Innovation and performance in Spanish manufacturing SMEs

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Abstract: Innovation facilitates how SMEs respond to market changes and maintain their competitive advantage. This paper analyses the relationship between the degree of innovation (measured as innovation in products, processes and administration systems) and performance among 1,091 Spanish manufacturing SMEs. The results show that innovation positively impacts SMEs performance in low and high technology industries. Innovation was more important to achieving a competitive advantage to high technology firms than low technology firms. These results support innovation as being important to a firm's sustainable competitive advantage.

Keywords: innovation; performance; SMEs; high and low technology.

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1 Introduction

The past few years has seen a growing interest in both the academic and business communities in understanding the relationship between innovation and company performance (Bisbe and Otley, 2004). The relevance of innovation has become even more important since the EU Lisbon meeting in March, 2000, established the goal of becoming the world's most competitive and innovative region by 2010 (Kemp et al., 2003). Innovation allows companies to achieve sustainable competitive advantages and is important to company growth (Vermeulen, 2004; Cheng and Tao, 1999). Small firm success and survival is often dependent on the degree to which they incorporate innovation into their strategies. Product innovation is important to maintain market share, process innovation is important to maintain competitive prices level, and managerial innovation is important to maintain a flexible and durable organisation (Heunks, 1998).

Spain's low productivity, which is lagging behind other EU countries, is a result of large growth in the Spanish labour market without a concurrent investment in human resource development and investment in technology (Banco de España, 2006). Low productivity coupled with low innovation (also lagging behind other industrialised countries) could result in the reduction of competitiveness among of Spanish firms (Cotec, 2006; European Trend Chart on Innovation, 2005). Understanding the relationship between performance and innovation can help Spanish SMEs develop policies that improve productivity, improve competitiveness, and increase performance (Freel, 2000). Developing a better understanding of issues that impact performance, especially company policies that affect competitiveness and performance, is especially important when the strategy that embraces innovation is confronted with internal resistance (Storey, 2000). Mosey et al. (2002) found that internal resistance was associated with management style and by the owner-manager relationship.

Research questions addressed in this paper include: Does innovation improve performance among Spanish SMEs' and what are the differences between innovation activities among low and high technology sectors? The concept of innovation is heterogeneous and broad. In accordance the European Commission (COM, 2003) and consistent with the Lisbon European Council, innovation is

> "the renewal and enlargement of the range of products and services and associated markets; the establishment of new methods of production, supply and distribution; the introduction in changes in management, work organization, and the working conditions and skills of workforce."

This classification of product, process, and managerial innovation is used in this paper.

The analysis examines product, process, and managerial innovation among a sample of 1,091 Spanish manufacturing SMEs. Constructs from Quinn and Rohrbaugh (1981) are used to measure performance. The dimensions of organisational effectiveness used in their model are human relations, internal process, open systems, and rational goal approaches. The paper extends previous research of Hsueh and Tu (2004), Hughes (2001), Verona (1999), Heunks (1998), Regev (1998), Moore (1995) and Geroski and Machin (1992) by providing empirical evidence on the relationship between innovation and SME performance when taking into account the technological intensity of the sector. The main contribution of the study is the analysis of the relationship between different types of innovation (product, process and managerial innovation)

and a performance measure from both different and comprehensive perspectives of SME organisational effectiveness. Innovation can be complex and includes many factors. Examining the relationship between innovation affects sales and productivity growth as well as whether innovation improves important organisational dimension such as customer relationships, human relations and internal organisation are key research questions. The Quinn and Rohrbaugh (1983) model of organisational effectiveness considers the above dimensions beside the rational goals that are related to market share and sales. This comprehensive methodological focus has not been used previously in the innovation literature.

Such a study has not been completed despite the importance of innovation in maintaining firm competitiveness in global markets and healthy country economic importance. The findings provide a better understanding of:

- SME innovation as a key factor in improving the Spanish firm competitiveness and performance
- the effectiveness of embracing innovation policies
- the role of public policies that support innovative activities among the Spanish manufacturing SMEs, policies that target better utilisation of scarce resources for incorporating innovation and increasing competitiveness.

The remainder of the paper is organised as follows. Section 3 provides the review of the previous literature and introduces Quinn and Rohrbaugh's model of organisational effectiveness. Section 4 presents information on the sample and methodology used to analyse the data. The last two sections discuss the results of the analysis and conclusions to the study.

2 Innovation and performance

Interest in the contribution of innovation to national economies has been increasing (Romer, 1994; Grossman and Helpman, 1994; Barro and Sala-I-Martin, 1995; Shefer and Frenkel, 2005). Endogenous growth models assume that firms invest in new technology if they perceive an opportunity to earn a profit. Innovation can lead to increased market share, greater production efficiency, higher productivity growth, and increased revenue (Shefer and Frenkel, 2005). Innovation enables firms to offer greater variety of differentiated products that can improve financial performance (Zahra et al., 2000). Keizer et al. (2002) argue that innovation contributes to economic growth and is among the most important means through which SMEs remain competitive.

Barney (1997), Peteraf (1993) and Grant (1991) emphasised that firms can gain a competitive advantage through intangible resources that competitors do not possess. Geroski et al. (1993) stress the importance of innovation as well as the learning process within the firm associated with innovation. From a resource-based view of the firm, innovative capability is critical to firms achieving strategic competitiveness (Conner, 1991). Innovation enables firms to achieve higher financial performance by offering a greater variety of valuable, rare, inimitable and differentiated products (Zahra et al., 2000).

Although several studies found a strong positive relationship between innovation and growth (Roper et al., 1996; Roper, 1997; Moore, 1995), the results are not conclusive. Geroski (1994) suggested two views on the relationship between innovation and growth. First, the production of new products or processes strengthens a firm's competitive position, but only if the innovating firm can defend its position against rivals. Alternatively, the process of innovation enhances the firm's internal capabilities, making it flexible and adaptable to market pressures.

Cainelli et al. (2004) and Regev (1998) found that innovating firms had higher labour productivity and sales growth than non-innovating firms. A study on British SMEs by the Cambridge Small Business Research Centre (1999) showed that 80% of the companies that developed innovation activities improved profits, market share, and new markets penetration. Hughes (2001) found that highly innovative British SMEs increased their profit margin. Hsueh and Tu (2004) showed that innovation positively affected earnings among Taiwanese SMEs. Bhaskaran (2006) found that Australian SMEs that focused on sales and marketing innovations were able to successfully compete with large companies.

Geroski and Machin (1992) did not find permanent growth differences between innovators and non-innovators. Heunks (1998) found that profits derived from innovation initiatives may not be apparent in the short term, but may take time to be realised. Olav and Leppälahti (1997) found that innovating Norwegian firms with more than 50 employees experienced higher profits than non-innovators firms, but did not find profit differences for firms with less than 50 employees. Yamin et al. (1999) examined relationships between organisational innovation and performance among Australian companies and found that innovative companies are more profitable, though highly innovative companies may not outperform average innovators. Kemp et al. (2003) found that innovation was associated with turnover and employment growth, but not profit and productivity among Dutch firms. Albors-Garrigós (2002) found that only 47% of Spanish firms believed that innovative activities significantly improved sales.

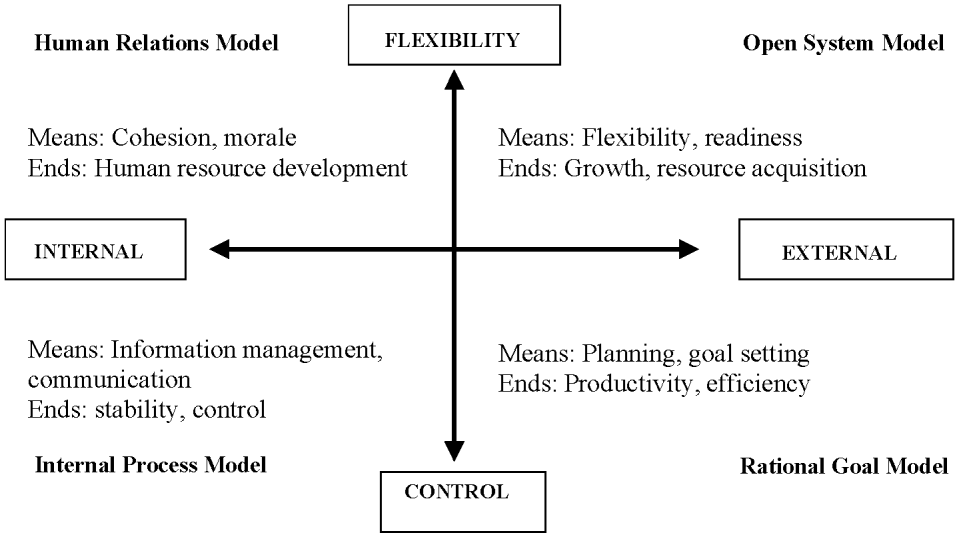
3 Proposed model

Quinn and Rohrbaugh (1983) model of organisational effectiveness was used as the basis for measuring performance. The validation of this approach is evident in its use in previous research (Miron et al., 2004; Brockman and Morgan, 2003; Frenkel et al., 2001; Walton and Dawson, 2001). Brockman and Morgan (2003) emphasise the importance of organisational learning as an important capability for achieving competitive advantage. The Quinn and Rohrbaugh model provides a method to measure the relationship between organisational culture and innovation. Innovation implies a complex system where many factors are involved. In this sense internal control, customer relationships and human resources play important roles in assuring the sustainability of the innovation process. To be successful, innovation within the firm must be organised in a way where innovation improves key firm dimensions, such as customer relationship, human resources and internal process and organisation.

The framework (see Figure 1) has four quadrants that describe outcome domains and associated management approaches to achieving outcomes (Patterson et al., 2005). Briefly, the model incorporates the following:

- *human relations approach*: internal focus and flexibility relative to the environment; emphasises the well-being, growth and commitment of workers.
- *internal process approach*: internal focus and tight control; reflects formalisation and internal controls to efficiently use resources.
- *open systems approach*: external focus and flexible relationships with the environment; emphasises the interaction and adaptation of the organisation in its environment in response to demands.
- *rational goal approach*: external focus with tight control; reflects a rational model of the organisation in which emphasis is on productivity and goal achievement.

Figure 1 Organisational effectiveness: Quinn and Rohrbaugh model

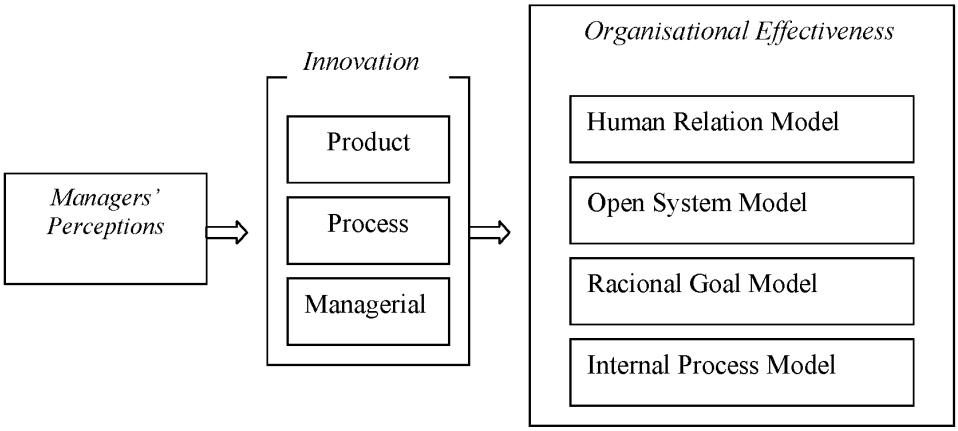


Source: Quinn and Rohrbaugh (1983)

The four models that comprise the framework are simultaneous, complementary opposites in the sense that they are embedded in contradictory or competing values. An effective organisation should perform well on all four sets of criteria. Ignoring a single criterion can result in a partial view of performance.

The study analysed manager perception of the impact of product, process, and managerial innovation on each organisational effectiveness dimension among Spanish manufacturing SMEs. Figure 2 shows the proposed relationships. Read (2000) pointed-out that innovation must be supported by managers and that performance should assess impact of innovation on performance. This study included both dimensions – inclusion of manager perception and use of performance to measure impact. The basic research questions address whether innovation improves manufacturing SME performance. Manager perceptions are used to measure the impact of product, process, and managerial innovation. The relationships between these perceptions are then compared to the four models of organisational effectiveness.

Figure 2 Innovation impact on organisational effectiveness's dimensions



4 Sample and methodology

4.1 Sample

The information was collected as part of the strategy and innovation of the manufacturing SMEs in Spain project that was completed by AECA (2005). SMEs in the sample consisted of firms that employed fewer than 250 employees and had annual sales less than 50 million euros or total assets less than 43 million euros (European Union, 2003). A questionnaire was faxed to the managers of 9,337 manufacturing firms (followed with a telephone call) between February and May 2004. A survey approach was used because of the advantage of greater accessibility to a sample national in scope (Sarabia, 1999). The survey provided a direct and broad-based understanding of the relationship between innovation and SMEs performance in Spain. To assure consistency, a telephone call was made after the questionnaires were faxed to verify that the person who completed the questionnaire was the company manager. Sample firms were small or medium sized manufacturing companies (CNAE 15 at 22 and 24 at 36) as defined by the European Commission. Micro-firms having less than ten employees and annual turnover or annual balance sheet totals lower than 2 million euros were not included in the analysis. Distribution of companies was estimated from the Central Directory of Companies published by the National Institute of Statistic (DIRCE 2003). The sample frame was the database SABI[1] elaborated by INFORMS CORP. The sample was proportionately segmented within each stratum and firms were randomly selected. This procedure was believed to be the best approach to avoid sample bias.

A total of 1,201 questionnaires were returned. Thirty-one (31) were eliminated because the firm had more than 250 or less than ten employees. Firms with less than ten employees were eliminated from the sample because the pre-test results indicated that responses relative to innovation activity by this type of firm were not reliable. The final sample, 1,091 valid questionnaires (relative frequency of response is $p = 0.5$), has a maximum error of 2.8% points and a reliability level of 95%. The final response rate was 11.68%. Table 1 lists respondents by manufacturing activity.

Table 1 Sample distribution (manufacturing)

Type of firm	*No. of companies*	*Total* (%)
High and Medium-High technology sectors	*241*	*22.7*
Chemicals	59	5.4
Machinery and equipment	79	7.2
Electronic and optical equipment	70	6.4
Motor vehicles	33	3.0
Low and Medium-Low technology sectors	*850*	*77.3*
Food, Beverage, and Tobacco	168	15.4
Textiles	51	4.7
Apparel	46	4.2
Leather goods	47	4.3
Wood and cork	46	4.2
Paper, publishing, and printing	63	5.8
Rubber and plastics	55	5.0
Other non-metallic minerals	74	6.8
Basic and fabricated metals	217	19.9
Furniture	83	7.6
Total	*1091*	*100*

Late respondents were used to test for non-response bias (Nwachukv et al., 1997). Responses of firms responding to the initial mailing (85% of the sample) were contrasted with those responding to the follow-up (15% of the sample). Of all the variables in the model, no responses were significantly different between the two groups using *t* and chi-squares tests.

4.2 Performance variables

A subjective approach to measuring performance was used for several reasons. First, accounting information omits some intangible assets that are important for measuring competitive success (Kaplan and Norton, 1993). Also, the accounting information was not available until companies deposit their balance sheets in the Mercantile Registration. Finally, competitive success is a relative term (AECA, 1988) that makes the position of the company in relation to competition a decisive indicator of its success or failure. Furthermore, if executives play any part in influencing effectiveness in organisations then their view of effectiveness influence the various criteria used in assessing and managing the firm. Objective performance measures such as return on assets, return on sales, and return on equity have inherent problems in that have a short term focus, not risk-adjusted, and difficult to relate to a specific innovation (Geyskens et al., 2002). Accounting measures are also based on historical costs and, thus, may not accurately reflect the future (Kalyanaram et al., 1995).

Performance measures included:

- human relations approach
- internal process approach
- open systems approach
- rational goal approach (see Patterson et al., 2005; Quinn and Rohrbaugh, 1981).

This approach to measuring organisation performance was also used by Miron et al. (2004) and Brockman and Morgan (2003).

Managers were asked to rank their firm's competitive position using 12 variables (three for each approach) using a 5-point Likert scale (1 = poor performance during the previous two years and 5 = high performance during previous two years). The arithmetic average of the three variables was used as the dependent variable for each approach. Cronbach's Alpha validated the reliability of the scale. Factor analysis was used to verify that the new variables appropriately summarised results. Information in Table 2, which shows the items and scale validation, supports the validity of the methodology.

Table 2 Variables of performance

Type of process approach	*Variables*	*Scale validation*
Internal process	Improved product quality	Cronbach's $\alpha = 0.661$
	Improved internal process coordination	Factorial: 1 factor
	Improved employee task organisation	Explained variance: 65%
		Sig. Bartlett: 0.000
		KMO: 0.634
Open systems	Increased customer satisfaction	Cronbach's $\alpha = 0.683$
	Increased ability to adapt to market needs	Factorial: 1 factor
	Improved company and the products image	Explained variance: 61%
		Sig. Bartlett: 0.000 KMO: 0.660
Rational goal	Increased in market share	Cronbach's $\alpha = 0.768$
	Increased in profitability	Factorial: 1 factor
	Increased in productivity	Explained variance: 68%
		Sig. Bartlett: 0.000 KMO: 0.676
Human relations	Increased employee motivation	Cronbach's $\alpha = 0.736$
	Decreased employee turnover	Factorial: 1 factor
	Decreased employee absence	Explained variance: 59%
		Sig. Bartlett: 0.000 KMO: 0.636

4.3 Innovation variables

The concept of innovation includes the technological innovation and innovation in organisational methods (AECA, 1995). Technological innovation refers to the changes in the products and production processes (product innovation and process innovation) (Freeman, 1974). Managerial and systems innovation is based on the changes introduced in the organisational structure of the company and the administrative process, aspects that are more related to management than with the company's main activities. This classification was also used by Huiban and Bouhsina (1998).

Managers/owners were also asked to rank four items of their company's competitive position using a 5-point Likert scale (1 = not competitive and 5 = very competitive) for each type of innovation (see Table 3). These four items were subsequently averaged to arrive at an overall ranking for each type of firm innovation (independent variables). Such subjective measures are appropriate for SMEs since objective measures tend to underestimate degree of innovation (Hughes, 2001). The subjective measures are based on self-reporting and are exposed to the subjective value judgements of the owner or manager. Several earlier studies claim, however, that perceptual measures are highly correlated with objectives measures of innovation and have the advantage of facilitating comparisons among firms in different industries (Frishammar and Hörte, 2005; Zahra et al., 2000). Then, self-reporting is a valuable measure of monitoring the management of innovation as well as identifying the obstacles that inhibit innovation in the firm (Kalantaridis and Pheby, 1999).

A similar methodology was used in the Study of the Harmonised Innovation of the European Union (2004). Cronbach's Alpha validated the reliability of this approach. Factor analysis demonstrated that the indicators can be summarised by a single factor. Table 3 shows the items as well as scale validations. The statistics support the validity of the methodology. Control variables used in the analysis are company

- size (log of number of employees in 2003)
- age (number of years the firm was in operation).

Other studies also used these as control variables when analysing the influence of innovation on performance (Chamanski and Waago, 2001; Hsueh and Tu, 2004; Huergo and Jaumandreu, 2004; Subrahmanya, 2005).

The following models were used to analyse the data:

$$Y_i = b_0 + b_1 \cdot \text{Age}_i + b_2 \cdot \text{Size}_i + b_3\, PI_i + \varepsilon_i$$

$$Y_i = b_0 + b_1 \cdot \text{Age}_i + b_2 \cdot \text{Size}_i + b_3\, PRI_i + \varepsilon_i$$

$$Y_i = b_0 + b_1 \cdot \text{Age}_i + b_2 \cdot \text{Size}_i + b_3\, MI_i + \varepsilon_i$$

where

Y_i: SME performance considering the four dimensions

Age_i: Years company has been in operation

Size_i: Log of number of employees

PI_i: Innovation of company relative to product

PRI_i: Innovation of company relative to the processes

MI_i: Innovation of company relative to systems and managerial issues.

Table 3 Variables of innovation

Type of innovation	*Variables*	*Scale validation*
Product innovation	Number of new or modified products introduced per year	Cronbach's $\alpha = 0.7812$
	Entrepreneurial character of the company when introducing new products	Factorial: 1 factor
	Speed of new products introduced by competitors	Explained variance: 61%
	R&D investment in new products	Sig. Bartlett: 0.000 KMO: 0.771
Process innovation	Number of modifications in processes introduced per year	Cronbach's $\alpha = 0.8252$
	Entrepreneurial character of the company when introducing new processes	Factorial: 1 factor
	Speed of new processes introduced by competitors	Explained variance: 66%
	R&D investment in new products	Sig. Bartlett: 0.000 KMO: 0.798
Managerial and system innovation	Number of changes in the managerial systems	Cronbach's $\alpha = 0.9014$
	Novelty of company's managerial systems	Factorial: 1 factor
	Search by company executives for new managerial systems	Explained variance: 77%
	Entrepreneurial character of the company when introducing new managerial systems	Sig. Bartlett: 0.000 KMO: 0.804

Question in the survey: What is the position of your company in relation to the competitors?

1: not competitive; 5: very competitive.

The sample is segmented into

- high and medium-high technology
- low and medium-low technology sectors (Table 1).

This classification groups industrial sectors according to direct and indirect R&D intensity and the ratio between R&D expenditure to value added, as defined by OECD/Eurostat (1997). Investment in innovation may be affected by type of sector, especially relative to low vs. high technology sectors, and reflected in R&D expenses (Acs and Audretsch, 1993; Frenkel et al., 2001). Comparing higher and lower technology sectors is relevant since industry structure impacts the company innovation behaviour (Shefe and Frenkel, 2005; Regev, 1998).

5 Results

5.1 Descriptive information

The responding firms were in the manufacturing sector throughout Spain. The mean age of companies was 27.3 years (minimum = 3 years and maximum = 144 years; standard deviation = 20.2 years). An average of 42.8 employees worked at responding firms (minimum = 10 employees and maximum = 249 employees; standard deviation = 48.4 employees).

Table 4 shows the descriptive statistics for the four approaches to measuring performance and three types of innovation. The internal process (mean = 3.8, standard deviation = 0.58) and open system (mean = 3.8, standard deviation = 0.57) approaches were ranked the highest. The rational goal (mean = 3.4, standard deviation = 0.71 and human relations approaches (mean = 3.4, standard deviation = 0.074) were ranked similarly 3.4 were also ranked similarly, but more important.

Table 4 Descriptive statistics (n = 1091)

Variable	*Mean*	*Standard deviation*
Internal process approach	3.8	0.58
Open system approach	3.8	0.57
Rational goal approach	3.3	0.71
Human relations approach	3.4	0.70
Product innovation	3.1	0.72
Process innovation	3.0	0.72
Managerial and systems innovation	3.2	0.78
Number of employees	42.8	48.4
Age	27.3	20.1

Respondent rankings of the three types of innovation had very similar means and standard deviations. Managerial systems innovation was ranked the highest (mean = 3.2, standard deviation = 0.78), followed by product innovation (mean = 3.1, standard deviation = 0.72) and process innovation (mean = 3.0, standard deviation = 0.72).

5.2 Regression results: Low-Medium Low (L-ML) technology companies

Table 5 shows the results of the regression analyses for the Low-Medium Low (L-ML) technology firms for the relationship between the four performance measures (internal process, open systems, rational goal, and human relations) and three innovation measures (product, process, and managerial/systems innovation) for non-technology firms. Table results indicate that all coefficients for innovation are significantly associated all measures of performance. Product innovation is positively related to SME performance (internal process approach = 0.298; open systems approach = 0.379; rational goal approach = 0.248; and human relations approach = 0.188). Process innovation is positively related to SME performance (internal process approach = 0.303; open systems approach = 0.323; rational goal approach = 0.241; and human relations approach = 0.209). Managerial and systems innovation is positively related to SME performance (internal process approach = 0.327; open systems approach = 0.289; rational

goal approach = 0.210; and human relations approach = 0.222). These results suggest that managers of L-ML technology firms believe that all types of innovation used in the study have a positive impact on performance.

Table 5 Relationship between performance and innovation: Low and Medium-Low technology firms (n = 850)

		Product innovation		*Process innovation*		*Managerial and systems innovation*	
Approach	*Variables*	*Coefficients*	*VIF*	*Coefficients*	*FIV*	*Coefficients*	*VIF*
Internal process	Age	0.032	1.036	0.017	1.032	0.009	1.033
		(0.966)		(0.498)		(0.260)	
	Size	–0.016	1.047	–0.030	1.060	–0.038	1.065
		(–0.463)		(–0.881)		(–1.140)	
	Innovation type	0.298***	1.016	0.303***	1.027	0.327***	1.035
		(8.991)		(9.123)		(9.879)	
		F = 27.170***		F = 27.963***		F = 32.761***	
		Adjusted R^2 = 0.085		Adjusted R^2 = 0.087		Adjusted R^2 = 0.101	
Open systems	Age	0.003	1.036	–0.017	1.032	–0.025	1.033
		(0.096)		(–0.523)		(–0.739)	
	Size	–0.034	1.047	–0.041	1.060	–0.040	1.065
		(–1.031)		(–1.230)		(–1.168)	
	Innovation type	0.379***	1.016	0.323***	1.027	0.289***	1.035
		(11.801)		(9.765)		(8.605)	
		F = 46.563***		F = 31.924***		F = 24.819***	
		Adjusted R^2 = 0.139		Adjusted R^2 = 0.099		Adjusted R^2 = 0.078	
Rational goal	Age	–0.097***	1.036	–0.111***	1.032	–0.116***	1.033
		(–2.898)		(–3.288)		(–3.424)	
	Size	0.055	1.047	0.045	1.060	0.047	1.065
		(1.618)		(1.312)		(1.364)	
	Innovation type	0.248***	1.016	0.241***	1.027	0.210***	1.035
		(7.454)		(7.194)		(6.179)	
		F = 23.526***		F = 22.234***		F = 17.633***	
		Adjusted R^2 = 0.074		Adjusted R^2 = 0.070		Adjusted R^2 = 0.056	
Human relations	Age	–0.011	1.045	–0.021	1.032	–0.026	1.033
		(–0.316)		(–0.605)		(–0.767)	
	Size	–0.095***	1.036	–0.106***	1.060	–0.112***	1.065
		(–2.743)		(–3.081)			
						(–3.232)	
	Innovation type	0.188***	1.016	0.209***	1.027	0.222***	1.035
		(5.542)		(6.151)		(6.515)	
		F = 12.069***		F = 14.458***		F = 16.003***	
		Adjusted R^2 = 0.038		Adjusted R^2 = 0.045		Adjusted R^2 = 0.050	

*p < 0.1; **: p < 0.05; ***: p < 0.01.

Coefficients: standardised coefficients (in brackets t value).

VIF: Variance Inflation Factor.

The R^2 for the regressions provide insight into differences in strength of relationships between performance and innovation measures. Managerial and systems innovation has the highest adjusted R^2 with the internal process (0.101). Product innovation has the highest adjusted R^2 (0.139) with the open systems approach. The open systems approach has the highest adjusted R^2 (0.139) of the four regressions, indicating that product innovation has the greatest impact on the open systems measure of firm performance as compared to the other measures of firm performance. Process innovation has the highest R^2 (0.099) with open systems approach.

Age and size are negatively associated to the rational focus and the human relationships approaches. The older the company, the lower the performance using the rational goal approach. The larger the company, the lower the performance using the human relations approach.

5.3 High-Medium High (H-MH) technology companies

Table 6 shows the results of the regression analyses for high-Medium High (H-MH) technology firms for the relationship between the four performance measures (internal process, open systems, rational goal, and human relations) and three innovation measures (product, process, and managerial/systems innovation) for technology firms. Table results indicate that all coefficients for innovation are significantly associated all measures of performance. Product innovation is positively related to managers' rankings of performance (internal process approach = 0.261; open systems approach = 0.395; rational goal approach = 0.256; and human relations approach = 0.249). Process innovation is positively related to managers' rankings of performance (internal process approach = 0.331; open systems approach = 0.346; rational goal approach = 0.342; and human relations approach = 0.279). Managerial and systems innovation is positively related to managers' rankings of performance (internal process approach = 0.331; open systems approach = 0.292; rational goal approach = 0.265; and human relations approach = 0.195). These results suggest that managers of H-MH technology firms believe that all types of innovation used in the study have a positive impact on performance.

Process innovation has the highest adjusted R^2 with the rational goal (0.130) approach. Product innovation has the highest adjusted R^2 (0.142) with the open systems, indicating that product innovation has the greatest impact on the open systems as compared to other measures of firm performance.

Age (control variable) is not significant in any of the regressions. Size (control variable) is positively associated to the rational process and negatively associated with the human relations approaches. The larger the company, the higher the performance using rational goal approach and the lower the performance using the human relations approach.

Table 6 Relationship between performance and innovation: High and Medium-High technology firms (n = 241)

		Product innovation		*Process innovation*		*Managerial and systems innovation*	
Approach	*Variables*	*Coefficients*	*VIF*	*Coefficients*	*FIV*	*Coefficients*	*VIF*
Internal process	Age	–0.057	1.072	–0.046	1.073	–0.039	1.074
		(–0.885)		(–0.732)		(–0.626)	
	Size	–0.007	1.096	–0.028	1.108	–0.031	1.111
		(–0.107)		(–0.444)		(–0.482)	
	Innovation type	0.261***	1.025	0.331***	1.034	0.331***	1.036
		(4.180)		(5.384)		(5.373)	
		F = 6.092***		F = 9.943***		F = 9.902***	
		Adjusted R^2 = 0.058		Adjusted R^2 = 0.098		Adjusted R^2 = 0.098	
Open systems	Age	–0.019	1.072	–0.007	1.073	–0.002	1.074
		(–0.312)		(–0.105)		(–0.031)	
	Size	–0.052	1.096	–0.055	1.108	–0.048	1.111
		(–0.840)		(–0.876)		(–0.740)	
	Innovation type	0.395***	1.025	0.346***	1.034	0.292***	1.036
		(6.626)		(5.648)		(4.679)	
		F = 14.655***		F = 10.654***		F = 7.319***	
		Adjusted R^2 = 0.142		Adjusted R^2 = 0.105		Adjusted R^2 = 0.071	
Rational goal	Age	–0.013	1.072	–0.002	1.073	0.001	1.074
		(–0.206)		(–0.034)		(0.022)	
	Size	0.128**	1.096	0.104*	1.108	0.116*	1.111
		(1.998)		(1.657)		(1.802)	
	Innovation type	0.256***	1.025	0.342***	1.034	0.265***	1.036
		(4.143)		(5.664)		(4.279)	
		F = 8.138***		F = 13.249***		F = 8.531***	
		Adjusted R^2 = 0.080		Adjusted R^2 = 0.130		Adjusted R^2 = 0.084	
Human relations	Age	–0.086	1.072	–0.077	1.073	–0.073	1.074
				(–1.229)		(–1.153)	
		(–1.367)					
	Size	–0.186***	1.096	–0.200***	1.108	–0.195***	1.111
		(–2.923)		(–3.150)		(–3.032)	
	Innovation type	0.249***	1.025	0.279***	1.034	0.242***	1.036
		(4.033)		(4.554)		(3.890)	
		F = 8.611***		F = 10.156***		F = 8.221***	
		Adjusted R^2 = 0.085		Adjusted R^2 = 0.100		Adjusted R^2 = 0.081	

*p < 0.1; **: p < 0.05; ***: p < 0.01.

Coefficients: standardised coefficients (in brackets t value).

VIF: Variance Inflation Factor.

5.4 Low and Medium-Low (L-ML) vs. High and Medium-High (H-MH) technology companies

The results for the L-ML and H-MH technology companies are very similar. All independent variables are significantly related to all dependent variables. Managers/owners ranked all types of innovation as making important contributions to firm performance. These results are, perhaps, not surprising since innovation is central to firms maintaining a competitive advantage in the market (Hsueh and Tu, 2004; Zahra et al., 2000; Peteraf, 1993; Geroski et al., 1993; Barney, 1997; Grant, 1991; Conner, 1991). Managers/owners demonstrated that they recognise the import relationship between performance and innovation.

T-tests of differences between L-ML and H-MH technology firm managers' mean rankings of competitive position for product, process, and managerial/systems innovations are shown in Table 7. The mean rankings of H-MH technology firms are greater than the mean rankings of L-ML technology firms. This result indicates that managers/owners of H-MH technology firms believe that their firms are more innovative than managers/owners of low technology companies. The table also shows significant differences between mean rankings for products and process innovation. The mean ranking of product innovation for L-ML technology firms (3.06) is significantly lower than for H-MH technology firms (3.32). The mean ranking of process innovation for L-ML technology firms (3.00) is significantly lower than for H-MH technology firms (3.16). The higher rankings indicate that managers/owners of H-MH technology believe their relative product and process innovations are more competitive than L-ML technology firms. The mean rankings of low and high technology firms for managerial/systems innovation are not significantly different.

Table 7 Low-Medium Low vs. High-Medium High technology firms: *T*-test of mean differences in ranking of importance of innovation

Variable	*Type of firm*	*Mean*	*t-statistic*
Product innovation	Low and Medium-Low technology	3.06	–4.866*
	High and Medium-High technology	3.32	
Process innovation	Low and Medium-Low technology	3.00	–3.067*
	High and Medium-High technology	3.16	
Managerial and systems innovation	Low and Medium-Low technology	3.20	–0.305
	High and Medium-High technology	3.22	

*$p < 0.01$.

6 Discussion

Innovation is important for firms to remain competitive. The lack of innovation at the firm level will result in firms losing market opportunities, market share, and earnings potential. Innovation contributes to firm growth, market opportunities, and profitability (Shefer and Frenkel, 2005; Cainelli et al., 2004; Keizer et al., 2002; Zahra et al., 2000). Hsueh and Tu (2004) suggested that aggressive investment in R&D leads to higher sales.

Innovation is also important for economies to remain dynamic, generate wealth, and increase employment (Keizer et al., 2002).

Rothwell and Dogson (1994) identified small firms advantages include the more flexible operating environment, limited bureaucracy, entrepreneurial management, rapid decision-making ability, effective internal communications, strong internal networks, and quick reactions to changing market environments. Disadvantages included lack management skills, lack of time and resources to develop external networks, weak technical skills, lack of diversification, and high cost of capital. Andreassi (2003) emphasised that most small companies have scarce resources. A consequence of scarce resources, especially financial resources, is that innovation is often under-funded. Insufficient funding of innovation may result in the firm not being competitive in the future. Investment in innovation is at the root of a firm's future competitiveness and survival.

This study demonstrated that innovation is positively related to firm performance and verifies the conclusions obtained by Roper et al. (1996), Roper (1997) and Moore (1995) who found a strong relationship between the innovation and the performance of the company. Innovation can be an important competitive advantage for firms. Product innovation impacts improvement of the performance related to the relationship with the customer and the adaptation of the company to the market. The innovation in processes influences in an important way in the economic efficiency of the high technology companies. Managerial and system innovation positively impacts internal performance. This innovation favours the internal focus of the company and the establishment of systems that improve quality and coordination of tasks. Harrison (2002) emphasised that product innovation is necessary to remain competitive, but is not sufficient to create a differentiation in the market.

Process innovation influences efficiency of companies. Thatcher and Oliver (2001) believed that investments in technology that reduce fix costs lead to higher profits and improve the productivity of the firm. The managerial and system innovation impacts positively internal performance in the high and low technology companies. This innovation favours the internal focus of the company and the establishment of systems that improve quality and coordination of tasks. The implementation in the SMEs of new information and managerial control systems, if well developed, can be a sustainable competitive advantage (Barney, 1991).

7 Conclusions

This study examined the relationship between performance and innovation among a sample of 1091 Spanish manufacturing firms. More insight into the relationship between innovation and performance can enable firms to develop more targeted strategies that ultimately might improve performance. An important contribution of the study is the empirical evidence on the relationship between three types of innovation (product, process, and managerial/systems) and four measures of performance (human relations approach, internal process approach, open systems approach, and rational goal approach).

Performance and innovation are key to firm success and competitiveness. Inadequate innovation will likely experience a declining competitive position in the market and, ultimately, weakening performance. Firms that develop innovative practices will be better positioned against their competition in the market and have the opportunity to achieve

strong performance. The results of this study demonstrate that product, process, and managerial/systems innovation have a positive on managers' rankings of performance using the human relations approach, internal process approach, open systems approach, or rational goal approach. In Spain, the low technological sectors are characterised by low levels of innovation, as the results of this study show. However, despite the lower level of innovation, the low technology sector revealed a positive effect of innovation on performance, similar to the high technology sector. The implication of this finding is crucial. Currently, Innovation Policy in Spain is focused on supporting innovation among high-technology firms. Our results highlight the need to support innovation in traditional sectors as well as the high technology sector.

The results may useful in helping firms to understand the important relationship between performance and innovation. Since performance is central to the concerns of all firms, understanding managers' perception of the relevance of innovation as well as the relationship between performance and innovation may help other firms develop better competitive strategies. The results may also be of interest to government policymakers. Government policy that encourages investment in innovation may lead to better firm performance, stronger economic growth, and employment growth. Finally the results may be useful to consultants and support agencies that provide assistance to SMEs. A greater understanding of the importance of innovation should provide greater insight into how firms can achieve better competitive strategies and performance. The results confirm that the importance of these issues is not limited to technology or non-technology firms.

The study has several limitations that provide avenues for potential future research. The data was also collected at a single point in time. A longitudinal study could provide evidence on the changes in evaluation over time. Future studies could expand the scope of research to include examine the relationship between performance and innovation over time. This type of study might reveal whether changes in performance occur in the short or long term. The study could also be expanded to identify differences in the relationship between innovation and performance in different countries, especially those in the European Union. Comparing differences by country could lead to different policies encouraging innovation in different countries or a European Union-wide policy initiative. Finally, future research could employ a case study approach to provide in-depth understanding of issues related to adopting and integrating innovation within a firm. Results from a case study in the form of a single respondent analysis could also be used in a university class in a discussion of the role of innovation in global markets. Assuring external validity, controlling extraneous variables, and assessing potential bias in all survey instruments would provide future research studies with valid data on the relationship between innovation and performance. Insuring validity is especially important for studies that might be used in the development of government and/or company policies.

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Note

[1]SABI database (Sistema Annual de Balances Ibéricos) contains relevant information for 850,000 Spanish firms. SABI covers 31% of firms with more than nine employees, and more than 50% of larger firms.