Journal of Scientific & Industrial Research
Vol. 77, August 2018, pp. 437-441

Innovation Management and Strategy

A J Briones Peñalver[1], José António C Santos[2]*, J A Bernal Conesa[3], and M C Santos[2]

[1]Technical University of Cartagena, 30202 Cartagena, Spain

[2]University of Algarve, ESGHT, Campus Penha, 8005-328 Faro, Portugal

[3]University Centre of Defense at the Spanish Air Force Academy, Spain

Received 04 April 2017; revised 15 December 2017; accepted 03 March 2018

This paper studies the capacities related with innovation, technological development, the role of the innovation systems and the institutional aspects on the strategy of companies related to the Spanish defence industry. The empirical part of the study is based on a survey to 236 small and medium-sized companies, which represent 52% of that universe. Concerning the innovation strategy, it defines the most important factors of the technological innovation processes and analyses the causal relationship between strategy and structure, the role of innovation in cooperation, intercompany relationships and the dependence relationship in technological innovation capacities.

Keywords: Innovation, Technology, Strategy, Capacities, Cooperation

Introduction

Technological development is among the most important drivers for innovation, since it enables success in a specific economic sector, allowing to obtain greater profitability. Innovation can be achieved through technological development, which may involve a new product, a new service, new practices in processes, and new technologies as well as the contribution of other sources of knowledge. There is a wide-ranging consensus regarding the role of technological progress for the creation of knowledge, and the implications of the dynamic capacities as a motor for growth and development[1]. The competitiveness of a company is reinforced by its capacity of technological innovation. The market acts as a regulatory and driving agent for innovation, although knowledge and skills are required in order to convert innovation into a sustainable competitive advantage[2]. This investigation has taken as its reference the study of the capacities for technological innovation in companies related with the Spanish defence industry, the analysis of the technological renewal process through R&D and innovation programmes, the establishment of national cooperation programmes to increase efficiency and the competitiveness of these companies.

*Author for Correspondence
E-mail: jasantos@ualg.pt

The conceptual framework of the capacities for technological innovation

Nowadays, innovation is a broader term than technological innovation, committing certain resources to the development of new products, as well as, the improvement of processes, permitting companies to be ahead of their competitors. Business model innovation is therefore core for entrepreneurship in industrial or service sectors[3]. Innovation comprises the following types: Process or technological innovation which supposes the research and the development of a key technology that must be commercialised on the market for the first time[4]. Innovation in products depends additionally on the mentioned competence in the sector; that the company possesses the sufficient capacity and sensitivity to react to the new demands of the market, incorporating new products and/or services, or modifying existing ones. Social Innovation refers to the introduction of changes related to new organisational and management forms, social networks and environmental innovation processes[5].

Systems of technological innovation: institutional aspects

Innovation systems can be defined as a complex structure composed of different types of agents with different but complementary functions throughout the interactive process, which range from the generation of new knowledge to the successful introduction of an innovation into the marketplace. The different focuses of innovation lead to the studying of different

contexts of knowledge, taking the different economic industries as the basis as well as the role of the institutions in the interaction of knowledge by means of collaboration with business agents. The companies and institutions, upon collaborating with each other, generate some innovation processes[6].

Hypothesis

Analysing the innovative capacity related to technological innovation is a way of perceiving business success[7]. Such innovations may involve radical technologies, which may be based on a combination of technologies applied to new uses, or may be derived from the utilisation of new knowledge, making it possible to acquire capacities for technological innovation. Taking theses premises into account, this paper seeks to evidence that by means of the presence of innovation systems, the companies related to defence benefit in the performance of their capacities for technological innovation, obtaining also certain competences which differentiate them with respect to other industries and other industrial sectors.

First hypothesis (H^A)

Authors such as Veciana[8], show that the small and medium-sized enterprises (SMEs) contribute to innovation as much as major companies. Therefore, it is relevant to study if inequalities in size and other structural variables affect the capacities for technological innovation and the competitive position of the company. This leads to the formulation of the hypothesis:

- H^A – Significant influence exists of certain contingent and structural factors associated to the measures and the degree of innovation of companies related with the defence industry.

Second hypothesis (H^B)

As a result of innovation processes, companies specialize in certain goods and services supplied to the Ministry of Defence and therefore become part of a structured network of suppliers. Through collaborations in R&D and the formation of strategic alliances the companies can gain technological knowledge which drives innovation[9]. Collaboration policies lead companies to respond to the needs of their environment when these policies promote innovation. From the above, a second hypothesis can be made (HB) with three working sub-hypotheses (HB1, HB2, HB3) which analyse the role of innovation in intercompany relations.

- H^B- Significant influence exists between business innovation developed in the companies related with the defence industry and the intercompany relations established between the same.
- H^{B1} – The measures of business innovation have a significant effect on intercompany relations.
- H^{B2} – The facilitating values of business innovation have a significant effect on intercompany relations.
- H^{B3} – The results of business innovation have a significant positive effect on intercompany relations.

Third hypothesis (H^C)

The capacities for innovation result from the efficient utilisation of business technology and the efficient management of human resources[10]. On the other hand, the material and immaterial elements of the company can be improved through the adaptation and optimisation of the resources, the production systems developed by experts, the R&D activities and efficient decision processes[10]. These statements justify the third hypothesis:

- HC- Significant influence exists of business innovation defined through the measures of innovation, the facilitator values, and the results of innovation on the capacities for technological innovation of the companies related with defence.

Empirical study

The survey covers the strategic determinants based on the strategy of professionalism and modernisation of the Armed Forces and the Defence Systems, and the analysis of the cooperation processes of the companies related with defence. This research is based on a survey to 236 suppliers of the Spanish Armed Forces, meaning a response rate of 52.44%, with an error of 4.4% for p=q=50% and a confidence level of 95.5%.

Results

The analysis on the capacities for technological innovation is grounded on three factors: (1) the measures associated with innovation; (2) the company values which lead to that innovation; and, (3) the results that come from the consideration of the company as being innovative. The Factor Analysis, the matrix of components, and the matrix of coefficients of the new variable denominated “Results of business

innovation". After analysing the establishment of cooperation agreements in companies related with defence, three conglomerates of variables were obtained: 1) variables related with the different collectives (interest groups) and with cooperation mechanisms; 2) variables related with the inhibitors to cooperation processes; and 3) variables which allude to cooperation relations. This allows constituting a dependent variable for the contrast of the second hypothesis, denominated Index of Intercompany Relations between Companies and the Ministry of Defence. The frequency has been calculated with the mean distance between the minimum (1.96) and maximum (4.81) values, and considering these as the confidence interval, it indicates that 70% of the analysed companies value very positively the aspects referring to the cooperation and intercompany relations in the Ministry of Defence. Table 1 presents the results of the contrast of the first hypothesis (H^A) of the association of the innovation measures with the contingent variables (such as *seniority, company size, globalisation, the sector of the activity, the location*) and the structural variable denominated "*specialisation of the goods and services for defence*". The t statistic carries out the contrast of the null hypothesis of "if the value of the contingent and structural variables is equal to zero"; finding that specialisation is the only important and significant variable (with a p-value of 0.004 < 0.10). Therefore, we can state that a significant dependency relation exists between the specialisation of the goods and services supplied to the Armed Forces and the measures of innovation. Table 2 presents the results of the contrast of the second hypothesis (H^B). This studies if a significant influence exists of the business innovation processes and the intercompany relations. To do so we utilised the working hypotheses (H^{B1}, H^{B2}, H^{B3}) and the index which proceeds from the study of the conglomerates of variables denominated *index of the Intercompany Relations between the Companies and the Ministry of Defence*. The results show the facilitator values and the results of innovation as significant factors; therefore, we can state that positive significant influence exists in the facilitator values of innovation and in the results of innovation on the cooperation and intercompany relationships. Table 3 shows the contrast of the third hypothesis (H^C), to study the dependency relationship

Table 1 — Index of the measures of business innovation

Predictive Variables	Standardised Coefficients (Beta)	T test (Sig.) (t)	Colinearity T	Colinearity FIV	Colinearity Diagnostic A	Colinearity Diagnostic IC
(Constant)		7.086[a]			3.508	1.000
Seniority of the Company.	0.103	0.561	0.302	3.310	1.328	1.625
Seniority of the Defence Relationship.	-0.002	-0.009	0.340	2.944	1.076	1.806
Size- Mean Number of Employees.	0.202	1.579	0.619	1.616	0.944	1.928
Globalisation and Internationalisation.	-0.036	-0.344	0.901	1.109	0.728	2.194
Sector of Activity of the Company.	-0.067	-0.636	0.902	1.109	0.297	3.436
Localisation of Work Centres.	0.039	0.361	0.873	1.145	0.075	6.850
Specialisation in goods and services for Defence.	0.309	2.829[a]	0.851	1.174	0.044	8.935
$R = 0.458$; $R^2 = 0.210$; R Adjusted = 0.139.			Durbin-Watson (DW) statistic = 1.926			
Standard error of the estimation = 4.596			ANOVA (F) = 2.964[a]			
SOURCE: Own production.						

Table 2 — Index of the intercompany relations

Predictive Variables	Standardised Coefficients (Beta)	T test (Sig.) (t)	Colinearity T	Colinearity FIV	Colinearity Diagnostic A	Colinearity Diagnostic IC
(Constant)		2.028[b]			3.934	1.000
Measure of Innovation INME_EMP	0.121	1.126	0.770	1.299	0.036	10.46
Values of Innovation INVA_EMP	0.208	1.932[c]	0.761	1.315	0.019	14.27
Results of Innovation INRT_EMP	0.635	6.572[a]	0.948	1.055	0.011	18.75
$R = 0.753$; $R^2 = 0.567$; R Adjusted = 0.540		Durbin-Watson (DW) Statistic = 2.160				
Standard error of the estimation = 0.386		ANOVA (F) = 21.375[a]				
SOURCE: Own production.						

Table 3 — Capacities for technological innovation

Predictive Variables.	Standardised Coefficients	T test (Sig.)	Colinearity		Colinearity Diagnostic	
	(Beta)	(t)	T	FIV	A	IC
(Constant)		-17.877[a]			6.696	1.000
Perception of professionalism by the client.	0.216	3.649[a]	0.574	1.741	0.121	7.445
Knowledge and increase in technological advances.	0.276	5.610[a]	0.829	1.206	0.070	9.781
Recognition of employees and human capital	0.230	4.718[a]	0.851	1.175	0.043	12.46
Incorporation of new products and services	0.265	5.181[a]	0.772	1.295	0.030	14.84
Accede to and specialise in niche markets	0.176	3.413[a]	0.754	1.327	0.024	16.86
Participation in tendering processes	0.271	4.759[a]	0.620	1.613	0.016	20.28
$R = 0.860$; $R^2 = 0.740$; R Adjusted = 0.728		Durbin-Watson (DW) statistic = 1.767				
Standard error of the estimation = 0.521		ANOVA (F) = 61.296[a]				

SOURCE: Own production.

of variables of the innovation processes with the dependent variable being "*Capacities for Technological Innovation*". According to the results, the processes of technological innovation in these SMEs are associated (with a probability of 99%) to internal capacities (professionalism, technological knowledge, and the recognition of the human capital), and to capacities relating to the incorporation of new products and services, the specialisation in niche markets and the participation in tendering processes for contracts with the Public Administration. This study also observed the relationship between the variables "knowledge and technological advances" with innovation in processes; and/or the "incorporation of products and services" with the innovation in products. These items provide the most noteworthy results and are associated in an important manner (t with a greater value) to the Capacities for Technological Innovation. The predictive equation obtains high determination coefficients ($R = 0.860$; $R^2 = 0.740$; R Adjusted = 0.728), and a standard error of the estimation of 0.521. Snedecor's F statistic, through the variance analysis with one factor (ANOVA), with the sample data falls into the critical region (with Sig.=0.000), thus, a linear relation exists between the independent variables and the dependent variable "Capacities for Technological Innovation", rejecting the null hypothesis that the population value of R is zero ($R^2=0$). The Durbin-Watson (DW) statistic value is 1.767 (it is between 1.5 and 2.5), thus it can be assumed that the residuals are independent. The tolerance values oscillate within the interval (0.574; 0.851); far from the value of 0.01 so therefore redundant variables do not exist. The value of $1/(1-R^2)$ is 3.846, and if it is compared with the variance inflation factors (VIF), it is observed that they are lower than the calculated index, therefore, there is stability in the estimations. The presence of self-values close to zero indicates that the independent variables are closely related (all are above the value of 0.01). The conditions index is greater than 15 (IC=20.286), yet it remains between 15 and 30.

Conclusions

In the last decades of the twentieth century a radical change occurred in the companies strategies, since to be able to survive in an increasingly competitive environment, companies needed to adapt and change both the products and services they offer – innovation in product - as well as the manner in which these are produced and delivered to the market –process or technological innovation. Those organisations, which operate in turbulent environments, should put greater emphasis on the exploration or creation of knowledge through strategies and innovation in products, services, technologies, and/or production processes. These companies therefore find themselves in a position of needing to continually innovate or in other terms, to generate new knowledge, which permits them to be more competitive. The dynamics of the environment and the technological advance drive companies to intensify their research, development, and innovation activities in search of technological and competitive improvement. Additionally, a large number of norms exist which seek to order and systemise the introduction of management systems relating to functions, such as the improvement in quality, environmental impact, labour risk prevention, corporate social responsibility, R&D and innovation activities, etc. However, production specialisation is the most important technological innovation found in the companies related with defence. Collaboration

policies capacitate the companies to be more innovative, to improve their decision making processes and ultimately their results. The factors which are positively and significantly associated with the cooperation relationships in the SMEs of the defence industry are the presence of a strategic culture supported on values; and the possibility to obtain results associated to innovation processes.

References

1 Dogson, M, Technological collaboration in industry: Strategy, policy and internationalization in innovation, Routledge, London (2018).

2 Bueno, E, Antón, J.M.R., & Salmador, M.P. Knowledge creation as a dynamic capability: implications for innovation management and organizational design, *Int J Techn Manage*, **41(1-2)** (2008) 155-168.

3 Taborda, CSB & Estêvão, CMS, Innovation management in the Beira Interior SME's: the manager perspectives, *Tour & Manage Stud*, **9(2)** (2013) 124-129.

4 Saur-Amaral, I, Soares, R R & Proença, J F, Business model innovation: towards a conceptual framework, *Tour & Manag Stud*, **14(1)** (2018) 80-93, DOI: 10.18089/tms.2018.14107

5 King, N & Anderson, N, *Cómo administrar la innovación y el cambio*, Ed Thomson, Madrid (2003)

6 Biemans, W, Managing innovation within networks, Routledge, London (2018).

7 North K & Kumta G, Knowledge Management: Value creation through organizational learning, Springer, Berlin (2018).

8 Briones, A J & Laborda, F, Valoración de la cooperación interempresarial en las microempresas del municipio de Murcia, proyectos micro y e-micro (2002-2007) *Cuad de Gest* **8** (2008) 59-72.

9 Saviotti, PP & Metcalfe, JS, Evolutionary theories of economic and technological change: Present status and future prospects, Routledge, London (2018).

10 Brem, A & Viardot, E, Revolution in innovation management: internationalization and business models, Palgrave Macmillan, UK (2017).