



Intellectual Capital Management and the Innovation Process: Does One Size Fit All?

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Abstract. Intellectual Capital Management (ICM) research has focused predominantly on demonstrating the link between ICM and innovative performance from a general, context-free perspective. This paper analyses deeper implications of ICM showing the inadequacy of this one-size-fits-all approach, and introduces a more realistic view of the role of ICM on innovation process. We propose an analytical framework where differences in ICM strategies are explained by differences in the environment faced by firms and characterized by disparate levels of threats posed by potential imitators. Although legal protection of intellectual property rights has been traditionally the center of attention on this topic, the firm's strategy might be far more complex involving alternative ICM activities guided by the incentives of the environment. Using panel data for Spanish SMEs over the 7-year period between 2008 and 2014, we provide evidence consistent with this approach. Empirical analysis shows that certain ICM strategies are profitable in specific environments, but might be very unattractive in other contexts where other strategies prove to be more efficient. These findings contribute to the development of a more nuanced interpretation of the role played by ICM on the innovation process.

Keywords: Intellectual Capital Management · R&D · appropriability regime · Innovation process

1 Introduction

Although there is a broad consensus about the importance of Intellectual Capital Management (ICM) as a source of value creation in today's economies, recent research suggests that the literature has focused predominantly on demonstrating the link between ICM and innovative performance from a general, context-free perspective (Mouritsen 2006; Guthrie et al. 2012; Dumay and Garanina 2013). As these authors state, this perspective is rooted on the mistaken belief that ICM will yield necessarily greater profits, regardless of the context where the empirical analysis takes place.

This paper analyses deeper implications of ICM showing the inadequacy of this one-size-fits-all approach, and introduces a more realistic view of the role played by ICM on innovation processes. We propose an analytical framework where the differences in ICM strategies followed by firms in order to profit from innovative activities are explained by differences in the environments they face and characterized by disparate levels of threats posed by potential imitators. Although legal protection of intellectual property rights has been traditionally the center of attention on this topic, the firm's strategy might be far more complex involving alternative ICM activities guided by the incentives of the environment. Under this approach some profitable ICM strategies in specific environments (e.g. patenting) might be, in contrast, very unattractive in other contexts where other strategies prove to be significantly more efficient (e.g. developing productive capabilities or market linkages). It is in this sense that we offer a context-dependent analysis of ICM rather than the one-size-fits-all approach prevalent in the literature.

Schumpeter (1950) and Arrow (1962) introduced the “appropriability problem” in the theoretical discussion of innovation, explaining that certain degree of monopoly might be desirable to foster innovation. This theoretical problem has been typically used to justify the introduction of intellectual property rights to guarantee the appropriation of benefits from innovations. However, it is evident that legal protection of intellectual property rights is not a perfect strategy in certain contexts. Teece's (1986) seminal work, *Profiting from technological innovation*, showed that the appropriation strategy of innovators might be quite complex, involving managerial decisions conditioned by the environment. In particular, innovators' strategy must be shaped by what he called the “appropriability regime”. This regime refers to the environmental factors, different from firm and market structure, that govern an innovator's ability to capture the profits generated by an innovation. According to Teece (1986), the most important dimensions of such a regime, are the nature of the technology and the efficacy of legal mechanisms of protection.

In this paper we integrate Teece's approach with the ICM literature to develop a non-trivial explanation of the role of ICM strategy in firms' innovation plans. In order to analyze typical responses of firms -in terms of ICM strategies- related to specific environments, we follow the sectorial taxonomy proposed by Castellacci (2008), that introduces differences in appropriability regimes, highlighting the relevance of different forms of intellectual property protection (patents, trademarks, or copyright) within each sector. Two sectors of activity, intimately related but with significant differences in their appropriability regimes, are used in our empirical analysis: hardware and software industries. The former relies significantly more on intellectual property protection than the later. Using panel data for Spanish SMEs over the 7-year period between 2008 and 2014, we show that certain ICM strategies are profitable in specific environments, but might be unattractive in other contexts where other strategies prevail. These findings contribute to the development of a more precise description of the role of ICM on the innovation process.

This paper is organized as follows. In Sect. 2 we present a critique of the current state of ICM research is discussed. Section 3 presents the use of Teece's approach to explain the differentiated role of ICM, affecting innovation process not only through its role on the “invention plan”, but also through the strategy followed by the firm to

effectively appropriate the benefits generated by those inventions. Section 4 discusses the appropriability regime concept, emphasizing the way it might induce firms to adopt different ICM strategies. Section 5 explains research design and methods. Section 6 presents the results of the empirical analysis. Finally, Sect. 7 provides a discussion of the managerial and policy implications of the results.

2 Intellectual Capital and Innovation: Overcoming Context-Free Theorizing

The concept of intellectual capital (IC), or intangible assets, is relatively new in the economic literature. It refers to those non-physical assets with three core characteristics: they are a source of probable future economic benefits, have no physical embodiment and, to some extent, may be retained and managed by companies (OCDE 2011).

Although in the past the concept of intangible asset was primarily related to R&D and intellectual property rights (such as patents and trademarks), the extension of innovative activities to other areas beyond the purely technological ones has led to an expansion of this concept. Nowadays it is widely accepted that IC consists of three interrelated bodies of knowledge: capabilities and skills of the members of the team; structured/codified knowledge owned by the firm (such as production processes, internal procedures, results of R&D activities, or intellectual property protection); and the set of relations established with other agents or organizations outside the firm. These three bodies of knowledge are usually called human capital, structural (or organizational) capital and relational capital, respectively (Cañibano et al. 2002).

The specialized literature has highlighted the effect of IC on the innovation process. Some authors have emphasized that organizations that develop and exploit effectively their IC have a competitive advantage (Steward 1997). Becerra et al. (2008) state that an effective ICM can avoid unauthorized knowledge transfers, which is one of the major risks faced by innovative firms. Along the same lines, other recent studies have found a positive relationship between IC management and innovation (Henry 2013; Kremp and Mairesse 2004; Mangiarotti 2012). Marvel and Lumpkin (2007) studied the role of experience, education and prior knowledge on innovation outcomes, and De Winne and Sels (2010) show that human capital (of managers and employees) and human resource management are important determinants of innovation in start-ups. There is a vast literature on the effect of R&D activities and patents on innovation performance, but we can also find studies on the effect of other kind of structured knowledge owned by the firm. As Huchzermeier and Loch (2001) pointed out, there are different sources of uncertainty in R&D activities (market payoffs, project budgets, product performance, market requirements, and project schedules), and management team's ability to adapt processes and procedures is key to improve risk management in R&D projects. Finally, there are several studies analyzing the relative impact of R&D collaborations and participation in networks on innovation performance (Ahuja 2000; Reagans and Zuckerman 2001; Belderbos et al. 2004; Czarnitzki et al. 2007; Un et al. 2010).

The existing literature on intangibles has been primarily devoted to emphasize the impact of IC on firm performance in an ostensive/general way and also to design new methods to measure IC. These two main concerns of research practices corresponds to

what Guthrie et al. (2012) denominate, respectively, the first and second stage of research on IC, focused on “revealing” the importance of intellectual capital to create competitive advantages, and on the design of indicators to measure and report IC within the firm. In both stages, the empirical evidence is insufficient or inconclusive, although there is a broad consensus on the importance of intangible assets as a source of value creation (Dumay and Garanina 2013). As discussed in Dumay (2012), IC research has not reached the point where it can be stated that managing IC leads to greater profitability because of the inability to make causal links between IC and value creation.

This paper is ascribed to what Guthrie et al. (2012) calls the “third stage” of IC research. This new stage, just in its infancy, attempts to provide deeper managerial implications, avoiding the general and somehow tautological perspective that simply postulates that ICM boosts innovative performance across the board. We sustain that ICM is part of the business strategy to profit from innovative activities and this strategy is clearly conditioned by the firm’s context. Our analysis focuses on differentiating between IC strategies of innovative firms in several contexts and rationalizing them as differences in business strategies to appropriate the benefits of their innovation activity. In this sense, our contribution to the literature is to unpack previous discussion on links between ICM and innovation, analyzing the role of ICM in a context-dependent strategy. This enables us to transcend the simple argument that “the more knowledge the better” and introduce the analysis of ICM into high-level debates about profitability of specific IC strategies, organization and market structure, and public policy.

3 Intellectual Capital, What for?

As stated before, much of the specialized literature has focused on demonstrating the link between ICM and innovative performance in a very general, context-free perspective. In fact, context-free theorizing has been very popular in management and accounting research (Llewelyn 2003). However, little attention has been paid to the specific role played by each element of ICM in the strategy of the innovative firm.

We follow the approach of Teece (1986), assuming that innovative firms are solving a problem: How to profit from their innovations? The contribution of Teece (1986) has to do with the different strategies that a firm can choose to guarantee the appropriation of the rents generated by innovations, conditioned by the characteristics of the knowledge embedded in the potential innovation (tacitness, complexity, observability), the legal instruments to protect innovations (patents, copyrights, designs, etc.), and the complementary activities or capabilities available to the innovator (such as marketing, competitive manufacturing, after-sales support, etc.). We argue that in order to understand the role of ICM in innovative activities, we need to be able to see how it fits in this different «appropriation strategies».

Elaborating on the argument of Teece (1986), there are at least two types of activities needed to profit from innovations:

- Inventive activities, to produce (or acquire) the “core knowledge” embedded in a potential innovation
- Appropriation activities, to profit from the creation of this core knowledge

It is obvious that not all firms engage in inventive activities (e.g. not all firms try to develop new products). And we've learnt from Teece that a successful innovation cannot be assured if the firms focus solely on inventive activities, given the need for managing and developing complementary assets in order to profit from innovation activities.

We propose to classify the role of the different ICM activities regarding their relation with these two types of activities. While certain ICM activities will be directly related with the innovation process, through their role in shaping and executing activities specifically aimed to the development of the core knowledge embedded in potential innovations (as context-free theorizing research has tried to prove), other activities might have a more complex, context-dependent relation with innovation process, e.g. providing services that might improve the ability of the innovative firm to appropriate the profits from its innovations in different specific contexts.

There are very good reasons to expect that ICM might be context-dependent, since the threats and opportunities for innovative firms might not be the same everywhere and the strategy of the firm must discriminate among ICM activities. Take, for instance, the case of tacit knowledge flowing with the mobility of workers. In this case the management of human capital in the company might be essential to guarantee the appropriation of profits from R&D (Hurmelinna-Kaukkanen and Puumalainen 2007; Hurmelinna-Laukkanen et al. 2007; Casper and Whitley 2004). Relational capital might also affect the ability of firms to appropriate the rents of innovation. As Henttonen et al. (2016) observe, collaboration with other partners for R&D activities might generate risks of spreading knowledge and misappropriation of the generated value. This risk can be managed by the firm using different strategies, alongside the mechanisms of protection of intellectual property: lead-time innovation, continuous incremental innovations, cost reduction of innovations, etc. (Pérez-Cano 2013).

We consider that ICM activities must coordinate the firm strategy to profit from the creation of new knowledge, depending on the context of the firm. For example, in an "ideal" (but not necessarily desirable) context where legal framework offers perfect intellectual property protection, inventive activities might be sufficient for the innovative firm, since the new knowledge can be sold or licensed. In this sense, this innovative firm might not need to develop manufacturing capabilities, market linkages, or other type of complementary assets to profit from innovations. As we move away from this ideal case, the threat posed by imitators forces the innovative firm to develop more complex strategies. We assume that ICM strategy is a mixed combination of the following activities:

- Management of the development of the «core knowledge» embedded in a potential new product invention
- Intellectual property protection
- Management of production processes and organizational procedures
- Management of commercialization

While the first one is clearly an Inventive activity, the three remaining activities are what we denominate Appropriation activities. The attractiveness of each possible combination of these four activities will depend on the context faced by the firm, and on the nature of the innovation.

4 ICM and Appropriability Regimes

It was Schumpeter (1950) and Arrow (1962) who introduced the “appropriability problem” in the theoretical discussion of innovation, linking the profitability of innovation with the market structure, in the sense that certain degree of monopoly might be desirable to foster innovation. This theoretical problem was conceptually tackled with the introduction of an ideal patent guaranteeing the appropriation of the benefits generated by innovations. However, as it is well known, legal protection of intellectual property fails to be efficient in certain contexts. As Teece (1986) argues, the appropriation strategy of innovators is far more complex, involving important managerial decisions conditioned by the environment.

The strategy to successfully commercialize an innovation will be strongly conditioned by the environment of the firm. Teece (1986) illustrated how the concept of “appropriability regimes” is useful to understand the different types of environments or contexts faced by innovative firms.

The appropriability regime is a theoretical construction assessing the threats for innovative firms posed by potential imitators. This regime can move within a range that goes from “tight” to “weak”, where the former indicates a regime where imitation is difficult (because of the legal framework or the complexity of the knowledge involved in the innovation), while the latter is a situation where it is easy for competitors to copy innovations.

Castellacci (2008) proposed a sectorial taxonomy that highlights the relevance of different forms of intellectual property protection (patents, trademarks, or copyright) within each sector. For example, sectors like Electronics or Machinery rely substantially more on patents than sectors like Software or Engineering. These differences induce different needs from the perspective of ICM: where intellectual property protection is not a profitable strategy (as might be the case of these latter sectors of activity) other types of ICM must emerge to accomplish the goals of innovative firms. In Fig. 1, we draw this possibility of differentiated profitability of ICM strategies as a function of the appropriability regime.

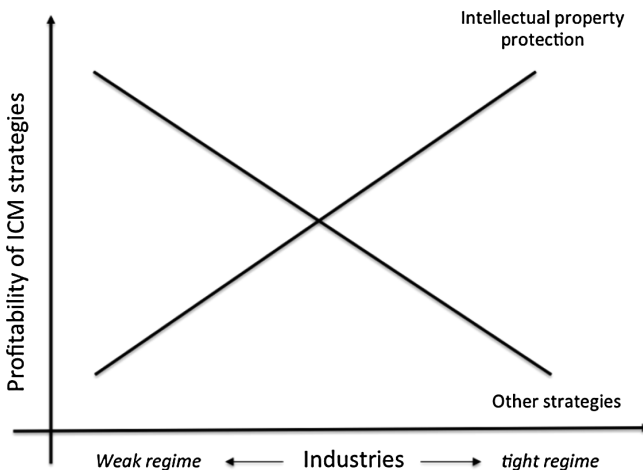


Fig. 1. Differentiated profitability of ICM strategies. Source: Own elaboration

5 Questions and Research Design

In this paper we posit that ICM activities cannot be studied through context-free theorizing, since this type of activities have an organic relation with the specific context faced by the firm. In this sense, and contrary to the tradition of literature relating ICM and innovation, we propose that not all ICM activities are necessarily desirable in all contexts. To challenge this view we ask: does the appropriability regime faced by the firm influence the impact of ICM on innovation activities? And, if this is the case, is it possible to find clear patterns for ICM responses from companies, which can be explained by differences in appropriability regimes?

We propose a semi-log model, where the dependent variable, called RDown, is the natural logarithm of R&D expenditure financed with the own funds of the firm (i.e., excluding funds from other private or public organizations). This variable will be explained by other variables divided in two groups: inventive activities and appropriation activities. The explanation provided by appropriation activities (divided in three subgroups: productive capabilities, commercialization and intellectual property) shows the non-trivial relation of the activities to appropriate profits with R&D effort. All variables are presented in Table 1. Table 2 shows the averages of the variables used in each industry analyzed.

Table 1. Variables of the model. Source: Own elaboration

Variable	Type	Description
Rdown	Dependent variable	In-house R&D expenditure financed with own funds (natural logarithm)
ln_size	Control variable	Num. Of employees (natural logarithm)
innprod	Innovation activities	Product innovation in the period from (t - 2) to t
innproc	Innovation activities	Process innovation in the period from (t - 2) to t
pat	Intellectual property protection	Patent applications
usoautor	Intellectual property protection	Use of copyrights
ln_prod	Productive capabilities	Labour productivity (natural logarithm)
market	Commercialization activities	Activities of market introduction of innovations
inn_comer	Commercialization activities	Marketing innovations
coopcli	Commercialization activities	Cooperation for innovation with costumers

The strategy of this paper to answer our research questions is to test the relation of appropriation activities with R&D profitability under different appropriability regimes,

following the sectorial taxonomy proposed in Castellacci (2008). In order to simplify the exposition of the results, we shall focus on two sectors of activity: Software and Hardware. The first is classified, as having a weak appropriability regime where patent protection is not a typical strategy, as opposed to the second where patenting appears to be a profitable strategy. In this sense, our study might be seen as a case study, where empirical evidence is intended to show the plausibility of the relation between the environment of the firm and the IC strategy. The justification for the choice of these two sectors is that they appear to be based on very different strategies regarding intellectual property protection; therefore we expect to find not only confirmation in these two sectors (i.e., showing that patenting is a more profitable strategy in Hardware than in Software industry), but also to prove that this difference induces another strategy in Software.

To test these relations, we use of the Spanish Panel of Technological Innovation (PITEC) –a CIS-type survey–, selecting a sample of Spanish SMEs over the 7-year period between 2008 and 2014. Given the fact that the aim of the study is to analyze the role of certain inputs in the profitability of R&D devoted to the generation of new products, the sample only includes firms declaring innovative activities in at least three years during the period considered. In order to solve potential endogeneity problems with the variables included in the model. Given the nature of our dependent variable, the models are estimated using Tobit model for panel data.

6 Results

Table 2 presents the main results of the estimated model for each sector. We have to underline that this table is interesting not only because it identifies the variables that best explain the behavior of the dependent variable, but also because those that are not relevant reflect differences in the use of mechanisms of appropriation of the rents of R&D activities. Using the information from Table 2, we can state that patenting is in fact a profitable strategy (more in the case of Hardware, as predicted by theory), but the successful strategy of firms from Software industry include other type of activities such as the use of copyright, productive capabilities or commercialization activities.

In terms of IC, our results reflect, first the existence of a positive relationship between many of the variables of IC and R&D, because of the positive effect of these elements on the ability to appropriate the returns from R&D activities. Second, that companies develop different strategies to benefit from their R&D, depending on their specific circumstances. For the hardware sector, the use of instruments of protection of intellectual property such as patents, has a positive and significant impact on the performance of R&D, while in the case of software companies it is also the availability of complementary production and marketing assets that increases the capacity of appropriation.

Table 2. Results of the estimated model

Explanatory variables	Hardware		Software	
	Coef.	P > t	Coef.	P > t
ln_size	4.596	0.000	2.510	0.000
ln_size2	-0.431	0.000	-0.218	0.000
innprod	1.430	0.000	1.469	0.000
innproc	0.509	0.036	0.289	0.156
pat	1.291	0.000	1.099	0.004
usoautor	0.355	0.685	1.986	0.001
ln_prod	0.235	0.210	0.480	0.002
market	0.285	0.171	0.595	0.003
inn_comer	0.424	0.059	1.184	0.000
coopcli	0.298	0.307	1.052	0.000
<i>Year</i>				
2009	-0.490	0.106	-0.349	0.218
2010	-0.602	0.047	-0.744	0.009
2011	-0.824	0.007	-0.539	0.057
2012	-0.814	0.010	-0.334	0.245
2013	-0.873	0.006	-0.736	0.012
2014	-1.376	0.000	-1.412	0.000
Cons.	-3.498	0.148	-3.466	0.070
<i>Num. of obs.</i>	1,428		2,869	
<i>Num. of firms</i>	263		494	
<i>R-squared</i>	0.275		0.152	

A summary of these results is presented schematically in Fig. 2, replicating the idea expressed in Fig. 1.

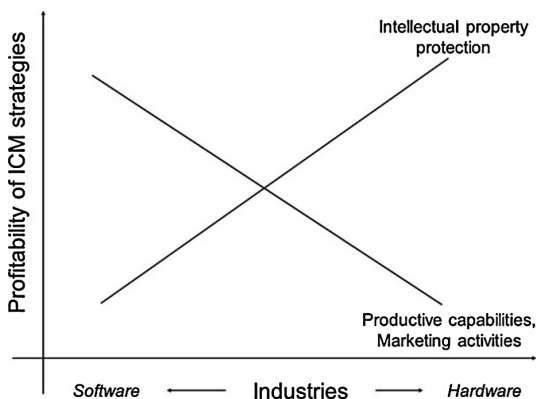


Fig. 2. Profitability of ICM strategies. Source: Own elaboration

7 Conclusions

The aim of this research was to answer the following two questions: Does the appropriability regime faced by the firm influence the impact of ICM on innovation activities? And, if this is the case, is it possible to find clear patterns for ICM responses from companies that can be explained by differences in appropriability regimes? Regarding the first question, evidence is consistent with the fact that there is a differentiated impact of ICM activities across sectors. In the Hardware sector, where patenting is profitable, in terms of R&D the size and marketing activities are not as relevant as in the case of the Software industry.

Indeed, the analysis has shown that, as noted in the taxonomy proposed by Castellacci (2008), appropriability is an element of sectorial differentiation in the sense that different economic activities involve different strategies on legal protection of IC. Since the elements of IC include instruments such as patents, licenses, etc. it can be argued that the capital structure between different sectors is due to the way companies try to appropriate the rents of innovation.

Regarding the second question, our empirical results might be rationalized through the existence of an appropriation strategy whereby firms try to profit from their R&D activities making use of a more diverse ICM beyond the intellectual property protection, either developing bigger productive capabilities or stronger connections with the market.

Our analysis also reveals that companies follow different strategies to pursue the benefits from innovation, even though there are sectors that have a greater supply of complementary assets. We have shown that the hardware sector, for which the appropriability regime is stronger, has higher levels of complementary assets both in terms of production and marketing, but the strategic importance of IC management with respect to the software sector is significantly lower.

This paper has contributed to improving our understanding of the role of IC, and its different elements, on innovative activity. The results confirm that IC management generates positive results through its positive effect on appropriation capabilities. Moreover, this work has contributed towards the development of the “third phase” of IC literature (Guthrie et al. 2012), which seeks to explain the causal relationship between IC and strategic management.

From a public policy perspective, contemporary thinking on innovation policy tends to focus on the generic promotion of the creation of the core knowledge embedded in potential new products, and on the strengthening of intellectual property protection. But patents (and other legal instruments), while offering considerable protection to some products, do not guarantee complete appropriability of some innovations especially in certain sectors. And, as Teece (1986) showed, profiting from innovations may depend not only on the legal protection offered by intellectual property rights, but also on the availability of other complementary assets and capabilities. In this sense, innovation policy becomes more closely aligned with the strategic analysis of markets and industries, considering alternative choices for public policy.

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