The Impact of Innovation Management Techniques on Radical Innovation: An Empirical Study

Juan Ignacio Igartua, Nekane Errasti and Jaione Ganzarain

Abstract While research in innovation management has provided many insights into specific aspects of innovation, the encompassing problems confronting general managers, especially managers of small and medium-size firms, have been overlooked in the development of innovation management techniques and tools. This paper analyses the way innovation management techniques (IMTs) influence innovation in firms. Specifically, this paper focuses on studying the role of IMTs in radical innovation. To this end, we propose a specific model of analysis, tested in a sample of more than 500 Spanish companies. Research results highlight that different sets of IMTs relate to radical and incremental innovation in different ways, and that therefore companies seeking radical innovation look for certain IMTs rather than others. This empirical study will help managers and practitioners to understand the role of IMTs in structuring radical innovation strategy, as well as researchers to focus on the role of such IMTs in innovation.

Keywords Innovation · Radical Innovation · Innovation Management Techniques · IMTs

1 Introduction

The need to understand innovation appears to be widespread, at business level. Some researchers have developed studies regarding the measurement of innovative performance in enterprises [18], using instruments such as the Community Innovation Survey instrument (CIS) trying to discover the factors that influence that result [3]. On the other hand, other scholars have investigated the role of innovation management and the analysis of its impact on innovation and innovation performance of firms [2, 24, 26], including the emphasis on the role of systems and tools [9].

Finally another incipient research approach has been orientated to analyse the role of techniques and tools for managing innovation [14].This approach highlights innovation as a fundamental process in organization performance [12, 25], a process that requires setting up a well-organized and well-run standardized set of tools [16].

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With this in mind, the aim of this paper focuses on understanding the influence of innovation management techniques (IMTs) on innovation in firms. Specifically, this paper focuses on studying the role of IMTs in radical innovation. Thus, the main purpose of the study reported in this paper is to understand how companies' implementation of IMTs, affects innovation (product, service, process, and other kinds of innovations) and the specific role of certain IMTs when looking for radical product or service innovation [19]. The objective of this paper is to understand whether IMTs play a significant role in innovation and the achievement of radical innovations.

After a brief introduction to innovation management techniques (IMTs), we develop the methodology used in this study. Subsequently we show some empirical results of the investigation, including a conclusions section.

2 Innovation Management Techniques (IMTs)

The need to manage the innovation process and context, demands that managers make effective and timely decisions based on multiple functions, inputs and disciplines [6]; and therefore, management tools and techniques are needed to support these complex decisions [22]. Brady et al. [5] define a management tool as "a document, framework, procedure, system or method that enables a company to achieve or clarify an objective" (p. 418).

Innovation management techniques (IMTs) can be defined as the range of tools, techniques and methodologies intended to support the process of innovation and help companies to meet new market challenges in a systematic way [22]. Chiesa and Masella [9], in their audit model of the process of technological innovation, identified the effective use of appropriate tools and systems as one of three facilitators of innovation processes, in conjunction with the deployment of human and financial resources and the leadership and direction of senior management.

An investigation conducted in Europe [11] affirmed that IMTs allow a company to combine technology and business strategy, fostering increased employee participation, and concluded that there is insufficient awareness of the variety and range of IMTs available, as well as the potential benefits of their use.

More recently, Hidalgo and Albors [14] argue that IMTs are critical to increasing competitiveness, showing that proper application of IMTs facilitates a company's ability to introduce appropriate new technologies in products or processes, as well as the necessary changes to the organization.

As regards the existing IMTs, several authors such as Phaal et al. [22] have worked towards the development of a catalogue of tools, as well as a series of research programs. In this direction, some works have tried to summarize the existing set of techniques [14], an approach followed by other researchers that focused on the role of certain tools [1, 10, 16,15, 17, 21, 27], or empirical studies [13, 4, 8].

Thus, the present research focuses on the role of 17 groups of IMTs identified in the literature (1. creative development, 2. technology management, 3. strategic

management, 4. people management, 5. business intelligence, 6. management innovative project, 7. development of new products-services, 8. techniques and practices for collaboration and networking, 9. design management, 10. knowledge management, 11. new business development, 12. financial resource management, 13. industrial property rights management, 14. production management, 15. marketing, 16. organizational practices, and 17. process improvement) [14, 23].

3 Research Methodology

The research was conducted through a survey targeted at business managers, similar to other research studies conducted in the field of innovation [20]. The research is based on a survey focused on innovation management where top managers, from more than five hundred companies over a defined universe of six thousand companies, were asked to answer a structured questionnaire from December 2008 till April 2009.

The instruments developed for the measurement of innovation (product-service and process) were based on variables used in the literature and on the Community Innovation Survey [7]. On the other hand, the measurement of the implementation of IMTs in companies was developed through a scale of 53 items from the identification of the aforementioned 17 IMT groups identified in the literature (Cronbach's alpha for this scale was 0.948).

The gathered data has been analysed using SPSS16 and statistical methods such as T Student Test, ANOVA and regression analysis (simple linear and multiple linear). Due to the fact that the sample meets the sampling criteria needed to ensure its representativeness, the implications of the study are directly extrapolated to the entire study population.

4 Results

In order to examine whether there are significant differences between the implementation of IMTs in companies and their innovation results, a Student's t-test comparison of two means was developed. The results of this test are summarized in Table 1.

Consequently, in all cases the t-statistic takes a critical level of bilateral significance lower than the critical value of 0.005 thereby rejecting the null hypothesis of equality of means, and therefore concluding that the use of IMTs in companies that innovate is higher compared to those companies that do not.

It was also considered that, when analyzing the use of IMTs by companies, these could be classified into four groups, depending on their product-service and process innovations results (Table 2).

Table 1 IMTs use related to Innovation (Product, service, process and other innovations)

		N	Mean	Std. D.	Std. Err. mean			*N*	Mean	Std. D.	Std. Err. mean
Prod	Yes	362	2.4700	0.67465	0.03546	Proc	Yes	378	2.4235	0.71159	0.03660
Inno	No	186	1.7004	0.63001	0.04619	Inno	No	176	1.7732	0.67540	0.05091
Serv	Yes	327	2.4267	0.68541	0.03790	Other	Yes	409	2.4319	0.69673	0.03445
Inno	No	221	1.8741	0.73550	0.04948	Inno	No	148	1.6291	0.62068	0.05102

Table 2 Companies classification based on innovation

Prod-Serv Inno	Process Inno	Group	*N*
YES	NO	1	85
YES	YES	2	332
NO	YES	3	44
NO	NO	4	93

Thus, when analyzing the use of IMTs on these four groups the statistical results based on ANOVA analysis (with a significance of 0.000 lower than the critical value of 0.005), show that for all the IMT groups (except the group of techniques related to production management: Just-in-time, ERP, Lean Management), the mean use of IMTs is higher for those companies that innovate in product-service and process altogether, than for those that only innovate in product, process or do not innovate at all (Fig. 1).

Finally, when analyzing the use of IMTs related to the innovation radicalness, two simple linear regression studies were developed, one for the radical innovation of product-services and the other for the incremental one (see Table 3). The models take a very high R (0.596) for radical innovation and an also high R (0.641) for incremental innovation; indicating that 35.5% of the variability of performance in radical innovation of product-services depends on the use of IMTs, as opposed to 41.1% in the case of incremental innovation. In addition, the F statistic shows for both regressions a value below the critical level (Sig 0.05), so it can be argued that variables are linearly related.

Besides, and in order to identify the IMT groups that are most related to the radical innovation of product-services and to the incremental one, two multiple linear regression analyses were carried out introducing variables step by step until the models were validated after five steps and six steps respectively (see Table 4 and Table 5).

So, the model of radical innovation was tested in five steps, after which the proposed model included a constant, and the variables referring the use of IMTs related to networking, economic and financial aspects, creativity techniques, techniques related to industrial property management, as well as those related to business intelligence and technological foresight.

In contrast, the model of incremental innovation was tested in six steps, after which the proposed model included a constant, and the variables referring the use

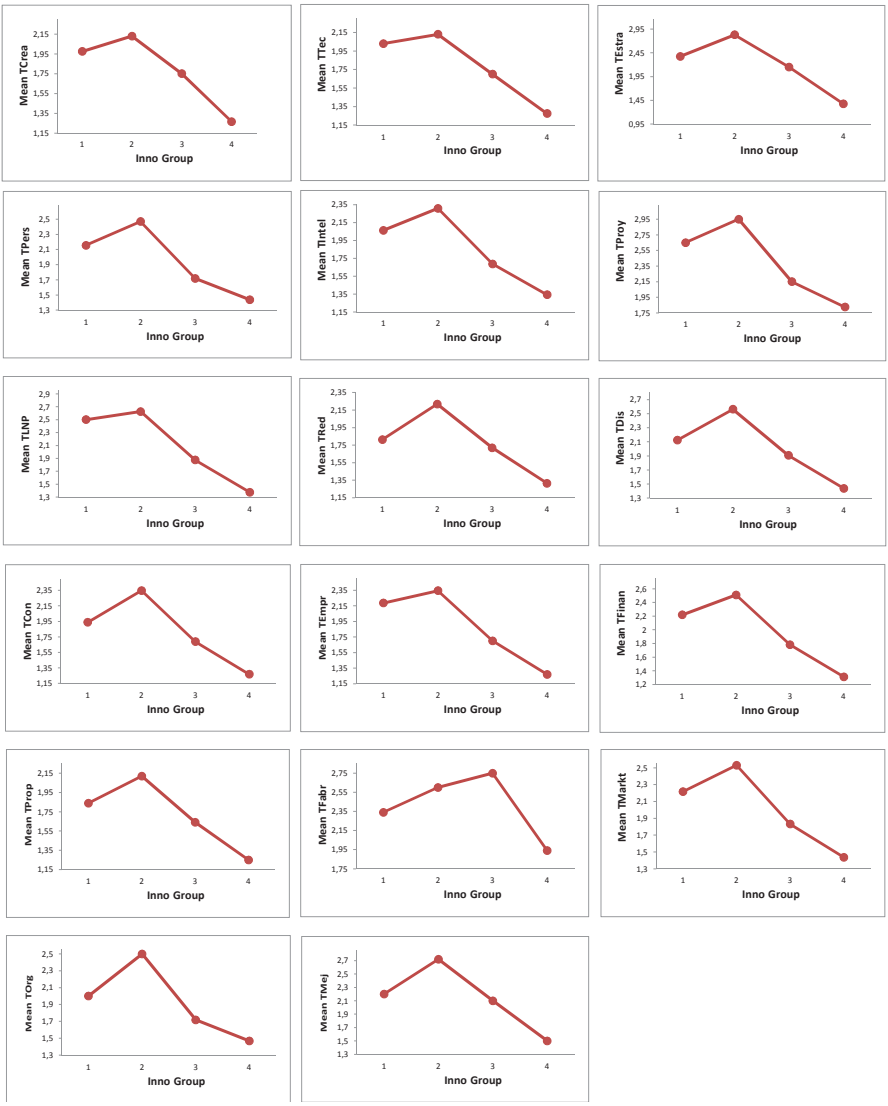

Fig. 1 Mean use of IMTs by companies' innovation activity classification

of IMTs related to new business development (business plan, transfer mechanisms, and spin-offs), new product development techniques, technology management, project management, industrial property management, and those concerning the management of networking activities.

Table 3 Companies classification based on innovation

Radical innovation					Incremental innovation				
Model	R	R^2	Adj. R^2	Std. Err. of estimate	Model	R	R^2	Adj. R^2	Std. Err of estimate
1	0.596[a]	0.355	0.354	0.77389	1	0.641[a]	0.411	0.410	0.78352

[a] Predictors: (Constant), IMTs

Table 4 Multiple linear regression (step-by-step) relating IMTs and Radical Innovation

Radical innovation: model summary[b]									
Model	R	R^2	Adj. R^2	Std.Err. of estimate	Change statistics				
					R Square change	F change	df1	df2	Sig. F. change
5	0.606[a]	0.368	0.361	0w.75135	0.008	6.581	1	508	0.011

[a] Predictors: (Constant), TRed, TFinan, TCrea, TProp, TIntel
[b] Dependent variable: InnoRadical

Table 5 Multiple linear regression (step-by-step) relating IMTs and Incremental Innovation

Incremental innovation: model summary[f]									
Model	R	R^2	Adj. R^2	Std.Err. of estimate	Change statistics				
					R Square change	F change	df1	df2	Sig. F. change
6	0.647[f]	0.418	0.411	0.77402	0.008	7.226	1	504	0.007

[f] Predictors: (Constant), TEmpr, TLNP, TTec, TProy, TProp, TRed
[g] Dependent variable: InnoIncremental

5 Discussion and Conclusions

The main purpose of the article was to identify the link between business innovation and its radicalness and innovation management techniques (IMTs) implemented by companies. The IMTs measurement was based on a set of 17 groups of techniques taken from the literature, while the innovation measurement was based on pre-existing instruments.

Thus, based on the extended set of data and using statistical methods (Student's t-test, linear regression and multiple linear regressions), the research has underlined the importance of IMTs and their differential role in the achievement of different kinds of innovations (product-service and process).

When analyzing innovation in companies, results indicate that the variability of performance in innovation depends on the implementation of IMTs, which underlines the importance of management techniques, coinciding with previous researchers [4, 8, 10, 13, 14, 16, 22, 23] .

Furthermore, the multiple linear regression analysis carried out also stress the role of certain IMTs for the development of radical versus incremental innovations. Thus, networking (open innovation and collaboration), as well as financing, creativity techniques, IPR management and business intelligence (technology watch)

seem to be techniques that are important for the development of radical innovations, while new business development techniques, new product development techniques, technology management and project management seem to influence incremental innovation of product or services.

The limitations of this paper result from the research model and the variables used. Further research and analysis would provide more detailed relationships. On the other hand, the contributions of this study must be interpreted with a degree of caution since it has focused on a regional context, which may have certain characteristics that can affect the findings.

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