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How Firms' Strategic Environmental Goals Influence Product Innovation

Wolfgang Gerstlberger, Alex da Mota Pedrosa and Reynir Smari Atlason

Introduction

On a global scale, sustainable manufacturing has attracted increasing attention, both among managers and policymakers (Jovane et al. 2008; Eccles

W. Gerstlberger (✉)

Department of Marketing and Management,
University of Southern Denmark, Odense, Denmark
e-mail: woge@sam.sdu.dk

A. da Mota Pedrosa

Duale Hochschule Schleswig-Holstein, Kiel, Germany
e-mail: alex.damotapedrosa@dhsh.de

R. S. Atlason

University of Southern Denmark, SDU Life Cycle Engineering,
Odense, Denmark
e-mail: resa@iti.sdu.dk

R. S. Atlason

Circular Solutions ehf., Ljósakur 6, Gardabaer, Iceland

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and Serafeim 2013). This is reflected in the UN Sustainable Development Goals, which, for example, indicate the need to focus on 'responsible consumption and production'. Despite this increasing political interest, there is a lack of knowledge regarding adequate strategies for how firms can implement sustainable innovation in a broader sense (Bocquet et al. 2017). Therefore, the question arises if improvements or internal strategies towards sustainable development affect the product innovation performance of firms.

For example, Patagonia and TOMS have strategically approached sustainability and reaped the benefits thereof (Hwang et al. 2016). Patagonia for instance has launched anti-consumerist advertisements, which have spurred product demand. Also, TOMS has focussed specifically on the social aspect of sustainability, promising that each sold item will contribute to a better life in the developing world, for example, by providing safe birth and eye treatments. As a further example, Apple has disclosed life cycle assessment studies of each of its products, which make users aware of the environmental impact (Apple 2018).

By contrast, many firms do not focus on creating environmentally friendly strategies, because in most cases their environmental protection activities are being compelled in response to external pressure and regulations imposed by institutions like the EU (Ambec et al. 2013; European Commission 2014). Current regulations by the EU include the improvement of resource efficiency and enhancement of the production of clean and efficient energy (Diedrich et al. 2011; European Commission 2014). Further EU regulations aim to increase environmental accounting of firms with more than 500 employees, which now need to report non-financial information (European Commission 2016).

Beyond complying with such external regulations, the development of an internal strategic approach to sustainability can be costly for firms (Walley and Whitehead 1994). The main argument supporting this assumption is that environmental improvements 'almost always require firms to allocate some input (labour, capital) to pollution reduction, which is unproductive from a business perspective' (Ambec and Barla 2006: 43). Due to this assumption, post-war corporate culture saw environmental strategies as a burden which would eventually hurt the financial performance of firms (Orr 1992; Eccles et al. 2014).

However, adopting a strategic innovation approach can also be an opportunity, as it may benefit firms and their products in the long run

(Roncha and Radcliffe-Thomas 2016). Therefore, and in general, in recent years policymakers have aimed to foster the environmental aspects of innovation within the private business sector and particularly the manufacturing industry (e.g. European Commission 2014). In this context, existing research has already identified policy-related factors that drive successful product innovation by firms focussing on the environmental aspect (Bossle et al. 2016; De Medeiros et al. 2014; Dangelico 2016). However, an important research gap exists concerning the question of how internal strategic environmental goals affect firms' product innovation. To investigate this research gap in this chapter, we define firms' internal 'strategic environmental goals' as corporate mid- and long-term aims that ensure that negative impacts and risks for the natural environment as well as product users and employees are reduced or avoided.

In the current economy, focussing on strategic environmental goal development might be beneficial, as any activity related to product innovation is of great interest to many firms (European Commission 2018). New research findings in this so far neglected field can help firms understand the potential benefits of strategic environmental goals for their product innovation activities. Because of the insight managers and researchers can gain from such new research findings, the objective of this chapter is to investigate and discuss the relationship between strategic environmental goals and product innovation in manufacturing firms. Manufacturing firms are of particular interest in this study, because they are the main exploiters of natural resources while manufacturing products for other businesses or consumers (Hart 1995).

Literature Review

The vast amount of studies on product innovation success factors (e.g. Cooper and Kleinschmidt 1995; Calantone et al. 1995; Kline and Rosenberg 2009; Tidd and Bessant 2013; Smith 2015) generally do not consider firms' internal strategic environmental goals as factors influencing the development of product innovation. However, over the last decade, a few studies have started to investigate whether or not focussing on environmental goals is beneficial to firms' product innovation activities in a wider sense (Ambec and Lanoie 2008; Lampikoski 2012; Ghisetti and Rennings 2014).

These recent studies have demonstrated that firms mainly have been forced by external regulation to implement environmental aspects, for example, technical solutions for reducing the energy consumption of buildings (Ornetzeder and Rohrer 2006). In addition, Lanoie et al. (2011) and Ambec et al. (2013) have attempted to empirically examine Porter's hypothesis that firms take into consideration external regulations in their product innovation and/or further activities, which influences their manufacturing processes.

The above-mentioned studies on environmental innovation have failed to investigate how firms' internal environmental goals influence their development of product innovation in general, which is not environmental innovation by definition (Ambec et al. 2013; Kemp and Pearson 2007; Arundel and Kemp 2009). This neglected aspect is of great relevance to managers and researchers, because it is plausible that managers in manufacturing firms would pay more attention to environmental goals if they knew that these goals would benefit their overall product innovation activities (Ambec and Lanoie 2008).

Another main argument in the reviewed literature is that there is no contradiction between internal environmental goals of firms and improved product innovation activities (Gerstlberger et al. 2016; Horbach et al. 2012). This argument is basically in line with the assumption of Porter and van der Linde (1995), who state that environmental regulation does foster innovation and thus enhances firms' competitive advantage. Multiple studies on Porter's hypothesis reveal, for example, a reduction in energy and material consumption during production and/or product use, which also seems relevant with regard to product innovation (e.g. Ambec et al. 2013; Gerstlberger et al. 2014). In addition, a more recent contribution by Porter and Kramer (2011), 'creating shared value', links societal needs (including environmental aspects) to firms' innovation management in general. However, the opposite argument can also be found in the more theoretical economic literature, namely that environmental goals may rather constrain than foster firms' product innovation due to the increased complexity of innovation-related decisions and activities (e.g. Walley and Whitehead 1994; Karvonen 2001).

Hypothesis Development

We take as our starting point for the development of hypotheses the established literature on success factors within new product development (Cooper and Kleinschmidt 1995; Cooper et al. 1999, 2002; Ritter and Gemünden 2004). This literature has identified strategic goal setting and portfolio management as important success factors of new product development projects besides input factors like internal and external R&D and upfront (e.g. marketing research) activities. Finally, our hypothesis on internal strategic environmental goals is informed by more recent literature on the internal drivers of firms' environmental product development or product innovation ('eco-innovation') (Dangelico 2016; Gerstlberger et al. 2014).

Recent eco-innovation literature's theoretical argument for considering internal strategic environmental goals potential drivers of product innovation refers to possible approaches to how to integrate additional product- and production-related environmental information into firms' innovation management processes (Dangelico 2016; Dangelico and Pujari 2010). Including such additional environmental information, for example, data referring to energy and/or material consumption during the production and/or use of newly developed products, can support not only eco-innovation, but also product innovation in general.

The reason for such a general, positive effect of additional environmental information on product innovation is the potential financial effects regarding new product characteristics like production cost and selling price (Dangelico and Pujari 2010). For example, a considerable material reduction of a newly developed product (compared to an already existing reference product) will typically also lead to a significant reduction in the production costs for this new product (Præst Knudsen and Gerstlberger 2015). Firms' internal strategic environmental goals can serve as a mechanism that 'force' the various departments responsible for a firm's production and new product development to systematically collect, document and integrate relevant environmental data into the respective firm's innovation management processes (Dangelico 2016; Dangelico and Pujari 2010; Præst Knudsen and Gerstlberger

2015). In the eco-innovation literature, such material and/or energy reductions in terms of production and/or use of newly developed products are sometimes labelled economic and environmental ‘win-win situations’ (e.g. Horbach 2008).

Based on the above theoretical arguments and the findings of our literature review we have formulated the following hypothesis:

H1 Manufacturing firms’ internal strategic environmental goals are positively correlated with new product introduction.

When firms set their own internal strategic environmental goals, internal R&D departments are often challenged by the limitation of little input from their part for the actual environmental goal development process. They may need to include specific technological input (e.g. regarding material selection or energy efficiency) in firms’ product innovation activities. This specific input forces many manufacturing firms to further formalise their internal R&D activities (De Marchi 2012). Other internal sources, such as documentation of practical experiences from production processes, often cannot provide the necessary technological input for complex innovation tasks that internal R&D can. Furthermore, both previous studies on success factors of new product development in general and on firms with proactive innovation strategies in particular have shown that systematic and strategic management of firms’ product portfolios (see also the argumentation above) is an important characteristic of successful product-innovative firms (Aragón-Correa 1998; Chen et al. 2012; Cooper et al. 1999, 2002).

In line with the above argumentation, we have formulated the below hypotheses. We have also included internal R&D activities and the composition of firms’ product portfolio (in terms of ‘old’ and ‘new’ products) as two further drivers of new product introduction in our analysis (e.g. Calantone et al. 1995; Tidd and Bessant 2013; Smith 2015). These additional considerations lead to H2a and H2b:

H2a Manufacturing firms’ internal R&D activities are positively correlated with new product introduction.

H2b Manufacturing firms' product portfolio composition is positively correlated with new product introduction.

Methodology

For the quantitative analysis of this study, we have used the Danish part of the European Manufacturing Survey (EMS) 2015 dataset. In addition, we have also conducted qualitative interviews with managers of Danish manufacturing firms, the results of which will be presented after the quantitative findings of the study.

Survey Design and Quantitative Findings

We investigated our hypotheses based on Danish data provided in the 2015 EMS. Focussing on the European manufacturing industry is highly relevant to this study and of high interest to both managers and policymakers as well as researchers in the field of sustainable innovation, due to its still large share of the global industrial production (EUROSTAT 2016). Furthermore, many leading innovative firms with strong environmental ambitions continue to have their headquarters in Europe (De Marchi 2012; ICF Consulting Services 2016).

The EMS is a multi-topic and country survey organised by a consortium of European research institutes and universities every third year (Fraunhofer ISI 2016). The EMS covers detailed information on the implementation of specific technologies, such as energy efficiency and production planning technologies, product innovation and environmental goals for product innovation. The EMS is exclusively targeted at plants in manufacturing sectors with 10 or more employees. The number of cases in the logistic regression analysis that we performed using an EMS 2015 sample was $N=150$.

The binary dependent variable for the logistic regression model was 'introduction of new product(s) in 2012-2014' (yes/no; OECD 2005). Our main independent variable was the environmental goals of a firm (see research model, Fig. 17.1). Based on Horbach (2008) we have

measured strategic environmental goals by focussing on four items. These four items are: (i) amount of used material in production, (ii) type of used material in production, (iii) energy consumption during product use and (iv) negative environmental impact of the product during use (Cronbach's Alpha=0.726). When measuring the strategic environmental goals, we used a five-point scale ranging from low relevance (1) to high relevance (5). For our logistic regression model (see Table 17.1), we included these items in an aggregated three-point scale.

Furthermore, we included two independent variables in our logistic regression model: (i) 'Did your firm accomplish research and development (R&D) internally in 2014?' (OECD 2005) and (ii) 'are there products that have been in the firm's portfolio for more than 10 years?' (Hart 1995). Also, these additional independent variables are dummies with yes and no as possible values.

The quantitative findings that we present in this chapter (Table 17.1) underline that strategic environmental goals are significantly and positively correlated with new product introduction in manufacturing firms. Based on this main finding of our quantitative statistical analysis, we can confirm our first and main hypothesis, H1.

Additionally, firms' internal R&D activities and, but only by trend, the composition of their product portfolio in terms of old and new

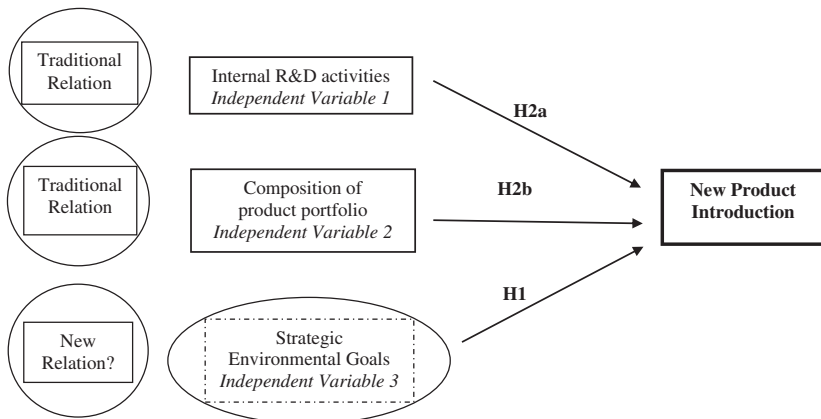


Fig. 17.1 Research model

Table 17.1 Logistic regression findings

Dependent variable name	Introduction of new product/s 2012–2014	
Independent variable name	Exp(B)	Standard error
Strategic environmental goals	7.823*	.856
Did your firm accomplish research and development internally in 2014?	2.627*	.404
Are there products that have been in the firm's portfolio for more than 10 years?	3.114	.678
<i>Constant</i>	2.023**	.002
Coefficient		Value
Nagelkerke R^2		.154
Hosmer-Lemeshow Test		Chi-square = 5.4 Significance = .143
<i>Predicted Percentage Correct (Overall)</i>		74.0%
The correlation table for the variables in the applied logistic regression model does not reveal any problematic values (Field 2000)		

$N = 150$. * $p \leq .05$. ** $p \leq .01$

products (10% significance level) show significant and positive correlations with environmental goals and product innovation performance. These additional findings of our quantitative statistical analysis enable us to also confirm our second hypothesis, H2a.

However, regarding our third hypothesis, H2b, these further statistical results demonstrate that manufacturing firms' product portfolio composition (in terms of old and new products) only tends to be positively correlated with new product introduction. Therefore, we can only conditionally accept H2b. One possible explanation for this last finding could be that a more detailed scale (beyond the rather simple differentiation between 'old' and 'new' products in a manufacturing firm's product portfolio, as in the EMS 2015 questionnaire which we could apply for this study) is needed to measure the effects of firms' product portfolio composition on new product introduction more precisely in future studies (e.g. Cooper et al. 1999).

Supplementing Qualitative Results

Due to the limitations of the EMS dataset, which we could apply for our quantitative analysis, our dependent variable ‘new product innovation’ (yes/no) does not consider in detail how new products are introduced by firms. Therefore, we do not know if the Danish EMS 2015 firms in our sample introduced their new products in 2012–2014 on their own or in cooperation with external partners, for example, customers of suppliers or in both ways.

In addition to the above-summarised quantitative findings, we have analysed some qualitative interviews as complementary investigation regarding our research objective. Parts of these qualitative interviews have already been used in the study by Goduscheit et al. (2015). To identify appropriate interview partners, firms that in the 2012 Danish EMS indicated being interested in both (i) the introduction of new products and (ii) the explicit formulation of strategic environmental goals were contacted. After having identified those firms, we called them in the summer of 2015 to gauge their interest in an additional study and to identify firm experts in the area of new product development and corporate environmental goals. Finally, five Danish production firms, which showed the best fit with the research objective of this study, were chosen for additional analyses of qualitative interviews. Following the described process, we ensured that the interview findings would further enhance our understanding of our research topic and in this way support and complement our quantitative survey data.

The five selected interviews lasted approximately 30–60 minutes and were transcribed in full. These five interviews covered the following firms and interviewees in more detail:

1. Basic metals and fabricated metal products industry, with metal and plastic material as main products (*CEO*).
2. Basic metals and fabricated metal products industry, with metal working, laser cutting and robot welding as main products (*CEO*).
3. Machinery and equipment industry with devices for industry kitchens as main products (*Sales Director*).

4. Electrical machinery and apparatus industry with solutions for utility companies as main products (*Head of Department*).
5. Medical, precision and optical instruments industry with metering devices for industrial purposes as main products (*Managing Director*).

The results of the analysed qualitative interviews indicate, first, that the formulation of internal strategic environmental goals has supported the given firms' systematic collection, documentation and use in product innovation processes of both economically and environmentally relevant data regarding the energy and/or material consumption of newly introduced products. As an example of this inclusion of additional data related to energy and/or material consumption in new product development processes, one interviewee mentioned that the head of the R&D department of the respective firm 'was asked to provide solid evidence for their newly developed product in terms of energy consumption' by the top management based on the firm's strategic environmental goals. A further example of the inclusion of additional economically and environmentally relevant data in firms' product innovation processes due to internal strategic environmental goals 'is the focus on material use reduction', as the interviewee from another manufacturing firm stated.

Finally, also the implementation of corporate environmental certifications by the investigated manufacturing firms has been driven by top managers' efforts to formulate internal strategic environmental goals and introduce new products in close cooperation with both internal (e.g. R&D, production and marketing/sales departments) and external (e.g. key customers and suppliers) stakeholders. In this context, three of the interviewees indicated that 'certifications like the ISO 14001 certification have pushed the effort to not only become eco-friendlier within the boundaries of the firm but also to seek to innovate products that are in line with the highest standards within use of resources, and emissions'. In these cases, certifications like ISO 14001 provided a supportive framework for increasing the level of producer-customer inter-firm information and knowledge transfer by setting standards for the form and quality of the exchanged data.

Discussion

Based on the presented quantitative and supplementing qualitative results, a first contribution of this chapter is that certain corporate capabilities are synergetic between product innovativeness in general and the introduction of new products with specific environmental ambitions. This first result is partly in line with literature on the drivers of environmental product innovation or ‘eco-innovation’ (Pujari et al. 2003; Dangelico 2016). More in detail, our study shows the significant positive correlation between manufacturing firms’ internal strategic environmental goals and new product introduction in general, while controlling for firms’ internal R&D activities and the composition of product portfolios (in terms of old and new products) as established product innovation success factors.

Second, this study contributes to the still emerging literature on sustainable innovation with the finding that manufacturing firms’ strategic environmental goals are not only positively correlated with eco-innovation (as can be expected and is known from the literature), but also with new product introduction in general. Based on our secondary analysis of qualitative interviews, one explanation for this second contribution is an increased degree of producer-customer (inter-firm) knowledge transfer in different kinds of environmental and general innovation projects in firms with strategic environmental goals. Such increased inter-firm knowledge transfer indicates that firms’ strategic environmental goals not only have implications for the content of innovation projects, but also for the form and intensity of inter-firm cooperation and knowledge transfer during innovation projects in general.

Conclusion

Contributions to Firms’ Strategic Environmental Goals for Theory and Practice

The results shown and discussed in this chapter can help managers of manufacturing firms to better see and exploit the advantages and

opportunities offered by strategic environmental goals with regard to product innovation development. In contrast to the more traditional opinion of managers working with innovation processes (Ambec et al. 2013; Walley and Whitehead 1994), we reveal in this chapter that focussing on strategic environmental goals also enhances the general product innovation activities of manufacturing firms. This result is substantially important for managers in the form of the following practical *take-aways*:

- Top managers (e.g. CEOs) and managers responsible for areas such as R&D, production and marketing can use this insight to identify and implement strategic environmental goals for their firms, which will lead to significant reductions in energy and/or material consumption in specific fields related to new product development (e.g. production, use, product refurbishment, maintenance of products and/or production facilities).
- Besides such potential reductions in energy and/or material consumption, also opportunities to avoid harmful substances (e.g. temperature regulation) during production processes and/or to simplify the recycling of used products can form part of firms' strategic environmental goals.

Both internal (e.g. R&D, production and marketing/sales departments) and external (e.g. key customers and suppliers) stakeholders of manufacturing firms should be involved in the identification and implementation of internal strategic environmental goals, depending on the specific internal and external cooperation networks of the respective firms.

Limitations of the Study and Suggestions for Future Research

Finally, we would like to point to the limitations of our study and to some suggestions for future research. We have studied Danish manufacturing firms. Although Denmark is an important EU and

OECD country in terms of product innovation in general (European Commission 2015) and environmental innovation (State of Green 2016), a quantitative and/or qualitative follow-up analysis could extend our findings. Furthermore, we delivered our EMS 2015 questionnaire to single respondents (production directors) in Danish manufacturing firms.

We encourage researchers who plan to conduct follow-up studies to test alternative, preferably also multi-item measures. Follow-up survey studies could develop and realise research designs with multiple respondents from the same manufacturing firm/plant. Beside production directors, CEOs or other top management members could be included as respondents. Another important recommendation for future studies refers to the type of applied data. We used the data of a cross-sectional manufacturing survey for our logistic regression analyses. Future research could also apply longitudinal survey data to extend our results. Finally, mixed-method studies in single or multiple countries could include additional research questions and dimensions, compared to our study (e.g. Del Río et al. 2015).

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