

UNIVERSIDAD PÚBLICA DE NAVARRA-NAFARROAKO UNIBERTSITATE PUBLIKOA

**OPEN INNOVATION AND  
ORGANIZATIONAL INNOVATION:  
ORGANIZATIONAL INNOVATION AS  
LEVERAGE FOR OPEN INNOVATION  
PRACTICES AND THE EFFECT OF OPEN  
AND ORGANIZATIONAL INNOVATION  
PRACTICES ON BUSINESS  
PERFORMANCE**

**TRABAJO DE FIN DE MÁSTER**

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MÁSTER EN ANÁLISIS ECONÓMICO Y FINANCIERO 2012-2013

**Paula Anzola Román**

**16 de septiembre de 2013**

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**VºBº DIRECTOR DEL TFM**

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## **OPEN INNOVATION AND ORGANIZATIONAL INNOVATION: ORGANIZATIONAL INNOVATION AS LEVERAGE FOR OPEN INNOVATION PRACTICES AND THE EFFECT OF OPEN AND ORGANIZATIONAL INNOVATION PRACTICES ON BUSINESS PERFORMANCE**

### **ABSTRACT**

Open innovation is currently one of the hottest topics in innovation management, in particular since in 2003 it was conceptualized as “the use of purposive inflows and outflows of knowledge to accelerate internal innovation and to expand the markets for external use of innovation, respectively” (Chesbrough et al., 2006). This concept is based on the idea that the search for innovations is carried out with the participation of external actors (Enkel et al., 2009).

However, there is still research to be done regarding the process through which companies incorporate open innovation practices and take advantage of them (Huizingh, 2011). Furthermore, it has been known for some time that innovation involves much more than technology and R&D (Chesbrough, 2007); however the literature available on organizational innovation is relatively scant.

Taking this into account, the present work aims to give some insight into the following questions:

- How do firms turn their innovation efforts into value and how do they capture part of that value?
- How does organizational innovation have an impact on the optimization of open innovation practices?
- What are the effects of open innovation and organizational innovation on the business performance?

The work addresses the aforementioned topic both through a qualitative and a quantitative research method.

As for the first one, an in-depth case study methodology is used. The firm studied is a brake systems designer and manufacturer that underwent a profound process organizational innovation. Also, the context of openness in which the company had already been moving began to be systematized thanks to the implementation of the new structure.

A business model perspective is used to explore the first two questions raised in the introduction. The work will adopt the definition of Osterwalder and Pigneur (2009), the

developers of the widely used “Business model canvas” tool for describing and discussing business models. Based on this framework, the work analyzes the process of change undergone by the firm and illustrates how and to what extent the organizational innovation contributes to the creation and capture of value, focusing especially on the way in which the open Innovation practices are leveraged by an appropriate business model design.

As for the quantitative research, it is based on the Technological Innovation Survey, provided by the INE. This survey has its origins in Community Innovation Statistics (CIS), produced at a supra-national level. The sample selected corresponds to 1,323 firms from Navarre that completed the CIS for the year 2008.

By means of econometric tools applied to the aforementioned data, the work aims to answer the third question posed in the introduction.

# CASE STUDY - ORGANIZATIONAL INNOVATION AS LEVERAGE FOR OPEN INNOVATION PRACTICES: A BUSINESS MODEL PERSPECTIVE

## 1. INTRODUCTION

The firm studied is a brake systems designer and manufacturer that underwent a profound process of strategic change. In this process deep organizational innovation took place. All of this occurred in a context of openness to innovation practices in which the company had already been moving, but which was strengthened on the basis of this process.

A detailed analysis is carried out of the changes that occurred in the firm due to the implementation of certain organizational innovation, paying special attention to the transformation in the collaborative practices for innovating. A business model perspective is used to explore the following question: how can firms transform their innovation activities into creating and capturing value?

In short, with this analysis, and while being aware of the limitations of the methodology, the main objective pursued here is to provide understanding as to how organizational innovation may constitute a key factor for generation of value and also a trigger to optimize open innovation practices. As will be seen, the firm's organizational innovation had a decisive effect on the establishment of a model of open innovation and so on the optimization of the generating and capturing of value through the development of these practices.

The case study is structured as follows: first, we conduct a literature review and establish a theoretical framework, then we explain the analytical methodology used before turning to the details of the case study. Finally, we summarize the main conclusions to be drawn from the analysis.

## 2. THEORETICAL FRAMEWORK

The third edition of the OCDE's Oslo Manual (2005) defines **organizational innovation** as "... the introduction of a new organizational method in the practices, the organization of the workplace or the external relations of the firm". For organizational change to be described as innovation it must involve "the introduction of an organizational method (...) that has not been previously used by the firm and which has been implemented as a result of strategic decisions by its leadership".

This work pays special attention to the concept of organizational innovation in the belief that giving it an appropriate degree of recognition constitutes a significant advance in the analysis of innovation processes, something which is necessary to support technological innovation in a context of growing competition stoked by globalization (Ayerbe, 2006).

With regard to **open innovation**, research in this area constitutes one of the most significant contributions to the literature on innovation management, in particular since Henry Chesbrough established the concept in 2003. According to Chesbrough, open innovation consists of “the use of purposive inflows and outflows of knowledge to accelerate internal innovation and to expand the markets for external use of innovation, respectively” (Chesbrough et al., 2006). This concept is based on the idea that in the innovation process, the search for, development and marketing of innovations is carried out with the participation of external actors (Enkel et al., 2009). Table 1 lists the main differences between closed and open innovators.

**Table 1:** Key differences between closed and open innovators

Closed Innovators	Open Innovators
The smart people in the field work for us.	Not all the smart people in the field work for us. We need to work with smart people inside and outside the company.
To profit from R&D, we must discover it, develop it, 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 the market first.	We don't have to originate the research to profit from it.
The company that gets an innovation to the market first will win.	Building a better business model is better than getting to the market first.
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 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 business model.

Source: Chesbrough, 2003

Recently various researchers have made contributions to revising earlier work on open innovation (e.g. Dahlander and Gann, 2010; Huizingh, 2011; Lichtenthaler, 2011). Huizingh, among other issues, has alluded to the necessity to make more progress in research into the “how to” of open innovation. Our case study here seeks precisely to offer a compressed view of the complex process of innovation carried out by the firm (both with regard to open innovation and organizational innovation).

In this regard it is worth highlighting that according to the Oslo Manual (OCDE, 2005) the introduction of an open innovation practice may be considered to be an organizational innovation when it involves a new form of organization. More specifically this means the introduction of a new organizational method in the firm’s external relations (the Manual

makes explicit mention of examples of new forms of collaboration with other firms, with research organisms and with clients).

With the objective of making the description and analysis of these innovation processes more systematic it was decided to use a **business model perspective**. In general this refers to the description of the different components or blocks which, when articulated, reflect the way in which a firm elaborates a proposition which generates value for its clients and itself captures some of that value (Demil and Lecocq, 2010). In this work we use the business model perspective in order to highlight how the organizational innovation process served to leverage the open innovation practices and how both kinds of innovation create value for the firm. In this way we use the business model concept as a tool to illustrate the changes that occurred in the firm and the way in which value was generated and captured on the basis of these changes.

### 3. METHODOLOGY

A single case study methodology was used due to the necessity for an in depth analysis of the organizational change and open innovation practices of the firm. Though it is important not to lose sight of the limitations of this method, especially with regard to the possibility of making generalizations from its results, it still remains a very useful tool for understanding the “How” and “Why” of complex phenomena in their natural contexts (Yin, 2003). It is also useful as a basis for suggesting good practices (Huizingh, 2011). As has already been pointed out, the objectives of our study coincide exactly with the advantages of this methodology.

The choice of Frenos Iruña, SAL as the object of study was made on the following basis: (1) it is an established firm, founded in 1956, (2) it is involved in open innovation activities and (3) it has undergone a significant organizational innovation process. With regard to the gathering of information, the principle of triangulation was respected (Jick, 1979) through the use of multiple sources, which strengthened the credibility of the information gathered (Yin, 2003). Thus various in depth interviews were carried out with the managing director of the firm and those in charge of several of its departments. Similar interviews were carried out with a representative external participant with the object of mitigating possible distortions and subjective interpretations. The interviews were complemented with information from the firm’s accounts, strategic plans, reports and presentations, as well as industry reports and newspaper stories<sup>1</sup>.

With the objective of systemizing the information gathered and carrying out the desired analysis we used the business model concept as a methodological tool. In the first place we

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<sup>1</sup> The data collection is framed by the development of the BMOI project (Business Models for Open Innovation), part of EURIS, which is supported by the INTERREG IV C program and financed by the European Union’s Regional Development Fund (ERDF).



established the components of the business model. Once defined, the construct serves to describe, for each of these components, the change carried out by the firm.

Various authors have proposed definitions for this concept. Chesbrough and Roosenbloom (2002), Amit and Zott (2001) and Morris et al., (2005), among others. However, all uses of the term have several things in common (Zott et al., 2011):

- The concept of value is central. The business model describes how organizations create and appropriate value.
- The business model often extends beyond the firm and includes partnerships with other organizations.
- Business models involve a holistic or systematic perspective (as opposed to a particularistic and functional perspective). The business model can be viewed as a system made up of components, linkages and dynamics. It involves simultaneous consideration of the content and process of doing business.

Osterwalder and Pigneur (2009) developed a very large and detailed tool known as the business model canvas to discuss and develop business models. They identify nine characteristic components of the business model which cover five main areas:

- **Customers:** Describes for whom the firm creates value and the type of relationships a company establishes with specific customer segments.
- **Value proposition:** Describes the bundle of products and services that create value for specific customer segments.
- **Key resources and activities:** Describes the most important assets required and the most important things a company must do to make its business model work.
- **Income and cost flow:** Relates to the financial viability of the business model.
- **Partnerships:** Describes the network of external partners that make the business model work.

In the description of each block we seek to go deeper in the understanding of how the organizational innovation contributes to the generation and capture of value, paying special attention Open Innovation practices, specifically identifying them in the case of alliances.

#### 4. CASE STUDY: FRENOS IRUÑA, SAL

##### 4.1. THE FIRM

Frenos Iruña, SAL (henceforth, FISAL), located in Pamplona, Spain, was founded more than 50 years ago and was acquired by its employees in 1980. It currently designs, develops and manufactures components for brake systems for cars and industrial vehicles as well as for

other markets, such as off highway vehicles and the wind power sector. In 2010, its turnover was around EUR 8 million and it had 77 employees.

### 4.2. THE ORGANIZATIONAL INNOVATION PROCESS IN FISAL

By the end of the 1990s FISAL had consolidated a significant redirection of its business from the automotive sector towards off highway vehicles. From that point on it began to take a series of strategic decisions to adapt itself to its environment, improve its technical efficiency and competitiveness, diversify its business and develop a presence in a wider geographic range of markets.

As a support for these decisions, the firm in 2001 also embarked on a process of organizational innovation starting with the introduction of Value Generating Units (henceforth VGUs) and continuing with the introduction of Business Lines in the 2009 strategic plan.

- **The VGUs**

Due to the existence of many distinct parts to be manufactured, requiring different fabrication processes, in 2001 FISAL implemented an organizational process based on VGU or “mini-factories”.

This organizational change involved a break with the departmental structure of the firm and the design of a flatter organization. It was motivated by the desire to ensure improvements to the manufacturing process through better production management. The traditional departments (administration, commercial, human resources etc.) became supports for the VGUs, around which the whole organization began to revolve.

Each VGU is in charge of all of the processes relating to the family of products for which it is responsible and is made up of a manager, a technical team (made up of a person in charge of quality, a product design engineer and a person in charge of supplies, planning and billing) and a manufacturing team.

The VGUs allowed the firm to improve its design and manufacturing processes, improve its technical efficiency and improve coordination of the various production activities.

- **The Business Lines**

After the introduction of the VGUs the most significant milestone in organizational innovation took place in 2009, when the firm’s Strategic Plan introduced the Business Lines into the organizational model. These structure the organization according to the different segments of clients with which the firm deals: automotive, off highway, wind power, aftermarket and foundry. Its objective is to ensure the development of all the markets where FISAL is present, consolidate the firm’s traditional business and strengthen its new ventures.

Through this new structure, the commercial side of the business is emphasized, with importance being given to the capturing and keeping of clients and efforts made to ensure that resources are assigned in a manner appropriate for the achieving of each Line's objectives. FISAL's client base has undergone considerable growth and diversification and it was decided to adapt the company's organizational structure to this new reality.

As well as articulating the Business lines with the VGUs (various VGUs may be involved in each line) the aim was to optimize the technology and advances acquired with the development of each new product and so guarantee the continual transfer of knowledge so that improvements made with one product could feed into those to come.

In terms of the requirements set out in the Oslo Manual (OCDE, 2005), the VGUs and later the Business Lines are both organizational innovations in the workplace. The Manual establishes that this type of innovation occurs when new methods of allocation of responsibilities and decision-making power between employees and the division of labor are implemented, as well as new structural concepts, for example, the integration of different activities by the company.

As well as the aforementioned, in 2008 FISAL acquired Fundiciones Greyco, a firm that produces castings, a very important input for the firm's range of products. This vertical integration can be understood as an innovation in the organization of the firm's external relations, as it comes under the Manual's "new methods of integrating providers" (Oslo Manual, 2005).

It is important to note that that the organizational innovation carried out by the firm implied an open process, as it was implemented thanks to the collaboration with a consulting company. As stated by the General Manager of FISAL: "When implementing the VGUs (...) we worked hand-to-hand with consultants who were familiar with this type of model."

### **4.3. THE CHANGES IN FISAL FROM A BUSINESS MODEL PERSPECTIVE**

Turning now to the previously explained business model construct we will describe and analyze the changes undergone by FISAL due to the implementation of the organizational innovations. The analysis will highlight the contribution to the creation and capture of value and the optimization of the open innovation practices due to these innovations in the organizational design.

#### **1. CLIENTS**

Prior to the organizational restructuring FISAL mainly worked with the following two client segments:

- In the automotive sector, the focus was on a specific niche, manufactures of vehicles with short production run (the usual number being around 20,000 vehicles a year).

- In the off highway sector the clients were mainly manufacturers of tractors, excavators and vehicles generally related to public works and agriculture.

The firm put most of its efforts into the second sector, which represented 60% to 70% of its business.

The successive strategic changes that have been described above resulted in a segmentation of FISAL's clients and the implementation of the Business Lines is a clear reflection of this reality.

- **AUTOMOTIVE:** On the basis of the segmentation strategy this niche was strengthened through the opening of new markets with the design and development of new products. Among these new products worthy of particular note is the fabrication of brake components for a prototype electric car for one client. Also worthy of mention is the entry into new geographic markets, with the help of collaborators, and even competitors.
- **OFF HIGHWAY:** As in the case of the automotive sector, in this case there has also been an entry into new geographic markets and the development of new products.
- **WIND POWER:** Braking systems are produced for manufacturers of wind power generators.
- **AFTERMARKET:** The production and sale of replacement brakes is a long standing activity in the firm and represents a small proportion of its sales volume.
- **FOUNDRY:** Fundiciones Greyco was acquired by FISAL. Although it provides services for external clients its main function lies within FISAL itself, participating in the manufacture of braking systems.

From this perspective the organizational innovation embodied in the Business Lines contributed to the creation of value in the following ways:

- Through the optimization of the use of resources and the organization of activities with the aim of capturing new clients and maintaining the loyalty and satisfying the expectations of existing ones.
- The consolidation of the traditional business at the same time as developing new markets.

## 2. VALUE PROPOSITION

FISAL's value proposition lies in its specialization in short run production, the quality of its own design and in the involving of the client in the whole process, from the start of the project, through the design of the prototype and its testing and on to the production phase

for a successful product. Without any doubt, this is one of the characteristics that define the essence of the firm.

Manufactures of vehicles with short production runs have greater difficulties than those that produce with longer runs in obtaining high quality components. The bulk of brake manufactures are not competitive with production runs of less than 100,000 a year. FISAL, by contrast, has both its staff and production management orientated towards short production runs and can be competitive at levels as low as 5,000 units (though in general it works at around the 20,000 units a year level). Thus, producing well designed, quality niche products forms the basis of FISAL's competitive advantage.

On the basis of the systematization of the segmentation of clients, the firm manages a specific product range for each Business Line, defined as an organizational innovation, as well as a distinct approach to and treatment of those clients in each case.

We now turn to setting out the differential characteristics of the value proposition of the automotive, off highway and wind power business lines.

- **AUTOMOTIVE:** The focus here is on short production runs. FISAL offers quality design to clients who cannot permit themselves the luxury of designs produced for long production runs.
- **OFF HIGHWAY:** The focus here is on design. Clients in this segment have difficulty finding suppliers who can provide them with products with the parameters of the automotive sector with regard to design and manufacturing quality.
- **WIND POWER:** Though design is also very important here, price competitiveness is of even greater importance. The products concerned are very heavy and involve a lot of raw material costs. It is also the case at the moment that the manufacturers of wind power generators are experiencing strong pressure on their profit margins.

In conclusion, it is safe to state that the organizational innovations carried out by FISAL have allowed it to clearly identify the characteristics of its value offer for each client segment and so allow the firm to concentrate on the most important issues for each Business Line in order to allow it to further construct and develop its competitive advantage.

### 3. RESOURCES AND KEY ACTIVITIES

The importance of internal design of products manufactured by the firm, as well as its capacity to carry out the whole process of development of new products, from the reception of the initial request till the delivery of the new product, specifically designed for the client's needs and including the testing of prototypes and production processes, has already been indicated. Thus the firm's knowledge base and dedicated facilities are very important resources. The design, development and testing of prototypes are key activities

for the firm. According to this, the R&D activities tending to generate innovations are also a great factor of success. Indeed, FISAL has consolidated a long tradition of internal innovation, which has allowed the firm to support and develop its Open Innovation practices. In fact, it is through internal R&D activities that firms enable their capabilities of scanning and integrating external knowledge (Arora and Gambardella, 1990; Laursen and Salter, 2006). Also, it is important to highlight that the concept of open innovation involves an engagement with external sources of knowledge, not a total reliance on them (Chesbrough, 2003, Berchicci, 2013).

The development of VGUs and Business Lines strengthens the development of internal technological innovation through the establishment of synergies and the continual transfer of knowledge among the various families of products. It has already been explained how the rupture of the firm's departmental structure permitted the improvements of the process of design and fabrication through improved coordination of activities, leading to the optimization of technical advances. As a result of the interaction between the VGUs and various Business Lines, these advances flow naturally and quickly so that the improvements obtained in one product are incorporated into the rest of FISAL's product range.

#### **4. INCOME AND COST FLOW**

The firm's income comes from the sales of its various products. Noteworthy among its costs are those associated with the design and fabrication of its products (these are proportionally greater than for larger automotive firms whose strategy is based on the acquisition of all the material already manufactured and its subsequent assembly).

With regard to the results of the organizational innovations, the acquisition of Greyco is of particular importance. The vertical integration of the manufacturing process gives FISAL a competitive advantage in the production of braking systems for wind power generators (a sector for which the importance of limiting costs has already been indicated) as it involved the incorporation into the firm of an essential input for the fabrication of its products.

#### **5. ALLIANCES: IDENTIFICATION OF OPEN INNOVATION PRACTICES**

We will focus solely on the alliances and partnerships carried out in order to develop innovations. Thus, the business model perspective allows us to clearly identify the practices introduced by FISAL which amounted to open innovation.

Prior to the changes described here, the main collaborations were carried out with other brake manufacturing firms and through them FISAL incorporated new technology into its activities. Furthermore, FISAL had for some time been constructing relations with its clients based on trust and cooperation. Thus joint participation in the design of products was already habitual for FISAL.

After the changes described, collaborative relations in the development of products with clients persisted and intensified. Furthermore, collaborations with external actors were

systematized in accordance with the Business Lines, in order to carry out innovations in the design and technological development of material and products.

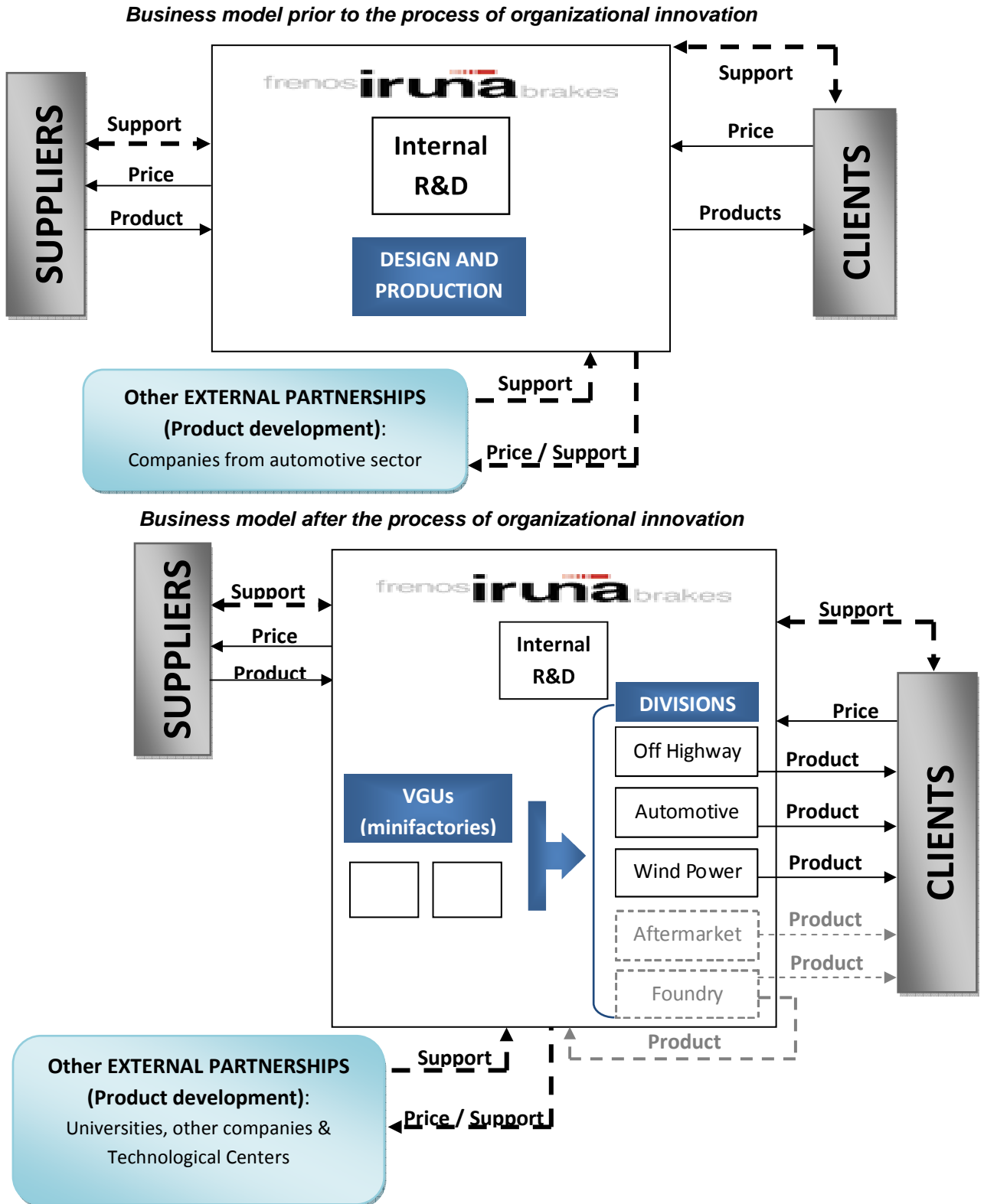
- **AUTOMOTIVE:** Worthy of particular note here is the cooperation between FISAL and a client to develop the caliper for the braking system of the client's prototype electric car. FISAL also has important relationships with material suppliers and technological centers.
- **OFF HIGHWAY:** The firm's collaboration with Universities is of particular importance for innovation in the design and manufacture of its products for this Line.
- **WIND POWER:** In 2012, FISAL began a collaboration project with another firm in the same sector for the development of an improved braking system for wind power generators. Collaborations with clients and suppliers are also very important in this area. Finally, it is worth highlighting the collaborations with two technology centers (one involved in metallurgy research and the other specialized in the development of technology for the automotive industry), that could provide the necessary knowledge to extended its value proposition by adding new brake systems targeted at the wind power industry. For developing these new products, Frenos Iruña worked intensively both of these technology centers, gaining access to outside technical knowledge regarding the manufacturing of the new prototypes and also to outside testing facilities, in order to verify the adequacy of these new products, much larger than the ones traditionally produced, as the firm did not have the capacity to do the testing by itself. As was stated by the manager: "In order to enter the wind power business, and regarding the development of the product, we have worked with a research centre well known for its experience with foundry materials. Also, another research centre has provided the facilities to do the dynamometric tests to the new prototypes."

Thus, the integration of knowledge gained through open innovation activities helps to generate additional value, and to capture part of that value. It has already been explained that these innovation methods also constitute a type of organizational innovation, in as much as they involve changes in how the firm deals without outside actors. There is no doubt that in the process of change studied here FISAL took the decision to redefine the way in which it related to certain external agents and so develop and strengthen collaborative relations with them. Once these practices become habitual it is logical that they lose their character of being organizational innovations and become part of a model of open innovation in the development of materials, models and markets.

Organizational innovation related to the Business Lines involved a systemization of these collaboration practices, as we have seen. That is to say, FISAL's processes of organizational innovation have had a decisive effect on the establishment of a model of open innovation and so on the optimization of the generating and capturing of value through the development of these process.

Figure 1 illustrates the business model change described above.

**Figure 1:** Diagram of the business model prior and after the process the process of organizational innovation





### 5. CONCLUSION

The culture of innovation impregnates FISAL's strategy, both with regard to the development of knowledge and technology and with regard to management and organizational models and the appropriate way to approach the challenges arising therefrom. The case study carried out here on the basis of a business model perspective has allowed us to see both how processes of innovation occur in the firm and also how these processes contribute to the creation and capture of value.

The introduction of new organizational methods in the form of the VGUs and Business Lines has had effects in various areas of the firm. It has optimized the utilization of resources and the coordination of activities and ensured the continuous transmission of technological advances and knowledge, it has allowed for the identification of competitive advantages in each of the areas affected and has led to a redirection of efforts towards the development of a growing body of clients.

Furthermore, the organizational innovation represented by the vertical integration of Fundiciones Greyco has also produced important competitive advantages, especially in the area of wind power.

Finally, the analysis carried out here shows how open innovation has been constructed through the introduction of innovations in the organization. It also clearly demonstrates the degree of openness in the firm and the importance of the incorporation of resources and knowledge from outside for its growth and development.

The deep revision of the various aspects of the organization helped to produce an appropriate fit between all the elements of the new business model that was being implemented, Therefore, FISAL's processes of organizational innovation have had a decisive effect on the establishment of a model of open innovation and so the optimization of the generating and capturing of value through the development of these process.

# QUANTITATIVE ANALYSIS - THE EFFECT OF OPEN AND ORGANIZATIONAL INNOVATION PRACTICES ON BUSINESS PERFORMANCE

## 1. INTRODUCTION

As stated before, in the current scientific literature there have been many studies devoted to understand the phenomena of open innovation. In this sense, research has shown that open innovation can increase a firm's return on innovation. For instance, open innovation may contribute to revenue growth (Chesbrough and Crowther, 2006), and the fraction of revenues that could be attributed to radical innovations (Laursen and Salter, 2006).

Non-technological innovation, on the other hand, constitutes yet a field to be explored, especially regarding organizational innovation, which is perhaps the most important form of non-technological innovation and also the most difficult to grasp both on a conceptual and an empirical ground (Evangelista and Vezzani, 2010).

However, a new stream of contributions has started to prove the importance of organizational innovation for competitiveness. Indeed, several studies have analyzed the impact of organizational innovations on business performance (Caroli and Van Reenen, 2001; Damanpour et al., 1989; Greenan, 2003; Piva and Vivarelli, 2002), showing that it has a positive effect on labor productivity (Falk, 2005) and on the revenues growth rate (Evangelista and Vezzani, 2010).

As for the eventual leverage effect that organizational could have on open innovation practices and that constitutes the central interest of the case study previously presented, no empirical work has yet appeared to confirm or refute it. In this sense, we intend to test if the findings of our qualitative research are supported by quantitative analysis.

This analysis uses a firm-level data provided by CIS survey in order to provide an answer to the following questions:

- What are the effects of open innovation and organizational innovation on the business performance?
- Does organizational innovation leverage the effect of open innovation practices on firm performance?

This part of the work is structured as follows: first, we explain the data analytical methodology used for the empirical analysis; then, we turn to the exposition and discussion of the results, and finally, we summarize the main conclusions and provide some insight as to why the analysis may have drawn the previously detailed results.

**2. DATA AND METHODOLOGY**

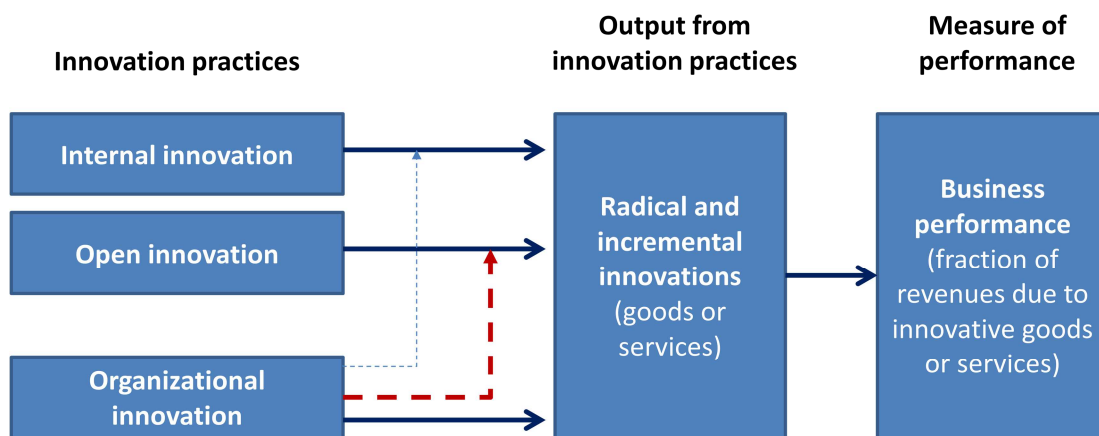
We use data from the Technological Innovation Survey referring to the period 2006-2008, provided by the INE. This survey has its origins in Community Innovation Survey (CIS), produced at a supra-national level. The sample selected corresponds to 1,323 firms from Navarre that completed the CIS for the year 2008.

CIS collects data on a wide range of aspects related to firms' innovation activities and performances. In particular, the survey includes some questions regarding the implementation of organizational innovations in the period 2006-2008, and also some questions as to what type of collaboration (if any) existed in the same period in order to develop product and process innovations.

In order to test the causal effects of organizational innovation and open innovation practices, as well as the eventual leverage effect previously mentioned, our empirical analysis is based on the following linear regression model (a visual representation of which is shown in Figure 2):

$$\text{Perc\_cn08innov0608}_i = \alpha + \beta_1 * \text{IntInn}_i + \beta_2 * \text{Olinformal}_i + \beta_3 * \text{OIformal}_i + \beta_4 * \text{OrgInn}_i + \beta_5 * \text{IntInnxOli}_i + \beta_6 * \text{IntInnxOIf}_i + \beta_7 * \text{IntInnxOrgInn}_i + \beta_8 * \text{OlixOrgInn}_i + \beta_9 * \text{OIfxOrgInn}_i + \beta_{10} * \text{sector\_hightech}_i + \beta_{11} * \text{sector\_mediumtech}_i + \beta_{12} * \text{size\_large}_i + \beta_{13} * \text{size\_medium}_i + \varepsilon$$

**Figure 2:** Expected effect of different innovation practices on business performance



**Business performance** is measured using an indicator directly provided by one of the survey questions: the fraction of revenues from 2008 that could be attributed to innovative good or services introduced between 2006 and 2008 that implied a novelty just for the firm (incremental innovations) or for the market (radical innovations). Thus, we are searching ultimately for the effect of different innovation practices on obtaining successful innovative goods or services.

Among these innovations practices, despite not being the focus of the study, the concept of internal innovation (as opposed to open innovation) is incorporated to the regression. The

reason to do so is that it is highly reasonable to think that internal innovation is indeed correlated to open innovation. If omitted, an endogeneity problem would be likely to exist in the model, for the regressor related to open innovation would be expected to be correlated to the error term, and thus the OLS estimation of the coefficients of these regressors would contain the effect of internal innovation on performance. The variable is constructed based on two different survey questions, referring to whether the firm did or did not perform internal R&D in year 2008 and, in case it did, whether it was on a regular basis or just occasionally. Therefore, the variable '**Internal innovation**' takes values 0, 1 or 2, for the cases in which the firm did not innovate internally, did so occasionally or performed internal innovation on a constant pace, respectively.

It should be pointed out that whereas the performance indicator and the other variables referring to innovation practices are related to the period 2006-2008, the internal innovation question refers only to year 2008. This may pose some disadvantages for the analysis, as there may be firms that having introducing internal innovations practices in years 2006 and 2007 do not declare to the show in 2008, and thus the effect expected on performance may be affected. As for this expected effect, scientific literature has widely proven the importance innovation both at a firm level. In particular, Business Week magazine found that the median profit margin for the top 25 innovative firms was 3.4% for the period 1995-2005, whereas the average for non-innovative firms was only 0.4%. Similarly, the median annual stock return was 14.3% for innovators and 11.3% for non-innovators. According to Statistics Canada, innovation is the main factor in improving a company's market share, profitability and growth rate. Also, Chesbrough's concept of open innovation emphasizes that firms that combine internal and external knowledge will win. The absorptive capacity approach also indicates that firms need internal knowledge and their own technology to be able to absorb and integrate the knowledge and technology acquired beyond the firm's boundaries (Cohen and Levinthal, 1990).

Regarding the indicator for open innovation practices, CIS poses two different set of questions, one regarding the importance that various external information sources had on innovation practices in years 2006 to 2008, and the other related to the existence of collaborations for innovation with several outside parties for the period 2006-2008. The first set of questions is used to construct the variable '**Informal open innovation**', just focusing on the fact of having or not used these external sources (i.e., suppliers, clients, competitors, consultants, , universities, public research institutes and R&D private centers), and matching the value with the number of sources used. This way, the variable ranges from 0 to 7. The second set of questions leads to the construction of the variable '**Formal open innovation**', which ranges from 0 to 8 (as CIS includes one more external agent for this set: other firms of the same group).

The definition of organizational innovations provided in the Oslo Manual 2005 serves as the basis for the questions on this matter. Thus, firms are asked whether they have or have not implemented the following changes in years 2006 to 2008:

- a new method in the practices for the organization of procedures and work,
- a new method in the organization of the workplace, in order to better attribute responsibilities and power of decision, and/or
- a new method in the external relations of the firm.

The variable '**Organizational innovation**', therefore, ranges from 0 to 3, capturing whether the firm has or has not implemented any kind of organizational innovation and also how many types it has introduced.

In order to capture the eventual **leverage effect of organizational innovation on open innovation practices**, the model includes the multiplicative variables combining both forms of open innovation with the organizational innovation indicators. Taking for instance the variable 'Formal open innovation x Organizational innovation', the estimation of its coefficient will show the additional predicted effect of increasing the value of 'Formal open innovation' in 1 unit. That is, the total effect of such an increase in the mentioned regressor would be the sum of the estimated value of its own beta plus the estimation of the coefficient of the multiplicative variable multiplied by the variable 'Organizational innovation':

$$\Delta \text{Perc\_cn08innov0608}_i \text{ (for an increase of OIformal in 1 unit)} = \hat{\beta}_3 + \hat{\beta}_9 * \text{OrgInn}_i$$

Thus, assuming a significative and positive value for the estimation of  $\hat{\beta}_3$ , when also positive and significative,  $\hat{\beta}_9$  would imply a leverage effect of organizational innovation on the impact that formal open innovation has on business performance, being the leverage greater the higher the value of 'Organizational innovation' is. Of course, these multiplicative variables do not exactly match the purpose of measuring a one-sided effect, as they actually reflect complementarity or substitution effects between both variables in the combination. Nonetheless, the model proposed is expected to provide some preliminary insights on the aforementioned aspects.

In addition to the variables combining open and organizational innovation, the model also introduces three more multiplicative variables combining internal innovation with formal open innovation, informal open innovation and organizational innovation.

Finally, some dummy variables have also been constructed, referring to both the size of the firms in the sample and the technological sector to which they appertain.

A summary of the CIS-based variables used for the OLS estimation is contained in Table 2.

**Table 2:** Indicators used in the empirical analysis

Indicators	Label	Description
Firm performance	Perc_cn08innov0608	Fraction of revenues from 2008 that can be attributed to innovative good or services introduced in 2006-2008.

Internal innovation	IntInn	Introduction of internal innovation in 2008. Values: 0 if no innovation; 1 if occasional innovation; 2 if regular innovation.
Informal open innovation	Olinformal	Use of external information sources in 2006-2008. Values: 0 if no use; 1-7 according to how many external sources have been used.
Formal open innovation	Oiformal	Collaborations for innovation with outside parties in 2006-2008. Values: 0 if no collaboration; 1-8 according to with how many external agents the firm has established a collaboration.
Organizational innovation	OrgInn	Introduction of organizational innovation in 2006-2008. Values: 0 if no introduction; 1-3 according to how many types of innovation the firm has introduced.
Internal Innovation x Informal open innovation	IntInnxOli	Multiplicative variable
Internal Innovation x Formal open innovation	IntInnxOlf	Multiplicative variable
Internal Innovation x Organizational innovation	IntInnxOrgInn	Multiplicative variable
Informal open innovation x Organizational innovation	OlixOrgInn	Multiplicative variable
Formal open innovation x Organizational innovation	OlfxOrgInn	Multiplicative variable
Firm sector	Sector_hightech	Dicothomic: 1 if high technology sector
	Sector_mediumtech	Dicothomic: 1 if medium technology sector
Firm size	Size_large	Dicothomic: 1 if 250 or more employees
	Size_medium	Dicothomic: 1 if between 50 and 249 employees

Before hitting to the results of the analysis, it is worthy to note that in the OLS estimation of the model, robust standard errors have been used, in order to avoid an eventual heteroscedasticity problem. In this sense, it is likely that firms that declare to have not introduced innovation practices show a small variance in the indicator of business performance, while for highly innovative firms the variance of such indicator is probably larger.

### 3. RESULTS

The results of the empiric analysis are shown in Table 3, and commented below.

**Table 3:** OLS estimation: the impact of different innovation practices on business performance

Linear regression		Number of obs = 1323 F( 13, 1309) = 16.71 Prob > F = 0.0000 R-squared = 0.1884 Root MSE = 26.102				
perc_cn~0608	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
IntInn	6.257826	2.450427	2.55	0.011	1.450632	11.06502
OIinformal	4.004083	.7357535	5.44	0.000	2.560698	5.447468
OIformal	1.653156	2.289439	0.72	0.470	-2.838216	6.144527
OrgInn	1.121056	1.026997	1.09	0.275	-.8936849	3.135796
IntInnxOIi	-1.178755	.735378	-1.60	0.109	-2.621403	.2638933
IntInnxOIf	-2.290662	1.722521	-1.33	0.184	-5.669865	1.088541
IntInnxorg~n	4.147731	2.008926	2.06	0.039	.2066638	8.088798
OIi_orgInn	-.1921559	.465658	-0.41	0.680	-1.105674	.7213617
OIf_orgInn	.073429	.8010016	0.09	0.927	-1.497958	1.644816
sector_high	-2.832017	3.765856	-0.75	0.452	-10.21979	4.555756
sector_med	7.304336	2.780737	2.63	0.009	1.849147	12.75952
size_large	-.9826355	3.710833	-0.26	0.791	-8.262466	6.297195
size_medium	-2.011727	1.588998	-1.27	0.206	-5.128989	1.105534
_cons	2.322509	.7803026	2.98	0.003	.7917286	3.853289

Some of the results drawn from the estimation of the linear regression model presented in this work over the sample of 1,323 Navarre firms do not sustain the hypothesis exposed earlier on. Indeed, only four of the thirteen regressors end up showing a significant impact on the performance indicator: 'Internal innovation', 'Informal open innovation', 'Internal innovation x Organizational innovation' and the sector dummy referring to medium technology, all of which with positive estimated coefficients.

Not being the focus of the analysis, it was nonetheless expected that internal innovation showed a clear positive effect on the fraction of revenues due to innovative goods and services. The fact that the question related to internal innovation referred solely to year 2008 does not seem to have altered these expectations.

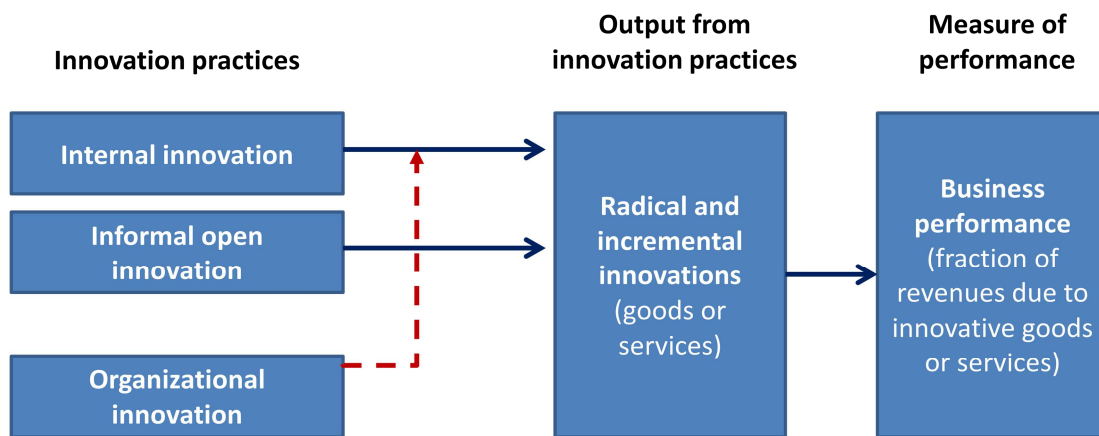
As for the impact of open innovation, only the informal typology has been proven to have a significant effect on the indicator of business performance (a positive impact, as expected). However, Navarre firms do not see the benefits of formal collaboration in terms of increased percentage of revenues due to innovative goods or services.

The main point of divergence with the hypothesis behind this work comes from the results regarding the impact of organizational innovation in business performance. First, the estimated coefficient for the aforementioned variable implies that it cannot be accepted that organizational innovation has any effect by itself on the increase of revenues due to innovations. Second, the leverage effect that constitutes the main finding of the case study has not been confirmed by this empirical analysis. Indeed, the estimated coefficients of the multiplicative variables that combine open and organizational innovation practices cannot be said to be other than zero.

However, organizational innovation does show a positive impact. Interestingly enough, the complementarity effect expected and not found with open innovation has shown up for the combination of internal and organizational innovation. That is, the aforementioned positive effect of internal innovation resulting from the estimation of the coefficient of this variable is completed by the positive effect related to the multiplicative variable. And also, though not representing any impact by itself on the indicator of performance, the implementation of organizational innovation practices implies a positive effect that depends on the accomplishment of internal innovation.

Figure 3 illustrates the aforementioned findings derived from our empirical analysis.

**Figure 3:** Estimated effect of different innovation practices on business performance



#### 4. CONCLUSION

The estimated effect on business performance of the different innovation practices taken into account in this analysis diverge at some point from expectations. Indeed, no impact has been proven regarding formal innovation practices and organizational innovation (by itself). Most importantly, the empirical analysis does not confirm the leverage of organizational innovation on the positive impact of open innovation on firm performance.

In this sense, it should be pointed out that the performance indicator is related to the introduction of innovative goods or services in years 2006 to 2008. The same period applies for the implementation of innovation practices (except for internal innovation, as stated before). That is, innovation practices and innovation outputs derived from these practices are being considered by CIS referring to the very same period. It is not unreasonable to think that some of these outputs may derive from practices implemented before 2006. And, more likely, some outputs from the practices actually implemented in the period 2006-2008 may very well not arise until 2009 or later, especially regarding organizational innovation practices, as we try to explain below.



As we have seen, CIS measures organizational innovations on an aggregate level, by asking about the implementation of certain practices. Thus, this approach provides limited response options (yes and no) and asks about the change within the last three years.

This approach draughts some important consequences. First, the monitoring of organizational innovations applied over the last three years is probably not adequate, as firms may clearly benefit from these practices for more than three years after they were first implemented, so that the positive effects of organizational innovation on performance indicators might even only be measurable several years after its implementation. Second, if only the firms which implemented new organizational concepts in the last three years are taken into account, the firms that might have done so four or five years ago are considered to be non-innovators, even though these firms actually adopted the organizational innovation earlier. And last, the survey does not take into account the extent of use of the new practices implemented by the firm, so that it is not possible to determine whether the lack of effect on the performance measure is actually due to the fact that a great proportion of firms that make use of a certain organizational innovation have not fully implemented it (Armbruster et al., 2008).

In any case, and despite the specifications already explained, the result of this analysis have shown the importance for Navarre firms of both open and organizational innovation practices in order to improve business performance.

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