The Role of Environmental Activity Integration into R&D Department to Obtain Competitive Advantage

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Abstract: The objective of this work is to examine to what degree the integration between the R&D and environmental departments facilitates the achievement of an environmental practice-derived competitive advantage. To do so, we surveyed 110 ISO 14001 certified factories. The results reveal, first of all, that the integration of the environmental action into the R&D department enhances the company's reputation through the product quality and image. Likewise, its relationships with internal and external stakeholders are improved, as is the company's innovative capability on the whole and, hence, its ability to penetrate international markets.

Keywords: Environmental R&D, Competitive advantage, Innovative capability, Business reputation, 'Green' product

1 Introduction

Recently, some empirical studies have identified regulatory pressures as the leading external driver in the adoption and innovation of cleaner technologies and environmental management systems (Green et al., 1994; Florida, 1996; Garrod and Chadwick, 1996; Howes et al., 1997; Sharfman et al., 2000). Nonetheless, companies also have other types of incentives to develop environmental technologies (Nameroff et al., 2004). New technological breakthroughs, corporate culture, managerial capabilities, and social pressure can also prompt companies to develop environmental innovations (Birdsall and Wheeler, 1992; Ashford, 1993; Fenn, 1995; Hart, 1995; Lave and Matthews, 1996; Tushman et al., 1997; Vickers and Cordey-Hayes, 1999; Christmann, 2000).

Traditionally, businessmen and management have taken for granted that, natural environment protection aside, any environmental practice inevitably entails a loss of competitiveness as cast in stone (Walley and Whitehead, 1994). Nevertheless, many research studies have revealed and even empirically proven that environmental actions can also be a source of competitive advantage (Maxwell et al. 1997; Christmann, 2000). It must be said at the outset that Shrivastava's contribution (1995b). Some studies have even demonstrated different mechanisms that make it possible to achieve competitive advantage from differentiated environmental approaches (Brío et al., 2005).

Companies tend to develop environmental actions beyond regulatory compliance when they perceive that they can strengthen their competitive advantages (Hart, 1995; Russo and Fouts, 1997). It is possible to distinguish between two pathways by which environmental action can serve as a source of competitive advantage. Some niches bring together consumers who attach special value to products' environmental dimension (Brockhoff et al., 1999; Roy, 1999). Thus, differentiation in the marketplace may emerge by marketing environmentally friendly products or by bolstering the company's 'green image' (Shrivastava, 1995a; Stead and Stead, 1996; Gage, 2000; Thomassin and Cloutier, 2001). Other works have referred specifically to the fact that innovative activity in the field of the natural environment probably creates and reinforces companies' unique capabilities (Hart, 1995, 1997; Christmann, 2000). Therefore, environmental action can influence non-environmental factors (Knight, 1995; Fiksel, 1996; Sharma and Vredenburg, 1998; Ellington et al., 2000). Environmental actions may be capable of bolstering companies' reputation (Azzone and Noci, 1998). Improving product quality, an 'accidental' consequence of implementing environmental practices, tends to strengthen their image, as well as relationships with different internal and external stakeholders, including the company's employees (Brennan et al., 1994). Environmental action

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may also generate knowledge that contributes to the company's overall innovative capability (Azzone and Noci, 1998). Likewise, the environmental practice itself may entail improving efficiency (Porter and van der Linde, 1995; Angell and Klassen, 1999). Thus, those firms that are able to create capabilities by means of their environmental practices will be willing to invest in protecting the natural environment in a different way (Curkovic et al., 2000). On the basis of these lines of thought, the literature has pointed out the need to conduct studies aimed at fostering learning processes in order to face environmental problems (Aggeri, 1999).

The influence of environmental activity on different dimensions of competitiveness has to do with the fact that the companies' environmental activity is interdisciplinary in nature (Checkland, 1981; Vickers, 1983). Hence, the capabilities it generates are socially complex, making them difficult to replicate (Corbett and Wassenhove, 1993). On a different level, Banerjee (2001) highlighted the relevance of integrating all functional strategies, including R&D, in order to boost environmental action-based competitive advantage (Winn and Roome, 1993). Consequently, the influence the R&D department has on a company's environmental activity must not be ignored (Nordhaus, 1969; Stoneman, 1979; Scherer, 1982; Gort and Wall, 1986; Kemp and Soete, 1992). However, the few studies performed thus far are largely theoretical (Kemp and Soete, 1992; Winn and Roome, 1993; Roome, 1994; Chatterji, 1995). Very little work has been conducted as yet on the debate surrounding the effects of the R&D department's response to the environmental challenge (Winn and Roome, 1993). There is one empirical study (Nameroff et al., 2004). Nonetheless, other works have suggested that achieving environmental excellence necessarily demands that R&D personnel, designers, and environmental technicians collaborate in investigating the environmental and health impacts of the products prior to entering into their design stage (Noori and Chen, 2003). They have suggested expanding its scope to include safety in implementing environmentally safe supply chains and production processes (Narasimhan and Carter, 1998). With such contradictions among the works, none of these results can be considered conclusive.

2 Theoretical Framework and Hypotheses

An environmental research stream begins with the supposition that the same practices that internalize negative environmental effects can simultaneously benefit the company as a whole, making it possible to achieve a competitive advantage that is not environmentally-derived. This research stream is reflected in works by Hart (1995), Porter and van der Linde (1995a), Russo and Fouts (1997), Sharma and Vredenburg (1998), and Christmann (2000), to name but a few of the most relevant. It is based on the prevailing point of view amongst those researchers who base their arguments on the resource-based view (Russo and Fouts, 1997). They follow Hart's line of thought (1995) that can be summed up as the idea of considering social demands as part of the business environment.

Some studies have shown that, when the main objective of a company's environmental practices is to avoid producing any type of waste or emissions, consumers perceive those products as being of higher quality (Azzone and Noci, 1998). A second aspect of the discussion is whether the environmental action has a positive or negative influence on the remaining dimensions of quality. Research has not settled the matter as yet (Winn and Roome, 1993). Some works have shown examples where R&D was unable to add environmental improvements to the products without deteriorating, albeit minimally, product quality (Winn and Roome, 1993). Nevertheless, other studies defend the opposite point of view, by manifesting how the product's quality can be improved by applying environmental considerations to its design, as suggested by Brennan et al. (1994) in order to obtain synergies (Klassen and McLaghlin, 1993). Hence, its expansion has been set down in Total Quality Environmental Management (TQEM) based on Total Quality Management (TQM) (Corbett and Cuttler, 2000). However, they can provoke a decrease in quality in the short run (Klassen and Whybark, 1999). Likewise, product design that takes environmental issues into account is linked to the development of process innovations, which supports relations with employees (due to perceived safety) (Florida, 1996). In turn, all of this has a positive impact on companies' reputation (Gilley et al., 2000), by improving their rela-

tions with different groups of external stakeholders (Marsden and Andriof, 1997). The literature has suggested that investment in environmental R&D produces a stock of technological knowledge and organizational capabilities that surpasses environmental point of view (Kemp and Soete, 1992). A common consequence is that the technological frontier of production possibilities shifts to the right, improving environmental performance and product quality at the same time (Kitazawa and Sarkis, 2000; Klassen, 2000).

When companies turn to formulae to obtain environmental technologies other than those that are internally generated in the R&D department, they generally create environmental technological alliances (Chesnais, 1988; Hagedoorn, 1993; Cantwell, 1998; Coombs and Metcalfe, 1998; Dyer and Sing, 1998; Inkpen, 1998). This is not a widespread phenomenon, although it is substantially original (Hartman and Stafford, 1997). The most striking characteristic of this type of alliance is that it is usually made up of a company and an environmental organization or similar group. Hartman and Stafford (1997) distinguish between several kinds of environmental alliances. As a result, by participating in environmental emergency programs, the workers simultaneously assume that the company is concerned about their job satisfaction and about their thoughts on the job environment (Florida, 1996; Forman and Jorgensen, 2001). Intrinsic product quality can even be improved, as in the case of the alliance between Bristol-Myers Squibb and Conservation International (Hartman and Stafford, 1997).

The cooperation of all these different parties from the initial stages of development (concurrent engineering) can improve process quality while at the same time enhancing environmental performance (Dyckhoff, 2000). In turn, by making processes safer, process quality improvement can go hand-in-hand with improving relationships with employees (Florida, 1996). The following hypothesis is derived from the afore-stated:

Hypothesis 1. The greater the natural environment protection integration into the R&D department, the greater the company's capability to enhance its reputation.

Studies of patents in environmental technology suggest that environmental pressure might stimulate innovation in products and processes (Porter and van der Linde, 1995a, 1995b). On the other hand, anything that strengthens the company's innovative capability favors the opening up of the company's international markets (Azzone and Noci, 1998). Nevertheless, some environmental economists are skeptical of this approach, suggesting that the development of environmental innovations has a negative effect on the companies' innovative capability in areas other than natural environment protection (Walley and Whitehead, 1994; Palmer et al., 1995; Simpson and Bradford, 1996). Certain organizational characteristics may foster environmental action-based knowledge, giving rise to increasing companies' innovative capability (Hart, 1995). Although there are no empirical studies in this regard, it seems reasonable to assume that investment in environmental R&D can lead to the development of unique organizational capabilities, which would hinder inimitability (Grant, 1991) and, consequently, enable companies to appropriate benefits from the innovation (Porter and van der Linde, 1995a). Likewise, by integrating environmental activities into the R&D department, companies can improve their overall innovative capabilities, especially 'first mover' advantages (Nehrt, 1996).

By collaborating with environmental activity, R&D personnel generate knowledge, which is partially tacit. This tacit knowledge may even go beyond the purpose for which it was generated (Garud, 1997). Recently, the aim of most of the alliances has been explained as a mechanism through which access to new and complementary technology can be attained, the purpose of which is to enrich the company's innovative and learning process (Chesnais, 1988; Hagedoorn, 1993; Cantwell, 1998; Coombs and Metcalfe, 1998; Dyer and Sing, 1998; Inkpen, 1998). The formation of technological alliances is particularly relevant when we refer to the natural environment, given the markedly interdisciplinary nature of environmental activity (O'Riordan, 1971). This notion is based on the argument that cooperation implies creating an entity that will provide technology, technological advice, and training, as well as researchers (Ouchi, 1984).

Sroufe et al. (2000) demonstrated that concurrent engineering makes environmental product innovation more efficient. However, concurrent engineering goes much further. The classical literature has dem-

onstrated its role in achieving successful innovations (Blackburn, 1991; Stalk and Hout, 1990; Clark and Fujimoto, 1991; Nayak, 1990; Youssef, 1994; Toni and Meneghetti, 2000). Concurrent engineering leads to overlapping problem-solving cycles that shorten times by performing different tasks simultaneously (Koufteros et al., 2002). The following hypothesis is therefore derived from the aforementioned:

Hypothesis 2. The greater the integration of the natural environmental protection into the R&D department, the greater the company's innovative capability and, hence, its level of penetration in international markets.

3 Research Methodology

In the design phase of the questionnaire we include a series of different actions that support the validity of the instrument and the items included in it. Firstly, we undertook a comprehensive review of the literature. We likewise took advantage of the accumulated experience in a previous case analysis. A third action was based on the precision used in defining the questionnaire items, which enables us to reduce ambiguity (Warshaw, 1980; Davis et al., 1989). The population includes all factories with International Standard Organization 14001 (ISO 14001) or Eco-Management and Audit Scheme (EMAS) registration (or both) dedicated to industrial activities. The questionnaires were sent out and received between the months of June and September 2003. One hundred and ten valid questionnaires were received, that is a 10.75% response rate. The sample representativity and distribution of the factories by sectors and sizes can be seen in Table 1. Two logit analyses were performed following Osterman's method (1994) in order to evaluate the sample representativity more reliably than a mere description.

We are now to present next the measures used in the study. Following recommendations by Malhotra and Grover (1998) internal consistency (or reliability) of the items has initially been carried out for each case through assessment of Cronbach's Alpha. Factor analysis using items from multiple measures in the research model has been used to establish construct validity. The items have been measured by five-point scales (1 if we consider that the factory has deterioriating regarding its competitors after implementing

Table 1 Comparison of Sample Distribution and Population by Size and by Sectors

Size				
	Population		Sample	
Workers	Number	Percentage	Number	Percentage
0-249	687	67.16	72	65.45
250-499	141	13.78	15	13.64
500-999	98	9.58	14	12.73
More than 1,000	97	9.48	9	8.18
Industrial Sector				
	Population		Sample	
Sector	Number	Percentage	Number	Percentage
Food	104	10.17	11	10
Chemical	233	22.78	34	30.91
Energy	42	4.11	6	5.45
Construction	147	14.37	13	11.82
Automotion	103	10.07	9	8.18
Electronics	114	11.14	10	9.09
Materials	162	15.83	15	13.64
Machinery	118	11.53	12	10.91

the environmental actions for the considered item and 5 if the factory has improved a lot). To measure the reputation, we support our arguments on papers by Kim y Arnold (1996), Sharma and Vredenburg (1998), Montabon et al. (2000), Hanna et al. (2000) and Baldwin and Lin (2002). The construct is composed of the items in Table 2. We support the construct for innovative capability on the papers by Kim and Arnold (1996), Sharma and Vredenburg (1998), Das et al. (2000), Montabon et al. (2000) and Adam et al. (2001). Table 3 also shows the items the construct is composed of, as well as its validity and reliability. The measurement of the integration between environment and R&D departments is supported our arguments on the paper by Brockhoff et al. (1999). Table 4 shows the items the construct is componed of, as well as its reliability and validity.

Table 2 Factor Loadings of Reputation

Items	Reputat
Product quality	0.706
Market share	0.669
Employee morale	0.700
Working conditions	0.786
Workers' skills	0.739
Consumer satisfaction	0.797
Product image	0.838
Corporate image	0.830
Relations with ecologists and environmental regulators	0.744
Cronbach's Alpha	0.907
Eigenvalue	5.180
Percentage of variance explained	57.55

Table 3 Factor Loadings of Innovative Capability

Items	Innovation
Process innovations	0.886
Product innovations	0.889
Penetration in international markets	0.823
Cronbach's Alpha	0.841
Eigenvalue	2.252
Percentage of variance explained	75.08

Table 4 Factor Loadings of the Cooperation

Items	Cooperat
The environmental approach in my factory significantly influence the R&D area	0.830
R&D personnel in my factory is a key element in its environmental activity	0.820
My factory develops a great deal of environmental technologies internally	0.795
My factory carries out environmental cooperation with research centres and other external organizations	0.679
Environmental innovations are carried out concurrently by employees from different departments in my factory	0.744
Cronbach's Alpha	0.834
Eigenvalue	3.007
Percentage of variance explained	60.13

Table 5 Results of Regression Analysis

	Model 1	Model 2	Model 3
Constant	8.007x10-19 (.....) 0.000 1.000	-1.573x10-16 (.....) 0.000 1.000	1.791x10-17 (.....) 0.000 1.000
COOPERAT	0.606 (0.606) 7.915 (0.000)	0.195 (0.195) 2.071 (0.041)	0.293 (0.293) 3.184 (0.002)
R2	0.367	0.038	0.086
Adjusted R2	0.361	0.029	0.077
F	62.649	4.291	10.138
Sig. F	0.000	0.041	0.002
N	110	110	110

4 Results

We show the results obtained from this empirical study. Table 5 shows its main results. Regression models are tested in accordance with the previously deduced hypotheses. We show two models. The first model shows the integration influence on the company reputation. The model 2 shows the integration influence on the innovative capability in the whole factory. The integration between environment and R&D departments and its influence on the factory's reputation were found to be statistically significant at $p<0.05$. The integration between environment and R&D departments and its influence on the achievement of an environmental action-based competitive advantage in a factory were found to be statistically significant at $p<0.001$. Hypothesis 1 is therefore validated. The integration between environment and R&D departments and its influence on the innovative capability were found to be statistically significant at $p<0.01$. Hypothesis 2 is therefore validated.

5 Conclusions

This work aims to determine to what degree the integration of the environmental activity into the R&D department affects the achievement of competitive advantage, not only to protect the natural environment, but also to strengthen the company's reputation, by enhancing product quality and its relations with all types of stakeholders, and even increasing the company's overall innovative capability, which would enable it to open up new markets.

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