The Role of Knowledge-intensive Service Activities (KISA) in Basic Agro-food Processes Innovation: The Case of Orange Packers in Eastern Spain

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Summary

The relevance of innovation in services has been outlined by the knowledge-intensive business services (KIBS) concept, which has been empirically and theoretically developed in the context of service innovation. The conceptual and methodology approach of knowledge-intensive service activities (KISA) links the production of knowledge to innovative activities, and has become a relevant focus for the analysis of innovation within a firm. Though relatively new, it has been given a great deal of attention by practitioners and academics in the last five years.

This paper will explore, analyze, and compare the ways in which knowledge-intensive activities occur in a small cluster of mature and low-tech industries: orange and lemon selection in Spain. The paper aims to assess the impact of KISA on the firm's innovation and performance, as well as to analyze whether KISA occurrence is correlated with certain characteristics of firms such as size, organizational profile, market focus, and other characteristics. A model correlating these variables will additionally be proposed and validated.

Key words: KISA, low technology, agro-food innovation, agro-food, Spain

1. Introduction

Tether (2003) has analyzed innovation dynamics in services and classified them into three sectors: traditional, systemic, and knowledge-based. In this paper we are concerned with the third sector because of its relevance to the creation and transfer of knowledge and innovation

through its support of innovative activities across a wide range of other business fields. Likewise, we are interested in its interconnecting role among the various clusters (Kuusisto and Meyer, 2003).

Knowledge-intensive service activities (KISA) are defined as "the production and integration of service activities undertaken by firms, in manufacturing or service sectors, in combination with manufactured outputs or as stand-alone services." KISA can be provided by private enterprises and government sector organizations. Typical examples of KISA include R&D services, management consulting, IT services, human resource management services, legal services, accounting and financing services, and marketing services (OECD, 2006). These services may be provided internally or externally to the firm. Examples of various approaches in this direction are provided by related literature.

KISA draw from the widely studied concept of KIBS, which is defined as "private companies or organisations who rely heavily on professional knowledge, i.e., knowledge or expertise related to a specific (technical) discipline or (technical) functional domain to supply intermediate products and services that are knowledge-based" (Den Hertog, 2000; Miles, 2000; Miles, et al., 1995). These sectors have grown considerably in terms of employment and output over the past two decades (Fischer, et al., 2001; Muller, 2001). According to Miles (2005), this employment growth can only mean that the use of knowledge-intensive services (KIS) has expanded.

KIS is a broad concept that can be defined as the "services which refer to processes or projects that are using knowledge as input to produce services" (Miles, 2003; Haataja, 2005). A narrower definition, adapted from Gadrey, et al. (1995) and den Hertog (2000), defines KIS as the "services produced through an interaction with the client by finding a solution to a problem together utilizing knowledge as the most important and critical resource (e.g., a bundle of capabilities and competencies)." In this definition, abstract thinking and interaction with the clients are essential. Czarnitzki and Spielkam (2003) view KIS as a bridge to innovation.

In general, the aforementioned terms KIBS, KIS, and KISA tend to be used synonymously, as can be found in any literature search (Aslesen, 2007). The predominance of the empirical and practical over academic literature has been pointed out (Nysveen and Pedersen, 2007).

The impact of KISA or KIS on the industry has been the subject of numerous papers which take the empirical more than the academic approach. The case of high-tech industries has been highlighted by a number of authors (Shan Hu, et al., 2006). Others have analyzed its impact on the software services (Martinez-Fernandez and Miles, 2006; Martinez-Fernandez and Krishna, 2006, Williams, 2006; Rajala, 2008), or medium-tech industries (Albors, et al.,

2008), tourism services (Touburn, 2004; Collado,) health services (Kivisaari, 2004), aquaculture (Aslesen, 2004), mining (Martinez-Fernandez, 2005), traditional industries (Ebersberger, 2004), and manufacturing (Lee, 2004). In a previous research, we have analyzed how the level or influence of KISA in medium-tech industries, is related to innovation, competitive advantages, and economic performance outputs, as well as to its customer focus (Albors, et al., 2008). The impact of KIS on international competitiveness has been analyzed by Windrum and Tomlinson (1999). The role of KIS in facilitating SME employment growth, competitiveness, and innovation has been pointed out by Haukness (1999). Drejer (2005), on the other hand, has analyzed the influence of geographical distance in the use of KIS by firms.

Recently, KISA have been given attention by a special-edition journal devoted to services (Martinez-Fernandez, 2006). The journal concluded that KIS activities oriented to the use and integration of knowledge are instrumental for building and maintaining a firm's innovation capability. In this direction, Alvesson (1993) has discussed the concepts of knowledge-intensive workers and their role in KIS. The journal likewise claimed that KISA improve its users' absorption capacity (Lee, et al., 2006). In addition, evidence of a synergistic effect is presented from the interaction between a firm's internal and relational resources.

However, KISA need inter-firm relationships. In the case of the firms covered by our research, a firm's relational capabilities are fundamental to achieving competitive advantages and export success. Firms must look beyond their boundaries and tap into the distinctive competencies of external actors such as distributors, competitors, suppliers, and other actors (Ling-Yee, and Ogunmokun, 2001; Mcevily, Marcus, 2005; Mcevily and Zaheer, 1999). Moreover, when firms are clustered, firm-specific characteristics such as absorption capacity or relational capabilities interact with the cluster resources and produce a synergic effect (Hervas and Albors, 2008).

Following this line of reasoning, we must consider that linkages with local knowledge institutions constitute one of the key elements for the development of new knowledge by firms. Thus, local entities such as R&D centers or universities can support these tasks (Rosenberg and Nelson, 1994). In addition, empirical evidence shows that the proximity of local universities with firms promotes the exchange of ideas (Lindelöf and Löftsen, 2004) and improves the performance of innovative firms (Hanel and St-Pierre, 2006).

Previous research supports the idea that the absorptive capacity is crucial to the effective exportation of external know-how and in obtaining the benefit from complementarities between internal and external resources such as KISA (Hervas and Albors, 2008). Miles (2005) has also suggested the interrelation between KIS and the firms' absorptive capacity. The latter is defined as the "rate or quantity of scientific or technological information that a

firm can absorb" (Cohen, 1990) and which "can be acquired, assimilated, transformed and exploited" (Zahra and George, 2002). Ducatel (2000) has outlined absorptive capacity in the context of IT. Despite all these, however, there is still a gap in the literature pertaining to KISA, particularly at the micro-level of firms, which this paper will try to fill[1].

Finally, the industry's (citrus sector) position in the global value chain and the upgrading implications on the firms (Cadilhon, 2003; Gereffi, 2005) has also been considered as a competitive contribution of KISA (i.e., innovation and marketing). Moreover, some authors (Humphrey and Schmitz, 2002) have analyzed the inclusion of firms in the global value chains and the role of local networking and cluster linkages in their upgrading. In our case, upgrading must be based on reinforcing the local governance of firms by active inter-firm cooperation, as well as active cooperation with local institutions. Moreover, innovative activities through learning by doing and spreading innovation in the cluster are fundamental to the upgrading process.

The global processes related to the citrus value chain involve production and product development, as well as delivery to the final consumers. Value-chain analysis, which includes the whole cycle, provides a tool for mapping the governance drives of the chain and outlines both intra-firm organization dynamics and relationships between firms (Kaplinski, 2004). It also points out the need to address the ways in which poor producers and countries connect with producers and consumers in the global economy.

2. Research Objectives and Questions

2.1 Research Objectives

This paper will analyze the role of KISA in low-tech industries linked to the agro-food processes. It will demonstrate how KISA play a fundamental role in these activities and contribute, not only to innovation activities of firms, but also to the firm's performance.

As input variables, the paper will analyze internal and external knowledge service activities, as well as other variables that may influence the orientation of KISA, such as the organizational aspects, strategic management approach, human capital, education and training of its personnel, and the relations with other firms or with research centers. Output variables such as economic performance, employment growth, and innovation indicators have also been

1) Nysveen and Pedersen (2007), as well as Yu, et al. (2005) open a debate on this subject from an empirical practitioners' perspective.

taken into account in the model.

2.2 Problems and Questions: Development of Hypotheses

The problems this paper tries to solve are related to the following questions: Are KISA relevant to low-tech industries? Do they have a significant impact on a firm's innovation? Does it make any difference whether KISA are internal or external to the firm? Which activities are more pertinent for firms? Are the organizational aspects of firms critical to the adoption of KISA? How do KISA relate to the firms' capabilities? How are the different contributions to KISA mixed and matched by the firm? Are the activities contributory to the upgrade of the firm's position in the value chain? How do the capabilities of the firms facilitate the influence of KISA?

Table 1 sums up and defines the relevant hypotheses that the research will try to answer. Figure 1 schematically shows the proposed model. According to this model, internal and external KISA, undertaken by firms in the low-tech manufacturing sectors, whether in combination with manufactured outputs or as stand-alone services, contribute to the firms' innovative and economic employment growth and performance. KISA's contribution is, however, regulated by the firm's absorptive capacity as measured by the level of skills and education of the employees.

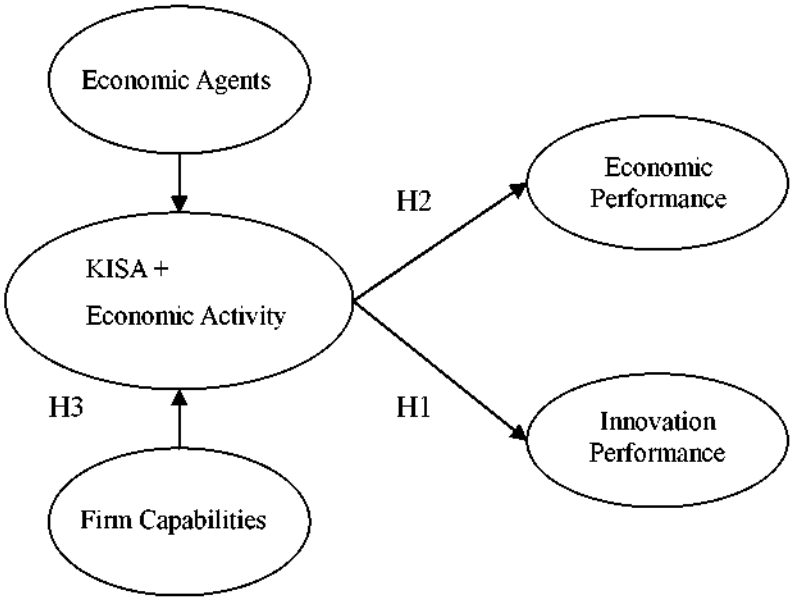

Figure 1: KISA and Their Influence on Firms' Performance

Table 1: Research Hypotheses

Hypothesis	References
H1: KISA have a relative influence on manufacturing firms' innovative activities, irrespective of their technology orientation	Albors, et al., 2008; Aslesen, 2004; Ebversberger1, 2004; Lee, 2004; Miles, 2005; OECD, 2006
H2: KISA have a relative influence on low-tech firms' employment growth and economic performance	Albors, et al., 2008; Aslesen, 2004; Haataja, 2005; Miles, et al., 1995; Windrum, 1999
H3: Absorption capacity of firms is a co-adjuvant in KISA influence	Hervas and Albors, 2008; Miles, 2005; Ducatel, 2000; Cohen, 1990; Zahra and George, 2002

3. The Value Chain of the Citrus Industry

3.1 Citrus Production in Spain

Citrus fruit growers in Spain are concentrated along the eastern and the southern coastal areas. The area of Valencia in the east produces approximately 60% of Spain's total citrus production[2]. Though exports are on the average 4-5% of the total Spanish production, they tend to be concentrated in the Valencia region, where 96% of the Spanish export facilities are based. Similarly, import facilities are concentrated in the region owing to the distribution infrastructure available in the area. Imports basically cover the spring and summer seasons when oranges and lemons are not available in Spain.

3.2 An introduction to the Citrus Industry in Spain.

Figure 2 sums up the basic steps that form this value chain. The suppliers are either small- or medium-scale farmers working independently or organized as cooperatives, or large producers belonging to groups that have their own export facilities and distribution networks.

The suppliers or farmers grow, pick, and sell the fruits to the selection and packing firms through various types of agreements. Other producers sell their fruits to the processing industry, which transforms them, either into juice, marmalade, or other by-products, depending on the fruit variety. Over the last few years, the international orange juice marketing chain has been marked by different developments, such as the penetration of global beverage brands.

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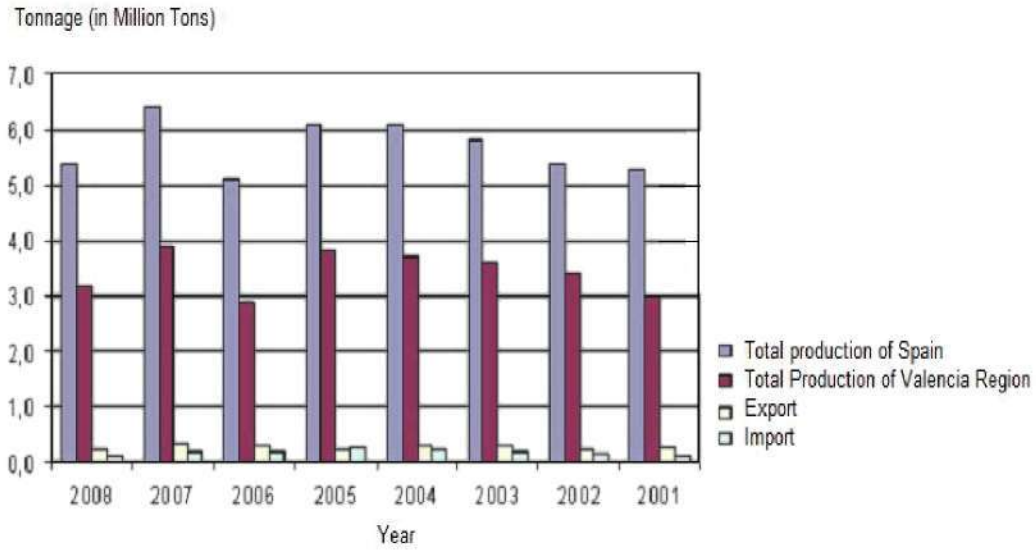
2) Total production of 6.13 million tons in 2004–2005 (*Intercitrus Report*, Valencia, 2005).



Source: Intercitrus (2008).

Figure 2: Evolution of Citrus Production, Exports, and Imports in Spain (2001–2008)

Some small retailers have their own fruit fields or special agreements with producers. As such, they have the claim to higher-quality products. Recently, the Internet has also facilitated direct distribution from producers to consumers of inorganic chemical-free oranges and lemons. These producers claim that there is a growing market demand for this web based service.

Distributors and/or agents link the packing firms with the larger global retail chains such as supermarkets, hypermarkets, and other warehouses (Cadilhon, et al., 2003; Gereffi, 2005). Some of them have integrated their chains, from the growing fields to the final selling points in Europe or the USA[3)]. As citrus products change form and move through various market channels, value is added through labor, capital, and marketing management.

The auxiliary industry is related to input supply businesses that provide fertilizers, chemicals, grove care services, and equipment selection. The latter has lately incorporated more sophisticated hardware such as sensors, electronics, and other hardware, as well as cleaning equipment, waxing, packaging materials, refrigeration and ripening chambers, transportation, and other services and materials. The last phases of the value chain have become critical. For one, fruits coming from South America and North Africa during the

3) The citrus market is actually a globalized market.

spring and summer seasons in Spain are selected, packed, branded, and exported as indigenous products[4] from Valencia, through the numerous enterprises working in this area.

Our field of study covers a group of packing firms located in the center of the Valencia Region. This region, where 15% of the Spanish produce is concentrated, has a long tradition of citrus exporting. There are approximately 145 firms working in the area. Though it would be difficult to consider them as a cluster, they share the characteristics of local concentration and certain patterns related to customers, suppliers, and others.

These firms tend to hire a high % of temporary labor in order to cover their seasonal campaigns because, as mentioned, the fruits are picked according to the campaigns of the various citrus varieties grown in the area. The samples studied covered 122 firms that represent 80% of the firms located in that area.

The average work force size of these firms is 60 employees; however, in high seasons they may contract extra manpower, which accounts for 40% of the total. Some firms are managed by the owners and others hire professional managers. In general, the education profile of the staff is rather low, technically speaking (only 7.1% of the staff have mid- or higher-level degrees). Evidently, this is a barrier for technology innovation. However, some innovate in the aspect of processing (30.1% believe their process technology is in the state-of-the-art level). In addition, they hire engineers to oversee this area. Other producers have agreements with research institutes and outsource these tasks. There are two R&D public centers in contact with this cluster: IVIA, which is related with agro-food research and IATA, which focuses on agronomical research. Overall, practically no firms have their own R&D facilities except for the larger, leading firms.

In general, it is the size of the firm that defines its organizational profile and complexity. Only larger firms have sophisticated organizations with marketing, planning cost control, R&D units, their own distribution channels, and other mechanisms. For this reason, some firms founded a local association, partially supported by the regional government; it owns a dock and a refrigerated warehouse that facilitates export activities, as well as health certification. Others have agreements with a local medium-sized trucking company, which has its own European transport structure. As previously mentioned, contacts between firms and suppliers or customers are frequent and are facilitated by local proximity. Nevertheless, and in spite of recommendations to offset their small size, these firms are against unified associations such as mergers or joint ventures with competitors.

We have not included the two leading firms in our study because they are not representative

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4) Partly because growing and fruit picking costs have become very expensive in Spain.

of the chosen study subject. Thus, they can be considered as outliers in the study. However, we will describe their organization, to shed light on how they have upgraded their position in the value chain in order to reach a higher hierarchical position. With a daily production capacity of 2,500 tons and a turnover of 100–120 million euros, they have their own harvesting fields and their activities cover the whole value chain from production (approximately 30% of the total fruit processing), picking, selection, ripening, packaging, and distribution, including a global export network. Their staff could number around 2,500 employees, 40% of whom work in the warehouses and packing facilities. Since they have at least 10 production lines, they have incorporated state-of-the-art technology and full automation of their plants and warehouses. Both firms have their own R&D departments where they carry out research on process and product innovation. Furthermore, they have agreements with the two regional R&D centers mentioned.

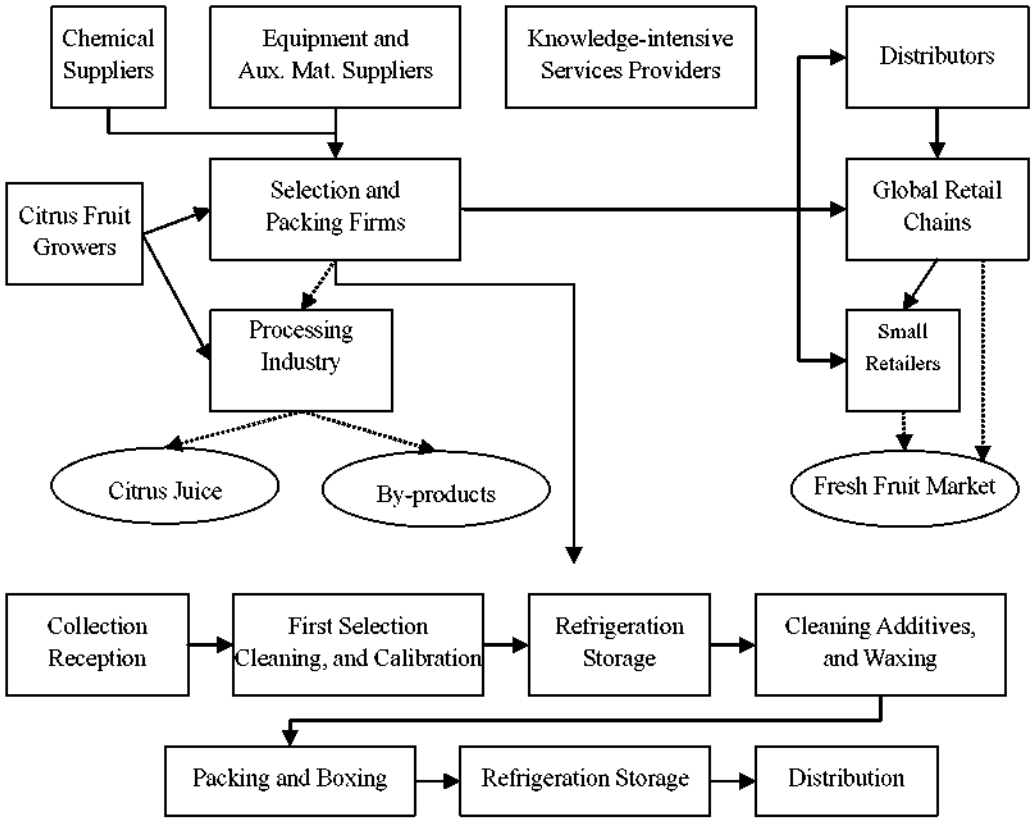

Figure 3: The Global Value Chain of the Citrus Industry: Selection and Packing Subsector Process

Humphrey and Schmitz (2002) considered that the relationships between buyers (hypermarket chains) and suppliers in citrus packaging firms, with the exception of the largest firms, could be classified as total or quasi-hierarchies, where leading firms directly control the suppliers or completely set the market rules.

4. Research Methodology

4.1 Field Work

During the first half of 2004, a representative sample of citrus packers in the La Safor region were interviewed as part of the regionally supported SME project. A total of 122 (84.13%) from a population of 145 firms agreed to participate in the field work. The contact persons were either the firms' general managers or first line managers. The firms filled in questionnaires and a number of firms (14) were visited personally by the researchers, in order to evaluate the survey more closely. The average size of the staff was 64.75 employees. The size distribution is shown in Figure 2. The firms had an average operating experience of 30.8 years.

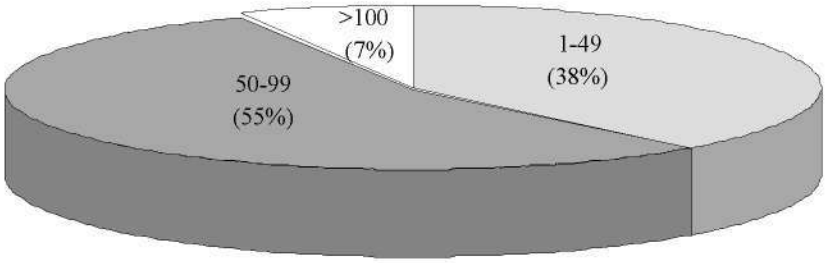

Figure 4: Staff Size Profile of the Firms

The survey covered a number of questions (see Table 2). Some questions referred to the firm's organizational characteristics such as size, whether the management was carried out by the owner or a hired professional, the % of university graduates among the members of the staff, the firms' employment growth measured by employment, R&D, and internal or external innovative activities. In addition, questions with regard to the number of dedicated full-time staff, local and external commercial contacts as a measure of the firm's network extension and depth, % of temporary staff members, number of brandings for product commercialization, marketing external services, grade of innovative equipment such as visual classification, continuous staff training, and other related items were included.

4.2 Variables and Descriptive Results of Field Work

4.2.1 Performance Measurement Variables

V_1 (Process innovation): Since product innovation is basically carried out by suppliers (citrus growers), innovation in this study is limited to the process[5]. Firms with obsolete process technology and equipment (older than five years) comprise 41.1%, while 36.1% have state-of-the-art technology and equipment. Firms that have acquired recent innovative technology and equipment incorporating some high-tech element such as video-classifying systems accounted for 22.8%.

V_2 (Performance): This variable measures the EBITDA[6] of the firms. Taking the sectoral database profit figures as an average (x =3) and grading this variable from 1 to 5, the sample average was 2.49.

V_3 (Growth): This variable measures the firm's employment variation in the previous five years. Firms that can be classified as stable or had reduced their average workforce accounted for 14.8%, 73.8% had increased their workforce in the range of 1–10%, while 11.5% of the firms had grown over 10%.

V_4 (Export): This indicates the turnover % marketed on international markets, the average being 32.5%.

4.2.2 Firm-context Variables

V_5 (Size): This refers to firm size measured by staff average number. This is a control variable.

V_6 (Professional management): This variable refers to management style, that is, whether the management of the firm is carried out by the owner or by professional managers. Firms with separate management and ownership accounted for 70.2%.

V_7 (Permanent staff) and V_8 (Temporary staff): These reflect the % of permanent employees versus those of seasonal/temporary employees. On the average, 34.59% of the workforce in the firms was permanent and 44.09%, temporary. This is a relevant factor in the sector since most firms work by campaigns because citrus fruits are picked seasonally. It has to be noted though that the tendency is to import citrus from overseas during the growing seasons.

V_9 (Education): This variable represents the staff % with mid- or higher-level education. It

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5) Product innovation is more limited to branding, product selection, and packaging.

6) EBITDA is a performance ratio that stands for 'Earnings Before Interest, Taxes, Depreciation, and Amortization'. It is drawn from the earnings and losses firm sheet.

had a value of 8.32% representing the firm's staff members who had university education.

V_{10} (Training): This variable represents whether the firm carries out technical training courses such as selection, waxing, cleaning, operating the equipment, and other courses in a permanent mode. These courses are generally promoted at no cost by government bodies such as the local agro-food offices. The firms who conduct training for their employees accounted for 58.9%.

V_{11} (Years): This refers to the number of years that the firm has been operating in the market, as well as the KISA carried out internally or contracted externally by the firm.

V_{12} (Accountancy): This represents not only standard accountancy activities services but also other procedures such as tax reporting, standards and norms and particular legal advice, as well as personnel management such as social security registration and payments. Firms who have outsourced accountancy activities provided a value of 29.5%. As had been pointed out by academics (Martinez, 2002, 2006; Miles, 2003), accountancy services, in spite of what could be expected, play a relevant role in organizing knowledge towards influencing strategy and interconnecting firms utilizing the same accountancy firm.

V_{13} (ISO): This covers activities associated with certification maintenance which are carried out externally for most firms. Firms that have been registered with ISO 9002 accounted for 32.8%.

V_{14} (Brand): This variable represents branding management, that is, whether firms manage their own brandings with which they commercialize their products. Branding is a key element in positioning the firm in the value chain. Large firms have strong brandings. Branding activity is carried out internally in most cases as seen in the 25.6% value of the total number of firms who market their brandings.

V_{15} (Marketing): This variable is linked to the previous variable. Here, we measure if the firms carry out marketing activities in support of their branding, such as designing and printing brochures describing the product specifications, and designing and printing product packaging. These activities are normally outsourced to external marketing firms. This is a less frequent service and is related to the product's added value. The reply is positive in 24.6% of the cases.

V_{16} (Firm agreements): 18% of the firms have signed formal agreements with other firms: citrus suppliers or cooperatives, competitors for common campaigns, competitors serving common customers, and other similar situations[7].

V_{17} (Internal contacts): As pointed out earlier, the firms' internal networking has been

7) This refers to formal agreements with mutual commitment between the signing parties.

measured by the normal, continuous, and formal (written) contacts that firms maintain with local firms in such areas as equipment, chemical, or product suppliers, as well as customers. All the sample firms maintain local contacts, with 98.47 as the average number. This variable can be a measure of the cluster effect of the group.

V_{18} (External contacts): This variable refers to the firms' external networking and had been measured by the normal, continuous, and formal (written) contacts, which firms have with external firms at the national and international levels. These external firms include equipment manufacturers or distribution customers. All the sample firms maintain external contacts, with 25.59 as the average.

V_{19} (R&D&I): The variable relates to R&D and innovative activities in the last three years.

V_{20} (Internal R&D): This variable represents the internal R&D and innovative activities.

V_{21} (R&D&I employment): This measures the intensity of R&D activities and innovative activities as evidenced by the respondent identifying at least one employee carrying out R&D and innovative activities.

V_{22} (R&D&I agreements): Finally, this variable measures R&D and innovation agreements with RTC organizations.

In relation with R&D and innovation variables (R&D&I), they were defined ex ante the field study and were reconsidered ex post[8]. Recent studies carried out in Europe point out the fact that R&D is not the only method of innovating. Other methods include technology adoption, incremental changes, imitation, and combining existing knowledge to form new ways (Arundel, et al., 2008). Most of these methods require relevant creative effort from the firm's management and employees and will consequently help to develop the firm's in-house innovative capabilities. These capabilities are likely to lead to productivity improvements, improved competitiveness, and to new or improved products and processes that can have wider impacts on the economy. For these reasons, the activities of firms that innovate without R&D performance are of interest to policymakers (EU, 2009). Nevertheless, the same study shows that non-R&D innovators are relatively more dependent than R&D-performing firms. The dependence is shown through the diffusion of knowledge from other firms, particularly through the knowledge embodied in the acquired products and processes and how these non-R&D innovators fail to benefit from the innovation policies (Eurostat, 2009).

In theory, and in relation to R&D or innovation variables, the results were as follows:

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8) During the interview stages, it was acknowledged that firms do not distinguish clearly between R&D and innovation. Thus, it was decided to denominate both activities as innovative in a wider sense. Some of them consisted of incorporating ground-breaking innovative equipment and learning to operate it effectively, adapting the software to their needs, and other mechanisms.

21.3% of the firms have carried out some innovative activity in the last three years; 16.4% of the firms could name an employee carrying out R&D or innovative activities; and finally, 8.2% of the firms in the sample had some agreement with a local research institute. It can be concluded that generally, internal KISA were externally supported in 40% of the cases.

V_{23} (Association): This variable represents the status of the firms; whether active or inactive members of an industry association. Most of them are partners of a cooperative, which manages a refrigerated port warehouse; 45.9% of the firms belonged to an industry association.

Table 2 summarizes and describes the variables, their theoretical base, and their range values.

Table 2: Survey Variables, Meaning, Range Values, and References

Symbol	Variable	Meaning	Values	References
Dependent				
V_1	Process innovation	Level of innovation in process	0-2	Hervas and Albors, 2008; Haukness, 1999
V_2	Performance	Profits against sector average	1-5	Hervas and Albors, 2008; Miles, 2005; Haukness, 1999
V_3	Growth	Employment growth level in last five years	0-2	Hervas and Albors 2008; Miles, 2005; den Hertog, 2000
V_4	Export	Turnover % on exports	0-4	Haukness, 1999
Firm's characteristics				
V_5	Size	Total average employment size	continuous	Control variable
V_6	Professional Management	Management run by a hired professional from outside	0-1	Zahra and George, 2002; Miles, 2000; Hervas and Albors, 2008; Cohen, 1990; Ducatel, 2000
V_7	Permanent Staff	Permanent employment	%	
V_8	Temporary Staff	Temporary employment		
V_9	Education	% of employees with university degrees		
V_{10}	Training	Regular training for staff	0-1	
V_{11}	Years	Number of years the firm has been operating in the market		Control variable

Table 2: Survey Variables, Meaning, Range Values, and References (Contd.)

Symbol	Variable	Meaning	Values	References
KISA				
V_{12}	Accountancy	Accountancy external services	0-1	Martínez, 2006; Miles, 2003
V_{13}	ISO	Quality, the firm is certified by an outside ISO 9000 agent	0-1	Miles, 2000; Hervas and Albors, 2008
V_{14}	Brand	Has its own brands	0-1	Cadilhon, et al., 2003; Martínez-Fernández, 2006; Miles, 2003
V_{15}	Marketing	Marketing services outsourced	0-1	
V_{16}	Firm agreements	Cooperation agreements with other firms	0-1	Humphrey and Schmitz, 2002; Martínez, 2006; Kaplinski, 2004; Hervas and Albors, 2007
V_{17}	Local contacts	Supplier and customer contacts, local	continuous	
V_{18}	External contacts	Supplier and customer contacts, international		
V_{19}	R&D&I	Existence of R&D and innovative activities	0-1	Lee, 2004; Cadilhon, et al., 2003; Martínez, 2006; Miles, 2003
V_{20}	Internal R&D&I	Carries out R&D and innovative activities internally	0-1	
V_{21}	R&D&I employment	Full time staff in R&D and innovative activities	0-1	
V_{22}	R&D&I agreements	Formal agreements with technology centers	0-1	
V_{23}	Association	Membership in associations	0-1	Humphrey and Schmitz, 2002; Martinez, 2006; Miles, 2003; Ogunmokun, 2001; Mcevil and Marcus, 2005; Mcevily and Zaheer, 1999; Lindelöf and Löftsen, 2004; Hanel and St-Pierre, 2006

4.3 Multivariate Analysis: Empirical Results and Discussion

In order to perform a multivariate analysis, and in order to select and identify the significant independent variables, a factor analysis was carried out as a first measure. The results of the analysis are shown in Table 2. A rotation was obtained after eight iterations and the factor analysis detected four components, which could explain 85.20% of the sample variance.

These components were associated to the variables in the following way: C_1= f (V_{12}, V_{14};

V_{15}; V_19; V_{20}; V_{22}); C_2 = f (V_5; V_9; V_7); C_3 = f (V_{17}; V_{18}); and C_4 = f (V_{11}). C_1 is associated with KISA such as branding development and marketing management, company agreements, accountancy, total R&D variables, and R&D agreements. C_2 is associated with firms' size, % of permanent staff, and education profile of staff. With the exception of size, this component is also a measure of the firm's absorption capacity. C_3 is related with the intensity of the contact networking of the firm. Finally, C_4 represents the experience of the firm represented by the number of years of operation.

Table 3: Rotated Component Matrix

Variables	Component			
	1	2	3	4
V_{14} (Brand)	0.9342			
V_{15} (Marketing)	0.9342			
V_9 (Education)		0.9085		
V_{17} (Internal contacts)			0.9065	
V_{18} (External contacts)			0.8840	
V_{19} (R&D&I)	0.9360			
V_{21} (R&D&I employment)	0.8771			
V_{22} (R&D&I agreements)	0.8716			
V_{16} (Firm agreements)	0.7033			
V_{20} (Internal R&D&I)	0.9531			
V_5 (Size)		0.9341		
V_{11} (Years)				0.9347
V_{12} (Accountancy)	0.7011			
V_7 (Permanent employees)		0.9457		

Notes: Extraction method: principal component analysis, rotation method; Varimax with Kaiser normalization; rotation converged in six iterations.

In the second step, we utilized the KISA variables pointed out by Component C_1 = f (V_{12}, V_{14}; V_{15}; V_{19}; V_{20}; V_{22}) (α Cronbach = 0.823). These results point out that the most relevant variables associated with KISA with the highest statistical weights are branding development and marketing management, accountancy services, total R&D&I variables, and R&D&I agreements. The effect of accountancy has been outlined in accordance with the academic literature (OECD, 2006), while the effect of marketing and branding development makes

sense from the context of value chain upgrading (Humphrey and Schmitz, 2002). Finally, the effect of R&D&I variables is inherent to the innovation and knowledge intensity of the activity.

In order to expand our analysis of the effect of KISA, we have applied a cluster analysis and regression exercises in order to justify the proposed model. A cluster analysis with this new variable (C_1) allowed the classification of the sample in three groups with 4, 36, and 82 members.

Table 4: Number of Cases in Each Cluster

	Number	Firms	Final Cluster Centers
Cluster	1	4	18,10
	2	36	9,89
	3	82	2,07
Valid		122	

Note: ANOVA for KISA, F= 231,672 with p<0,0001.

Table 5 shows the mean differences for the value of the different variables. It can be observed that variables such as V_2 (Performance), V_4 (Export), V_6 (Professional management), V_7 (Permanent staff), V_9, (Education), V_1 (Process innovation), and V_{23} (Association) have statistically significant and different mean values. Moreover, the groups (numbers 1 and 2) with higher KISA values have higher positive replies for these variables.

On the other hand, variables V_3 (Growth), V_5 (Size), and V_{11} (Years) with the latter two being the control variables, do not reveal any statistical mean differences among all cluster groups.

Next, a correlation analysis was performed (results are shown in Table 6). This showed a significant correlation between KISA and the output variables such as process innovation (V_1), firm performance (V_2), and level of export intensity (V_4). KISA are correlated with the absorptive capacity variables such as firms' permanent employees (V_7) and education (V_9). No correlation appeared between KISA and the control variable growth (V_3) or the professional management (V_6).

Hence, the multivariate analysis has shown that the outstanding KISA are: branding development and marketing management, accountancy services, R&D and innovative activities (internal), as well as R&D&I agreements (external). Networking activities are relevant, as well as the variables connected with the absorptive capacity of the firms.

Table 5: Mean Differences between Clusters for Variables

Clusters		Output variables				Absorptive capacity variables			Relational variables	Control variables	
N		Performance (V_2)	Export (V_4)	Process Innovation (V_1)	Growth (V_3)	Professional Management (V_6)	Education (V_9)	Permanent Staff (V_7)	Association (V_{23})	Size (V_5)	Years (V_{11})
1	4	4.0	65.5	1.5	2.0	1.0	16.0	51.8	1.0	80.5	20.5
2	36	4.2	58.0	1.2	1.9	0.7	10.0	52.0	0.8	65.1	24.8
3	82	1.7	19.7	0.9	1.4	0.9	8.9	26.1	0.3	63.9	34.0
sign. p		<0.001	<0.001	<0.001	n.s.	<0.05	<0.001	<0.05	<0.05	n.s.	n.s.

Table 6: Correlation between KISA and Other Variables

KISA	Process Innovation (V_1)	Performance (V_2)	Export (V_4)	Professional Management (V_6)	Education (V_9)	Growth (V_3)	Permanent Staff (V_7)
Pearson correlation	0.454	0.576	0.582	-0.148	0.416	0.185	0.473
Sig. (2-tailed)	<0.001	<0.001	<0.001	n. s.	<0.001	n. s.	<0.001

KISA appear correlated with the variables reflecting process innovation, firms' performance, and export intensity, as well as the absorptive capacity variables such as the firms' permanent employment and staff education.

Finally, we proceeded to make a regression analysis and a discriminant analysis to identify which dependent variables, in particular, have a stronger influence on the dependent variables: V_2 (Performance), V_4 (Export), or V_1 (Process innovation). The results are summarized in Tables 7 and 8. The results of the regression analysis show that the independent variables V_{14} (Brand), V_{12} (Accountancy), V_{19} (R&D&I), V_{16} (Firm agreements), and V_{17} (Local contacts) are related with the dependent variable V_2 (Performance). Moreover, the second regression analysis shows that the independent variables V_7 (Permanent staff), V_{12} (Accountancy), and V_{19} (R&D&I) are connected with the dependent variable V_4 (Export).

The results of the discriminate analysis show how the following variables compose the canonical functions that discriminate the process innovation level of the firms. These are V_7 (Permanent staff), V_9 (Education), and V_{16} (Firm agreements).

Table 7: Results of the Lineal Regression Model of V_2 (Performance)

Introduced Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	2.006**	1.314**	1.277**	1.097**	1.061**
V_{14} (Brand)	1.174**	1.293**	1.245**	1.338	1.418**
V_{12} (Account)		0.737**	0.577**	0.539**	0.581**
V_{19} (R&D&I)			0.377**	0.275**	0.163*
V_{16} (Firm agreements)				0.260	.0258**
V_{17} (Local contacts)					-0.011**
Chi-Squared	9.212	13.395	14.387	14.747	15.015
Nagelkerke R^2	0.583	0.858	0.923	0.949	0.996
-2 log-lik.					
% correct p.					
N	122	122	122	122	122

Notes: ** p< 0.0001, * p<0.001. Dependent variable V_2 (Performance): the variables not shown in the model were excluded because of their lack of contribution to the model in the adjusted R^2, through the stepwise procedure in the linear regression analysis.

Table 8: Results of the Linear Regression Model of V_4 (Export)

Introduced Variables	Model 1
Constant	2.196**
V_7 (Permanent staff)	0.198*
V_{12} (Accountancy)	0.254*
V_{19} (R&D&I)	0.270*
Chi-Squared: 13.212, Nagelkerke R^2: 0.883, -2 log-lik. % correct p., N: 122	

Notes: ** p< 0.0001, * p<0.05. Dependent variable V_4 (Export): the variables not shown in the model were excluded because of their lack of contribution to the model in the adjusted R^2, through the stepwise procedure in the linear regression analysis. Only one model was obtained in this exercise.

Table 9: Discriminant Analysis (Dependent variable V_1, Process innovation)

Step	Introduced	Statistic	Statistic	Sig.
1	V_{16} (firm agreements)	.864	18.818	.000
2	V_{17} (permanent staff)	.774	17.392	.000
3	V_9 (employees with degrees)	.698	17.005	.000

Note: The canonical functions were significant (Wilks's Lambda 0.864, 0.77, 0.689 at p<0.01).

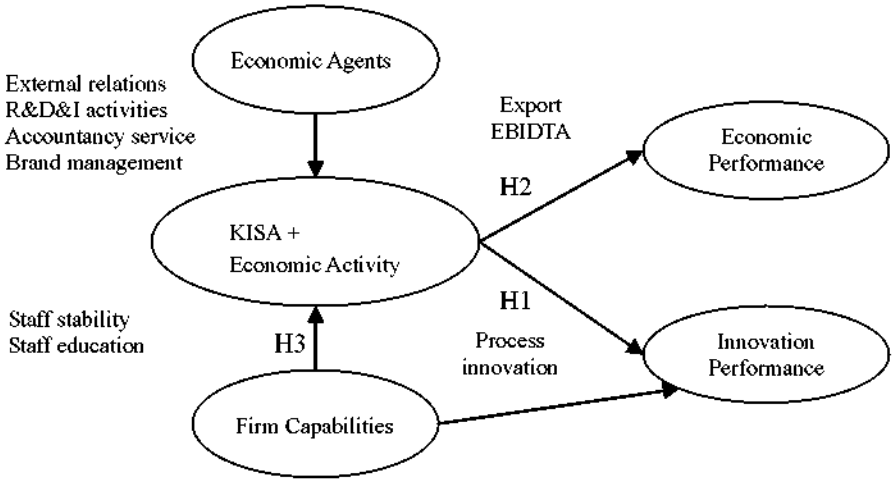

Figure 5: Proposed Model of KISA Interaction and Their Influence on the Firm's Performance: Empirical Results

The empirical results show that the hypotheses proposed have been validated. H1, which states that KISA have a relative influence on the firms' innovative activities irrespective of their technology orientation, has been proven to be right in our case (low-tech manufacturing). This has been shown by the cluster and regression analyses. H2, which proposed that KISA have a relative influence on firms' employment growth and economic performance, has been partially validated because although KISA appear correlated with EBIDTA, this is not the case with the employment growth variable.

Finally, H3, the hypothesis on the influence of firms' absorption capacity, as a co-adjuvant in the KISA influence, has also been validated. KISA-related variables, such as employees' education and staff stability, have an impact on innovation performance. Meanwhile, it has to be noted that control variables, such as firms' size (measured by the number of employees) and the number of years of operation, are not significant. A third variable, staff employment growth, does not appear to be relevant either. This reinforces the idea that staff stability (permanent workforce) is the relevant dimension in this respect. Finally, it has been observed that most KISA are external, as could be explained by the average firm size of the sample.

5. Conclusions

The example discussed in this paper shows the relevance of KISA in the low-tech sectors as

well as in the mature industry where positioning in the value chain connotes improving the performance of firms. Branding and marketing management, as well as distribution control by firms, help to upgrade their position in the value chain, thus reinforcing their competitiveness and performance. The research consequently links KISA to chain governance and opens up a new research alternative.

Among the various types of KISA, branding development, marketing management, firm agreements, accountancy, internal R&D, and innovation activities, as well as external R&D&I have a higher statistical relevance in this research. In particular, the regression analysis showed that branding development, external accountancy activities, R&D and innovation activities, inter-firm formal agreements, as well as local internal contacts (a cluster effect) are correlated with the firms' performance as measured by the EBIDTA. The firms' performance measured as turnover export % is connected with external accountancy activities, R&D and innovation activities, and permanent staff.

A discriminant analysis used for identifying the variables with the most weight in the firm's innovation level concluded with the formulation of a canonical function composed of firms' formal agreements, permanent staff, and level of education of employees. This function was able to predict the innovation level with 92.3% probability.

The conclusion of the research points to the relevance of KISA for firm innovation performance as measured by the firms' profits, as well as export performance. An additional conclusion was the evidence of the impact of the firms' absorption capacity as a co-adjuvant in the KISA effects.

Because there is no previously published evidence, the contribution of the paper lies basically in explaining KISA's role in innovation especially, in the low-tech and mature sectors. This has implications, particularly in the case of SMEs, on innovation policy and the policymakers' recommendations to support KISA, especially those activities that contribute to innovation. It could be pointed out as well that KISA are connected with the issues of human capital and knowledge management. KISA are likewise relevant to low-tech and mature sectors where upgrading the firm's positioning in the value chain implies an improvement in the firm's performance.

Externally provided services for KISA play a relevant role in the case of SMEs with restricted in-house resources. The role of industry associations in the sector consisting of SMEs has to be considered as well. The research showed that the KISA variables associated with this dimension are relevant. The clustering effect is also shown to have synergy with KISA adoption and impact.

Finally, from a practitioner's view, the paper sheds light on the reasons involved in KISA

adoption, on how KISA relate to the firms' capabilities, and on how these can be a barrier to KISA adoption.

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