or offering licenses or royalty agreements to other organisations to better profit from your intellectual property, such as patents, copyrights or trademarks (Van de Vrande et a. 2009).			
Examples	IBM; Air Products; Dow Chemicals; Lucent Technologies; Philips; Saab; Schindler.			
OI practices (other terms used for same practices)	OIP15	Regional innovation clusters	Recommended references from the literature	Bullinger et al. 2004
Definition	These so-called regional innovation clusters are a specific form of networks and play a central role in generating new knowledge and regional competitive advantage. The concept of geographical clustering has been raised by Alfred Marshall as early as 1921, but especially has recently gained importance in the light of increasing innovation efforts (Bullinger et al. 2004).			
Examples	The tri-national BioValley along the upper river Rhine valley comprising Alsace in France, South Baden in Germany and the area around Basle, Switzerland.			

OI practices (other terms used for same practices)	OIP16	Scientific committee (Advisory review boards)	Recommended references from the literature	Dogson et al. 2006; Chiaroni et al. 2011;
Definition	A group of external specialists on the technologies of interest for the firm, that maintain regular contacts with the firm to bring information about the advances in relation with those technologies, identify experts for arranging collaborations, evaluate proposed projects (adapted from Chiaroni et al. 2011)			
Examples	Italcementi's Scientific Committee ; P&G's Technology Entrepreneurs network; Novartis; Hoffmann LaRoche;			
OI practices (other terms used for same practices)	OIP17	Shared facilities/facilities sharing	Recommended references from the literature	Mina et al. 2013; EURIS -SFFS 2012
Definition	Shared Facility: A joint investment in new facilities by multiple organizations, with the goal to share and exploit the facilities together, in order to ensure a high level of usage and reduce the overall costs. Facility Sharing: Sharing of existing facilities with third parties, in order to increase the level of usage and reduce the overall costs (SFFS project 2012)			
Examples	Volvo Group; Philips High Tech Campus Eindhoven (Netherlands); (1) Shared facilities: Automotive Intelligence Center (AIC) from Spain, Lindholmen Science Park - Test Site Sweden - Active Safety Test Area from Sweden, Dutch Integrated Testsite for Cooperative Mobility from The Netherlands, AutomotiveCampusNL – Automotive Facility Brainport from The Netherlands (EURIS project); (2) Facilities sharing: Center of Automotive Research on Integrated Safety Systems and Measurement Area from Germany, Flanders' DRIVE from Belgium, Ford Lommel Proving Ground from Belgium, Benteler Engineering Services from The Netherlands.			

OI practices (other terms used for same practices)	OIP18	Staff exchanges (Personnel Exchange; Human resource transfer)	Recommended references from the literature	Perkmann and Walsh 2007; Awazu et al. 2009; Di Minin et al. 2010; Ili et al. 2010; Lazzarotti et al. 2013;
Definition	Temporary mobility of researchers between different organisations to promote or develop innovation activities (own construction)			
Examples	ZF Friedrichshafen AG; Fiat; Pininfarina;			
OI practices (other terms used for same practices)	OIP19	Technology scouting	Recommended references from the literature	Ili et al. 2010; Mortara and Minshall 2011; Parida et al. 2012; Lazzarotti et al. 2013;
Definition	Collaborate with external partners to systematically assessing and observing technology trends in order to detect opportunities and encounter threats in a timely manner (adapted from Parida et al, 2012)			
Examples	The BMW Group's technology scouting office in Palo Alto, California; Daimler and VW 'trend-scouts' in North America and Tokyo.			

Table 2.8. Final proposal if list of OI practices

As a result from the performed analysis, some interesting relationships are observed between different types of OI practices:

- Confusion between innovation contests (OIP4) and innovation marketplaces (OIP5): There are several examples of this confusion in the articles analyzed, such as the reference to Innocentive as a user idea competition in Piller and Walcher (2006), when Innocentive mainly offers services to solve technological challenges for their customers with the contribution of external technological experts. We decided to treat them as separate practices because from the review of the literature we can clearly find differences between both, like the fact that while innovation marketplaces are IT platforms exploited by an intermediary company that join demand and offering for innovative ideas and technologies, innovation contest are in general implemented by organisations that look for innovative ideas for their own benefit.
- Confusion between innovation networks (OIP6), crowdsourcing (OIP2) and innovation communities (OIP12), a clear example could be the Dell's IdeaStorm initiative that different authors classify in different typologies of OI practices (Di Gangi and Wasko 2009; Badawy 2011, Adamczyk et al. 2012).
- Innovation contest (OIP4) can be used as a first step for other OI practices such as Innovation networks (OIP6), lead user methods (OIP10) (Piller and Walcher, 2006) or innovation communities (OIP12) (Ebner et al 2009). Innovation networks (OIP6) may also evolve into formal collaborative efforts such as R&D partnership (OIP8) (Van de Vrande et al. 2009). This indicates that there are relationships between different OI practices that would be interesting to analyze in more detail.
- Living labs are considered in the OI literature as an infrastructure that can be used to implement some OI practices, such as Lead-user method (OIP10) (Liedtke et al. 2011). Therefore we decide to consider this as a particular case of Shared facilities (OIP17).
- Similarities between innovation networks (OIP6) and regional clusters (OIP15): Regional clusters (OIP15) seem to be a particular modality of innovation networks (OIP6) characterized by the importance of local proximity (Bullinger et al. 2004). We decided to

treat them as separate practices because after the review of the literature we did not find references that clarify relation between both practices.

- Outsourcing of R&D (OIP13) is the typology of OI practices in which there is more cross references with other streams of research, such as R&D collaboration, without explicit reference to OI concept.

2.4 CHARACTERIZATION OF OI PRACTICES: DIMENSIONS AND FINDINGS

Once we have proposed a comprehensive list of typologies of OI practices, providing a definition for each practice and examples of their application, and we have recommended references from the literature where we have found extended information about each typology of practices, in this section we look for characterization of these practices to propose a new framework that may provide managers key insights in the implementation of OI practices and enrich the OI literature.

Our source for identifying the dimensions of OI practices were the papers ranked in Topics 1 and 2 of our database. We look for dimensions used by the authors to compare or classify OI practices and the results from this analysis are presented following in Table 2.9. For each dimension we present: the references in which the dimension is proposed, the different values that each dimension can have and a brief description of what each value means.

Dimension	Participation	References	Pisano and Verganti, 2008
Range of Values	Description		
Open	Everyone (suppliers, customers, designers, research institutions, inventors, students, hobbyists, and even competitors) can participate. A sponsor makes a problem public and then essentially seeks support from an unlimited number of problem solvers, who may contribute if they believe they have capabilities and assets to offer.		

Close	<p>Closed OI practices in contrast, are like private clubs where a company shares a problem with few parties that it selects because it believes they have the crucial capabilities and assets to provide innovative solutions. When you use a closed mode, you are making two implicit bets: that you have identified the knowledge domain from which the best solution to your problem will come, and that you can pick the right collaborators in that field.</p>		
Dimension	Governance structure	References	Pisano and Verganti, 2008; Lazzarotti et al. 2010; Mortara and Minshall 2011
Range of Values	Description		
Hierarchical	<p>In the hierarchical form, a specific organisation has this authority, which provides it with the advantage of being able to control the direction of the innovation efforts and capture more of the innovation's value. Hierarchical governance is desirable when your organisation has the capabilities and knowledge needed to define the problem and evaluate proposed solutions..</p>		
Flat	<p>In the flat form, these decisions are either decentralized or made jointly by some or all collaborators; the advantage here is the ability to share with others the costs, risks, and technical challenges of innovating.</p>		
Dimension	Direction of resources flow	References	Gassman and Enkel, 2004; Rohrbeck et al. 2009; Van de Vrande et al. 2009; Lazzarotti et al. 2010; Mortara and

			Minshall 2011; Rass et al. 2013; De Araujo et al. 2014;
Range of Values	Description		
Inbound or Outside-in or Technology exploitation	Purposive inflows of knowledge to capture and benefit from external sources to enhance current technological developments.		
Outbound or Inside-out or Technology exploration	Purposive outflows of knowledge to leverage existing technological capabilities outside the boundaries of the organisation.		
Coupled	Inside-out and outside-in processes are combined and partners share complementary resources		
Dimension	Kinds of partners	References	Poot et al. 2009; Lazzarotti et al. 2010
Range of Values	Description		
Competitors	This dimension can take as many different values as different types of partners for OI practices.		
Suppliers			
Clients or customers			
Consultancies			
Universities			
Research institutes			
Other organisations			
Dimension	Innovation process stage	References	Rohrbeck et al. 2009; Lazzarotti et al. 2010; Theyel, 2013
Range of Values	Description		
Idea generation	Including any sources and activities that contribute to the		

	development of a new innovation.		
Research	Instruments directed at facilitating research collaboration or in sourcing of technologies.		
Development	Activities aimed at engaging with partners in the creation of new products or new services.		
Commercialization	Activities that engage with outside partners to bring technologies or products/services to market.		
Dimension	Governance mechanisms or modes of governance	References	Mina et al. 2013; Rass et al. 2013
Range of Values	Description		
Formal	Engaging in contractual arrangements, operating on the basis of market prices, as a formal framework for cooperation.		
Informal	Unstructured interaction with collaborators or sharing of un-codified know-how with other firms. In these types of activities collaboration tends to be based on mutual trust and moral obligations rather than legally binding contracts.		
Dimension	Change impetus for the adoption of OI	References	Mortara and Minshall 2011
Range of Values	Description		
Top-down	A direct intervention of top managers who became convinced of the need for OI practices implementation.		

Evolutionarily	Achieved as a result of adaptation to the environment

Table 2.9. OI practices dimensions from articles ranked in Topic 1

Obviously the number of identified dimensions was high, and develop a comprehensive analysis of each type of OI practices to classify them according to each dimension would imply an effort that the author did not consider necessary to achieve the objectives of the research.

For this reason, it was taken the decision to select a reduced group of these dimensions that, according with the information provided in the papers ranked in Topic, 2 can be evaluated for all the OI practices typologies included in Table 2.7. The selected dimensions, according with this criterion were the following:

- Direction of resources flow: Inbound, outbound or coupled.
- Kinds of partners: Supplier, Customers/Users, Competitors, Research Centers, Universities, Consultants, Other companies, Government institutions, Professional Associations, General public, External experts.
- Innovation process stage: Opportunities identification, Idea generation, Concept and product development, Prototype, Commercialization.

Once we select these three dimensions, next step was to review articles included in the field “Recommended references from the literature” on Table 2.7 to map each OI practices typology with the possible values that can take each dimension.

2.4.1 DIRECTION OF RESOURCES FLOW

The most widespread definition of the possible values of this dimension is that of Gassman and Enkel (2004) that describes the following three core process for OI practices:

- (1) The outside-in process: Enriching the company's own knowledge base through the integration of suppliers, customers and external knowledge sourcing can increase a company's innovativeness.
- (2) The inside-out process: earning profits by bringing ideas to market, selling IP and multiplying technology by transferring ideas to the outside environment.
- (3) The coupled process: coupling the outside-in and inside-out processes by working in alliances with complementary partners in which give and take is crucial for success.

Assuming these definitions, we reviewed the papers identified in the field "Recommended references from the literature" of Table 2.7, to find information that confirm the value that this dimension can have for each OI practices typology.

The following figure (Figure 2.7) summarizes the classification of each OI practices typology according with these three possible values for the direction of resources flow:

As can be seen in figure 2.7 there are two specific typologies, Innovation networks and Shared facilities/facilities sharing, that the literature classify with dual values on this dimension.

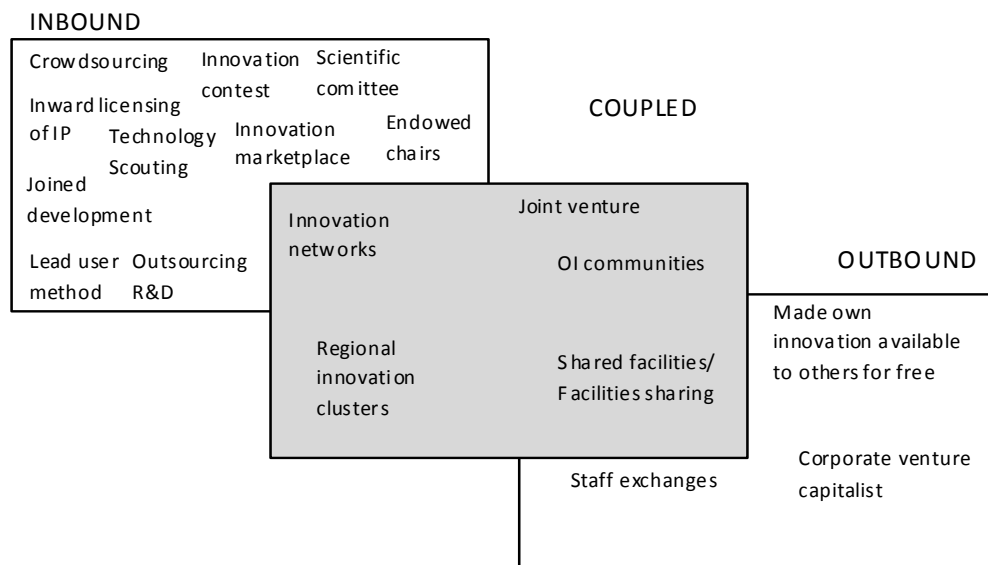


Figure 2.7. Classification of OI practices typologies according to the “Direction of resources flow” dimension

2.4.2 KINDS OF PARTNERS

A starting point for the idea of openness is that a single organisation cannot innovate in isolation. It has to engage with different types of partners to acquire ideas and resources from the external environment to stay abreast of competition (Chesbrough, 2003a; Laursen and Salter, 2006).

The way the innovation process can be opened has been studied in innovation and technology literature according to the number and typologies of partners (von Hippel, 1986; Pisano and Verganti, 2008; Enkel et al., 2009; Keupp and Gassmann, 2009).

According with our systematic review of the literature we found the relationship that is shown in Table 2.10. between the dimension “Kind of partner” and OI practices.

		Kinds of partners	
		Suppliers	Customers/Users
OIP 1	Corporate venture capitalist		
OIP2	Crowdsourcing		Enkel et al. 2009; Kleemann et al. 2008; Poetz and Schreier 2012
OIP3	Endowed chairs		
OIP4	Innovation contests		Ebner et al. 2009; Leimester et al. 2009; Hutter et al. 2011
OIP5	Innovation marketplaces		
OIP6	Innovation networks	Bigliardi and Galatti 2013; Dittrich and Duysters 2007	Bigliardi and Galatti 2013; Brunswicker and Vanhaverbeke 2011; Di Minin et al. 2010; Dittrich and Duysters 2007
OIP7	Inward licensing of IP		
OIP8	Joined development	Theyel 2013	Theyel 2013
OIP9	Joint venture	Lazzarotti et al. 2013	
OIP10	Lead user method		von Hippel 1986; Di Gangi and Wasko 2009;
OIP11	Made own innovation available to others for free	von Hippel and von Krogh 2006	von Hippel and von Krogh 2006
OIP12	OI communities		Di Gangi and Wasko 2009
OIP13	Outward licensing of IP		
OIP14	Regional innovation clusters	Bullinger et al. 2004	Bullinger et al. 2004
OIP15	Outsourcing R&D	Rammer et al. 2009	Rammer et al. 2009
OIP16	Scientific committee		
OIP17	Shared facilities/facilities sharing	Mina et al. 2013	
OIP18	Staff exchanges		Awazu et al. 2009; Di Minin et al. 2010; Lazzarotti et al. 2013
OIP19	Technology scouting		

Table 2.10. Relationship between “Kind of partner” dimension and OI practices typologies (Part I)

Kinds of partners			
Universities	Other companies	Competitors	Research Centres
Vanhaverbeke et al. 2008	Vanhaverbeke et al. 2008		
Chesbrough 2003a			
Adamczyk et al. 2012; Ebner et al. 2009			
	Natalicchio et al. 2014		Natalicchio et al. 2013
Bigliardi and Galatti 2013; Chiaroni et al. 2011; Di Minin et al. 2010; Lambert and Schaeffer 2010; Lee et al. 2010;	Dittrich and Duysters 2007; Lambert and Schaeffer 2010; Lee et al. 2010	Dittrich and Duysters 2007	Bigliardi and Galatti 2013; Di Minin et al. 2010; Lambert and Schaeffer 2010; Lee et al. 2010;
Bianchi et al. 2011	Bianchi et al. 2011		
Chesbrough 2007a			Spithoven et al. 2010
		Chesbrough and Schwartz 2007	
		von Hippel and von Krogh 2006	
Ebner et al. 2009			
	Lichtenthaler 2010	Lazzarotti et al. 2013	
Bullinger et al. 2004	Bullinger et al. 2004		
Rammer et al. 2009; Narula 2004			Narula 2004
Chiaroni et al. 2011			
		EURIS-SFFS 2012	EURIS-SFFS 2012
Perkmann and Walsh 2007			
			Ili et al. 2010

Table 2.10. Relationship between “Kind of partner” dimension and OI practices typologies
(Part II)

Kinds of partners				
OI practices		Consultants	Government institutions	Professional Associations
OIP 1	Corporate venture capitalist			
OIP2	Crowdsourcing			
OIP3	Endowed chairs			
OIP4	Innovation contests			
OIP5	Innovation marketplaces			
OIP6	Innovation networks			
OIP7	Inward licensing of IP			
OIP8	Joined development			
OIP9	Joint venture			
OIP10	Lead user method			
OIP11	Made own innovation available			
OIP12	OI communities			
OIP13	Outward licensing of IP			
OIP14	Regional innovation clusters	Bullinger et al. 2004	Bullinger et al. 2004	Bullinger et al. 2004
OIP15	Outsourcing R&D			
OIP16	Scientific committee			
OIP17	Shared facilities/facilities		EURIS-SFFS 2012	
OIP18	Staff exchanges			
OIP19	Technology scouting			

Table 2.10. Relationship between “Kind of partner” dimension and OI practices typologies (Part III)

Kinds of partners	
General public	External experts
Bartl et al. 2010; Schroll and Mild 2011; Kleemann et	Kleemann et al. 2008
	Ebner et al. 2009 (IBM Innovation
	Natalicchio et al. 2014
	Mina et al. 2013

Table 2.10. Relationship between “Kind of partner” dimension and OI practices typologies
(Part IV)

From this table we can conclude that there are some practices, such as innovation networks, regional innovation clusters and shared facilities/facilities sharing, that can be implemented with many different kind of partners and therefore are much more versatile in relation to this dimension than other practices, than in general can be applied with one or two different kinds of partners.

Furthermore, from this information we can also conclude that the types of partners with whom a company can establish a wider range of types of OI practices are users/customers and universities.

2.4.3 INNOVATION PROCESS STAGE

Several authors from our literature review refer to the relationship between the stages of the innovation process and OI practices (Rohrbeck et al. 2009; Lazzarotti et al. 2010; Theyel, 2013). Each of these authors proposes a different model for stages of innovation process as can be seen in Table 2.11.

Rohrbeck et al. 2009	Lazzarotti et al. 2010	Theyel, 2013
Idea generation		
Research	Exploration	Technology development
Development	Development	Product development
		Manufacturing
Commercialization	Commercialisation	Commercialisation

Table 2.11. Innovation process stages proposals from the literature

After the reviewed of the publications ranked in our database in topics 2 and 4, we propose the following classification of innovation process stages in relation to OI practices typologies:

- **Opportunity identification:** First stage of innovation process where the company can identify opportunity gaps in the market and undertake sound decisions regarding which ideas of innovative products/services to develop (Fetterhoff and Voelkel , 2006; Parida et al. 2012).

Usually, a firm sets up knowledge exploration processes after perceiving unexploited opportunities (Lichtenthaler, 2011). Therefore from our point of view, this stage of the innovation process can be considered a keystone of the openness and should be included in our research.

- Idea generation: This is the creative stage where new ideas of innovative product/processes are generated (Rohrbeck et al. 2009).
- Concept and product development: The focus of this stage is to transform the ideas into workable concepts. A concept could be developed from different combinations of different ideas (Theyel, 2013).
- Prototype: The concepts developed in the prior stage are further developed in this phase, through the use of prototyping and modeling to check market feasibility of the new developments (own construction).
- Commercialization: Activities that engage with outside partners to bring technologies or products/services to market (Rohrbeck et al. 2009).

In Table 2.12 we present the relationship between OI practices and the dimension called “Innovation process stage” as a result of the systematic review of the literature that we develop in this section.

OI Practices		Innovation process stage	
		Opportunity identification	Idea generation
OIP1	Corporate venture capitalist	Kirschbaum 2005; Vanhaverbeke et al. 2008; Mortara and Mindshall 2011	
OIP2	Crowdsourcing		Bartl et al. 2010; Kleemann et al. 2008; Poetz and Schreier 2012; Sandulli and Chesbrough 2009
OIP3	Endowed chairs	Vanhaberbeke et al. 2008	
OIP4	Innovation contest	Ebner et al. 2009; Leimester et al. 2009	Piller and Walcher, 2006; Adamczyk et al. 2012; Leimester et al. 2009; Terwiesch and Xu 2008; Ebner et al. 2009
OIP5	Innovation marketplaces		Natalicchio et al. 2014
OIP6	Innovation networks		van de Vrande et al., 2009; Lee at al. 2010; Rondani et al. 2013
OIP7	Inward licensing of IP		
OIP8	Joined development		
OIP9	Joint venture		
OIP10	Lead-user method	Bartl et al. 2010; Bilgram et al. 2008; Parida et al. 2012;	Bartl et al. 2010; Bilgram et al. 2008; Piller and Walcher 2006;
OIP11	Made own innovation available to other for free		
OIP12	OI communities	Ebner et al. 2009; Di Gangi and Wasko 2009; Hutter et al. 2011	Di Gangi and Wasko 2009; Hutter et al. 2011;
OIP13	Outsourcing R&D		
OIP14	Outward licensing of IP		
OIP 15	Regional innovation clusters	Bullinger et al 2004	
OIP16	Scientific committee		Chiaroni et al. 2011
OIP17	Shared facilities/facilities sharing		
OIP18	Staff exchanges		
OIP19	Technology scouting	Parida et al. 2012; Rondani et al. 2013	Parida et al. 2012; Rondani et al. 2013

Table 2.12. Relationship between “Innovation processes stage” dimension and OI practices typologies (Part I)

Concept and product development	Prototype	Commercialization
Kleemann et al. 2008	Sandulli and Chesbrough 2009; Kleemann et al. 2008; Bartl et al. 2010	Kleemann et al. 2008
Natalicchio et al. 2014		
	Brown and Hagel 2006	
Tao and Magnotta 2006; Bianchi et al. 2011		
Dittrich and Duysters 2007; Rohrbeck et al. 2009;		
Lazarrotti et al. 2013		Chesbrough and Schwartz 2007; Lazarrotti et al. 2013; Tao and Magnotta 2006
	Dahlander and Magnusson 2008	von Hippel and von Krogh 2006;
Dhalander and Wallin 2006; Di Gangi and Wasko 2009; Hutter et al. 2011; Rass et al. 2013	Hutter et al. 2011	
Narula 2004; Cassiman and Valentini 2009		
	Bianchi et al. 2011	Bianchi et al. 2011
		Ferrary 2011
EURIS-SFFS 2012	EURIS-SFFS 2012	
Awazu et al. 2009; Lazarrotti et al. 2013		Di Minin et al. 2010

Table 2.12. Relationship between “Innovation processes stage” dimension and OI practices typologies (Part II)

From Table 2.12 we can conclude that the number of possible OI practices to apply on each “Innovation process stage” is quite balanced for all the possible stages. The “Concept and product development” is the stage on which more different practices are reported but the difference with the other stages is quite low.

Also we observe that most of the OI practices can be used in more than one innovation process stage and that there are two specific OI practices, Crowdsourcing and OI communities, which stand out because they can be used in four different phases of the innovation process.

2.5 PROPOSED FRAMEWORK FOR OI PRACTICES

In this chapter we have developed a systematic and comprehensive review of the literature in relation to OI practices typologies and the dimensions that characterize these practices.

The contribution of this chapter to the state of the art is threefold. First, we propose a comprehensive list of OI practices typologies that contributes to standardize the terms used to identify the practices of OI and use it more accurately for development of quantitative and qualitative research.

Second, we identify a comprehensive list of the dimensions that characterize OI practices providing a detailed view of all the information that managers have to take into account when taking decisions about implementing OI practices.

Third, selecting three of these dimensions, (1) Direction of resources flow, (2) Kind of partners and (3) Innovation process stage, we have characterized all the OI practices typologies proposed in our list, providing different views of these OI practices that could help managers to select more appropriate OI practices according with their needs and resources.

Finally, according with the detailed review of OI practices literature that we have developed, we propose a hierarchical classification of the typologies of OI practices based on the “Direction of resources flow” and “Innovation process stage” dimensions and a new dimension that we named “Kind of relationship”.

This dimension reflects, in the opinion of the author, the complexity of implementing an OI practice, which increases with the quantity of partners.

We propose three possible values for this dimension:

- One to one: When a company need to involve only one partner for the implementation of the OI practice.
- One to many: When a company should involve more than one partner in the implementation of the OI practices.
- Many to many: When the implementation of the OI practice involves the participation of a set of partners that cooperate with each other in win-win conditions.

According with these three selected dimensions, we propose that OI practices typologies can be classified as can be seen in Figure 2.8. In this figure the IPSx labels indicate the innovation process stage where the practices, according with our review of the literature of OI practices, are most commonly applied (IPS1: Opportunity identification; IPS2: Idea generation; IPS3: Concept and product development; IPS4: Prototype; IPS5: Commercialization).

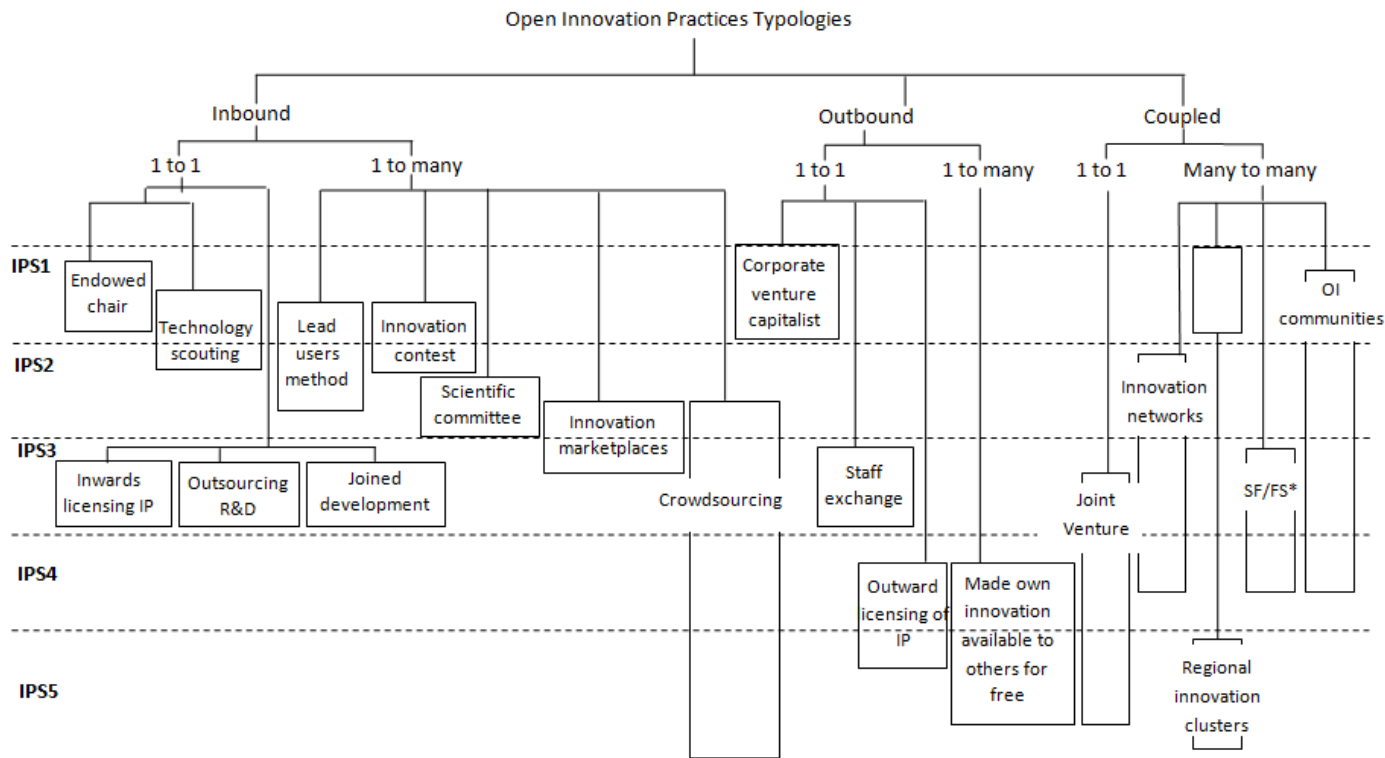


Figure 2.8. Classification of OI practices typologies in relation to “Direction of resources flow”, “Number of partners” and “Innovation process stage” dimensions

2.6 FACTORS THAT INFLUENCE ADOPTION OF OI PRACTICES

A fundamental question remains in force in the OI literature: Why do some firms conduct OI to a greater extent than other firms, and how do these firms differ? (Keupp and Gassmann, 2009). It is unlikely that a management concept has positive effects in any situation, implying that the effectiveness of OI must be context dependent. There is not one single best approach to managing a firm's OI activities, which depends on internal and external factors (Lichtenthaler & Lichtenthaler, 2009).

A contingency approach is needed that focuses on the context characteristics determining OI effectiveness and answering an important question that could be formulated as follows: What are the contingency factors that affect the conditions under which OI is effective? (Elmquist et al. 2009).

The context in this sense can be characterized by both internal and external environment and may moderate the relationship between OI and performance. This implies that OI practices can be more effective in one context than in another (Huizingh, 2011).

The importance of context factors can be studied in three different ways:

- First, they can be related to the adoption level of OI, e.g., in contexts with a high degree of globalization, companies are likely to use OI strategies more often.
- Second, the context characteristics can be related to the application of particular OI practices. For example in contexts with a high technology intensity, inbound OI may be important as even large companies are able to cope with or afford to develop technology on their own (Gassman, 2006), but the same may not necessarily be the case for outbound OI.
- Third, the context may moderate the relationship between OI and performance. This implies that OI practices are more effective in one context than in another. For example, outbound OI may be a more profitable strategy in contexts where intellectual property protection is relatively straight forward compared to situations where it is hard to protect inventions.

In this dissertation we will focus in the second one, looking for relations between OI practices and context factors that could help managers to identify most suitable OI practices taking into account internal and external context factors for their companies.

Underlying factors of opening up the innovation process deserve further analysis. While some potential drivers have been mentioned in earlier work, such as increasing technological complexity and growing environmental turbulence, a thorough understanding of the factors is essential to evaluate the performance of OI practices (Lichtenthaler, 2011; Hung and Chou, 2013; Wynarczyk 2013).

Our first approach to the scope of context factors, that influence the adoption of OI practices, has been a detailed review of 36 articles ranked in our database on topics 3 and 4 (see Section 2.2.1).

A first conclusion of this review is that in the literature there are two main approaches to answer the question of: Why do some firms conduct OI to a greater extent than other firms, and how do these firms differ? First, some authors have explained this difference as a result of firm-external factors (Gassman, 2006; Van de Vrande et al. 2009; Brunswicker and Vanhaverbeke, 2011) while others explain this difference as a result of firm-internal factors (Keupp and Gassmann 2009). Secondly, in recent years some authors propose a more integrative view of the contextual factors taking into account both internal and external contextual factors (Idrissia et al. 2012).

In this review we have identified internal and external contextual factors that the authors have related to the degree of openness. All the identified factors that are relative to internal context of the firms are included in Table 2.13 and factors relative to external context of the firms are included in Table 2.14. In both tables are also included different terms used by the authors to refer to the same factor and the references to the papers where the factors are proposed.

Internal Factors (firm specific)	Similar terms	References
I1: Firm size		Lichtenthaler and Ernst, 2009; Barge-Gil, 2010; Brunswicker and Vanhaverbeke, 2011; Idrissia et al. 2012
I2: Age		Idrissia et al. 2012
I3: Modularity	High product modularity; Knowledge leveraging	Gassmann and Enkel, 2004; Gassmann, 2006; Ozman, 2011.
I4: Intellectual property management	Appropriability strategy	Gassmann and Enkel, 2004; West and Gallagher, 2006; Munsch, 2009; Laursen and Salter, 2013
I5: Absorptive capacity		Gassmann and Enkel, 2004; West and Gallagher, 2006; Munsch, 2009; Laursen and Salter, 2014
I6: Corporate culture	Organisational culture	West and Gallagher, 2006; Tether and Tajar, 2008; Munsch, 2009; Slowinski et al. 2009; Mortara and Minshall 2011
I7: Ambidexterity		Lichtenthaler and Lichtenthaler, 2009; Di Minin et al. 2010; Mortara and Minshall, 2011
I8: Technology strategy	Technology aggressiveness	Lichtenthaler and Ernst, 2009

Table 2.13. Internal factors that influence the adoption of OI

External Factors	Similar terms	References
E1: Sector		Chesbrough and Crowther, 2006; Keupp and Gassmann, 2009
E2: Technological turbulence	Technological complexity; High knowledge intensity; Unpredictability of technology development; Technological change	Bullinger et al. 2004; Gassmann and Enkel, 2004; Gassmann, 2006; Fetterhoff and Voelkel, 2006; Barge-Gil, 2010; Mortara and Minshall, 2011; Idrissia et al. 2012; Hung and Chou, 2013
E3: Market turbulence	Highly volatile market; Increasing globalization; New business models; Crisis	Gassmann and Enkel, 2004; Fetterhoff and Voelkel, 2006; Gassmann, 2006; Di Minin et al. 2010; Mortara and Minshall, 2011; Hung and Chou, 2013
E4: Intermediaries	External support services	Spithoven et al. 2010; Idrissia et al. 2012;
E5: Proximities	Abundance of external innovation-relevant knowledge	Idrissia et al. 2012; Garriga et al. 2013

Table 2.14. External factors that influence the adoption of OI

As we can see in Table 2.13, internal context characteristics include company characteristics related to demographics and strategies (Huizingh, 2011). Demographics include number of employees, sales, profits, age, location, marketshare, and ownership type. Strategy characteristics include strategic orientation, aspects or goals of the innovation strategy, incumbents versus new entrants, organisational culture, as well as other purposeful acts that could be related to OI performance.

On the other hand, the most obvious external context characteristic is industry. Many OI studies focus on specific industries. Going beyond industry, Gassman (2006) suggests that OI is more appropriate in contexts characterized by globalization, technology intensity, technology fusion, new business models, and knowledge leveraging.

However, more systematic empirical research is needed to determine the impact of these and other external context characteristics. Possible other relevant characteristics include typical innovation risk patterns (Bianchi et al. 2011), manufacturing versus services, the importance of patenting and other forms of intellectual property protection, market turbulence, technological turbulence, and competitive intensity. (Huizingh, 2011).

2.7 THEORETICAL FRAMEWORK RELATING OI PRACTICES AND FACTORS

After the identification and the classification of context factors that influence the adoption of OI practices, we can clearly state that this is a multidimensional issue that has not been properly addressed in the existing literature, mainly due to the complex interdependencies among all these factors.

Existing references on the literature have mainly analyzed the influence of context factors in the adoption of OI practices in a general way, but relations between context factors and the typologies of OI practices have not been addressed previously to our knowledge.

In this section, we construct a theoretical framework that may help managers to select more suitable OI practices typologies according with the context factors included in Table 2.13 and 2.14.

This first version of our theoretical framework will be based on a review of the literature that includes all the articles classified in Table 2.7, such as “Recommended references from the literature” on specific OI practices typologies.

Following we present main findings in relation to each of the selected context factors included in Table 2.13 and 2.14.

2.7.1 FIRM SIZE

Differences in strategies of adoption of OI practices between large firms and SMEs is an open question in the literature on OI and some researchers (Keupp and Gassmann, 2009; Lichtenthaler and Ernst, 2009; Van de Vrande et al. 2009; Barge-Gil, 2010; Nieto and Santamaría, 2010) have made progress in the research of relationships between this factor and the typologies of OI practices, offering different conclusions that justify the greater suitability of some OI practices depending on the size of the company and also its experience in the field of OI.

Parida et al. (2012) state that SMEs in high-tech industries striving to increase their innovation performance should consider specific OI practices typologies. As technology scouting (OIP19) is fairly easy to implement and also has strong positive effects on innovation performance, it seems appropriate to start with this activity. Doing so, the SME probably can reap significant benefits for a rather limited cost, and technology scouting also seems to be a good start regardless of the innovation ambitions in the firm.

The next step toward adoption of OI largely depends on whether incremental or radical innovation is the main focus of the firm. These authors propose that if radical innovation is targeted by SME managers, then it will be advisable to team up with strong customer firms in the value chain and become a specialized supplier for them in the area where the firm has its competence base (OIP8). The authors also propose several alternative OI practices for similar objectives, such as interactions with end users and lead users (OIP 10) that can provide insights about future market needs, technology sourcing (OIP13) that can also be a viable alternative to achieve radical innovation or acquiring licenses (OIP7).

For technology exploration, by far most SMEs somehow try to involve their customers in innovation processes (OIP 10) by tracking their modifications in products, proactively involving them in market research, etc. (Van de Vrande et al. 2009), this result confirms the importance of user innovation (Von Hippel, 2005) for many SMEs and these researchers state that reducing the focus of OI in SMEs to science-driven innovations would seriously bias our understanding of OI for this category of firms. Furthermore, external networking (OIP6) to acquire new or missing knowledge is an important OI activity among SMEs (Van de Vrande et al. 2009).

The more popular practices like customer involvement (OIP 10) and external networking (OIP6) are informal, unstructured practices which do not necessarily require substantial investments. IP licensing (OIP7), venturing and external participation (OIP1) on the contrary, require financial investments, formalized contracts and a structured innovation portfolio approach to manage the risks (Van de Vrande et al. 2009). This finding is in line with former studies about innovation in SMEs (e.g. Vossen, 1998).

Furthermore, some authors state that, according to their research results, promoting in-house R&D is not fully supported when it comes to SMEs, due to that in-house R&D in SMEs seems to be particularly effective only if combined with external knowledge sourcing (OIP13) (Rammer et al. 2009).

Other researchers highlight that not all firms have strong brand names or an equal strategic “mindshare” with outsiders, something that could be very common when talking about SMEs. Therefore the researchers propose that for those players, the future might lie in using well-known innovation intermediaries (OIP5) who hold strong brands, such as InnoCentive, which attracts a larger audience of outside experts (Wallin and von Krogh 2010).

Moreover some OI practices, such as made own innovation available to others for free (OIP11) can be interesting for SMEs taking into account that obtaining a patent typically costs thousands of dollars, and it can take years to get the necessary approval (von Hippel and von Krogh 2006).

As a summary of these references we can state that size factor has to be taken into account when selecting OI practices typologies. The SMEs, due to their limited resources and difficulties to attract external partners, could find more suitable to start opening their innovation process with more unstructured practices which do not necessarily require substantial investments and could be easier to implement such as the following:

- Technology scouting (OIP19).
- Joined development (OIP8) with strong customer firms in their value chain.
- Lead user method (OIP 10).
- Outsourcing R&D (OIP13).

- Innovation networks (OIP6).

According with the classification of OI practices typologies proposed in section 2.5 of this dissertation, most of these OI practices typologies are included in the left area of the classification tree showed in Figure 2.8. This result supports our hypothesis that this proposed hierarchical classification of OI practices typologies contribute to understand the complexity in implementing OI practices, to the extent that most of the recommended first experiences of OI practices in SMEs focus on the inbound practices and those corresponding to the value 1 to 1 of our proposed new dimension “Kind of relationship” as can be seen in Figure 2.9.

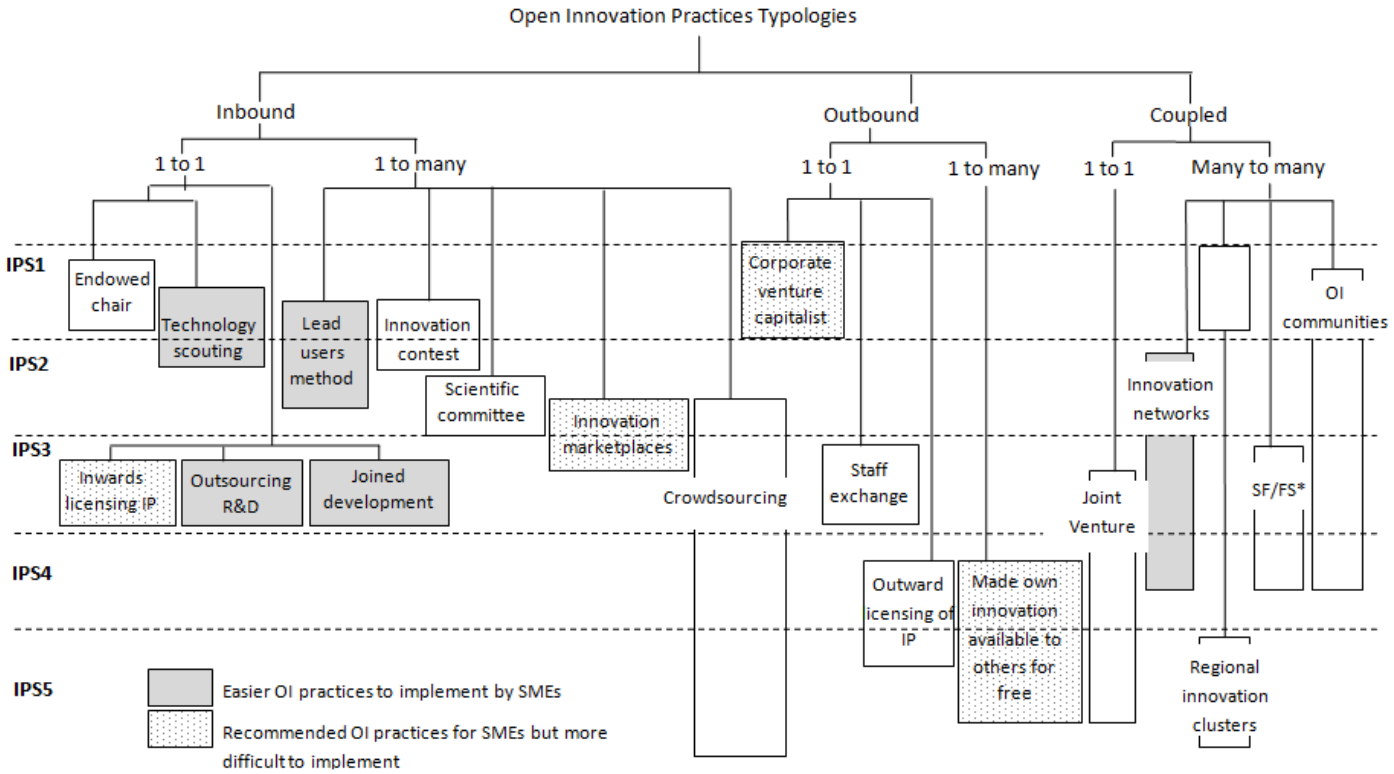


Figure 2.9. OI practices typologies in SMEs

Other OI practices that require financial investment, formalized contract and a structured innovation portfolio approach to manage the risks, such as acquiring licenses (OIP7), venturing and external participation (OIP1), innovation marketplaces (OIP5) or made own innovation available to others for free (OIP11) could also add value to innovation in SMEs but are more difficult to implement. A strategy that can help managers to reduce the risk of failure with these practices is to implement these typologies of OI practices when the SME has already previous successful experiences in OI.

This result also support our hypothesis that our proposed hierarchical classification of OI practices typologies contribute to understand the complexity in implementing OI practices, to the extent that most of these practices are located more to the right in the tree of classification of OI practices typologies, as can be seen in figure 2.9. This group of OI practices includes outbound OI practices and two of them have the value “1 to many” in the dimension “Kind of relationship”.

Besides this preliminary results that talk about relationship between the size factor and some specific typologies of OI practices typologies, this review also suggest that some of the most widespread claims in the literature regarding the factors that favor the implementation of OI practices, such as the need for absorptive capacity, may not be true in the case of SMEs.

2.7.2 AGE

This firm-specific factor has been paid very little attention on OI literature and in fact the authors did not found any reference that relates this factor with specific OI practices typologies.

Recently Idrissia et al. (2012) study the influence of age in the degree of openness of SMEs, measuring this factor as the number of years from which the firm was established to date.

These researchers found that a decrease in the age of the SMEs decreases the likelihood for a higher degree of openness. This result suggests that aging provides SMEs with the experience needed to forge more relations and trust with external partners and to be more open. Therefore they suggest that managers should be aware of the importance of the age of the firm in approaching openness. In fact, managers in SMEs should open up their innovative process progressively, because opening up the process of innovation implies building relations and trust between the firm and its external partners.

Trust is developed over time through continuing interactions which may need more time to be established (Amara and Landry 2005).

2.7.3 MODULARITY

West and Lakhani (2008) explain that in many sponsored communities (OIP12) (such as MySQL) firms tightly control code including the technical modularity that enables decentralized innovation.

Not surprisingly, the incentive to freely reveal decreases if the agents compete with one another—for example, if they are firms making the same end product. Selective openness strategies illustrate this point nicely. Thus, Henkel (2006) has documented selective free revealing (OIP11) among firms in the case of embedded Linux software. The firms partition their code into open modules on which they collaborate and closed modules on which they compete.

As a summary of these references, we can state that intellectual property management factor has to be taken into account when selecting OI practices typologies. We have found in our literature review researchers that connect this internal factor and the following specific OI practices typologies:

- Open innovation communities (OIP12).
- Free revealing (OIP11).

2.7.4 INTELLECTUAL PROPERTY MANAGEMENT

Concerning intellectual property management (IP management) Hutter et al. (2011) highlights the key concerns about this factor in case of OI communities (OIP12). Collaboration in OI communities is based on the participants' willingness to freely reveal their knowledge and expertise and openly work together (von Hippel & von Krogh, 2003). Free revealing means that all existing and potential intellectual property rights to that information are voluntarily given up by that innovator and all interested parties are given access to it. Well-known community examples of free revealing and open collaboration can be found in the context of open-source software development communities.

Dhalander and Wallin (2006) in their paper focus on software firms that sponsor individuals to act strategically within a free and open source software (FOSS) community, refers to the relevance of appropriability. These authors

state that a user community (OIP12) can be seen as a complementary asset that can be used, in conjunction with the firm's internal expertise, to develop competitive products and services. But on the other hand although this engagement in a community creates value for the firm, also it is more difficult to appropriate of the generated value because competitors may interfere.

Other OI practice typology that is closely related to this factor in the literature is Innovation marketplaces (OIP5). An example is the one from Innocentive where this firm acts as a broker with the intellectual property rights between the seeker, that proposed the challenge, and the solvers, that propose solutions, contributing with its expertise in IP management as a trustworthy third party (Terwiesch and Xu, 2008).

In the same line, Natalicchio et al. (2014) explain that intellectual property management is a crucial issue for markets for ideas (OIP5), because this factor contributes to explain their success or failure. As these authors expose knowledge owners tend to protect their ideas, hence reducing available information and risk of replication, while knowledge seekers need the highest amount of information and insights to fully appreciate the value of the proposed ideas. Thus, a tension emerges between the necessities of owners to retain knowledge about their innovative solutions and the needs of seekers to understand the supplied solutions, thus implying asymmetric information between buyer and seller.

Another balance characterizing market for ideas (OIP5) refers to the public disclosure of ideas, which, on the one hand, may increase the scope of recombination and the average quality of ideas, while, on the other hand, may reduce the protection of each idea, hence augmenting the risk of misappropriation (Dushnitsky and Klueter, 2011), namely the unauthorized appropriation or use of owners' ideas. With this regard, two different approaches emerge from the analysis of existing markets for ideas (OIP5). For example, Natalicchio et al. (2014) proposes the following example: In Atizo, ideas are public and users can read and vote on them to provide suggestions to the seekers. In this case, monetary rewards are rather low, and thus, the potential costs associated with the replication of the ideas are generally lower than the benefits of building on others' knowledge. Instead, in InnoCentive the situation is the opposite. In fact, monetary prizes are quite high and ideas are not disclosed to the other participants, hence suggesting the importance of intellectual property policies to assure the effectiveness of the market.

Evidence in the literature shows that firms who elect to freely reveal their innovations (OIP 11) can gain significant benefits and also avoid some important costs (Baldwin and von Hippel, 2011). With respect to benefits, innovators that freely reveal their new designs often find that others then improve or suggest improvements to the innovation, to mutual benefit (Raymond 1999) and firms that implement this OI practices can also may benefit from enhancement of reputation, from positive network effects as a result of increased diffusion of their innovation, and from other factors such as obtaining a source of supply for their innovation that is cheaper than in-house (Allen et al. 1983, Lerner and Tirole 2002, Harhoff et al. 2003, Lakhani and Wolf 2005, von Hippel and von Krogh 2006). With regard to cost, protecting is generally expensive, requiring security walls and restricted access or the enforcement of intellectual property rights (Blaxill and Eckardt 2009). For this reason, preventing others from viewing and using a new design may be significantly more costly than leaving the design open for inspection or use by any interested party (Baldwin 2008).

Other interesting example from the literature is the one from the Italian company Italcementi. Chiaroni et al. (2011) explain how one of their first actions in their journey towards OI was the creation of a new organisational unit called the Intellectual Property Office, dedicated to manage the existing and new knowledge base of the firm.

Later on, in this journey, when they enter as participants into an European network of Universities (OIP6) they decide to strengthen their intellectual property protection systems, by hiring new personnel for their Intellectual Property Office. That demonstrates that even for large companies, the IP management is a key factor in relation to OI practices.

Bianchi et al. (2011), in their paper where they investigate the adoption of OI practices in the bio-pharmaceutical industry, find that these firms with time tend to establish more in-licensing agreements (OIP7), thus allowing reduction of the risk of competence spill-over, to better protect intellectual property, and to ensure a tighter control and independence in the management of drug discovery and development process. One of the conclusions of their paper is the need to further research about the problems related to the management of IP and their impact on how firms implement inbound and outbound OI practices.

Gassmann and Enkel (2004) illustrate the benefits of a good IP management strategy with the example of Schindler, a large German company of the

elevator market, which developed aramid cables to replace elevators' steel cables. These cables contain carbon fibers to enable remote diagnosis and therefore support elevators' service and safety. But further to exploit these results in their own market, Schindler applied for patents for application of this technology to non-elevator applications and sold these patents for \$6 million to other companies (OIP14) and thus financed the whole R&D project.

As a summary of these references, we can state that intellectual property management factor has to be taken into account when selecting OI practices typologies. We have found in our literature review researchers that connect this internal factor and the following specific OI practices typologies:

- OI communities (OIP12).
- Innovation marketplaces (OIP5).
- Made own innovation available to others for free (OIP11).
- Innovation networks (OIP6)
- Inwards licensing of IP (OIP7)
- Outwards licensing of IP (OIP14)

According with the classification of OI practices typologies proposed in section 2.3, as we can see in Figure 2.10, IP management seems to be more relevant in relation to typologies that have a value of "1 to many" or "many to many" in the dimension of "Kind of relationship", this could mean that when the practice imply a higher number of partners, the relevance of this factor for their implementation is higher.

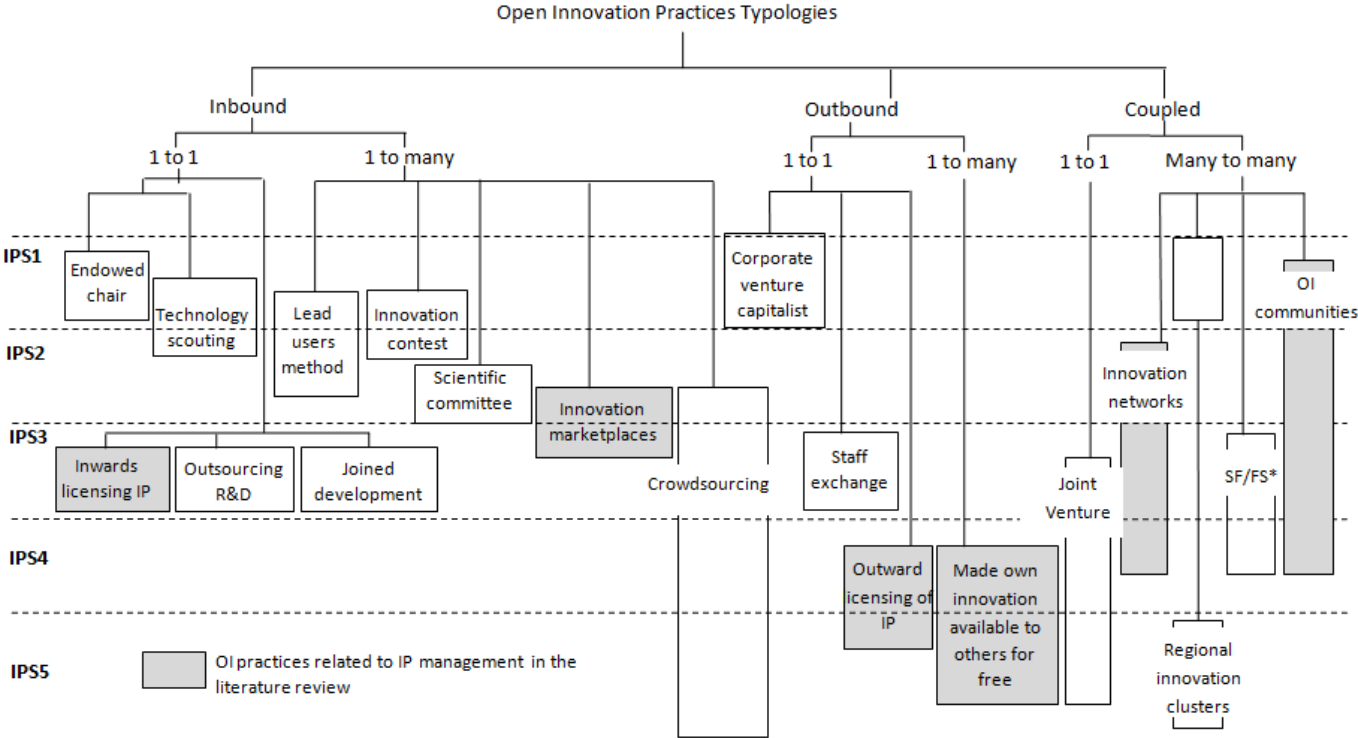


Figure 2.10. OI practices typologies related with IP management factor

2.7.5 ABSORPTIVE CAPACITY

Bartl et al. (2010) conclude that one of the major dimensions to take into account for a successful implementation of crowdsourcing practices (OIP2) is the establishment of structures and routines not only to acquire external inputs but to assimilate digest and capitalize on the value of this co-creation practice within the companies.

Di Gangi and Wasko (2009) present a case study of implementation of OI community (OIP12) in Dell, where they show a clear relationship between implementation of this OI practice typology and development of absorptive capacity. These researchers state that as organisations gain more experience with user innovation communities (OIP12), they may find it far easier to value and assimilate new ideas coming from these communities that means that they gained greater absorptive capacity with the implementation of these OI practices.

Also, in reference to OI communities (OIP12) Dahlander and Magnusson (2008) propose that firms need to have the competencies and selection mechanisms to decide which contributions are critical. Otherwise, there is a risk that the firm will be submerged under a plethora of ideas and suggestions, without the capability to prioritise among them and turn this knowledge into successful products. The reverse can also occur: if too little attention is paid to external actors, firms run the risk of missing out to competitors on critical developments.

On the other hand, other OI practices such as Outsourcing of R&D (OIP13) are related to the loss of absorptive capacity (Mortara and Minshall, 2011). These researchers state that their findings supported observations of Howells et al. (2008) in the pharmaceutical industry, also anticipated by Gassmann et al. (2010), about that Outsourcing of R&D (OIP13) that often is the first step towards openness, in excess reduces performance because, as highlighted by Cohen and Levinthal (1990), the depletion of internal competencies compromises absorptive capacity.

Rammer et al. (2009) state that human resource management and team work are innovation management tools that can help non-R&D performing SMEs to gain similar innovation success as R&D performers, especially when combined with each other or combined with external knowledge sourcing or formal co-operations with external partners (OIP13). According with these results these

researchers proposed that for SMEs it is possible to find a substitution effect of internal R&D, which is one of the main measures of absorptive capacity, by innovation management practices.

Vanhaverbeke et al. (2008) analyse corporate venturing practices (OIP1) and they argue that firms have to learn new skills and routines, such as develop absorptive capacity to learn effectively from other companies, because benefits from this OI practice typology do not automatically materialize. These researchers found that corporate venturing allows firms to tap into different technologies at the same time, with small initial investments they can learn about the different technological opportunities ahead. In this way, the investing firm builds up absorptive capacity in a number of technologies simultaneously.

Moreover these researchers propose that R&D expenditure levels alone cannot explain the large variability in absorptive capacity among innovating firms. It is the organisation of the internal R&D unit, its connection with external partners and its interaction with the other parts of the company that determine the innovative capability of a firm. These results point in the same direction as those obtained by Rammer et al. (2009) in the sense that in addition to internal R&D other capabilities, such as innovation management, may be critical to the successful implementation of certain types of innovation practices.

As a summary of these references, we can state that absorptive capacity factor has to be taken into account when selecting OI practices typologies. We have found in our literature review researchers that connect this internal factor and the following specific OI practices typologies:

- Crowdsourcing (OIP2).
- OI community (OIP12).
- Outsourcing of R&D (OIP13).
- Corporate venturing capitalist (OIP1).

According with the classification of OI practices typologies presented in previous sections, as we can see in figure 2.11, the most relevant results from our literature review in relation to this factor, is that absorptive capacity seems to be influenced by the typology of OI practice selected, such as some can increase the absorptive capacity of the firm and others can be related to a loss

of absorptive capacity. Moreover we find that in relation to OI practices management capabilities can be as relevant as internal R&D capacity.

2.7.6 CORPORATE CULTURE

Corporate culture is a broad concept largely intangible and made up of attitudes, behaviors and past experiences and that includes both managerial and organisational issues. Culture is a powerful force that guides employees' attitudes and behaviors. Employees repeat behaviors that are rewarded and that have worked in the past, even if these behaviors have outlived their usefulness (Slowinski et al. 2009).

Organisational and corporate culture-related issues that typically emerge when two or more companies are working together are clearly important barriers/ that firms face when they engage in OI (Van de Vrande et al. 2009). Therefore literature in OI has analyzed several elements associated with these concepts such as top management commitment, need for a champion supporting external technology integration, exploitation of the personal relationships of personnel, incentives and reward systems and so on.

Ebner et al. (2009) relates that in the innovation contest (OIP4) organised by SAP a top management representative of SAP research took part in the evaluation process of received ideas. That could be identified as an explicit commitment of the top management in promoting the transition towards an OI.

Bartl et al. (2010) refers to corporate culture talking about the case study of BMW group Co-Creation lab, a crowdsourcing practice (OIP2), and these researchers refers to incentive structures which takes users into account who act outside the company and are not legally linked via contracts of employment.

Brown (2006) explains how in case of creation nets (OIP6) implemented by western original-design manufacturers (ODMs) thus begin with a network organizer, in the role of gatekeeper, which decides who participates in the network. ODMs, for instance, rigorously scrutinize not only the technological capabilities of prospective participants but also whether their corporate culture promotes collaboration and risk taking.

Van de Vrande et al. (2009) state that organisation and corporate culture-related issues that typically emerge when two or more companies are working

together are clearly the most important barriers that firms face when they engage in venturing (OIP1), and the involvement of external parties and users.

Lichtenthaler (2010) explain how in the case in the business unit of a large machinery company before addressing the licensing organisation, managers need to make sure that the firm's licensing strategy is communicated throughout the organisation. Accordingly, a firm-level strategy that clearly indicates the goal of active licensing (OIP14) should be the starting point.

On this basis, the case study has shown that the support of executive champions is helpful because these persons can ensure that an active licensing strategy is actually implemented. These champions are high-ranking employees who actively and enthusiastically promote technology licensing throughout the organisation. For instance, the chief technology officer or the head of intellectual property management may take this informal promoting role in many firms in order to strengthen the firm's licensing activity. This top-down approach signals the importance of licensing throughout the organisation, particularly to the managers in a firm's business units, which may be relatively reluctant to license technology to address job-related markets.

As a summary of these references, we can state that corporate culture factor has to be taken into account when selecting OI practices typologies. We have found in our literature review that researchers that have connect this factor with specific OI practices typologies mainly refer to top management involvement, incentives structures and need for a champion supporting OI practices.

As showed in Figure 2.11, OI practices that have explicitly been related to this factor are the followings:

- Innovation contest (OIP4).
- Crowdsourcing (OIP2).
- Innovation networks (OIP6).
- Corporate venturing capitalist (OIP1)
- Outward licensing (OIP14)

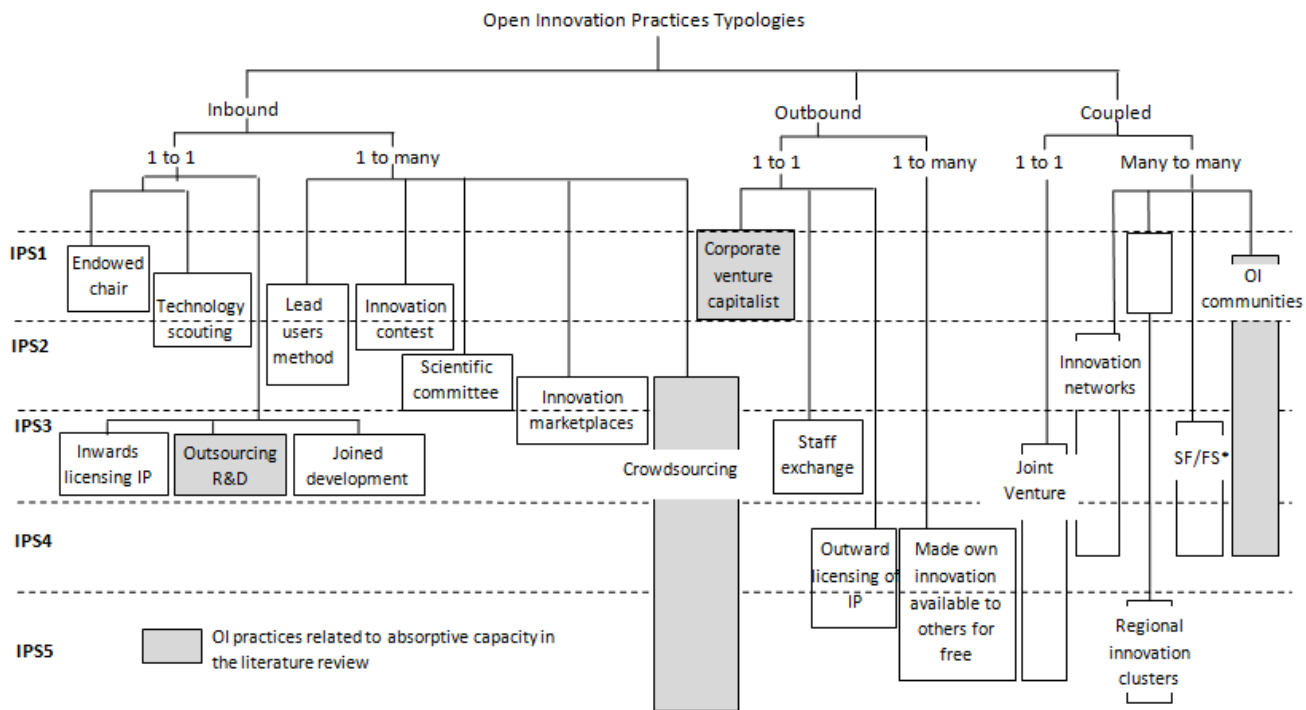


Figure 2.11. OI practices typologies related with corporate culture

2.7.7 AMBIDEXTERITY

Managing innovation does not only include the coordination and supervision of the innovation process, it also requires making decisions and resolving dilemmas wherever different options are at hand. March's seminal work has become part of a wider academic discussion about the challenges and dilemmas in organisational design for innovation. There is common agreement that organisations require different structures for finding new innovations on the one hand and being efficient in their existing business on the other hand (Volberda, 1996).

In order to pursue both objectives simultaneously, successful companies have implemented what Duncan (1976) called the "ambidextrous organisation". By "hosting multiple contradictory structures, processes, and cultures within the same firm" (Tushman and O'Reilly, 1996), companies manage to balance between contradictory objectives and thus create an optimal setting for a sustainable business development. Balancing in this context does not mean finding a punctual equilibrium, but rather excelling at both ends of the continuum (Atuahene-Gima, 2005; Gupta et al. 2006). The application of this concept to organisation science has become widespread in the past decades (Raisch and Birkinshaw, 2008).

Brunswick and Vanhaverbeke (2011) state that for SMEs relationships with network partners (OIP6) are usually long-term oriented and aim for achieving joint value creation rather than efficient transactions. That is clearly related with an ambidexterity behavior where the SMEs look for accessing to complementary innovation assets to substitute the need for internal capabilities that require years to be acquired (Baum et al., 2000). Due to the synergistic nature of interactions, network relationships make it easier to identify, access, and absorb external ideas.

Mortara and Minshall (2011), in their research found that firms with less turbulent environments focus primarily on inbound OI activities, whilst environmental uncertainty and the need for ambidexterity (Tushman and O'Reilly, 2002) led firms to develop both inbound and outbound activities. These researchers found several firms that implemented OI practices, such as corporate venture (OIP1), license out IP (OIP14) and lead users (OIP10) to support innovation in fields beyond the core company business, as a means to achieve ambidexterity.

Stoetzel and Wiener (2013) from their case finding suggest a causal relationship between well organised and successful OI environments and the application of ambidexterity for managerial and organisational practice. They suggest that future research could provide further insights by conducting additional case studies, developing testable propositions, and aiming to explain the general nature of the relationship between ambidexterity and OI performance. The only explicit relationship that these researchers found between ambidexterity factor and specific OI practices is the relation between temporal ambidexterity with regards to decision making policies in particular in web-based idea contests (OIP4).

As a summary of these references, we can state that research to understand the relationship between ambidexterity factor and OI practices typologies includes references to the following two OI practices typologies:

- Innovation networks (OIP6)
- Corporate venture (OIP1)
- License out IP (OIP14)
- Lead users (OIP10)
- Innovation contest (OIP4)

2.7.8 TECHNOLOGY STRATEGY

A technology strategy comprises various dimensions, which have been addressed in different detail in prior research, e.g., technology aggressiveness, technology timing, and technology diversification (Arora et al., 2001; Lin et al., 2006). Basically, the fundamental issues of a technology strategy may be boiled down to the following question: Which technologies should be used at which capability levels for which purpose at what time? (Lichtenthaler and Ernst, 2009).

Vanhaverbeke et al. (2008) explain the direct relation between corporate venture capitalist (OIP1) and technology strategy because with the implementation of this typology of OI practice, innovating firms benefit from early involvement in new technologies or business opportunities with the advantage that at this stage investment are small and reversible when investing companies decide to exit.

Natalicchio et al. (2014) analyzed 43 articles relatives to market for ideas and found that many of these researches focused on technology strategy and discuss the use of market for ideas (OIP5) to sell and buy knowledge, highlighting managerial challenges, trade-offs, and dilemmas that seekers and owners have to face.

As a summary of these references, we can state that research to understand the relationship between technology strategy factor and OI practices typologies includes references to the following two OI practices typologies:

- Corporate venture capitalist (OIP1).
- Market for ideas (OIP5)

2.7.9 SECTOR

Enkel et al. (2009) explain that in the software sector users develop open source platforms through co-creation (OIP10).

Sandulli and Chesbrough (2009) explain how through open APIs (Application Programming Interfaces) operators are beginning to share the network (OIP17) with application developers, which can be accessed through this collaboration to a new distribution channel. These third-party applications could come into direct competition with their own applications developed by operators. In this case, the shared resource is competitive as is eroding the normal source of income for the operator. Yet at the same time, the sharing of the network can result in an indirect increase revenues through the possible increase of traffic on the network to have more applications and royalties that the operator gets to assign your network provider application.

Perkmann and Walsh (2007) state that in science based sectors such as pharmaceuticals, biotechnology or chemicals, with strong complementarities between academic research and firm R&D, firms tend to rely on collaborative research (OIP8) as well as research services (contract research and consulting) that have stronger commercial features. By contrast, sectors emphasizing incremental improvement rather than scientific breakthroughs, such as mechanical engineering or software development, show a preference for contract research (OIP13).

Rass et al. (2013) said that the category of revealing captures activities (OIP11) with which 'firms reveal internal resources without immediate financial rewards,

seeking indirect benefits to the focal firm' can often be observed in the IT sector, where some companies reveal their internally developed software codes to external open source communities. The code developed within the community is freely available to all community members. As such, efforts of companies that engage in open source software development belong to the category of free revealing.

Lambert and Schaeffer (2010) explained that the concept of cooperative innovation (OIP8) is no longer limited to one industrial sector, but connects companies from different industries through innovation projects by making new knowledge combinations. In their paper they explained an example where the avionics and automotive sectors implemented this type of OI practice.

As a summary of these references, we can state that research to understand the relationship between sector factor and OI practices typologies includes references to the following OI practices typologies:

- User co-creation (OIP10).
- Shared facilities (OIP17).
- Contract research (OIP13).
- Collaborative research (OIP8)
- Free revealing (OIP11).

2.7.10 TECHNOLOGICAL TURBULENCE

Dittrich and Duysters (2007), through their study of international innovation networks of Nokia case, proposed that innovation networks (OIP6) are particularly important in industries where technology changes rapidly and product life cycles are short. These researchers explain that the need for weak ties has been shown to be particularly high under conditions of rapid technological change where the need for explorative learning is highest.

Also Lee et al. (2010) state that well-constructed and managed networks (OIP6) can offer clear benefits to SMEs, helping them decode and appropriate flows of information such as technological change, sources of technical assistance,

market requirements and strategic choices by other firms, thus strengthening their competitive advantage (Bougrain and Haudeville, 2002).

Vanhaverbeke et al. (2008) said that one way for firms to cope with the technological and market uncertainty associated with new business development is by making small investments in multiple options on technology. These researchers explain that in early phases of innovation process with unacceptable levels of technological and market uncertainty, firms are better off creating options through learning investments: grants to universities to further explore new inventions or emerging technologies (OIP3), joining a research consortium or establishing research agreements with partners (OIP8), or investing in seed capital ventures or corporate ventures (OIP1) are different possibilities to explore technologies or business opportunities in the first phase. Once the learning investments result in an improved understanding of the technology and uncertainty has dropped to an acceptable level, innovating firms may invest in more substantial ways using other external governance modes such as equity alliances, joint ventures, spin-ins or outright acquisitions (Van de Vrande et al., 2009).

According to these references we can conclude that technological turbulence is a factor that can indicate that the most suitable OI practices to cope in this kind of external context will be those that are applied in the first stage of the innovation process, such as grants to universities to further explore new inventions or emerging technologies (OIP3) or corporate ventures (OIP1), in order to cope with an exploratory strategy. But in the literature also appear references that join this factor with other OI practices, such as innovation networks (OIP6), research consortium or research agreements with partners (OIP8) that indicate that further research is needed to clarify these relations.

2.7.11 MARKET TURBULENCE

Bartl et al. (2010) in their literature review explain how lead users (OIP10) are far ahead of market trends relative to the majority of product as they are familiar with future conditions and virtually "live in the future".

Dittrich and Duysters (2007) article presents the case study of Nokia, one of the first longitudinal studies which describes the use of innovation networks (OIP6) as a means to adapt swiftly to changing market conditions and strategic change. Their research illustrates the importance of strategic technology networks for strategic repositioning under conditions of change and how such

inter-firm networks seem to offer flexibility, speed, innovation and the ability to adjust smoothly to changing market conditions and new strategic opportunities.

Bigliardi et al. (2011) investigated the adoption of OI practices in one of the largest manufacturer of pasta in Europe. The adoption process was the result of a new direction in consumer demand, and hence competition between companies, and was due on the one hand, to the growing changes in the competitive context (market turbulence), and in particular to the growing importance of functional nourishing foods; on the other hand, to the reinforcement of the strategic decision to enter in the market with very high-quality foods. This company established a wide network of collaboration (OIP6) mainly in order to acquire technologies externally to be used to carry out various stages of basic and applied research. Partners were represented by suppliers, consumers, companies belonging to other industries (e.g., a major Japanese company specializing in the production and development of biosensors for process monitoring, considered an essential element in ensuring the quality of food products), and Universities (in particular, two Chinese universities for the development and marketing of functional foods).

Bullinger et al (2004) explain that in highly innovative industries, but increasingly also in traditional industries, striving for innovation often lack clear market needs due to the dynamics of change in the knowledge-driven economy. In this environment of high technological dynamics, changing working environments, increasing globalization and fast changing markets, information exchange has become increasingly important and the knowledge about customer needs and technological advancements has become crucial for the success of enterprises. In parallel with this still increasing globalization, the increasing importance of regional cooperation and concentration is being contemplated today. The so-called regional innovation clusters (OIP15) are a specific form of networks and play a central role in generating new knowledge and regional competitive advantage. This regional innovation cluster replaced lack of concrete demand by a common vision about future technologies and their application demand. This common vision can only be created by frequent, often informal, contacts among the participants, therefore proximity is needed and the regional character of this networks to fulfill this criteria.

As a summary of these references, we can state that market turbulence factor has to be taken into account when selecting OI practices typologies. We have

found in our literature review researchers that connect this external factor and the following specific OI practices typologies:

- Lead user method (OIP10).
- Innovation networks (OIP6)
- Regional innovation clusters (OIP15)

As we can see in Figure 2.12. the OI practices typologies related with this external factor have a value of “1 to many” or “many to many” in the dimension of “Kind of relationship”, this could mean that for context of market turbulence OI practices that need for a higher number of partners are more suitable to obtain a richer picture about customer needs.

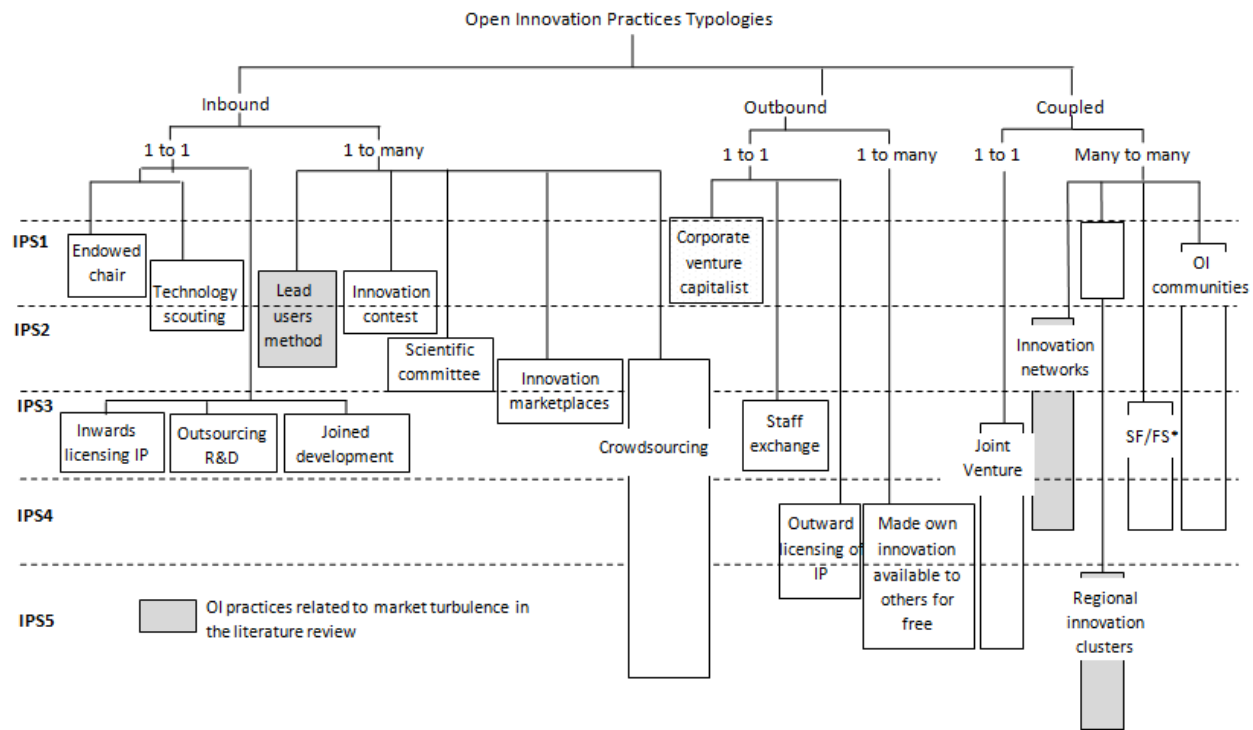


Figure 2.12. OI practices typologies related with market turbulence

2.7.12 INTERMEDIARIES

Throughout the OI implementation process, all the firms, but specially SMEs, could require the help of a broker, who could act as an expert intermediary in network management, information systems, communication platforms, to develop the culture of collaboration and facilitate cooperation (Grimaldi et al. 2013).

A crucial ingredient in OI approaches is the connection of different parties which are industrial firms, universities and research institutes, political arrangements that support innovation (Van Lente et al., 2003). The connection of these parties can be guaranteed by intermediaries that connect, translate and facilitate flows of knowledge.

The main reference in the literature in relation to intermediaries is the one from Lee et al. (2010) that suggest the key role of an intermediary in facilitating OI practices in SMEs.

These researchers state that searching for and deciding on who to collaborate with to create an effective network (OIP6) can be difficult for SMEs, which may have limited information sources, and lack the financial resources to gather vital information (Julien, 2002) compared to larger firms, who can often afford professional intelligence processes for scanning and monitoring their technological environments to search for competitors, potential collaborators and customers in the markets for their technology (Makadok and Barney, 2001).

In their article, the case of the KICMS, an association established to facilitate collaboration between Korean SMEs, is analyzed. With the help of KICMS a number of SMEs' networks have been organized to compete against large firms. KICMS has introduced the collaboration models actively to the SMEs and provided the information that they need together with the basis of trust, helping to organize their collaboration networks effectively.

Nataliccio et al. (2014) explain that organisations willing to sell or license their intellectual property (OIP14) may benefit from the intermediary role played by markets for ideas (OIP5), such as InnoCentive, Yet2.com or NineSigma, in identifying market applications and managing transactions (Nambisan and Sawhney, 2007).

As a summary of these references, we can state that intermediaries factor has to be taken into account when selecting OI practices typologies. We have found

in our literature review researchers that connect this external factor and the following specific OI practices typologies:

- Innovation networks (OIP6).
- Outward licensing of IP (OIP14).
- Market for ideas (OIP5).

Moreover, Lee et al. (2010) proposed that a relationship can exist between this external factor and size internal factor when a company wants to implement specific OI practices.

According with this information, we propose that the role of intermediaries, in case of SMEs can have a substitution effect of the need for absorptive capacity to implement some specific OI practices. As has been exposed in section 2.7.5 of this chapter, Rammer et al. (2009) proposed that, for SMEs, it is possible to find a substitution effect of internal R&D, which is one of the main measures of absorptive capacity, by innovation management practices, and in this section we found that intermediaries can develop this role in some specific OI practices.

2.7.13 PROXIMITIES

The literature on innovation has suggested that regional environments and proximity are vital to the innovation process (Maskell and Malmberg 1999). In fact, proximity is important to access markets, suppliers, and so on.

Indeed, based on the investigation of the innovation activities and networking of 53 SMEs, Doloreux (2004) found that the prime location factors for these SMEs is proximity and access to information provided by leading customers.

Moreover, being physically close to regional centers of excellence enables a firm to increase its absorptive capacity (Cohen and Levinthal, 1990).

Lambert and Schaeffer (2010) related innovation networks (OIP6) with geographical proximities. These authors state that to stimulate innovation, companies should aim to extend its network to actors who are not habitual partners, partnerships cannot effectively stimulate innovation unless there are strong bonds of confidence. Human relations play a very important role. Confidence is built over time through the multiplication of contacts, even if

they seem mundane. Geographical proximity becomes a valuable advantage because meetings between people are essential. Talking together about subjects that might seem unremarkable creates a favorable context for the emergence of new ideas that can lead to innovations.

Also, Bullinger et al. (2004) explain that up to today it is not yet possible to diffuse tacit knowledge, by the use of ICT as it cannot be codified. Tacit knowledge needs spatial proximity of knowledge and innovation agents as it has to be communicated face to face. Therefore spatial proximity of innovation actors has become crucial for the success of innovation networks (OIP 6).

Theyel (2013) states that sharing equipment (OIP17) are inherently location-sensitive OI activities, so the firms might best be located in proximity to their customers and suppliers. While distance does not preclude these types of OI practices, it is likely to limit the opportunities during this part of a firm's value chain.

As a summary of these references, we can state that proximities factor has to be taken into account when selecting OI practices typologies. We have found in our literature review researchers that connect this external factor and the following specific OI practices typologies:

- Innovation networks (OIP6).
- Sharing equipment (OIP17).

2.7.14 THEORETICAL FRAMEWORK OF RELATIONSHIPS BETWEEN OPEN INNOVATION PRACTICES TYPOLOGIES AND CONTEXT FACTORS

The following Tables 2.15 and 2.16 summarize relationships among OI practices typologies and factors that influence adoption of OI practices found in our previous review of the literature:

OI practices		Internal factors							
		Firm size	Age	Modularity	IP Management	ACAP	Corporate culture	Ambidexterity	Technology strategy
OIP1	Corporate venture capitalist								
OIP2	Crowdsourcing								
OIP3	Endowed chairs								
OIP4	Innovation contests								
OIP5	Innovation marketplaces								
OIP6	Innovation networks								
OIP7	Inward licensing of IP								
OIP8	Joined development								
OIP9	Joint venture								
OIP10	Lead user method								

Table 2.15. Summary of founded relationships between OI practices typologies and analyzed internal factors (Part I)

OI practices		Internal factors							
		Firm size	Age	Modularity	IP Management	ACAP	Corporate culture	Ambidexterity	Technology strategy
OIP11	Made own inn. available for free								
OIP12	OI communities								
OIP13	Outsourcing R&D								
OIP14	Outward licensing of IP								
OIP15	Regional innovation clusters								
OIP16	Scientific committee								
OIP17	Shared facilities/facilities sharing								
OIP18	Staff exchanges								
OIP19	Technology scouting								

Table 2.15. Summary of founded relationships between OI practices typologies and analyzed internal factors (Part II)

OI practices		External factors				
		Sector	Technological turbulence	Market turbulence	Intermediaries	Proximities
OIP1	Corporate venture capitalist					
OIP2	Crowdsourcing					
OIP3	Endowed chairs					
OIP4	Innovation contests					
OIP5	Innovation marketplaces					
OIP6	Innovation networks					
OIP7	Inward licensing of IP					
OIP8	Joined development					
OIP9	Joint venture					
OIP10	Lead user method					

Table 2.16. Summary of founded relationships between OI practices typologies and analyzed external factors (Part I)

OI practices		External factors				
		Sector	Technological turbulence	Market turbulence	Intermediaries	Proximities
OIP11	Made own inn. available for free					
OIP12	OI communities					
OIP13	Outsourcing R&D					
OIP14	Outward licensing of IP					
OIP15	Regional innovation clusters					
OIP16	Scientific committee					
OIP17	Shared facilities/facilities sharing					
OIP18	Staff exchanges					
OIP19	Technology scouting					

Table 2.16. Summary of founded relationships between OI practices typologies and analyzed external factors (Part II)

2.8 RESEARCH QUESTIONS

From these review we can conclude that interrelations between OI practices typologies and context factors exist but has been analyzed in a very fragmented way until now in the literature.

As has been explained in previous sections of this chapter, existing references on the literature have mainly analyzed the influence of context factors in the adoption of OI practices in a general way, but relations between context factors and the typologies of OI practices have not been addressed previously to our knowledge.

Therefore, according with the developed theoretical framework in this chapter 2, relating to OI practices and context factors, we find some preliminary answer for our research questions, that were the following:

Research question 1: Can contextual factors be used by managers to decide what OI practices typologies to use for opening their innovation process?

Research question 2: Are there some OI practices typologies more effective in one context than in another?

Research question 3: Are there any complementarity or substitution effects among some of these context factors to take into account when implementing OI practices?

In relation to our Research question 1, it is possible to state that information about which relations between context factors and OI practices typologies are collected in the literature, can provide managers with useful information to decide what OI practice can be more suitable depending on their needs, internal capabilities and resources and external factors.

Moreover, we can preliminary state that Innovation networks (OIP6) is the OI practices typology, that according with our research, has been analyzed more extensively in the literature in relation to context factors.

In the following chapters 3 and 4, we expose the empirical research that we have conducted in order to advance in the knowledge about relation between context factors and open innovation practices typologies.

CHAPTER 3

MULTIPLE CASE STUDY FOR SMES FROM THE AUTOMOTIVE SECTOR

3.1 RESEARCH STRATEGY AND DESIGN

As has been exposed in the conclusions of the previous chapter, after our review of the literature we conclude that relationships among OI practices typologies and context factors exist, but has been analyzed in a very fragmented way until now in the literature.

Therefore conclusions in relation to our research propositions cannot be answered based on a theoretical review of the literature and further empirical research is needed to clarify these issues.

Given the objectives of this research and the corresponding need for deep insights into the relationship between OI practices typologies and context factors, we decide to develop the empirical research of this dissertation with a qualitative case-study methodology (Yin, 1994).

The case study can answer "how" and "why" questions within real-world contexts, so, is recommended when the issues are complex and evolving. Therefore when the concepts under study are abstract and when the boundaries between phenomenon and context are not clearly evident, the case

study approach will be imposed (Yin, 1994). Furthermore according to Yin (2003), a case study research strategy should be followed when researchers want to describe, explain, illustrate and explore conditions related with research topic and therefore, consistent with Siggelkow (2007), provide a rich illustration of the phenomenon under analysis.

Case study has two major designs. First one is a single case study where a single subject is examined in-depth and another one is a multiple case study where several cases or events are studied. A multiple case study enables the researcher to explore differences within and between cases. The goal is to replicate findings across cases. Because comparisons will be drawn, it is imperative that the cases are chosen carefully so that the researcher can predict similar results across cases, or predict contrasting results based on a theory (Yin, 2003).

We found that this multiple case study methodology can be adequate for our dissertation because the phenomenon that we would like to investigate is still quite unclear and we look for a deeper understanding of the relationships among OI practices typologies and context factors, that means “how” and “why” companies implement specific OI practices typologies in relation to specific context factors.

The following decision to take was to identify the sample of companies to conduct the multiple case study. At this point of our research we take two main decisions for this empirical part of our research:

- First we decide to focus our empirical research on SMEs. As we are going to explain deeply later in section 3.2. of this chapter, this is an under-research issue in the literature on OI and some interesting findings of our research in previous chapters, such as the possible substitution effect among absorptive capacity and intermediaries for SMEs, indicate that SMEs could be an interesting subject in our research stream.
- Second, taking advantage of the relationship between the University of Navarra and Volkswagen Navarra (one of the production plants of the Volkswagen consortium in Spain), in the framework of the “Cátedra de Empresa Volkswagen Navarra – Universidad de Navarra”, we decide to focus on the automotive sector. This decision is twofold; firstly we can take advantage from our relationship with Volkswagen Navarra to identify SMEs from our research from the automotive sector. Secondly, the results of our

research could be a starting point for future action research projects where this company could have interest.

Moreover, this sectorial choice is no casual, because the automotive sector has a huge economic direct and indirect impact in the European Economy. The European Automobile Manufacturers' Association (ACEA) reports that in 2013 the turnover generated by the automotive sector represents 6.9% of EU GDP and also account for a total of 12.9 million European people are employed in the sector. Also it is remarkable that the automotive industry is the largest private investor in R&D in Europe, investing over €32 billion into R&D and applying for 9,500 patents per year.

Also, this is a sector that has special presence in the references from the literature related to case studies of OI practices in Europe (Gassmann, 2006; Dilk et al., 2008; Ili et al. 2010; Lazzarotti et al. 2013) and thanks to that, we will be able to contrast the results of our empirical research with a bigger amount of literature references.

Finally, we think that limiting the empirical research to a single industry, we will avoid unnecessary "noise" due to industry factors (Westerberg et al. 1997; Parida et al. 2012) that could hinder achievement of valuable conclusions.

In sections 3.2 and 3.3 we summarize main conclusions of our literature review in relation to OI in SMEs and OI in the automotive industry.

3.2 OPEN INNOVATION PRACTICES IN SMES

An SME is defined by the European Commission as a firm with less than 250 employees; not being controlled for more than 25% by firms that are not SMEs; having an annual turnover of less than 50 million euro and a balance total inferior to 43 million euro (EU definition of an SME – Article 2 of the Annex of Recommendation 2003/361/EC).

According to the Annual report on small and medium-sized enterprises in the EU 2011/12 (Ecorys, 2012), more than 98% of all European businesses are SMEs, they provide a 67 per cent of total employment and a 58 per cent of gross value added of the private sector in the EU. Moreover, SMEs are the true

back-bone of the European economy, being primarily responsible for wealth and economic growth, next to their key role in innovation and R&D.

Gassmann et al. (2010), in an editorial about OI, adequately introduce the issue of OI on SMEs by affirming that SMEs are the largest number of companies in an economy, but they are under researched in the OI literature.

The research literature on OI has begun to pay attention to the implementation of the paradigm of OI in SMEs in recent years (Van de Vrande et al. 2009; Lee et al. 2010; Spithoven et al. 2013; Idrissia et al. 2012; Parida et al. 2012; Verbano et al. 2013).

The results of our literature review in chapter 2 (section 2.2.2 - figure 2.6) show that until 2009 the literature in this area was very scarce and it is from this year on that it increases significantly, although still is much lower than that from large companies.

These studies have shown that SMEs increasingly develop successful OI activities and have also shed light on the main motivations and barriers for SMEs in this area. Van de Vrande et al. (2009) found that SMEs in their study engaged in many OI practices and had increasingly adopted such practices since the early 2000's. They also found that SMEs pursued OI primarily for market-related motives such as meeting customer demands, keeping up with competitors or opening up to new markets, with higher-order objectives to secure revenues and to maintain growth. Moreover these researchers discovered a sequence in the adoption of OI in SMEs, starting with customer involvement, following with employee involvement and external networking, and ending with more 'advanced' practices like IP licensing or R&D outsourcing.

Brunswick and Vanhaverbeke (2011) identify five different types of approaches for OI search in SMEs in Europe: (1) Closed innovator, that follow a closed innovation strategy and emphasizes internal control of innovation activities; (2) Supply-chain searcher, characterized by intense interactions with direct customers and suppliers in comparison to other external sources, that means that these SMEs heavily rely on "traditional" supply-chain linkages; (3) Technology-oriented searcher, that is characterized by a high degree of interaction with universities, research organisations and IPR experts, that indicates that these SMEs are interested in getting access to inventive trends as early as possible; (4) Application-oriented and demand-driven searcher, that regularly interacts with value chain actors such as customers and suppliers to

get access to new ideas and that are active in involvement of indirect customers that they consider “value generators” rather than “value receivers” and apply OI search to get access to sticky information about customer needs; (5) Full-scope searcher, which shows a strong interest in external ideas from various innovation sources and have built an innovation ecosystem for new ideas and knowledge covering different domains such as market, technology and scientific knowledge.

Their research reveals that the five patterns of OI search can be found in all industry groups. However the distribution across industries is not uniform and in some industries some strategies are more prevalent than others. This suggests that OI search in SMEs is not merely a “strategic choice” but seems to be conditioned by factors outside the organisational boundaries such as the nature of industry (Christensen et al. 2005). Moreover these researchers found that the nature of a firm’s OI search strategy is apparently not conditioned by a firm’s age but instead it seems to be influenced by external factors such industry environment or firm size.

Parida et al. (2012) argue that if SMEs can perform technology scouting, vertical and horizontal technology collaboration, as well as technology sourcing, they can partly overcome their liability of smallness and drive their innovation performance better than if all innovative activities are done in-house.

Recently, Spithoven et al. (2013), in a quantitative research using a sample of 967 innovative Belgian firms, have found that SMEs are more dependent on OI than large companies, because, although large companies are involved in more OI activities, the ratio of OI activities over employment shows that SMEs have a much higher intensity for all types of OI activities than large companies.

Therefore we can see that OI practices in SMEs is still an area that need for further research and where qualitative case study research is justified due to the small amount of literature that has analyzed these phenomenon and the fact that most of these previous research works are based on quantitative research that fails at providing answers to “how” and “why” questions that are really important issues in relation to our research propositions.

3.3 OPEN INNOVATION IN THE AUTOMOTIVE INDUSTRY

OI is a phenomenon that has become increasingly important for both practice and theory over the last few years in the automotive industry. Nowadays the automotive industry is trapped by cost and innovation pressure. One of the reasons for these changes are the customers. They want more and more car for the same old price. Their demands and expectations are driving Original Equipment Manufacturers (OEMs) into a race to innovate.

In addition, mature markets in industrialized countries provide only marginal growth as they are almost saturated. As a consequence of this, OEMs have to focus more than ever on customer desires. Other drivers that cause innovation pressure are strict environmental protection guidelines and safety conditions. Simultaneously increasing innovativeness and controlling costs will be the key approach in the future to achieving strategic business objectives (Ili et al. 2010).

The following Table 3.1. summarizes main references from previous studies of OI in the automotive sectors included in our database, and shows the approach follows by the authors of each of them:

Reference	Contents	Approach
Fuller et al. 2004	Case study focuses on the development of Infotainment systems at the Audi AG introducing a systematic method of realising Community Based Innovation (CBI). The authors had the possibility to accompany the Audi project called “Virtual Lab” from initiation to project conclusion.	Action research from an OEM point of view to involve end-users in new product development (NPD).
Di Minin et al. 2010	This article focuses on the organisation and innovation strategy devised by FIAT during the 1990s, which resembled and anticipated most of the underpinnings of what would become known as the OI paradigm.	Longitudinal historical case study from an OEM point of view.
Ili et al. 2010	The status quo regarding OI has been evaluated among all major German car manufacturers and automotive suppliers.	Quantitative approach with a sample of 42 companies

	<p>The results show that OI is already appropriate for the automotive industry, and that it will be a crucial factor in the next decade.</p>	<p>(including five OEMs) with >200 employees and >€100 million.</p>
<p>Lambert and Schaeffer 2010</p>	<p>The authors stand that the concept of cooperative innovation is no longer limited to one industrial sector, but connects companies from different industries through innovation networks by making new knowledge combinations.</p> <p>The authors present an example of implementation of an innovation network between large companies and SMEs from the avionics and automotive sectors. In this example the innovation does not pass from one type of structure to another, but is the fruit of an impressive technological wager based on the pooling of efforts by small and large structures through synergies whose potential is far from being exhausted.</p>	<p>Case study that reveals new approaches to the creation of knowledge in cooperation with external actors who are differentiated by size and activity: some are tied to a client-supplier relationship, others have no ties within a given value chain and still others belong to or came from academic research.</p>
<p>Lazzarotti et al. 2013</p>	<p>The paper explores the concept of OI and evaluates whether, why and how it is adopted in the automotive field.</p> <p>The authors studied the experience of three well-known large companies operating at different levels in the value chain of the automotive industry:</p> <ul style="list-style-type: none"> • An Italian OEM • Two suppliers: Pininfarina that is a designer company and Bosch that is a supplier of components. 	<p>The research is carried out in large companies with a combination of literature analysis and face-to-face interviews, conducted with a semi-structured protocol.</p>

	<p>At the conclusions of their paper the authors suggest that similar analysis could be conducted on SMEs operating in the automotive industry.</p>	
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Table 3.1. References from previous studies of Open Innovation in the automotive sector.

A deep review of these references shows that there is general consensus on the need to produce more empirical evidence about the automotive industry and its propensity to adopt OI approaches, how they are implemented and with what results (Ili et al., 2010). Therefore we can state that our research strategy from this chapter it is suitable for advancing in a richer understanding on how and why OI practices are implemented in the automotive sector.

Moreover some crucial questions for SMEs are how they can manage OI despite the liability due to their smallness. This is especially relevant when a firm is dependent on a few strong customers, such as normally happens in the automotive sector. (Gassmann et al. 2010).

On the other side of the mirror are the customers, the Automotive Original Equipment Manufacturers (OEMs), that due to competitive trends in their sector (increasing innovation, cost pressure, globalization, technology intensity and fusion of technologies), need to look outside their own boundaries and OI should be considered a good opportunity even though some barriers are still remaining (Gassmann, 2006; Ili et al. 2010).

A relevant contribution is from Dilk et al. (2008) that, through a series of semi-structured interviews with managers from European automobile firms, find that their most important goals in managing R&D activities include “flexible access to technologies”, “intensified contact with clients and markets”, “long-term bonding of suppliers and clients”, “access to other competencies (besides technology)”, “improving quality of R&D”, “reducing R&D costs” and “reducing R&D time”.

OEMs can significantly benefit if they are able to set up relationships with high levels of trust and commitment with their suppliers (Dyer and Singh, 1998). Suppliers’ early involvement in the innovation projects increases innovation performance in most industries (Hagedoorn, 2002; Johnsen, 2009).

Suppliers can enhance the success of a firm’s innovation process by contributing their specific capabilities. Supplier involvement is also considered

a promising source of competitive advantage by practitioners and management scholars alike (Teece, 1986; Kaufman et al., 2000; Sobrero and Roberts, 2002).

This remains also an under-researched area in the OI literature and therefore through the selection of our case studies, we look for achieving a better understanding of the process of opening innovation by a group of SMEs from the automotive sector, the OI practices that they implement, the factors that influence their strategy opening their innovation process and the interaction within this process with one of their customer OEMs.

3.4 ADDITIONAL RESEARCH QUESTIONS ACCORDING WITH CASE SELECTION

In Chapter 2 we formulate the following research questions:

Research questions 1: Can contextual factors be used by managers to decide what OI practices typologies to use for opening their innovation process?

Research questions 2: Are there some OI practices typologies more effective in one context than in another?

Research questions 3: Are there any complementarities or substitution effects among some of these context factors to take into account when implementing open innovation practices?

In this context, and according with the decisions that we have taken for designing our empirical research strategy, we formulate four additional research question that are related to the research context focused in SMEs from the automotive sector:

Research questions 4: Is the Open Innovation model appropriate to foster and reinforce innovation activities between OEMs and SME suppliers in the automotive sector?

Research questions 5: Which OI practices are currently implemented by automotive SME suppliers and which benefits they obtain from these OI practices?

Research questions 6: Which barriers and enablers can occur by adopting OI practices by SMEs automotive suppliers?

Research questions 7: Which are the contextual factors (internal and/or external) that can facilitate or hinder OI practices between OEMs and SME suppliers in the automotive sector?

The next task in the development of this dissertation was the identification of the SMEs for the multiple case study. At this point we contacted with the coordinator of the Cátedra de Empresa Volkswagen Navarra – Universidad de Navarra in Volkswagen Navarra, for identifying people within their organisation to conduct face-to-face semi-structured interviews in order to obtain information on the following topics:

- Understand their relationships with their suppliers.
- Identify OI initiatives where they have participated with their suppliers.
- Identify a group of SME suppliers that stand out for their innovation pro-activity.

The suppliers' coordinators from the following four departments were selected: quality department, logistics department, maintenance department and process and installation department.

We obtained their contact information and sent them the questionnaire that we were going to use during the face-to-face interviews, one week in advance. The complete questionnaire it is included in Appendix A of this dissertation.

Concerning interviews the methodology chosen was semi-structured interviews that is the most used method of gathering qualitative data in managerial research (Koskinen et al. 2005). Thematic interviews are based on an interview template that the researcher prepares beforehand. The template includes a few themes that will be gone through in each of the individual interviews. The template is not strictly binding – the questions do not have to be answered in the same order, and the interviewer may formulate questions freely under each theme in each interview, and the interviewees can answer in their own words and bring up additional issues in the conversation about theme in question.

The interviewer uses the template to make sure that all the themes are gone through with each of the interviewees, and that the main questions will be asked. Although the interview is somewhat conversation-like, it is the

responsibility of the interviewer to make sure that the discussion revolves around issues that are relevant for the research. (Koskinen et al. 2005).

The interviews were developed in January 2014. Each interview lasted between 1,5 and 2 hours. During the interviews the researcher taking notes that after each interview were transcript and sent to the interviewees for their review. Some corrections were made and some numerical data are also added, as the economic benefits of some practices of OI developed with suppliers.

The following Table 3.2. summarizes main findings in the interviews with Volkswagen Navarra's coordinators of suppliers and includes some quotes that illustrate these findings:

Objective of this part of the interview	Understand the relationships with their suppliers	
Main findings	Sample quotes	
<ul style="list-style-type: none"> • The assembly plants are the partners of OI activities with SMEs suppliers, while large suppliers collaborate directly with the headquarters of the VW consortium. 	<p>“At the end innovation is initiative and can come from many places.”</p>	
<ul style="list-style-type: none"> • Most SME suppliers are companies with geographical proximity to the assembly plant and service suppliers (engineering, maintenance, repairs of production facilities, and so). 	<p>“Some suppliers come and show us their innovative developments and inspire us new ideas to solve our internal needs applying the same technologies”</p>	
<ul style="list-style-type: none"> • All the interviewed departments manage SME suppliers except the quality department, because due to the concentration suffered in automotive sector in recent years, all their parts suppliers are large companies. 	<p>“Ideas from suppliers are bought if they arrive at the right time”</p>	
<ul style="list-style-type: none"> • With the exception of the quality 	<p>“The innovation initiatives with suppliers are done by voluntarism, there are no explicit responsible for this.”</p>	
	<p>“When the purchasing department comes in, they manage innovation projects as industrial projects, but they are not the same.”</p>	

department, the level of systematization to assess to SME suppliers is low and most of the times the final decision to select one of them rest in the purchasing department, that is not located in the assembly plant, and that follows mainly economic criteria.

- Most innovation opportunities are identified internally and many times the coordinator or technicians from the departments offer to some SME suppliers, whose capabilities could be complementary to theirs, the opportunity to collaborate in the idea generation stage.
- In rare cases, when an SME supplier proposes an innovation by its own initiative, this is implemented. These cases occur when it matches with a need of one of the areas, but if this match is not giving, these ideas are not recorded and may be lost. Moreover the opportunities to innovate that the SME suppliers offer to the departments are not recorded.
- The management of innovation initiatives, if they are develop internally is done in the same way that other projects of investment or continuous improvement.

<ul style="list-style-type: none"> • In case the innovation initiative will be develop in an open way, with the collaboration of external agents, such as SME suppliers, in the conceptual stage is managed by the technical manager in charge of the project, and if it arrives to the industrialization the purchasing department choose the right partners at this stage. 	
Objective of this part of the interview	Identify OI initiatives where they have participated with their suppliers.
Main findings	Sample quotes
<ul style="list-style-type: none"> • All the coordinators that manage SME suppliers report some experiences in OI activities with these types of partners and valuate these experiences as positive and explain main benefits obtained for Volkswagen Navarra and also for the SME suppliers. • The release process is very similar in all of these experiences. A technician from VW Navarra asks to SME supplier for innovative ideas to solve a need or problem that they have identified internally, therefore we can state that most of the OI practices that were reported were Joined development (OIP8). • The barriers that they found to promote OI activities with their SME 	<p>“One of the main external barriers is economical. Cost pressure has grown up with suppliers and during first stages of OI initiatives the supplier assumes its personnel costs and we only pay them for materials of prototypes. That generates conflicts to our partners in their companies, their bosses’ question: who is going to pay for the time invested in these initiatives?”</p> <p>“Sometimes we have problems with intellectual property issues with our SME suppliers when the innovation project arrives to industrialization stage and our purchasing department asks for more offers to other suppliers and shares information with them.”</p>

suppliers are common to all the departments: cost sharing and IPR are the most important.	
Objective of this part of the interview	Identify a group of SME suppliers that stand out for their innovation pro-activity.
Main findings	Sample quotes
<ul style="list-style-type: none"> • The coordinators from logistics department, maintenance department and process and installation department, very easily propose names of 2-3 SME suppliers with who they have had experiences of OI or that they consider proactive in innovation activities. • One of the SMEs is proposed by two different coordinators. • The coordinator from quality department has not SME suppliers. 	<p>“SME suppliers are quite pro-active, they propose new things and that helps us move forward.”</p> <p>“One of the keys of our innovation is to find a supplier who is willing to do so. Keep in mind that, because of the characteristics of our production (more than 1,000 cars a day), our facilities require very high levels of availability and this is very challenging for suppliers”</p> <p>“When a supplier comes with an innovative idea that he want to develop in the process and installation department of our plant, we ask him the commitment to follow the development until the homologation phase. Those with difficulties to work with the central offices of the consortium in Germany (where the homologation has to be obtained), due to language or to travel costs, smaller companies usually give up.</p> <p>“Some of the suppliers involved in OI initiatives with us have developed value-added capabilities and its quality has improved as suppliers. Our relationship with them has been strengthened because they</p>

know us better and can help us to solve more problems.”

Table 3.2. Main findings in the interviews with Volkswagen Navarra's coordinators of suppliers

One finding that was particularly interesting for the researcher during the interviews was information about the benefits that Volkswagen Navarra and their SME suppliers obtain of two of the OI practices that were reported from the maintenance department.

In the first one they did a joined development (OIP8) of a tool for maintenance of the installation of airbags with one of their SME suppliers. The collaboration was so successful that they share the experience with other assembly plants of the consortium and thanks to that their supplier was subcontracted from the assembly plant of the consortium in India, providing an opportunity for internationalization for this supplier. The responsible from the maintenance department consider that was a good example of win-win benefits, because beyond the economic benefit of easier maintenance of airbag's installation, they have been able to share this project as a best practice with the maintenance departments of other companies in the consortium gaining prestige within the consortium. Finally it is interesting to see that this SME supplier was a service company and that thanks to that collaboration they were able to develop a new product.

In the second one the maintenance department did another joined development (OIP8) of a system of sensors to solve problem of measuring humidity in the plant. In this case, the supplier developed a new product that at the end, once it has been implemented in Volkswagen Navarra, they have been able to introduce this product as a new product in their product catalog.

In both experiences the SME supplier has been able to develop a new product, even in one case being a services company. Also in one case the SME supplier has been able to internationalize its business, selling to the assembly plant of Volkswagen consortium in India.

The other finding that the researcher considers also interesting is that some of these coordinators of suppliers highlighted that some innovation management practices implemented in the Volkswagen consortium contribute to increase

motivation in their suppliers to participate in OI activities and also the benefits that Volkswagen Navarra obtain from these practices.

The first one was the innovation ideas bank for maintenance departments, which has been implemented in 2013 at consortium level for all the maintenance departments of the assembly plants. In this bank, that it is organized as a database including sheets that summarize each innovation idea that the maintenance departments has successfully implemented, they share their innovation practices (open or close) and all the directors of maintenance departments on each assembly plant of the group has to report to the consortium their opinion about each entrance on this database, explaining if they found it applicable for their plant or not.

Thanks to the use of this innovation management tool one of their SME suppliers, as reported in the previous table, achieved to work with the Volkswagen assembly plant from India. This is obviously a very interesting motivation tool, because for their SME suppliers can be a tool for internationalization of their products and/or services.

Maintenance department also reported two OI practices that they have developed in collaboration with a local university in the last three years, but surprisingly none of the achieved innovations have arrived to be implemented.

The second is the “Innovation Tag”. It is a day when all the responsible of logistic departments of the assembly plants of the Volkswagen consortium meet in one of the assembly plants and share the projects of innovation in logistic that they have successfully implemented. In many cases the suppliers that have collaborated with the team of the logistic department to develop the innovation accompanies responsible from logistic department in their presentation. Normally many logistic departments from different assembly plants prepare stands and videos to show their successful innovation projects. They reported that for their suppliers to assist to this event is a very interesting issue such as they can show their capacities to many assembly plants of the Volkswagen consortium all around the world and also they can use their participation in the “Innovation Tag” as a reference for other potential customers.

This responsible tell us that thanks to this event, the logistic department of Volkswagen Navarra is one of the main references of logistic innovation not only in the other Volkswagen assembly plants but even in other assembly plants of the consortium.

The third one is an innovation management practice for the process and installation departments of all the assembly plants of the consortium. Each three months they meet together and visit one of the assembly plants. In each event they visit the workshop and the host presents them the innovation highlights of its plant.

Main findings from the interviews with supplier coordinators of Volkswagen Navarra have been presented in this section. At this point of our empirical research, with the collaboration of these coordinators we have identified eight SME suppliers that their OEM customer considers that are pro-active innovators.

Moreover, we find that some innovation management practices implemented within the Volkswagen consortium, where responsible for the same departments of different assembly plants share successful open and close innovation experiences, can be a tool for motivation of internal personnel and also of suppliers to collaborate in innovation projects.

In the following section we explain the methodology of the empirical research for the multiple case study and the findings from these qualitative research.

3.5 DATA COLLECTION METHODOLOGY.

We contacted the eight SME suppliers identified by suppliers coordinators of Volkswagen Navarra and invited them to participate in our empirical research. After providing them information about our research objectives and how it will be developed, seven of them accepted this invitation and we arrange to conduct face-to-face interviews with these seven SMEs, following a semi-structured protocol. The interviews were developed from March to May in 2014. Each interview lasted between 1,5 and 2 hours. During the interviews the researcher taking notes that after each interview these notes were transcript and sent to the interviewees for their review and approval.

Each of the interviews was planned with the contact person on each SME and the researcher went to the agreed place for the development of the interview. Most of them were developed in the SME facilities and two of them in the facilities of Volkswagen Navarra. In some of the interviews more than one person participates in the interview to provide richer information about the subjects of the interview. The profiles of the interviewees are detailed in Table 3.3.

SME Supplier	Number of interviewees	Interviewee profile
SME 1	1	Managing director
SME 2	3	Managing director + Responsible for innovation + Responsible of robotic area
SME 3	1	Project manager (works in the company since its foundation)
SME 4	1	Managing director
SME 5	1	Technical sales manager
SME 6	2	Managing director + Technical manager
SME 7	1	Director of technical office

Table 3.3. Profiles of the interviewees

In the Figure 3.1 we present the structure of contents of the interviews and the questionnaires designed for their development. The complete questionnaire it is included in Appendix A of this dissertation.

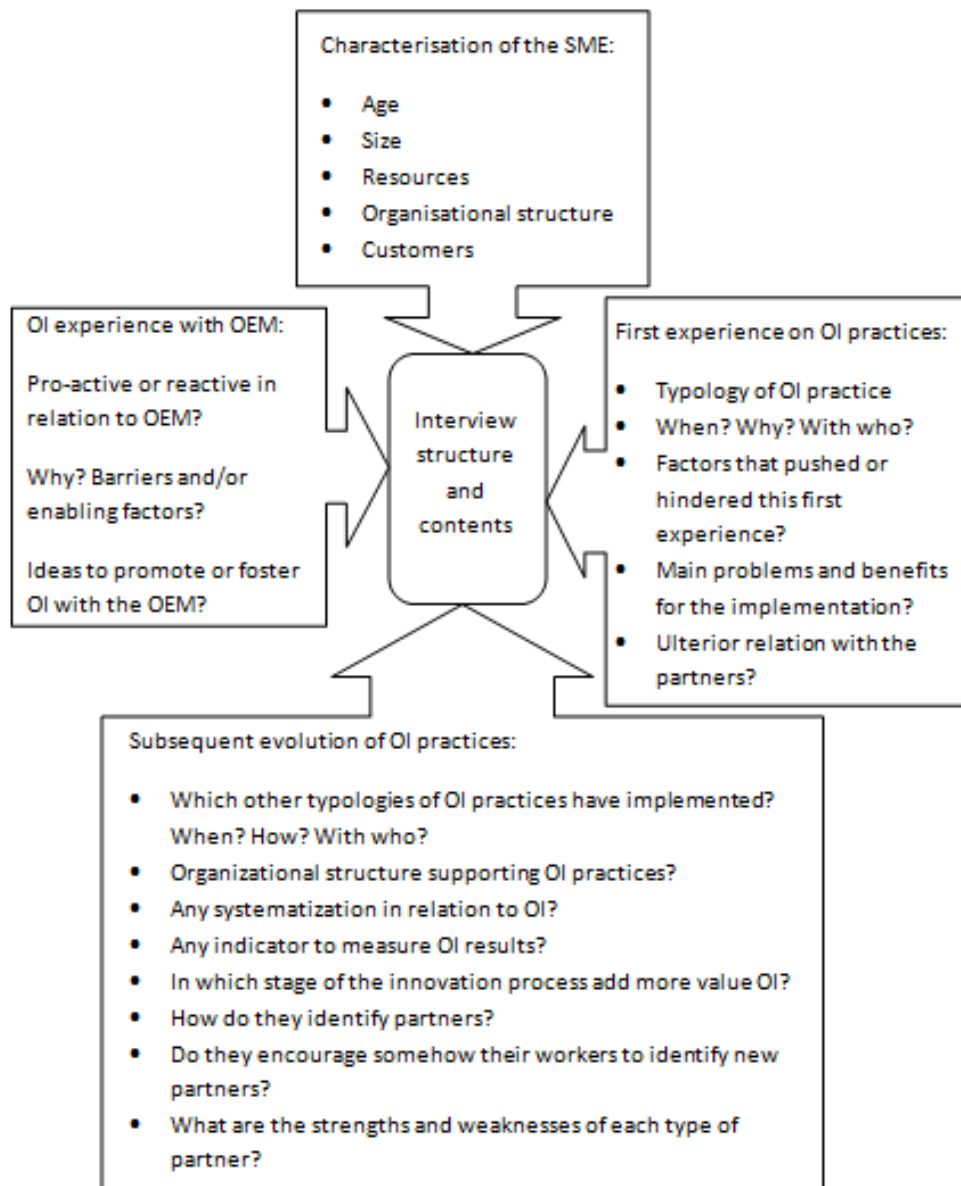


Figure 3.1. Contents of the questionnaires designed for multiple case study

In the following table we present main characteristics of the 7 SME suppliers that have participated in the multiple case study. We avoid putting the original names for confidentiality reasons:

SME Supplier	Location	Size	% graduates	Age	Activity	Innovation resources	Level of dependency from OEM
SME 1	Navarra	9 people	22%	40 years	Electronic repairs for industrial customers	2-3 people partially dedicated to innovation activities	High (80-90% of their total turnover).
SME 2	Navarra	17 people	10%	14 years	Mechanical and electrical maintenance services and some development for process automation.	1 person exclusively and 2-3 partially dedicated to innovation activities	High (is their main customer)
SME 3	Valencia	40 people	20%	8 years	Automated transmission lines primarily for the automotive sector (90-95% activity) and also offers maintenance of these facilities	3 people exclusively dedicated to innovation activities	Medium (they also work for other OEMs).
SME 4	Basque Country	21 people	96%	14 years	Artificial vision systems applied to industrial environments, medical and animation and custom software development.	7-8 people partially dedicated to innovation activities	Low (they have a very diversified customer base)

Table 3.4. Main characterization of the SMEs that participate in the multiple case study (Part I)

SME Supplier	Location	Size	% graduates	Age	Activity	Innovation resources	Level of dependency from OEM
SME 5	Basque Country	128 people	20%	55 years	Design, manufacture and commercialization of innovative storage and logistics solutions.	1 person exclusively and 10 partially dedicated to innovation activities	Medium (they work for other OEMs and also TIER 1 automotive suppliers)
SME 6	Navarra	5 people	80%	12 years	Consultants and integrators of IT solutions and peripherals. For specific projects also mechanical designs.	2 people lead the innovation activities (but they also develop day-to-day activities) and the rest participate in innovation activities in some degree.	Medium (they work also for other sectors: pharmaceutical, medical, energetic).
SME 7	Navarra	67 people	15%	10 years	On-site services for maintenance of electromechanical systems	4-5 people partially dedicated to innovation activities	Low (they have a very diversified customer base).

Table 3.4. Main characterization of the SMEs that participate in the multiple case study (Part II)

From this information we can observe some similarities and differences among these SME suppliers in relation to the factors that we identified in chapter 2 of this dissertation:

- Proximities: Six of the seven SMEs are very close geographically to Volkswagen Navarra, less than 150 km ago. This geographical proximity facilitates frequent contacts with their leading customer and can contribute to an easily interchange of tacit knowledge. Both things increase chances of identifying opportunities to innovate openly with their customer.
- Size: Only taking into account their size, we can say that majorities are small companies and two of them can be medium companies. Analyzing relation between R&D capacity and size we do not find any correlation, we find that companies that have a higher % of graduates (96% and 80%) are not the bigger companies.
- Age: Concerning age, we find that none of these SMEs is a start-up, because all of them have more than 5 years and we do not find any correlation between size and age.
- Ambidexterity: Taking into account the innovation resources that the SMEs have, we can say that most of the SMEs implement a contextual ambidexterity, because most of their innovation resources are partially dedicated to innovation activities. With this ambidexterity mode the individuals are enabled to decide context-based how to divide their time between conflicting tasks (between day-to-day activities and innovation activities). Only three of the SMEs have some person exclusively dedicated to innovation.
- Dependency from the OEM: An interesting factor that arises during the interviews was the level of dependency of these SMEs from Volkswagen Navarra. We can see in the previous table that in the sample used in our research this factor is very variable, we have SMEs with low, medium and high level of dependency and therefore we cannot suggest any relation between this factor and any bias from these firms and the answers that they give, especially in relation to their interactions with Volkswagen Navarra. That gives a higher reliability to our results.

Once main characteristics of the sample used in the multiple case study has been presented, in the following section we present main results from this research.

3.6 CASE STUDIES

In this section we present the results for the interviews with the contacts from the seven SMEs. For each SME, we present a summary table in which we have included the information recovered on each interview organized according with the structure of the questionnaire that has been previously presented in Figure 3.1.

3.6.1 CASE STUDY 1: SME1

Sections of the interview	Main findings
Characterization of the SME	<p>The main activity of the company from their foundation has been electric reparation services, but one year ago the property change and the new property has decided to implement a specialization strategy for focusing their business on industrial robots associated electronics (servos, control PCs, power supplies, etc..).</p> <p>A 80-90% of their turnover comes from Volkswagen Navarra. They also work with the SEAT plant from Martorell (Catalonia – Spain) which also belongs to the same consortium that Volkswagen Navarra.</p> <p>Innovation activity is very new for them but there are 2-3 people partially involved in innovation activities.</p>
First experience on OI practices: <ul style="list-style-type: none"> • Typology of OI practice • When? Why? With who? • Factors that pushed or hindered this first experience? 	<p>Their first experience on OI practices has been the joined development (OIP8) of a system of sensors to solve problem of measuring humidity in the plant with Volkswagen Navarra.</p> <p>This OI practice was develop two years ago. The opportunity arises from Volkswagen Navarra</p>

- Main problems and benefits for the implementation?
- Ulterior relation with the partners?

maintenance department. When SME1 was working in their assembly plant doing some reparations, their partner in Volkswagen Navarra told them the problems that they were having due to humidity in the final inspection facilities and said them “look at this if you could give me any idea to solve it” The decision to start this collaboration was taken by the previous managing director.

About the context factors and their influence in the OI practice implementation, SME1 provided the researcher the following information:

Factors that have positive influence:

- Intermediaries: They collaborate with a local university for accessing to public funding for this project.
- Market turbulence: They said that their main objective with this OI practice has been to demonstrate to its customers that they can provide added value services beyond usual repair tasks.
- Corporate culture: They say they have a culture of innovation, but their resources are limited and therefore they must be measured very well that innovation projects may face.
- IP management: With this first experience, they realize that they do not have IP management capacity and they need it to protect their development, therefore they collaborate with an expert company to ask their first utility model. Now they plan to develop their own capacity to manage their IP.

Factors that have negative influence:

- Ambidexterity: They say that when they deal with OI

activities, their day-to-day activities suffer for slowing down.

- Absorptive capacity: They plan to hire a person who can be exclusively dedicated to innovation activities. Not only to develop but also to manage them, because they find difficult to make compatible their day to day activities and the OI practices.

Cost of this OI practice:

The spent around 20.000 € (personnel + materials) and achieve a public funding of 3.000 €.

Benefits from this OI practice:

- Satisfaction of seeing that our customer implement our solution.
- Moreover VW Navarra share this project with other plants of the Volkswagen consortium and thanks to that other assembly plant of the consortium, SEAT Martorell from Catalonia, is testing our solution in its facilities.
- The success of this project has contributed to enhance the partnership with Volkswagen Navarra, now they have more confidence with us to share their needs and look together for innovative ideas.
- This year a new opportunity of OI with VW Navarra has emerged. The maintenance department asked our collaboration to design an automated solution to collect cables that join robots and their control consoles with the objective of reduce of cable breakages.

For us, this new OI experience can be very interesting because, in addition to the fulfillment of a need for our main customer, we can develop a new product that can be commercialized to non-competitors of Volkswagen Navarra.

<p>Subsequent evolution of OI practices:</p> <ul style="list-style-type: none"> • Which other typologies of OI practices have implemented? When? How? With who? • Organisational structure supporting OI practices? • Any systematization in relation to OI? • Any indicator to measure OI results? • In which stage of the innovation process add more value OI? • How do they identify partners? • Do they encourage somehow their workers to identify new partners? • What are the strengths and weaknesses of each type of partner? 	<p>Other typologies of OI practices that they have implemented:</p> <ul style="list-style-type: none"> • With other customers, as a center for sports medicine, in the last two years, we have also develop some joined developments (OIP8) that have allowed us to generate new products that can be sold to other potential customers. <p>Organisational structure supporting OI practices:</p> <ul style="list-style-type: none"> • The Managing director is directly the contact person for OI initiatives because we are interested in promoting this type of practices. • Moreover we try to be more pro-active, for example, through the analysis all the reparations that we did for a customer, we can suggest innovations that can contribute to the reduction of failures. <p>Still we have not advanced in the systematization of these activities and we do not use any specific indicator to measure OI results.</p> <p>The stage of the innovation process in which OI practices add more value, is in the generation of ideas for new products. Customers are the kind of partners that they collaborate the most with.</p>
<p>OI experience with OEM:</p> <ul style="list-style-type: none"> • Pro-active or reactive in relation to OEM? • Why? Barriers and/or enabling factors? • Ideas to promote or foster OI with the OEM? 	<p>Our attitude depends of the dimension of the innovation, for incremental innovations of small economical dimension, we are more pro-actives, but for more radical and bigger innovations we usually act in a more reactive way, waiting for a challenge that our customers offer us.</p> <p>Main barriers that they found for development of OI practices with Volkswagen Navarra:</p>

	<ul style="list-style-type: none"> • The lack of agility: When they raise their need ask us for a quick response, but when we propose our innovation ideas, the process of decision-making to launch the innovation projects is very slow and opaque. We do not know when he will make the decision, or who is going to take, nor what criteria they will use. <p>Ideas to foster OI with the OEM:</p> <ul style="list-style-type: none"> • To appoint a specific responsible for managing OI activities in VW Navarra. • Define the process for managing OI activities: steps, criteria, responsible, timings, and so. • Promote a vision more global thanks to collaboration between different internal departments of Volkswagen Navarra. In the electronic field, there are many synergies that they can take advantage of.
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Table 3.5. Summary of information from SME1 case study

3.6.2 CASE STUDY 2: SME2

Sections of the interview	Main findings
Characterization of the SME	<p>The company provides mechanical and electrical maintenance services and some developments for process automation.</p> <p>The company was founded in 2000 year and works exclusively for Volkswagen Navarra, a 50% for maintenance department and the other 50% for process and installation department.</p> <p>They technicians work directly in the facilities of Volkswagen Navarra for maintenance services. This is a great advantage because they have a deep knowledge about people from different departments in Volkswagen</p>

	<p>Navarra, who is who and relationships among them.</p> <p>This proximity also offers them lot of opportunities to identify new needs and to be there when people from Volkswagen Navarra need help.</p> <p>They are 17 workers, 15 of them are technicians. One of the technicians works exclusively in innovation projects. Other 2-3 people, depending on the technology that the project need, work also in the innovation project.</p> <p>Moreover, they said that it is not difficult for them to start working in an OI project with Volkswagen and stop some day-to-day activities, because as far as they work so close to their customer, the customer ask them to change priorities between tasks. They find therefore that physical proximity is a factor that in general favors their OI activities with Volkswagen Navarra.</p>
<p>First experience on OI practices:</p> <ul style="list-style-type: none"> • Typology of OI practice • When? Why? With who? • Factors that pushed or hindered this first experience? • Main problems and benefits for the implementation? • Ulterior relation with the partners? 	<p>The first OI experience of SME2 was a joined development (OIP8) of automation systems for the lines of mobile parts (doors) of a new model of car that Volkswagen Navarra started to produce in 2002.</p> <p>The opportunity arrives from Volkswagen, they offer us the possibility to be their partner in this innovation project. They told us that we have in our team all the technical profiles that they need for this development.</p> <p>The decision was not easy because it was a great change of the kind of activities that our small company was doing in this moment. We were just experts in maintenance service and this was a job of design of automation systems. But we said yes, “we take the wave”.</p>

About the context factors and their influence in the OI practice implementation, SME2 provided the researcher the following information:

Factors that have positive influence:

- **Technology turbulence:** In our sector technology evolves very quickly therefore in Volkswagen facilities there is a wide offer of courses for the technical personnel to present new technologies that could be applied in the car production. Volkswagen Navarra, as far as we work continuously in their facilities, invites us to participate in these courses and the Volkswagen technicians ask us for ideas about how to apply these new technologies in their production facilities. That generates more opportunities for OI projects.
- **Proximity:** We are working in Volkswagen Navarra 24 hour a day, 365 days a year doing maintenance services. Therefore at any time a technical responsible of any department or section calls you into his office to propose a joint development. Also due to this continuous relationship we have all the information about how their actual facilities work, what problems they have and so on. That gives us a great advantage to propose innovative solutions in a short time period, because we do not need to look for information to make a formal proposal, we already have all the information that we can need.

Factors that have negative influence:

- **IP management:** They recognize that is one of their pending issues. They have developed a machine for Volkswagen Navarra, which has been also installed in SEAT Martorell, which could have been patented and

	<p>commercialized for other applications to non competitors of Volkswagen Navarra. Internally they have some discussions about the possibility of patenting this machine. The managing director though that it could generate problems with Volkswagen because they have participate in the development and therefore they decide to decided not to patent this machine.</p> <p>Their main limitation for development of this kind of activities is the economical dimension of the project that they can afford without need to go for bank financing</p> <p>In this first experience we had many problems to achieve bank financing because we were a small and young company and the banks were asking us guarantees. That happens because in this project a 70% of the costs were from materials and we needed to pay our suppliers for building the prototypes.</p>
<p>Subsequent evolution of OI practices:</p> <ul style="list-style-type: none"> • Which other typologies of OI practices have implemented? When? How? With who? • Organisational structure supporting OI practices? • Any systematization in relation to OI? • Any indicator to measure OI results? • In which stage of the innovation process add more value OI? • How do they identify 	<p>The two subsequent years, after the first experience with Volkswagen Navarra, we continue to develop other similar experiencies, not only with this company from the consortium, we have developed and innovative machine for sanding welding seams of the roofs of cars for SEAT Martorell (OIP8).</p> <p>We also started with other business activities, such as sale of equipment that are discarded in Volkswagen assembly plants.</p> <p>Concerning the organisational structure, we have one person fully dedicated to thin on innovative ideas; he is an expert on automation technologies.</p> <p>We have other two people dedicated partially to these</p>

<p>partners?</p> <ul style="list-style-type: none"> • Do they encourage somehow their workers to identify new partners? • What are the strengths and weaknesses of each type of partner? 	<p>activities, one is an expert on robotics and the other is an expert on communications.</p>
<p>OI experience with OEM:</p> <ul style="list-style-type: none"> • Pro-active or reactive in relation to OEM? • Why? Barriers and/or enabling factors? • Ideas to promote or foster OI with the OEM? 	<p>The managing director from SME2 considers that they are pro-active, because they share with Volkswagen Navarra technicians their ideas to improve their facilities performance and maintenance. They found that their customer trust in them, and also hears them.</p> <p>They think that the main barriers are the economical and IP property issues, especially when the purchasing department enters in the game.</p> <p>They feel very upset when they have been taking the risk for looking for an innovative solution and after they check that it is technical feasible and Volkswagen want to industrialize the development, the purchasing department gives all the specification of their solution to other competitors looking for more proposals and at the end one of their competitors obtain the contract.</p> <p>The managing director remembers that some time ago, when the purchasing department was located in Volkswagen Navarra (now is located in SEAT Martorell), one of the responsible told him that to solve this situation perhaps they can give them an economical advantage in the industrial phase of projects. This responsible said that SME2 could valueate the cost of their innovation development and after they can make and economical proposal for the industrialization phase</p>

	<p>from which economical proposal the cost of the previous phase could be reduced.</p> <p>Moreover they talked about the internal suggestion box of Volkswagen Navarra. They said that there is one on each department and that that tool incentivizes the participation in the ideas generation from Volkswagen Navarra workers. Many of these ideas arrive to them as opportunities for proposing innovation projects.</p> <p>They think that could be useful that this tool or something similar can be accessible for suppliers to propose new innovative ideas.</p>
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Table 3.6. Summary of information from SME2 case study

3.6.3 CASE STUDY 3: SME3

Sections of the interview	Main findings
Characterization of the SME	<p>The company develops automated transmission lines primarily for the automotive sector (90-95% activity) and also offers maintenance of these facilities.</p> <p>The company is an SME, but belongs to two Italian companies that are also SMEs. These companies compete in the Italian market but collaborate in other markets creating societies to exploit jointly their capabilities.</p> <p>10 of the 40 workers of the company are dedicated to design new products, and 3 of them are focus on developments to apply emerging technologies to their products, such as wifi control boxes and contactless technologies that have been applied in their last developments. The other 30 workers are dedicated to</p>

	<p>maintenance activities. The detailed design, once the concepts are designed and prototyped and the manufacturing of the installations are made in the Italian companies, and for the installation they subcontract with specialized suppliers.</p>
<p>First experience on OI practices:</p> <ul style="list-style-type: none"> • Typology of OI practice • When? Why? With who? • Factors that pushed or hindered this first experience? • Main problems and benefits for the implementation? • Ulterior relation with the partners? 	<p>They cannot remember their first experience of OI, because you usually work with customers form. The customer has a need, contact them and ask them innovative ideas to resolve it. Combining the ideas from SME3 and internal ideas the customer asks many suppliers for proposals to develop the project (OIP8).</p> <p>Although this implies the possibility that a competitor will benefit from their innovative ideas, this OI attitude compensates to SME3 because they are the first to know the needs of their customers and therefore have an advantage over their less innovative reactive competitors. They have more time and direct information to offer their customers more innovative and tailored to their needs and budget.</p> <p>They explain an example of this kind of OI practice with Volkswagen Argentina. The objective was to maximize the number of car bodies that they could store in a specific part of their workshop. With the original design from their customer they were able to store 40 car bodies, with the innovative ideas provided by SME3 they were able to store 84 car bodies in the same space.</p> <p>Anyway they say that competition in this sector is very strong, there is a closed group of competitors who have all the certifications required to work with OEMs and everyone knows what everyone does in a very short time.</p>

About the context factors and their influence in the OI practice implementation, SME3 provided the researcher the following information:

Factors that have positive influence:

- Absorptive capacity: Taking into account the dimension of the company, to have 3 people fully dedicated to innovation activities clearly communicates the high interest of the direction in innovation activities.
- Corporate culture: The matrix companies from Italy are very innovative companies. They develop continuously innovation projects and achieve grants from the Italian government, but they assume risk of failure. SME3 explain to the researcher two examples of innovation projects develop by the Italian matrix, one was successful and the other not, but they said that acquired knowledge in the second one surely will be applied in future projects.
- IP Management: Since the foundation of the company, SME3 has paid special attention to IP management. In fact, one of their first patents, a system called power&free has been key in their competitive success. In fact they have had some patent infringement litigation to protect this development.

Factors that have negative influence:

- Ambidexterity: Despite having staff fully dedicated to innovation activities, to make this innovative developments compatible with other day-to-day activities, like maintenance services, is difficult due to their resource constraints.

Benefits from their OI practices:

	<ul style="list-style-type: none"> • The customer look for two types of benefits: Increase the performance of the installations and reduce operational costs. • Collaboration with relevant customers, such as Volkswagen consortium or Ford consortium, to develop innovative solutions help us to have a reputation from innovation in the automotive sector that is the 90-95% of our market.
<p>Subsequent evolution of OI practices:</p> <ul style="list-style-type: none"> • Which other typologies of OI practices have implemented? When? How? With who? • Organisational structure supporting OI practices? • Any systematization in relation to OI? • Any indicator to measure OI results? • In which stage of the innovation process add more value OI? • How do they identify partners? • Do they encourage somehow their workers to identify new partners? • What are the strengths and weaknesses of each type of partner? 	<p>Other typologies of OI practices that they have implemented:</p> <ul style="list-style-type: none"> • In relation to customer they follow with the same typologies of OI practices, joined development (OIP8). • But they have evolved to collaborate with a new kind of partners in their OI practices, their suppliers. Before was SME3 who transmitted their needs to their suppliers and they offered them their catalog products based on those needs. Now, thanks to the success of OI practices with OEMs, suppliers have identified to SME3 as an innovative customer and have changed to a more proactive attitude and tell SME3 about their more innovative developments to gain possibilities of test these new products in SME3 innovative projects. • Their organisational structure supporting OI practices are the 3 people that they have fully dedicated to innovation activities. • They do not have any specific indicator to measure OI results, separate from their other activities. • OI practices add value to the stage of generation of ideas for new solutions to customers.
<p>OI experience with OEM:</p> <ul style="list-style-type: none"> • Pro-active or reactive in relation to OEM? 	<ul style="list-style-type: none"> • They consider that are pro-active in their relation with OEMs. • Trust is the main enabling factors for OI with

<ul style="list-style-type: none"> • Why? Barriers and/or enabling factors? • Ideas to promote or foster OI with the OEM? 	<p>Volkswagen Navarra.</p> <ul style="list-style-type: none"> • Main barrier is the long time for closing an agreement with the purchasing department of Volkswagen Navarra when the innovation project needs inversions to develop prototypes.
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Table 3.7. Summary of information from SME3 case study

3.6.4 CASE STUDY 4: SME4

Sections of the interview	Main findings
<p>Characterization of the SME</p>	<p>The company develops artificial vision systems applied to industrial environments, medical environments and animation companies and custom software development.</p> <p>The company was founded in 1998 as a spin-off of a technological research center located in the same city.</p> <p>The company has 21 workers, and 17 of them are technicians. Its workforce has a high qualification, 20 of their workers are graduates and 4 of them are PhD graduates.</p>
<p>First experience on OI practices:</p> <ul style="list-style-type: none"> • Typology of OI practice • When? Why? With who? • Factors that pushed or hindered this first experience? • Main problems and benefits for the implementation? • Ulterior relation with the partners? 	<p>At the time of its inception, the founders, which initial idea was to develop and commercialize a system of motion capture to train people for playing golf, look for collaboration to innovate with external partners.</p> <p>As it seemed that the main market could be located in USA, they established a joint venture (OIP9) with one of their hardware suppliers from USA. This partner ceded them a part of its facilities in Boston to start their commercial activity in USA.</p> <p>After a few years trying to introduce their product in the market they realize that it was not a successful product</p>

because the golf teachers preferred the traditional methods and they stopped this activity and look for diversification in the national market, finding new application of their technological knowledge in the industrial and medical sectors.

About the context factors and their influence in the OI practice implementation, SME4 provided the researcher the following information:

Factors that have positive influence:

- Absorptive capacity: Due to the high qualification of their workers they were able to collaborate with their hardware suppliers and to assimilate their new technologies very quickly.
- Corporate culture: The managing director considers that their entrepreneurship culture is one of the drivers of their company. They have a positive attitude to risk and that allows them to be such innovative.

Factors that have negative influence:

- IP Management: Although their developments are mainly based on software and therefore are not patentable, SME4 looks for protection of their knowledge, in fact they have register some trademarks.

Their main achievement with this experience was to gain pragmatism. After this first experience they realized that market forecast is just theoretical information that you cannot be confident that will be true.

Now they know that the customer is the only one that

	<p>can tell you what they need and want, and therefore they collaborate with lead-users (OIP10) to achieve innovative solutions.</p> <p>They continue collaborating with hardware suppliers for designing innovative solutions applying the last hardware technology.</p>
<p>Subsequent evolution of OI practices:</p> <ul style="list-style-type: none"> • Which other typologies of OI practices have implemented? When? How? With who? • Organisational structure supporting OI practices? • Any systematization in relation to OI? • Any indicator to measure OI results? • In which stage of the innovation process add more value OI? • How do they identify partners? • Do they encourage somehow their workers to identify new partners? • What are the strengths and weaknesses of each type of partner? 	<p>We are continuously developing joined innovation projects (OIP8) with customers. In many of these projects we do not have competition because there are not competitors that want take the risks of development of these solutions.</p> <p>An example is the first project that we have developed for Volkswagen Navarra in 2013 called “Hawkeye”. Volkswagen Navarra has been looking for a partner to develop this project for more than one year before they found us, and they did not found any other company that wanted to collaborate in this project with them.</p> <p>Nowadays collaborate with customers in innovation projects is an important part of our business. With other kind of partners, such as technological research centers, they collaborate because they raise the possibilities to obtain public subsidies for our innovation project and reduce the financial risk of our innovation activities.</p> <p>They also participate in a regional cluster (OIP15) where most of the companies that are related to ICT technologies are associated. From this cluster they have been able to participate in some innovation projects but the fact is that they are most interested in the information that they can obtain about activities of their competitors that really the results that they can obtain in</p>

these project and they think the other companies do the same.

Concerning the organisation structure for supporting OI practices, there are three people that take the responsibility of promoting opportunities and negotiate with the potential partners.

They do not have systematized the process relative to OI practices. But they think that they have so much ideas that they need to do something for help them to focus in the best innovation options.

They measure OI practices success with their ROI. Their OI activities add them lot of value in the commercialization phase, being so open is one of their best competitive advantages with their customers.

In relation to partners' identification, last year they subcontracted a specialized consultancy company as intermediary to help them to find opportunities and partners for the new framework program of the European Commission (Horizon 2020). It is an activity very time-consuming because of the complexity of the programs and they prefer to focus on development and look for help in management of these opportunities. But the fact is that until now they have not achieved any result with this intermediary.

Talking about each strengths and weaknesses of each type of partner, the managing director of SME4 explained the following:

- Customers: In the industrial segment their customers are top companies Volkswagen, BSH, and so on). With

	<p>these customers is easy to find opportunities for OI. They have always new problems and needs and are open to collaboration when they trust in your capabilities.</p> <p>In the other segments of their market, the medical and the animation, in general they do not find so easy collaboration.</p> <ul style="list-style-type: none"> • Technological research centers: They have people with high technological level, but they do not have industrial mind, that means that they do not finish their developments enough to solve industrial problems. <p>Moreover this kind of centers from our region are not internationalized, if you work in projects for multinational customers is complicated to work with them.</p> <p>Their technicians start their careers being young and very talented but after some years they diverge from the reality of the industry and stay only thinking in very scientific projects without looking at the industry to help them to absorb their technologies. There is a big gap between this centers and real industry.</p>
<p>OI experience with OEM:</p> <ul style="list-style-type: none"> • Pro-active or reactive in relation to OEM? • Why? Barriers and/or enabling factors? • Ideas to promote or foster OI with the OEM? 	<p>Thanks to their pro-active attitude they have achieved an opportunity to present their first project with Volkswagen Navarra to the director of innovation of the Volkswagen consortium.</p> <p>We have very clear the benefits that customers such as Volkswagen Navarra look for:</p> <ul style="list-style-type: none"> • Improvement of quality of their products. • Reduce cost thanks to reduction of man-hours need for their processes.

	<p>The main barriers that we have found in Volkswagen Navarra to promote open innovation projects is the rivalry between their own departments. Volkswagen Navarra is our first customer in the automotive sector, perhaps is normal in this sector but it has surprised us.</p> <p>Now that we have finished this first successful project, other departments start to contact with us to propose us some challenges (for the development of artificial vision systems to detect cracks in presses and look for defects in the final assembly section).</p> <p>The most complicated is to understand the internal relations between different departments, and which the objectives of each of them are.</p>
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Table 3.8. Summary of information from SME4 case study

3.6.5 CASE STUDY 5: SME5

Sections of the interview	Main findings
Characterization of the SME	<p>This company main activity is the design, manufacture and commercialization of innovative internal storage and logistics solutions. The company belongs to an industrial group whose former company was born in 1958 to produce industrial furniture (such as lockers and desks for workshops) in steel to compete with existing products at the time that were made mostly of wood.</p> <p>Nowadays the group continues being an SME, with a total number of 128 workers and three design and manufacturing locations, two in Spain and the third one in Portugal. From their total turnover a 70% is related to the internal logistic systems and a 30% to their</p>

	<p>traditional product such as lockers, shelves and other furniture for industrial environments. The traditional products are mature products, continually demand drops and due to logistic cost they only can sell these products in the Spanish market.</p> <p>They are a reference in the design and manufacturing of internal logistic containers for the automotive sector in Spain. They design and manufacture containers that cater for their customers' specific demands in production lines, such as those in the car industry and other businesses that require a system that adapts to the material contained in them. SME5 endorsed as a supplier by such major car manufacturers as Renault, Mercedes Benz Spain, Volkswagen, General Motors, Seat and also to some of their main parts suppliers such as Faurecia group.</p> <p>They started their internationalization some years ago, thanks to their customers that move their production to other countries, such as Portugal or Turkey (where they have warehouses for their standard products).</p> <p>Concerning their personnel structure, their technicians develop technical and commercial tasks. They work with the customer to achieve the product specifications; containers tailored for specific pieces, they close the contract and then design the product for the customer.</p>
<p>First experience on OI practices:</p> <ul style="list-style-type: none"> • Typology of OI practice • When? Why? With who? • Factors that pushed or hindered this first 	<p>They consider that their first OI practice was an innovation contest (OIP4) that they organize in 2006. The need that brought them to organize this contest was a clear threat to their competitive position. At this moment they mainly sold standard containers for storing parts in assembly or production lines to automotive</p>

experience?
• Main problems and benefits for the implementation?
• Ulterior relation with the partners?

companies (OEMs and their parts suppliers). They designed and built this kind of containers and they need to install inside these containers a product called automatic columns.

These products allowing once the operator takes the top part which is in the container, the following piece by a mechanical mechanism is placed in the position of the above. This product improves the ergonomics for the workers and consequently productivity. As SME5 did not have his own automatic columns, they had to pay royalties to some of their competitors that already had their own designs of this product, to use their patents and install the columns of their competitors in their own containers.

The added value of the set container + automatic column, was increasingly in the automatic columns, because the standard containers were coming a commodity. They launched internally an innovation project to design their own automatic column, and they started working with an innovation consultancy to look for public subsidies for afford the costs of this project with a lower level of risk.

But the fact was that their technicians had many difficulties to find ideas for an innovative design to avoid patent conflicts with existing products. The innovation consultancy company, that had had previous experiences helping other SMEs to organize innovation contests, suggest them the idea of using this practice of OI to collaborate with some local universities looking for creative and innovative designs for these product.

The managing director found this idea very interesting and convinced two of their technicians to start working with this innovation consultancy to organize the innovation contest. This first experience was very successful. Three local universities accepted the challenge and a group of students can work in the design of the automatic columns with a double incentive:

- Thanks to the implication of some teachers from these universities, the designs that they developed for the competition were valid as assessable practical work for some subject related to the mechanical design.
- They competed for an economical prize offered to the winning student by SME5.

SME5 thanks to this innovation contest managed to develop their own automatic column based on the design proposed by one of the students that fulfilled all their requirements and moreover was patentable.

Besides this direct result, with other designs received from participating students SME5 received a lot of ideas for future developments for your new product. The CEO of SME5 valued the results of this contest of ideas as a "huge boost to the creativity of its technical team." The technicians that participated in the management and organisation of this innovation contest also found this practice very valuable. They said that people from outside of their market can achieve innovative solutions that sometimes people from inside their market, due to the excessive knowledge of the solutions existing already in the market have many problems to generate.

About the context factors and their influence in the OI practice implementation, SME5 provided the researcher

the following information:

Factors that have positive influence:

- **Intermediaries:** In this first experience the collaboration of the innovation consultancy, giving them the idea for developing this innovation contest, designing the contest bases and managing the relation with the universities during the development of the contest, was a key of the success. SME5 thinks that without their support, they alone, they could not have been able to successfully develop the contest.
- **Corporate culture:** Managing director's direct involvement was key to the success of this experience. He was the one that convinced their technicians about the interest of this practice, and participated directly in the key meetings during the design and management of the innovation contest.
- **IP Management:** SME5 thanks to his knowledge of patents, acquired by the need that until then had to use patents to other manufacturers of automatic columns (OIP7), was able to properly manage everything related to industrial property in relation to the results of the competition innovation.

Factors that have negative influence:

- **Ambidexterity:** When developing this first experience of OI, was hard to find time for activities that were not directly related to the daily life of our business. Taking the time to innovate in new products, not related to a direct demand from customers it was very difficult.
- **Absorptive capacity:** We had no people in the company dedicated to innovation activities. Our technicians were capable of doing metal-mechanical design but automation was a technology that we do not

	<p>dominate.</p> <p>After this first experience SME5 has replicated the experience, another innovation contest some years later but in this case they did not need the help of the innovation consultancy, because they already knew how to do it.</p>
<p>Subsequent evolution of OI practices:</p> <ul style="list-style-type: none"> • Which other typologies of OI practices have implemented? When? How? With who? • Organisational structure supporting OI practices? • Any systematization in relation to OI? • Any indicator to measure OI results? • In which stage of the innovation process add more value OI? • How do they identify partners? • Do they encourage somehow their workers to identify new partners? • What are the strengths and weaknesses of each type of partner? 	<p>Their following experience in OI practices was in 2010. In this moment their customers, such as Volkswagen, were doing a big change in their internal logistics, from the concept of traditional warehouses to a new concept called “supermarket” (or Kanban system) that has been firstly introduced by Toyota.</p> <p>This new concept implies a radical change in the internal logistic of assembly plants and one of the consequences is that the use of forklifts is substituted by a new product called “logistic train”.</p> <p>They decided to develop their own logistic train and taking advantage of the close relationship of the technical director of their Portuguese plant with the Polytechnic Institute of Setubal, they designed an innovation contest (OIP4) in which students from this educational institution could participate.</p> <p>This time, SME5 was able to design and manage the contest by herself, without relying on intermediaries, based on the knowledge gained on innovation contest in their first experience.</p> <p>Also SME5 introduced some improvements in the process. For example, they provide students direct contact with potential customers, to facilitate the</p>

understanding of the needs they wanted to address. For this they engaged in the development of the contest one of their clients, Volkswagen Portugal, and organized a tour of the facilities for students in which the team of Volkswagen Portugal told the students the needs that should answer the new product.

One of the concepts presented by the students won the innovation contest and the technical team from Imeguisa Portugal worked with this student to develop this product concept.

Some of the components of this new product were patented and SME5 considers this OI practice a new success. Moreover thanks to this development and the involvement of Volkswagen Portugal they had the opportunity of presenting this innovative product to all the industrial directors of the assembly plants of the Volkswagen consortium. The visibility that they have achieved thanks to this development has been enormous.

Added to this experience, they have also collaborated with two of their suppliers in two different joint developments (OIP8):

- One for developing and innovative glue that could substitute the welding in some of their product.
- The other for developing and anti-panic paint so that in case of power failure operators can see the shelves in the dark and avoid accidents.

Both projects were technically successful but as far as the resulting products were exclusively for SME5 and the volume of these products they may consume is too low, the cost to apply this product industrially was too

high.

Concerning their organisational structure, they have recently, in 2013, hired an industrial design engineer who works full time designing innovative products inspired by the trends identified in the medium-long term in the automotive sector or by unmet customer needs that are identified by the commercial department. It is the first time in the history of the company that they decide to allocate exclusively any human resource to innovation activities looking for the medium-long term.

As an example our contact mentioned that this industrial design engineer is nowadays working on the development of a new concept of automatic warehouse to maximize the use of the warehouse space of the suppliers of plastic injected parts. Nowadays these kinds of warehouses only leverage a vertical level and the new solution will take more levels till the roof of the warehouse solving the problem of how to transport the parts from higher levels to lower.

Added to this engineer nowadays there are other 10 people that dedicates partially their time to innovation activities. In relation to systematization, SME5 has designed a process for the organisation of innovation contest, and they improve this process from their first experience to the second one. In the second one they decide to involve also a potential customer, to help participant students to have a deeper knowledge of the real context where their ideas are going to be applied and moreover to demonstrate to customers that they are a pro-active and innovative company that looks to the future and seeks innovative solutions inside and outside

	<p>your company.</p> <p>To measure OI results they calculate the ROI of the OI practices. They find that innovation contest add lot of value in the ideation phase of their innovation projects.</p> <p>Talking about internal motivation for their workers to collaborate in OI practices, our contact from SME5 remembered that in the first experience, the managing director had invited to dinner to the technicians who had collaborated in the project in one of the best restaurants of their region. He said that more than the dinner, the technicians were very grateful for public recognition of their involvement.</p> <p>Concerning their partners in OI practices, in the case of universities SME5 found that it complex to encompass the rhythm of the university with the rhythm of the company. Launch innovation contest in proper dates for students it is key to assure that they can spend many time working on it.</p> <p>The biggest strengths of universities is their creativity. Students have the technical knowledge but also the freshness of not knowing exhaustively the products of competitors. That allows them to be more open to new ideas, get away from the existing and find new ways to solve the same problems.</p>
<p>OI experience with OEM:</p> <ul style="list-style-type: none"> • Pro-active or reactive in relation to OEM? • Why? Barriers and/or enabling factors? • Ideas to promote or foster 	<p>Their experience with Volkswagen Navarra in normal projects is good, but in OI activities they find important barriers. They think that as suppliers their pro-activity in this kind if activities is not valued.</p> <p>Further they believe that Volkswagen Navarra has no</p>

OI with the OEM?

interest in keeping up with the new capabilities of its suppliers. They stay with the image that the supplier has when they start working together and to show them new skills is very complicated, do not listen, do not pay attention to know what else the supplier can offer.

They feel that the only way to collaborate in innovation activities is when Volkswagen Navarra technicians have an emergency and call them to help them to solve it.

But the problem in this cases is that many times is a personal initiative of one of the Volkswagen Navarra technicians and many times this kind of collaboration has a bigger cost in man-hours (for generating innovative ideas) and a small materials cost. After having found the possible solution, the purchasing department enters in the relation to make a formal proposal for industrialization and as far as the previous work has not an official order they just want to pay for the materials. Moreover the purchasing department sends system specifications to two other suppliers, competitors of SME5) to have a minimum of 3 bids from which to adjust prices. So, they do not pay the man-hours that SME5 has invested in the innovative solution and they share the generated knowledge with their competitors and they do not feel that this effort has been taking into account in their relation with Volkswagen Navarra, just with a specific technician that manage to solve his problem.

As they find so many barriers to present their new developments and capabilities, they feel that sometimes they are able to give more innovative solutions to smaller customers than to big customers such as

Volkswagen Navarra.

There is no one in Volkswagen Navarra that can be the contact to present him innovation ideas or new capabilities from suppliers. In fact we are working in innovative products with other companies from the Volkswagen consortium (Volkswagen Mexico and Volkswagen Argentina) and with some competitors that could be interesting for Volkswagen Navarra but we do not find anyone that has the interest to hear us.

In some cases we have finally managed to present them some of our most innovative developments, but after our demonstration they do not give us any feedback, we did not get to know if they have liked them or not.

That happens with one of their new products, the e-frame, that has been described previously. They presented this product to all the industrial managers of the assembly plants of the Volkswagen consortium inside the facilities of Volkswagen Navarra and after this presentation they do not receive any feedback from Volkswagen Navarra responsible, when they ask them what has been the opinions of the people that attend to the presentation the answer were vague “some say they like and others do not ...”.

Talking about ideas to promote OI practices between Volkswagen Navarra and their suppliers, SME5 propose to establish a clear procedure to manage OI initiatives, since the stage of ideas generation, where the real cost that this collaborations have for the supplier can be taking into account.

	<p>They said that in day-to-day projects relation between Volkswagen Navarra and their suppliers is very well managed. In the case of their product, containers, Volkswagen pay for the design and therefore they think that is fair that after having paid for it they can share this design with other suppliers.</p> <p>Something similar can work in OI projects, if one supplier accepts to take the risk of these type of collaboration they have to think how to valueate this collaboration in the industrialization stage.</p>
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Table 3.9. Summary of information from SME5 case study

3.6.6 CASE STUDY 6: SME6

Sections of the interview	Main findings
Characterization of the SME	<p>They are consultants and integrators of IT solutions and peripherals (RFID, mobile technologies, sensors and so). For specific projects also mechanical designs.</p> <p>The company was born in an incubator for start-ups from the regional government in 2002. The founders come from a North-American multinational company that develops software for OEMs of the automotive sector (Volkswagen, Ford, Volvo and so on.)</p> <p>Now they are 5 people working in the company but before the crisis they arrived to 9 people. Two of them, the founders, are the ones that drive the innovation activities and the others participate in the innovation projects.</p>
First experience on OI practices: • Typology of OI practice	<p>Their first OI experience was in 2007 with CENER (National Renewable Energy Centre). A former co-worker offered them the opportunity to collaborate in a</p>

<ul style="list-style-type: none">• When? Why? With who?• Factors that pushed or hindered this first experience?• Main problems and benefits for the implementation?• Ulterior relation with the partners?	<p>project where the objective was to develop a solution for automation of collection of test data of solar collectors with a web application. The OI practice in this case was an Outsourcing of R&D (OIP13).</p> <p>It was an opportunity to open a new line of business for a new customer sector, as they like to collaborate and are open they found it interesting. About the context factors and their influence in OI practice, SME6 provided the researcher the following information:</p> <p>Factors that have positive influence:</p> <ul style="list-style-type: none">• Intermediaries: Because they were born in an incubator for start-ups, there they had a tutor with who they still maintain their relationship. This tutor plays the role of intermediary because thanks to its huge agenda of industrial contacts can help them to identify new opportunities to collaborate with other organisations and companies.• Technological turbulence: From being software developers, they have evolved to develop also hardware and peripherals. Collaboration with their technology suppliers allow them to progress very fast. They are continuously innovating and applying new technologies.• Absorptive capacity: The company was born with the vocation of continuous innovation because their technologies change very quickly and therefore they need to be able to absorb the new technologies very fast to apply them in their developments.• Corporate culture: When we founded our company it was an open project, we wanted to be specialist in a particular field and to collaborate with other specialist. We had not intent to grow much, but to create stable partnerships and move forward together with our long-
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term partners. But we collided with the culture of non-collaboration in our industrial environment.

However, we still have an open mind and seek for win-win relationships with our customers and suppliers and potential new customers. Everything is more difficult than we expected, because we were accustomed to American business culture that is much more open to collaboration and to take more risks. We can only find this open mind in our multinational customers and suppliers.

Factors that have negative influence:

- Market turbulence: There are many movements at both customers and institutions that influence us negatively to find receptive partners to innovate. Changes of interlocutors involve restart a way to build trust and being an SME generates much suspicion.

Sometimes it is shocking that for our interlocutors from multinational customers is easier to defend a collaboration that cost 30,000 € with a large company that one that costs 3.000 € with an SME like us. Our size generates lack of trust.

But at the same time, purchasing departments only take into account the price for taking their decisions. These departments do not consider other parameters that could favor to SMEs, such as the level of service, results on previous experiences, and so on.

- IP Management: In the first experience of OI with CENER, they care about intellectual property, and therefore they subcontracted an IP expert. They realize

	<p>that their main value was the software that they design, but this is very difficult of protecting successfully because legally if someone changes a line of code, the software is considered different.</p> <p>The only protection that they have is the signature of agreements with their workers to avoid that if they leave the company they can take the source code with them.</p> <p>Benefits from their OI practices:</p> <ul style="list-style-type: none"> • The software developed with CENER was the base to develop an innovative application for the University Clinic of Navarra, to capture results from clinical trials (OIP13). • This software has possibilities for being commercialized to other medical institutions with the collaboration of IDIFARMA (OIP14), a firm that is leader in services for development of pharmaceutical products. <p>IDIFARMA arrange the validation of their software with one of the biggest hospitals in Spain, the hospital of La Paz in Madrid, but then the crisis arrived and their budget for inversions was reduced and the project was paralyzed.</p>
<p>Subsequent evolution of OI practices:</p> <ul style="list-style-type: none"> • Which other typologies of OI practices have implemented? When? How? With who? • Organisational structure supporting OI practices? • Any systematization in 	<p>After this first experience, we also collaborate with a pharmaceutical company in the development of an innovative solution for registration of batches of medicines. This project has been subsidized by the Spanish Ministry of Industry and lasts three years (OIP8).</p> <p>SME3 also reports a recent experience that was unsuccessful. The regional government organizes a</p>

relation to OI?

- Any indicator to measure OI results?
- In which stage of the innovation process add more value OI?
- How do they identify partners?
- Do they encourage somehow their workers to identify new partners?
- What are the strengths and weaknesses of each type of partner?

forum to promote OI among different companies and institutions from their region.

They accept to collaborate with the cardiology unit of the biggest public hospital of the region (OIP8). The objective of the collaboration was to develop a solution for fast transmission of results from electrocardiograms from small medical centers that are located far from this hospital. This information about the cardiac patients can be evaluated in real-time by a group of specialist and save time for taking decisions about these patients.

In 2012 they develop the first prototype in a medical center and the results were great. They were able to transmit a high quality signal independently of the manufacturer of the electrocardiograph. This was an important requirement because the park of electrocardiographs is very diverse (there are 251 machines from 14 different manufacturers). Some of the manufacturers accept to collaborate with them, providing information about the codification of their signals, but others not.

Despite the technical success, problems that arose later have impeded its implementation. We cover all the cost of our development, and therefore we wanted to be the owners of the source code and sell licenses to use this solution. The government did not agree with this proposal and the project was not implemented.

In spite of this failure in the commercialization phase, they have the satisfaction of seeing that have been able to solve a complex problem that can contribute to social improvement. Due to their small size, they do not have

	<p>an specific organisational structure to support their OI practices, neither indicators to measure results from these activities.</p> <p>Finally they told us that they participate in the IT cluster from Navarra (OIP15). They benefit mainly from the sharing of information about market and technologies with other companies from the same sector.</p>
<p>OI experience with OEM:</p> <ul style="list-style-type: none"> • Pro-active or reactive in relation to OEM? • Why? Barriers and/or enabling factors? • Ideas to promote or foster OI with the OEM? 	<p>From 2003 they have collaborate with automotive supplier's part suppliers and logistic operators).</p> <p>In 2010 they started to collaborate with Volkswagen Navarra. From them we have maintain a pro-active attitude, proposing them new ideas.</p> <p>One of the innovation projects that we develop with Volkswagen Navarra was presented to other assembly plants from the Volkswagen consortium and we participate in the presentation. Thanks to that event the same solution has been implemented in SEAT Martorell (another plant of the Volkswagen consortium).</p> <p>Main barriers for promoting OI with Volkswagen Navarra are the following:</p> <ul style="list-style-type: none"> • There too much voices, there is no a clear interlocutor for these activities and too many people can criticize what is proposed. • The internal bureaucracy kills the agility for launching new initiatives, delays the decisions but not the deadlines for the implementation of the solutions. • Ideas are not as physical parts, therefore cannot be treated in the same way. They do not valuate the time that you invest to think on new and innovative solutions.

	<p>In SEAT Martorell, SME3 thinks that this works in a different way, people from this plant has more freedom to propose new projects and take decisions and take risks.</p> <p>To foster OI activities in Volkswagen Navarra, they propose the need for a gatekeeper. Someone from Volkswagen Navarra with a big capacity to move internally projects and filter internal voices, look for consensus and capacity for selling internally the projects depending of the profile of the buyers (level of innovation, cost reduction or quality improvement).</p>
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Table 3.10. Summary of information from SME6 case study

3.6.7 CASE STUDY 7: SME7

Sections of the interview	Main findings
Characterization of the SME	<p>This company belongs to a group whose former company, SME7, was born in 2004 for providing on-site services for maintenance of electromechanical systems, mainly industrial machinery. In 2006 they founded a second SME with expertise in reforms for electrical installations. Finally in 2013 they founded a new SME to provide services of metalworking and welding. The whole group together remains an SME with a total of 67 employees.</p> <p>They have a very diversified customer portfolio. They are suppliers of services for companies from the following sectors: automotive, food and beverages, building, engineering machinery, renewable energy, pharmaceutical, household appliances and so on.</p> <p>With many of their customers they have a stable</p>

	<p>relation, because technicians from SME7 work continuously in the facilities of their customers as an outsourcing of their maintenance services. Customers are geographically close and this generates a close relationship between the direction of SME7 and their clients that has been important to its growth strategy.</p>
<p>First experience on OI practices:</p> <ul style="list-style-type: none"> • Typology of OI practice • When? Why? With who? • Factors that pushed or hindered this first experience? • Main problems and benefits for the implementation? • Ulterior relation with the partners? 	<p>Their first experience in OI practices was launched in 2012. The need arises from the difficulties that the company had to manage quickly and effectively the working parts of their technicians working in customer facilities.</p> <p>Until then, each technician had to deliver monthly a working part in paper with the detail of the hours that he had worked on maintenance services for their customer companies. This procedure generated lot of problems, because it was very slow and consequently billing for services provided to customers was delayed and which meant a delay in the payment for such services.</p> <p>They had the idea of developing a hardware-software system that could be installed quickly and easily on the facilities of their customers that could register these data automatically and transfer them in real-time to their internal ERP system.</p> <p>This project has been jointly developed (OIP8) with several external agents:</p> <ul style="list-style-type: none"> • With a hardware provider for the design and manufacturing of the hardware device that records inflows and outflows of workers in client facilities. • With the software company that provides them their ERP system, to found the manner to connect their own developed software with this commercial tool.

- With some of their customers to install in their facilities the first prototypes of the system and perform field tests to validate their design.

The internal team for this project has also been multidisciplinary, mainly because different profiles were needed to maintain the interface with the different external agents that collaborate in the project:

- The technician in charge of the coordination of the project manages the collaboration with the hardware provider.
- Their IT manager manages the collaboration with the provider of the ERP system.
- Their commercial department manages the contact with the customer to perform the field tests.

About the context factors and their influence in the OI practice implementation, SME7 provided the researcher the following information:

Factors that have positive influence:

- Ambidexterity: The people that are working in the project are partially dedicated to day-to-day activities. Perhaps the project could have been developed quicker with full-time dedication but in this way the economical impact is more affordable for SME7.
- IP Management: From the starting of the project they have in mind the possibility of patenting the system, because the solution can be interesting for other companies, as existing solutions in the market for similar applications are very limited.

SME7 not identify any factor that has negative influence

	<p>in this first experience.</p> <p>The total cost of the development has been approximately of 140.000 € in three years, from 2012 to 2014. They achieved a small grant from the regional government and in the moment of the interview they were finishing the field tests with good results.</p>
<p>Subsequent evolution of OI practices:</p> <ul style="list-style-type: none"> • Which other typologies of OI practices have implemented? When? How? With who? • Organisational structure supporting OI practices? • Any systematization in relation to OI? • Any indicator to measure OI results? • In which stage of the innovation process add more value OI? • How do they identify partners? • Do they encourage somehow their workers to identify new partners? • What are the strengths and weaknesses of each type of partner? 	<p>At the moment of the interview they have not planned any other OI practice, but they said that the success of this first experience has shown them that, being small, for innovating they can join forces with other companies and the effort to manage these experiences has a positive effect on the results.</p> <p>After their first experience they think that OI can add value in all the stages of the innovation process. In fact in their project they collaborate with different partners in different stages of the project:</p> <ul style="list-style-type: none"> • Concept and product development stage: With the hardware provider for the design and manufacturing of the hardware device and with the software company that provides them their ERP system, to found the manner to connect their own developed software with this commercial tool. • Prototype stage: With some of their customers to install in their facilities the first prototypes of the system and perform field tests to validate their design.
<p>OI experience with OEM:</p> <ul style="list-style-type: none"> • Pro-active or reactive in relation to OEM? • Why? Barriers and/or 	<p>SME7 considers that their attitude in relation to Volkswagen Navarra is reactive because they think that this company has everything so standardized that is difficult to bring new ideas that may be of interest for</p>

enabling factors?

- Ideas to promote or foster OI with the OEM?

them. They collaborate in small developments for Volkswagen Navarra that usually comes from the internal suggestion box.

They explain that the level of innovation is higher at the beginning of the life cycle of a new model of car. Normally in Volkswagen Navarra the total life cycle of a model lasts seven years, is one of the largest of the Volkswagen consortium. As an example the actual model is arriving at final of his life cycle and therefore is not cost effective to invest in big innovation project for this model, because with the new model most of the assembly facilities will be changed.

Regarding to maintenance activities when a new vehicle model is launched the headquarters in Germany define a protocol to standardize maintenance activities. Later, as maintenance teams of the different assembly plants caught experience with the new facilities; many innovations emerge originating from assembly plants.

SME7 said that from their experience there is more collaboration between technicians from the same department of different assembly plants of the Volkswagen consortium that between different departments from the same assembly plant.

They say that the ideas emerge when you are working on-site, in the assembly plant; if you are not working there it is more difficult to add value. Therefore they think that is easily that innovation ideas emerge from inside Volkswagen Navarra.

Most of the times, maintenance responsible from

	<p>Volkswagen Navarra as them to make a tender for ideas that they received from the suggestion box. Starting from a specification given to them from Volkswagen Navarra they propose new ideas and after Volkswagen Navarra maintenance department analyzes the technical and economical viability of their proposals. Most of them are rejected for economical reasons.</p> <p>They are suppliers from Volkswagen Navarra since 2013 but the Director of the technical office had worked with them in a previous job for other company.</p>
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Table 3.11. Summary of information from SME7 case study

3.7 FINDINGS AND IMPLICATIONS FOR THEORETICAL FRAMEWORK

After having presented the detailed information obtained in the interviews with the seven SMEs in the previous section, following we summarize main findings from this chapter in relation to our research propositions.

The following Table 3.12. summarizes the OI practices reported by these SMEs:

OI practices (other terms used for same practices)		SME1	SME2	SME3	SME4	SME5	SME6	SME7
OIP1	Corporate venture capitalist							
OIP2	Crowdsourcing							
OIP3	Endowed chairs							
OIP4	Innovation contests					Universities + Customers		
OIP5	Innovation marketplaces							
OIP6	Innovation networks							
OIP7	Inward licensing of IP					Competitors		
OIP8	Joined development	Customer	Customer	Customer	Customer	Customer, Suppliers	Customer	Suppliers + Customers
OIP9	Joint venture				Supplier			
OIP10	Lead user method				Customers			
OIP11	Made own innovation available to others for free							
OIP12	OI communities							
OIP13	Outsourcing R&D						Customer	
OIP14	Outward licensing of IP						Customer	
OIP15	Regional innovation clusters				Competitors		Competitors	
OIP16	Scientific committee							
OIP17	Shared facilities/facilities sharing							
OIP18	Staff exchanges (Personnel Exchange; Human resource transfer)							
OIP19	Technology scouting							

Table 3.12. Open innovation practices reported by the SMEs from the multiple case study

Concerning previous research on OI practices in SMEs, from the detailed information included in section 3.6 and from the content of this Table 3.12., we can say that our findings in relation to OI practices in SMEs agree with Van de Vrande et al. (2009) because all the interviewed SMEs have been engaged in OI practices. Moreover the motives that pushed them towards OI were primarily the need to meet customer demands (such as the cases of SME1, SME2, SME3 and SME4), keeping up with competitors (SME5) and opening new markets (SME6). In addition to these motives we also find that SME7 looks for improvement of performance and efficiency of an internal process.

Concerning the discovery of Van de Vrande et al. (2009) about the sequence in the adoption of OI in SMEs, we found that SME1, SME2, SME3, SME6 and SME7 started with customer involvement but SME4 and SME5 followed a different sequence. SME4 started with suppliers and SME5 started with the university. Therefore our findings do not support this proposition from Van de Vrande et al. (2009).

In relation to Brunswicker and Vanhaberbeke (2011) proposal of five different types of approaches for OI search in SMEs in Europe, most of our analyzed SMEs could be included in the second type “supply-chain searchers” that focus their OI interactions with customers and suppliers. Just SME5 do not fit with this type, because their intense relation with universities can indicate that they are better classified in the third type “technology-oriented searcher” because they are interested in getting access to inventive trends as early as possible.

Added to the relation with previous research references, with our research we have achieved the following findings in relation to the typologies of OI practices and their dimensions:

- All the OI practices reported from the SMEs that participate in our experimental research are identified in the proposal of OI practices typologies that we presented in chapter 2. More exactly, these SMEs have reported eight different typologies of OI practices. From these eight practices we can see that:
 - Five of them (OIP4, OIP7, OIP8, OIP10 and OIP13) are inbound OI practices
 - One of them (OIP14) is outbound OI practice.

- Two of them (OIP9 and OIP15) are coupled OI practices.

From all these OI practices, the coupled are the ones that, according with the information provided by the SMEs that implemented them, which results were unsuccessful or not relevant for them.

- In relation to the “Kind of relationship” dimension, proposed in chapter 2 as a new dimension, which could help to classify OI practices typologies, we found that the reported OI practices belong to all the three possible “Kind of partner” dimension.
- Being a small sample of SMEs, we find that the implemented OI practices typologies cover all the innovation process stages, from opportunity identification to commercialization, which could mean that SMEs can use OI practices all along of their innovation process.
- All the SMEs that participate in our research have an OI in common, the joined development (OIP8) and all of them have implement this typology of OI practice with customers.
- Through the implementation of the joined development (OIP8) SME1, SME5, SME6 and SME7, that are services companies, have develop their own innovative products.
- SME5 is the only SME that in our sample has implemented the innovation contest, and moreover they did it twice. From our knowledge, this is the first reference in the literature to an SME that implements this typology of OI practice.
- From the results of this multiple case study we can see that the companies that have implemented a bigger diversity of OI practices (SME 4 and SME5) are the companies that have higher percentages of graduates.
- The case of SM5 stands out in the sample for several reasons:
 - Having a similar percentage of graduates, a 20%, that most of the other SMEs, this company had implemented three different OI practices typologies while the others just implemented one typology. Could it be due to its

size? This company is the bigger of the SMEs that participate in this multiple case study. Other explanation for this situation can be the substitution effect of the need for absorptive capacity by the role of intermediaries, such as in their first OI practice implemented they relied on a consulting expert in innovation as an intermediary for this implementation.

- SME5 has collaborated with four different types of external agents (customer, suppliers, competitors and universities), more types of external agents that SME4 and SM6, despite having a lower % of graduates that these other companies.
- Moreover SME5 is the first SME that has reported the successful implementation of innovation contest in the sample but also, from our knowledge, in the OI literature.

Following Tables 3.13. y 3.14. summarize the inter-relation reported by these SMEs between OI practices and context factors. Analyzing these results we can propose the following conclusions:

- Internal factors seem to have a bigger influence for all the reported OI practices. Absorptive capacity and Corporate culture have influence in all the reported OI practices but also IP Management and Ambidexterity seem to have a high heavy in implementation of OI projects-
- External factor only seems to have influence in joined development or in outsourcing of R&D.

OI practices		Internal factors							
		Firm size	Age	Modularity	IP Management	ACAP	Corporate culture	Ambidexterity	Technology strategy
OIP4	Innovation contests				SME5 (+)	SME5 (-)	SME5 (+)	SME5 (-)	
OIP8	Joined development				SME1 (+) SME2 (-) SME3 (+) SME7 (+)	SME1 (-) SME3 (+)	SME1 (+) SME3 (+)	SME1 (-) SME3 (-) SME7 (+)	
OIP9	Joint venture				SME4 (-)	SME4 (+)	SME4 (+)		
OIP13	Outsourcing R&D					SME6 (+)	SME6 (+)		

Table 3.13. Relationships reported between Open Innovation practices typologies and internal factors in multiple case study

OI practices		External factors				
		Sector	Technological turbulence	Market turbulence	Intermediaries	Proximities
OIP4	Innovation contests				SME5 (+)	
OIP8	Joined development		SME2 (+)	SME1 (+)	SME1 (+)	SME2 (+)
OIP9	Joint venture					
OIP13	Outsourcing R&D		SME6 (+)	SME6 (-)	SME6 (+)	

Table 3.14. Relationships reported between Open Innovation practices typologies and external factors in multiple case study

In Table 3.15 we present the correlation of findings from this multiple case study and the theoretical framework relating OI practices and factors that we developed in section 2.7.

We have to remark that due to the characteristics of our sample (all the companies are SMEs and from the automotive sector) there are two factors that that cannot be studied with this sample: Firm size and Sector.

We can support some of the relationship between OI practices and factors found previously in the literature, such as influence of corporate culture and ambidexterity for innovation contest (OIP4) but there are many relationships, such as those identified for the joined development typology (OIP8) that we do not find in the literature but are strongly supported by the results from this multiple case study.

Take into account the following information to understand the Tables 3.15 and 3.16. When a cell on a table is filling with one of these images, we can understand that the OI practices from the row and the factor from the column are related and, depending on the content of the cell, is indicated if the relationship is supported by the literature review or by the multiple case study or by both at the same time.



Literature review



Multiple case study



**Multiple case study supports
literature review results**

OI practices		Internal factors							
		Firm size	Age	Modularity	IP Management	ACAP	Corporate culture	Ambidexterity	Technology strategy
OIP1	Corporate venture capitalist	■				■	■	■	■
OIP2	Crowdsourcing					■	■		
OIP3	Endowed chairs								
OIP4	Innovation contests				▨	▨	▩	▩	
OIP5	Innovation marketplaces	■			■				■
OIP6	Innovation networks	■			■		■	■	
OIP7	Inward licensing of IP	■			■				
OIP8	Joined development				▨	▨	▨	▨	

Table 3.15. Correlation between theoretical framework relating Open Innovation practices and internal factors and results from multiple case study (Part I)

OI practices		Internal factors							
		Firm size	Age	Modularity	IP Management	ACAP	Corporate culture	Ambidexterity	Technology strategy
OIP9	Joint venture								
OIP10	Lead user method	■						■	
OIP11	Made own innovation available to others for free	■		■	■				
OIP12	OI communities			■	■	■			
OIP13	Outsourcing R&D	■				■			
OIP14	Outward licensing of IP				■		■	■	
OIP15	Regional innovation clusters								

Table 3.15. Correlation between theoretical framework relating Open Innovation practices and internal factors and results from multiple case study (Part II)

OI practices		Internal factors							
		Firm size	Age	Modularity	IP Management	ACAP	Corporate culture	Ambidexterity	Technology strategy
OIP16	Scientific committee								
OIP17	Shared facilities/facilities sharing								
OIP18	Staff exchanges (Personnel Exchange; Human resource transfer)								
OIP19	Technology scouting								

Table 3.15. Correlation between theoretical framework relating Open Innovation practices and internal factors and results from multiple case study (Part III)

OI practices		External factors				
		Sector	Technological turbulence	Market turbulence	Intermediaries	Proximities
OIP1	Corporate venture capitalist					
OIP2	Crowdsourcing					
OIP3	Endowed chairs					
OIP4	Innovation contests					
OIP5	Innovation marketplaces					
OIP6	Innovation networks					
OIP7	Inward licensing of IP					
OIP8	Joined development					

Table 3.16. Correlation between theoretical framework relating Open Innovation practices and external factors and results from multiple case study (Part I)

OI practices		External factors				
		Sector	Technological turbulence	Market turbulence	Intermediaries	Proximities
OIP9	Joint venture					
OIP10	Lead user method					
OIP11	Made own innovation available to others for free					
OIP12	OI communities					
OIP13	Outsourcing R&D					
OIP14	Outward licensing of IP					
OIP15	Regional innovation clusters					

Table 3.16. Correlation between theoretical framework relating Open Innovation practices and external factors and results from multiple case study (Part II)

OI practices (other terms used for same practices)		External factors				
		Sector	Technological turbulence	Market turbulence	Intermediaries	Proximities
OIP16	Scientific committee					
OIP17	Shared facilities/facilities sharing					
OIP18	Staff exchanges (Personnel Exchange; Human resource transfer)					
OIP19	Technology scouting					

Table 3.16. Correlation between theoretical framework relating Open Innovation practices and external factors and results from multiple case study (Part III)

Finally in Table 3.17 we summarize the main findings in relation to the research questions 4, 5, 6 and 7, which we formulate at section 3.4 of this chapter.

Research questions	Main findings
RQ4. Is the Open Innovation model appropriate to foster and reinforce innovation activities between OEMs and SME suppliers in the automotive sector?	<p>OEM and SME suppliers find that OI is a model that reinforces their relationship. After collaborate in OI joined projects (OIP8), the OEM has more confidence to share problems and needs in which the supplier can contribute.</p> <p>Some of the OI projects have given the opportunity to develop new products to some SME suppliers that originally were service companies. That motivates the suppliers to collaborate closely with their OEM customer because the relationship is a win-win relation.</p>
RQ5. Which OI practices are currently used by automotive SME suppliers and which benefits they obtain from these OI practices?	<p>Joined development (OIP8) with customers (OEMs but also with other customers, in cases where the SME has a bigger customer base) and suppliers is the more common practice among SME suppliers.</p> <p>One of the SMEs has experience with inward licensing of IP (OIP7), two Innovation contests (OIP4) with a group of universities, something that is completely new in the OI literature, and two joined developments (OIP8) with suppliers. This case study is particularly interesting because this SME supplier developed their first innovation contest in 2006, with the help of an intermediary (a consultancy company with expertise in OI practices), involving several universities nearby geographically.</p> <p>After this first successful experience, they replicate the same OI practice on their own in 2010, in their subsidiary firm in Portugal and in this occasion they invite their OEM customer in Portugal to collaborate with them. They achieve a design for an innovative new product and the opportunity to present the results to the industrial managers of all the Volkswagen</p>

	<p>consortium assembly plants in the world.</p> <p>Other two SMEs, both with expertise en ICT technologies, participate in regional clusters (OIP15).</p>
<p>RQ6. Which barriers and enablers can occur by adopting OI practices by SMEs automotive suppliers?</p>	<p>Because of its limited human resources, SMEs find very challenging to develop OI activities in parallel with day-to-day activities. SMEs perceive that large companies are very slow taking decisions to develop OI practices.</p> <p>Also the non-systematization of the OI management in OEMs is a barrier to promote this kind of practices with them. SMEs are concerned about the lack of definition in the distribution of intellectual property in OI practices with OEM customers.</p> <p>The SMEs find that the relationship with OEMs is mainly unidirectional; the OEM poses a challenge and invites them to bring innovative ideas. In the other direction, these suppliers find lot of barriers to propose their own innovative ideas to its OEM customer. Therefore they ask for a figure that can be responsible of management of these ideas inside the OEM's house. That figure is similar to the one described as the gatekeeper in the literature on OI (Chiaroni et al. 2011).</p>
<p>RQ7. Which are the contextual factors (internal and/or external) that can facilitate or hinder OI practices between OEMs and SME supplier in the automotive sector?</p>	<p>Internal factors that facilitate OI practices:</p> <ul style="list-style-type: none"> • Absorptive capacity: Those companies that have a bigger percentage of graduates report more experiences in OI practices and with more diverse kind of partners. • Intellectual property management: It is a challenging issue for SMEs, and most of them start being concern about IPR with their first experiences with OI practices. • Corporate culture: Collaboration and openness are in the DNA of most of these SMEs. Moreover, some of them, such as SME2 and SME4, have been funded with an openness strategy. The involvement of managing directors launching OI practices is also a positive indicator of this factor in most of the SMEs of

	<p>our sample.</p> <p>External factors that facilitate OI practices:</p> <ul style="list-style-type: none"> • Technological turbulence: Thanks to collaboration with their technology suppliers they can be in the state of the art of newest technologies and offer them to OEMs, which due to its size has more inertia which makes them slower to incorporate new technologies. • Proximities: Geographical proximity facilitates opportunities for OI between OEMs and suppliers SMEs. The figure of the resident technician is positively valued by SME suppliers, to enhance the confidence and the interchange of tacit knowledge that push the arising of innovation ideas. • Intermediaries: SMEs with low absorptive capacity can complement their capacities with intermediaries that will enable them to implement easily OI practices. <p>Internal factors that hinders OI practices:</p> <ul style="list-style-type: none"> • Ambidexterity: Is one of the main challenges for these companies, how to make compatible day-to-day activities with innovation activities with their limited resources. From an organisational point of view, from their first experiences in OI, the SMEs see the need to have someone with exclusive dedication to innovation activities. The SMEs that still do not have this figure in their company express the need to create that role in the coming years.
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Table 3.17. Main findings of our research from the multiple case study with SME suppliers

Taking into account the results of the multiple case study, we decide to deepen in the case of SME5, because this SME shows some interesting findings and in chapter 4 we present the first case study from an SME in the literature of OI analyzed using a retrospective case study.

CHAPTER 4

RETROSPECTIVE CASE STUDY

4.1 CASE SELECTION

In previous chapter, chapter 3, we conduct an empirical research using a multiple case study. Thanks to this qualitative research work we realize that the seven SMEs, which Volkswagen Navarra's managers have identified as proactive suppliers in innovation activities, have implemented OI practices.

Our results supports previous findings in the literature, obtained with quantitative research methods, that have claimed that SMEs have increasingly adopted OI practices in recent years and that SMEs pursue OI primarily for market-related motives such as meeting customer demands, or keeping up with competitors (Van de Vrande et al. 2009).

Moreover we have identified which typologies of OI practices have implemented these SMEs and we have realized that were eight different typologies of OI practices.

Our analysis of the results of the multiple case study, offers us some interesting findings about the relationship between context factors and OI practices. These findings highlight us that one of the researched SMEs, SME5, stands out from the sample in relation to several issues:

- The diversity of OI practices that has implemented.

- The diversity of partners which they have collaborated with and the fact that is the only SME that has reported OI practices with universities; an innovation contest (OIP4), which, to our knowledge, has not been previously reported in the literature of OI in SMEs.
- The success in their experiences with OI practices for NPD (new product development), such as they were able to develop two new innovative products by using innovation contests (OIP4).
- The evolution of their capacities along the time. At the beginning they need to collaborate with an intermediary for designing and managing their first OI experience. Later on they did it by themselves and finally they coped to generate internal capabilities for NDP.
- In relation to systematization, the intermediary proposed a process for the development of the first innovation contest (OIP4). Later on SME5 has improved this process, from their first experience implementing an innovation contest to the second one.

Therefore we find that a deeper analysis of the case of SME5 could shed light to the importance of context factors in relation to OI practices implementation and success, and to achieve some results that could help us to propose an strategy for implementation of OI practices for SMEs, in general or for specific typologies of OI practices.

4.2 RESEARCH METHODOLOGY AND DATA COLLECTION PROCESS

In order to obtain the best results from the in-depth analysis of the case of SME5 we choose as research method the retrospective case study. Retrospective case studies are a type of longitudinal case study design in which all data, including first-person accounts, are collected after the fact. The events and activities under study have already occurred, and the outcomes of these events and activities are known (Yin, 2008).

In retrospective case studies a time line of events and variables that changed over the time period is reconstructed after the events have occurred. All retrospective case studies have three factors in common: (1) data are collected after the significant events have already occurred, (2) researchers have access to

both first-person accounts and archival data, and (3) the final outcomes—which were presumably influenced by the variables and processes under study—are already known when data collection takes place. In the literature of OI research this methodology has been previously used by researchers such as Chiaroni et al. (2011), that analyses the case of Italcementi from 1990 to 2006, or Kirschbaum (2005), that analyses the case of DSM from 1990 to 2004.

Having selecting the retrospective case study method for our research we explained to SME5 the objectives and the methodology of this deeper research and they agree to collaborate. In a first meeting to look for the information, that they could already have and that can be useful for our research we discover that their managing director has participated in some workshops in relation to OI. They provided us the presentations that their managing director has prepared, with detailed information about their OI experiences, to share with the audience of these events.

The existence of such events shows the increasing interest in the business community by OI and the value that expert associations in working with SMEs (such as the indicated in Table 4.1.: ADEGI, CEIN and CEBEK) give to the dissemination of success stories like these from SME5, as a way to demonstrate to managers that OI is also possible for SMEs. Moreover one of the events was organized for the Automotive Cluster of Navarra, which supports our previous decision to choose the automotive sector for our research, because the sector seems to be interested in OI and therefore the results from this dissertation will find a favorable environment for dissemination to the automotive industry.

The following table summarizes the general information about these events:

Title	Organizer	Venue /Duration	Event date	Other participants	Audience	Summary of contents presentation
Open Innovation, is it just possible in big multinational companies?	ADEGI (Business Association of Gipuzkoa)	ADEGI facilities/ 4 hours	02/03/2011	5 other companies with open innovation experiences (3 of them SMEs) + 2 universities + 1 consultancy company	Manager from associated companies	The managing director from SME5 explained why and how they implemented their first innovation contest and the results from this experience.
Open Innovation: Tools and experiences to open innovation	CEBEK (Business Confederation of Bizkaia)	CEBEK facilities / 2 hours	05/05/2011	1 consultancy company	Managers from associated companies	
Advantages and opportunities of implementing open innovation models in the Automotive Cluster of Navarra	CEIN (European Business and Innovation Centre of Navarre)	CEIN facilities / 2 hours	10/24/2012	1 university+ 1 consultancy company + CEIN	Members from the automotive cluster of Navarra	The managing director from SME5 explained why and how they implemented their two contests.

Table 4.1. Events in which managing director of SME5 has presented their Open Innovation experiences

After the review of the information included in these presentations, we realized that almost all the information that we would need for the retrospective case study of SME5 was there: detailed information about the need that SME5 wanted to address with each OI practices; the chronology of each experience; the costs and the benefits of some of the practices; the kind of partners that collaborated with SME5, information about the process designed for managing the innovation contests (OIP4).

Moreover, these secondary information sources have been triangulated with data drawn for the interview conducted previously for the multiple case study of the previous section with the Technical Sales Manager (Yin, 2003). Finally, telephone follow ups and interviews with the managing director were conducted in order to gather some additional information. The gathered data and information allowed us to identify and analyze the phases that SME5 went through in the last eight years to evolve from a closed to OI model.

4.3 CASE STUDY

In this section we present the contents of this retrospective case study. To facilitate its comprehension at the beginning of the section, in Figure 4.1. we include a time-line that summarizes main events of this case study describing the journey of SME5, through which it evolved from being a closed firm in terms of innovation to become an open firm. The journey, according to the gathered information started indeed in 2006 and continues today. Figure 4.1 is a time-line that summarizes main milestones of this journey from SME5.

As we already included general information about SME5's characteristics and history in previous chapter (section 3.6.5), we avoid repeating these data in this chapter.

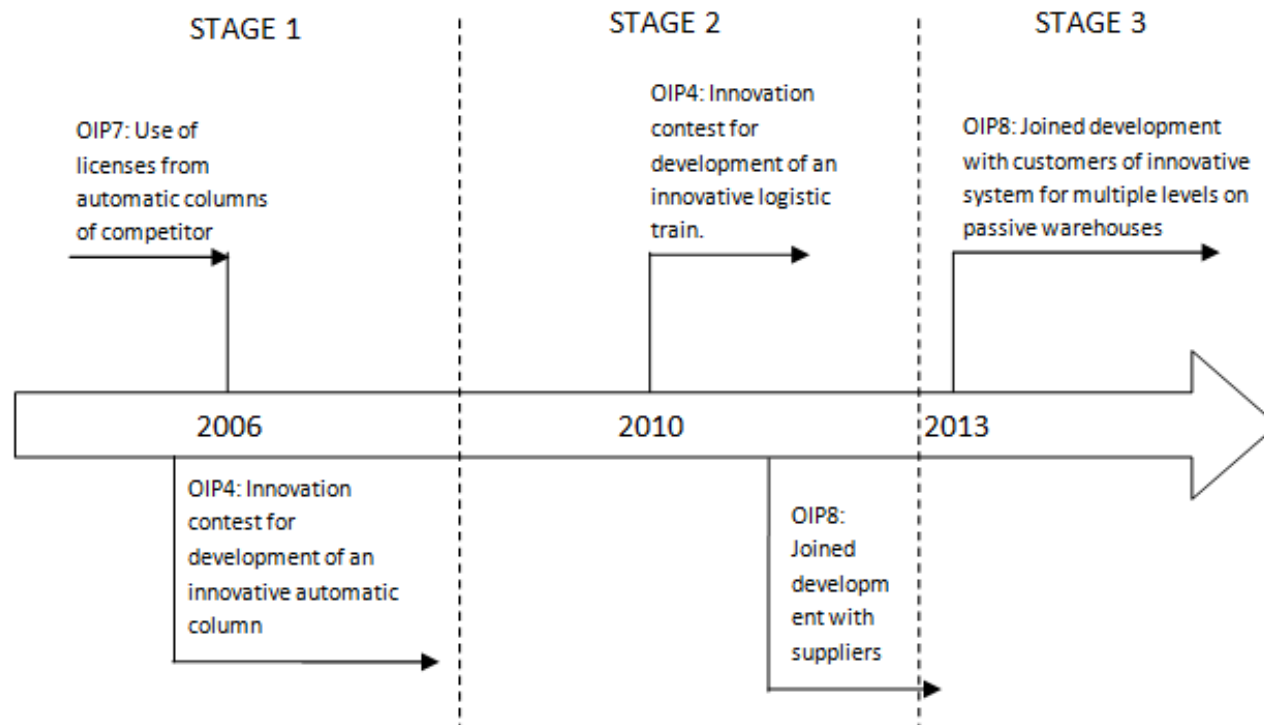


Figure 4.1. Time-line of the retrospective case study

4.3.1 FIRST OPEN INNOVATION EXPERIENCE (2006).

Competitive challenge

In 2006 the competitive positioning of SME5 was at risk due to some threats in the automotive sector, there was a growing demand for special containers in the sector, and SME5 was recognized in the market by their standard containers. In the special container, the biggest part of the added value of the product comes from the component called automatic column (see previous chapter, section 3.6.5. for a description of this component and Figure 4.2. for images of some special containers with automatic columns installed inside). As SME5 did not have its own automatic columns, they had to pay royalties to some of their competitors that already had their own designs of this product, to use their patents (OIP7) and install the columns of their competitors in their own containers. This was a threat for their competitive positioning and moreover a loss of potential added value.



Automatic columns

Figure 4.2. Examples of special containers with automatic columns

The automatic column is an ideal solution for parts requiring special care in handling (parts with areas not allowed contact with each other, fragile parts, heavy pieces that give ergonomic problems for operators, parts manipulated by robots and so on).

The sector in these years was suffering an increase in the rate of vehicle renewal; this meant an increase in the rate of design of new vehicle parts. This would have made the design of the parts that would be loaded into the columns would have a shorter life-cycle.

In relation to technological trends two main topics were emerging at that time. The first one was the use of new materials to reduce vehicle weight (for improving the environmental impact) and shock absorption (improved security). The second one was the use of automation elements, such as robots or manipulators, for the elimination of direct labor in many assembly tasks.

The future of SME5, at this moment, depended on its ability to change, adapt and take advantage of new opportunities in a market as competitive, dynamic and changing as the automotive sector.

Therefore they decided to develop their own automatic column, a product that could give them visibility on the market and also avoid dependence of their competitors in this product of added value. This decision was taken by the direction board and the managing director took directly the responsibility of managing this NPD project.

Process and resources

The first thing that the managing director did was create an internal multidisciplinary team with their own staff. This team included five people from two different areas of SME5: three from technical office (two designers and one draftsman) and two from the production area. With these profiles, the managing director looked to integrate from the beginning of the project all matters relating to the technical and economic feasibility for manufacturing the new product.

After that, he looked for external collaboration, in particular he was looking for a consultancy company that could complement their internal capabilities in the following areas:

- Intellectual property management: SME5 will need to protect their development and ensure that their new product does not conflict with patents of its competitors and that means having knowledge about search, analysis and definition of international patents.
- Experience in processes to generate innovative products: Until then SME5 products had been generated in an informal way, there was not a systematic process to generate new ideas neither to value these ideas nor to take decisions about which could be developed.

The managing director started searching for a suitable partner and thanks to personal contacts, he found an innovation consultancy company that was located in the capital of their province. This was a small company, with 10-15 workers, but very specialized in innovation management and with references from previous projects of NPD with SMEs. The managing director met with the director of the consultancy company, explained their need and asked for a proposal to collaborate with them. Figure 4.3. presents the process that the innovation consultancy proposed to SME5.

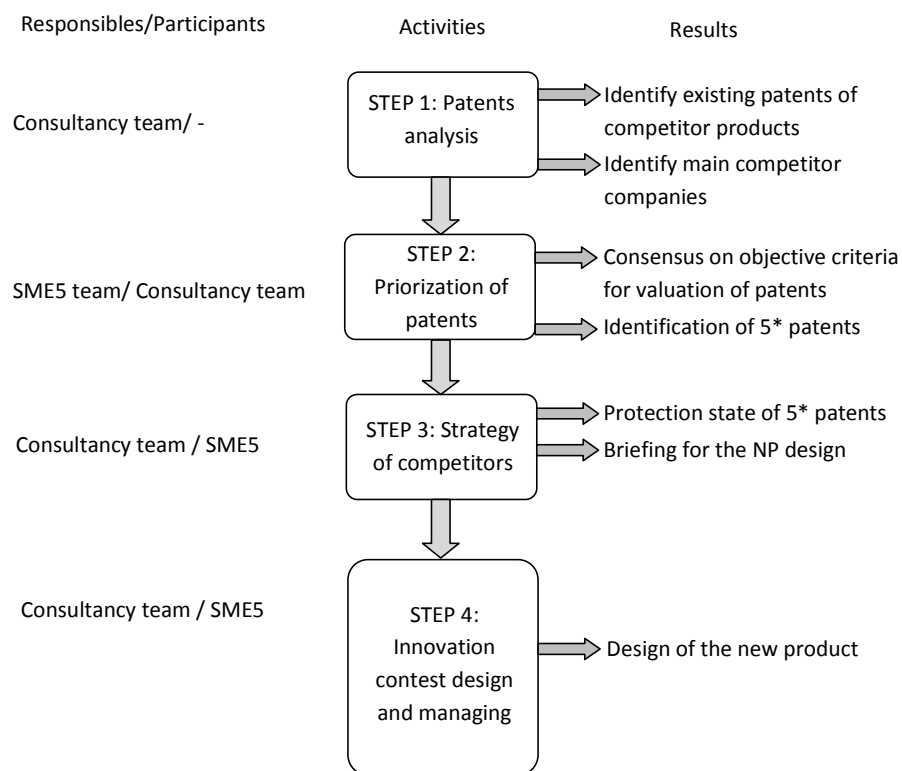


Figure 4.3. NPD process proposed by the consultancy company to SME5

It is important to highlight that in Step 4 the consultancy company proposed to implement an OIP, an Innovation Contest (OIP4) for the design of the new product.

Now we explain in detail how this process took place after the managing director of SME5 made the decision to outsource to this consultant.

STEP 1: Findings and preliminary analysis of existing and valid patents of automatic columns

The project development required continuous collaboration between the internal team and the consultancy team. In the first part of the process, the work was centered in collecting information from the analysis of existing patents for similar products as a key input for the establishment of the design requirements for the new automatic column. This information would be obtained by the team from the consultancy company from patents databases and after they would organise some sessions with the team from SME5 to analyze these patents.

This information was obtained by the team of the consultancy company from databases of patents, and after this, they analyzed all these patents to obtain a first vision of this information with the following objectives:

- Find different ideas for new developments that could help them to find multiple solutions for a technical problem.
- Identify trends in the solutions adopted by competitors along the time and understand the technological evolution followed by each competitor.

After this analysis they found more than thirty different solutions for the same function. In Figure 4.4. as an example are shown three figures from some of these patents. Moreover they had identified the main technological trends that have emerged in the automatic columns in the last twenty years to answers the evolution of the automotive sector, such as the change from solutions based on “hit” to solutions based on “drag” or the change on materials used for these products, the introduction of electronic control, and so on.

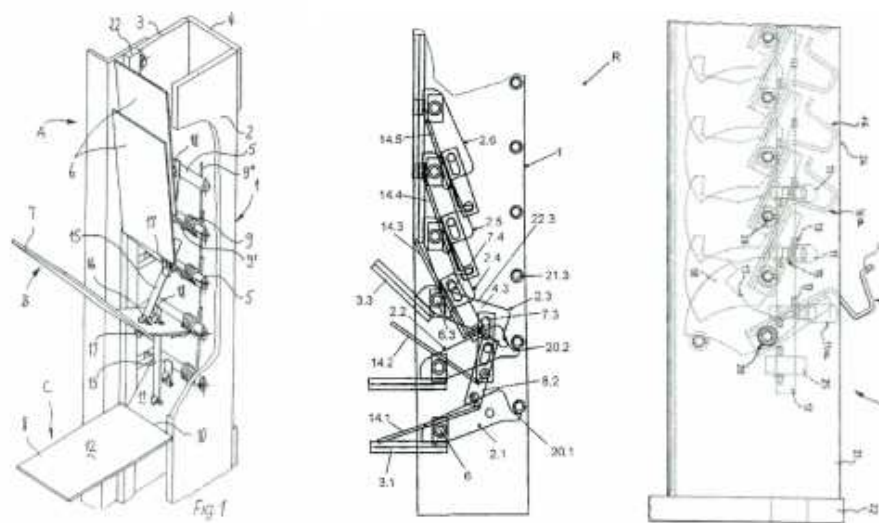


Figure 4.4. Examples of different solutions for automatic columns from analyzed patents

STEP 2: Objective prioritization of patents

The second step of the project was to share the information obtained from the databases of patents with the internal team of SME5. The main objective was to discuss this information and work together to identify the design requirement for their own automatic column, taking into account existing solutions on the international market. In figure 4.5, we show an example of the type of tables used to evaluate and compare the patents in relation to a set of criteria selected by the internal team of SME5.

The criteria selected included technical and economical parameters and the valuation that the internal team did was qualitative. For each of the criteria the internal team from SM5 evaluates whether the proposed solution in each patent has advantages (the cell is colored in green), disadvantages (the cell is colored in red) or if neither one nor the other (the cell is colored on white). The last column, was a summary of the valuation for each patent, more stars indicated a better valuation.

PATENT	ASIGNEE	DATE	PRECIO	PAISO	CAMBIO PAISO	CIBRE	MATERIAL	FACILIDAD FABRIC.	FIABILIDAD	PUNTAJACION
GB2148618	FORD	1986								★
EP0192611	SCHWEIZERISCHE	19/02/1986								★★
EP028173	AUSTRIA, METAL	1987								★
US4712881	BRILL	1987								★★★
EP0216224	VERENIGTE	1988								★★★
US618861	FABRIC. ELECTRICAS	1991								★★
EP0338214	FORD	26/09/1992								
EP0604237	HUMBERT FRERES	23/12/1993								★★
EP0610406	CORNET	19/01/1994								★
EP0484700	CROON & LUCKE	31/08/1994								★
EP0696234	FORD	26/09/1997								★★★★★
EP0813237	FORD	06/09/1997								★★★★★
EP13167040	MTS	01/09/2001								★★★★★
EP0890631	MTS	17/10/2001								★★★★
EP0940246	SCHAMMBACH	07/09/2003								★★★★
EP0946271	MTS	23/07/2003								★★★★
EP1340687	WEIDNER	19/11/2003								★★★★
DE2811310	MTS									
EP0879417	MTS									
EP1328458	MTS	2003								
	MTS	2003								★★★

Figure 4.5. Example of summary table of patents analysis

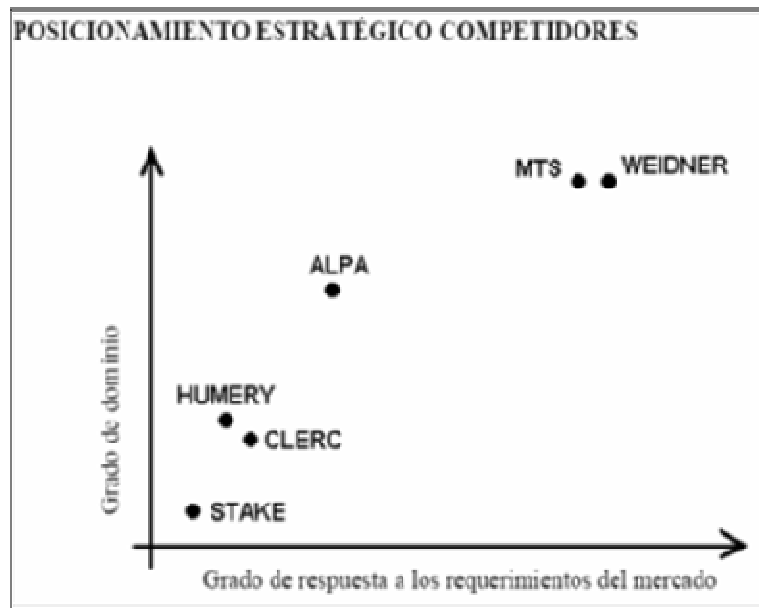


Figure 4.6. Strategic positioning of the main competitors

COMPETIDOR	COLUMNA	CONTENEDOR	CLIENTES	MERCADO
ALPA				
WEIDNER				
HUMERY				FRANCIA
MTS				
CLERC				FRANCIA
PAÛL MULLER				ALEMANIA
STAKEHILL				INGLATERRA

Figure 4.7. Analysis of products, customers and geographical market of main competitors

A final task of this step was to analyze the state of the protection (effective date and geographic area of protection) of the “five stars” patents identified in step 2 and the claims from each of them. Finally the team achieved the objective of defining explicitly and consensually the requirements for the new product.

STEP 4: Generation of ideas for NPD

In this step it starts the creative phase of the NPD process. First the team from the consultancy company drafted the competition rules for the innovation contest (OIP4), including the information that they would provide to the participant students. This information included references to the “five stars” patents in order to provide to the participants codified information that could be valuable for them to understand in a short time the requirements and desirable characteristics of the new product.

They also met the managing director from SME5 to agree about the prizes for the innovation contest (OIP4). They agree to reward the three best works, because the consulting firm told to the managing director that in previous experiences had shown them that having several prizes increased the number of participants because students thought the odds of winning a prize would increase.

Following they contacted with the four schools of mechanical engineering that were located closer to SME5. Two of them were public and the other two were private. The geographical proximity was important because the consultancy team wanted to achieve a close collaboration with some teachers from these schools to try that the works done by the students for the SME5’s innovation contest (OIP4) were evaluable for some of their subjects. This would suppose an additional motivation for students and also favor that the teachers would supervise the work of their students and give them advice if they need it. These organisational details could help you get a better level of quality for solutions received.

The consultancy company told to the managing director that they were designing the contest (OIP4) to obtain a controlled number of works, to prevent the number of entries received could overwhelm the capabilities of evaluation from SME5 in a reasonable time period and looking for high quality results.

Finally three of the four schools disseminated the innovation contest (OIP4) to their students and two of these schools used the innovation contest (OIP4) as an evaluation work for one subject.

The innovation contest (OIP4) was launched in these three engineering schools, spreading the contest through posters placed in the notice boards of schools and also directly through the teachers involved. The competition rules and the technical information in relation to existing patents that could serve students as references (“five starts” patents” were located in the web server of the company and the students could download the document from there. The deliverable of the innovation contest (OIP4) may be a physical panel with a clear description of the proposed solution for the automatic column, which should include sketches and a writing description of the mechanism that would automatically ran the movement of the pieces in the column. In Figure 4.8, 4.9 and 4.10. we shown the deliverables from the winner and the two finalists of the innovation contest (OIP4).

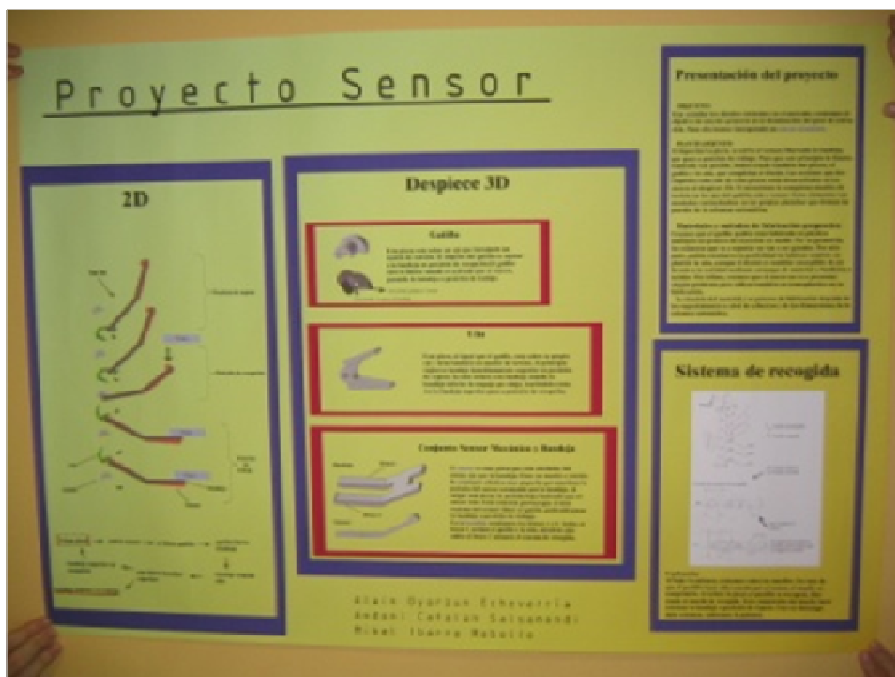


Figure 4.8. Deliverables from the three finalist of the Innovation Contest (1st Prize)

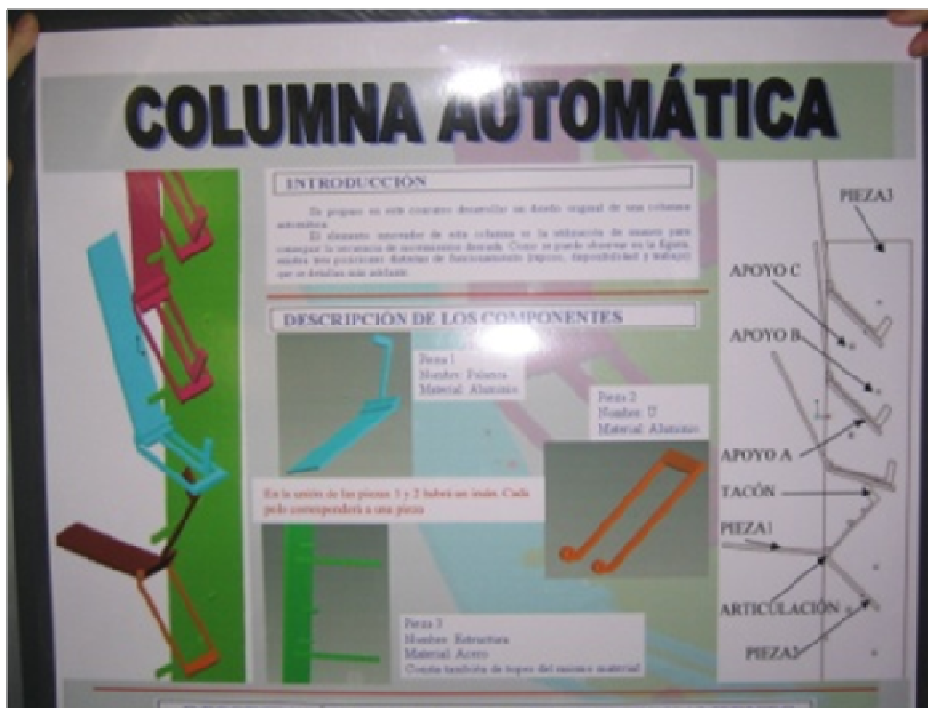


Figure 4.9. Deliverables from the three finalist of the Innovation Contest (1st Finalist)



Figure 4.10. Deliverables from the three finalist of the Innovation Contest (2nd Finalist)

During the development of the innovation contest (OIP4) period, the teachers that accepted the challenge from SME5 as practical works from their subjects established some contacts with the team of SME5 to clarify some doubts. The participation of students from these two schools was clearly higher than in the school in which no teachers involved in the competition.

When the deadline for receiving the works of the participants closed, all the works were carried to the facilities of SME5 and stayed in one of their meeting rooms for being individually reviewed by all the members of the internal team.

Two weeks after, they had a meeting, coordinated by some members of the team from the consultancy, where the internal team put together their valuations of the works and selected the three finalists shown in figure 4.8. The general comments about the result of the contest were that, in general, the proposed solutions were quite innovative in relation to the existing solutions on the market. The members of the internal team from SME5 told that they

thought that, due to their excessive knowledge of existing solutions from competitors, their creativity when they wanted to design a new solution for this product would be lower than those received from the Innovation contest (OIP4). This result is in line with Almirall and Casadesus-Masanell (2010), which concluded that an OI strategy allows the firm to discover areas of the product landscape that would be hard to imagine otherwise.

On the other hand, some of the solutions received would have been more complicated to manufacture than competing products and consequently more expensive, but the three final solutions, and the first prize in particular, pooled innovation and simplicity, a winning combination for this product.

Before the communication of the results of the innovation contest (OIP4) a patentability analysis to the Spanish Patent Office of the winning solution was sought and after confirmation of patentability of the winner solution, the results were announced and the awards to the winning students were awarded.

Results from the experience for all the participants

The managing director of SME5 valued qualitatively the benefits that they obtained from this experience in three time horizons:

- Short-term: Based on the winning concept of the innovation contest (OIP4), they have designed and developed an automatic column that has enabled to SME5 to consolidate their position into the automotive market with a new own product, eliminating dependencies on third parties (competitors).
- Medium-term: They have identified different lines of product evolution, more technologically advanced, which would allow SME5 answer in the near future to new opportunities in the changing automotive industry.
- Long-term: They have developed a design capacity of own product that has allowed them to gain positions in the value chain of the automotive suppliers. This new product would give them visibility in their value chain and access to purchases of special containers.

The internal team from SME5 that participated in the design and management of the innovation contest (OIP4) highlighted the creativity of the students. In

general they found that the solutions proposed by the students were more innovative than those that the internal technicians had proposed before. They described the ideas proposed by the students as “fresh air” for their internal staff. Students did not have so strong references as SME5's staff and for the ideation stage of the innovation process, this characteristic clearly enriched the creativity of the proposal solutions.

SME5 also assessed the quantitative benefits of this experience with the data included in Table 4.2.

CONCEPT	2006	2007	2008	2009	2010
Automatic columns	0 €	363.453 €	7.180.718 €	1.090.359 €	1.308.431 €
% Automatic columns to automotive sales	0	3	16	14	14
Automotive sector sales	8.272.982 €	10.913.101 €	13.808.446 €	7.670.373 €	9.450.710 €
% Automotive sales to total sales	61	80	71	47	90
Total sales	13.788.304 €	13.641.376 €	19.726.351 €	9.034.557 €	10.500.789 €

Table 4.2. Quantitative benefits from the new automatic column of SME5

As we can see in this table, the impact on sales of the new automatic column was very quick and since their launching to the market on 2007 this product maintains a stable contribution of about 15% of automotive sales, allowing to offsetting a decline in sales of other customer sectors that occurred sharply with the economic crisis since 2008.

Concerning the rest of the participants in the design, management and development of this innovation contest (OIP4), they also obtained relevant benefits from this experience, which are summarized in Table 4.3. This is in line with the proposition of Slowinski and Sagal (2010), which states that partners are better able to reach compromises when they focus on mutual interest.

Collaborator	Tasks	Benefits	
		Quantitative	Qualitative
Innovation consultancy	(1) Design the process for NPD; (2) Patent research; (3) Design of the innovation contest; (4) Contacts with engineering schools; (5) Support SME5 team for systematic evaluation of received works	They received the payment agreed on their proposal for collaboration with SME5	They strenght their relation with the universities and have a new succesfull reference as intermediaries in an open innovation project for the automotive sector, that is one of the relevant sector in their geographical market.
Teachers from the engineering schools	(1) Introduce the contest to their students; (2) Have a challenge from a real company to motivate their students to apply their knowledge in mechanical design		Positive impact on personal CV and better valuation of their capabilities to connect with the industry in their universities + Have more elements to motivate their students with the practical work of SME5 in their subjects + Include SME5 in their contacts and send them invitation to other initiatives from their engineering schools.
Students	(1) Propose innovative concepts to solve the challenge of SME5	For the winners, the prizes	For all the students: enrich their CV and portfolio + practical application of the knowledge adquired in the subjects

Table 4.3. Benefits for the other participants

4.3.2 SECOND OPEN INNOVATION EXPERIENCE IN NPD (2010).

Competitive challenge

The following experience in OI of SME5 was launched in 2010. The automotive market at that time was increasing considerably the rate of renewal of vehicle models and new production management concepts that favored flexibility in production, such as Kanban, were causing changes in SME5's market.

Many of SME5's customers were adopting the logistic system ideated by Toyota. That system implies a radical change in the internal logistic of the assembly plants. One of the main changes was that in the areas of logistics and final assembly, automation elements (such as robots and manipulators) lost

importance and the organisation of these areas was being designed to support direct labor.

One of the changes that was more related to SME5's products was the shopstock (stock supply close to workstation) concept. Figure 4.11. shows the basic principles of this concept and how this concept affects to the assembly line and its logistics.

In area 1, the new concept changes from the previous logistic model where a pallet truck carry large containers of parts this area, to an structure of modular shelves with small boxes that contain parts that are located as close as possible to the assembly line.

In area 2, there is a system of small modular trains, called "logistic trains", that are compound of hand-portable containers, which supply the line, making frequent deliveries, such as happens in a real supermarket.

Main advantage of hand-portable containers in place of large containers is the improvement of logistics productivity. Expensive-to-run lift trucks are replaced by small versatile trains circulating between shopstocks and the line sides. Small container flows are set up to shopstocks with side racks providing better rotation of circulating assets.

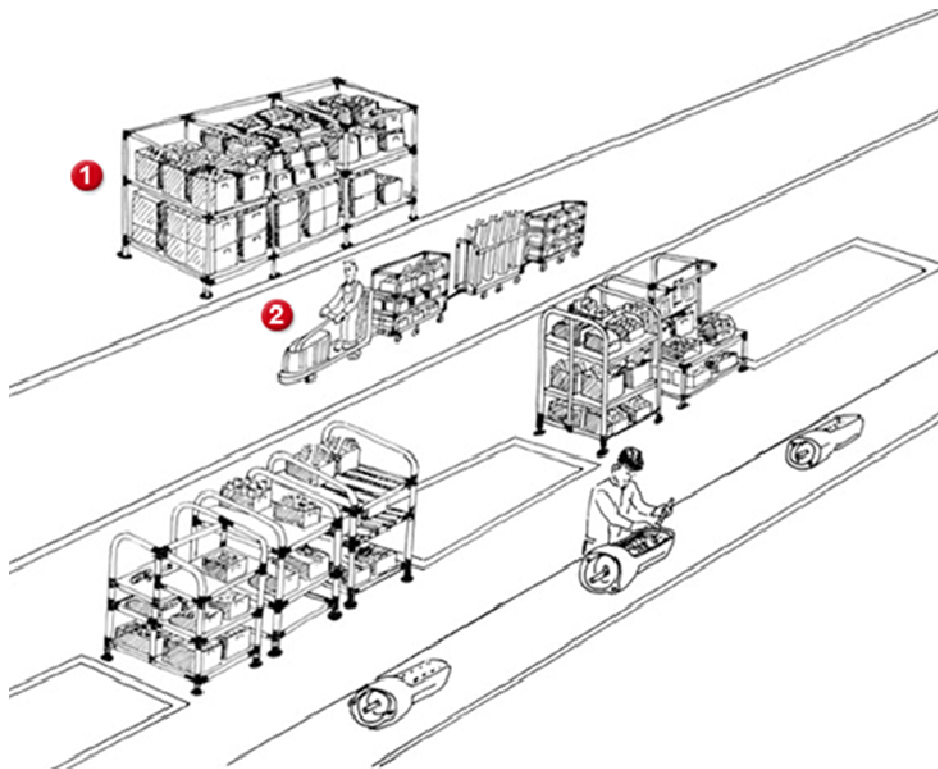


Figure 4.11. Description of shopstock concept

These changes affect directly to SME5's main products for internal logistic in automotive assembly plants, the containers, because these elements are designed to be transported by pallet trucks.

SME5 instead of looking this situation as a threat, decide to look at it as an opportunity to develop a new product, their logistic train system.

Process and resources

STEP 1: Lessons learned from previous experience

In this occasion the Managing Director of SME5 decided to make some changes in relation to the previous innovation contest (OIP4).

First, he decided not to use the services of any intermediary. From the previous experience the SME5's internal team learns how to design and management an innovation contest (OIP4) therefore he thought that it was time to apply these new capabilities in their NPD process.

Second, the results from the previous innovation contest (OIP4) were successful, but the managing director thought that thanks to this experience and the "lessons learned" some changes could be implemented in the previous process to achieve a higher quality of the received contributions.

After discussing with the internal team that participated in the previous innovation contest (OIP4), they came to three conclusions:

- (1) They would like to involve a new external agent in the innovation contest (OIP4), a customer. The participant students will have the opportunity to visit customer facilities and that the customer technicians could explain them the need what they want to solve with the logistic train and shown the physical space where the new product would be used. Moreover if the customer had a strong brand, it would be an additional motivation to the students and to the teachers from the universities, as to gain visibility for a big company and that could be the germ of a future job or collaboration.

- (2) They would like to show students their internal resources and capabilities. The students, with this knowledge, would be more aware of assets and capabilities of SME5 for taking them into account when thinking about the feasibility for industrial production of their proposals.

- (3) Ideas received from students are like "raw diamonds" that technicians from SME5 need "polish" to develop the final design of a new product. Taking these ideas from other people, in that case students, imply to think the reasons why each part of the design is like it is, to imagine what was the student thinking on when he designed each part of the solution.

Taking these ideas from other people, in this case students, imply to think the reasons why each part of the design is like it is, to imagine what was the students thinking on when they designed each part of the solution. This could imply more time for developing and also the possibility of misunderstandings that would avoid achieving the most

value of the students' designs. Why not to integrating the selected students in their technical team, using existing tools in the universities (such as practices or final degree projects) to extend on the time the relationship with the winner students? Apart for these benefits for SME5, also the motivation of the students to participate could increase with this opportunity. It would be a great opportunity also to achieve a deeper contact with some students and perhaps some of them could be hired from the company in the future. Apart for these benefits for SME5, also the motivation of the students to participate could increase with these opportunities.

STEP 2: Leadership and internal working team creation

The next step was to create the internal team to design and manage the innovation contest (OIP4). In this occasion the leader of the team would be the Technical Director of their plant in Portugal, because he had a close relationship with one of their customers there, Volkswagen Portugal that had interest in this product development, and moreover he has a close relationship with a local engineering school, with excellent reputation in their country, that was located near their facilities.

This Technical Director knew in detail the experience of the innovation contest (OIP4) developed in 2006 in SME5, by the internal diffusion that SME5 made of this success, and as a result, when the Director General proposed him to lead the working team for this new project, he quickly accepted. Moreover, in the internal working team were included two of the technicians that had participated in the previous experience. For them it was recognition of work well done and their motivation to participate was very high. The rest of the team was integrated by one technician from the technical office and two technicians from the production department, all of them from the Portuguese plant of SME5.

STEP 3: Contacts and implication of external agents

At this stage of the project the leader of the working group contacted with both external agents, the customer and the engineering school to explain them the initiative and look for their collaboration.

The university welcomed the proposal with great interest and thankful that the Technical Director had had them in mind for this experience. The university

took the compromise to look internally for a teacher to who would like to use the challenge from SME5 as a valuated work in one of its subjects and support the students that will participate in the contest (OIP4).

From the Volkswagen Portugal side, at first their contact there, that was the responsible of the logistic area, was a little wary, but when the Technical Director explained the previous experience of SME5, he saw that the company had experience and had successfully developed an innovation contest (OIP4) before, and agreed to collaborate.

The agreement was to give the opportunity to the students that would register for participating in the innovation contest (OIP4), to visit their facilities and explain then how the new trend in internal logistic of assembly plants would change their needs, their working flow, ergonomics of internal logistic and assembly line, security issues and so on.

STEP 4: Finding and preliminary analysis of existing and valid patents

In this case, the team from SME5 subcontracted to the Spanish office of patents and trademarks a report on the state of the art about similar products in their geographical markets. This is a standard service that these offices give to third parties and, annexed to the report, they include to the company all the existing patents with validity dates.

After the reception of the report, the internal team met to analyze the results and to prepare a first draft of the information that they would provide to the participants in the innovation contest (OIP4) as formal information about the technical requirements of the new product and competing products.

STEP 5: Analysis of the strategy of their main competitors

Once the “five stars” logistic trains were identified in the previous step, the internal team looked for information about the main competitors. As far as the logistic train was a more novel product in the market, there were a low number of competitors and the development of this task could be done internally with the collaboration of the commercial department.

Some of the conclusions of this analysis were used to review the conclusions of STEP 4, and changed the weight that had some technical parameters for the new product, looking for a clear differentiation of their new product in the market.

STEP 6: Generation of ideas for NPD

First, based on the rules of the previous innovation contest (OIP4), the internal working team prepared the rules for the new one. Design parameters were almost the same (deadlines, kind of deliverables, prizes and so on), with two novelties:

- (1) The participants should register at the beginning of the innovation contest (OIP4). This condition was necessary for knowing the number of people that would participate in the visits to Volkswagen Portugal facilities and facilities from SME5.
- (2) The prize for the winner of the contest (OIP4) also included the possibility to collaborate with SME5 in the development of the new product as practices or final project for its degree.

Then the innovation contest (OIP4) was launched with a presentation in the engineering school with the participation of the Technical Director from SME5, and the visits to Volkswagen Portugal and SME5 were developed as planned.

In the deadline, SME5 received the deliverables of the students and the members of the internal working team proceeded to review these works. Once the individual valuations were made, they met to discuss about the works and to decide which would be the winners. In Figure 4.12. the winning solution is shown.

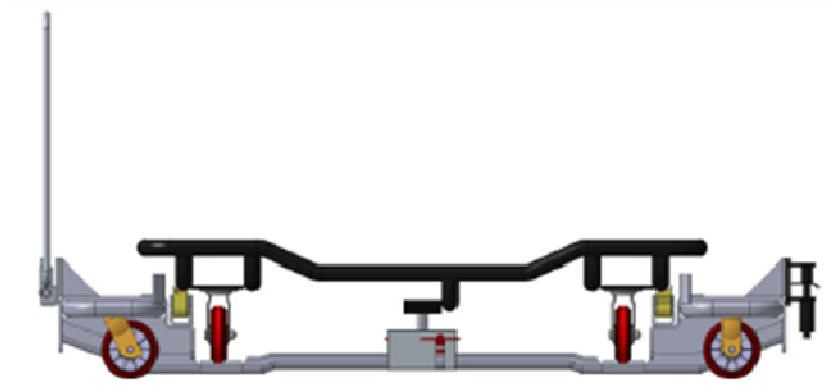


Figure 4.12. Winning solution from the innovation contest developed in 2010

According to the specified in the contest rules, the student author of this work received the first prize and the opportunity to collaborate further with SME5 for developing his solution until industrialization stage. The student started working in the Portuguese plant of SME5 and the product was developed in a first stage until the 3D modeling, such as showed in Figure 4.13. Finally SME5 patented the developed solution and the winner student figured as inventor in the patent.



Figure 4.13. 3D model of the logistic train of SME5

Thanks to collaboration in the innovation contest (OIP4) of Volkswagen Portugal, a few months later, SME5 had the opportunity to present a physical and functional prototype of its new product in Volkswagen Navarra to all the industrial managers of the assembly plants of Volkswagen group. This presentation was recorded in video and was used for commercial promotion of the product. In figure 4.14 is shown an image of this video. The complete video can be viewed at the following Internet address:

<https://www.youtube.com/watch?v=CV1s98iaV3w>

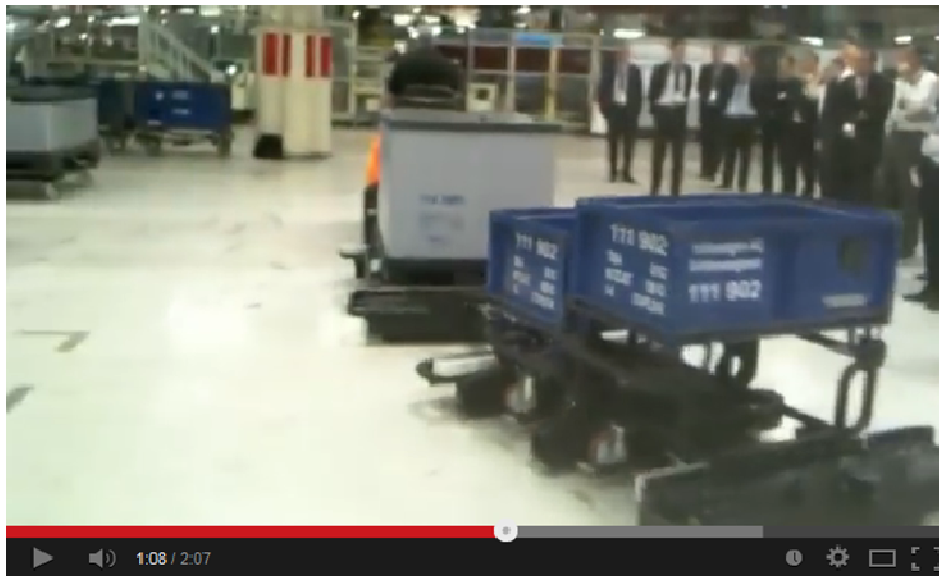


Figure 4.14. Image from the video of the presentation of the new logistic train from SME5 in Volkswagen Navarra.

Results from the experience for all the participants

The managing director from SME5 valued this experience as very successful, because they achieved the objective of developing their own logistic train in a very short period of time (less than one year) and thanks to the implication of their customer Volkswagen Portugal they had the opportunity to present the prototype of the new product to a group of senior managers of the Volkswagen consortium.

Also the other main change that they introduced in the design of the Innovation contest (OIP4), the opportunity to the winner student to collaborate with them in the development of the product was a success, and the time to arrive to the prototype stage of the project was shorter than in previous experience.

The internal team also perceived that the visits that they included in the development of the project to their facilities in Portugal and to the assembly plant of Volkswagen Portugal had a positive effect in the industrial feasibility of the received works from the students. The opportunity of students to have a closer contact during these visits with a typical customer for the product that

they had to design and with the production equipment, facilities and workers from SME5, allowed them to delve into the needs and capabilities of both stakeholders in a way that in the previous contest was not done.

Moreover as happened with the previous innovation contest (OIP4), further from the short-term results, SME5 valued also the medium and long-term results. They received many ideas, alternative solutions that enriched the creativity of their technicians for this family of new products, the logistic trains.

The external agents that collaborated in this innovation contest (OIP4) also had some relevant benefits as summarized following in Table 4.4.

Collaborator	Tasks	Benefits	
		Quantitative	Qualitative
Volkswagen Portugal	(1) The company open the doors of their facilities to the students that participate in the innovation contest, to show them the real context where the product that they have to design will work.		They strenght their relation with SME5 and also with the local university where the innovation contest has been launched. They marketed their brand, with students that are inside their objective public, and also attract students to apply for jobs there.
Teachers from the engineering schools	(1) Introduce the contest to their students; (2) Take students to the visits of facilities of SME5 Portugal and Volkswagen Portugal; (3) Support students for the development of their ideas and to prepare the deliverables for the contest. (4) Manage inside the university, the administrative process to arrange the collaboration of the winner student in the project of development of its design.		Positive impact on personal CV and better valuation of their capabilities to connect with the industry in their university + Have more elements to motivate their students with the practical work of SME5 in their subjects + Include SME5 and Volkswagen Portugal in their contacts and send them invitation to other initiatives from their engineering schools.
Students	(1) Propose innovative concepts to solve the challenge of SME5	For the winner, the prizes + The remuneration that he obtain from the collaboration in the development of the product with SME5.	For all the students: enrich their CV and portfolio + practical application of the knowledge adquired in the subjects

Table 4.4. Summary of benefits for external agents in second innovation contest of SME5

4.3.3 CHANGE IN THE INTERNAL ORGANISATION FOR NPD (2011-2013).

After their two innovation contests (OIP4), SME5 personnel felt more motivated to propose innovative ideas for both new products and improved existing products. Two of the ideas proposed were accepted by the direction of the company for being developed:

- The first one was the development of a glue that could replace welds in some of their products.
- The second one was the development of an anti-panic paint. Products like containers and shelves could be painted with this paint and, in case of power failure operators can see these products in the dark and avoid accidents.

Both experiences were developed with the collaboration of suppliers (OIP8) that were already suppliers of chemical products (paints, anti-corrosion protective product and so on) of SME5.

Technically, both developments were successful, but from the economical point of view, due to the quantities of these new products that could consume SME5, the cost of production at industrial scale was not affordable.

Anyway, SME5 obtained some qualitative benefits from these experiences that they explained us as following:

- “The relationship with these two suppliers was improved. Now the suppliers know that SME5 is a company that is open to collaborate with them in innovation projects, that is able to dedicate time from their technicians to explore and test the application of innovative products, and therefore they consider that their relationship has evolved and has strengthened”.
- “Internally, the motivation of our technicians to propose ideas for innovation also has strengthened. More when they saw that even when the results of the innovation project were not economically successful, our managing director valued positively the qualitative effect in their relationship with suppliers”.

The firm considered these experiences as a step in their path to create a culture of innovation in the company. The managing director said: “It is easy to encourage people to innovate when you have success experiences, but it is more important to do it when the experiences are not so successful, then is when you demonstrate that the bet for innovation is true, that you accept that failure is part of the game”.

After these experiences, in 2013 the direction of the company decided to hire a person to be full time dedicated to medium-long term innovation projects. This decision could be considered a first step for developing a structural ambidexterity in SME5. This will be the first technician separate from day-to-day activities and focused in new ideas for innovation in NDP or new designs of existing products.

The direction discussed about the profile that could be more suitable for this position and, taking into account the success experience from their innovation contests (OIP4), they decide to offer a position to an industrial design engineer. It was a new profile in their company, because all their technicians were from the branch of the mechanical engineering.

But the fact was that the students that had won their innovation contest (OIP4) were industrial design engineers and they found that this profile complemented their internal capabilities with new capabilities that could be a key in their NPD process. Moreover, this profile could be a perfect interface for managing future innovation contests (OIP4) and their contacts in the industrial design world could open new gates to new target groups for launching these kinds of OI practices, and also to absorb the knowledge achieved in these kinds of OI practices.

After the incorporation of this industrial design engineer, he started working in a NPD. The opportunity of this NPD was proposed by the commercial director of SME5. He suggested that there was an opportunity for a NPD in relation to passive warehouses because these products are currently only using one level of vertical storage. The proposed idea would be to design a system that would allow in a shopstocks configuration to have more levels of vertical storage, almost to the ceiling height. This type of system would optimize the use of horizontal space available in passive warehouses.

When this experimental research finished, in May 2014, SME5 was in the first stages of this innovation project and they were doing the project with internal resources. But they thought that in the prototype stage, they would open the

project to some customers for testing the prototype and improve the first designs with the customer point of view (OIP8).

4.4 FINDINGS AND IMPLICATIONS FOR THEORETICAL FRAMEWORK

The results of this retrospective case study will be analyzed in relation to the following two main subjects analyzed from a theoretical point of view on chapter 2 of this dissertation:

- Open Innovation Practices Typologies and their dimensions
- Relationship between context factors and OI practices

First, we seen in this case study that the OI practice that SME5 implemented more successfully, along the period included in our research, was the innovation contest (OIP4). Taking as reference the description of Adamczyk et al. (2012) of the design elements for an innovation contest (OIP4) the following table summarizes the design elements of both experiences of innovation contest (OIP4) from SME5:

Design elements	2006 Innovation contest	2010 Innovation contest
Media (online; offline; mixed)	Offline	Offline
Organizer (company; public organization; non-profit; individual)	SME5 (company)	SME5 (company)
Task/topic specification (open task/low; specific task/high)	Specific task/high	Specific task/high
Degree of elaboration (idea; sketch; prototype; solution; evolving)	Detailed design	Detailed design
Target group (specified; unspecified)	Specified (students of engineering)	Specified (students of engineering)
Participation (individual; team; both)	Individual	Individual
Contest period (very short; short term; long term; very long term)	Short-term	Short-term
Reward / motivation (monetary; non-monetary; mixed)	Monetary + Non-monetary	Monetary + Non-monetary
Community functionality (given, not given)	Not given	Not given
Evaluation (jury evaluation; peer review; self-assessment; mixed)	Jury evaluation	Jury evaluation
Attraction (online; offline; mixed)	Offline	Offline
Facilitation (professional facilitation; peer facilitation; mixed)	Professional	Internal
Sponsorship (family, friends and colleagues; universities; national associations; specific industries; mixed)	SME5 (Specific industry)	SME5 (Specific industry)
Contest phases (one, two; more)	One	One
Replication (biannual; annual; less frequent; more frequent)	Less frequent	Less frequent

Table 4.5. Design elements for SME5 innovation contest

From this detailed analysis of the design elements of both innovation contest (OIP4) we can see that the only design elements that is different between both Innovation contests (OIP4) is the facilitation. But as we have seen in the second Innovation contest (OIP4), results were considered more successful by SME5 because they achieve to obtain more industrially viable concepts. Therefore we can conclude that the list of design elements proposed by Adamczyk et al. (2012) could be enlarged with a new element, which we can name as “Relation between promoter and participants” and the possible values for that design element can be: Online, offline, no direct relation.

This new design element can reflect an aspect of the Innovation contest (OIP4), that we have found in the analysis of the SME5 retrospective case study, which seems to be critical to improve the empathy of the participants in two senses:

- The needs of the final user, in this case represented by VW Portugal.
- The capabilities and resources of the promoter, in this case SME5.

This case study did us to think that this empathy can be difficult to achieve in on-line Innovation contests (OIP4), where the direct contact between the participants and the promoter is limited or inexistent.

In Innovation contests (OIP4) where the participants can have a direct experience as end-users of the product to develop, is easy to achieve the empathy with the needs of the final user. However, in Innovation contests (OIP4) that look for developing products for industrial use, such as the case of SME5's Innovation contests (OIP4), this empathy would be hardly achievable without direct contact with the end users.

This direct experience of participants with end-users, the role played by Volkswagen Portugal in the second innovation contest (OIP4) of SME, also is the key to have the opportunity for SME5 for presenting the prototype of their logistic train to all the industrial managers of Volkswagen consortium, because this collaboration creates also a stronger link with the project and a deeper knowledge of the possibilities of the new product.

In relation to the visit to SME5 facilities and the direct contact with their technicians, we can state that this design element of the second innovation contest (OIP4), contribute to the industrial feasibility of the results of the innovation contest, but going further we found that also can be an interesting stream of research (OIP4) for the future, in particular its influence in the Not-Invented-Here (NIH) syndrome (Chesbrough, 2003; Katz and Allen, 1982; Lichtenthaler and Ernst, 2006; De Araújo et al. 2014). Recently De Araújo et al. (2014) have expanded the theory on NIH syndrome by developing arguments around moderators, such as employee training, that have the potential to mitigate the impact of undesirable attitudes via learning mechanisms. Our research opens a new research line about the effect of design elements on specific OI practices and their effect on NIH syndrome.

Following with this analysis, Table 4.6. shows the OI practices that SME5 has implemented along its history and details the value of each dimension that we have deeply analyze in chapter 2: Direction of resources flow, kinds of partners, innovation process stage and kind of relationship:

OI practices	Direction of resources flow	Kinds of partners	Innovation process stage	Kind of relationship
OIP7: License of automatic columns	Inbound	Competitors	Concept and product development	1 to 1
OIP4: 2006 Innovation contest	Inbound	Universities	Idea generation	1 to many
OIP4: 2010 Innovation contest	Inbound	Universities + Customer	Idea generation	1 to many
OIP8: Joined development of glue and anti-panic paint	Inbound	Suppliers	Concept and product development	1 to 1

Table 4.6. Dimensions for the Open Innovation practices implemented by SME5

As a result of this analysis we can confirm that the values of “Direction of resources flow”, “Innovation process stage” and “Kind of relationship” dimensions from the OI practices implemented by SME5 coincide with the theoretical framework developed in chapter 2 of this dissertation.

The only value that does not coincide with this theoretical framework is the “Kind of partners” in OIP7 with competitors, to buy them licenses of their patents of automatic columns, and be able to commercialize their special containers with this element, when they still had not their own design.

Other interesting observations from these results are the relation between two of this dimensions. For “Idea generation” innovation process stage, the “Kind of relationship” seems to be more suitable when the company interacts with many external partners, looking for creativity. While for “Concept and product development” innovation process stage, the dimension “Kind of relationship” shows that relationship with only one external agent is more suitable, this could be a higher intellectual property.

Following with the analysis of this case study in relation to the proposed theoretical framework of Chapter 2, we analyze the relationship between OI

practices and context factors (I: Internal context factors / E: External context factors). In Table 4.7, we present our conclusions and following we discuss about how this conclusions affect to the theoretical framework proposed in section 3.7 of this dissertation.

OI practice	OIP7: License of automatic columns
Context Factors (I/E)	Conclusions
Modularity (I)	SME5 can buy patents from their competitors because the special containers have a high degree of modularity and can integrate and element such as automatic columns from those other companies.
IP Management (I)	Thanks to have implemented previously this OIP7, SME5 have experience in patents and feel “comfortable” working with IPR.
OI practice	OIP4: 2006 Innovation contest
Context Factors (I/E)	Conclusions
IP Management (I)	With their previous experience of implementing OIP7, SME5 is capable of using patents as source of knowledge to develop a formal knowledge that could be provided to participants in the innovation contest to facilitate their understanding of the contents of the contest. Moreover the winner concept is quickly protected and this provides a competitive advantage to SME5.
ACAP (I)	SME5 has demonstrated a high capability of team working in this first innovation contest development. This is in line with Rammer et al. (2009) that state that human resource management and team work are innovation management tools that can help non-R&D performing SME5 to gain a similar success as R&D performers, especially when combined with each other or combined with external knowledge sourcing.
Corporate culture (I)	In chapter 2 we explain that in our literature review we have found that this factor is mainly related to top management

	<p>involvement, incentives structures and need for a champion supporting OI practices.</p> <p>In this OI experience of SME5 top management is the leader of the team from the beginning to the end of the innovation contest and this transmits to all SME5 staff the importance of this experience.</p>
Ambidexterity (I)	It is difficult for SME5 to find inside the company the time and expertise for NPD. SME5 look for accessing to complementary innovation assets to substitute the need for internal capabilities that require years to be acquired (Baum et al. 2000).
Technological turbulence (E)	Two main technological trends had emerged when SME5 decided to implement the first innovation contest (Baum et al. 2000): new materials to reduce vehicle weight and shock absorption.
Market turbulence (E)	When SME5 decided to implement the first innovation contest competitive positioning of SME5 was in danger due to some threads in the automotive sector.
Intermediaries (E)	Obviously, the collaboration of the innovation consultancy as intermediary is a key factor that enables the successful implementation of the innovation contest, facilitating this OI practice to SME, and that accelerates their learning curve and that teach them how to design and manage an innovation contest that can be affordable for them (in cost and time).
OI practice	OIP4: 2010 Innovation contest
Context Factors (I/E)	Conclusions
IP Management (I)	<p>The previous experience with the innovation contest helps to SME5 to develop forwards their IP Management, how to conduct a state of the art review, how to valuate patents and so on.</p> <p>Therefore in this second innovation contest, they feel confident to develop the contest on their own and do not need to subcontract again the innovation consultancy.</p>
ACAP (I)	SME5 detected in its previous experience some improvement areas and they were able to modify some design elements from

	<p>this second innovation contest experience and achieve successful results.</p>
Corporate culture (I)	<p>In this second innovation contest we discover that involvement of technicians that had participated in the previous innovation contest was recognition of their good job and would have a motivation effect on the rest of the company.</p> <p>Moreover, the leadership of the internal team was offered to the Technical Director of their plant in Portugal who knew in detail the previous innovation contest thanks to the internal diffusion that SME5 did of this success.</p>
Ambidexterity (I)	<p>In this second innovation contest, the complete design and management of the contest is developed with internal resources. These resources have compatibilized these OI activities with their day-to-day activities.</p> <p>But, it is relevant that following this experience the managing director took the decision to hire an industrial design engineer that will be responsible of medium-long term product developments. This is the first sign of structural ambidexterity, that could it be motivated by the difficulties to manage internally this OI experience at the same time that day-to-day activity.</p>
Market turbulence (E)	<p>Competitive position of SME5 in the market is threatened by the changes in the new production management concepts. Then SME5 makes a decision to develop a new product through a second innovation contest.</p>
Proximities (E)	<p>The selection of a local university close to the SME5 Portuguese location and the customer, VW Portugal, also close to them, facilitated the interchange of tacit knowledge among all the participants.</p>
OI practice	OIP8: Joined development of glue and anti-panic paint
Context Factors (I/E)	Conclusions
Corporate culture (I)	<p>These experiences could be considered unsuccessful, because their results were economically not suitable for industrial</p>

<p>application.</p> <p>In this occasion, the managing director disseminates the qualitative benefits derived from these two experiences, and that dissemination increase the trust of all the company in relation to OI activities.</p>

Table 4.7. Relationship between Open Innovation practices and context factors

As a summary of this analysis, following we present the new theoretical framework relating open innovation practices and internal factors (Table 4.8) and external factors (Table 4.9) that include results from the retrospective case study develop in this chapter 4.

The empirical research developed in this chapter provides us the possibility to contrast the theoretical framework in relation to the three different OI practices implemented by SME5 along this period from 2006 to 2014. In relation to this OIP we achieve the following conclusions:

- Innovation contest (OIP4): As can be seen in Table 4.8 there are two internal factors, Corporate culture and Ambidexterity, that have a high correlation with this OI practices typology because are supported by the literature review and by both empirical research methods (multiple case study and retrospective case study).

Three other factors, 2 internal (IP Management and ACAP) and 1 external (Intermediaries) present correlation with this OI practice typology in both empirical research methods, but not in literature.

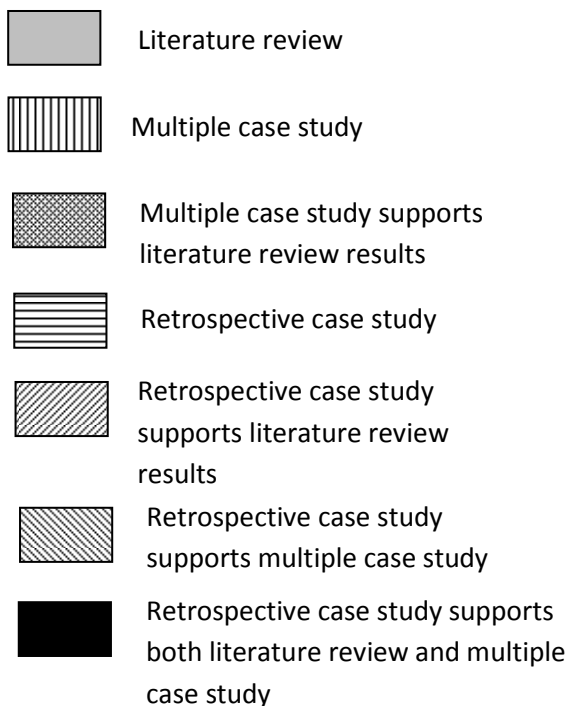
Finally, other three external factors (Technological turbulence, Market turbulence and proximities) have been identified just in the retrospective case study.

- Inward licensing of IP (OIP7): The factors that are related with this OI practice typology are Modularity, supported by the retrospective case study, and IP Management, supported by the literature review.
- Joined development (OIP8): Six factors, three internal (IP Management, ACAP and Ambidexterity) and three external (Market turbulence, Intermediaries and Proximities) were supported by the literature review and by the multiple case study. Only two factors,

one internal (Corporate culture) and one external (Technological turbulence) are supported by the retrospective case study and one of the other research methods.

It is interesting to note that in case of the OI practices more successful for SME5, the Innovation contest (OIP4), the retrospective case study results present a high correlation with the factors identified also in the literature review and in the multiple case study. That can be interpreted as a sign that SME5 has taken into account the right factors to implement this OI practice.

Just the opposite happens with the Joined development (OIP8) that they implemented twice in a short period of time with not so successful results. In that case in the retrospective case study we only identified two relevant factors while the literature and the multiple case study reported eight. This can be interpreted as a sign that SME5 had not took into account some relevant factors for implementing this typology of OI practice and this had a negative influence in their results.



OI practices		Internal factors							
		Firm size	Age	Modularity	IP Management	ACAP	Corporate culture	Ambidexterity	Technology strategy
OIP 1	Corporate venture capitalist	■				■	■	■	■
OIP2	Crowdsourcing					■	■		
OIP3	Endowed chairs								
OIP4	Innovation contests				▨	▨	■		
OIP5	Innovation marketplaces	■			■				■
OIP6	Innovation networks	■			■		■	■	
OIP7	Inward licensing of IP	■		▨	▨				
OIP8	Joined development				▨	▨	▨	▨	

Table 4.8. Theoretical framework for internal factors completed with the literature review, multiple case study and retrospective case study (Part I)

OI practices		Internal factors							
		Firm size	Age	Modularity	IP Management	ACAP	Corporate culture	Ambidexterity	Technology strategy
OIP9	Joint venture								
OIP10	Lead user method	■						■	
OIP11	Made own innovation available to others for free	■		■	■				
OIP12	OI communities			■	■	■			
OIP13	Outsourcing R&D	■				■			
OIP14	Outward licensing of IP				■		■	■	
OIP15	Regional innovation clusters								

Table 4.8. Theoretical framework for internal factors completed with the literature review, multiple case study and retrospective case study (Part II)

IP practices		Internal factors							
		Firm size	Age	Modularity	IP Management	ACAP	Corporate culture	Ambidexterity	Technology strategy
OIP16	Scientific committee								
OIP17	Shared facilities/facilities sharing								
OIP18	Staff exchanges (Personnel Exchange; Human resource transfer)								
OIP19	Technology scouting								

Table 4.8. Theoretical framework for internal factors completed with the literature review, multiple case study and retrospective case study (Part III)

IP practices		External factors				
		Sector	Technological turbulence	Market turbulence	Intermediaries	Proximities
OIP 1	Corporate venture capitalist					
OIP2	Crowdsourcing					
OIP3	Endowed chairs					
OIP4	Innovation contests					
OIP5	Innovation marketplaces					
OIP6	Innovation networks					
OIP7	Inward licensing of IP					
OIP8	Joined development					

Table 4.9. Theoretical framework for external factors completed with the literature review, multiple case study and retrospective case study (Part I)

OI practices		External factors				
		Sector	Technological turbulence	Market turbulence	Intermediaries	Proximities
OIP9	Joint venture					
OIP10	Lead user method					
OIP11	Made own innovation available to others for free					
OIP12	OI communities					
OIP13	Outsourcing R&D					
OIP14	Outward licensing of IP					
OIP15	Regional innovation clusters					

Table 4.9. Theoretical framework for external factors completed with the literature review, multiple case study and retrospective case study (Part II)

OI practices		External factors				
		Sector	Technological turbulence	Market turbulence	Intermediaries	Proximities
OIP16	Scientific committee					
OIP17	Shared facilities/facilities sharing					
OIP18	Staff exchanges (Personnel Exchange; Human resource transfer)					
OIP19	Technology scouting					

Table 4.9. Theoretical framework for external factors completed with the literature review, multiple case study and retrospective case study (Part III)

Finally we can state that our research contributes to clarify elements that are still under-research in specific OI practices, such as Innovation Contest (OIP4). Adamczyk et al. (2012) highlights that future research is required that investigates the design elements 'attraction' and 'facilitation' which are essential to understand how to attract participants to the innovation contest (Adamczyk, et al. 2012) and how to facilitate them during the contest (Haller et al., 2011).

In this retrospective case study, the attraction is a design factor that evolved from the first to the second innovation contest organized by SME5, thanks to the involvement of a customer recognized brand, which increased the attraction of the students to participate. On the other hand, the facilitation was mainly based on the involvement of teachers from the universities, in both experiences, which would act as a filter for solving questions and doubts from the students that would have optimized the dedication of the team from SME5 to these tasks.

Moreover taking into account the resources limitation of SMEs, the second innovation contest implemented by SME5 is a case that can be considered a good example of "low-cost" ideation contest, because the design is done with a clear objective of "resource economics", that means, how to achieve a balance between the quality of the results and the resources invest in the management of the innovation contest.

CHAPTER 5

CONCLUSIONS AND FURTHER RESEARCH

5.1 CONCLUSIONS

This chapter summarizes the main conclusions of the research work done in this thesis. We describe the contributions from both the academic and managerial point of view. Moreover, the limitations and difficulties encountered during the research are detailed, and future lines of research that are derived from this work, including projects that already have been launched are presented.

In observing this thesis as a whole, a parallelism related to photography can be very useful for explaining its development and contributions in a very visual way. Our research starts from a wide angle view of OI, conducting an extensive review of the academic literature on the topic, and then it evolves chapter by chapter until it arrives at a micro view of a retrospective case study of an SME, much like the macro function on a digital camera which allows small things to be photographed with high accuracy.

We believe that the contributions made in the course of carrying out this research, both from the theoretical and managerial point of view will be useful for academic researchers as well as for managers who face the challenge of opening their innovation process.

This thesis began with an overview of the OI paradigm, which allows us to offer a holistic but pragmatic vision, through the identification, definition,

characterization and classification of the 19 typologies of OI practices, thanks to a study of the literature, which produced the first theoretical contribution from this work. This contribution addressed objective 1, which was identified in Section 1.3 of this dissertation.

At this point we want to emphasize that these 19 typologies are not statics, which means that surely there are companies in the world that are developing and/or implementing new OI practices typologies that are not included in this work due to the delay between practice and academic research. That means that the most important contributions of our work in terms of OI practices typologies are not the 19 typologies themselves, but rather it is the systematic process followed to identify, define and characterize them, which may be used from now on by other researchers in order to include new OI practices.

The next step was to identify and classify the context factors that may be related to the implementation of OI practices. This was also a vast territory that needed clarification as well as unification, since in the body of literature that was current at the time our research was carried out, this area of research had been analysed in a very disjointed way.

Our main contributions in this sense are the identification and detailed description of each of the 8 internal and 5 external factors obtained from the review of the literature, which was described in Sections 2.6 and 2.7. This contribution answers objective 2, identified in section 1.3 of this dissertation.

After that, the combination of both theoretical contributions, namely the OI practices typologies and the context factors related to their implementation, which were developed in section 2.7 (where we analysed the relationships between the two concepts as reported by the academic literature), enabled the development of the theoretical framework that was presented in section 2.7, from which the general research propositions of this doctoral dissertation emerged and that was the base for the empirical research performed in this thesis.

In Chapter 3 we started with the empirical contrast of our theoretical framework. The research strategy designed for this part of the thesis included a particularization of the proposed theoretical framework for SMEs from the automotive sector, taking advantage of the opportunity to include the Cátedra de Empresa Volkswagen Navarra – Universidad de Navarra in this research.

The first research methodology that we decided to apply in this part of the thesis was a multiple case study. To identify the companies that would participate in the multiple case study we developed a round of previous interviews with four supplier coordinators from Volkswagen Navarra.

These interviews offered us the opportunity to expand our original research propositions by including four additional research questions, which could be answered with our research thanks to the possibility of triangulating information between supplier coordinators and SME suppliers.

With regard to research question 4, from the results of the multiple case study we realized that both OEMs and SME suppliers found that implementing OI practices reinforced their collaboration in innovation activities because the OEM had more confidence about sharing problems and needs that the suppliers could contribute to. Moreover we state that main motivation that pushed SME suppliers towards OI were the need to meet customer demands, keeping up with competitors and opening new markets.

Addressing research question 5, the SME suppliers reported eight different OI practices (OIP4, OIP7, OIP8, OIP10, OIP13, OIP14, OIP9 and OIP15), five of which were inbound practices. Despite being a small sample of SMEs we found that the implemented OI practices covered all the innovation process stages, from opportunity identification to commercialization, which could mean that SMEs can use OI practices all throughout of their innovation process. The joined development (OIP8) with customers and suppliers was the most common practices among the researched SMEs.

In relation to research question 6, the main barriers identified for SMEs by adopting OI practices were the following:

- They find it very challenging to develop OI activities in parallel with day-to-day activities.
- SMEs perceived that large companies are very slow at taking decisions to co-develop OI practices together.
- The non-systematization of OI management in OEMs is a barrier to promoting OI practices.

- SMEs are concerned about the lack of definition in the distribution of IPRs with OEMs.
- The SMEs find that the relationship with OEMs is mainly unidirectional, and they find a lot of barriers to proposing their own innovative ideas to their OEM customers.

Turning to research question 7 we found the following results:

- Absorptive capacity, IPR management and corporate culture are the internal factors that seem to facilitate OI practices for the SMEs studied.
- Technological turbulence, proximities and intermediaries are the external factors that seem to facilitate OI practices for the researched SMEs.
- Ambidexterity is the internal factor that hinders OI practices.

From the results of this multiple case study, we can say that we made relevant contributions fulfilling objectives 4 and 5 in section 1.3 of this dissertation. But at this point, we decided to delve more deeply in the case of one of the SME suppliers of Volkswagen Navarra, SME5, whose case shows interesting issues about the relationship between context factors and OI practices.

In Chapter 4, we carried out the retrospective case study of SME5 from 2006 to 2014. This retrospective case study provided us with the opportunity to understand whether the OI process changes over time as an organisation grows older, develops new capabilities and faces new challenges.

One of the findings from this retrospective case study, directly contributes to Research question 3, because in this case we can see how the collaboration of an innovation consultancy as intermediary, is a key factor that enables the successful implementation of the innovation contest. This intermediary helped SME5, using knowledge that they had acquired from previous experiences, to design and manage the first innovation contest of SME5, and this accelerated SME5's learning curve in successfully implementing this kind of OI practices in relation to cost, time and quality of results. This reveals that the intermediary factor has a substitution effect on the ACAP factor in this case.

Other relevant findings from this case study were the correlation of our theoretical framework with the results from this case study in the case of the innovation contest, as explained in section 4.5.

In relation to research questions 1 and 2, the results from our theoretical framework and its empirical contrast, show that the relationship between the effectiveness of OI practices and context factors is a fact. From this contribution, we can positively answer both research questions, and state that in-depth knowledge of internal and external factors from a company that decides to open its innovation process, helps enhance the selection of the most appropriate OI practices typologies and can be used by managers as key knowledge to increase the effectiveness of the implemented OI practices.

Additionally, some conclusions from this case study contribute to the clarification of the relevance of two design elements of the innovation contest (OIP4), namely attraction and facilitation, that Adameczyk et al. (2010) highlighted as essentials for understanding how to attract participants. According to the retrospective case study's results both design factors were directly related to the attaining of a balance between the cost of implementation and the quality of results.

We can state that from now on, researchers working in the field of OI can design their quantitative research studies using the typologies of OI practices proposed in this thesis. This common terminology will allow them to perform consistent comparative analysis to find synergies, complementarities and differences.

Moreover the proposed framework for relating OI practice typologies with context factors will serve as a guide for identifying un-researched relationship between both issues, which could be a seed for future OI research. Also this framework will serve as a guide for understanding how the already existing research into this field, fits in the proposed theoretical framework.

In terms of to practitioners we can summarize that our main contributions are the following:

- Clarification of the different OI practices typologies that practitioners could use to open their innovation with detailed information about advantages and disadvantages, barriers and enablers from each of these typologies.

- Identification of the context factors that should be taken into account when implementing OI practices typologies and which could be more critical depending on the specific OI practices.
- Understanding of the need for a dynamic strategy in OI implementation because capabilities are dynamical and will evolve as SME gain more experience implementing OI practices.

5.2 LIMITATIONS AND FURTHER RESEARCH

As detailed in section 1.4 of this dissertation, this research work has several limitations that suggest caution in generalizing achieved conclusions. The main limitations are the qualitative methodology followed in the empirical research and the focus on a specific sector, the automotive sector.

But from these limitations, future research lines emerge, such as the opportunity to perform a quantitative research to study implementation of OI practices in SMEs from different sectors. The results from a quantitative research could provide external validity of the proposed theoretical framework in this dissertation and consequently strengthen the validity of this framework.

Moreover, along this research work, many ideas for further research, that could enrich the OI theory and connect it with other theories, have emerged:

- To launch action research projects to experimentally contrast the application of the proposed theoretical framework in order to implement OI practices in SMEs or to promote OI collaboration between OEMs and their SME suppliers. In relation to this last issue, we can report that we are working now with the head of OI at Volkswagen Navarra to promote actions that will advance in this direction.
- To analyse this research work from the supply-chain perspective. The supply chain is a key element in business competitiveness and therefore, it is important to have a deeper understanding of the variables that influence on its performance. From this thesis we open a new research perspective in order to understand the influence of the implementation of OI practices, between customers and suppliers, on the performance of the supply chain.

- To deepen on the role of intermediaries in OI paradigm implementation. What different profiles of intermediaries are there? Are there specific profiles of intermediaries that are most suitable in relation to the OI practices that a company wants to implement?
- The results of the retrospective case study analysed in Chapter 4, shown that there are connections between the paradigm of OI and the field of NPD. In this particular case it appears that the implementation of an OIP, the innovation contest (OIP4) in this case, allows the NPD process to be systematized in SMEs. From this point of view, an interesting field of research is opened: are certain OIPs that are more suitable for systematizing the NPD and others that are most suitable for process innovation?

Other future research lines, more related to managerial issues, emerge also from this work:

- The results of our research could be a first step toward proposing a model for OI systematization in SMEs. Systematization of OI practices in SMEs can be an advantage that allows these companies to offset their limited resources to manage and develop innovation activities.
- Moreover, this thesis can be a starting point for helping large companies to define protocols for the development of OI practices with SMEs. The results of the thesis provide a deeper understanding of the critical factors to consider in this type of collaboration, thereby reducing the risk of failure thanks to:
 - (1) Choosing practices that have a greater chances of success in SMEs
 - (2) Identifying critical factors for managing OI practices in order to obtain better results

Finally, in the practice, new types of OI practices continue to emerge, and therefore, our theoretical framework will need to be upgraded in the future to include these new types of OI practices. But it is undeniable that our contribution to OI theory provides a systematic methodology to identify these new practices, describe them and relate them with context factors.

APPENDIX A: INTERVIEW QUESTIONNAIRES

SEMI-STRUCTURE INTERVIEW FOR VOLKSWAGEN NAVARRA

1. RELACIÓN CON PROVEEDORES:

- a. ¿Qué tipo de empresas proveedoras pertenecen al tipo de proveedores correspondiente (proveedores de piezas, proveedores logísticos, proveedores de servicio, proveedores de proceso)? Definición de cada tipo de proveedor.
- b. ¿Cuál es su labor en relación con este tipo de proveedores?
- c. ¿Cuánto tiempo lleva desempeñando esta labor?
- d. ¿Cómo se organiza la relación con estos proveedores en su departamento o área?
- e. ¿Qué se valora de un proveedor? ¿Qué tipo de indicadores se utilizan?
- f. ¿Quién realiza esa valoración y con qué frecuencia?
- g. ¿Cuántos proveedores de este tipo gestiona su equipo? ¿que % de ellos son proveedores regulares, es decir, con los que se mantiene una relación estable? ¿Qué % de ellos son PYMEs?
- h. ¿Existe la figura de “proveedores críticos”? ¿Cuántos proveedores críticos gestiona su equipo?
- i. ¿Cuál es el origen principal de las ideas para innovar que surgen en su departamento o área? ¿Qué % diría que son

internas? ¿qué % diría que surgen en proveedores? ¿y el resto dónde surgen?

j. ¿Cómo se gestionan estas ideas para innovar?

2. EXPERIENCIAS DE INNOVACIÓN ABIERTA:

- a. Experiencias en actividades de Innovación Abierta destacables de su departamento o área en los últimos 3 años.
- b. ¿Con qué tipo de agentes externos se han desarrollado?
- c. ¿Cómo surgieron? ¿fueron iniciativa de VW Navarra o de los agentes externos?
- d. ¿Cuáles han sido las principales barreras para ponerlas en marcha? ¿eran barreras internas o externas?
- e. ¿Cuáles han sido los principales beneficios de estas actividades (cualitativos y cuantitativos) (en el corto, medio y largo plazo)?
- f. ¿Puede estimar el coste de estas actividades o dar un rango de magnitud del mismo?
- g. Si volviesen atrás y pudieran empezar de cero cada colaboración ¿qué cosas cambiaría? ¿qué lecciones aprendidas en cada una de estas colaboraciones le parecen destacables?
- h. ¿Considera que la relación con los proveedores que han participado en esas actividades ha cambiado? ¿en qué sentido?
- i. Identificar proveedores PYME que puedan ser interesantes como casos de estudio para el proyecto. ¿Por qué son interesantes cada uno de ellos?

3. DATOS A RECOPIRAR SOBRE ACTIVIDADES DE INNOVACIÓN ABIERTA

1. Nombre de la actividad
2. Periodo de desarrollo
3. Agentes externos colaboradores
4. Origen de la iniciativa
5. Principales barreras para su puesta en marcha
6. Beneficios:
 - a. Corto plazo:
 - i. Cualitativos
 - ii. Cuantitativos
 - b. Medio-largo plazo
 - i. Cualitativos
 - ii. Cuantitativos
7. Coste aproximado
8. ¿Qué cambiaría de la experiencia?
9. Evolución de la relación con los proveedores participantes

SEMI-STRUCTURE INTERVIEW FOR SMEs**1. DATOS BÁSICOS SOBRE LA EMPRESA**

a. Describa brevemente la actividad de su empresa (unidades de negocio, productos y/o servicios y el peso aproximado en % que tienen en su facturación actual).

b. ¿Su empresa es PYME o no?

Definición de PYME según la Comisión Europea:

- Nº de trabajadores < 250
- Volumen de negocio anual \leq 50 millones de euros
- Balance general \leq 43 millones de euros

c. ¿En qué año se fundó la empresa? ¿Cuántos años de vida tiene?

d. ¿Cuál es el número aproximado de trabajadores actuales?

e. ¿Puede describir brevemente la estructura de su empresa y el reparto aproximado del nº de trabajadores en las diferentes áreas o departamentos?

f. Aproximadamente ¿cuántos de sus trabajadores se dedican exclusivamente a tareas de I+D+i?

g. Aproximadamente ¿Cuántos trabajadores del resto participan habitualmente en tareas de I+D+i?

h. ¿Qué porcentaje de su plantilla son titulados superiores?

2. PRIMERAS EXPERIENCIAS EN PRÁCTICAS DE INNOVACIÓN ABIERTA:

- a. ¿Qué actividad o proyecto considera usted que fue la primera experiencia de Innovación Abierta que se desarrolló en su empresa? ¿aproximadamente en qué año se puso en marcha? ¿Fue una iniciativa que surgió internamente o la oportunidad llegó de la mano del algún agente externo?
- b. Describir la situación estratégica de la empresa en ese momento y las principales necesidades a las que daba respuesta dicha actividad o proyecto.
- c. ¿Quién tomó la decisión de poner en marcha dicha iniciativa?
- d. ¿Cuáles fueron los principales factores que influyeron en la decisión? ¿el efecto de estos factores favorecía o dificultaba la toma de la decisión?
- e. ¿Cómo se puso en marcha? ¿qué pasos se dieron?
- f. ¿Qué agentes externos participaron en dicha actividad o proyecto y que roles y/o actividades desempeñaron?
- g. ¿Cómo identificaron a estos agentes? ¿existía una relación previa entre su empresa y dichos agentes? ¿Cómo se estableció el contacto?

-
- h. ¿Qué recursos humanos internos participaron en dicha actividad o proyecto y que roles y/o actividades desempeñaron?
 - i. ¿Cómo se financió? ¿Qué coste aproximado tuvo para la empresa?
 - j. ¿Cuáles fueron los principales problemas que surgieron en el desarrollo de esta actividad o proyecto? ¿cómo los afrontaron?
 - k. ¿Cuáles fueron los principales beneficios obtenidos de esta actividad o proyecto? (tanto cuantitativos como cualitativos).
 - l. ¿A partir de la experiencia de esta actividad o proyecto se sacaron lecciones aprendidas que han servido para posteriores actividades de Innovación Abierta? ¿Cuáles fueron?
 - m. Si se encontrase de nuevo en esa situación y momento ¿qué haría de forma diferente para afrontar una primera experiencia de Innovación Abierta?
 - n. La relación con los agentes externos que participaron en esta actividad o proyecto ¿se ha mantenido? ¿con cuáles de ellos? ¿se han vuelto a desarrollar otras actividades o proyectos con ellos? ¿se ha formalizado de alguna manera, mediante acuerdos de colaboración estables por ejemplo, esta relación?

3. EVOLUCIÓN DE LA INNOVACIÓN ABIERTA EN SU EMPRESA

- a. Posteriormente a esa primera actividad o proyecto de Innovación Abierta del que hemos hablado en el apartado 2 ¿se han desarrollado nuevas actividades o proyectos de Innovación Abierta? ¿de qué tipos? ¿a qué necesidades principales de su empresa han respondido estas actividades?
- b. ¿Cómo describiría la situación actual de la Innovación Abierta en su empresa?
- c. ¿Existen en su organización personas responsables de promover y/o gestionar las actividades de Innovación Abierta?
- d. ¿Se han formalizado procesos o procedimientos internos para la promoción, gestión y/o desarrollo de las actividades de Innovación Abierta?
- e. ¿Se dispone de algún tipo de indicador que permita medir la incidencia de la Innovación Abierta en la empresa?
- f. ¿En qué fase o fases del proceso de innovación diría usted que la Innovación Abierta aporta mayor valor a su empresa actualmente?

-
- g. ¿Con qué tipo de agentes externos es con los que más frecuentemente colabora actualmente su empresa en actividades de Innovación Abierta?

 - h. ¿Cómo identifica a estos agentes externos? ¿Utiliza algún tipo de intermediario para identificar y/o contactar con agentes externos? ¿Se incentiva de alguna manera a su personal interno para que identifique agentes externos de interés para su empresa en el ámbito de la innovación?

 - i. ¿Cuáles diría usted que son las principales fortalezas y debilidades propias de cada tipología de agentes externos con los que colaboran?

4. EXPERIENCIA EN ACTIVIDADES DE INNOVACIÓN CON VOLKSWAGEN NAVARRA

- a. ¿Considera que su empresa tiene actualmente una actitud pro-activa o reactiva en su relación con Volkswagen Navarra en el ámbito de la innovación?

- b. Si considera que es reactiva, es decir, que cuando se desarrollan actividades de innovación conjuntas es a iniciativa de Volkswagen Navarra:
 - Exponga cuales son las principales barreras que dificultan una mayor pro-actividad.
 - ¿Qué cambios cree que podrían potenciar una mayor pro-actividad por parte de su empresa para proponer nuevas ideas o para colaborar con Volkswagen Navarra en ideas que ellos puedan proponerles?

En la medida de lo posible ponga ejemplos que ilustren esta información.

- c. Si considera que es pro-activa, es decir, por parte de su empresa se aportan ideas a VW Navarra sobre innovaciones en las que podrían trabajar juntos:
 - Exponga cuales son los factores que más favorecen esta pro-actividad.
 - ¿Qué cosas podrían mejorar para que esta pro-actividad fuera más exitosa?

En la medida de lo posible ponga ejemplos que ilustren esta información.

APPENDIX B: PUBLICATIONS

This appendix gathers the papers written so far to the research from this work. These papers include contributions to international conferences. The papers are listed next and also are included their abstracts in their final format:

1. M. I. Rodríguez (2014) “How and when to implement OI in SMEs? Theoretical framework for practices selection.”. 7th European Academic of Management (EURAM) Doctoral Colloquium, Valencia (Spain).

ABSTRACT: The research field of OI (OI) has grown exponentially since Chesbrough coined the term in 2003. But after more than a decade of research, still remain some under-researched areas, as remarked in the most cited and recent reviews of the OI literature in recent years.

Some essential areas of research, that could clarify managers when could be more suitable for their companies to implement OI and how to do it, such as OI practices and success factors for their implementation, are still fragmented and uncompleted.

Moreover, when analyzing deeply the state of the art in OI, we realize that most of the references and case studies are relative to large companies. Therefore many researchers argue that OI in SMEs has been scarcely analyzed and emphasize the need to develop a theoretical framework in which SME managers can answer the question that arises them: when and how open their innovation?

Thus the present research proposal objectives are first to identify and characterize the different types of practices of OI and internal and external factors that influence the implementation and sustainability of OI practices. Second, propose a theoretical framework that helps to establishing relations among different types of OI practices, and the influence of the internal and external factors for their successful implementation. Third, the proposed framework will be particularized

for the case of SMEs, looking for identifying which OI practices seem to be more suitable for SMEs and their main challenges.

These objectives will be pursued using review of the literature methodology in a first step and after supplemented with qualitative methods based on multiple case study and longitudinal case study, that will provide solid foundations for the conclusions of this research and a deeper understanding on the field of implementation of OI practices in SMEs.

2. M. I. Rodríguez, F. Sandulli and J. A. Alfaro (2014) “The role of local subsidiaries in OI practices in MNEs: The case of Volkswagen in Spain”. WOIC 2014 (1st Annual World Open Innovation Conference), Napa Valley, California (USA) *Accepted extended abstract*.

ABSTRACT:

1. Introduction

Innovation in multinationals (MNEs) has traditionally been concentrated in their core units (headquarters) but is now increasingly dispersed among the subsidiaries in different countries with the globalization of research and development activities (R&D). However, the Open Innovation literature, despite young, has focused primarily on the Open Innovation strategies and external sourcing of knowledge of the headquarters. This paper aims to define a framework for Open Innovation strategies in subsidiaries by combining the literature on Open Innovation with the vast research on R&D activities of Multinational Enterprises. The Volkswagen case is used to illustrate the theoretically derived points throughout this paper, as it serves as a concrete example of how local and global Open Innovation Strategies, and their associated mechanisms, interact in practice.

2. The role of subsidiaries in knowledge sourcing

A major portion of corporate R&D still tends to be concentrated in firms' home countries. Moreover, the literature on Open Innovation has focused primarily on the Open Innovation practices at the headquarters (e.g. Rohrbeck et al., 2009; DiMinin et al., 2010; Lazzarotti et al., 2013).

On the other hand, there is a vast literature on R&D internationalization (e.g. Kenney and Florida, 1994; Florida, 1997), however this research has paid little attention to the external sourcing of knowledge in subsidiaries. With R&D remaining a centralized function within numerous firms, the R&D strategy of subsidiary companies may be seriously affected by the parent company (Veugelers & Vanden Houte, 1990). Deeds and Hill (1996), for instance, found evidence that firms listed as a subsidiary of another firm, performed significantly better in terms of bringing new products to the market than non-subsidiary firms. Subsidiaries of MNE can be open than local firms. For instance, Faems et al., 2010 found that the technology alliance portfolio diversity of firms, which are a subsidiary of another firm, is significantly higher compared with independent firms.

One of the most important distinctions between innovation activities of parent firms and subsidiaries is the different approach between research oriented activities and develop oriented activities. The literature shows that the activities of subsidiaries tend to be more focused on develop activities. According to Li and Kozhikode (2009) research-oriented activities usually are of greater strategic importance to MNEs than are development-oriented activities and therefore tend to be centralized in the headquarters. Moreover, research-oriented activities are more tacit in nature than are development oriented activities and are therefore less patentable and thus more susceptible to expropriation than the outcomes of develop-oriented activities. These differences explain why some MNE in China have implemented a thorough hierarchical compartmentalization of its R&D to protect its IPR (Quan and Chesbrough, 2008), where basically develop-oriented activities are performed by Chinese subsidiaries, while research-oriented activities are located at US headquarters.

Unlike research-oriented activities, development often requires close interaction with local firms, which tend to be better informed than a multinational subsidiary about the needs of local customers. In fact, MNEs now need to adapt their products and services to local markets than ever before, which often require extensive local knowledge (Florida, 1997; Howells, 1990a; Kogut and Chang, 1991). Therefore, applied research and production engineering need to be in close proximity to manufacturing (Kenney and Florida 1994). Florida (1997) found that even though a considerable fraction of foreign R&D activity appears to be related to supporting U.S. manufacturing, such activity primarily takes

the form of technical support rather than developing new technological assets. However, Florida (1997) also found that firms in the automotive sector were two to three times more likely to rate suppliers and manufacturing plants as very important sources of project ideas. In this case, external sourcing of knowledge stems from partners that are not primarily concerned with generating new knowledge but with producing a product or service. However, in the course of producing this product or service they generate new knowledge. For example, the suppliers of computer or auto components or systems are increasingly expected to generate the knowledge that is required to produce better or new components or systems. Some literature suggests that this practice of pushing the innovation function onto suppliers of components is increasing (Jürgens, 2000; 2001; Humphrey, 2003; Fuchs, 2005). Florida (1997) also found that firms in the automotive and chemical and materials sectors appeared to place more importance on market-oriented activities, such as supporting U.S. manufacturing operations (Florida, 1997). Confirming this, former literature on strategic partnerships also suggested that MNEs can significantly benefit if they are able to set up relationships with high levels of trust and commitment with their suppliers (Dyer and Singh, 1998). Suppliers' early involvement in the innovation projects increases innovation performance in most industries (Hagedoorn, 1993, 2002; Johnsen, 2009). Suppliers can enhance the success of a firm's innovation process by contributing their specific capabilities. Supplier involvement is also considered a promising source of competitive advantage by practitioners and management scholars alike (Teece, 1986; Kaufman et al., 2000; Sobrero and Roberts, 2002).

Therefore, our first research proposition will be that Open Innovation strategies in subsidiaries will be more development oriented. This statement is based on the evidence found in previous literature of the need for local adaptation of product and processes and the hierarchical compartmentalization of knowledge activities.

Moreover, according to previous literature on the automotive industry, suppliers will play a key role in the innovative activities. Therefore, we will pay more attention to the local the relationship with the suppliers within the Open Innovation program. In first place, we will consider the governance of the Open Innovation process studying the control relationship between the subsidiary and the headquarters. Previous research suggested that while subsidiaries require linkages to

headquarters to coordinate their activities, higher degrees of control from headquarters can have negative impacts on innovative performance (Davis and Florida, 1996, Florida 1997; Chiesa and Manzini, 2009). On the other hand, excess distribution may hamper the diffusion and replicability of new knowledge generated at the subsidiaries throughout of the organization. In fact, An important task for management is therefore to carefully analyze and design the activities to avoid stickiness becoming an obstacle for conducting dispersed and disaggregated open innovation in subsidiaries (Anderson and Pedersen, 2010). Furthermore, a number of studies highlight the tension between the autonomous pursuit of research and innovation and the need to channel and direct innovation activities toward areas of strategic interest (Gomory, 1989, Florida and Kenney, 1990). The strategic alignment of Open Innovation activities would explain also that innovation projects with external partners tend to be initiated by the subsidiaries rather than by the suppliers (Florida, 1997).

Therefore, our second research proposition will be that in order to improve innovative performance subsidiaries need to develop autonomous Open Innovation programs, as long as they solve the costs related to the transfer of valuable knowledge to the rest of the organization, and will initiate the Open Innovation process in order to stay aligned with the strategic priorities of the corporation.

3. The case of Volkswagen Navarra.

In Section 3 we study the case of Volkswagen Navarra to test our research propositions. This local subsidiary has recently created a local program of Open Innovation, a few years later than the parent firm started its own OI strategy. Using case study methodology we conducted face-to-face interviews, following a semi-structured protocol, with their main responsible of coordination of suppliers from four different departments of the company: quality department, logistics department, maintenance department and process and infrastructure department. In addition, we conducted also in-depth interviews with seven suppliers outstanding in the OI process according to Volkswagen managers.

The results confirmed the hierarchical structure of OI. While the partners of open innovation activities with the subsidiary were mainly small and medium suppliers, large suppliers cooperated directly with the

headquarters. OI projects mainly involved develop-oriented activities related to plant engineering or MRO activities.

Regarding the OI process at the subsidiary, it confirms to some extent also the second research proposition. The subsidiary has free action in the first stages of the OI process such as idea sourcing or the development of the first drafts of a solution. These first processes are managed by technicians from the subsidiary who identified the necessity and contacted the local suppliers that they believe had the best capabilities to develop the new solution. However, if the idea is going to be implemented or scaled up, the procurement department not located at the subsidiary takes the responsibility and this creates some inefficiencies. In first place, the innovation process is treated as a common procurement process. This implies that there is a competitive selection of suppliers, mainly following economic criteria and not taking into account the innovative capabilities of their suppliers. The result is that often the supplier implementing the new technological solution is not the same that developed it in the early stages. This process created two problems. On one side, there are problems in the implementation phases. On the other side, this process destroys the incentives of suppliers to participate in OI projects, since they take most of the risk and the financial effort (Volkswagen does not pay any reward to suppliers developing the first drafts of the solutions, except the material costs of prototypes) and could not get any income in return. Finally there are also IP issues created by this process since suppliers are also afraid of their knowledge, while being transferred to Volkswagen in the first stages of the OI project, could finish in hands of their competitors if the procurement department selects them.

Furthermore, the data from Volkswagen supports the statement that the OI process is strongly aligned with the strategic orientation of the firm since ideas start mainly from the subsidiary rather than from the suppliers. Suppliers do propose new developments, however most of them are not considered if there is not a pressing need related to these solutions. These proposals are not even recorded for future opportunities and get lost. This process, while keeping Volkswagen within the limits of corporate priorities, discourages the investment of suppliers in open innovation processes.

4. Conclusions

The paper has studied the role of subsidiaries in the open innovation strategy of MNEs. The case from Volkswagen Navarra confirms that the need for local adaptation of products and processes and the compartmentalization of R&D activities moves the focus of Open Innovation strategies in subsidiaries on develop-oriented activities. In second place, the study confirms that in the case of Volkswagen, the limited autonomy of the subsidiary creates strong barriers to the engagement of suppliers in the OI strategy of the firm.

The study has strong limitations such as the focus on a single subsidiary of a single MNE, however we believe that the insights provided by the theoretical framework and the results of the case study are a significant contribution in the way the open a new and valuable line of research with the goal of tapping the current research gap on the globalization of OI strategies.

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