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## SME Innovative Capacity, Competitive Advantage and Performance in a 'Traditional' Industrial Region of Portugal

Carla Susana Marques<sup>1</sup>, João Ferreira<sup>2</sup>

### Abstract

This study aims to identify the factors that contribute to the building of a firm's innovative capacity and to assess the way in which this contributes to our understanding of how much this contributes to improvements in the firm's performance. A conceptual model is proposed consisting of five separate dimensions: the firm; the entrepreneur; the external business environment; the firm's innovative capacity; and the firm's performance. The study was based on questionnaire-based data from a sample of firms drawn from the manufacturing industry in the Beira Interior Region of Portugal. The results provided evidence regarding the factors influencing the innovative capacity of firms and permitted conclusions to be drawn regarding effects of superior innovative capacity on the construction of firms' competitive advantage, which in turn contributes to improved performance.

**Keywords:** competitive advantage; innovative capacity; performance; SME; strategy.

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## Introduction

The capacity to innovate is recognised today as one of the main aspects leading to a competitive advantage amongst firms. A regional context that supports innovation and entrepreneurial initiative encourages competitiveness. In order to understand the features of regional competitiveness, a variety of conceptual models have been developed in recent years (e.g. Isaksen, 2001; Cooke, 2007). Traditionally, the efforts to explain the competitiveness of a region have been based on an aggregate perspective, concentrating on the characteristics of the factors involved, on macroeconomic indicators and on government policies.

The institutional endowment of a region can help generate sustainable advantages only if the resulting regional competences are valuable (i.e. they must allow firms to generate profit), scarce (i.e. they cannot be in abundant supply), not subject to substitution and imperfectly imitated, (i.e. policy-makers in other regions cannot readily copy them (Barney, 1991)). The existence of a regional innovation system (RIS) will help promote competitiveness among the firms of the region and to develop their (and the region's) innovative capabilities.

Innovation reflects the tendency of a firm to lend its support to new ideas, novelty, experimentation and the creative processes that may result in new products, services or technological processes (Lumpkin and Dess, 1996). A broad categorisation of innovation is difficult to achieve, because innovation normally covers a considerable range and combination of products/markets and technological innovation, as in the case of sophisticated, technologically innovative products designed to meet demand in a specific market. So far most, research has centred on *technological* innovation, which mainly consists of the development of products and processes, engineering, research, and has an emphasis on industry-relevant technical expertise and knowledge.

Under current market conditions, characterised by rapidly saturated demand, one firm's competitiveness relative to others tends to be determined more by its innovative capacity than by its productivity (Becattini, 1999). Porter (1990, 1996) proposed a new paradigm of competitiveness based on a process of dynamic innovation of firms and industries, arguing that interrelations between firms,

institutions and industries sustain and develop the competitiveness of a region. With a view to improving the existing theoretical framework, various authors have developed concepts (e.g. Porter, 1990; Zahra, et al., 1988; Roberts and Amit, 2003) that capture the contextual and relational elements of the innovation process that contribute to regional economic performance. Innovation is an important component of a firm's strategy mainly because it constitutes one of the principal means through which it can seek new business opportunities (Covin and Slevin, 1991; Lumpkin and Dess, 1996; Wiklund, 1998). Schumpeter (1934) was one of the first authors to emphasise the role of innovation in business, identifying it as a process of "creative destruction" through which wealth was created when existing market structures were interrupted by the introduction of new products or services. Today more than ever, a firm's construction of sustainable competitive advantage crucially depends on its capacity to innovate, i.e. its cumulative involvement in learning processes that go far beyond the borders of R&D and in which organisational and managerial aspects play a fundamental role. For this reason, it is important to understand the complexities of innovation, the way in which it influences firms' economic and financial results and the mechanisms through which economic and social actors are involved in the whole process, as well as the intrinsic difficulties and risks involved in the management of innovation (Nayak and Ketteringham, 1986; Leifer et al., 2000).

Despite the risk and uncertainty, when successful, innovation can have a sizeable impact on firms' financial results and economic performance. In order to deal with this environment of risks and uncertainties, firms must recognise the basic need for innovation in order to obtain and sustain competitive advantage and develop strategies directed towards the development of new products able to compete in a highly competitive business environment. Innovation is considered by many researchers and managers to be critical for firms to compete efficiently in both domestic and global markets (Hitt, 2001). Hamel (2000) argues that innovation is the most important component in a firm's strategy. In view of the contemporary challenges firms face, innovation is seen as an increasingly key factor in the competitiveness of firms; as a result, the more detailed study the factors that encourage and limit innovative capacity of firms is crucial (Silva, 2003; Stieglitz and Heine, 2007). Besides the

importance of understanding whether firms are or are not innovative, and identifying which factors contribute to the development of innovative behaviour, the ways in which innovative behaviour influences firm performance also needs closer analysis (Acquaah, 2007).

Porter (1996) states that a firm will only be able to obtain better results than its competitors if it manages to create a specific and durable differentiating factor, and that innovative behaviour being the principal means of creating this competitive advantage. Mogollón and Vaquero (2004) interpret firms' innovation efforts as evidence of their increasing awareness of innovation as a source of competitive advantage. Thus many authors see innovation, competitive advantage and performance as interconnected concepts and processes, and their inter-relationship has been studied widely analysed (see e.g. Porter, 1994; Teece and Pisano, 1994; Tidd, et al., 2001; Roberts and Amit, 2003; Short, et al., 2007; Newbert, 2007).

Based on a study of a region in the interior of Portugal, the present article aims to propose a methodology for evaluating the innovation capacity of SMEs in a given region and to thereby contribute towards the analysis of the factors that determine firms' innovative capacity, and the subsequent influence on firm performance. Such a methodology would provide the basis for inter-regional comparisons to be made either in the same country or between regions in different countries. The research undertaken focuses on two key questions: (1) What factors contribute towards the development of innovative behaviour in manufacturing firms in the Beira Interior region? (2) In what ways does the development of an innovative entrepreneurial strategy influence the performance of these same firms?

## Method

### Subjects or Participants

The unit of analysis was a sample of Portuguese firms from the Beira Interior region. Beira Interior is situated in the centre of Portugal, in the eastern inland area of the country. The region is bordered by the River Douro to the North and the River Tagus to the South, covers an area of 7819 km<sup>2</sup> and represents roughly 9% of the total area of mainland Portugal. Beira Interior comprises 5 NUTS III (Nomenclature of Territorial Units for Statistical

Purposes): (1) Pinhal Interior Sul, (2) Serra da Estrela, (3) Beira Interior Norte, (4) Beira Interior Sul and (5) Cova da Beira. The research population was obtained from a database provided by the Portuguese National Statistical Office (Instituto Nacional de Estatística – INE), covering a total of 1,307 firms. Given this large number, it was decided that the sample could be stratified by firm size (as measured by number of employees) and the type of economic activity in which the firm was engaged (as indicated by its CAE, or Classification of Economic Activity).

The sample was obtained in accordance with the following criteria: (1) because it contained so few medium-sized firms (70) and large firms (8), it was decided to include all these firms in the sample; (2) because there was a large number of micro firms (951) and small firms (278), it was decided to calculate a representative percentage of the total number of firms in the region, based on the CAE. This percentage was then applied to the number of micro and small firms in the database. In this way, the final sample was reduced of a total of 246 firms, of which 140 were micro, 40 small, 60 medium-sized and 6 large firms. In terms of the CAE, the sample was composed as follows: CAE category 15 (food and beverage industries) 144 firms, CAE category 17 (textiles) 30 firms, CAE category 18 (clothing industry) 31 firms, CAE category 20 (wood and cork industries) 17 firms and CAE category 28 (metal products) 24 firms.

The data were obtained from a questionnaire sent to the 246 firms in the sample. A total of 59 answers were received, corresponding to a response rate of 24%, with answers being provided by 19 micro, 15 small, 21 medium-sized and 4 large firms. As far as the CAE is concerned, 24 answers were received for firms in category 15, 13 for CAE category 17, 12 for CAE category 18, 6 for CAE category 20 and 4 for CAE category 28. In view of the research model proposed, its objectives, and the need to empirically validate the research hypotheses, both simple and multiple linear regression methods were applied.

### Design

After consulting various studies on this theme, a research model was developed with the following five dimensions: (1) the firm (Ferreira, 2003; Acquaah, 2007; Short et al., 2007); (2) the entrepreneur (Ferreira, 2003); (3) the firm's

external business environment (Hitt, *et al.*, 2001; Elbanna and Child, 2007); (4) the firm's innovative capacity (Rothwell, 1991; Silva, 2003); and (5) the firm's performance (Ferreira, 2003; Acquaah, 2007; Moliterno and Wiersema, 2007). These dimensions will now be characterised in brief.

#### **The firm:**

Earlier studies, namely Rothwell (1991), Ussman, *et al.* (1998), Hernandez (2000), Silva (2003), Avermaete, *et al.* (2003), Mogollón and Vaquero (2004), Pazos and López (2004), and Silva, *et al.* (2004), have highlighted the influence that internal factors can have on a firm's innovative capacity. For this reason, the questionnaire tried to identify internal variables that tend to explain a firm's innovative behaviour, namely, (i) size (Ferreira, 2003); (ii) age; (iii) level of training of the workforce (Ferreira, 2003; Newbert, 2007); (iv) sector of activity (Acquaah, 2007; Short, *et al.*, 2007); and (v) life cycle (Ferreira, 2003; Stieglitz and Heine, 2007). These variables are measured according several indicators (See Appendix I at the end of the article).

#### **The entrepreneur:**

Previous studies (Miller, 1983; Mintzberg, 1984; Drucker, 1985; Ferreira, 2003; Pazos and López, 2004; Mogollón and Vaquero, 2004) sought to assess the influence that the entrepreneur can have on a firm's innovative capacity, as the enterprising spirit and driving force behind the organisation's innovative behaviour. Mogollón and Vaquero (2004) considered both the age and the experience of the entrepreneur as determining factors in a firm's innovative capacity. Consequently, our study collected data on these two aspects, namely (i) the age of the entrepreneur; and (ii) the entrepreneur's enterprising spirit as measured by several indicators (See Appendix 2).

#### **The firm's external business environment:**

Various earlier studies (Ussman *et al.*, 1998; Kaufman, Wood, and Theyel, 2000; Silva, 2003; Mogollón and Vaquero, 2004) had already considered the setting up of partnerships between a firm and other firms and/or organisations, and the extent of the firm's openness to the external environment, measured through its volume of imports and exports, as factors determining its innovative

behaviour. In the research model proposed here, this dimension includes the external relations established between the firm and its business environment, as measured by the following variables: (i) the establishment of partnerships and cooperation agreements and (ii) the extent of a firm's openness to the external environment. These variables are measured according several indicators (See Appendix 3).

#### **The firm's innovative capacity:**

The present study considers innovative capacity or innovative behaviour of firms (Silva, 2003; Roberts and Amit, 2003; Mogollón and Vaquero, 2004), to include a number of dimensions of a firm's innovation process, namely product innovation, process innovation, market innovation and organisational innovation. Thus the following variables were considered as measuring the intensity of innovative capacity: (i) product innovation; (ii) process innovation; (iii) investment in R&D; and (iv) new distribution channels. Several studies (Nas and Leppälähti, 1997; Klomp and Van Leeuwen, 1999; Kleinknecht and Oostendorp, 2002; Kemp, *et al.*, 2003; Roberts and Amit, 2003; Ferreira, 2003; Mogollón and Vaquero, 2004; Marques and Monteiro, 2006) have sought to establish a link between the innovative behaviour of firms and their performance. The aim of this study is also centred on assessing the influence that a firm's innovative capacity can have on its performance. These variables are measured according several indicators (See Appendix 4).

#### **Firm's performance:**

In other studies, the most concise indicator of performance is growth itself, frequently regarded as more accessible than accounting indicators and comparatively superior to indicators of a firm's financial performance (Fombrun and Wally, 1989; Tsai, *et al.*, 1991; Brush and VanderWerf, 1992; Chandler and Hanks, 1994). Other researchers also consider performance from a multidimensional viewpoint (Lumpkin and Dess, 1996; Lumpkin and Dess, 1997; Wiklund, 1998), suggesting that, in empirical studies, it is advantageous to include various dimensions of performance. They argue that the results may be more favourable in one particular dimension than in another, depending on the processes and aspects of performance that are measured. Thus it was decided to measure firm performance through: (i) turnover/sales; (ii)

net profit/loss; (iii) the success achieved with new products; and (iv) the perception of the results obtained by the firm. These variables are measured according several indicators (Appendix 5).

In the light for the above, the conceptual model that served as a basis for the empirical study can be summarised as follows:

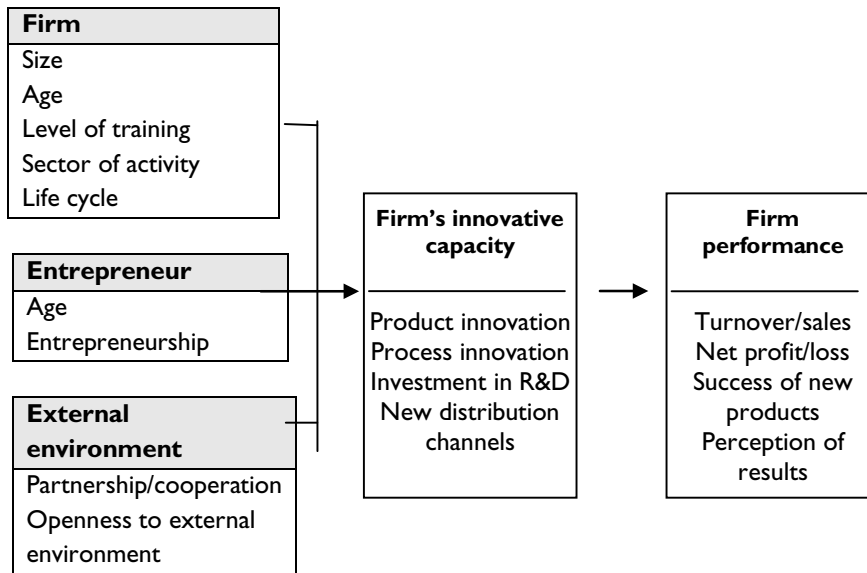


Figure 1. Proposed research model

The set of research hypotheses established is directly related to the different aspects of the research model discussed above and aim to validate each of the

relationships identified. The 10 research hypotheses thus formulated are presented in Table I.

Dimension	Research Hypotheses	Studies undertaken on similar hypotheses
<b>Firm</b>	H1: The size of the firm has a positive influence on its innovative capacity.	Rothwell (1991);Ussman, <i>et al.</i> (1998) Avermaete <i>et al.</i> (2003); Mogollón and Vaquero (2004); Silva <i>et al.</i> (2004); Pazos and López (2004)
	H2: The age of the firm has a negative influence on its innovative capacity.	Hernández (2000); Avermaete, <i>et al.</i> ; (2003); Mogollón and Vaquero (2004)
	H3: The level of training of the firm's labour force positively influences innovative capacity.	Ussman, <i>et al.</i> (1998); Pazos and López (2004)
	H4: The firm's sector of activity influences its innovative capacity.	Ussman, <i>et al.</i> (1998); Avermaete, <i>et al.</i> (2003); Silva, <i>et al.</i> (2004)
	H5: The phase of firm's life cycle negatively influences its innovative capacity	Scott and Bruce (1987); Ferreira (2003)

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<b>Entrepreneur</b>	H6: The age of the entrepreneur negatively influences the firm's innovative capacity.	Cressy (1996); Harada (2001); Mogollón and Vaquero (2004)
	H7: Entrepreneurship positively influences the firm's innovative capacity.	Miller (1983); Mintzberg (1984); Drucker (1985); Ussman, <i>et al.</i> (1998); Mogollón and Vaquero (2004)
<b>External environment</b>	H8: Partnerships and cooperation agreements with other firms and/or institutions positively influence the firm's innovative capacity.	Ussman, <i>et al.</i> (1998) ; Kaufman, <i>et al.</i> (2000); Mogollón and Vaquero 2004
	H9: A firm's openness to the external environment positively influences the firm's innovative capacity	Porter (1990); Pazos and López (2004); Silva, <i>et al.</i> (2004)
<b>Innovative capacity and performance</b>	H10: The firm's innovative capacity has a positive influence on its performance.	Zahra <i>et al.</i> (1988); Ussman, <i>et al.</i> (1998) Roberts and Amit (2003) Mogollón and Vaquero (2004); Marques and Monteiro (2006)

Table I. Research Hypotheses

## Results

### Factors Determining Innovative Capacity

In order to identify the determinants of innovative capacity, multiple linear regression methods were used, with innovative capacity taken as the dependent variable and with the following variables taken as independent variables (i) firm size; (ii) firm's age; (iii) level of training of the labour force; (iv) sector of activity; (v) life cycle; (vi) age of the entrepreneur; (vii) entrepreneurship

characteristics; (viii) extent of partnerships/cooperation agreements establishment; and (ix) extent of the firm's openness to the external environment.

The multiple linear regression methods were applied up to the point where it was considered justifiable to include five variables in the model, with the other four being excluded, the exclusion criterion being the point at which the values of R (0.931), R<sup>2</sup> (0.866) and R<sup>2</sup> Adjusted (0.854) were the highest (Table 2).

Model	Non-standardised coefficients		Standardised coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	0.328	0.565		0.580	0.565
Entrepreneurship	0.693	0.129	0.424	5.391	0.000
Partnerships/cooperation	0.891	0.271	0.276	3.292	0.002
Size of the firm	0.133	0.106	0.079	1.254	0.215
Life cycle	-0.530	0.132	-0.308	-4.018	0.000
Age of the firm	0.360	0.113	0.199	3.198	0.002

Table 2. Factors determining innovative capacity

Taking into account the standardised beta coefficients, it can be seen that entrepreneurship is the variable that best explains the firm's innovative capacity, with a beta value of 0.424. The next most powerful explanatory variable is the

firm's life cycle, with a beta value of (-0.308), followed by the extent of inter-firm partnerships/cooperation agreements (0.276), the age of the firm (0.199), and finally

the size of the firm (0.079). On the basis of these results, the following conclusions can be drawn:

With regard to the hypotheses we were able to confirm:

**Hypothesis 1** is confirmed. Thus, as the size of firms increases, so does their innovative capacity. This confirms results from previous studies (Ussman, et al., 1998; Silva, 2003; Silva et al., 2004; Mogollón and Vaquero, 2004).

**Hypothesis 5** is confirmed. The phase of the life-cycle in which a firm finds itself influences its innovative capacity (the negative relationship between these two variables behaving been confirmed). In other words, as a firm advances into the later phases of its life cycle, its innovative capacity begins to diminish. This conclusion confirms the results of earlier studies (Scott and Bruce, 1987; Ferreira, 2003; Stieglitz and Heine, 2007).

**Hypothesis 7** is confirmed. In other words, the better and more appropriate is the quality of the entrepreneurship practiced, the greater is the firm's innovative capacity. Entrepreneurship showed itself to be one of the variables that most influenced a firm's innovative capacity. The studies of Mogollón and Vaquero (2004); Miller (1983); Mintzberg (1984); Drucker (1985) and Pazos and López (2004) also confirmed that this variable was a determinant of the innovative capacity of firms.

**Hypothesis 8** is confirmed. In other words, firms that establish partnerships and cooperation agreements with other firms and/or organisations have a greater innovative capacity. This conclusion is in line with other conclusions drawn previously by Kaufman, et al. (2000).

With regard to the hypotheses not confirmed:

**Hypothesis 2** is not confirmed, or, in other words, the 'senescence' of a firm is confirmed as a factor that has a negative influence on its innovative capacity: this is in keeping with the results obtained in earlier studies (e.g. Hernández, 2000) which showed that younger firms had a greater propensity to innovate and that, as they grew older, they gradually became less innovative.

**Hypothesis 3** is not confirmed. In this study, the level of training of the workforce was excluded as a variable from

the linear regression model, as this did not show itself to be a determinant of a firm's innovative capacity, even though this variable had shown itself to be significant in other studies (e.g. Pazos and López, 2004).

**Hypothesis 4** is not confirmed. In this study, the sector in which a firm operates does not determine its innovative capacity. This may have been due to the fact that this study focussed on the most representative sectors of the manufacturing industry in the Beira Interior region, and took into account the following sectors: (i) food/beverages; (ii) textiles; (iii) clothing; (iv) wood/cork; and (v) metal products. These are the more traditional sectors of the region's economy, none of which stand out as being technologically more intensive or thrusting than the others, as Ussman, et al. (1998) have noted. As a consequence, the more innovative behaviour in certain sectors may have masked by the less innovative behaviour of firms in the predominant traditional sectors.

**Hypothesis 6** is not confirmed. It is not possible to identify a relationship between the age of the entrepreneur and a firm's innovative capacity, something that Mogollón and Vaquero (2004) had already established.

**Hypothesis 9** is not confirmed. It cannot be concluded that the extent of the firm's openness to the external environment is an influential variable in the model. In other words, it cannot be confirmed that firms that export more have a greater innovative capacity. Though the study by Silva (2003) revealed the existence of a positive relationship between the extent of a firm's openness to the external environment and its capacity to undertake product innovation, no such a relationship was found between its openness and either process-related or technologically-based innovation.

## Innovative Capacity and Performance

Finally, an attempt was made to check whether a firm's innovative capacity has an influence on its performance. The simple linear regression model obtained (Table 3) has a value of 0.832 for R, 0.692 for  $R^2$  and 0.686 for  $R^2$  Adjusted, with the explained variance being relatively high in this latter case.



Model	Non-standardised coefficients		Standardised coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	1.472	0.165		8.930	0.000
Innovative capacity	0.603	0.053	0.832	11.313	0.000

Table 3. Influence of innovative capacity on performance

Based on Table 3, it can be seen that the beta standardised coefficient for the variable of innovative capacity has a value of 0.832, so that it can be concluded that a firm is able to reap rewards from its innovative capacity. In view of the results obtained, Hypothesis 10 can be confirmed i.e. it can be concluded that the greater a firm's innovative capacity the better is its performance, a conclusion also drawn in the studies by Zahra, *et al.* (1988); Roberts and Amit (2003) and Mogollón and Vaquero (2004).

Given this confirmation of Hypothesis 10, it seemed appropriate to undertake a more detailed analysis of this

relationship, even though it had not been included in the original research hypotheses. In other words, an attempt was made to discover, using multiple linear regression, which of the sub-variables included in the firm's innovative capacity (i.e. product innovation, process innovation, investment in R&D and the use of new distribution channels) most influenced firm performance. Given that the results obtained for R (0.862), R<sup>2</sup> (0.744) and R<sup>2</sup> Adjusted (0.734) were the highest, the forward (or stepwise) method was used in the multiple linear regression undertaken (See Table 4).

Model	Non-standardised coefficients		Standardised coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	2.050	0.112		18.226	0.000
Process innovation	1.611	0.209	0.693	7.691	0.000
Investment in R&D	0.559	0.219	0.230	2.555	0.013

Table 4. Variables of innovative capacity that influence performance

The variables considered in the model were process innovation (beta = 0.693) and investment in R&D (beta = 0.230). The results confirm that the dimension of innovative capacity that most influences firm performance is process innovation (beta = 0.693), a conclusion that was also reached by Marques and Monteiro-Barata (2006), followed by investment in R&D (beta = 0.230). In the latter case, Marques and Monteiro-Barata (2006) identified total investment in innovation as the crucial factor determining improved firm performance, a rather broader measure than investment in R&D. POn the other hand product innovation and the use of new distribution channels were excluded as variables from the model as they did not show evidence of significant influence on firm performance, a conclusion also reached by Marques and Monteiro-Barata (2006).

## Discussion

In the light of this study and the results obtained, what are the factors that contribute most towards the development of innovative behaviour amongst manufacturing firms in the Beira Interior region of Portugal? The literature identifies a large number of factors that may be considered possible determinants of the innovative capacity of firms. The model employed in the present research deployed the vast majority of the variables assumed to influence firms' innovative capacity were grouped into three categories:

- (I) Those relating to the firm itself: (i) size; (ii) age; (iii) labour force training levels; (iv) sector of activity; and (v) the phase of its life cycle.

- (2) Those relating to the entrepreneur: (i) age; and (ii) the quality of entrepreneurship.
- (3) Those relating to the external business environment:
  - (i) establishment of partnerships and cooperation agreements with other firms and/or institutions; and (ii) the extent of openness to the external environment as measured by the importance of its export activities.

Through the use of multiple linear regression, it was possible to identify the factors determining the innovative capacity of manufacturing firms in the Beira Interior region. It was concluded that, in decreasing order of importance, the factors that the most influential factors are: (1) entrepreneurship; (2) life cycle; (3) establishment of partnerships and cooperation agreements with other firms and/or institutions; (4) the age of the firm; and (5) the size of the firm.

As to the type of influence that these factors have on a firm's innovative capacity, the following situations can be noted: (1) the greater the quality of entrepreneurship, the greater is the firm's innovative capacity; (2) as firms progress through the different phases of their life cycle, their innovative capacity diminishes; (3) firms that establish partnerships and cooperation agreements with other firms and/or institutions display greater innovative capacity; (4) as the age of the firm increases, so does its innovative capacity; and (5) the greater the size of the firm the greater its innovative capacity.

In what ways does the development of an innovative entrepreneurial strategy influence firm performance? According to Roberts and Amit (2003), successful innovation activity helps establish a more positive competitive position for a firm, bringing it a competitive advantage and, consequently, an improved performance. This assumption provided one of the starting points for the present research; in other words, it is assumed that a firm's improvements in its competitive advantages that result from the exploitation of its innovative capacity are reflected in the firm's performance. Using a simple linear regression model, it was shown that the greater a firm's innovative capacity the better is its performance, with competitive advantage acting as the mediating factor.

On the basis of this conclusion, it was decided to check which of the four sub-variables summarised in the concept

of the firm's innovative capacity – namely (i) product innovation; (ii) process innovation; (iii) R&D investment; and (iv) the use of new distribution channels – is/are the one(s) that have a greater influence on a firm's performance. The results of multiple linear regression analysis indicated that, among the four sub-variables of innovative capacity, process innovation, followed by investment in R&D, were the two variables that best explained firms' improved performance and that, consequently, these are the variables that lead to the creation of competitive advantage.

In the light of the conclusions derived from the application of this research model to a specific region located in the interior of Portugal, it would seem appropriate to apply a similar approach to the comparative analysis of regional innovation experiences in other European countries, either in country-specific or international studies. In addition to improving understanding of the factors involved both in firms' innovation processes and the role of firms' innovation in the construction of sectorial and territorial competitiveness, the wider application of this approach could yield improvements both to the methodology and to the policies conventionally used to promote innovation, competitiveness and territorial development.

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## Appendix

### The Dimensions of the model: The firm, the entrepreneur, the external environment, the firm's innovative capacity, and the firm's performance

#### Appendix I – Dimension I: The firm

Variables	Indicators
<b>Size</b>	Measured on a scale of 1-4, according to the EU's definition, i.e. with micro-firms (labour force ≤ 9) = 1, small firms (10-99) = 2, medium-sized firms (100-249) = 3, and large firms (250+) = 4.
<b>Age</b>	<p>Measured on a scale of 1-4, with the age of the firm being based upon the year in which it was founded: founded no more than 10 years prior to survey = 1, found between 11 and 20 years prior to survey, 2; founded between 21 and 30 years prior to survey = 3; founded 31 or more years prior to survey = 4.</p> <p>The qualification/training level of the labour force was measured in terms of the number of employees who had completed a first degree as a proportion of the total labour force, i.e.</p> $\frac{\text{Total N}^{\circ} \text{ of employees with graduate status or higher}}{\text{Total N}^{\circ} \text{ of employees in the firm}} \times 100$
<b>Sector of activity</b>	The sample covered 5 distinct sectorial categories (according to Portugal's National Statistical Institute's Classification of Economic Activities – CAE); each as given a different coding, as follows: (1) CAE 15, food and beverage industries; (2) CAE 17, textile production; (3) CAE 18, clothing industry; (4) CAE 20, metal products; e (5) CAE 28, wood and cork industries.
<b>Life cycle</b>	<p>Those surveyed were asked to choose which of the following statements best described the stage of its life cycle the firm the currently occupied (Note: the 5 definitions used in this typology are particularly relevant to firms in the rather traditional sectors surveyed in this research)</p> <p><input type="checkbox"/> Start-up (i.e. the firm has a simple structure, relatively centralised and with an informal organisation)</p> <p><input type="checkbox"/> Growth (i.e. the firm has a functional structure, a degree of centralisation and a formal organisation)</p> <p><input type="checkbox"/> Maturity (i.e. the firm has a functional structure, limited centralization and a highly formalized organization)</p> <p><input type="checkbox"/> Diversification (i.e. the firm is structured in divisions, high levels of decentralisation, and a formal bureaucratic organisation)</p> <p><input type="checkbox"/> Decline (i.e. the firm has either a functional or division-based structure, and is excessively bureaucratic and centralised.</p>

**Appendix 2 – Dimension 2: The entrepreneur**

Variables	Indicators
<b>Age</b>	<p>Age of entrepreneur based on date of birth, and divided into four intervals: (1) <math>\leq 35</math> years; (2) 36 - 45; (3) 46 - 55; e (4) <math>\geq 56</math> years.</p> <p>Entrepreneurs surveyed were asked to reply to the following questions, each referring to a different aspect of entrepreneurial behaviour:</p> <p><u>(1) Attitudes towards risk-taking:</u></p> <p>When you undertake new investments or launch new projects, do you have the greatest propensity to:</p> <p> <input type="checkbox"/> run substantial risks    <input type="checkbox"/> run some risks    <input type="checkbox"/> be very careful with regard to risks  <input type="checkbox"/> barely run risks    <input type="checkbox"/> be extremely risk-averse </p> <p><b>Entrepreneurship</b></p> <p><u>(2) Pro-activity:</u></p> <p>As an entrepreneur, when compared to the actions taken by your competitors, do you usually:</p> <p> <input type="checkbox"/> always lead    <input type="checkbox"/> sometimes lead    <input type="checkbox"/> sometimes lead, sometimes follow  <input type="checkbox"/> often follow    <input type="checkbox"/> always follow </p> <p>As an entrepreneur, are you typically:</p> <p> <input type="checkbox"/> very confident    <input type="checkbox"/> confident    <input type="checkbox"/> fairly confident    <input type="checkbox"/> not very confident  <input type="checkbox"/> lacking in confidence </p> <p><u>(3) Innovation:</u></p> <p>When you undertake a new investment, are you typically:</p> <p> <input type="checkbox"/> very optimistic    <input type="checkbox"/> optimistic    <input type="checkbox"/> fairly optimistic  <input type="checkbox"/> pessimistic    <input type="checkbox"/> extremely pessimistic </p>

**Appendix 3 – Dimension 3: The external environment**

Variables	Indicators																																				
	Has the firm established any cooperation agreements with other firms relating to innovation activities in the period 2000-2004? <input type="checkbox"/> Yes <input type="checkbox"/> No																																				
	2 – If so, indicate the type of organisation with which you cooperated:																																				
Partnership/cooperation agreements	<table><tr><th>Type of partner</th><th>National</th><th>EU-based</th><th>non-EU based</th></tr><tr><td>Other firms in the same group</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td>Suppliers</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td>Clients</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td>Competitors</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td>Consultancy firms</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td>Laboratories or R&amp;D companies</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td>Universities or other higher education institutes</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td>State research institutes; state, private or not-for-profit R&amp;D centres</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr></table>	Type of partner	National	EU-based	non-EU based	Other firms in the same group	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Suppliers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Clients	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Competitors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Consultancy firms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Laboratories or R&D companies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Universities or other higher education institutes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	State research institutes; state, private or not-for-profit R&D centres	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Type of partner	National	EU-based	non-EU based																																	
	Other firms in the same group	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																	
	Suppliers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																	
	Clients	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																	
	Competitors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																	
	Consultancy firms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																	
	Laboratories or R&D companies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																	
	Universities or other higher education institutes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																	
State research institutes; state, private or not-for-profit R&D centres	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																		
Firm's openness to the external environment	<p>The degree of openness to the external environment was measured according the following ratio:</p> $\frac{\text{export volume}}{\text{sales volume}} \times 100$																																				

**Appendix 4 – Dimension 4: Firm's innovative capacity**

Variables	Indicators										
	During the period 2000 a 2004 did you launch onto the market any product(s) or service(s) that, from the firm's standpoint, were new or significantly improved? <input type="checkbox"/> Yes <input type="checkbox"/> No										
Product innovation	2 – If so, how many products or services? <input type="checkbox"/> < 5 <input type="checkbox"/> 6 – 10 <input type="checkbox"/> > 11  3 – Who developed these products/services? <input type="checkbox"/> the firm itself <input type="checkbox"/> the firm in collaboration with (an)other firm(s) or institution(s) <input type="checkbox"/> (an)other firm(s) or institution(s)										
Process innovation	1 – During the period 2000 a 2004 did the firm adopt any production process(es) that, from the firm's standpoint, was/were new or significantly improved? <input type="checkbox"/> Yes <input type="checkbox"/> No  2 – If so, how many production processes? <input type="checkbox"/> < 5 <input type="checkbox"/> 6 – 10 <input type="checkbox"/> > 11  3 – Who developed this/these process(es)? <input type="checkbox"/> the firm itself <input type="checkbox"/> the firm in collaboration with (an)other firm(s) or institution(s) <input type="checkbox"/> (an)other firm(s) or institution(s)										
	4 – During the period 2000 a 2004 did the firm adopt any new distribution channels/methods for its products/services? <input type="checkbox"/> Yes <input type="checkbox"/> No  5 – During the period 2000 a 2004 did the firm <input type="checkbox"/> create its own retail outlets? <input type="checkbox"/> make agreements with super-/hyper-markets? <input type="checkbox"/> make agreements with retail outlets? <input type="checkbox"/> contract new sales personnel/agents? <input type="checkbox"/> via the internet? <input type="checkbox"/> via other means? Specify _____										
	1 – Does the firm have its own R&D department? <input type="checkbox"/> Yes <input type="checkbox"/> No  2 – If so, how many of the firm's employees work in the R&D department in the following years?										
Investment in R&D	<table><tr><td>2000</td><td>2001</td><td>2002</td><td>2003</td><td>2004</td></tr><tr><td>_____</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr></table>	2000	2001	2002	2003	2004	_____	_____	_____	_____	_____
2000	2001	2002	2003	2004							
_____	_____	_____	_____	_____							
	3 – During the period 2000 a 2004 was the firm's R&D activity <input type="checkbox"/> sporadic? <input type="checkbox"/> continual?										
New Distribution channels	When the firm used new distribution channels, the answer was codified as (1); When the firm did not use new distribution channels, the answer was codified as (2).										



**Appendix 5 – Dimension 5: Firm's performance**

Variables	Indicators						
<b>Turnover/Sales</b>	$\frac{2004 \text{ sales volume} - 2000 \text{ sales volume}}{2000 \text{ Sales volume}} \times 100$						
<b>Net profit/loss</b>	$\frac{2004 \text{ net profits} - 2000 \text{ net profits}}{2000 \text{ net profits}} \times 100$						
<b>Success achieved with new products</b>	<p>Respondents were asked to indicate the share of 2004 total sales volume attributable to:</p> <table border="1"> <tbody> <tr> <td>New or significantly improved products/services launched by the firm in the period 2000 – 2004</td><td>□□□ %</td></tr> <tr> <td>Unmodified products/services supplied by the firm and available on the market in the period 2000 – 2004</td><td>□□□ %</td></tr> <tr> <td></td><td>100%</td></tr> </tbody> </table>	New or significantly improved products/services launched by the firm in the period 2000 – 2004	□□□ %	Unmodified products/services supplied by the firm and available on the market in the period 2000 – 2004	□□□ %		100%
New or significantly improved products/services launched by the firm in the period 2000 – 2004	□□□ %						
Unmodified products/services supplied by the firm and available on the market in the period 2000 – 2004	□□□ %						
	100%						
	<p>Are the firm's results net profits better or worse than those of its competitors?</p> <p> <input type="checkbox"/> much better                      <input type="checkbox"/> somewhat better                      <input type="checkbox"/> comparable  <input type="checkbox"/> worse                                      <input type="checkbox"/> much worse         </p>						
<b>Perception of results</b>	<p>2 – How as the firm's sales volume evolved in comparison with that of its competitors?</p> <p> <input type="checkbox"/> very positively                      <input type="checkbox"/> positively                      <input type="checkbox"/> comparably  <input type="checkbox"/> negatively                      <input type="checkbox"/> very negatively         </p> <p>3 – How has the firm's cash flow compared with that of its competitors?</p> <p> <input type="checkbox"/> much more positive                      <input type="checkbox"/> more positive                      <input type="checkbox"/> comparable  <input type="checkbox"/> more negative                      <input type="checkbox"/> much more negative         </p>						