Which Factors Favour Becoming a Technology-Based & Highly Innovative Firm? The Role of Knowledge, Technological and Managerial Capabilities, and Entrepreneurs´ Education Background

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Abstract

Which resources and capabilities ease the change to become a Technology-Based and Highly Innovative Firm –*TB&InnF*–, focused in the creation of value to market? We analyse this question using a novel data panel assembled for 326 Spanish industrial firms, along the period 1984-2012. Our findings show the probability of becoming a *TB&InnF* growths when firms are able to accumulate a high endowment of knowledge and technological capabilities, and a managerial team with: experience, strong power position and previous technical and managerial education. Results also indicate the CEO´s educational profile in management is preferable to a pure technical profile, because this complements firm´s knowledge and technological capabilities and enables the transformation of a scientific or technological project into a successful entrepreneurial innovation, which creates new value to market.

Keywords: technology-based & highly innovative firm; knowledge-based capabilities, technological capabilities, managerial capabilities, entrepreneurial education
JEL classification: M10

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Introduction

High levels of R&D, creation of new knowledge, and a high level of employment of scientific and technical personnel are features that distinguish TBF from others less technologically intensive firms. However, to be a TBF is a necessary but not a sufficient condition to become a TB&InnF that generates innovative value propositions. Within the framework of the resource-based view (RBV), this study examines the role of knowledge, technology, managerial-based capabilities and education background as determinants of a firm´s transition to become a TB&InnF.

Since the publication of the seminal study by Little (1977) regarding the characteristics of the new TBFs in the United States and Europe, extensive research efforts have been dedicated to investigating various aspects of this select group of firms (Barringer et al., 2005; Wu, 2007; Wu et al., 2007; Colombo et al., 2005, 2010; Brinckmann et al., 2011; O'Gorman, 2003; Colombo et al., 2007; Autio et al., 1998; Alecke et al., 2006; McAdam et al., 2008; Dezi et al., 2009; Maine et al., 2010). The study of the factors that facilitate or hinder the configuration of a firm as a TBF generates increasing interest since the 1990s (e.g., Fontes et al., 1996; Storey et al., 1998; Capaldo et al., 2001; Bonnes, 2003; Lutz, 2003). However, the failure of many Technology-Based start-ups since the early 2000s (Burger-Helmchen, 2009) generates the necessity to have a better understanding of the factors that stimulate their appearance and specially which ones explain the difference between TBF and a TB&InnF that is capable to create new value to market. Among the constituent elements identified as significant determinants of TB&InnFs are, on one hand, external factors (Fontes et al., 1996; Bonnes, 2003; Lin et al., 2010; Lutz, 2003; O´Gorman, 2003). On the other hand, internal forces promoting TB&InnF are less analised. Although some have focused on the critical role of financial resources (March-Chordà, 2004; Burger-Helmchen, 2009) or human resources, more needs to be known. The RBV (Wernerfelt, 1984; Barney, 1986, 1991) can be particularly enlightening for an understanding of the internal factors underlying the establishment of a TB&InnF (Yan et al., 2003; Wu, 2007; Burger-Helmchen, 2009; Lin et al., 2010; Haeussler et al., 2012; Brinckmann et al., 2011). Nevertheless, the role of organizational capabilities in this process has been overlooked in these contributions, possibly because of the inherent difficulties associated with the measurement of these intangible assets. In this regard, our study makes three contributions to the existing literature on TB&InnFs.

First, our study contributes to the specialized literature examining the determining factors associated with the creation and development of TB&InnFs by identifying driving forces, such as knowledge-, technology-, and managerial-based capabilities.

Second, the unit of analysis applied in this study is not restricted to new and/or small TBFs. We take a broader view that incorporates not only firms that operate in high-technology intensive industries, but also others that take an active role in the development of innovations that create new value propositions to market.

Third, this research widens the framework of analysis by not restricting it to those companies born as TB&InnFs. Companies can at some point be restructured and redefined as TB&InnFs and it is therefore important to understand the factors that facilitate such transition.

The remainder of the work is structured as follows. A review of the literature on the determining factors leading to the establishment and development of TB&InnFs is presented, the specific case of knowledge-, technology-, and management-based capabilities is examined, and working hypotheses are proposed. The methodology, databases, and the measurement of variables included in the logistic regression analysis are presented in the third section. The results of the statistical analysis are presented in the fourth section. The fifth section consists of a discussion of the results. The final section includes the conclusions of the study, recommendations for business practice, and a description of the study limitations and future research directions.

Technology-Based & Highly Innovative Firms

Technology-Based & Highly Innovative Firms –TB&InnF– have traditionally been defined according to the technological intensity of the industry in which they

operate (e.g., Colombo et al., 2005, 2010; Zheng et al., 2010). Contrary to these studies, our present work makes a clear distinction between pure technological innovation and value innovation (Kim et al., 2005). Considering innovation as the capability to create new value to market and generate new demand gives room to the consideration of knowledge-intensive firms that can be categorized as highly innovative but whose primary activity is not associated with technology-based industries. Then, we include firms in our study that simultaneously introduce a mix of technological, marketing and organizational innovations focused toward the creation of new value propositions.

A second difference is the organizational size of the firms analysed. In general, studies on TBFs focus on small-young firms (new technology-based firms or high-tech start-ups) (e.g., Colombo et al., 2005; Colombo et al., 2010; Brinckmann et al., 2011). However, large firms with a clear inclination towards differentiation and innovation that can establish themselves as TB&InnFs should also be considered. Therefore, the focus of this study is the analysis of TB&InnFs, which are defined as those capable create new value propositions to market through a proper mix of technological, market and organizational innovations regardless of their size and age.

Organizational capabilities as drivers of Technology-Based & Highly Innovative Firms

Table 1 provides a summary of the most relevant studies analysing the factors that facilitate or inhibit the creation or development of TB&InnFs.

Table 1

Principal Determinants of the Creation or Development of Technology-Based or Highly Innovative Firms

Study	Type of Firm	Phase in Life Cycle	Type of Study	Country	Determining Factors
Fontes and Coombs (1996)	New Technology Based Firms	Creation and Development	Empirical	Portugal	• RD Infrastructure of the Country in which the Firm Operates • Characteristics of the Players
Storey and Tether (1998)	New Technology Based Firms	Creation and Development	Theoretical	Europe	• Financial Resources • Marketing Strategy • Human Resources Strategy • Legal Regulation • Managerial Capabilities •
Capaldo and Fontes (2001)	New Technology Based Firms	Conception of Business Idea and Creation	Empirical	Portugal and Italy	• Founders´Characteristics • Relationships with Support Organizations • Managerial Capabilities
Bonnes (2003)	Technology-Based Start-Ups	Creation	Empirical	France	• Relationshps with External Agents
O'Gorman (2003)	High-Tech Ventures	Creation	Empirical	Ireland	• Political Intervention
Martínez (2003)	Technology-Based and Innovative Firms	Creation	Theoretical	Spain	• Support for the RD Group Creating the Firm
Lutz (2003)	New Technology-Based Firms	Creation	Theoretical	Germany	• Excellent RD Infrastructures for New Technologies and the Potential Founders of Firms • Stimulation, Motivation and Preparation Programs and Initiatives. • Competititon for Business Planning • Initiatives Motivating and Promoting the Creation of New Firms Associated with Institutes and Universities.

Table 2
Principal Determinants of the Creation or Development of Technology-Based or Highly Innovative Firms (continued)

					• Entrepreneurship Institutes in All Universities. • Business and Innovation Centers Focusing on New Technologies. • Financing for Incubators and Risk Capital. • Risk Capital. • Business Angels. • Networks of Founders, Investigators, Risk Capital Investors, and Consultants Promoting Contacts and Business Culture.
March-Chorda (2004)	Innovative Start-Ups	Development	Empirical	United States	• Funding • Management • Focus • Personal Profile • Goals • Growth Strategy
Burger-Helmchen (2009)	Small High-Tech Firms	Development	Empirical		• Entrepreneurial Resources: • Human Resoureces Related Resources • External Cooperation Related Resources: Economic Indicators
Lin et al. (2010)	New High-Tech Ventures	Development	Empirical	Taiwan	• Technology • Networking • Legitimacy

Source: Authors' work

Knowledge-based capabilities and Technology-Based & Highly Innovative Firms

The study of knowledge creation capabilities focuses on all the competencies associated with the creation of an internal system of continuous learning in the firm (Camisón-Zornoza et al., 2009). Camisón-Zornoza et al. (2009) indicate that these capabilities include specific aspects such as: the ability of a firm to develop organizational systems that emphasize the development of skills; the promotion of communication among the members of the organization; and the degree to which the members of the organization are committed to the goals of the firm, knowledge, innovation, and quality. The capability for knowledge creation facilitates more abstract mapping of the domain of the firm's activity (Camisón-Zornoza et al., 2009). The generation of knowledge improves the firm's ability to exploit it for commercial ends through its incorporation into the firm's operations (Van den Bosch et al., 1999). Therefore, these knowledge creation capabilities can play an especially important role in a firm becoming TB&InnF. This line of reasoning is reflected in the following hypothesis:

- Hypothesis 1: The likelihood of a firm to become Technology-Based & Highly Innovative increases when the firm has a high endowment of knowledge-based capabilities.

Technological innovation capabilities and Technology-Based and Highly Innovative Firms

RBV states that innovative capabilities are critical to creating value (Tuominen et al., 2004), to achieving a competitive advantage (Duysters et al., 2000), and consequently to business competitiveness (Coombs et al., 2001).

García-Muiña et al. (2007, p. 180) define technological innovation capabilities as any knowledge intensive generic property that enables the simultaneous mobilization of different individual scientific and technical resources, allowing the

development of successful innovative products and/or processes by a firm, and of value for the implementation of competitive strategies that create value under specific environmental conditions In the case of TB&InnFs, the analysis of this capability as a determining factor for its establishment is particularly relevant given that it is crucial for delivering new products to the market (Zheng et al., 2010; Haeussler et al., 2012). This idea is reflected in the second hypothesis:

- Hypothesis 2: The likelihood of a firm to be Technology-Based & Highly Innovative increases when the firm has a high endowment of technological innovation capabilities.

Managerial capabilities and technology-based and highly innovative firms

Managerial capabilities are derived from activities involving the tacit knowledge deposited in managers and consist of a technical component, which reflects the know-how of the managers, and a cognitive component, which reflects the values or the personality of the management. Based on the classification of managerial competences reported by Camisón (2004), we study the following dimensions of managerial capabilities: Manager experience –length of time in the profession, decision-making, training, an international career, or the variety of previous experience–; Manager position and exercise of power –amount of influence that managers can exert on the organization and their propensity to make use of it–; Manager education: This includes the education of the manager (Ansoff, 1979), particularly, the degree of managerial and technological education.

These types of capabilities can be a source of competitive advantage because they decisively determine the acquisition, development, and deployment of the rest of the resources and capabilities, their conversion into valuable products, and the creation of value (Hambrick et al., 1988; Barney, 1991; Castanias et al., 1991; Penrose, 1995), and also are determining factors of the utilization of resources and the subsequent growth of TBFs (Brinckmann et al., 2011; Colombo et al., 2004; Burger-Helmchen, 2009). This line of reasoning is reflected in the following hypothesis:

- Hypothesis 3a: The likelihood of a firm to be Technology-Based & Highly Innovative increases when the manager has a high endowment of managerial experience.
- Hypothesis 3b: The likelihood of a firm to be Technology-Based & Highly Innovative increases when the manager has high endowments of position and capabilities for the exercise of power.

Alike, we expect that a firm will be become TB&InnF when the administration has technical and management training (Capaldo et al., 2001; Colombo et al., 2004; Colombo et al., 2005, 2010). Therefore, administrators that are more technically and managerially qualified are expected to facilitate the performance of TB&InnFs. These ideas are summarized in the following two hypotheses:

- Hypothesis 3c: The likelihood of a firm to be Technology-Based & Highly Innovative increases when the manager has technological education.
- Hypothesis 3d: The likelihood of a firm to be Technology-Based & Highly Innovative increases when the manager has managerial education.

Knowledge-based and technological capabilities, managerial education, and Technology-Based & Highly Innovative Firms

According to Barea (2003) and Capaldo et al. (2001), one of the main problems faced by TBFs is that the person who normally places a new technology on the

market (technologist or scientist) is not a manager. The personal characteristics required to make significant technological advances are not the same as those required to create and launch to market innovative value propositions. In other words, the administrator's level of qualification in business education can determine the probability that an entrepreneur possessing only knowledge- and technology-based capabilities can become a manager. To increase the likelihood of a company become a TB&InnF, it must simultaneously possess knowledge-based capabilities, technological capabilities, and business education. This line of reasoning is reflected in the last hypothesis:

- Hypothesis 4 (H4): The likelihood of a firm to be Technology-Based & Highly Innovative increases when the firm simultaneously possesses knowledge and technological capabilities and the manager has economic or management education.

Methodology

Sample

The database used in this study originated from an initial research study on the competitiveness of industrial firms in a region of Spain, the Comunidad Valenciana. The universal study object consists of a group of Valencian firms, excluding the energy sector and micro-firms (firms with less than 10 employees). Sample selection was performed using the database ARDAN-Comunidad Valenciana, including a total of 3,394 registered firms stratified according to industry and size; we established a confidence margin of ±95% and an error level of ±5%. Data were obtained through personal interviews with firms' top management through a structured questionnaire administered between November to December 1998. A total of 550 valid answers were included in the study, neither of them could be classified as TB&InnF at that time. The firms included in the sample showed diverse organizational sizes and belong to 18 industries (CNAE to two digits). Firms with less than 50 employees comprised 76,1% of the sample, 22,2% were medium-sized firms with a workforce of 50 to 249 employees, and the remaining 1.7% were large companies with more than 250 employed individuals.

We have observed whether these firms are turned into TB&InnF along the period 1997-2012. The data panel is assembled for 326 firms that have survived for the time period indicated. Firms with less than 50 employees comprised 67% of the final sample, 31% were medium-sized firms with a workforce of 50 to 249 employees, and the remaining 2% were large companies with more than 250 employed individuals.

The information contained in the primary survey was used to measure the technological intensity of the industry, its innovative or technology base, its rate of growth, and the potentially explanatory factors of its expansion. In addition, this information has been completed with financial information from the SABI database referring to the period 1997-2012. The descriptive statistics and correlations for the variables in the model are shown in Table 2. There is little correlation between variables, reducing the risk of disturbing effects due to multi-colinearity.

Table 3
Means, Standard Deviations, and Correlations among Study Variables

	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9	10
TB&InnFs	0.26	0.44	1									
Age	32.46	20.90	0.05	1								
Productivity	202.69	2272.82	-0.02	-0.00	1							
Size	178.20	227.80	-0.03	-0.04	0.03	1						
Uncertainty	3.20	0.37	-0.06	0.02	-0.05	0.07	1					
Knowledge Capabilities	3.68	0.45	0.24**	-0.09	0.00	0.07	-0.00	1				
Techological Capabilities	3.20	0.62	0.25**	-0.02	-0.01	0.04	0.10	0.28**	1			
Managerial. Experience	2.60	0.62	0.17**	0.12*	0.01	0.07	0.19**	0.07	0.26**	1		
Power Capabilities	3.59	0.56	0.17**	0.05	0.00	-0.04	0.02	0.19**	0.13*	-0.06	1	
Economic Education	0.46	0.49	0.11*	0.02	-0.04	-0.03	-0.10	0.10	-0.02	-0.03	0.10	1
Technical Educ.	0.27	0.44	0.05	0.02	-0.03	0.08	0.07	-0.09	0.04	0.07	-0.08	-0.57**

Note: ** p < 0.01 * p < 0.05.
Source: Authors' work

Dependent variable

Technology-Based & Highly Innovative Firms: The dependent variable in the model is a categorical variable given a value of 1 for those firms classified as TB&InnFs and 0 for the remaining firms. To classify firms into one group or another we used the following process:

- The first step was to classify firms as a function of the technological intensity of the industry in which they operate. For this purpose, we used the guidelines of the International Standard Industrial Classification (ISIC). The updated version of this list, which was revised in 2010, defines the following cut-off points: low-tech, when the total intensity in R&D is below 1.0%; medium-low-tech, when such intensity is between 1.0% and 2.5%; medium-high-tech, when such intensity is between 2.5% and 8.0%; and high-tech, when it is above 8%. We have thus classified the firms included in the sample into one of the above four groups.
- The second step consisted of the classification of the firms according to innovative intensity. To be classified as highly innovative, a firm must have simultaneously developed product, process, and organizational innovations during the last three years.

Independent variables

Knowledge-based capabilities: This variable captures the capability of the firm to create internal knowledge. We use a multi-item scale developed by Camisón-Zornoza et al. (2009). The internal knowledge creation capacity measurement scale is presented in the Annex. The measure of internal consistency through the Cronbach's alpha is 0.618. Goodness-of-fit of indicators obtained through CFA take the following values: Normed Chi-Square = 2.451, IFI = 0.952, Bentler-Bonnet Non-Normed Fit Index = 0.902, GFI Fit Index = 0.985, RMSEA = 0.067. Therefore, the consistency of the measurement scale is satisfactory.

Technological innovation capabilities: The search for a measurement tool that accurately expresses the concept of technological innovation capabilities remains active in the specialized literature. In this study, the assessment of such intangible concepts using a single indicator, such as patent indicators (patent statistics)

(Bachmann, 1998; Praest, 1998; Duysters et al., 2000; Coombs et al., 2001; Schoenecker et al., 2002; Ahuja et al., 2004), or as was the percentage of expense dedicated to R&D (Anand et al., 1997; Moon, 1998), was considered insufficient. Instead, we supported the need to create an assessment tool composed of multiple indicators capable of reflecting the technological situation of the firm through the perception of top-management; this was similar to previous studies (e.g., Guan et al., 2003; Flor et al., 2005; Perdomo-Ortiz et al., 2006). We developed a multi-item scale to measure this capacity. The scale is presented in the Annex. We analyzed the internal consistency of this scale through the Cronbach's alpha, 0.918. The results of the CFA show that the goodness-of-fit of indicators are, once again, satisfactory ((Normed Chi-Square = 2.87, IFI = 0.921, Bentler-Bonnet Non-Normed Fit Index = 0.903, GFI Fit Index = 0.912, RMSEA = 0.078).

Managerial capabilities: To introduce managerial capabilities into the model, we distinguish three dimensions of the concept identified by Ansoff (1979) and Camisón (2004): managerial experience capabilities, power and exercise of power capabilities, and managerial education.

Managerial experience capabilities: This variable gathers the manager's length of time in the profession, decision-making, training, international career, or the variety of previous experience. We have used a multi-item scale developed by Camisón (2004). The scale is presented in the Annex. The Cronbach's alpha takes a value of 0.781.

Position and exercise of power capabilities: This variable reflects the ability of the managers to exert their influence on the organization (position of power) and their propensity to make use of this ability (exercise of power). To measure this variable, we refer again to a multi-item scale developed by Camisón (2004). The scale is presented in the Annex. The Cronbach's alpha takes a value of 0.748.

Manager technological or scientific education: This variable captures whether the manager has an education in technology or science. It was measured with a categorical variable having the value of 1 for those managers who had a technological or scientific education and 0 for the remaining cases.

Manager managerial or economic education: This variable captures whether the manager has an education in management or economics. It was measured with a categorical variable having the value of 1 for those managers who had a managerial or economic education and 0 for the remaining cases.

Control variables

Four variables were included in the model as control variables: organizational size, age, productivity (productive efficiency), and environmental uncertainty. Previous research has shown that these variables can affect the behavior of TB&InnFs (Colombo et al., 2004; Brinckmann et al., 2011).

- Size: Organizational size was measured by the number of employees.
- Age: Firm age was measured as the number of years since its foundation.
- Productivity: Productivity was measured by the revenue per employee.
- Environmental uncertainty: To operationalize environmental uncertainty we use a measurement scale developed by Camisón (2004), which gathers the dimensions identified by Dess et al. (1984): dynamism, munificence, and complexity. These dimensions have been previously applied in relevant works (Lawless et al., 1989. The scale is presented in the Annex. The internal consistency of this scale is satisfactory, with a value of the Cronbach's alpha of 0.706.

Statistical techniques

To test the hypotheses proposed, we have applied a binary logistic regression by using SPSS 22.00 software. We have performed the binary logistic regression in six steps. First, control variables are included in the baseline model. Second, control variables plus knowledge-based capabilities are included in model 1. Third, control variables plus technological innovation capabilities are included in model 2. Fourth, control variables plus managerial capabilities are included in model 3. Fifth, a model including control variables and the three kinds of capabilities considered is presented in model 4. Finally, a model is created containing control variables, the three organizational capabilities, and the interaction effects derived from Hypothesis 4. To create the interaction effects we first standardized the variables and then created the interaction terms by multiplying them.

To assess the goodness-of-fit of the model, the following indicators have to be analysed. First, the R2 indicates the overall fit of the model. However, the R2 should not be compared with the regression R2 as in the logistic regression the values are usually much lower (Tödtling et al., 2009). Second, the Hosmer-Lemeshow test has to be analysed. A p-value of less than 0.05 indicates that the model does not fit at a 5% significance level. Third, the correct classification table states what percentage of the predicted outcomes has been classified correctly. The higher the percentage of correct predictions, the higher the fit of the model. Finally, it is expected that the goodness-of-fit of the complete model would be higher than for the individual models. We also carried out a CFA with the program EQS 6.0 to analyse the goodness-of-fit of the measurement scales utilized to measure knowledge and technological capabilities.

Results

The estimated logistic regression models are presented in Table 3, which shows all models from the baseline to the complete model. These show that the sequential addition of the investigated variables significantly increases the explanatory power and the goodness-of-fit of the models, which reach adequate levels.

Specifically, the explanatory capability and the adjustment indexes show a significant increase in the complete model (Full model: R2 = 0.269; % correct classification = 76.4) compared to the results obtained when only the following are considered: knowledge-based capabilities (Model 1: R2 = 0.105; % correct classification = 74.8); technology-based capabilities (Model 2: R2 = 0.120; % correct classification = 73.6); management capabilities (Model 3: R2 = 0.156; % correct classification = 73.6); or even when the three types of capabilities are considered (Model 4: R2 = 0.246; % correct classification = 76.1). The Hosmer-Lemeshow test also indicates a satisfactory goodness-of-fit of the models.

With regard the control variables environmental uncertainty is significant and negative. This indicates that the existence of a high environmental uncertainty decreases the probability that a firm will be established as TB&InnF. This is consistent with previous research predicting this negative relationship (Autio et al., 1998). The results suggest that knowledge (H1) and technological (H2) capabilities, managerial capabilities based on managerial experience (H3a), the position and capabilities for the exercise of power of the manager (H3b), the manager's technological/scientific education (H3c), and the manager's economics/management education (H3d) increase the probability that a firm will be TB&InnF. To contrast the significance of H4, we introduced a term defining the interaction between knowledge-based capabilities, technological capabilities, and management training to demonstrate that the likelihood that a firm will be established as TB&InnF increases when it

possesses the three types of capabilities together. Furthermore, to reinforce this idea, we introduced a second term of interaction between knowledge-based capabilities, technological capabilities, and the technical or scientific training of the businessperson. The significance of the interaction between knowledge-based capabilities, technological capabilities, and economics or management training serves to contrast H4.

Table 3
Results of the Estimated Regression Models

Variables	Model 0: Baseline Model		Model 1: Knowledge-Based Capabilities		Model 2: Technological Capabilities		Model 3: Managerial Capabilities		Model 4: Model With Three Types of Capabilities		Model 5: Full Model	
	Coeff.	Signif.	Coeff.	Signif.	Coeff.	Signif.	Coeff.	Signif.	Coeff.	Signif.	Coeff.	Signif.
Constant	0.155	0.887	-4.948**	0.002	-2.772**	0.029	-4.813**	0.002	-	0.000	-	0.000
	(1.090)		(1.599)		(1.269)		(1.556)		9.367***		8.694***	
									(2.025)		(2.129)	
Control variables:												
Age	0.006	0.294	0.009	0.140	0.008	0.199	0.001	0.847	0.006	0.388	0.007	0.327
	(0.006)		(0.006)		(0.006)		(0.006)		(0.006)		(0.007)	
Productivity	0.000	0.654	0.000	0.658	0.000	0.698	0.000	0.761	0.000	0.784	0.000	0.772
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
Size	0.000	0.653	0.000	0.472	0.000	0.519	-0.648*	0.074	-0.001	0.378	-0.001	0.340
	(0.001)		(0.001)		(0.001)		(0.362)		(0.001)		(0.001)	
Environmental Uncertainty	-0.409	0.226	-0.448	0.196	-0.615	0.076*	-0.648	0.074	-0.692*	0.066	-0.755	0.049**
	(0.338)		(0.347)		(0.347)		(0.362)		(0.376)		(0.384)	
Knowledge Capabilities:												
Knowledge-Based Capabilities			1.378***	0.000					0.965**	0.006	0.933**	0.013
			(0.317)						(0.352)		(0.376)	
Technological Capabilities:												
Technological Capabilities					1.082***	0.000			0.747**	0.004	0.670**	0.012
					(0.232)				(0.258)		(0.267)	
Managerial Capabilities:												
Managerial Experience							0.820***	0.000	0.562**	0.021	0.588**	0.017
							(0.232)		(0.243)		(0.247)	
Power Capabilities							0.790***	0.001	0.555**	0.033	0.523**	0.049
							(0.246)		(0.260)		(0.266)	
Economic/Management Education							1.061**	0.005	1.103**	0.005	0.960**	0.016
							(0.380)		(0.397)		(0.399)	
Technical/Scientist Education							1.138**	0.005	1.242**	0.003	1.174**	0.006
							(0.408)		(0.425)		(0.423)	
Interaction Effects:												
Technological Cap. x Knowledge Cap. x Management Educ.											0.480**	0.037
											(0.230)	
Technological Cap. x Knowledge Cap. x Technical Educ.											0.286	0.205
											(0.226)	
Test Statistics:												
R2 Nagelkerke	0.014		0.105		0.120		0.156		0.246		0.269	
Hosmer–Lemeshow Goodness-of-Fit	10.750	0.216	9.701	0.287	1.332	0.995	4.218	0.837	5.551	0.697	2.638	0.955
Correct Classification (%)	73.3		74.8		73.6		73.6		76.1		76.4	

Note: *** p < 0.001, ** p < 0.05, * p < 0.1.

Source: Authors' work

Discussion and Conclusion

To determine which factors enable that a firm becomes a TB&InnF, from RBV, this study examines the role of organizational capabilities based on knowledge, technology, and management. We analyse a sample consisting of 326 Spanish industrial companies that includes TB&InnFs as well as non-TB&InnFs.

Our results indicate that companies possessing a higher capacity to generate knowledge are more likely to be established as TB&InnF (H1). Alike, technological capabilities are another determining factor for the establishment of such firms (H2). Managerial capabilities are another factor of particular relevance to explain why a company becomes TB&InnF (H3a,b,c,d). Finally, results of this study also show that a company is significantly more likely to become a TB&InnF when it integrates knowledge- and technology-based organizational capabilities, and in addition, the businessperson possesses adequate training in business or economics (H4). This result confirms the theories expressed by Barea (2003), who argued that TB&InnFs depend as much on the knowledge and technologies that enable the development of innovative projects as on the managerial capabilities that allow an invention to become a marketable product and an attractive managerial project through the business or economics training of the administrator.

In general, our results contribute to the literature regarding the determining factors for the development of TB&InnFs (Storey et al., 1998; Capaldo et al., 2001; Bonnes, 2003; O'Gorman, 2003; Burger-Helmchen, 2009; Lin et al., 2010) and add three new intangible elements to the list, namely knowledge-based capabilities, technological innovation capabilities, and managerial capabilities. Results also underscore the value of the RBV for the analysis of firms with this profile, supporting the body of work developed with this approach (Yan et al., 2003; Wu, 2007; Wu et al., 2007; Haeussler et al., 2012; Brinckmann et al., 2011). Technological and managerial capabilities are not only determinants for the generation of competitive advantages, as previously shown (e.g.,; Haeussler et al., 2012; Colombo et al., 2004; Colombo et al., 2005, 2010), our study shows they are also important factors in determining the likelihood of a firm becoming TB&InnF.

The implications of our work for managers are as follows. First, managers must be aware that organizational capabilities play a critical role. Specifically, the development the generation of knowledge, technological capabilities, and managerial capabilities. With this combination, the firm simultaneously possesses the knowledge and technology to become highly innovative and the managerial abilities to convert their innovations into successful business projects that produce new value propositions to market.

Among the limitations of this study, which will become the subjects of future lines of research, we must include our somewhat partial analysis of the determining factors for the establishment of TB&InnFs. In respect of the control variables, although an attempt was made to collect other factors previously reported to affect the establishment of TB&InnFs, there are other organizational capabilities that can play a relevant role and have not been considered. For example, examining the role of the capability to absorb knowledge, learning capabilities and/or non-technological innovation capabilities. On the other hand, this study was limited to analyzing the effect of organizational capabilities based on knowledge, technology, and management on the likelihood of a company being established as TB&InnF without considering the additional impact of these factors on the growth of these firms. To advance on the premises of RBV, it would be interesting to determine whether the

three types of organizational capabilities analyzed can be a source of competitive advantage that produce superior performance in TB&InnFs.

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