SUSTAINABLE NEW PRODUCT DEVELOPMENT: THE ROLE OF THE ENVIRONMENTAL SPECIALIST AND ENVIRONMENTAL MARKETING STRATEGY DEVELOPMENT

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ABSTRACT

Companies in the twenty first century are exposed to a variety of pressures to respond to environmental issues and responding to these pressures affects several aspects of business such as purchasing, marketing and logistics. Conventional wisdom regarding the incorporation of sustainability posits sustainability as a tradeoff with other corporate goals; however, during the last decade, this paradigm has been challenged by a view that proposes this incorporation as a complementary strategy, or even as an opportunity. Understanding how firms integrate environmental issues into their corporate agendas and how these integration strategies affect performance has become very important. The process of sustainable new product development (SNPD) is one of the core areas that these strategies focus on in order to achieve economic and environmental sustainability. This thesis investigates the integration of environmental specialists into SNPD teams and the relative influence of motivational factors of environmental strategy development and the structural relationship of how they affect the performance of SNPD. It relies on two main research streams: work on sustainable management and conventional new product development.

The first essay examines the integration of environmental specialists into new product development teams that are composed of several other functional specialists such as marketing, manufacturing, and R&D personnel, and its impact on SNPD performance across three stages: (1) concept development (CD) (e.g., the generation and refinement of new product ideas, market analysis, preparation of product concepts), (2) product development (PD) (e.g., actual technical product development, execution of prototype tests, test marketing), and (3) product commercialization (PC) (e.g., market launches, training, after-sales support). In this paper, we draw upon

resource dependency theory as our theoretical background. We present evidence that, integrating an environmental specialist into a new product team has a positive influence on SNPD project performance beyond what the traditional members of such a team would accomplish. Through analyzing this relationship across the stages of SNPD, we gained a clearer picture of the effectiveness of this integration. In particular, the integration of the environmental specialist was more effective on SNPD project performance in the final stage of the SNPD process when the product was being launched. This effect is even greater for high-innovative projects.

The second essay investigates the different motivations that drive firms to adopt environmental marketing strategies and their relative impact on new product advantage and SNPD performance. Theoretically grounded in Stakeholder Theory and the Resource - Based View of the Firm Theory, a conceptual framework was developed that portrays the antecedents and consequences of environmental marketing strategy. In regard to the antecedents of environmental marketing strategy, we examined the drivers of environmental marketing strategy development: public concern, regulatory pressures and market opportunity. The results showed that developing environmental strategies that exceed regulations (proactive strategies) leads to better new product performance than only adhering to regulations (reactive strategies). In addition, the results showed that commitment from top management becomes critical only for proactive strategies, not for reactive strategies. Finally, in regard to the consequences, we found that environmental marketing strategies lead to new product advantage and in turn, better sustainable new product performance.

This thesis fills a gap in the literature with respect to the lack of conceptual and empirical contributions on the integration of sustainability issues into the new product development process, by aiming to provide new insights into how firms are

integrating environmental specialists into their new product development teams and by extending our knowledge of how firms develop environmental marketing strategies and how these strategies affect new product performance.

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DEDICATION

I dedicate my dissertation work to my father and my mother for being there for me throughout my education life and especially for my doctoral program. I will always appreciate all you have done for me.

I especially dedicate my work to my beloved husband, Omer Faruk Genc, for holding my hand from very beginning that I started to this journey till the end. Your love and support always encouraged me and made it possible for me to complete my degree.

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CHAPTER 1

INTRODUCTION

At this point in time, the degradation of the natural environment has become an important issue for governments and societies throughout the world (Stern Report, 2006). The trend of international conventions about environmental protection, such as the Kyoto Protocol (entered into in force) in 2005 and the World Summit on Sustainable Development in 2002 changed the patterns of competition around the world. After governments and societies awakened to the urgency of this problem, they started to put pressure on companies in various ways. Now, regulators are increasing legislation, community groups and activists are protesting against firms that have unsustainable business practices, and consumers are demanding environmentally-friendly or "sustainable" products. Responding to this change, an increasing number of firms are committing to including the natural environment in their corporate agendas and have adopted sustainable business practices (Kolk, 2008; Madsen, 2009; Marcus & Fremeth, 2009). In tandem with the shift in the business world, several research studies have been conducted about distinct aspects of sustainability. Relevant issues, such as corporate social responsibility (CSR) (Brown & Dacin, 1997), enviropreneurial marketing (Varadarajan, 1992; Menon & Menon, 1997), and corporate environmentalism (Banerjee, Iyer, & Kashyap, 2003) have emerged as important topics, and impressive progress has been made in understanding the importance of sustainable business practices in marketing and many other fields (Varadarajan, 2010). However, there is still a debate about what impact incorporating sustainability concerns into the corporate strategies has on firm's financial performance. On one hand, it has been thought that the incorporation of sustainability

issues into the corporate strategy is a tradeoff with a firm's other goals, specifically performance goals (Mathur & Mathur, 2000; Walley & Whitehead, 1994). More recently, this view has been challenged by a number of scholars, in particular by Porter. The Porter Hypothesis (1991, 1995) holds that pollution is often associated with a waste of resources, such as material and energy, and that the explicit incorporation of environmental issues can stimulate innovation which may compensate for the costs incurred during the incorporation process. Thus, the long-lasting question to be answered is "Does it pay to be green?" (Ambec & Lanoie, 2008; King & Lenox, 2001). Several studies have found that the expenses incurred by sustainability initiatives can be compensated for gains made elsewhere; namely, it does "pay to be green" (Ambec & Lanoie, 2008; Clemens, 2006; Hart & Ahuja, 1996). These studies represent an important advance in the literature; however, their measures of sustainability take place generally in the context of pollution reduction, emissions of toxic chemicals, spills and other plant accidents, instead of adopting a more holistic and strategic point of view. In addition, these previous studies looked at firms' overall operating and financial performance (i.e. Tobin's Q) (Hart & Ahuja, 1996; King & Lenox, 2001), rather than the impact on product levels. This thesis differs from prior research in several important dimensions. We look at the incorporation of sustainability issues into the product development level and adopt a holistic and broad, strategic viewpoint, above and beyond pollution reduction. In fact, little research has been done about sustainable new product development (Pujari, Wright, & Peattie, 2003; Huang & Wu, 2010). More specifically, empirical research examining the factors affecting the performance of sustainable new products is still scarce.

Sustainability concerns bring new customer requirements regarding how products are made, how they are used, and how they can be disposed of (Peattie, 1999). These product attributes are increasingly becoming as important as product quality, functionality, and cost, which necessitates substantive changes at the product development level. Thus, superficial changes or improvements made to current products may not satisfy today's environmentally sensitive consumers. Sometimes they may even lead to protest actions, especially in the case of *greenwashing*, the practice of making an unsubstantiated or misleading claim about the environmental benefits of a product, service, technology or company practice. As a result, a paradigm shift towards the more explicit incorporation of sustainability concerns into product development is considered to be under way (Pujari, Wright & Peattie, 2003). Therefore, there is a need for an explicit and clear incorporation of sustainability issues into the conventional NPD process, which we refer to here as *sustainable new product development* (SNPD). In this thesis, SNPD is defined as "an organization-wide process of new product development into which sustainability concerns are explicitly integrated to minimize the impacts on the natural environment, and on animal and human health, via sustainable product designs, sustainable R&D, sustainable production and sustainable marketing." Producing sustainable new products requires the integration of sustainability concerns into the product development process in a profitable way. This thesis investigates the impact of the cross-functional teams that include an environmental specialist along with conventional NPD team personnel and the relative impact of motivational factors to environmental marketing strategy development on SNPD performance. It relies on two main research streams: work on sustainable management and conventional new product development.

Sustainability considerations have had a great impact on product development processes in many industries (e.g. the food, apparel, and automobile industries). Furthermore, these days, a great number of new product introductions involve a primary emphasis on sustainability-related attributes (e.g. low-emission vehicles, biodegradable packages, energy-efficient appliances). Companies realize that they can incorporate sustainability ideas into the design and packaging of products to increase the advantages of product differentiation (Shrivastava, 1995). In recent years, sustainable products on market shelves have been increasing at an accelerating rate. For instance, from 2007 to 2008, the number of sustainable products doubled (Greenbiz, 2009) and 13,000 new sustainable food and beverages were launched between 2005 and 2010 (Mintel, 2010).

In spite of the increasing trend to launch sustainable products, little research has been conducted on areas where the sustainable and the conventional new product development processes converge and diverge. More specifically, cross-functional integration in the context of SNPD has received little research attention (e.g. Pujari, Wright & Peattie, 2003; Huang & Wu, 2010). More importantly, the literature does not give a clear picture of how the integration of environmental specialists into conventional NPD teams might influence the market success of new products across the stages of the SNPD. To address this gap in the literature, in the first essay, we examine the impact of cross-functional integration on the success of sustainable new products, with particular attention to the integration of environmental specialists into teams. In other words, the first essay examines the integration of environmental specialists into new product development teams that are composed of several other functional specialists, such as marketing, manufacturing, and R&D

personnel, and its impact on SNPD performance across three stages of the new product development process: (1) concept development (CD) (e.g. the generation and refinement of new product ideas, market analysis, preparation of product concepts), (2) product development (PD) (e.g. actual technical product development, execution of prototype tests, test marketing), and (3) product commercialization (PC) (e.g. market launches, transportation, training, after-sales support).

The effect of cross-functional integration on NPD performance has received considerable attention in the marketing literature in relation to conventional NPD process. Several studies point to the benefits of employing cross-functional integration in the conventional NPD process, and many suggest that integration across functions has a positive effect on new product performance (e.g., Gemser & Leenders, 2011; Nakata & Im, 2010; Song & Swink, 2009; Leenders & Wierenga, 2008; Griffin & Hauser, 1996; Gerwin & Barrowman, 2002; Song & Parry, 1997a). We can see several successful implementations of cross-functional teams in the business world. For instance, in the automobile industry, where even the biggest players were on the verge of bankruptcy, BMW successfully managed to generate healthy profits, and it is known that one of the important factors for that success was known as its reliance on cross-functional integration throughout the new product development process. "Good companies have this lateral ability to communicate across divisions and silos, not just up and down the hierarchy. That's what makes BMW tick," said Chief Financial Officer Stefan Krause at BMW. They replaced the traditional sequential management system with a cross-functional team of engineers, marketers, designers and other department people (*Business Week*, 2006). Especially the divergent views and complementary skills of the cross-functional team members brought success to the company. Like BMW, various companies such as P&G,

Electrolux, Whirlpool, LG Electronics and Samsung, have been benefiting by employing cross-functional teams in their NPD processes. We expect that these benefits would carry over to SNPD teams, helping them create sustainable new products with superior features and market appeal.

Because tasks and activities differ across SNPD stages, the marginal contributions of separate functions to the SNPD process inherently varies across these stages. This leads to varying levels of interdependencies and, in turn, varying levels of cooperation among functions (Olson, Walker, Ruekert, & Bonner, 2001). In other words, both the level and character of integration are likely to change across stages of SNPD. Therefore, the impact of cross-functional integration on SNPD performance varies across the different stages of the SNPD process (Ernst, Hoyer, & Rubsaamen, 2010; Olson et al., 2001; Song, Thieme, & Xie, 1998). Therefore, we have adopted a process-oriented perspective to examine the impact of cross-functional integration on SNPD performance across multiple SNPD stages. In line with prior work (Ernst et al., 2010; Song & Parry, 1997a), our model addresses cross-functional integration at three basic stages of the overall SNPD process: (1) concept development (CD), (2) product development (PD), and (3) product commercialization (PC).

In the specific context of SNPD, it is important to recognize that the development of sustainable products involves looking not only at the finished product, but also, and more importantly, at the production processes involved. Generally, it entails adopting some sort of sustainability standards for the entire supply chain, from material sourcing to packaging, transportation, and product disposal (Sharman, Ellington, & Meo, 1997; Simon, Poole, Sweatman, Evans, Bhamra, & McAloone, 2000). In order to make that adaptation process more effective and efficient, we suggest that environmental specialists also be integrated into the cross-functional

teams at every stage of the process. Studying the role of environmental specialists in SNPD should expand existing knowledge on the antecedents of new product success and failures.

Overall, in the first essay, we address the following research questions:

- Is it effective to employ cross-functional teams in the sustainable new product development process? If yes, does this effect vary across stages?
- How does the integration of environmental specialists affect the performance of SNPD?
- How does product newness moderate the relationship between a cross-functional team and sustainable new product performance?

The second essay investigates the different motivational factors that drive firms to adopt environmental marketing strategies and their relative impact on new product advantage and SNPD performance. The sustainability paradigm mentioned above had an impact on prevailing management theories in 1990s. At that time, the environments that affect a firm's strategy development were considered to be only the legal, political, economic, social and technical environments, and not the natural environment. Hart (1995) noted that existing theories had a significant omission, the natural environment, and as a solution, he proposed a revised version of the Resource-Based View (Barney, 1991) - the Natural Resource-Based View (NRBV). This new perspective proposed a systematic examination of the relationship between the natural environment and a firm's performance by linking resource, capabilities and strategic outcomes. Throughout the years, this model has been widely accepted among scholars and applied in several research studies (i.e., Fraj, Martinez, & Matute, 2011; Walls, Phan, & Berrone, 2011). However, after fifteen years, Hart (2011) stated that there is still work to be done linking resources, capabilities and performance with a natural

environment perspective. Second essay partly fills this gap in the literature by examining the impact of environmental marketing strategies on new product advantage and SNPD project performance.

Several studies have been done regarding the operationalization of various dimensions of corporate environmentalism (Banerjee, 2002; Banerjee et al., 2003, Menguc & Ozanne, 2005; Walls et al., 2011) and its effect on firm performance (Stone & Wakefield, 2000; Menguc & Ozanne, 2005; Fraj et al., 2011). Yet little empirical research has been done in marketing that examines environmental marketing strategies as they relate to SNPD performance (Baker & Sinkula, 2005). As an attempt to fill this gap, this study models the antecedents and consequences of an environmental marketing strategy in the SNPD context. Our purpose is to advance the literature by examining different motivational factors, namely public concern, regulatory pressures and market opportunity, which drive firms to adopt environmental marketing strategies, and by examining their relative impact on new product advantage and SNPD performance. We utilize stakeholder theory (Freeman, 1984; Harrison & Freeman, 1999; Henriques & Sadorsky, 1999) and NRBV theory (Barney, 1991; Hart, 1995) as the theoretical background for testing our model.

In the second study, we address the following research questions:

- How do the motivational factors that drive the development of environmental marketing strategies relatively influence new product advantage and SNPD performance?
- Is it beneficial for a firm to go beyond the minimum standards required by law and adopt proactive environmental strategies?
- How does an environmental marketing strategy affect new product advantage and SNPD project performance?

CHAPTER 2

CROSS-FUNCTIONAL INTEGRATION IN THE SUSTAINABLE NEW PRODUCT DEVELOPMENT PROCESS: THE ROLE OF THE ENVIRONMENTAL SPECIALIST

Literature Review

Although today many large companies have started to produce sustainable products, relatively few studies to date have empirically examined the impact of producing sustainable products on a firm's performance (e.g., Prothero & McDonagh, 1992; Pujari & Wright, 1996; Pujari et al., 2003; Huang & Wu, 2010). This relatively new notion is at the center of two streams of research: work on conventional NPD and work on sustainable management. The conventional NPD literature is replete with variables and models that have been proposed and empirically tested; however, as stated above, the question of how considerations of sustainability should be integrated has not yet been resolved. Likewise, the sustainable management literature has not adequately addressed the direct impact of sustainability concerns on the market success of new products.

Sustainable Management

Since sustainability concerns are now a matter of concern on a global scale, firms can no longer be allowed to ignore the impact of their business activities on the natural environment, regardless of whether or not they wish to be perceived as "environmentally-friendly" institutions. As a result, more firms have adopted the view that they are responsible to society in terms of the consequences of corporate activities, in addition to their responsibility to shareholders (Bowen, 1953). Any activities designed to fulfill that responsibility have been referred to in the literature as

corporate social responsibility (CSR) practices. Several corporate actions can be categorized as CSR activities, such as minority support programs, donations to non-profit organizations, support for educational activities and sustainable management. This paper will focus on sustainable management, specifically sustainable new product development. *Sustainable management* can be generally defined as minimizing the negative impacts of business practices on the environment. It affects many aspects of the businesses operations, such as corporate strategy development, purchasing, manufacturing and marketing (Shrivastava & Hart, 1994; Menon & Menon, 1997).

According to the traditional view, spending corporate funds voluntarily on sustainable management is contrary to a firm's objective to maximize shareholders' wealth (Mathur & Mathur, 2000; Walley & Whitehead, 1994). However, later on, these sustainable management practices came to be seen as compliant with other corporate objectives, which is portrayed as a "win-win" paradigm by Porter (Porter & van der Linde, 1995). A number of empirical studies using archival data have been conducted to test the proposition that ''it pays to be green" (Ambec & Lanoie, 2008; Clemens, 2006; Hart & Ahuja, 1996; Klassen & McLaughlin, 1996). Hart and Ahuja (1996) examined whether emissions reduction enhanced a firm's operating and financial performance in concurrent and subsequent periods. The authors interpreted their findings to mean that it does ''pay to be green," although the economic benefits of becoming green appear to occur one to two years later. King and Lenox (2001) explored the relationship between environmental performance and financial performance, using a sample of 652 manufacturing companies from 1987 to 1996. They examined whether relative environmental performance, measured as the weighted average of toxins released, normalized by firm size (the number of

employees), affected Tobin's Q. Consistent with previous studies, they found that relatively high emissions were negatively associated with Tobin's Q. In the finance literature, a number of studies have examined the market returns of portfolios of environmentally friendly firms. Klassen and McLaughlin (1996) investigated the relationship between environmental performance and financial performance, using an event study methodology. They examined market reactions to the announcements of positive sustainability-related events, such as environmental awards, and negative environmental events such as oil spills. They find that investors reward firms with positive sustainability related events and penalize firms with negative events. Cohen and colleagues (1995) used several measures of environmental performance derived from the U.S. Environmental Protection Agency (U.S. EPA) databases to construct two industry-balanced portfolios of firms. They found no penalty for investing in the green portfolio and a positive return for green investing. Although these studies advanced the literature that proposes a strong relationship between environmental protection and financial performance, they took a narrow view by just focusing on the pollution reduction rather than a holistic and broader view that includes product development. Therefore, a fuller examination of the question "Does it pay to be green?" requires an empirical study of firm strategies that extends beyond lowering production emissions, such as product stewardship strategies that would consider sustainability at every stage of the product development process (Hart & Ahuja, 1996).

Another stream of research has shed light on many benefits of sustainable management, such as increased sales (Fierman, 1991); enhanced competitiveness (Miles & Munilla, 1993; Porter & van der Linde, 1995; Reinhardt, 1999); improved customer feedback (Frankel 1992); improved corporate image (Engleberg, 1992;

Kolk, 2000), high consumer trust and, in turn, better consumer actions towards a company and its products (Pivato, Misani, & Tencati, 2008). From a different perspective, Clemens (2006) examined the relationship between environmental and financial performance for small firms. He found a positive relationship meaning that those small firms that perform better environmentally are also the most successful financially. The main finding that can be taken from all of these studies is that sustainability management can really help a firm's bottom line. For example, as of 2012, GE has earned $85 billion in revenue from sustainable products and solutions, since it developed its *ecoimagination*, defined as the commitment to imagine and build innovative solutions for today's environmental challenges while driving economic growth strategies.

Sustainable New Product Development

It is widely accepted that firms have to develop new products in order to remain competitive for success in the long run (Cooper, 1983; Ulrich & Eppinger, 1995; Wheelwright & Clark, 1995). On the other hand, in the previous section, we mentioned the benefits for a firm of incorporating of sustainability concerns. Porter and van der Linde (1995) observed that reducing inefficiencies during the production process or focusing on innovation to meet strict environmental regulations may bring early-mover advantages for companies. Siegel (2009) argued that firms can adopt sustainable product innovation, such as redesigning packaging, developing more sustainable products and advertising the sustainable benefits of those products to create differentiation advantages and gain market share. In addition, some sustainable management actions, such as redesigning, substituting less polluting inputs, and recycling the by-products of processes may promote cost advantages. Therefore,

integrating sustainable management into the conventional NPD process would help firms to achieve long-run competitiveness and sustainability goals, which would lead to a win-win situation for both the firm and the society (Chen, Lai & Wen, 2006).

Furthermore, sustainability concerns include new customer requirements above and beyond conventional product quality, functionality, and cost, regarding how products are made, how they are used, and how they can be disposed of (Peattie, 1999). However, just playing with the cosmetics of existing products, like renaming them or repackaging them with some sustainability emphasis, provides only limited opportunities for a firm, and sometimes it may even be detrimental, as in the case of *greenwashing*, the practice of making an unsubstantiated or misleading claim about the environmental benefits of a product, service, technology or company practice. Pujari et al. (2003) conclude that a paradigm shift is under way towards a more explicit incorporation of sustainability concerns into product development among UK manufacturers. Because, recently, the wider responsiveness to sustainability at the corporate level necessitates more substantive changes at the product development level, whereas before it involved only relatively superficial changes. Therefore, there is a need for an explicit and clear incorporation of sustainability issues into the conventional NPD process.

One of the most important aspects of the SNPD process is its adoption of a "cradle-to-grave" approach which means minimizing the impact on the environment at every stage of the process. This approach addresses a wide range of considerations, from where raw materials come from to what happens to products post-use (Sharman et al., 1997, Simon et al., 2000). Therefore, SNPD requires a detailed understanding of the socio-environmental impacts of the entire supplier system. In conjunction with the "cradle-to-grave" nature of SNPD, it encompasses a range of factors that require

integrating of various functions in an organization, such as manufacturing, marketing, and R&D (Huang, 2005). Therefore, this study emphasizes the multi-functional nature of the SNPD process.

Sustainable management practices can be applied to the production processes of a wide range of products, from apples (e.g., organic) to cars (e.g., low-emission). These products may use fewer chemicals in their production, produce limited carbon footprints, require fewer resources to produce, and consume less energy or emit fewer hazardous emissions. In spite of its wide use, sustainable management is not a well-defined concept in the literature (Chen, 2001). It has been argued in previous studies that sustainable management needs to go beyond compliance with the law and should take further action towards the efficient use of resources, the minimization of waste, pollution prevention, and the recycling and reuse of used goods through the use of new innovative methods (Marcus & Fremeth, 2009; Hart, 2005). Peng and Lin (2008) defined it as producing sustainable products and minimizing the overall impact on the environment via sustainable product designs, sustainable R&D, and sustainable marketing. Haden, Oyler and Humphreys (2009) regarded it as the organization-wide process of applying innovation to achieve sustainability, waste reduction, and social responsibility. Huang and Wu (2010) defined it as the organization-wide process of developing and producing environmentally-friendly products and reducing sources of pollution to minimize risks to human health and the natural environment. Consequently, this study defines *sustainable new product development* (SNPD)[1] as "an organization-wide process of new product development into which sustainability concerns are explicitly integrated to minimize impacts on the natural environment, and

[1] There is small but growing literature on SNPD. The authors variously used ENPD, GNPD. For this paper, *sustainable NPD* is used with a meaning similar to *environmental NPD* (Pujari, Wright & Peattie, 2003) and *green NPD* (Huang & Wu, 2010). We prefer "sustainable" to "environmental" or "green" because we think this term is clearer and more definite than the others.

on animal and human health, via sustainable product design, sustainable R&D, sustainable production and sustainable marketing. This includes redesigning existing products to reduce their impact on the sustainability of resources and developing of new products and services driven by sustainability concerns (Berchicci & Bodewes, 2005). SNPD is not a radically different process than conventional NPD[2], but it involves considerations about sustainability in addition to the other factors considered for market success.

Although there is frequently cited anecdotal evidence of the market success of sustainable products such as Toyota's Prius brand or P&G's Future-Friendly products (i.e. Lenor concentrated fabric softener), relatively little empirical research has been conducted on the impact of sustainable new product development on the market success of these products (e.g., Pujari et al., 2003; Huang & Wu, 2010). Huang (2005) argued that most of the previous studies tend to be rather conceptual, normative, and subjective, although having clear contributions to the literature of SNPD. Such studies placed less emphasis on exploring and explaining the implications of incorporating sustainability concerns into product development (Baumann, Boons, & Bragd, 2002; Lenox & Ehrenfeld, 1997) and dwelling more on anecdotal evidence (Pujari et al., 2003). To our knowledge, very little work has been done to explore the success factors of SNPD, in particular the impact of cross-functional integration (i.e., Pujari et al., 2003; Huang & Wu, 2010). Therefore, this study is designed to narrow this gap by integrating the mainstream research on sustainable management and new product development to further explore the impact of cross-functional integration on the market success of sustainable new products across stages of the SNPD process.

[2] *Conventional NPD* refers to NPD processes without particular regard for, or attention to, sustainability.

Like conventional new products, sustainable new products should achieve market success by performing well financially, which determines the degree to which firms are more profitable than their competitors (Clemens, 2006; Judge & Douglas, 1998). Being preferred by more consumers contributes to a firm's bottom line and should later contribute to the pursuit of sustainability as an asset, which will create an example for the win-win paradigm developed by Porter (Porter & van der Linde, 1995). Therefore, in order to benefit society overall, sustainable new products should wrestle market share away from their conventional counterparts.

SNPD and Performance

For environmentally oriented products to succeed, they need to be effective in terms of their marketplace performance while they are reducing the impact on the environment (Pujari et al., 2003). Developing such products requires an understanding of a product's environmental impact and an ability to foresee the options available to make improvements in this area. On the other hand, we cannot pursue sustainability if the sustainable products cannot achieve financial success. In other words, SNPD should aim not only for environmental excellence, but also for the achievement of higher financial performance. Therefore, financial performance and a positive impact on the natural environment become the two key outcomes of sustainable new product market success.

Paladino (2007, p. 541) defined "new product success as the ability of a new product or innovation to avoid failure in the marketplace". Taking this definition as a basis, this study defines sustainable new product success as the ability of a sustainable new product to compete in the marketplace. New product studies typically capture success either as an objective assessment (return on investment, sales, market share,

profits) or a subjective assessment (managerial perceptions of how well a new product performed relative to expectations) (Troy et al., 2008). As new product strategy researchers (Im & Workman, 2004; Montoya-Weiss & Calantone, 1994; Paladino, 2007) have recommended, we adopted measures of sustainable new product success that assess the different perspectives of sustainable new product performance (Ernst et al., 2010; Song & Parry, 1997a). Financial performance is the degree to which firms are more profitable than their competitors (Clemens, 2006; Judge & Douglas, 1998).

Diversity in Teams

Nowadays, there is a great interest in studying organizational teams in light of their growing use in companies, which has increased significantly in response to competitive challenges and the organizational needs of flexibility and adaptation. Katzenbach (1993) defined a *team* as "a small number of people with complementary skills who are committed to a common purpose, performance goals and approach for which they hold themselves mutually accountable." The literature on teams categorizes the factors that affect team performance mainly into three groups: (1) individual team member characteristics (e.g., competencies, personalities), (2) team-level factors (e.g., task structure, external leader influences), and (3) organizational and contextual factors (e.g., organizational design features, environmental complexity). Among other variables, the direction and magnitude of team diversity effects on team outcomes have been thoroughly studied (i.e., Jackson, May & Whitney, 1995; Miller, Burke & Glick, 1998). Diversity is often described as a "double-edged sword" in contemporary organizational theory. At one end of the continuum, proponents of team diversity highlight the positive effects of member heterogeneity on team outcomes, whereas other researchers propose that many

conflicting views among diverse members cause dysfunctional team interactions and suboptimal performance (Horwitz & Horwitz, 2007).

There are two competing perspectives regarding the impact of team diversity on team outcomes, namely, the cognitive diversity hypothesis and the similarity–attraction paradigm, (Miller et al., 1998). Based on the cognitive diversity hypothesis, several researchers have held that team diversity has a positive impact on performance because of the unique viewpoints that members contribute to the team, which encourages creativity, innovation, and problem solving (Cox & Blake, 1991; Hambrick, Cho & Chen, 1996). In contrast, researchers taking the similarity–attraction paradigm when examining teamwork often conclude that member diversity has an adverse impact on team outcomes (Tajfel & Turner, 1986; Tziner, 1985) because they believe heterogeneous teams have fewer shared characteristics, which decreases team cohesion and performance.

The controversy in the literature may be a result of varying effects of components of diversity, namely bio-demographic and task-related diversity. Bio-demographic diversity refers to innate member characteristics that are immediately observable and categorized (e.g. gender, age and race/ethnicity) whereas task-related diversity refers to individual attributes (e.g., education, functional expertise and organizational tenure) that have been postulated to be more germane to accomplishing tasks than bio-demographic diversity (Horwitz & Horwitz, 2007).

A recent meta-analysis that investigates the relationship between team diversity and team performance concluded that task-related diversity is positively related to both the quality and quantity of team outcomes (Horwitz & Horwitz, 2007). Furthermore, this study confirms that task-related diversity in team members improves team performance. In other words, there is “value” in diversity in team settings. No

relationship was, however, found between bio-demographic diversity and team performance. When we interpret these results in the context of cross-functional integration in the SNPD process, we can expect a positive relationship between team integration and performance outcomes, since the diversity in the current context is mostly the task-related. Besides, we can eliminate the potential downside of diversity in the team by proposing an organic structure to the team where only the most necessary functions determine the team for each stage. For example, our model does not include manufacturing in the concept development stage, since we think manufacturing integration at this stage cannot provide enough insights to compensate for the complexity or conflict it created.

Cross-Functional Integration in (Conventional) NPD

Among other organizational factors studied, cross-functional integration has been identified as one of the most important factors for explaining new product success (Berchicci & Bodewes, 2005; Pujari, 2006; Troy, Hirunyawipada, & Paswan, 2008). From a theoretical perspective, resource dependency theory provides a useful perspective for examining the role of cross-functional integration in NPD (Olson et al., 1995; Salancik & Pfeffer, 1978). Hypotheses regarding the positive effects of cross-functional integration among environmental specialists, and marketing, R&D and manufacturing personnel on NPD performance can be derived from resource dependency theory (Ruekert & Walker, 1987; Salancik & Pfeffer, 1978). According to this theory, the degree of interdependence and the nature of interactions among functional units in an organization are influenced by the accomplishments of the collective task (Song and Swink, 2002). NPD processes require the participation of various functions, such that each one involves specific information and resources that

are needed for the process. (Song, Thieme, & Xie, 1998). However, the objectives and resources committed by each functional unit may be highly interdependent. Resource dependency theory argues that such interdependencies must be considered in order to maximize new product success. For example, marketing requests regarding product features create requirements for manufacturing production capabilities. Due to the added production costs required in meeting every customer's needs and desires, manufacturing departments have to restrict production choices. In addition, further restrictions are placed on other functional units as a result of product sustainability considerations identified by environmental specialists. Therefore, these different thoughtworlds of each of the functions lead to a need for effective integration to achieve positive NPD performance (Di Benedetto, 1999; Song, Thieme, & Xie, 1998; Urban & Hauser, 1993). Therefore, cross-functional integration should increase SNPD performance.

Different terminology is used in the literature to define the notion of people from different departments jointly involved in performing goal-oriented tasks (Pinto & Pinto 1990), for example "integration", "cooperation", "coordination" and "collaboration". In this paper, we use the terminology "*cross-functional integration*" in reference to Song and Weiss's (2001, p. 65) definition of "the magnitude of interaction and communication, the level of information sharing, the degree of coordination and the extent of joint involvement across functions in specific new product developments tasks."

Creating new products requires multidisciplinary viewpoints and the involvement of different functional units (Olson et al., 2001). Cooper (1994) argues that product development requires a cross-functional team approach, as the process cuts across traditional functional boundaries. The traditional way of involving

departments into the NPD process was using *the sequential product development approach*. Under this approach, one company function works individually to complete its part of the process before passing the new product along to the next function and stage. However, functional units have different sources of knowledge and different types of expertise and often develop different thoughtworlds (Dougherty, 1992). If such differences are not well integrated with a team-based structure, they may create conflict among functions, which may affect performance in a negative way. With a team-based approach, where various company functions work closely together, cross-functional integration provides several significant benefits for the whole SNPD process by increasing both communication frequency and the amount of information flow in the organization (Randolph & Posner, 1992). First of all, integration can stimulate creativity by establishing a ground from which different viewpoints to can emerge, which is very important step in the creation of innovative product ideas. Second, throughout the process, such heterogeneity of viewpoints may increase the possibility of discovering novel ways to solve problems and stimulate creative problem solving in the NPD process (Im et al., 2003), which helps in resolving innovation dilemmas (Griffin & Hauser, 1996; Moenaert & Souder, 1990; Song & Parry, 1997a, 1997b). In addition, effective cross-functional integration may significantly reduce NPD task-related errors and lead to the early detection of mistakes (Menon & Lukas, 2004). Third, effective integration encourages open communication, which enables each function to better understand the other functions' timelines and enhances the speed of problem solving (Han, Kim, & Srivastava, 1998). Fourth, information integration in the cross-functional structure helps employees from different functional units achieve a common understanding of the product and enhances consistency among the decisions made throughout the NPD process, both of

which are considered critical for success (Sethi, 2000). Joint planning gives employees from different functions, an opportunity to have an earlier and deeper understanding of all aspects of product strategy. Furthermore, by allowing every functional unit to see the "big picture" of the NPD process, cross-functional integration helps each department to better understand the effects of departmental objectives on the company's overall strategy (Ford & Randolph, 1992). Finally, cross-functional integration combines resources and skills from different functions, providing flexibility in the workforce and capital resources and prompting better utilization of organizational resources (Ford & Randolph, 1992). Therefore, integration efforts in NPD can also be viewed as more efficient use of company's resources. In summary, to implement an effective integration, the functions must exchange information, interact and cooperate closely towards a common goal (Griffin & Hauser, 1996) which can be achieved through team-based integration.

The Role of the Environmental Specialist

Several regulations have been enacted by the federal government that aim to protect human health and the environment, such as the Pollution Prevention Act (PPA), the Toxic Substances Control Act (TSCA), the Clean Air Act (CAA), and the Clean Water Act (CWA). Given the more rigorous environmental regulations being implemented day by day, as a first step, firms need to be aware of all of these regulations and comply with them in all actions of their corporate strategy. One of the domains where the regulations apply is the process of new product development. Furthermore, more than ever before, consumers seek "green" products for their families and their planet. They want goods and services that are more sustainable and more specifically environmentally-friendly. A study by the U.S. Environmental

Protection Agency (EPA) showed that the environmental aspects of a product are becoming more valuable to consumers. Correspondingly, many firms meet that consumer demand by launching sustainable products through sustainable management practices that go above and beyond existing regulations, such as optional ISO certifications that are widely recognized by the European Union or any sustainability-related labeling certifications. Given these conditions in the market, there should be some individual in the company who is dedicated to supervising the application of new environmental requirements; identifying sustainability procedures for the new product development process, in terms of compliance with applicable laws, regulations and other sustainability-oriented requirements, performing environmental audits, spotting significant areas for reducing energy use and waste, and proposing modifications to the whole process by going above and beyond what is required by law. Their role could involve actively designing-in environmentally benign materials and designing-out environmentally harmful materials, and conducting sustainability impact analyses at every stage. These individuals in a company are referred to as *"environmental specialists*[3]*"* in this study.

Researchers have explored the effects of cross-functional integration in various forms, including overall cooperation- without an emphasis on individual functions- and multifunctional approach (Ernst et al., 2010; Gemser & Leenders, 2011; Nakata & Im, 2010; Olson, Walker & Ruekert, 1995), but generally in the form of bi-functional cooperation, such as between marketing and R&D (Lenders & Wierenga, 2008; Garcia, Sanzo, & Trespalacios, 2009; Li & Calantone, 1998; Song & Parry, 1992), between R&D and manufacturing (Swink, 1999; Terwiesch, Loch, & DeMeyer, 2002)

[3] In the literature, various terms have been employed to define the job fulfilled by these individuals such as *environmental coordinator* (Pujari et al., 2003) and *environmental quality manager* (Huang and Wu, 2010). We prefer to use *environmental specialist* because we think that this term represents the nature of the role that s/he plays in the team in a better way. In selecting this term, we refer to terms used in analogous contexts, like *IT specialist* or *design specialist*.

and between marketing and manufacturing (Kahn & Mentzer, 1994; Song & Swink, 2009). However, to our knowledge, there is not much research on cross-functional integration in the context of SNPD (e.g., Pujari et al., 2003; Huang & Wu, 2010). Pujari and colleagues emphasized the importance of including an environmental specialist in the SNPD process, but they did not explain the impact this would have, nor the nature specialist's interaction with the team members from other functions. They (2003) examined the impact of integration only on the ecological, not the financial performance, of the product. Charter and Clark (2007) recognized that there is weak interaction between marketing and environmental specialists and a poor understanding of each other's respective roles and challenges. The authors concluded that the relationship between marketing-sales and environmental specialists is under-researched and, given the number of people employed in business worldwide, this is a major gap in the literature. Therefore, our study extends the literature in this respect, since previous studies indicate there is a strong need for more research in this relatively neglected but important area of study.

It is well known that every functional unit within an organization has its own goals and objectives. For example, while manufacturing departments give high importance to cost efficiency, marketing generally focuses on the needs and wants of consumers, which often increase the cost of production. Similarly, sustainability considerations, as identified by environmental specialist, such as sustainable materials procurement, production and packaging, have their own requirements and restrictions, which may have an impact on the whole process, but not be part of the knowledge or interests of the other functional units. The current literature argues that the successful incorporation of sustainable management strategies into corporate strategic planning necessitates cooperation among environmental specialists, engineers and production

personnel (Cordano & Frieze, 2000; Russo & Harrison, 2005; Boks, 2006, Petala, Wever, Dutilh, & Brezet, 2010) and advances a firm's financial and environmental performance (Judge & Douglas, 1998). Specifically, lack of cooperation among departments has been identified as a major obstacle to the integration of sustainability considerations into the product development process (Boks, 2006). Furthermore, it is argued that organizational factors, as opposed to technical/process factors are more likely to hamper the success of SNPD (Lenox & Ehrenfield, 1997) which points to the additional importance of cross-functional integration in the context of SNPD. Therefore, we propose that cross-functional integration is an important success factor of SNPD and may even be more critical than conventional NPD. Moreover, we assume that the integration of environmental specialists with the team will lead to a smooth and efficient transition from the conventional NPD process to the SNPD process, and, in turn, that will result in sustainable new products that can achieve better results in the market. Therefore, we suggest that the SNPD team should include an environmental specialist and that the presence of this expert on the team will have a positive effect on sustainable new product's performance.

The integration of environmental specialists in the SNPD process can take place at different levels. Barrett (1993) suggests three fundamental scenarios for that: a business-as-usual approach (participating in the process when problems arise), a "gamekeeper" approach (involving closer central control and promoting a distinct auditing role), and a "sharing the burden" approach (becoming actively involved in the process by providing guidance, data, and verification). Today, since firms have becoming more proactive in responding to environmental challenges, the role of the environmental specialist is shifting from a purely technical focus to a more business-oriented focus. This provides a strong motivation for corporate managers to ensure a

place for the environmental specialist at the SNPD table at every stage of the process, namely, a role like that identified by Barrett as “sharing the burden” approach (1993).

Hypothesis Development

Stages of SNPD

Although extensive research suggests a positive tie between integration and NPD performance (Pujari, 2006; Griffin & Hauser, 1996; Hoopes & Postrel, 1999; McDonough, 2000; Gerwin & Barrowman 2002; Song & Parry, 1997a), some have found nonexistent or even negative effects (e.g., Gray, Matear & Matheson, 2002). A recent meta-analysis by Henard and Symanski (2001) indicates the relationship between integration and NPD performance is indeterminate, meaning that the effect on performance does not generalize across research models. Specifically, they found that the mean correlation between cross-functional integration and new product performance was positive (r =.23) but not significant. Nevertheless, they call for further research to examine this relationship in specific contexts such as the stages of NPD and product innovativeness. They state that the stage of the process would moderate the relationship in such a way that its effect would be more salient in some stage than in others. Moreover, in their meta-analysis regarding cross-functional integration, Troy et al (2008) suggest that future research involve a more detailed assessment of the process specifically a stage-by-stage analysis which they think could provide significant insights into how integration can most positively affect new product success. Further, Song, Thieme and Xie (1998, p.289) state that “new product success may be more likely when a firm employs function-specific and stage-specific patterns of cross-functional integration than it is when the firm attempts to integrate

all functions during all NPD stages." Only limited research has been done to study the effects of some sorts of integration in earlier versus later stages of NPD projects (Song & Swink 2009; Olson, Walker, Ruekert & Bonner, 2001; Song, Thieme & Xie, 1998). In fact, studies that analyzed the effects of integration on performance, based on the stages, found that they actually varied across stages (i.e Song & Swink, 2009; Ernst, Hoyer, & Rubsaamen, 2010; Brettel, Heinemann, Engelen, & Neubauer, 2011). As an extension of the previous literature, we propose that the effect of cross-functional integration on sustainable new product performance should be examined stage-by-stage, with particular attention to the integration of the environmental specialist. To assess the phase-specific impact of functional units on SNPD performance, in line with prior work on related topics (Song & Parry, 1997a), we divided the SNPD process into three sequential phases: (1) concept development (CD) (the generation and refinement of new product ideas, market analysis, preparation of product concepts), (2) product development (PD) (actual technical product development, execution of prototype tests, test marketing), and (3) products commercialization (PC) (market launches, transportation, training, after-sales support).

Moreover, the interdependencies among functional units, and therefore the performance effects of cross-functional integration among departments, may vary across stages. Troy et al. (2008) also suggest a more fluid type of organizational structure in which structures change and cross-functional team members enter and exit the new product process at varying stages**.** Indeed, the different functions are inherently more or less involved at different stages. For example, while R&D has a more prominent role during the concept development and product development stages, its role decreases during the product commercialization stage, when marketing is more critical to an effective launch. Therefore, the right mix of cross-functional

involvement differs depending on the stage of the NPD process (Song, Thieme & Xie, 1998). Song and colleagues (1998) found that new product success is more likely when firms employ function-specific and stage-specific patterns of cross-functional integration. Brettel and colleagues (2011) argued that the benefits of cross-functional integration depend on the stage of NPD and the functions involved. This notion is supported by resource dependency theory, which suggests that the relative importance of each function in NPD depends greatly on the nature of the task and the activities involved. Therefore, we propose that an organic structure should be constructed for the team, in which the functions to be integrated vary stage-by-stage, in order to follow through the process in a more effective and efficient way. In this study, we model integration so that we can see the impact of functional integration at every stage (i.e marketing- R&D integration at the concept development stage, marketing-R&D integration at the product development stage and so forth). In addition to contributions to the literature in regard to the impact of the environmental specialist, this study aims to contribute by showing the impacts of functional integration at each stage.

On the other hand, according to the prevailing cradle-to-grave approach in sustainable process management, firms should consider the "life cycle" of environmental impacts at every stage of NPD process from product design and concept development through manufacture, storage, packaging, use and disposal (Beaumont, Pedersen, & Whitaker, 1993). Therefore, like the marketing function, we hypothesize that the integration of environmental specialists in cross-functional teams at every stage of the process would generate additional contributions above and beyond the positive impact of conventional team members on SNPD performance. In the following section, we will explain our hypotheses in the form of various combinations of functions (i.e. marketing and R&D; marketing, R&D and

environmental specialist) for each of the three stages (see figure 1 for the conceptual model).

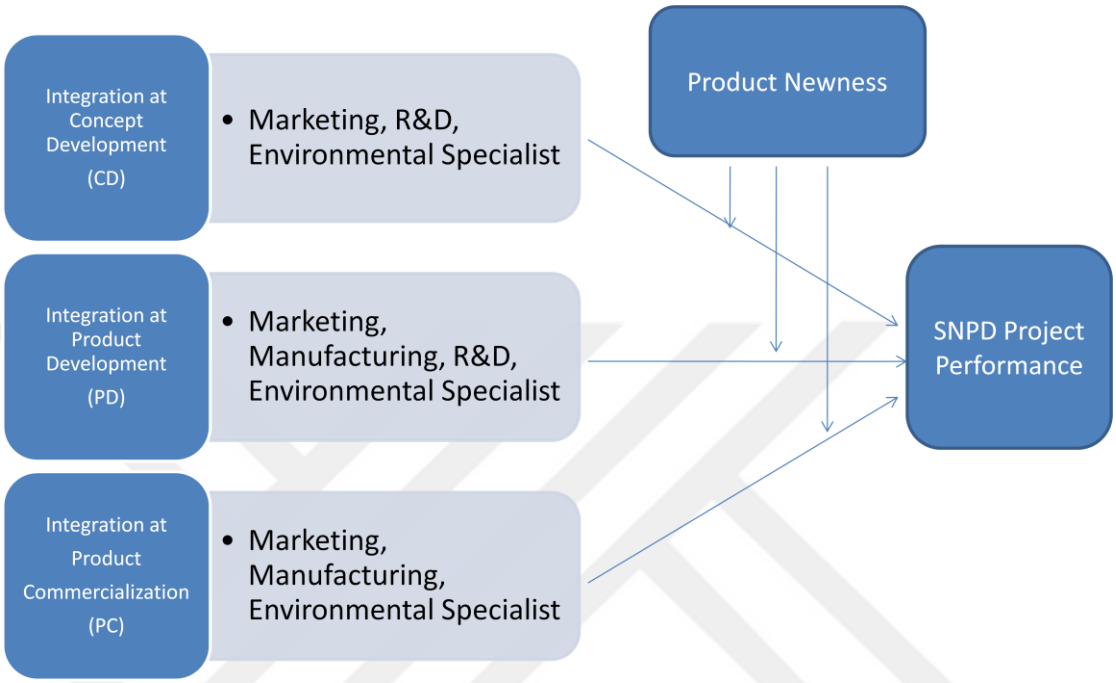

Figure 1 The Conceptual Framework of Cross-Functional Integration in the Sustainable New Product Development Process

Cross-Functional Integration across Stages

Stage 1: Concept Development (CD)

The concept development stage typically involves the generation and evaluation of new product ideas and then the refinement of the most promising ideas into actual new product concepts before they pass to the development stage (Kim & Wilemon, 2002). Beyond the generation of new product ideas, decisions regarding product concepts and design and concept testing, are also made in this stage (Ernst, 2002). A substantial amount of conceptual and empirical research has analyzed the

integration between marketing and R&D in the NPD process because both departments are highly relevant for successful NPD (e.g. Song & Song, 2010; Song, Thieme, & Xie, 1998; Gupta, Raj, & Wilemon, 1986; Leenders & Wierenga, 2008).

Drawing on resource dependence theory, we argue that marketing–R&D integration is important in the concept development phase because involvement and information sharing between the two departments leads to a better understanding and meeting of customer requirements. For example, in the case of idea generation, the marketing department gives valuable insights about new product ideas that are more in line with customer needs and wants. This increases the number of potentially successful ideas entering the NPD process, which also increases the odds of new product success. In addition, integration with marketing during concept testing enables R&D to acquire immediate, valuable customer feedback on new product ideas and possible product features. Integration almost ensures that ideas that are generated internally and taken to the next stage are in line with customer needs and wants. This also results in cost efficiency because a huge amount of R&D resources are committed a NPD project, which then becomes difficult to terminate (Biyalogorsky, Boulding, & Staelin, 2006; Boulding, Morgan, & Staelin, 1997) and missteps could become too costly to the company. Therefore, the high risk resulting from uncertainty at this critical stage of the SNPD project can be significantly reduced by ensuring that the features of the product are aligned with customer requirements and that customers actually perceive the superiority in the value proposition to competing products (which is an important antecedent of new product success; see Ernst, 2002).

Effective collaboration on the front end of the SNPD process would be highly beneficial for product success, combining what is desired by the current and potential customers with what is technologically feasible. Such an exchange should produce a

superior value proposition that is both acceptable to the target markets and deliverable by the firm. In the early stages of SNPD, the marketing function is responsible for a wide range of activities that provide relevant market information for the entire SNPD process. These activities include, among others, market trend analysis, market research, market targeting and segmentation, product differentiation and positioning, and communication (Griffin & Hauser, 1996; Rouzies, Anderson, Kohli, Michaels, Weitz, & Zoltners, 2005). Answering demands from different segments might require different sets of attributes to be attached to a product. Research indicates that isolated marketing representatives are likely to push for a broad mix of product features in an attempt to maximize market share. On the other hand, the R&D department is primarily concerned with producing new technological knowledge and applying it to the designing of new products (Griffin & Hauser, 1996). In the absence of strong integration with the marketing department, R&D may lose touch with the actual users of the product and with their needs and wants.

Integration with R&D would be beneficial for the marketing department to understand what is technically feasible among their many proposed product options that will, in effect, please customers. In addition, creating a cross-functional team on this front end of the SNPD process will lead to mutual learning opportunities. Marketing personnel can educate R&D personnel on market potential, competitor offerings, and the product's place in the firm's entire product portfolio. In return, R&D representatives can debate the merits of these strategies in light of the availability of technology, along with considerations of the existing production mix.

Because interdependence is high during the concept development stage (Kim & Wilemon, 2003), in line with the previous literature, we suggest that marketing–R&D integration is critical to the overall SNPD project success. Given the different

responsibilities of each functional unit, an alignment between marketing plans and R&D capabilities is needed to develop a new product that meets market needs and wants, and generates satisfactory profits for the firm. This alignment can be achieved through cross-functional integration between R&D and marketing during this early stage (Griffin & Hauser, 1996).

H_1: Integration between Marketing and R&D in the concept development (CD) stage of SNPD will be positively associated with SNPD project performance.

The effectiveness of sustainable initiatives often requires cooperation among environmental specialists, engineers, and production personnel (Cordano & Frieze, 2000; Russo & Harrison, 2005). Integration of environmental specialists into new product teams in the concept development stage will ensure that ideas that are generated internally and taken to the next stage are in line with the firm's sustainability objectives. Products that are developed based on these objectives may help firms to lower costs, improve their reputation, and achieve a strategic alignment with future changes in the general business environment (Hart, 1995; Sharma & Vredenburg, 1998). Therefore, successful integration of sustainability concerns into concept development advances a firm's bottom line, in addition benefiting society. As previously stated, the cradle-to-grave nature of sustainable management processes requires that environmental issues be integrated into SNPD processes from the earliest stages, when new product ideas are generated, evaluated and concept tested and the most promising ideas are refined into actual new product concepts. In the concept development stage, environmental specialists can contribute to the success of SNPD projects by conceptually designing-in environmentally benign materials and

designing-out environmentally harmful materials, and by conducting environmental impact analyses. Hence, we hypothesize that the integration of environmental specialists into the marketing–R&D team in the concept development stage will be positively associated with the product success.

H_2: The integration of an environmental specialist into the cross-functional team in the concept development (CD) stage of SNPD will be positively associated with SNPD project performance.

Manufacturing influences early in the project may overly constrain the flexibility and creativity of the project team, thus limiting product advances (Olson et al., 2001). These arguments and research findings suggest that the integration of the manufacturing department into the early stages of SNPD is likely to be ineffective, and possibly even detrimental, to product market success when product innovation levels are high. We expect that manufacturing personnel's limited scope, their tendency to be locked-in to existing technologies, and the constraining nature of integration methods all hamper the effectiveness of the integration of the manufacturing department into the early stages of SNPD. Therefore, we recommend not including the manufacturing function to the team at this stage.

Stage 2: Product Development (PD)

The product development stage involves actual technical product development, the execution of prototype tests, and test marketing. The technical development of the product is mainly a task for R&D. However, R&D needs further information from marketing. In particular, marketing can help R&D get feedback from customers on technical product design by testing the prototype with selected customers (Song &

Parry, 1997a). Furthermore, marketing carries out test-marketing activities to assess the overall market acceptance of the new product before actually launching it. Test-marketing activities are widely recognized among many firms because they prevent companies from making costly mistake. In addition with advances in technology, marketing people can use laboratory simulation, which enable advertising and other promotional materials for several products to be shown to members of the target market to test their reactions. The participants are taken to a mock or real store where their purchases are recorded. The strategic information acquired through test marketing needs to be shared with R&D so that modifications to the product design can be made to increase the new product's market potential.

In the product development stage when technical product development takes place, differences between the view points of manufacturing and the other functions become most pronounced. Generally, the debate is hinges on product features. For instance, marketing is likely want to have as many features as possible added to the product to offer the maximum number of variants of the product (e.g., different sizes or different flavors) to meet different customer needs. In contrast, manufacturing is likely to minimize product modifications to reduce costs and benefit from economies of scale. However, an excessive emphasis on product standardization for the sake of lower manufacturing costs is likely to result in unsatisfied customers (Kotabe, 1992). In other words, these are two sides of a standing debate between two viewpoints: standardization versus customization. Integration will afford them an opportunity to better understand each other's viewpoint and engage in joint-decision making. Therefore, the integration of the manufacturing department into the team will produce the advantage of being able to make effective decisions by acknowledging the requisite capacity, cost-volume relationship and cost-product variety relationship. This

will lead to a critical balance of maintaining high customer satisfaction while being profitable at the same time.

Similarly in the test-marketing step of the PD stage, incorporation of the manufacturing standpoint will lead to effective prioritization of product alternatives. Furthermore, it is been argued that the integration of manufacturing improves the translation of practical customer requirements into technical product and process design language (Song et al., 1998). Therefore, we propose the following hypothesis:

H_3: The integration of Marketing, R&D and Manufacturing in the product development (PD) stage of SNPD will be positively associated with SNPD project performance.

Effective integration of an environmental specialist into the team at the PD stage can lead to both cost and differentiation advantages (Siegel, 2009). Cost advantages can stem from improving inefficiencies in the production process, redesigning and innovating for less polluting production processes, promoting the sustainable use of resources, substituting less polluting inputs, and recycling the by-products of processes. Differentiation advantages may arise from redesigning the packaging of products and communicating the benefits of such products to attract consumers who have concerns about sustainability.

It is argued in previous sections that the role of the environmental specialist consists of monitoring the production process in terms of compliance with the law and incorporating sustainable actions. Examples of these actions would be the efficient use of raw materials, the minimization of waste, pollution prevention, and the incorporation of recyclable materials into the production process (Marcus & Fremeth,

2009; Hart, 2005). As mentioned previously, the first step in this stage is the actual technical product development. In this step, the environmental specialist can contribute to the effective implementation of the sustainable design created in the CD stage. Furthermore, the environmental specialist can issue guidelines about redesigning existing production methods to reduce the environmental impact regarding materials, manufacture, use or disposal. More specifically, the environmental specialist can emphasize the efficient use of resources, minimization of the use of chemicals during the production process, and the minimization of waste by suggesting new, innovative methods. In the next step, where prototypes are tested, the environmental specialist can screen the results and evaluate them based on governmental standards or other, optional labeling standards (e.g., organic) that have been established by authorized institutions. Another important role of the environmental specialist would be to conduct an environmental impact analysis at every step, in order to ensure that sustainability objectives are met. Therefore, we hypothesize that the integration of an environmental specialist at the product development (PD) stage, into a SNPD team that already includes R&D, marketing and manufacturing would further benefit product success.

H_4: The integration of an environmental specialist into a cross-functional team in the product development (PD) stage of SNPD will be positively associated with SNPD project performance.

Stage 3: Product Commercialization

The commercialization stage typically involves activities such as market launches, product training, after-sales support, and the monitoring of competitors'

reactions (Song & Parry, 1992). During the PC stage, marketing possesses information that is critical to SNPD performance, such as identifying and contacting certain customers who are crucial for the diffusion of new products in the market—for example, opinion leaders, innovators, and early adopters (Gordon & Schoenbachler, 1997; Hultink & Atuahene-Gima, 2000; Rochford & Wotruba, 1996). Marketing managers seek to capture the highest possible market share by quickly tracking and processing customer orders, and speeding the diffusion of the product to the market through the most appropriate channels. In the absence of integration, marketing personnel may push for heavy inventories and flexible production capacities in order to provide fast and fluid adaptations to changes in customer demands. On the other hand, manufacturing personnel are likely to seek to reduce costs by attempting to keep inventory levels and production disruptions at a minimum by forecasting sales as accurately as possible. These variations in objectives prompt a need for the joint involvement of marketing and manufacturing in production planning and demand management activities during the commercialization stage. We believe that with effective integration, marketing people would have better information about production ramp-up progress and associated problems, and so they might be less prone to overpromise when negotiating sales agreements and less willing to agree to last-minute changes in deliveries. On the other hand, if manufacturing personnel have a better understanding of customers' needs and wants and of market potential, they might be more effective in setting production priorities and attaining schedule goals. Another benefit of integration would be the speedy handling of final product design changes. As challenges are faced in production, distribution or sales, integration across functions would facilitate quicker resolutions of problems and quicker processing of design improvements. The net results of these activities would include

better responses to customer needs and, at the same time, more efficient uses of inventory and productive capacity, thereby achieving better market performance for a product. Therefore, we propose the following hypothesis:

H_5: Integration between Marketing and Manufacturing in the product commercialization (PC) stage of SNPD will be positively associated with SNPD project performance.

The activities in the commercialization stage involve last-step decisions regarding packaging, waste disposal and the selection of appropriate channels of distribution. Packaging is very important in terms of both reducing the environmental footprint and maintaining profitability. The role of the environmental specialist at this stage would include pointing out the benefits of recyclable and biodegradable packaging and eliminating excessive packaging, for the benefit of both the environment and the company's bottom line. Even a small decrease in packaging would lead to fewer shipments by trucks and, in turn, more fuel savings for the company and less CO_2 emissions for the earth. For instance, General Mills cut 20 percent off the paperboard packaging for hamburger helper, resulting in 500 fewer distribution trucks on the road each year. As another example, Wal-Mart estimates that its reduced supplier-packaging initiative will produce savings of $3.4 billion and prevent 667,000 metric tons of CO_2 emissions, equivalent to removing 213,000 trucks from the road.

On the other hand, as highlighted before, new performance metrics have emerged, and one of them is the return-to-landfill rate. The higher this rate, the better for the environment and company's bottom line. A good example of this is the Subaru

of Indiana company case. Subaru of Indiana has achieved zero-waste-to-landfill, which means they have a hundred percent return-to-landfill ratio. Last year, the plant saved $5.3 million by reducing waste and recycling (Farzad, 2011). Therefore, environmental specialists can educate other SNPD team members about effective changes and technologies for dealing with production waste. This will help the company to have better sustainability metrics and a higher return-to-landfill rate, and save cash along the way.

Furthermore, "greening up" a company's channels often takes substantial commitment, ingenuity, and investment. In addition to benefits to the environment (e.g., less hazardous gas emissions) and to the company (e.g., greater efficiency, lower costs and higher profits), today, many customers of larger firms (e.g., Wal-Mart) are demanding it. Therefore, sustainability is fast becoming a critical factor in selecting channels of distribution. Among other considerations, logistic activities such as transportation, warehousing and packaging are vital elements that create the greatest impact on the environment. Environmental specialists can suggest new technologies or methods, such as installing more efficient engines and tires, and using hybrid drive systems to reduce the company's environmental footprint and increase efficiency. Consequently, we hypothesize that the integration of an environmental specialist at the PC stage would enhance the performance of the SNPD process.

H_6: The integration of an environmental specialist into the cross-functional team in the product commercialization (PC) stage of SNPD will be positively associated with SNPD project performance.

R&D's role at this stage typically involves interacting with customers to provide product training and support. The customer support offered by R&D is a standard service which does not really require much interaction between R&D and other functions (Ernst et al., 2010). Given that, resource dependence theory would predict that integration at this stage between other functions and R&D has little effect on SNPD performance. Therefore, we recommend not including the R&D function in the team in the product commercialization stage of SNPD.

Moderating the Effect of Product Newness

We build on two theories to explain the possible moderating effect of product newness: resource dependency theory and contingency theory. According to resource dependency theory, perceptions of environmental uncertainty affect the degree of interdependence among the functions and the nature of their resulting interactions (Olson, Walker, & Ruekert, 1995; Ruekert & Walker, 1987). Given that a higher level of product newness implies a higher level of external and internal uncertainty, resource-dependency theory suggests that as the degree of product newness increases, so do functional interdependence and cross-functional information and resource exchanges among the three functional areas in NPD activities. According to contingency theory, the characteristics of the task, specifically the degree of newness, affect the timing and effectiveness of different coordination mechanisms (Zollo & Winter, 2002). Thus, both theories support a general positive moderating effect of product newness on the integration-performance relationship.

The literature highlights the importance of considering the degree of product newness (e.g., Shenhar, 1998; Tatikonda & Rosenthal, 2000). Radical projects often require both significant product and process improvements, whereas incremental

projects require less concomitant product and process improvements. Evidence shows that more complex tasks necessitate more cooperation and coordination among team members (Akgun, Byrne, Keskin, Lynn, & Imamoglu, 2005; Wheelwright & Clark, 1992). Olson et al. (1995) argue from dependence theory that, when product newness is high, members from various functions on the NPD team perceive their tasks to be more challenging and depend more heavily on other functional specialists for the expertise, information, and other resources they need to arrive at creative and successful solutions, because they have fewer relevant experiences to draw upon. In short, as the degree of newness increases (i.e., the breakthrough or radical projects), it is generally necessary to improve integration among the various functions of the NPD teams. In the specific context of SNPD, we expect similar results. Pujari et al. (2003) suggested future research on SNPD that is more specific in regard to how new sustainable products are defined; specifically, they suggested distinguishing between products with a high degree of newness, such as radical, new-to-the-world products, and those with a low degree of newness, such as ones featuring incremental improvements to existing products.

Accordingly, we presume that some of the relationships between cross-functional integration and new product success are probably moderated by the degree of product newness, since the uncertainty and task complexity related to the development process vary with the type of the innovation (i.e., radical or incremental). We call this concept *product newness* in the interest of clarity. Therefore, we hypothesize that cross-functional integration would make SNPD more effective when product newness is high.

$H_{7a–c}$: Cross-functional integration during the (a) CD (b) PD and (c) PC stages of SNPD will be more positively associated with SNPD project performance on high-product-newness SNPD projects than on low-product-newness SNPD projects.

Methodology

In order to test the foregoing hypotheses, we collected data describing completed SNPD projects via an online survey. In the following sections, we will describe the sample, data collection procedures and the survey instrument.

Sample

This study primarily focused on processes and outcomes associated with individual SNPD projects rather than on the aggregate SNPD performance of an entire firm or division. Consequently, it examined the cooperation among functions over the course of an SNPD project. Product/project managers in various U.S. companies who were appropriate for the study objectives were contacted to ensure that the final sample consisted only of respondents who had worked actively on new product development projects for which performance data were available. The respondents who participated in the study worked in companies that are operated across several industries. In order to increase the diversity of projects involved in the study, we maintained the anonymity of the respondents. We specifically sought projects that differed in terms of product newness and which had been completed within the past five years. The key participants were the “product/project managers” or the “team leaders” of the SNPD projects, as the people with the most direct responsibility for the projects. This approach is consistent with previous research studies (Henard & Szymanski, 2001), and no differences were found when single to multiple

respondents' approaches were used (Slater & Narver, 1998). To encourage participation, we established a confidential agreement with each company and promised to give it an executive summary of results upon request. Respondents received a hyperlink to an internet-based questionnaire by e-mail. They were asked to fill out the survey for the most recently introduced product that the respondent was knowledgeable about and for which performance data were available. Each participant was asked to complete the questionnaire, which assessed his or her perceptions regarding the hypothesized constructs, and asked for performance measures and company demographic information (e.g., the industry, the number of employees). A total of 1,200 respondents were contacted. Overall, 282 questionnaires were returned, which made for a response rate of 23%. The elimination of sixty-three surveys because of incomplete responses left 219 usable questionnaires. The sample covered a range of industries, including industries involved in electrical and electronic devices and equipment, chemicals, hospital and medical devices, agriculture and processed food products, machinery, pharmaceuticals, automotive and spare parts, and steel products. T-tests were applied between early and late responses, and the results did not show significant differences on all of the variables, treated separately (Armstrong & Overton, 1977). We also performed a multivariate analysis of variance (MANOVA) to compare early respondents with late respondents on all of the variables. Similarly, the results were not significant at the 95% confidence level, suggesting there were no significant differences between early and late respondents. Both of these analyses suggested that non-response bias was not a concern.

Measures

We reviewed the literature to identify scales to measure each construct. All of the measures were adopted by the appropriate research studies. In the following section, we explain in detail how we measured each construct. The questionnaire instrument was composed of three parts, starting with a cover letter describing the purpose of our survey and communicating the approval of the Institutional Review Board. The first part consisted of items for measuring the hypothesized constructs. The second part contained items measuring the performance of the SNPD projects, and the third part contained items measuring company descriptive data, including the number of employees, the year founded, the industry sector, etc. All of the constructs were measured using seven-point Likert scales from 1 to 7, ranging from strong disagreement (1) to strong agreement (7). Firm size (a control variable) was measured by the number of employees. The definitions and measurements of the constructs are further defined as follows:

Project performance: This refers to the ability of a sustainable new product or innovation to compete in the marketplace and to the degree to which firms are more profitable than their competitors (Clemens, 2006; Judge & Douglas, 1998). Overall, SNPD project performance captures the success of the completed SNPD project. We followed previous NPD research and used a commonly applied subjective measure of new product success (Ernst et al., 2010; Song & Parry, 1997a) (for a detailed description of the SNPD performance measures, see the Appendix). Subjective measures have the advantage of facilitating comparisons across the SNPD projects of firms from different industries (Atuahene-Gima, 1995).

Cross-functional integration. In the previous literature, NPD processes were divided into different numbers of stages (e.g., two, three, four, and five). We

determined the number of stages as three, in order to be able to capture the key steps in the SNPD process without making the model too complicated, consistent with Ernst et al.'s work (2010). Following Song and Parry (1992) and Ernst et al. (2010), we identified 18 key activities along the entire SNPD process that could potentially require the integration of an environmental specialist with marketing, R&D, and manufacturing personnel.

For each of these 18 SNPD activities, we asked product/project managers for their perceptions of the level of integration of the various functions for a particular SNPD project. *Level of integration* refers to the level of involvement and information sharing with the other department(s) with regard to each of the 18 SNPD activities. All items were measured on a seven-point scale, ranging from "strongly disagree" (1) to "strongly agree" (7) (for a detailed description of the measures, see the Appendix).

Product newness. In order to measure product newness, we adapted items from previously validated, high-reliability scales in the literature. The scale for product newness includes four items assessing the newness to the industry of the product and its associated technologies (Song & Xie, 2000; Song & Swink, 2009). All items were measured on a seven-point scale, ranging from "strongly disagree" (1) to "strongly agree" (7) (for a detailed description of the product newness scale measures, see the Appendix).

We also included two control variables in the analyses, the industry type and the company size. By including the industry type as an overall control variable, we were able to adjust for significant differences between industries with regard to new product performance. By including company size, we were able to control for any differences that might have been caused by the firm's size. All questions were pre-coded and pretested with managers and academics to ensure that our questions were

clearly understood and easily answerable by the respondents. At this stage, no particular problems with the wording or response format were found.

Psychometric Properties of the Scales

Before starting the main analyses, several tests were conducted in order to validate the psychometric properties of the scales used. First, potential common method bias was discarded using the Harman test, which revealed that five different factors emerged from a factor analysis that explained more than 74% of the extracted variance (Podsakoff & Organ, 1986). The unrotated principal component factor analysis, the principal component analysis with varimax rotation, and the principal axis analysis with varimax rotation all revealed the presence of five distinct factors with eigenvalues greater than 1.0, rather than a single factor. Thus, no general factor was apparent. Moreover, the confirmatory factor analysis showed that the single-factor model did not fit the data well: $\chi 2 = 4746.165$, p=.000, GFI= .381; CFI= .629; RMSEA= .140. Table 1-1 reports the means, standard deviations, skewness and kurtosis for all of the variables. Examination of the skewness and kurtosis values for all of the variables (see Table 1-1) indicated that the number of employees (firm size) was skewed. We transformed this variable by taking its logarithm to ensure normal distribution.

Table 1-1 Descriptive Statistics

	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Marketing-R&D-Stage1	5.6249	0.99959	-0.835	0.164	0.47	0.327
EnvSpeacilist with team-Stage1	5.2551	1.34461	-0.909	0.164	0.633	0.327
Marketing-Manufacturing-R&D-Stage2	5.529	1.07549	-0.855	0.164	0.801	0.327
EnvSpecialist with team-Stage2	5.2485	1.40025	-0.975	0.164	0.701	0.327
Marketing-Manufacturing-Stage3	5.6393	1.06579	-0.746	0.164	0.091	0.327
EnvSpecialist with team-Stage3	5.2169	1.40395	-0.834	0.164	0.298	0.327
PERF	5.524	0.90154	-0.449	0.164	0.742	0.327
NEWNESS	4.9886	1.47548	-0.646	0.164	-0.168	0.327
EMP	15880.6	43019.4	3.522	0.164	12.21	0.327
logEMP	2.9598	1.1167	0.288	0.164	-0.483	0.327

We tested constructs for multicollinearity by calculating variance inflation factors on the item level (Im et al., 2003; Michael, Rochford, & Wotruba, 2003). The results show no significant parameter distortion due to multicollinearity problems (variance inflation factor < 10). To assess the scale's reliability, the value of Cronbach's alpha value was studied. Cronbach's alpha for all the scales far exceeded the critical limit of 70% (Nunnally, 1978) (see Table 1-2).

Table 1-2 Factor Analysis and Reliability

Factor Name	Items	Loading	Reliability
1. Product Newness	Item 1	0.935	0.931
	Item 2	0.913	
	Item 3	0.902	
	Item 4	0.89	
2. Marketing-R&D-Stage1	Item 1	0.785	0.916
	Item 2	0.731	
	Item 3	0.759	
	Item 4	0.786	
	Item 5	0.8	
	Item 6	0.632	
	Item 7	0.728	
3. Environmental Specialist with the team-Stage1	Item 1	0.809	0.959
	Item 2	0.842	
	Item 3	0.815	
	Item 4	0.851	
	Item 5	0.839	
	Item 6	0.825	
	Item 7	0.85	
4. Marketing-Manufacturing-R&D-Stage2	Item 1	0.68	0.923
	Item 2	0.772	
	Item 3	0.826	
	Item 4	0.793	
	Item 5	0.8	
	Item 6	0.747	
	Item 7	0.802	
5. Environmental Specialist with the team-Stage2	Item 1	0.738	0.96
	Item 2	0.833	
	Item 3	0.865	
	Item 4	0.863	
	Item 5	0.881	
	Item 6	0.867	
	Item 7	0.849	

Table 1-2 Cont. Factor Analysis and Reliability

Factor Name	Items	Loading	Reliability
6. Marketing-Manufacturing-Stage3	Item 1 Item 2 Item 3 Item 4	0.861 0.72 0.813 0.804	0.872
7. Environmental Specialist with the team-Stage3	Item 1 Item 2 Item 3 Item 4	0.828 0.861 0.883 0.89	0.934
8. Financial Performance	Item 1 Item 2 Item 3 Item 4	0.85 0.828 0.807 0.754	0.884

An exploratory factor analysis was performed on independent variables for each stage, using principal component analysis (the varimax method). Table 1-2 shows the results; each model produced two factors with eigenvalues greater than 1 and factor loadings of 0.60 as the cutoff points, accounting for 74%, 75%, 78% of the variance, respectively, for each stage: concept development, product development, product commercialization (K–M–O statistic .93, Barlett statistic 3015, significance .000). An analysis of the Scree plot also shows a two-factor solution for each stage (see Table 1-2 for individual factor loadings).

Next, a series of confirmatory factor analyses (CFAs) was performed to test the scales on unidimensionality of the scales. Instead of examining all of the variables in a seven-construct model, three models were fitted for two groups of theoretically interrelated variables, to avoid a violation of the five-to-one ratio of sample size to parameter estimates (Bentler & Chou, 1987). Model 1 contained marketing and R&D cooperation at stage 1 and the integration of the environmental specialist with the team at stage 1 constructs ($\chi 2$ = 71.858, p=.104; GFI= .955; CFI= .995; RMSEA=

.033; see Table 1-3). Model 2 contained marketing, manufacturing and R&D cooperation at stage 2, and the integration of the environmental specialist with the team at stage 2 constructs ($\chi 2$ = 67.569, p=.263; GFI= .959; CFI= .998; RMSEA= .022; see Table 1-4). Model 3 contained marketing and manufacturing cooperation at stage 3, and the integration of the environmental specialist with the team at stage 3 constructs ($\chi 2$ = 15.897, p=.320; GFI= .982; CFI=. 999; RMSEA= .025; see Table 1-5). All three of the CFA models showed good fits. The significant factor loadings demonstrated convergent validity for all scales.

Table 1-3 Confirmatory Factor Analysis – Model 1 (Standardized Estimates)

			Estimate	S.E.
MRCoop7	<---	F1	0.814*	
MRCoop6	<---	F1	0.768*	0.077
MRCoop5	<---	F1	0.804*	0.074
MRCoop4	<---	F1	0.839*	0.068
MRCoop3	<---	F1	0.723*	0.068
MRCoop2	<---	F1	0.835*	0.075
MRCoop1	<---	F1	0.736*	0.082
E1Coop7	<---	F2	0.892*	
E1Coop6	<---	F2	0.875*	0.053
E1Coop5	<---	F2	0.881*	0.053
E1Coop4	<---	F2	0.899*	0.051
E1Coop3	<---	F2	0.818*	0.056
E1Coop2	<---	F2	0.870*	0.054
E1Coop1	<---	F2	0.892*	0.058

* $p < 0.001$

Table 1-4 Confirmatory Factor Analysis – Model 2 (Standardized Estimates)

			Estimate	S.E.
MMRCoop7	<---	F1	0.832*	
MMRCoop6	<---	F1	0.851*	0.072
MMRCoop5	<---	F1	0.869*	0.07
MMRCoop4	<---	F1	0.875*	0.068
MMRCoop3	<---	F1	0.822*	0.073
MMRCoop2	<---	F1	0.700*	0.068
MMRCoop1	<---	F1	0.547*	
E2COOP7	<---	F2	0.896*	0.041
E2COOP6	<---	F2	0.912*	0.054
E2COOP5	<---	F2	0.898*	0.05
E2COOP4	<---	F2	0.901*	0.051
E2COOP3	<---	F2	0.880*	0.059
E2COOP2	<---	F2	0.867*	0.048
E2COOP1	<---	F2	0.783*	0.072

* $p < 0.001$

Table 1-5 Confirmatory Factor Analysis – Model 3 (Standardized Estimates)

			Estimate	S.E.
MMCOOP4	<---	F1	0.756*	
MMCOOP3	<---	F1	0.864*	0.101
MMCOOP2	<---	F1	0.776*	0.1
MMCOOP1	<---	F1	0.729*	0.082
E3COOP4	<---	F2	0.874*	
E3COOP3	<---	F2	0.933*	0.051
E3COOP2	<---	F2	0.891*	0.054
E3COOP1	<---	F2	0.814*	0.05

* $p < 0.001$

To test convergent validity, exploratory factor analysis was performed on the product newness and project performance scales. The results produced a single factor for each scale, specifying eigenvalues greater than 1. Then, confirmatory factor analysis was run separately on two of the scales. The results showed that one factor model fit the data well for each scale. (For the project performance scale: GFI= .995;

CFI= .999; RMSEA= .026; thus, for this scale, the variables seem to converge, giving evidence of convergent validity. For the product newness scale: GFI= .993; CFI= .997; RMSEA= .095). Therefore, the results of both the exploratory and confirmatory factor analyses suggest that all of the scales exhibit unidimentionality. Provided with this evidence of satisfactory psychometric properties, the constructs were formed by averaging the responses to all the remaining items in a particular scale.

Analyses and Results

Patterns of Cross-Functional Integration

In this section, we present the results regarding the effect of cross-functional integration on SNPD project performance across three SNPD stages. First of all, we wanted to see the impact by stage. In order words, we were answering the question; does the impact of cross-functional integration vary throughout the stages of the SNPD process? By conducting a series of contrast analyses, we were able to compare the stages with each other as nested (blocked) variables. The results from the model comparison analyses revealed that the stage makes a significance difference in SNPD project performance. In particular, cross-functional integration at stage 3 becomes the most significant factor for explaining the variations in project performance. There was no effect of integration on stage 2 after controlling for the existence of cross-functional integration in stages 1 and 3 because of the high correlation between stage 2 and 3 variables. Therefore, cross-functional integration at stage 2 does not contribute to project performance beyond the integrations at stages 1 and 3. After selecting the best model, the multiple-regression method (Cohen & Cohen, 1983) was applied to specify the regression models. We ran the full model for all of the stages, as shown in Table 1-6 (Full Model). We faced multicollinearity problems in the full model since

VIF > 5 for some variables. As mentioned in the contrast analysis, this was a result of the high correlation between stage 1 and stage 2 variables. Given the results of the contrast analysis and the multicollinearity problems, we removed insignificant stage 2 variables and ran a second regression (reduced model). The results are shown in Table 1-6 in the reduced model column. Therefore, the results revealed that the best model includes stage 1 and 3 variables and excludes stage 2.

Table 1-6 Full-Reduced Models Comparison (Standardized Estimates)

Integration between	Full Model		Reduced Model	
	Estimate	SE	Estimate	SE
Marketing and R&D-Stage 1	.284*	.100	.337*	.083
EnvSpecialist with team-Stage1	-.294*	.081	-.219*	.073
Marketing-Manufacturing-R&D-Stage2	.122	.098		
EnvSpecialist with team-Stage2	.161	.089		
Marketing-Manufacturing-Stage3	.152	.076	.193*	.071
EnvSpecialist with team-Stage3	.171	.083	.275*	.066

* $p < 0.05$

Visual inspection of the plots of the histogram and the normal probability plots confirmed the multivariate normality of the data (Hair, Black, Babin, Anderson, & Tatham, 2006). The variance inflation factors in the reduced model were all below five, indicating that multicollinearity was not a serious problem.

At this point, we wanted to add interaction effects, as we had hypothesized. Table 1-7 (Model 1) shows that the control variables explain 7.1% of the variance in project performance. Adding the stage 1 variables in Model 2 increased R^2 by 24.3% ($\Delta F = 37.827$, $p < .01$). Then, adding the stage 3 variables in Model 3 resulted in a further increase in R^2 of 4.9% ($\Delta F = 8.066$, $p < .01$). Finally, in model 4, interaction variables were added, with an R^2 of 7.7% ($\Delta F = 9.623$, $p < .01$). So, the final model,

which included stages 1 and 3 and the interaction variables, explains 43.9% of the variance in SNPD project performance.

Table 1-7 Model Comparison

Model	R^2	Adj-R^2	SE	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. F Change
1	.071	.062	.87315	.071	8.203	2	216	.000
2	.313	.301	.75401	.243	37.827	2	214	.000
3	.362	.344	.73028	.049	8.066	2	212	.000
4	.439	.415	.68943	.077	9.623	3	209	.000

The outcomes of the multiple regression analyses are presented in Table 1-8. H_1 proposed that during concept development, marketing-R&D integration would have a significant, positive impact on SNPD project performance. This hypothesis is supported because the coefficient for marketing-R&D cooperation in the concept development stage is positive (.270) and significant ($p \leq .05$). H_5, which pertains to marketing-manufacturing integration in the commercialization stage, is also supported. The coefficient of .163 ($p \leq .05$; see Table 1-8) reveals a significant, positive relationship between the level of marketing-manufacturing integration and SNPD project performance at this stage. These results are consistent with the literature.

Table 1-8 The Influence of Cross-functional Integration on SNPD Project Performance (Standardized Estimates)

	Estimate	SE
(Constant)		.439
Manufacturing vs Service Industry	.081*	.109
Firm Size	.136*	.044
Marketing-R&D-Stage1	.270*	.081
Environmental Specialist@Stage1	-.223*	.072
Marketing-Manufacturing-Stage3	.163*	.068
Environmental Specialist@Stage3	.322*	.067
Product Newness	.156*	.058
Product Newness*Environmental Specialist Integration @Stage 1	.030	.067
Product Newness*Environmental Specialist Integration @Stage 3	.220*	.064

* $p < 0.05$

The Integration of Environmental Specialist

As we predicted, the impact of the integration of the environmental specialist varies across stages. H_2 pertains to the impact of the integration of the environmental specialist on SNPD project performance during concept development. Counter to our prediction, integration of an environmental specialist at the concept development stage is proved to be negatively associated with SNPD project performance (significant

coefficient of -.223, $p < .05$; see Table 1-8). More important, as H_6 predicted, the integration of the environmental specialist at the commercialization stage had a strong positive and significant impact on overall SNPD project performance (with a coefficient of .322 ($p \leq .01$); see Table 1-8).

The Moderating Effects of Product Newness

While the integration of an environmental specialist at the concept development and commercialization stages were significantly related to project performance, the unanswered question is whether those relationships are moderated by an individual project's characteristics, in particular by the product newness. To answer this question, we tested for the interaction effects of integration and product newness on project performance. We regressed the project performance variable on integration variables plus on two interaction variables that were formed by multiplying the integration of an environmental specialist at the concept development and commercialization stages by the product newness variable. We mean-centered product newness before creating the interaction terms, in order to avoid multicollinearity (Aiken & West, 1991).

We argued that the increased uncertainty and functional interdependence associated with high innovative SNPD projects, where firms have little relevant prior experience to draw upon, will likely strengthen the impact of the integration of the environmental specialist during the SNPD stages. We predicted in H_{7a} that the integration of the environmental specialist at the concept development stage would be more positively related to SNPD project performance in relatively high innovative projects than low. The result in Table 1-8 fails to support this prediction, since the interaction variable for the integration of an environmental specialist at the concept

development stage was found to be insignificant. Therefore, the integration of an environmental specialist at the concept development stage is not more important in high product newness projects than low product newness projects. On the other hand, we predicted in H_{7c} that the integration of an environmental specialist at the commercialization stage would be more positively related to SNPD project performance in relatively high product newness projects than low. The result—a significant interaction effect for the integration of an environmental specialist at the commercialization stage—supported this hypothesis, with a coefficient of .22 ($p \leq .05$; see Table 1-8). Therefore, the integration of environmental specialists at the commercialization stage is more important in high product newness projects than low product newness projects.

In addition to testing for interaction effects in detail, we performed the Aiken and Wet procedure to test the effects of integrating an environmental specialist on SNPD project performance at high and low levels of product newness (based on a median split), separately. The results of these two models are reported in Table 1-9. At high levels of product newness, the integration of an environmental specialist at the commercialization stage is positively associated with SNPD project performance (β=.723; $p < .01$), whereas at low levels, the integration of an environmental specialist at commercialization stage was not related to SNPD project performance. This result shows the importance of integrating an environmental specialist at the commercialization stage, especially when product newness is high.

Table 1-9 Low-High Product Newness Comparison (Standardized Estimates)

	Low-Newness Projects		High-Newness Projects	
	Estimate	SE	Estimate	SE
Environmental Specialist@Stage3	-0.08	0.104	0.723*	0.14

* $p < 0.05$

Discussion

To the best of our knowledge, this study is the first empirical examination of the impact of the integration of an environmental specialist into a SNPD team. As we mentioned earlier, most previous studies in this area have only looked into this conceptually. Aside from everything else, this study contributed to the NPD literature by responding to a call by a recent meta-analysis. In that analysis, Troy et al. (2008) called for future research involving a more in-depth examination of the process, specifically a stage-by-stage analysis that could provide significant insights into how integration can most positively affect new product success. By analyzing with a stage-by-stage framework, this study found that cross-functional integration had a significant impact on SNPD project performance in the early and late stages of the SNPD, the concept development and commercialization stages, respectively, but not in the middle, the product development stage. In addition to this contribution, this study aimed to contribute to the literature by showing the impact of the integration of an environmental specialist at each stage. Our results show the integration of the environmental specialist into the team had a strong and positive impact on SNPD project performance at the commercialization stage, beyond the well-known effect of marketing and manufacturing cooperation on SNPD project performance. Moreover, the positive impact of the integration of an environmental specialist becomes apparent when the product being developed is rather new. The results further reveal that the impact of the integration varies across the stages of the SNPD process, where we see a significant negative effect at the concept development stage. By considering a more complex set of effects, our results extend those of prior studies for traditional functional integration as well. The significant stage-to-stage effects revealed in this

analysis provide a more complete picture than prior studies. These findings have important theoretical and managerial implications.

Theoretical Implications

Our first important finding suggests that the benefits, detriments and costs of the cross-functional integration of the SNPD process can vary considerably across SNPD stages and the levels of innovation attempted. Importantly, these effects appear to be more complex than a simple "direct" model might suggest (Swink & Song, 2007).

Our findings are consistent with extended arguments from resource dependency theory that increased novelty in SNPD increases the need for cross-functional integration between marketing and R&D at the concept development stage because of greater interfunctional dependence (Clark, 1989; Gupta et al., 1986; Ruekert & Walker, 1987; Takeuchi & Nonaka, 1986). Similarly, high levels of novelty at the commercialization stage of the SNPD process increase the need for cross-functional integration between marketing and manufacturing. Contrary to our prediction, integration at the middle stage of the SNPD process, where product development takes place, does not appear to be significant. This may, in fact, be explained by resource dependency theory, because mostly in this stage, standardized production is scheduled, in other words, a decrease in novelty is taking place for the job being done. According to resource dependency theory, this leads to less interfunctional dependence and so less need for cross-functional integration. In addition, this result can be explained by Mudambi's "smile curve," where he uses the curve to explain how developed market firms make their decisions to concentrate on high value-added activities and relocate/outsource low value-added activities to firms

in emerging economies (2008). As high value items, he identified early activities such as R&D and design, and late activities such as commercialization, logistics and after-sale services, which resemble the activities that take place in the concept development and commercialization stages of the SNPD process. He also identified low-value items such as standardized manufacturing, which resembles the activities that take place in the product development stage. In relation to the smile curve, high-value items give rise to a strong need for cross-functional integration, whereas low-value items do not, which explains our finding of the significant impact of integration at the concept development and commercialization stages, but not at the product development stage.

Second, several researchers (Hart & Ahuja, 1996; King & Lenox, 2001; Charter & Clark, 2007) have called for empirical evidence examining the effects of integrating an environmental specialist with other functional departments throughout the entire SNPD process. In this regard, this study makes several important research contributions as well. We do conceptualize and empirically investigate integrating an environmental specialist with other functional departments across the entire SNPD process (i.e., concept development, product development, and commercialization). The phase-specific analyses show that the integration of the environmental specialist with the SNPD team has a significant, positive impact on new product project performance during the commercialization stage. As explained earlier, the role of the environmental specialist at this stage includes suggesting new technologies or methods, the installation of more efficient engines and tires, using hybrid drive systems to reduce a company's environmental footprint and increase efficiency, and indicating effective ways and technologies to deal with production waste, which helps a company have better sustainability metrics and a higher return-to-landfill rate, and saves cash along the way. All of these activities lead to cost-efficiency and cash

savings, which explains the significant positive impact of the integration of an environmental specialist on SNPD project performance. As an example, Subaru of Indiana has attained zero-waste-to-landfill, which means they have a hundred percent return-to-landfill ratio. According to the data, last year the plant saved $5.3 million by reducing waste and recycling (Farzad, 2011).

On the other hand, the most surprising finding of this study is the observation that the integration of an environmental specialist into the SNPD team at the concept development stage had a significant negative impact on SNPD project performance. One possible explanation for this would be that the suggestions made by environmental specialists at the concept development stage may require costly investments or incur additional expenses, which impact project performance negatively in the short run. However, we still think that the integration of an environmental specialist and integrating sustainability into the conceptual stage of SNPD would have a positive impact on the overall brand image in the long run.

Finally, the findings show that the degree of innovation of the product being developed influences the impact of the integration of an environmental specialist on project performance differently across stages. The results revealed that the integration of the environmental specialist with the SNPD team in the commercialization stage has a stronger positive impact on new product performance in high-innovative product development projects than in low-innovative ones. However, the integration of an environmental specialist at the concept development stage appears not to be impacted by the degree of innovation.

Managerial Implications

Our findings suggest that organizations need to carefully manage cross-functional integration in the SNPD process, and that managers need to foster cross-functional integration among personnel from the marketing, R&D, and manufacturing departments and environmental specialists at specific stages of the SNPD process. Thus, managers are not well advised if they adhere to the popular view that integration of the same functions across all of the stages of SNPD is good for product success. Instead, they need to focus on facilitating cooperation, especially when the novelty of the job being done is high, as in the concept development and commercialization stages of the SNPD process. Specifically, managers should seriously consider integration between marketing and R&D during the concept development stage, and between marketing and manufacturing during the commercialization stage. More important, our results show a strong positive impact on SNPD project performance when an environmental specialist is integrated into the team. Managers should understand that integrating environmental specialists is an effective way to bring the "voice of sustainability" into a firm and make a positive contribution to new product development project performance. Therefore, managers need to take strong, proactive initiatives to bring environmental specialists into the NPD process. A promising strategy would be to integrate environmental specialists into cross-functional teams, especially at the commercialization stage, where decisions regarding product launches, logistics and transportation are made.

However, when trying to integrate functional departments, managers face some challenges arising from the different mindsets of different functions in the team. Managers should ensure that functional personnel participate in adequate numbers, that they are well trained in integration methods, and that they have enough of a

reputation to be accepted as valued partners in decision-making processes. Specific training for the traditional team members (i.e., marketing, R&D) should concentrate on giving them a holistic view of why integrating environmental sustainability into the SNPD process is important. Moreover, functional members of the team need to understand how suggestions made by the environmental specialist can affect the overall market success of the product strategy. Certainly, measures and rewards need to be adjusted to be consistent with this overall view. Cross-training may serve to build cross-functional empathy and a collegial environment, which are needed to establish respect and trust across departments (Susman & Dean, 1992). Information systems can also play a role in facilitating communication and collaboration throughout the SNPD phases (Swink, Sandvig, & Mabert, 1996).

Limitations and Future Research

The primary limitations of this study are those inherent in survey-based research. First, the data are self-reported and so are subject to bias, although we checked for common-method bias and found it not to create much difference as also suggested by meta-analysis of studies. Second, asking respondents to provide retrospective evaluations might lead to their simply forgetting relevant information. Third, we recruited only one respondent per firm, though only surveys completed by knowledgeable respondents were included in the analyses. Finally, we used a cross-sectional methodology, which constrains the ability to infer causation, although it is useful for hypothesis testing. Our understanding of why the results are what they are would clearly benefit from future research employing a larger sample and longitudinal methods.

Further research could follow other fruitful avenues. One would focus on extending cooperation beyond the functional members by including other, external constituents, such as customers, suppliers or distributors.

Although this study offers a lot of clues about which members should be integrated at various stages of the SNPD process, another avenue for future research would be to examine ways to improve the integration, such as coordination mechanisms, tracking and assessment procedures, and incentive policies.

Conclusion

This study shows the positive influence on new product performance of integrating an environmental specialist with the traditional members of an NPD team. By designing a framework to analyze this relationship across the stages of sustainable new product development (SNPD), we gained a clearer picture of the effectiveness of that integration. First, cross-functional integration becomes critical when the novelty of the task increases. This occurs when the product is in the concept development stage and when it is launched in the commercialization stage. Second, the integration of an environmental specialist is more effective for product performance in the final stage of the SNPD process, when the product is launched. This effect especially becomes apparent for high-innovative projects. These new and detailed insights will help academics better understand the nature and effects of cross-functional integration in SNPD and will help managers take appropriate and actionable measures to lower failure rates and boost SNPD performance.

CHAPTER 3

THE MOTIVATIONS FOR ADOPTING AN ENVIRONMENTAL MARKETING STRATEGY AND THEIR IMPACT ON SUSTAINABLE NEW PRODUCT PERFORMANCE

Literature Review

The Origins of Corporate Environmentalism

The book *Silent Spring*, published by Rachel Carson in 1962, has been credited as the origin of modern environmentalism. In this book, Carson discusses how the use of pesticides and insecticides was polluting water resources and soil and threatening to become a major health problem. Since then, it started to become clear how important the protection of the natural environment is for the future of human beings. This and subsequent books published at that time created a public awareness that led to green movements. The 1970s were an era of the formalization of environmental protection organizations, such as Environmental Protection Agency (EPA) in the U.S. In 1984, the world's greatest industrial disaster occurred, Union Carbide's gas leakage at Bhopal. This event brought further attention to corporate responsibility regarding the natural environment and brought the strategic decisions of firms into the limelight (Shrivastava, 1992). Accordingly, the idea that it is the responsibility of companies to protect the natural environment was widely accepted.

In 1987, The World Commission on Environment and Development (WCED) defined sustainable development as "development that ensures that it meets the needs of the present without compromising the ability of future generations to meet their own needs" (p. 8). After the 1990s, consumer movements favoring sustainable business practices and demanding sustainable products emerged. This further instigated another wave of environmental legislation in most countries, emphasizing

the twin objectives of economic growth and environmental protection. These consumer movements also initiated the sustainable new product development period.

Previously, the integration of sustainability and environmental concerns into a firm's decision-making criteria and corporate strategies was considered to be a tradeoff between sustainability and economic performance, because it necessitated new investments that meant additional costs (Mathur & Mathur, 2000; Walley & Whitehead, 1994). Later, this view was challenged by ideas that recognized the benefits associated with sustainable business practices and proposed sustainability as a potential tool for competitive advantage (Porter & van der Linde, 1995). The leading scholars introduced a win-win paradigm; namely, that a firm could be even better off by adopting sustainable business practices (Brown & Dacin, 1997; Reinhardt, 1999; Porter & van der Linde, 1995). In tandem with the positive views asserted in the academic world, more and more companies have included sustainable business practices and introduced sustainable new products. For some companies, this even became a core strategy. Among the classic examples is Patagonia, an American sport garments company, which in the 1990s launched new lines of clothing made of recycled PET (polyethylene terephthalate) and organic cotton. This was a commercial success in spite of the higher price of these products (Reinhardt, 2000). Kuosmanen and Kuosmanen (2009, p. 235) affirm that "sustainability is nowadays generally accepted as one of the key success factors in the long term business strategy of the firm." Nguyen and Slater (2010) stated that two out of three companies on *Fortune's* "Global 100 Most Sustainable Corporations" list outperformed their less sustainable competitors.

Environmental Strategy

Hart (1995) argued that existing marketing and management theories in the 1990s had a serious omission since they viewed the “environment” of the firm as consisting of legal, political, economic, social, and technical elements. He proposed that this view was narrow because it ignored the interactions between organizations and their natural environment. The natural environment can create serious constraints on firms’ attempts to gain competitive advantage, since these constraints can make some product-market policies and strategies unsustainable in the long run. On the other hand, as was concluded by many studies (i.e., Porter & van der Linde, 1995), the inclusion of the natural environment in a firm’s decision-making criteria could create market opportunities that would lead to competitive advantage. Hart concluded that “it is likely that strategy and competitive advantage in the coming years will be rooted in capabilities that facilitate environmentally sustainable economic activity—a natural-resource-based view of the firm” (Hart, 1995: 991).

Later, Varadarajan (1992) and Menon and Menon (1997) introduced the concept of *enviropreneural marketing*, which is a reflection of a company’s environmental orientation and commitment in its marketing strategy. Varadarajan (1992) called for *enviropreneurship* as "an idea whose time has come" (p. 342). Accordingly, he defined the term *enviropreneurial marketing as* "environmentally-friendly marketing practices, strategies, and tactics initiated by a firm in the realm of marketing: (1) to achieve competitive differentiation advantage for the firm's offerings vis-à-vis competitors' offerings, and (2) influenced by the firm's views on the duties and responsibilities of a corporate citizen" (p. 342). Menon and Menon (1997) discussed the role of the natural environment in marketing strategy and firm performance and proposed a testable model. Sharma and Vredenburb (1998)

conducted an empirical examination of the natural resource-based view (NRBV) of the firm perspective proposed by Hart. They found that strategies of proactive environmental responsiveness were associated with the emergence of unique organizational capabilities, and these capabilities, in turn, were found to have implications for firm competitiveness. Stone and Wakefield (2000) adapted Jaworski and Kohli's market orientation framework (intelligence generation, intelligence dissemination and responsiveness) to examine firms' environmental orientation. He found that firms that are responsive to environmental issues perform better in the marketplace. Banerjee defined corporate environmentalism as "the organization-wide recognition of the legitimacy and importance of the biophysical environment in the formulation of organization strategy, and the integration of environmental issues into the strategic planning process" (2002:181). Later, Banerjee et al. (2003) identified public concern, regulatory forces and competitive advantage as important antecedents of corporate environmentalism. They also operationalized the concept of corporate environmentalism. They found that corporate environmentalism is related to all of the proposed antecedents and that top management support is a mediator between these antecedents and corporate environmentalism. Our study is an extension of this study; we also examine the consequences of corporate environmentalism, specifically environmental marketing strategy in terms of SNPD performance, as Banerjee et al (2003) proposed. As mentioned previously, little empirical research has been done about the consequences of environmental marketing strategies as they relate to SNPD performance (Baker & Sinkula, 2005). Baker and Sinkula (2005) operationalized the enviropreneurial marketing construct and examined its relationship to firms' NPD performance and market share. They defined enviropreneurial marketing as strategy development that balances organizational and social concerns. Unlike them, we

aimed to analyze the relative impacts of the antecedents (namely, the motivations for developing an environmental marketing strategy) on new product advantage and SNPD performance. Since the relationship of environmental marketing strategies to SNPD performance is relatively under-researched, we think that this study makes a substantial contribution both to the sustainability and the NPD literature.

Sustainable New Product Development

It is widely accepted that firms have to develop new products in order to remain competitive for success in the long run (Cooper, 1983; Ulrich & Eppinger, 1995; Wheelwright & Clark, 1995). On the other hand, in the previous section, we mentioned the benefits for a firm of incorporating of sustainability concerns. Porter and van der Linde (1995) observed that reducing inefficiencies during the production process or focusing on innovation to meet strict environmental regulations may bring early-mover advantages for companies. Siegel (2009) argued that firms can adopt sustainable product innovation, such as redesigning packaging, developing more sustainable products and advertising the sustainable benefits of those products to create differentiation advantages and gain market share. In addition, some sustainable management actions, such as redesigning, substituting less polluting inputs, and recycling the by-products of processes may promote cost advantages. Therefore, integrating sustainable management into the conventional NPD process would help firms to achieve long-run competitiveness and sustainability goals, which would lead to a win-win situation for both the firm and the society (Chen, Lai & Wen, 2006).

Furthermore, sustainability concerns include new customer requirements above and beyond conventional product quality, functionality, and cost, regarding how products are made, how they are used, and how they can be disposed of (Peattie,

1999). However, just playing with the cosmetics of existing products, like renaming them or repackaging them with some sustainability emphasis, provides only limited opportunities for a firm, and sometimes it may even be detrimental, as in the case of *greenwashing*, the practice of making an unsubstantiated or misleading claim about the environmental benefits of a product, service, technology or company practice. Pujari et al. (2003) conclude that a paradigm shift is under way towards a more explicit incorporation of sustainability concerns into product development among UK manufacturers. Because, recently, the wider responsiveness to sustainability at the corporate level necessitates more substantive changes at the product development level, whereas before it involved only relatively superficial changes. Therefore, there is a need for an explicit and clear incorporation of sustainability issues into the conventional NPD process.

One of the most important aspects of the SNPD process is its adoption of a "cradle-to-grave" approach which means minimizing the impact on the environment at every stage of the process. This approach addresses a wide range of considerations, from where raw materials come from to what happens to products post-use (Sharman et al., 1997, Simon et al., 2000). Therefore, SNPD requires a detailed understanding of the socio-environmental impacts of the entire supplier system. In conjunction with the "cradle-to-grave" nature of SNPD, it encompasses a range of factors that require integrating of various functions in an organization, such as manufacturing, marketing, and R&D (Huang, 2005). Therefore, this study emphasizes the multi-functional nature of the SNPD process.

Sustainable management practices can be applied to the production processes of a wide range of products, from apples (e.g., organic) to cars (e.g., low-emission). These products may use fewer chemicals in their production, produce limited carbon

footprints, require fewer resources to produce, and consume less energy or emit fewer hazardous emissions. In spite of its wide use, sustainable management is not a well-defined concept in the literature (Chen, 2001). It has been argued in previous studies that sustainable management needs to go beyond compliance with the law and should take further action towards the efficient use of resources, the minimization of waste, pollution prevention, and the recycling and reuse of used goods through the use of new innovative methods (Marcus & Fremeth, 2009; Hart, 2005). Peng and Lin (2008) defined it as producing sustainable products and minimizing the overall impact on the environment via sustainable product designs, sustainable R&D, and sustainable marketing. Haden, Oyler and Humphreys (2009) regarded it as the organization-wide process of applying innovation to achieve sustainability, waste reduction, and social responsibility. Huang and Wu (2010) defined it as the organization-wide process of developing and producing environmentally-friendly products and reducing sources of pollution to minimize risks to human health and the natural environment.

Consequently, this study defines *sustainable new product development* (SNPD)[4] as "an organization-wide process of new product development into which sustainability concerns are explicitly integrated to minimize impacts on the natural environment, and on animal and human health, via sustainable product design, sustainable R&D, sustainable production and sustainable marketing. This includes redesigning existing products to reduce their impact on the sustainability of resources and developing of new products and services driven by sustainability concerns (Berchicci & Bodewes, 2005). SNPD is not a radically different process than conventional NPD[5], but it

[4] There is small but growing literature on SNPD. The authors variously used ENPD, GNPD. For this paper, *sustainable NPD* was used regarding similar meaning with *environmental NPD* (Pujari, Wright & Peattie, 2003) and Green NPD (Huang & Wu, 2010). We prefer "sustainable" to "environmental" or "green" because we think this term is clearer and more definite than the others.

[5] *Conventional NPD* refers to NPD processes without particular regard for, or attention to, sustainability.

involves considerations about sustainability in addition to the other factors considered for market success.

Although there is frequently cited anecdotal evidence of the market success of sustainable products such as Toyota's Prius brand or P&G's Future-Friendly products (i.e. Lenor concentrated fabric softener), relatively little empirical research has been conducted on the impact of sustainable new product development on the market success of these products (e.g., Pujari et al., 2003; Huang & Wu, 2010). Huang (2005) argued that most of the previous studies tend to be rather conceptual, normative, and subjective, although having clear contributions to the literature of SNPD. Such studies placed less emphasis on exploring and explaining the implications of incorporating sustainability concerns into product development (Baumann, Boons, & Bragd, 2002; Lenox & Ehrenfeld, 1997) and dwelling more on anecdotal evidence (Pujari et al., 2003). To our knowledge, very little work has been done to explore the success factors of SNPD, in particular the impact of cross-functional integration (i.e., Pujari et al., 2003; Huang & Wu, 2010). Therefore, this study is designed to narrow this gap by integrating the mainstream research on sustainable management and new product development to further explore the impact of cross-functional integration on the market success of sustainable new products across stages of the SNPD process.

Like conventional new products, sustainable new products should achieve market success by performing well financially, which determines the degree to which firms are more profitable than their competitors (Clemens, 2006; Judge & Douglas, 1998). Being preferred by more consumers contributes to a firm's bottom line and should later contribute to the pursuit of sustainability as an asset, which will create an example for the win-win paradigm developed by Porter (Porter & van der Linde,

1995). Therefore, in order to benefit society overall, sustainable new products should wrestle market share away from their conventional counterparts.

To our knowledge, little research has been done on the success factors of SNPD, in particular on the relative impact of the motivations that lead to the development of environmental marketing strategies (i.e., Pujari et al., 2003; Huang & Wu, 2010). Therefore, this study is designed to narrow this gap by integrating the mainstream literature on sustainable management and new product development to further explore various motivations—specifically public concern, regulatory pressures and market opportunity—that lead firms to adopt environmental marketing strategies and their impact on product advantage and SNPD performance.

Theoretical Background

What factors lead a firm to embrace an environmental marketing strategy? Is it a response to regulatory pressures or part of a proactive strategy to gain competitive advantage in the marketplace? What will be the outcome of the environmental strategy on product advantage and SNPD performance? To address these questions, in developing our theoretical model, we combined stakeholder theory with a natural resource-based view (NRBV) of the firm. We used stakeholder theory (Harrison & Freeman, 1999; Henriques & Sadorsky, 1999) to identify environmental stakeholders and NRVB theory (Hart, 1995) to frame the model in terms of a resource-capability-performance relationship.

Stakeholder Theory

Firms try to satisfy stakeholders with different strategies, which leads to variations in corporate performance (Harrison & Freeman, 1999; Henriques &

Sadorsky, 1999). We denoted *environmental stakeholders* as individuals or groups that can affect or be affected by the accomplishment of a firm's environmental tasks (Freeman, 1984). Accordingly, the environmental stakeholders are regulators, community members and organizational members (Henriques & Sadorsky, 1999). Regulators require compliance to environmental standards and are one of the key stakeholders that have a say in the development of a firm's strategy. Community stakeholders, such as environmental activists, consist of nongovernmental organizations and lobbies that have an interest in the preservation of the natural environment. Organizational stakeholders include shareholders, customers, and employees. The way in which a firm responds to these stakeholders' interests determines its environmental marketing strategy and NPD performance (Baker & Sinkula, 2005). Based on the findings of the study by Banerjee et al. (2003) and one by Baker and Sinkula (2005), we identified public concern, market opportunity and regulatory pressures as important antecedents to a firm's environmental marketing strategy. For stakeholders to be effective in influencing a firm's strategy, they need access to, and the attention of, top management (Agle, Mitchell, & Sonnenfeld, 1999). Therefore, we identified top management as a key mediator between the motivations and the strategy.

Resource-Based View (RBV) Theory

The resource-based view of the firm asserts that the performance of companies differs because they own heterogeneous resources (Barney, 1991; Dierickx & Cool, 1989). Such heterogeneity is a result of a firm's rare, valuable, non-substitutable and imperfectly imitable resources and its ability to translate these resources into capabilities that lead to the development of a competitive advantage over the competition. Hence, RBV theory asserts that there is path dependency among

resources, capabilities and firm performance. Hart (1995) further asserts that environmental constraints motivate firms to develop new and distinctive resources and capabilities. These capabilities allow firms to respond more efficiently to environmental pressures through the design of new and flexible strategies that, in turn, are likely to be translated into sustainable competitive advantages and better performance. He asserted, “[S]trategists and theorists must begin to grasp how environmentally oriented resources and capabilities can yield sustainable sources of competitive advantage" (1995, p. 99). In fact, a study by Baker and Sinkula (2005) examined the tenets of the resource-based view (RBV) within the context of enviropreneurialism and found that such an orientation led to new product success and competitive advantage. This study, following Hart’s (1995) approach, considered environmental marketing strategy to be a competitive strategy that allows firms to enhance SNPD performance through creating product advantage, as a source of competitive advantage. Within this framework, top management support is seen as an intangible asset that mediates the relationship between the environmental strategy and its antecedents.

Hypotheses Development

In the following section, we explain our hypotheses regarding the proposed framework (see Figure 2).

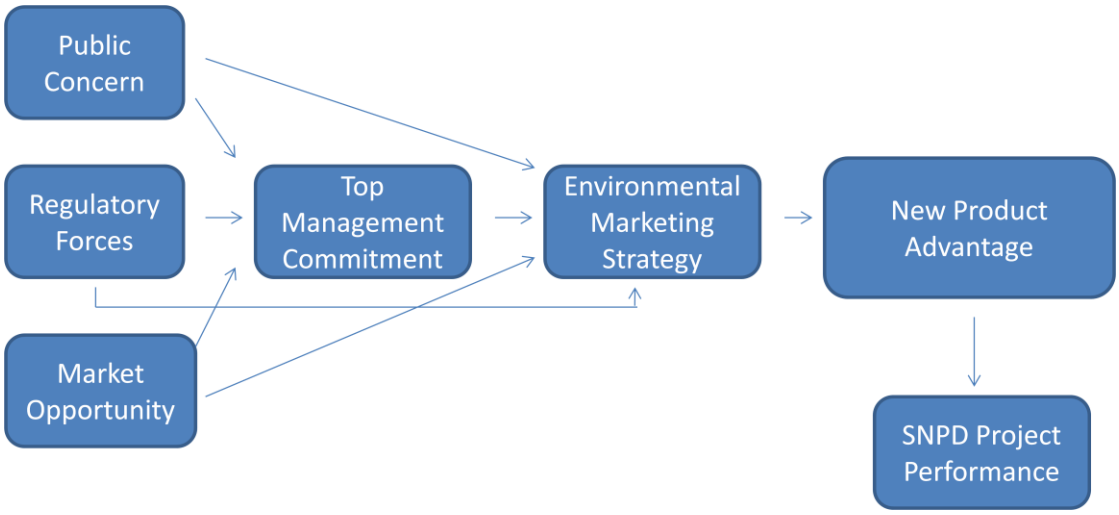

Figure 2 The Conceptual Framework of Antecedents and Consequences of Environmental Marketing Strategy

Public Concern for the Environment

Since the 1970s, environmental concerns have been a major a public issue. Especially after the 1990s, consumers started to favor environmentally friendly products by reporting that they were willing to pay premiums for environmentally friendly products (Ottman, 1998), and many environmental activist groups organized events to invite firms to become more environmentally responsible. Here, we consider public concern as including both community stakeholders, such as environmental activists, and customers demanding environmentally friendly products. Public concern can influence corporate environmentalism in two ways: First, firms may improve their corporate image by showing their responsiveness to the public, and second, firms could benefit by targeting green consumers who prefer environmentally responsible products over conventional ones and are generally willing to pay more for them.

Public concern, therefore, becomes a major motivation for firms to develop environmentally friendly strategies.

H_1: Public concern will be positively related to environmental marketing strategy.

Regulatory Forces

Regulators are important stakeholders who mandate compliance with environmental standards. Regulations have an impact on firms' strategies in various domains, such as packaging content (McCrea, 1993), product formulation (Ottman, 1993), and distribution channels (Green Market Alert, 1993). In a study based on surveys of 20 chemical firms, Ochsner (1998) found that environmental legislation is the most important incentive for firms' developing pollution prevention strategies. Accordingly, we include regulatory forces as another important factor that motivates firms to develop environmental marketing strategies.

H_2: Regulatory forces will be positively related to environmental marketing strategy.

Market Opportunity

Competitive advantage is a powerful economic force, internal and external to a firm, that influences corporate environmentalism (Lee & Green, 1994; Taylor & Welford, 1993). In their leading article, Porter and van der Linde (1995) state that proper environmental strategies can generate innovations that either lower costs or improve value, which leads to competitive advantage in the long run. Another study concludes that producing an environmentally friendly product helps target new markets and maintain or increase market share (Roy, 1999). Many firms are now

regarding sustainable management as a strategic tool for gaining competitive advantage (Hart, 2007; Hoffman, 2007; Porter & Reinhardt, 2007; Schwartz, 2007). Firms are increasingly adopting sustainability performance standards that go beyond regulatory compliance (Christmann, 2004). Sustainability initiatives that stand at the intersection of environmental concerns and market opportunities may lead to the greatest chance of success (Connelly, Ketchen, & Slater, 2011). Environmental policies that exceed legislative guidelines have resulted in substantial cost savings for many firms, including 3M, AT&T, Chevron, DuPont, and IBM. For example, 3M has saved more than $1 billion and prevented more than 1.13 million tons of pollutants since it launched its Pollution Prevention Pays program in 1975 (3M, 2007). In addition, targeting environmentally conscious consumers with sustainable products can also lead to competitive advantage. There are even some firms that have specifically positioned themselves around environmental concerns, such as Ben and Jerry's, The Body Shop, and Patagonia. As a result, they derive competitive advantage and gain unique market positions from their environmental strategies (Kearins & Klyn, 1999; Sweeney, 1997). Therefore, we hypothesize that seeing sustainable business practices as a market opportunity would be an important factor leading to environmental marketing strategy development.

H_3: Market Opportunity will be positively related to environmental marketing strategy.

Top Management Commitment

The involvement of top management is a critical factor in shaping both organizational values and goals (Drumwright, 1994) and in implementing

organizational strategies (Nystrom, 1990). It has a crucial impact on any company initiatives; however, it may have an even more vital role in the success of environmental management initiatives, since integrating environmental concerns sometimes can be a challenge to the existing organizational culture. Therefore, integrating environmental strategies into new product development processes requires clear support and commitment from top management. In fact, the commitment of top management has been found to be a key factor in the promotion of corporate environmentalism (Pujari et al., 2003; Drumwright, 1994; Starik & Rands, 1995; Taylor & Welford, 1993). This involvement may be found at different levels in different companies. In some companies, top management can demonstrate its support of corporate environmentalism by having special environmental units; in others companies, it may involve assigning senior managers to be responsible for overseeing the firm's environmental orientation and strategies. In other cases, top management might be directly involved, as in the case of the DuPont and 3M companies (Coddington, 1993). Therefore, we propose the following:

H_4: Top management commitment will be positively related to environmental marketing strategy.

Top management directly influences corporate environmentalism, and, by recognizing only the more salient, legitimate, or powerful stakeholders (Mitchell, Agle, & Wood, 1997), also mediates the effects of all of the other factors. For example, unless environmental considerations receive the attention and support of top management, even a high level of public concern may not result in a modification of corporate environmental strategy, such as developing and marketing sustainable

products. Environmental regulations should also get top management's attention (Agle, Mitchell, & Sonnenfeld, 1999) to have an impact on the firm's strategy development process. The role of top management in the SNPD context could be really decisive. If they insist on improving the environmental impact of products, then the project teams, which desire approval for projects, will be more motivated to engage. A lack of commitment and support on the part of management has been identified in the literature as an obstacle to the integration of sustainability considerations in the innovation processes of organizations (Boks, 2006).

H_5: Top management commitment will mediate the impact of public concern on environmental marketing strategy.

H_6: Top management commitment will mediate the impact of regulatory forces on environmental marketing strategy.

H_7: Top management commitment will mediate the impact of market opportunity on environmental marketing strategy.

We also distinguish motivations that lead firms to develop environmental marketing strategies as being either proactive or reactive. A firm's attempt to develop environmental strategies may lie along a continuum of "reactive" to "proactive" activity (Aragón-Correa, 1998; Hart, 1995; Henriques & Sadorsky, 1999; Hunt & Auster, 1990; Klassen & Whybark, 1999; Russo & Fouts, 1997; Sharma & Vredenburg, 1998; Shrivastava, 1995). Is it beneficial for a firm to exceed legal standards and execute proactive environmental strategies? To answer that question,

we wanted to compare the results realized from reactive and proactive environmental strategies. Corporate environmentalism generally starts as compliance with legislation; however, several studies show that environmental strategies must exceed government regulations and be future-oriented in order to gain competitive advantage, meaning that the strategies are proactive (Aragón-Correa, 1998). Reactive environmental strategies simply comply with environmental regulations (Walls, Phan, & Berrone, 2011), whereas proactive environmental strategies go beyond compliance and make additional efforts to execute sustainable business practices, because firms see it as a market opportunity when their public is demanding sustainable new products that go beyond what is required by law. We expect that firms that implement proactive strategies would have a better competitive advantage, since they can easily differentiate themselves from the competition which, in turn, leads to better performance. Accordingly, we have the following hypotheses:

H_8: Firms that are relatively motivated by Market Opportunity (MO)(a proactive strategy) to develop environmental marketing strategies would have on average better SNPD project performance than firms that are motivated by Regulatory Forces (RF) (a reactive strategy).

H_9: Firms that are relatively motivated by Public Concern (PC) (a proactive strategy) to develop environmental marketing strategies would have on average better SNPD project performance than firms that are motivated by Regulatory Forces (RF) (a reactive strategy).

New Product Advantage

In regard to strategy, environmental marketing plays a crucial role for firms aiming to reduce negative environmental and social impacts coming from existing products and production systems (Peattie, 2001). It is said that a firm that incorporates sustainability into its marketing strategy could have a differential advantage over the competition (Ferrell, 2010). Similarly, incorporating sustainability considerations into the product development process could result in new product advantage. New product advantage occurs when a new product offers unique benefits and is superior to competing products; for instance, it might have unique features, relatively high product quality, or the ability to reduce consumer costs or enable the consumer to perform a unique task (Atuahene-Gima, 1995; Calantone & Di Benedetto, 1988; Song & Parry, 1997). Environmental attributes attached to new products could provide additional benefits and value for consumers. It depends on the extent to which a new product's sustainability-related attributes are beneficial and/or valuable to consumers in light of its unique features. Consider organic products. Consumers may value organic products because they are sustainable; in other words, they are good for the environment. Furthermore, more benefits and desirability can be achieved by offering improved performance associated with other attributes in the new product. In this case, consumers may also value organic products because of the superior functionality afforded by attributes such as taste or nutritional value, making them superior to their conventional counterparts. Therefore, we hypothesize that incorporating environmental strategy into the new product development process will be associated with new product advantage.

H_{10}: Environmental marketing strategy will be positively associated with new product advantage.

According to a recent meta-analysis on NPD, new product advantage is the most important determinant of new product performance (Henard & Szymanski, 2001; Montoya-Weiss & Calantone, 1994). Song and Parry (1996) found significant correlations between multi-item measures of product advantage and several measures of product success. In line with the prior research, we hypothesize that:

H_{11}: New Product Advantage will be positively associated with SNPD project performance.

Methodology

In order to test the foregoing hypotheses, we collected data describing completed SNPD projects via an online survey. In the following sections, we will describe the sample, the data collection procedures and the survey instrument.

Sample

This study is primarily focused on the processes and outcomes associated with individual SNPD projects rather than on the aggregate SNPD performance of an entire firm or division. Consequently, the study examined cooperation among functions over the course of an SNPD project. Product/project managers in various U.S. companies who fit the study objectives were contacted to ensure that the final sample consisted only of respondents who had worked actively on new product development projects for which performance data were available. Respondents who participated in the study were working in companies that operate across several industries. In order to increase

the diversity of projects in the study, we maintained the anonymity of the respondents. We specifically requested projects that differed in terms of product newness and that had been completed within the past five years. The key participants were the "product/project managers" or the "team leaders" of the SNPD projects, as the people with the most direct responsibility for the project. This approach is consistent with previous research studies (Henard & Szymanski, 2001), and no differences were found when single or multiple respondents' approaches were used (Slater & Narver, 1998). To encourage participation, we made a confidentiality agreement with each company and promised to give them an executive summary of results upon request. Respondents received a hyperlink to an internet-based questionnaire by e-mail. They were asked to fill out the survey for the most recently introduced product that they were knowledgeable about and for which performance data were available. Each participant was asked to complete the questionnaire, which assessed his or her perceptions regarding the hypothesized constructs, and was asked for performance measures and company demographic information (e.g., industry type, number of employees). A total of 1,200 respondents were contacted. Overall, 282 questionnaires were returned, which made for a response rate of 23.5%. The elimination of sixty-three surveys because of incomplete responses left 219 usable questionnaires. The sample covered a range of industries, including industries involved in electrical and electronic devices, chemicals, hospital and medical devices, agriculture and processed food products, machinery, pharmaceuticals, automotive and spare parts, and steel products. T-tests were applied between early and late responses, and the results did not show significant differences on all of the variables, treated separately (Armstrong & Overton, 1977). We also performed a multivariate analysis of variance (MANOVA) to compare early respondents with late respondents on all of the variables. Similarly,

the results were not significant at the 95% confidence level, suggesting there were no significant differences between early and late respondents. Both of these analyses suggested that non-response bias was not a concern.

Measures

We reviewed the literature to identify scales to measure each construct. All of the measures were adopted by the appropriate research studies. In the following section, we explain in detail how we measured each construct. The questionnaire instrument was composed of three parts, starting with a cover letter describing the purpose of our survey and communicating the approval of the Institutional Review Board. The first part consisted of items for measuring the hypothesized constructs. The second part contained items measuring the performance of the SNPD projects, and the third part contained items measuring company descriptive data, including the number of employees, the year founded, the industry sector, and so forth. All of the constructs were measured using seven-point Likert scales from 1 to 7, ranging from strong disagreement (1) to strong agreement (7). Firm size (a control variable) was measured by the number of employees. The definitions and measurements of the constructs are further defined as follows:

Project performance: This refers to the ability of a sustainable new product or innovation to compete in the marketplace and to the degree to which firms are more profitable than their competitors (Clemens 2006; Judge and Douglas 1998). Overall, SNPD project performance captures the success of the completed SNPD project. We followed previous NPD research and used a commonly applied subjective measure of new product success (Ernst et al., 2010; Song & Parry, 1997a) (for a detailed description of the SNPD performance measures, see the Appendix). Subjective

measures have the advantage of facilitating comparisons across SNPD projects of firms from different industries (Atuahene-Gima, 1995).

To measure public concern (PC), we asked managers about their perceptions of the importance the general public assigns to protecting the environment and their perceptions of the potential customer demand for environmentally friendly products and services. We measured regulatory forces (RF) with items dealing with managerial perceptions of the influence of government regulation on strategy and with the level of environmental regulation faced by the industry. We measured market opportunity (MO) using items that focused on investment in research and development, cost savings, and growth opportunities in new markets. We measured top management commitment (TMC) via the respondents' perceptions of top management's commitment to, and support for, environmental initiatives. To measure environmental marketing strategies (EMS), we included items that assessed the degree to which environmental concerns were integrated with the firm's product-market decisions. The measure for new product advantage (NPA) was based on items measuring managers' perceptions of the benefits that customers receive from buying and using a new product and their perceptions of the superiority of the product over the competition (see Appendix for details).

Psychometric Properties of the Scales

Before starting the main analyses, several tests were conducted to validate the psychometric properties of the scales. First, potential common method bias was discarded using the Harman test, which revealed that four different factors emerged from a factor analysis that explained more than 73% of the extracted variance (Podsakoff & Organ, 1986). The unrotated principal component factor analysis, the principal component analysis with varimax rotation, and the principal axis analysis

with varimax rotation all revealed the presence of four distinct factors with eigenvalues greater than 1.0, rather than a single factor. Thus, no general factor was apparent. Moreover, the confirmatory factor analysis showed that the single-factor model did not fit the data well: $\chi 2$ = 2395.847, p=.000, GFI= .479; CFI= .679; RMSEA= .150. Table 2-1 reports the means, variances, standard deviations, skewness and kurtosis for all of the variables. Examination of the skewness and kurtosis values for all of the variables (see Table 2-1) indicated that the regulatory forces and new product advantage variables were skewed. Necessary transformations were applied to these variables to ensure normality. To assess the reliability of all of the scales, the value of Cronbach's alpha was studied and was found in all cases to far exceed the recommended threshold of 70% (Nunnally, 1978) (see Table 2-2).

Table 2-1 Descriptive Statistics

	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
PC	5.5297	1.20967	1.463	-.934	.164	.724	.327
RF	5.4030	1.27138	1.616	-1.029	.164	1.174	.327
MO	5.3455	1.25885	1.585	-.746	.164	.302	.327
EMS	5.2359	1.41445	2.001	-.685	.164	-.212	.327
TMC	5.5723	1.21082	1.466	-.843	.164	.375	.327
NPA	5.8782	1.01437	1.029	-1.164	.164	1.200	.327
PERF	5.5240	.90154	.813	-.449	.164	.742	.327

Table 2-2 Reliability Analyses

	Cronbach's alpha
PC	.880
RF	.892
MO	.944
EMS	.926
TMC	.909
NPA	.938
PERF	.883

An exploratory factor analysis was performed on the independent variables relating to the motivations for developing an environmental marketing strategy, using principal component analysis (the varimax method). Table 2-3 shows the results, which produced three factors with factor loadings of 0.60 as cutoff points (except for the fourth item in the regulatory forces construct),[6] accounting for 79% of the variance, (K–M–O statistic .93, Barlett statistic 2378, significance .000).

Table 2-3 Explanatory Factor Analysis Loadings

Rotated Component Matrix

	Component		
	1	2	3
PC1			.763
PC2			.835
PC3			.659
RF1		.797	
RF2		.830	
RF3		.805	
RF5		.813	
MO1	.688		
MO2	.810		
MO3	.816		
MO4	.808		
MO5	.810		
MO6	.842		

[6] As a result, we dropped this item from the scale.

Next, a series of confirmatory factor analyses (CFAs) was performed to test the scales on their unidimensionality. Instead of examining all of the variables in a six-construct model, two models were fitted for two groups of theoretically interrelated variables, to avoid a violation of the five-to-one ratio of sample size-to-parameter estimates (Bentler & Chou, 1987). Model 1 contained public concern, regulatory forces and market opportunity constructs (GFI= .908 ; CFI= .964; RMSEA= .077). Model 2 included environmental marketing strategy, top management support, new product advantage constructs (GFI= .910 ; CFI= .965; RMSEA= .092). Both of the CFA models revealed good fits. The significant factor loadings demonstrated convergent validity for all of the scales (Tables 2-4 and 2-5).

To test convergent validity, exploratory factor analysis was performed on the project performance scale. The results of this analysis produced a single factor for the scale by specifying eigenvalues greater than 1. Then a confirmatory factor analysis was run on the financial performance scale. The results showed that one factor model fit the data well for the scale (GFI= .995; CFI= .999; RMSEA= .026). Thus, for the project performance scale, the variables seem to converge onto that scale, giving evidence of convergent validity. Therefore, the results of both the exploratory and confirmatory factor analyses suggest that all of the scales exhibited unidimensionality. With this evidence of satisfactory psychometric properties, the constructs were formed by averaging the responses to all of the remaining items in a particular scale.

Table 2-4 Confirmatory Factor Analysis - Model 1 (Standardized Estimates)

			Estimate	S.E.
PublicConcern3	<---	F1	0.884*	
PublicConcern2	<---	F1	0.763*	0.054
PublicConcern1	<---	F1	0.882*	0.055
RegForces5	<---	F2	0.753*	
RegForces 3	<---	F2	0.789*	0.078
RegForces 2	<---	F2	0.802*	0.077
RegForces 1	<---	F2	0.862*	0.081
MarketOpp6	<---	F3	0.842*	
MarketOpp5	<---	F3	0.886*	0.051
MarketOpp4	<---	F3	0.879*	0.061
MarketOpp3	<---	F3	0.878*	0.059
MarketOpp2	<---	F3	0.867*	0.06
MarketOpp1	<---	F3	0.794*	0.069

* $p < 0.01$

Table 2-5 Confirmatory Factor Analysis - Model 2 (Standardized Estimates)

			Estimate	S.E.
EMS3	<---	F1	0.867*	
EMS2	<---	F1	0.911*	0.051
EMS1	<---	F1	0.918*	0.052
TMS3	<---	F2	0.859*	
TMS2	<---	F2	0.892*	0.052
TMS1	<---	F2	0.885*	0.053
NPA6	<---	F3	0.825*	
NPA5	<---	F3	0.849*	0.058
NPA4	<---	F3	0.868*	0.065
NPA3	<---	F3	0.836*	0.065
NPA2	<---	F3	0.838*	0.075
NPA1	<---	F3	0.844*	0.072

* $p < 0.01$

Analyses and Results

A path analysis was employed to test the hypotheses. First, we estimated a path model using all of the hypothesized paths. We refer to this as the full model (χ^2_{7df} =

13.029, $p < .071$, goodness-of-fit index [GFI] = .983, comparative-fit index [CFI] = .994, RMSEA = .06). Second, we eliminated one insignificant path and estimated a reduced model ($\chi^2_{8df} = 13.909$, $p < .084$, goodness-of-fit index [GFI] = .982, comparative-fit index [CFI] = .995, RMSEA = .058). Based on the goodness of fit statistics, both the full and the reduced model had excellent fits to the data, but in general the reduced model fit the data better than the full model (see Table 2-6).

Table 2-6 Model Comparison based on the Goodness-of-fit Statistics

	Model 1: Full Model	**Model 2: Reduced Model**
Parameters	21	20
df	7	8
Chi-Square	13.029	13.909
p-value	0.071	0.084
CMIN/DF	1.861	1.789
GFI	0.983	0.982
CFI	0.994	0.995
RMSEA	0.063	0.058
AIC	55.029	53.909

In hypothesis 1, we predicted that public concern (PC) would be positively related to environmental marketing strategy (EMS). We found that the PC —> EMS was significant, supporting our H_1 with a significant path coefficient of .143. Our prediction regarding regulatory forces (RF) as an antecedent to EMS in H_2 also received support, with a significant path coefficient of .23. As H_3 predicted, market opportunity (MO) was found to have a significant influence, being positively related

to environmental marketing strategy as well, since the MO —> EMS path is significant (with a coefficient of .277). On the other hand, we predicted in H_4, the role of top management commitment would be an antecedent to an environmental marketing strategy. This hypothesis was supported because the path coefficient is positive (.36) and significant ($p \leq .05$, see Table 2-7).

Table 2-7 Path Model (Standardized Estimates)

Path			Estimate	S.E.
TMC	<---	PC	0.283*	0.06
TMC	<---	MO	0.582*	0.058
EMS	<---	PC	0.143*	0.048
EMS	<---	MO	0.277*	0.053
EMS	<---	RF	0.23*	0.094
EMS	<---	TMC	0.36*	0.051
NPA	<---	EMS	0.755*	0.022
PERF	<---	NPA	0.775*	0.167

* $p < 0.01$

We report the direct, indirect, and total effects of all of the antecedents on the constructs of EMS in Table 2-8. H_5, which pertains to the mediating effect of top management commitment between PC and EMS, was also supported, since it had a significant direct effect (.143, $p < .001$), as well as a significant indirect effect (.102, $p < .001$) on EMS. Similarly, we hypothesized in H_7 that top management commitment (TMC) would mediate the impact of market opportunity on environmental marketing strategy. As Table 9 shows, TMC significantly mediated the effect of MO on EMS, having a significant direct effect (.277, $p < .001$), as well as a significant indirect

effect (.209, $p < .001$). However, counter to what was predicted in H_6, TMC did not significantly mediate the effect of RF on EMS, since RF had no direct effect on TMC.

Table 2-8 The Mediation Effect of Top Management Commitment (TMC) between Different Motivations and Environmental Marketing Strategy (EMS) – Standardized Estimates

	EMS	
	Direct	Indirect
PC	0.143	0.102
RF	0.23	0
MO	0.277	0.209

In H_8, we predicted that MO, on average, would have a greater influence on new product performance (PERF) than RF. This hypothesis was supported, since the total (direct plus indirect) standardized effect of MO on PERF is greater than the total standardized effect of PC on PERF (.285 > .134). Similarly, H_9, which proposed that PC, on average, would have a greater influence on PERF than RF, was also supported, since the total standardized effect of MO on PERF was greater than the total standardized effect of PC on PERF (.144 > .134; see Table 2-9).

Table 2-9 The Total Standardized Effects of Different Motivations on SNPD Project Performance

	PERF
	Total Standardized Effect
PC	0.144
RF	0.134
MO	0.285

H_{10} proposed a direct effect of environmental marketing strategy on new product advantage. This, too, was supported, with a significant path coefficient of .755, $p < .001$). Finally, we found that the NPA —> PERF relation was significant, supporting our H_{11} with a significant path coefficient of .775 ($p < .001$; see Table 2-7).

Discussion

The overall purpose of this research was to provide empirical data to help integrate the notion of environmental sustainability into the marketing literature at the product level, by examining the drivers of environmental marketing strategy (EMS) and their impact on new product performance. In keeping with this purpose, we (1) developed a large framework of antecedents and consequences of environmental marketing strategy, and (2) modeled its relationships with its drivers with new product advantage and with SNPD project performance. In particular, we aimed to assess how much EMS is cultivated by proactive or reactive strategies and how they relatively impact SNPD project performance. Environmental strategy is an emerging area of research with little empirical evidence available, especially at the product level; our study is an attempt to fill this gap. Because the proposed model fit the data well, we were able to present much-needed empirical support for the relationships among various antecedents and consequences of environmental strategy. Altogether, our results have many implications for managers, which we discuss below. Furthermore, this study has important theoretical implications, since we observed that there are certain path dependencies in our results that mirror NRBV theory (Barney, 1991; Hart, 1995).

Public concern, a motivation for a proactive strategy, was positively related to environmental marketing strategy. Public concern, therefore, appeared as a major motivation for firms to develop environmentally friendly strategies. Our results also showed that public concern was indirectly related to the development of an environmental marketing strategy through top management commitment. That means, top management commitment partially mediated the relationship between public concern and environmental marketing strategy. Likewise, as another motivation for proactive strategy, market opportunity influenced the development of an environmental marketing strategy, and its impact was found to be partially mediated by top management commitment. Consistent with stakeholder theory, this signifies the importance of top management in fostering environmental sustainability. This result indicates that many firms are regarding environmental strategy as a strategic tool for gaining competitive advantage. Both of these results suggest that proactive environmental strategies need a commitment by top management in order to be completely implemented.

Regulatory forces had a significant direct influence on environmental marketing strategy, since regulations are important incentives for developing environmental strategies. However, their impact was not mediated by top management commitment. This result might be because regulations are coercive and do not need the attention of top management to be implemented, unlike public concern and market opportunity. Taken together, top management commitment was, with its direct and mediating effects, emerged as an influential antecedent to the formulation of an environmental marketing strategy.

As one of the main contributions of this study, environmental marketing strategies have been found to have a significant positive influence on SNPD project

performance through significantly impacting new product advantage, and new product advantage, by itself, has a significant positive influence on SNPD project performance. In line with prior research which states that new product advantage is an important determinant of new product performance, incorporating environmental sustainability into the product development process provides new product advantage, such as additional benefits and value for consumers, and, in turn, leads to better SNPD project performance.

Another important contribution of this work is that proactive environmental strategies were found to lead to better SNPD project performance than reactive environmental strategies. Specifically, the impact of adopting an environmental strategy in response to public concern on new product advantage and SNPD project performance was found to be higher than the impact of adopting it in response to regulatory forces. Similarly, the impact of adopting an environmental strategy in response to market opportunity on SNPD project performance was higher than the impact of adopting it in response to regulatory forces. This may be because being proactive in developing environmental strategy leads to higher performance by creating new product advantage, such as providing additional benefits and value to consumers, rather than just reactively following what is required by regulations.

Theoretical Implications

According to the resource-based view of the firm (Barney, 1991), organizations identify and differentiate themselves by the set of resources they choose to develop. Hart (1995) further asserts that environmental constraints motivate firms to develop new and distinctive resources and capabilities. These capabilities allow firms to respond more efficiently to environmental pressures through the design of

new and flexible strategies that, in turn, will be likely to be translated into sustainable competitive advantages and better performance. As a result, he proposed a revised version of resource-based view—the natural resource-based view (NRBV). This new perspective proposed a systematic examination of the relationship between the natural environment and a firm's performance by linking resources, capabilities and strategic outcomes. Our framework makes a theoretical contribution to NRBV by empirically examining the drivers of environmental marketing strategies at the product development level and analyzing their impact on new product advantage and new product performance. The path dependencies suggested by NRBV were supported in our results, which show that a firm's environmental marketing strategy development is positively related to new product advantage, and, in turn, new product advantage is positively related to new product performance.

Inducing firms to adopt environmental sustainability requires the use of different drivers. These drivers may be proactive, such as responding to public concerns or responding to market opportunities, or they may be reactive, such as merely complying with government regulations. While proactive strategies that move firms toward environmentalism should recognize the significant role of a commitment by top management, reactive strategies do not necessarily need this. According to stakeholder theory, the choice of corporate strategy and, as a result, the recognition accorded various stakeholders, are driven by a firm's desire to balance its and its shareholders' fiscal welfare with other stakeholders' interests. In this respect, gaining the attention and concurrence of top management is necessary because of its strong influence.

Managerial Implications

Thus study has several important implications for managers. First, managers should assume that a business philosophy that includes a commitment to the environment is a strategy that complements other corporate goals, or is even an opportunity consistent with Porter's win-win paradigm. The results of this study suggest that while environmental marketing strategies may contribute to environmental sustainability, they are not necessarily a tradeoff to the economic sustainability of the firm. Indeed, there are many examples of firms that have used EMS to improve their competitive position.

In addition, the results of this study reveal that going beyond what is required by law and proactively developing environmental strategies even lead to better new product performance. The obvious implication is that managers should proactively develop environmental marketing strategies and incorporate them into the SNPD process. Another result of this study indicates that these proactive strategies need to gain the attention of top management in order to be completely incorporated into the SNPD process. Therefore, managers should show a commitment to the development and implementation of these strategies by taking the necessary actions.

Additional implication for policy makers is that regulators can move nonprofit organizations and other community groups towards maintaining public pressure on firms. For instance, this might include arranging informational programs sponsored by environmental nongovernmental organizations to promote environmental sustainability. In the long run, modified market characteristics will weed out less efficient firms and reward sustainable innovation.

Limitations and Future Research

Our study has some limitations that we must acknowledge. First, we used cross-sectional data to infer causation. Second, we recruited only one respondent per firm, though only surveys completed by knowledgeable respondents were included in the analyses. Third, we measured only managers' perceptions; we did not measure the environmental investments made by firms. These may be a better indicator of a firm's environmental strategy and ought to be included in further studies.

Further research, in addition to addressing these limitations, can follow other fruitful avenues. One would focus on how environmental strategies are disseminated throughout an organization and whether there are barriers to implementing environmental strategies, which we deliberately kept outside the scope of our current research. The goal of such further research would be to identify barriers to, and enablers of, environmental strategies.

Another avenue for future research is to mount inquiries using a comprehensive set of performance criteria in addition to financial performance, such as customer loyalty and customer retention. Also, studies that examine the extent of the impact of the sustainable new product development process on a firm's overall image and its ability to recruit dedicated employees would be useful. One could also hypothesize a mediation impact of overall corporate image, which might translate into increased market share and profitability. The rising trend of environmental sustainability initiatives in the market will make such studies of great value to corporations.

Conclusion

We wanted to address the following questions with this study: What factors lead a firm to embrace an environmental marketing strategy? Is instituting an environmental marketing strategy a response to regulatory pressures or part of a proactive strategy to gain competitive advantage in the marketplace? What will be the outcome of an environmental strategy on product advantage and SNPD project performance? The results showed that both regulatory pressures and proactive strategies (strategies that surpass minimal compliance standards) lead firms to develop environmental strategies at the new product development level. Both of these factors positively influence new product advantage and, in turn, new product performance, with proactive strategies leading to significantly better new product performance.

CHAPTER 4

CONCLUDING REMARKS

In this dissertation, we explored the incorporation of sustainability into the new product development process. In particular, this thesis investigates (1) the integration of environmental specialists into sustainable new product development teams and (2) the relative influence of motivational factors on environmental strategy development and the structural relationship of how they affect the performance of sustainable new product development (SNPD). It relies on two main research streams: work on sustainable management and work on conventional new product development.

We presented evidence in the first essay that integrating an environmental specialist into a traditional NPD team has a positive influence on new product performance beyond the impact of the traditional members of the NPD team. Through analyzing this relationship across the stages of the sustainable new product development (SNPD), we gained a clearer picture of the effectiveness of this integration. In particular, the integration of an environmental specialist has a greater effect on product performance in the final stage of the SNPD process, when a product is launched. In addition, we saw that this effect becomes especially salient with high-innovative projects. These new and detailed insights will help academics better understand the nature and effects of cross-functional integration in SNPD in regard to the role of the environmental specialist, and will help managers take appropriate actions based on the characteristics of a product.

In the second essay, we examined the drivers of environmental marketing strategy development, and the consequences of that strategy in terms of new product

advantage and (SNPD) project performance. As the drivers of the environmental marketing strategy, we specifically looked into the development of the environmental marketing strategy as a response to firm's public, as a response to regulatory pressures, and as a response to market opportunities to grow and increase competitiveness. The drivers of environmental strategy influence new product performance in different ways, which supports our hypotheses. In particular, the results showed that proactively developing an environmental marketing strategy led to better new product performance than reactively responding to regulations. In addition, the results show that a commitment from top management is important only for proactive strategies, not for reactive strategies. Therefore, it is highly essential for managers take necessary actions if they want to strategically incorporate sustainability beyond the scope of what is required by regulations. Furthermore, we found that an environmental marketing strategy leads to new product advantage and, in turn, better sustainable new product performance.

Overall, this thesis is a step towards resolving the longstanding debate over whether "it pays to be green." We presented evidence that the integration of environmental specialists into new product teams should lead to better SNPD project performance. In addition, proactively incorporating sustainability into the new product development agenda by going beyond what is required by law should lead to better SNPD project performance as well. These results provide guidance as to how it is possible to have environmental and economic sustainability at the same time.

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APPENDIX A

SCALES, MEASUREMENT ITEMS, AND RESPONSE FORMAT FOR ESSAY 1

SNPD Project Performance Project Performance (adapted from Song and Parry 1997a; Ernst et al 2010).

Project performance will be assessed by the project leader of Project X. To what extent do you agree with the following statements related to the success of the new product (Project X):

- How successful was this new product from an overall profitability standpoint? (1 = "a great financial failure," and 7 ="a great financial success")
- Relative to your firm's other new products, how successful was this new product in terms of revenues? (1 = "far less than our other new products," and 7 = "far greater than our other new products")
- Relative to your firm's other new products, how successful was this new product in terms of profits? (1 = "far less than our other new products," and 7 = "far greater than our other new products")
- Relative to your firm's objectives, how successful was this new product in terms of profits? (1 = "far less than our objectives," and 7 = "far exceeded our objectives")

Cross-Functional Integration across Stages of SNPD (adapted from Ernst et al 2010)

The scales for the integration between marketing, R&D, manufacturing and environmental specialist were formative constructs and were rated on a seven-point

Likert scale, anchored by 1 = “strongly disagree” and 7 = “strongly agree.”

Cooperation is defined and explained to respondents as the level of involvement and information sharing. Project leader/manager will assess the level of integration among the functions for the particular SNPD project. An example for a specific item is as follows: In the SNPD Project X, personnel from marketing cooperated with personnel from R&D during the following SNPD activities …

Stage 1. Concept Development

•Planning and formulating of the new product goal and strategy.

•Idea generation.

•Analysis of trends, market changes, and potentials.

•Assessment and selection of new product ideas.

•Assessment of needed funds, times, and risk related to the new product development project.

•Preparation of the written product concept.

•Determination of desired product features.

Stage 2. Product Development

•Actual development of the prototype.

•Preparation of the commercialization concept.

•Execution of prototype tests with customers.

•Selection of customers for test-marketing reasons.

•Execution of test-marketing measures before market introduction of the new product.

•Final evaluation of market acceptance before market introduction of the new product.

•Determination of the overall strategy before introducing the new product into the market.

Stage 3. Product Commercialization

•Market introduction of the new product (selling, advertising, distribution).

•Product training for customers.

•Customer enquiries/after-sales support.

•Monitoring competitors' reactions and their strategies.

Moderating variable: Product newness (adapted from Song and Swink 2009)

(0 = "strongly disagree" and 7 = "strongly agree).

- This product relied on technology that has never been used in the industry before.
- This product caused significant changes in the whole industry.
- This product was one of the first of its kind introduced into the market.
- This product was highly innovative—totally new to the market.

APPENDIX B

SCALES, MEASUREMENT ITEMS, AND RESPONSE FORMAT FOR ESSAY 2

SNPD Project Performance Project Performance (adapted from Song and Parry 1997a; Ernst et al 2010).

Project performance will be assessed by the project leader of Project X. To what extent do you agree with the following statements related to the success of the new product (Project X):

- How successful was this new product from an overall profitability standpoint? (1 = "a great financial failure," and 7 ="a great financial success")
- Relative to your firm's other new products, how successful was this new product in terms of revenues? (1 = "far less than our other new products," and 7 = "far greater than our other new products")
- Relative to your firm's other new products, how successful was this new product in terms of profits? (1 = "far less than our other new products," and 7 = "far greater than our other new products")
- Relative to your firm's objectives, how successful was this new product in terms of profits? (1 = "far less than our objectives," and 7 = "far exceeded our objectives")

Public Concern (adapted from Banerjee et al 2003)

(1 = "strongly disagree" and 7 = "strongly agree")

To what extent do you agree with the following statements related to the success of the new product?

- Our customers feel that environmental protection is a critically important issue facing the world today.
- The North American Public is very concerned about environmental destruction.
- Our customers are increasingly demanding environmentally friendly products and services.

Regulatory Forces (adapted from Banerjee et al 2003)

(1 = “strongly disagree” and 7 = “strongly agree”)

To what extent do you agree with the following statements related to the success of the new product?

- Regulation by government agencies has greatly influenced our firm's environmental strategy.
- Environmental legislation can affect the continued growth of our firm.
- Stricter environmental regulation is a major reason why our firm is concerned about its impact on the natural environment.
- Our firm's environmental efforts can help shape future environmental legislation in our industry.
- Our industry is faced with strict environmental regulation.[D7]

Market Opportunity (adapted from Banerjee et al 2003)

(1 = “strongly disagree” and 7 = “strongly agree”)

To what extent do you agree with the following statements related to the success of the new product?

[7] Item dropped

- Being environmentally conscious can lead to substantial cost advantages for our firm.
- Our firm has realized significant cost savings by experimenting with ways to improve the environmental quality of our products and processes.
- By regularly investing in research and development on cleaner products and processes, our firm can be a leader in the market.
- Our firm can enter lucrative new markets by adopting environmental strategies.
- Our firm can increase market share by making our current products more environmentally friendly.
- Reducing the environmental impact of our firm's activities will lead to a quality improvement in our products and processes.

Top Management Commitment (adapted from Banerjee et al 2003)

(1 = “strongly disagree” and 7 = “strongly agree”)

To what extent do you agree with the following statements related to the success of the new product?

- The top management team in our firm is committed to environmental preservation.
- Our firm's environmental efforts receive full support from our top management.
- Our firm's environmental strategies are driven by the top management team.

Environmental Marketing Strategy (adapted from Banerjee et al 2003)

(1 = “strongly disagree” and 7 = “strongly agree”)

To what extent do you agree with the following statements related to the success of the new product?

- We emphasize the environmental aspects of our products and services in our ads.

- Our marketing strategies for our products and services have been considerably influenced by environmental concerns.
- In our firm, product-market decisions are always influenced by environmental concerns.

New Product Advantage (adapted from Rijsdijk et al 2011)

(1 = “strongly disagree” and 7 = “strongly agree”)

To what extent do you agree with the following statements related to the success of the new product?

- The new product provides many benefits to the customer.
- The new product offers much value to the customer.
- The new product offers many advantages.
- The new product is superior to competing products.
- The new product is the best of its kind in the market.
- The new product is superior in its category.