Product Innovation and Relational Capital: Evidence From Portugal

Pedro Figueroa Dorrego[1], Ricardo V. Costa[2] and Carlos Fernández-Jardon Fernández[3]
[1]Departamento de Organización de Empresas y Marketing, at Facultad de Ciencias Sociales y de la Comunicación, Universidade de Vigo, Spain
[2]ISMAI, Maia Institute of Higher Education, Research Unit UNICES, Portugal
[3]Departamento de Economia Aplicada, at Facultad de Ciencias Economicas y Empresariales, Universidade de Vigo, Spain
figueroa@uvigo.es
rvfcosta@gmail.com
cjardon@uvigo.es

Abstract: At a time when intellectual capital and product innovation management are both considered to be critical for companies to gain a competitive edge (and even survive) in today's unstable business environment, this paper discusses the influence of relational capital on product innovation performance at innovative small and medium enterprises (SMEs). Building upon the intellectual capital and new product development perspectives, an empirical research was conducted, using a questionnaire administered to a network of Portuguese innovative SMEs. The findings suggest that relational capital does have a positive effect on product innovation performance. In particular, "Vertical relationships" emerges as the main relational capital element significantly affecting product innovation at the innovative SMEs level. The existence and proactive management of relationships with customers and suppliers emerge as critical factors to product innovation success. We find our results to be useful for both researchers and practitioners: we contribute to the ongoing understanding of relational capital's impact on critical business phenomena, while also identifying additional critical factors for new product development success.

Keywords: intellectual capital, relational capital, product innovation, new product development, innovative SMEs, Portugal

1. Introduction

Academic research on business competitiveness has for the past decades gradually changed its focus. The development of dynamic capabilities sustained in factors that are tacit, invisible or intangible by nature has arisen as a privileged mean to achieve greater resource efficiency and create competitive barriers (Barney 1991, and Itami 1987). At the same time, innovation has increasingly emerged as one of the most crucial factors for structural development (Lederman 2010). Against this backdrop, the general purpose of this research is to study interaction effects between intangible assets and innovation at the firm level. Specifically, we intend to analyse the influence of relational capital on product innovation performance at innovative small and medium enterprises (SMEs).

It is nowadays generally accepted that the main components of intellectual capital can be structured into three dimensions: human capital, structural capital and relational capital (Martin de Castro et al. 2011). The relational capital concept is based on the consideration that companies are not isolated systems. On the contrary, they are actively and permanently connected to multiple external entities. All valuable relationships of this kind, with customers, suppliers and other relevant stakeholders, represent relational capital (Roos et al. 2001). Bontis (1998) argues that the knowledge of marketing channels and customer relationships is the main theme of relational capital. It represents the potential an organization has due to external intangibles, including the knowledge embedded in customers, suppliers, the government or related industry associations. Bueno & Salmador (2000) state that relational capital represents the firm's "competitive and social

Reference this paper as: Pedro Figueroa Dorrego et al. "Product Innovation and Relational Capital: Evidence From Portugal" *The Electronic Journal of Knowledge Management* Volume 11 Issue 4 (pp295-308 available online at www.ejkm.com

intelligence", while Martin de Castro et al. (2011) adds that relational capital provides critical information (market needs and opportunities, competitive dynamics, etc.) that serve as a useful external guide for the firm to improve and develop new knowledge. For the purpose of this study, we will therefore define relational capital as all valuable relationships, channels and networks that exist between an organization and its stakeholders.

Innovation, in the broadest sense, is in the heart of economic change. The vision of innovation as the main driver of long term development is today widely accepted (Lederman 2010, and Leiponen 2005). At the firm level, innovation is nowadays considered to be inevitable: driven by a variety of forces (including globalization, technological evolution and demography), the economic environment is changing rapidly. To succeed in such a context, or even to remain viable, corporations must respond with innovation (Govindarajan and Trimble 2005). Different types of innovations are usually distinguished (OECD 2005): product innovations, process innovations, marketing innovations and organisational innovations. Among these, product innovation, for its visibility in the relationship between companies and consumers, stands out as an element of particular importance to any business. Companies must develop new products, at least on occasion, to maintain or gain competitive advantages, and their ability to create new products has been linked to performance and even long-term survival (De Jong and Vermeulen 2006, and Linzalone 2008). This study will therefore focus on product innovation, defined in the Oslo Manual (OECD 2005) as the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses.

Intangible assets are positively and significantly associated with the firms' innovative capabilities, as demonstrated by several empirical studies (for example Canibaño et al. 2002; Chen et al. 2004; Del Canto and González 1999; European Commission 2006; Linzalone 2008; Santos Rodrigues et al. 2010; Subramaniam and Youndt 2005; Wu et al. 2008). Nevertheless, those researches were hardly ever specifically oriented at assessing the impact of relational capital on product innovation performance. Similarly, several authors from the product innovation field (e.g. Abetti 2000; Bullinger et al. 2004; Cooper et al. 2004, 2004a, 2004b; Kandemir et al. 2006; Montoya-Weiss and Calantone 1994; Shum and Lin 2007) have searched for critical success factors for new product development (NPD), but they rarely focused on the specific importance of relational capital elements. In order to fill these gaps, the main purpose of this study is to empirically validate if the existence of relational capital elements at the firm level influences product innovation performance. The decision to focus on innovative SMEs was based on the notion that innovative organizations represent a particularly interesting subject for studying knowledge-related topics (Delgado-Verde et al. 2011). Also, innovative development is usually challenging for SMEs, as they usually have limited financial resources, often lack a multidisciplinary competence base, and tend to use less structured approaches to innovation (Parida et al. 2012). Altogether, these factors emphasise the importance of identifying those elements that are most critical to the success of their product innovation initiatives.

The structure of this study is as follows: the following section proposes a brief review of the literature regarding the relationships between relational capital and product innovation, and a presentation of our research goals. The next section describes our research methodology, namely the variables definition, the sample choice and the process for data collection. We will then present the statistical analysis and its results. Finally, some insights will be extracted and discussed and some conclusions will be drawn.

2. Literature review and research goals

Product innovation is by definition an uncertain process, with few repetitive or predictable elements. Consequently, it requires a search for knowledge outside the firm's existing knowledge base, often in areas unrelated with its current operations. This is why relational capital, or the intensity with which the organization is connected with elements outside its walls, can be a critical source of innovation.

One of the most famous creators of new products, Thomas Edison, is mentioned by Hargadon and Sutton (1997) as a good example of how developing network connections across industries can benefit product innovation. In fact, Edison's products were not entirely original: they often resulted of combining ideas that already existed but were not connected, typically picked up by his engineers while working in other, diverse industries. This illustrates the fact that continuous innovation is often related to occupying a "structural hole", that is, the gap in the flow of information between subgroups in a larger network (Hargadon and Sutton 1997). Knowledge is often shared imperfectly through time, people, organizations and industries. The ideas that come up in a group could solve other groups' problems, but that can only happen if there are links that can go through the existing frontiers between solutions and problems. When those connections take place, existing ideas can appear new and creative, as they change shape and are combined with other ideas to solve new problems. We thus argue that high levels of relational capital at the firm level (through a clear orientation to develop links with multiple external knowledge sources) strengthen the firm's ability to absorb and transform new knowledge, and thus its product innovation potential. In fact, some authors (eg. Cohen and Levinthal 1990) state that the ability of a firm to recognise the value of new, external information, assimilate it, and apply it to commercial ends (that is, the firm's "absorptive capacity") represents a learning process that is critical to its innovative capabilities. Nieves and Osorio (2012) stress that the exchange and combination of knowledge that social networks provide is widely recognized as an antecedent of knowledge creation and innovative results.

Empirical support was also found for the notion that developing and nurturing the existence of knowledge flows beyond the borders of the firm and through distinct scientific areas turns R&D efforts more productive (Pike et al. 2005). This includes cooperation agreements with suppliers, external experts, research centres or universities, as well as contacts with regulatory entities. Nonaka and Takeuchi (1995) argue that the creation of an R&D network based on strong connections with suppliers was determinant for the success of Japanese firms' innovation efforts in the 80's. Other studies (for example, Ahuja 2000) tried to understand the importance of establishing collaboration networks to the firm's innovative capabilities. It was found that the existence of direct and indirect ties with other firms and institutions, as well as the existing links between them, has an influence on the firm's innovation output. In fact, the existence of collaboration networks was found to have two types of benefits: on one hand, they contribute to the sharing of existing knowledge, know-how and physical resources; on the other hand, they increase the access to new knowledge and its diffusion, serving as "conductors" through which the news of technological breakthroughs, new solutions to existing problems or failed approaches travel from one firm to another. Bullinger et al. (2004) also argue that the existence of vertical and horizontal networks (with customers and suppliers, and with other firms) is a very important factor to the firm's ability to innovate. Firms "need to build up a company-wide internal innovation network of innovation actors and integrate their innovation process in mutual horizontal and vertical networks" (Bullinger et al. 2004, pp. 3346) in order to share knowledge and benefit from complementary competencies, as a critical way to timely identify new innovation options and directions. Subramaniam and Youndt (2005) conclude that external relationships, alliances and collaboration networks are essential to an organization's innovation versatility, adding that "social capital" is gaining increasing importance and visibility as an organizational resource.

Some studies stress the importance of relational capital as a manifestation of the organization's market orientation. Bontis (1999) mentions the relevance of an organization-wide generation of market intelligence regarding current and future needs of customers. This market-oriented perspective of relational capital stresses the importance of developing multiple vertical links as a way to increase the firm's ability to identify the true needs of the market, and thus increase the potential success of its new products. Shum and Lin (2007) argue that getting close to the customer is a top priority, as customer knowledge is a main driver of innovation among innovative companies, while Desouza et al. (2008) argue that involving customers in the innovation process ("customer-driven innovation") is a significant way to enable continual, sustainable innovation. Other

studies have found that lead users can provide critical inputs to a producer's internal innovation process (Bogers et al. 2010).

We thus find some evidence that relational capital, representing the set of channels, contacts and initiatives that build bridges between the firm and its external environment, can be a critical source of new knowledge that feeds the firm's innovative capabilities. Therefore, it seems acceptable to assume that the existence and proactive management of relationships with external stakeholders will have a relevant influence on product innovation efforts at innovative SMEs. These relationships increase access to new ideas and contribute to a better understanding of the target markets, increasing the odds of success at launching new products.

We will thus hypothesise that:

> *Hypothesis 1 - relational capital is positively associated with product innovation performance at innovative SMEs.*

Having put forth this general hypothesis, another important interrogation remains: which of the constitutive elements of relational capital are the main drivers of product innovation? Within the notion of collaborative networks lies a wide array of possibilities, namely regarding the decision to establish relationships with very different types of stakeholders. Understanding which are more relevant to product innovation at innovative SMEs is particularly critical, more so if we accept the notion that collaborative networks are harder to establish and manage at the SME level. Another purpose of this article is then to identify eventual differences between relational capital elements, in what concerns their impact on product innovation performance.

We will therefore also hypothesize that:

> *Hypothesis 2 - There are significant differences between relational capital elements regarding their impact on product innovation.*

3. Research methodology

Once presented the theoretical background that inspired this research, we will now display the methodology that guided our empirical work, aimed at understanding the relationship between relational capital and product innovation performance at innovative SMEs.

3.1 Variable definition and measurement

Being a volatile and uncertain process, product innovation often requires a search for knowledge outside the firm's existing knowledge base, frequently in areas not directly related to its current activities. That is why relational capital, or the intensity with which the firm relates with external entities, can be an essential basis to acquire new knowledge. It thus seems adequate to assume that the existence of direct and indirect links with external stakeholders will have a determinant impact on the innovative SMEs' innovation capabilities, and particularly on its product innovation performance. Firms with stronger ties to its suppliers and customers also gain an increased sensitivity towards market needs, which turns their product innovation effort into a more oriented and effective process. In order to study the existence of relationships with the exterior, and also to understand to what extent they are proactively managed, we chose to consider two relational capital elements: the existence of vertical and horizontal relationships; and the management of relationship processes (incorporating contributions from Ahuja 2000; Bontis 1998; Bullinger et al. 2004; Cooper et al. 2004b; IADE 2003; Pike et al. 2005; Subramaniam and Youndt 2005, and Youndt et al. 2004):

- ***Vertical and horizontal relationships*** surveyed the existence of relationships with customers, suppliers, competitors and other institutions with the specific goal of enriching the firm's product innovation capabilities. We relied on three indicators to measure this element:

- *There are vertical relationships (with customers and suppliers) with the specific goal of strengthening our product innovation capabilities*
- *There are horizontal relationships (with partners and competitors) with the specific goal of strengthening our product innovation capabilities*
- *There are relationships with other institutions (government agencies, external experts, public and private R&D centres, shareholders, etc.) with the specific goal of strengthening our product innovation capabilities*

- ***Management of relationship processes*** relates to the proactive and systematic management of existing relationship processes and channels with the exterior. We relied on five indicators to measure this element:
  - *The company makes a specific effort to identify and establish relationships with customers or users who are more receptive to innovative products (lead users)*
  - *The company actively manages formalized relationship processes with clients*
  - *The company actively manages formalized relationship processes with suppliers*
  - *The company actively manages formalized relationship processes with competitors*
  - *The company actively manages formalized relationship processes with institutions, shareholders and investors*

In what concerns the measurement of product innovation performance, a growing number of studies is relying on the use of the so-called "impact indicators", which measure the financial and economic significance of product innovation to the company (Shum and Lin 2007; Souitaris 2002). With that in mind, we relied on three indicators to measure product innovation performance, incorporating contributions from Cooper (2004), OECD (2005), Shum and Lin (2007) and Souitaris (2002):

- Proportion of projects entering development stage that became commercial successes (met or exceeded sales goals) in the past three years;
- Percentage of current sales revenue derived from new products introduced in the past three years;
- Proportion of projects hitting their launch dates on time and on budget.

3.2 Sample definition and data collection

This research was conducted at the firm level, as in most studies concerning intellectual capital and product innovation. The theoretical population was established as "small and medium Portuguese innovative firms". As argued before, the decision to analyze innovative firms was based on their adequacy to the kind of research we intended to conduct. Also, firms where there is little innovation activity tend to find that participating in such studies represents a disproportionate burden, and their non-response rates tend to be higher (OECD 2005). The decision to focus on small and medium companies (SMEs) was based on a number of reasons. First of all, the study of intellectual components at SMEs is still very incipient. Some studies have tried to establish relationships between intellectual capital and innovation in organizations, but little attention has been focused on the specific case of SMEs, and even less on innovative SMEs. Small and medium companies have different characteristics from the larger companies that are usually studied in this context (Tovstiga and Tulugurova 2007; Cohen and Kaimenakis 2007). Also, SMEs generally cannot assume the financial risk of conducting a large portfolio of new product projects, and have smaller financial capacity and less market power than larger companies. They are therefore more dependent on innovative dynamics (European Commission 2006, Vaona and Pianta 2008, Parida et al. 2012). In view of these criteria, we decided that the best possible sample for our theoretical population was COTEC's "Rede PME Inovação", a network of Portuguese innovative SMEs. COTEC is

a non-profit association supported by the Portuguese Government and the institutions of the National Innovation System, aimed at promoting the competitiveness of companies established in Portugal, through the development and the diffusion of a culture and practice of innovation. COTEC's membership list includes virtually all of the most prominent companies operating in Portugal. Among its initiatives, COTEC endorses an expanding innovative SMEs network ("Rede PME Inovação") based in Portugal, which comprises innovative SMEs that, having applied for network membership, fulfil a set of specific criteria and enjoy a minimal score on COTEC's "innovation scoring". At the date of the research, this network comprised 100 firms, with a total of around 7729 employees and 782 million Euros of total turnover.

Once the research constructs and the population sample were established, a preliminary version of the questionnaire was designed. A 5-point Likert scale was used in relational capital indicators (comprising a total of eight statements), and a choice of percentage intervals was used in product innovation performance items (three in total). A pilot study with four firms and an expert interview were conducted, and some items were refined through this purification process. The data collection took place in 2009, via e-mail, involving all 100 companies. The request included a description of the study, stating its usefulness and social value, and a statement of confidentiality. The questionnaire, which included a larger survey beyond the data reported in this study, was directed to the CEO of each firm, as suggested by the Oslo Manual (OECD 2005). Follow-up telephone calls were made to each firm explaining the purpose of the research, and a few questionnaires were taken in person. 72 responses were received, for a response rate of 72 percent.

4. Data analysis and results

This section is dedicated to the empirical findings of the research. Once all questionnaires were received, we proceeded to the treatment and analysis of the data, using a combination of multivariate statistical techniques.

4.1 Preliminary analysis

A preliminary analysis of the data was conducted, using SPSS software. The existence of abnormal behaviour was studied through the analysis of frequency tables and descriptive statistic measures, as well as through a joint purification by classifying the data into clusters, using k-averages. As a consequence, two cases were considered to be outliers, and were therefore excluded. A homogeneity test confirmed the representativeness of the sample (Newbold et al., 2002). Cronbach's α coefficients of the constructs were then calculated. This method can be defined as the correlation one expects to obtain between the scale used and a hypothetical scale of the same universe, with the same number of items, measuring the same characteristics. It produces values ranging from zero to one. The closer the value is to one, the more reliable is the construct. Cronbach's α coefficient for "relational capital" was 0.770, and Cronbach's α coefficient for "product innovation performance" was 0.746. Typically, the minimum threshold of Cronbach's α coefficient is 0.7 (Hair et al. 2006).

4.2 Partial least squares analysis and results

The first step of the study was to empirically test Hypothesis 1, which predicted that relational capital is positively associated with product innovation performance at innovative SMEs. In order to test our assumption, a partial least squares (PLS) analysis was conducted, using SmartPLS version 2.0 (Ringle, 2005). The PLS method is a structural equation modelling technique, usually described as an example of "second generation multivariate analysis". The PLS method was designed to reflect the theoretical and empirical conditions of social and behavioural sciences, where it is common to find situations where theory is weak and there isn't much solid information available (Wold, 1979). The underlying mathematic and statistic procedures are rigorous and robust, creating optimal predictive linear relations between variables, but the model is flexible in the sense that it does not make assumptions concerning measuring levels, data distribution and sample size. The PLS model is based on theoretical constructs or latent variables, with the exogenous

constructs (in our case, relational capital) representing the predictive variables of the endogenous constructs (in this case, product innovation performance). In this research, a decisive argument to use PLS as an investigation methodology was the sample size: this study had a potential maximum of 100 cases, which is below the usual threshold recommended for other structural equation modelling techniques. PLS is less sensitive to sample size, so it allows working with smaller samples. In fact, Chin (1998) suggests that sample size can be equal to the larger of the following criteria: 1) ten times the largest number of indicators on the most complex formative construct, or 2) ten times the largest number of independent latent variables that affect a dependent latent variable. In our case, the second condition applies, as we have no formative indicators. As our model uses only one independent latent variable affecting a dependent latent variable, 1x10=10. Our sample size is 70.

Our measurement model consists of the relationship between the two constructs and their measurement indicators. We used three methods to assess the adequacy of the measurement: individual items reliability (by examining their respective loadings, or simple correlations between the measurement items and their construct); constructs reliability (by analyzing the composite reliability, a measure recommended by Fornell and Larcker (1981), similar to Cronbach's α but preferred in this context because it estimates consistency based on actual construct loadings); and convergent validity (by calculating the average variance extracted (AVE), a measure designed by Fornell and Larcker (1981) that indicates the amount of variance captured by a construct from its measurement indicators in relation to the amount of variance due to its measurement error. Its values should be greater than 0.5, indicating that over 50% of the construct variance comes from its indicators).

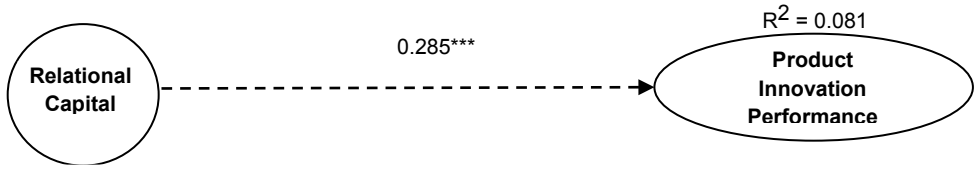
We examined the factor loadings to assess individual items reliability. A rule of thumb in this situation is to accept those items with loadings over 0.7 (Cepeda and Roldán, 2004), but it is common to find studies where some measurement items reveal loadings under that limit, especially when new indicators or scales are used. That is the recommendation of Barclay et al. (1995) and Chin (1998), accepting loadings that equal 0.4. In our case, we decided to establish a 0.5 cut-off, eliminating all items presenting loadings under this threshold.

The next step was to assess the constructs reliability. Composite reliability values for both constructs are over 0.8, as shown on Table 1, which exceeds the strictest parameters associated to a good internal consistency. Finally, convergent validity was tested, by examining AVE. Both constructs reveal AVE values over the 0.5 threshold, as also shown on Table 1:

Table 1: Composite Reliability and AVE

	Composite Reliability	**AVE**
Relational Capital	0,848431	0,58569
Product Innovation Performance	0,839643	0,642017

To assess the statistical significance of the path coefficients, a bootstrapping analysis was performed. This nonparametric test of significance generates a high number of random samples from the general data, re-calculating the coefficients using each one of these random samples. This technique allows the calculation of t-Student values, and the correspondent p-values. The resulting structural model is shown on Figure 1:



- Number on top is the path coefficient (β), t-value in brackets
- Significance levels: *p<.05; **p<.01; ***p<.001 (based on t(499), 2-tailed).

Figure 1: PLS Structural Model

The model examines the influence of relational capital on product innovation performance. The relationship is significant, with p-value under 0.001 and path coefficient over 0.2, thus validating Hypothesis 1.

4.3 Regression analysis and results

The next step of the study was to empirically test if the distinct elements that comprise relational capital affect product innovation performance at innovative SMEs differently, as predicted by Hypothesis 2. In order to reduce the data and fine-tune our constructs, we used a principal components factor analysis. This technique explores the observed variables for patterns of correlations that can be combined into a set of common factors. The internal structure of the factors obtained through this method allows us to sharpen our constructs, by combining the elements that the respondents think are related. In what concerns the selection of the number of factors that better describe the data, there is no absolute rule as to how many factors to retain, and some degree of subjectivity is admitted on that assessment (Hair et al., 2006). Our decision resulted from the combination of three commonly used criteria: the analysis of the cumulative total variance explained (that should always be over 50 percent), the Kaiser criterion (factors with explained variance, or initial eigenvalues, over one), and the visual analysis of the scree plot. Factors were submitted to an orthogonal Varimax rotation, with Kaiser Normalization, which simplifies the interpretation of the results as it produces a solution where values close to one (in absolute value) indicate positive association between the variable and the factor, and values close to zero indicate absence of association. Geometrically this corresponds to a rotation of the factorial axis, not affecting the structure of the data.

To confirm that the elements were factorable, we used Bartlett's sphericity test and the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy. The first test verifies whether the correlation matrix between the original items is an identity matrix. The second test measures sampling adequacy by comparing the partial correlation between the items involved. The closer to one the results are, the closer to zero will partial correlations be, meaning that the specifications of each item are small in relation to the overall data. Values are usually considered to be acceptable if greater than 0.6 (Hair et al., 2006).

In what concerns relational capital, KMO's measure of sampling adequacy was 0.696, signalling an acceptable quality of correlation between variables. Bartlett's test resulted in a 0.000 level of significance, dismissing the hypothesis that the correlation matrix is the identity matrix. These results allowed us to proceed with factor analysis for relational capital. Two factors were extracted under the established criteria, as presented in Table 2, obtained through a Varimax rotation with Kaiser normalization that converged in three iterations. These factors account for 59,476 percent of cumulative variance explained. All item loadings are over 0.5, which is commonly considered as a high significance level.

Table 2: Factor analysis results for relational capital

Factor	Percentage	Item description	Loadings
Factor 1: Vertical relationships		The company actively manages formalised relationship processes with clients	,893
		The company makes a specific effort to identify and establish relationships with customers or users who are more receptive to innovative products (lead users)	,794
		There are vertical relationships (with customers and suppliers) with the specific goal of strengthening our product innovation capabilities	,673
Variance explained	39,575	The company actively manages formalised relationship processes with suppliers	,624
Cumulative variance explained	39,575		
Factor 2: Horizontal and institutional relationships		The company actively manages formalised relationship processes with institutions, shareholders and investors	,807
		There are relationships with other institutions with the specific goal of strengthening our product innovation capabilities	,786
		There are horizontal relationships (with partners and competitors) with the specific goal of strengthening our product innovation capabilities	,706
Variance explained	19,901	The company actively manages formalised relationship processes with competitors	,604
Cumulative variance explained	59,476		

According to the characteristics of the items, we labelled these two factors as follows:

- Factor 1: "vertical relationships", representing the existence and proactive management of vertical relationships (with customers and suppliers), aimed at improving the firm's product innovation capability;
- Factor 2: "Horizontal and institutional relationships", representing the existence and proactive management of horizontal relationships (with partners and competitors, as well as with shareholders, investors and other institutions), aimed at improving the firm's product innovation capability.

In what concerns product innovation performance, KMO's measure of sampling adequacy was 0.653, signalling a reasonable quality of correlation between variables. Bartlett's test resulted in a 0.000 level of significance, dismissing the hypothesis that the correlation matrix is the identity matrix. These results allowed us to proceed with factor analysis for product innovation performance. One single factor was extracted under the established criteria, as presented in Table 3, which accounts for 66,657 percent of cumulative variance explained. Therefore, we aggregated the three items into one single measure for product innovation performance. Again, all item loadings are over 0.5.

Table 3: Factor analysis results for product innovation performance

Factor	Percentage	Item description	Loadings
Factor 1: Product Innovation Performance		Proportion of projects entering development stage that become commercial successes (meet or exceed sales goals) in the past three years	,871
		Proportion of projects hitting their launch dates on time and on budget	,811
Variance explained	66,657	Percentage of current sales revenue derived from new products introduced in the past three years	,764
Cumulative variance explained	66,657		

We proceeded by performing a multiple linear regression on the data resulting from our factor analysis. The results are contained on Figure 2.

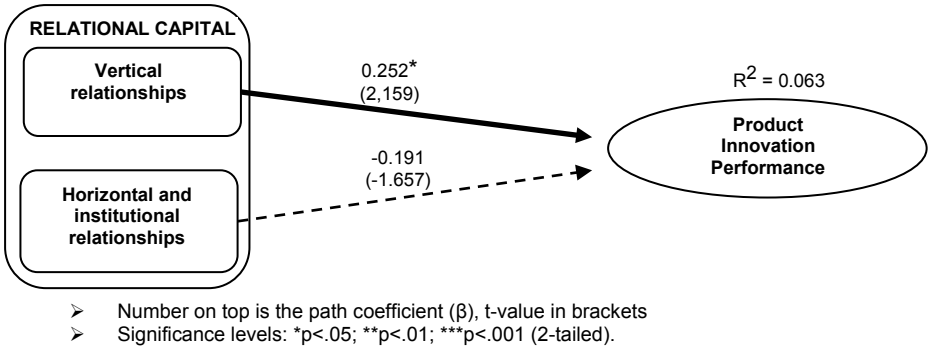


Figure 2: Regression analysis

The results confirm that relational capital does have a positive influence on product innovation performance, but strong differences in significance levels show that not all relational capital elements we considered have such a relevant effect. In fact, only the element we called "vertical relationships" reveals a significant impact on product innovation performance. Hypothesis 1 and 2 are therefore validated.

5. Discussion, limitations and directions for future research

The objective of this study was to analyse the influence of relational capital on product innovation at innovative SMEs. We conducted both a PLS and a linear regression analysis between constructs to test our hypothesis, which were validated by the results: relational capital showed a positive and significant impact on product innovation performance (validating hypothesis 1). This result is consistent with some fragmented research findings published in similar contexts (e. g. Bontis 1998; Cabrita and Bontis 2008; Chen et al. 2004), and allow us to generally conclude that the better the innovative SMEs manage and nurture their relational capital, the more successful those firm's product innovation efforts will be. However, only one of the elements that comprised relational capital revealed a significant impact on product innovation performance (thus validating hypothesis 2). That element was identified as "vertical relationships", representing the existence and proactive management of vertical relationships (with customers and suppliers) aimed at improving the firm's product innovation capabilities. Other types of relationships the firm establishes and manages with the exterior, namely with partners and competitors, shareholders, investors and other institutions, did not show a significant effect on product innovation performance at the companies we analysed. Looking at the overall

responses to the questionnaire, we verify that horizontal and institutional relationships reveal much lower mean scores than vertical relationships. This indicates that it is more common to create links with clients and suppliers than it is with other stakeholders. Thus, one possible explanation to our results is that because these specific companies are more used to establish and manage vertical relationships than horizontal ones, the former end up being more effective and significant to their product innovation efforts.

The specific relevance of "vertical relationships" that was detected is consistent with the interpretation of relational capital as a manifestation of the firms' "market orientation". In fact, an effective way to gather important knowledge regarding current and future market needs is through the establishment of relationships with clients and suppliers. By doing this, firms are able to more easily obtain, absorb and internalise market knowledge and to manage their product development process in a more oriented and effective manner. This idea is supported by some authors from the product innovation research stream (for example Cooper et al. 2002 and Kotler 1991), who emphasize the importance of creating strong ties with clients and suppliers to enhance the firm's ability to identify market needs and thus increase its product innovation effectiveness. Some other studies on this topic also reinforce this perspective, coining such terms as "customer-driven innovation" (Desouza et al. 2008), "customer-centric innovation" (Selden and MacMillan 2006), or "users as innovators" (Bogers et al. 2010) to emphasize the importance of integrating customers in the innovation process. Rosell and Lakemond (2012) argue that although the actual contributions of suppliers to innovation are underexposed, suppliers may provide a valuable contribution to new product development, as they provide access to external knowledge that complements the firm's internal knowledge base. Our research indicates that these assumptions also seem to apply to Portuguese innovative SMEs.

We hope this study contributes to clarify which relational capital elements are the most important to product innovation success at innovative SMEs, offering some clues on how to address the problem of managing relational capital to increase product innovation performance. Developing and managing relationships with customers and suppliers seem to be key factors to consider. Additionally, the fact that "horizontal and institutional relationships" showed a low mean score within our sample indicates that Portuguese innovative SMEs should try to dedicate more time and resources to this particular relational capital element. Chiu (2009) suggests that in order to succeed in the social construction of innovation performance within a cluster, companies must focus on enhancing their network competence and strive for more central network positions.

This research has some limitations that need to be addressed. The first one relates to the population being studied, COTEC's "Rede PME Inovação". We cannot state without reservations that these firms are representative of all Portuguese innovative SMEs, so the generalization of our results must be cautious. Conducting further research within a larger population would be useful to confirm the generalization of our results to all innovative SMEs.

Another issue to consider regards the decision to analyse the influence of only one intellectual capital component on product innovation. Some studies (for example, Bontis 1998; Bontis et al. 2000; Cabrita and Bontis 2008; Chen et al. 2004; Santos Rodrigues et al. 2010) have found that intellectual capital components often reveal relevant path dependencies among themselves, when measuring their combined influence on organizational phenomena. Low R^2 readings on our model suggest the convenience to rebuild it by incorporating other intellectual capital components.

References

Abetti, P. (2000) "Critical Success Factors for Radical Technological Innovation: a Five Case Study", *Creativity and Innovation Management*, Vol. 9, No. 4, pp 208-221.

Ahuja, G. (2000) "Collaboration Networks, Structural Holes and Innovation: a Longitudinal Study", *Administrative Science Quarterly*, 45 (2000), pp 425-455.

Barclay, D.; Higgins, C. and Thompson, R. (1995) "The Partial Least Squares (PLS) Approach to Causal Modelling: Personal Computer Adoption and Use as an Illustration", *Technology Studies*, *Special Issue on Research Methodology*, Vol. 2 No. 2, pp 285-309.

Barney, J. (1991) "Firm Resources and Sustained Competitive Advantage", *Journal of Management, Vol. 17, No. 1, pp 99-120.*

Bogers, M.; Afuah, A. and Bastian, B. (2010) "Users as Innovators: A Review, Critique, and Future Research Directions", *Journal of Management,* Vol. 36, No. 4, pp 857-875.

Bontis, N. (1998) "Intellectual Capital: an Exploratory Study that Develops Measures and Models" *Management Decision*, vol. 36, No. 2, pp 63–76.

Bontis, N. (1999) "Managing Organizational Knowledge by Diagnosing Intellectual Capital: Framing and Advancing the State of the Field", *International Journal of Technology Management*, 18/5-6-7-8, pp 433–462.

Bontis, N.; Keow, W. and Richardson, S. (2000) "Intellectual Capital and Business Performance in Malaysian Industries", *Journal of Intellectual Capital*, vol. 1, No. 1, pp 85-100.

Bueno, E. and Salmador, Mª. P. (2000) "Perspectivas sobre Dirección del Conocimiento y Capital Intelectual", *Instituto Universitario Euroforum Escorial*, Octubre, Madrid.

Bullinger, H.-J.; Auernhammer, K. and Gomeringer, A. (2004): "Managing innovation networks in the knowledge-driven economy" *International Journal of Production Research*, vol. 42, No. 17, pp 3337-3353.

Cabrita, M. and Bontis, N. (2008) "Intellectual capital and business performance in the Portuguese Banking Industry", *International Journal of Technology Management,* vol. 43, No. 1-3, pp 212-237.

Cañibano, L.; Sanchez, P., García-Ayuso, M. and Chaminade, C. (2002) "Directrices para la Gestión y Difusión de Información sobre Intangibles", MERITUM Project, available at http://www.uam.es/personal_pdi/economicas/palomas/DIRECTRICES%20MERITUN%20-%20 ESPANOL.pdf

Cepeda, G. and Roldán, J.L. (2004) *Aplicando en la Práctica la Técnica PLS en la Administración de Empresas*. *Presentation from the "XIV Congreso Nacional de ACEDE"*, Murcia.

Chen, J.; Zhu, Z. and Xie, H. (2004) "Measuring Intellectual Capital: a New Model and Empirical Study", *Journal of Intellectual Capital*, vol. 5, No. 1, pp 195-212.

Chin, W.W. (1998) "The Partial Least Squares Approach to Structural Equation Modeling", in G.A. Marcoulides (ed.): *Modern Methods for Business Research*, Mahwah, NJ., Lawrence Erlbaum Associates, Publisher, 295-336.

Chiu, H. (2009) "How network competence and network location influence innovation performance". *Journal of Business & Industrial Marketing,* Vol. 24, No. 1, pp 46–55.

Cohen, S. and Kaimenakis, N. (2007) "Intellectual Capital and Corporate Performance in Knowledge-intensive SMEs", *The Learning Organization*, Vol. 14, No. 3, pp 241-262.

Cohen, W. and Levinthal, D. (1990) "Absorptive Capacity: A New Perspective on Learning and Innovation", *Administrative Science Quarterly*, *Special Issue: Technology, Organizations, and Innovation (March, 1990)*, 35/1, pp 128-152.

Cooper, R.; Edgett, S. and Kleinschmidt, E. (2002) "Optimizing the Stage-Gate Process; What Best-practice Companies Do - I", *Research Technology Management*, September-October 2002, pp 21-27.

Cooper, R.; Edgett, S. and Kleinschmidt, E. (2004) "Benchmarking Best NPD Practices – I", *Research Technology Management*, January-February 2004, pp 31-43.

Cooper, R.; Edgett, S. and Kleinschmidt, E. (2004a) "Benchmarking Best NPD Practices – II", *Research Technology Management*, May-June 2004, pp 50-59.

Cooper, R.; Edgett, S. and Kleinschmidt, E. (2004b) "Benchmarking Best NPD Practices – III", *Research Technology Management*, November -December 2004, pp 43-55.

De Jong, J. and Vermeulen, P. (2006) "Determinants of Product Innovation in Small Firms - A Comparison Across Industries", *International Small Business Journal*, vol. 24/6, pp 587-609.

Del Canto, J., and González, I. (1999) "A Resource-based Analysis of the Factors Determining a Firm's R&D Activities", *Research Policy*, 28 (1999), pp 891-905.

Delgado-Verde, M.; Martín-de Castro, G. and Navas-López, J.E. (2011) "Organizational Knowledge Assets and Innovation Capability: Evidence from Spanish Manufacturing Firms", *Journal of Intellectual Capital*, Vol. 12, No. 1, pp 5-19.

Desouza, K.C.; Awazu, Y.; Jha, S.; Dombrowski, C.; Papagari, S.; Baloh, P. and Kim, J. (2008) "Customer-driven Innovation", *Research Technology Management,* May-June 2008, pp 35-44.

European Commission (2006) *RICARDIS: Reporting Intellectual Capital to Augment Research, Development and Innovation in SMEs*, Luxembourg.

Fornell, C. and Larcker, D.F. (1981) "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error", *Journal of Marketing Research*, Vol. 18, February, pp 39-50.

Govindarajan, V. and Trimble, C. (2005) "Organizational DNA for Strategic Innovation", *California Management Review*, vol. 47, No. 3, Spring, pp 47-76.

Hair, J.; Black, W.C.; Babin, B.J.; Anderson, R.E. and Tatham R.L. (2006) *Multivariate Data Analysis*, (6th Edition), Prentice Hall, New Jersey.

Hargadon, A. and Sutton, R. I. (1997) "Technology Brokering and Innovation in a Product Development Firm", *Administrative Science Quarterly*, 42/4, pp 716–49.

IADE (2003) "Metodología para Elaboración de Indicadores de Capital Intelectual", *Documentos Intellectus nº 4*, Centro de Investigación sobre la Sociedad del Conocimiento - Universidad Autónoma de Madrid.

Itami, H. (1987) *Mobilizing Invisible Assets*, Harvard University Press, Cambridge, MA

Kandemir, D.; Calantone, R. and Garcia, R. (2006) "An Exploration of Organizational Factors in New Product Development Success", *Journal of Business and Industrial Marketing*, 21/5, pp 300-310.

Kotler, P. and Armstrong, G. (1991) *Principles of Marketing*, Prentice-Hall, Englewood Cliffs, NJ.

Lederman, D. (2010) "An International Multilevel Analysis of Product Innovation", *Journal of International Business Studies*, Vol. 41, No.4, pp 606-619.

Leiponen, A. (2005) "Skills and Innovation", *International Journal of Industrial Organization*, 23/2005, pp 303-323.

Linzalone R., (2008) "Leveraging Knowledge Assets to Improve New Product Development Performances", *Measuring Business Excellence,* vol. 12, No. 2, pp 38-50.

Martín de Castro, G.; Delgado-Verde, M.; López-Saez, P. and Navas-López, J.E. (2011) "Towards 'an intellectual capital-based view of the firm': origins and nature", *Journal of Business Ethics*, 98, pp 649-62.

Montoya-Weiss, M., and Calantone, R. (1994) "Determinants of New Product Performance", *Journal of Product Innovation Management*, 1994/11, pp 397-417.

Nonaka, I. and Takeuchi, H., (1995) *The Knowledge-Creating Company*, Oxford University Press, Oxford.

Newbold, P.; Carlson, W.L. and Thorne, B. (2002) *Statistics for Business and Economics* (5th Edition), Prentice Hall, Upper Saddle River, N.J.

Nieves, J. and Osorio, J. (2012) "The role of social networks in knowledge creation", *Knowledge Management Research & Practice,* 11, pp. 62–77.

OECD - Organisation for Economic Co-Operation and Development (2005) "Guidelines for Collecting and Interpreting Innovation Data", *Oslo Manual (3rd. Edition),* OECD, Paris.

Parida, V.; Westerberg, M. and Frishammar, J. (2012) "Inbound Open Innovation Activities in High-Tech SMEs: The Impact on Innovation Performance", *Journal of Small Business Management*, Vol. 50, No. 2, pp 283–309.

Pike, S.; Roos, G. and Marr, B. (2005) "Strategic Management of Intangible Assets and Value Drivers in R&D Organizations", *R&D Management*, 35/2, pp 111-124.

Ringle, C. M.; Wende, S. and Will, A. (2005) SmartPLS 2.0. Hamburg, 2005. Retrieved from http://www.smartpls.de

Roos, G.; Bainbridge, A. y Jacobsen, K. (2001) "Intellectual Capital Analysis as a Strategic Tool", *Strategy & Leadership*, vol. 29, No. 4, pp 21-26.

Rosell, D. T. and Lakemond, N. (2012) "Collaborative innovation with suppliers - a conceptual model for characterizing supplier contributions to NPD", *International Journal of Technology Intelligence and Planning*, Vol. 8, No. 2, pp 197-214.

Santos Rodrigues, H.; Figueroa Dorrego, P. and Fernández-Jardón, C. M. (2010) "The Influence of Human Capital on the Innovativeness of Firms", International Business & Economics Research Journal (IBER), vol. 9, No. 9.

Selden, L. and MacMillan, I. (2006) "Manage Customer-Centric Innovation – Systematically". *Harvard Business Review,* Vol. 84, No. 4, pp 108–116.

Shum, P. and Lin, G. (2007) "A world class new product development best practices model", *International Journal of Production Research,* vol. 45, No. 77, pp 1609-1629.

Souitaris, V. (2002) "Firm-specific Competences Determining Technological Innovations: a Survey in Greece", *R&D Management*, vol. 32, No. 1, pp 61-77.

Subramaniam, M. and Youndt, M. (2005) "The Influence of Intellectual Capital on the Types of Innovative Capabilities", *Academy of Management Journal*, vol. 48, No. 3, pp 450-463.

Tovstiga, G. and Tulugurova, E. (2007) "Intellectual Capital Practices and Performance in Russian Enterprises", *Journal of Intellectual Capital*, Vol. 8, No. 4, pp 695-707.

Vaona, A. and Pianta, M. (2008) "Firm Size and Innovation in European Manufacturing", *Small Business Economics*, vol. 30, No. 3, pp 283–299.

Youndt, M. A.; Subramaniam, M. and Snell, S. A. (2004) "Intellectual Capital Profiles: an Examination of Investments and Returns" *Journal of Management Studies*, 41/2, pp 335–61.

Wold, H. (1979) "Model Construction and Evaluation when Theoretical Knowledge is Scarce: an Example of the Use of Partial Least Squares", *Cahiers du Département D´Économétrie, Faculté des Sciences Économiques et Sociales*, Université de Genève.

Wu, W.; Chang, M. and Chen, C. (2008) "Promoting Innovation through the Accumulation of Intellectual Capital, Social Capital, and Entrepreneurial Orientation", *R&D Management*, vol. 38, No. 3, pp 265-277, June 2008.