

Chapter 13

Sustainability and New Product Development: Five Exploratory Case Studies in the Automotive Industry

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Abstract Purpose – Companies receive growing pressure from customers, non-governmental organizations, and public administration through legal acts to generate products both providing value to the customers and being sustainable. This requires a move beyond green products, which are therefore not perceived as sufficient anymore. Hence, research on new product development toward the aspects of sustainability attracts more attention. The purpose of this study is herewith to analyze how sustainability influences new product development (NPD) and companies manage this challenge.

Design/methodology/approach – A multi-case study approach with a total of 19 interviews in five automotive manufacturing companies has been conducted. The data originates from preinterview questionnaires, publicly available data, and semi-structured interviews with departments focusing on sustainability and product design.

Findings – The findings of this chapter refine the understanding of a sustainable new product development. NPD success factors are closely linked with the triple-bottom-line dimensions. The case studies show that the social aspect is hardly present in NPD. Nevertheless, it becomes evident that strategic management for sustainability and new product development has to be aligned closely to reach sustainable products.

Research limitations/implications – The chapter uses a case study approach, so generalizability of the study is limited. This approach enables to examine explicitly the relationship between sustainability and NPD, where empirical research is lacking.

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Originality/value – The chapter contributes to prior research in sustainability and new product development by analyzing the interconnection of NPD and the triple bottom line on a success factor level and provides case studies for justification.

Keywords Corporate sustainability • New product development • Automotive industry • Case study

13.1 Introduction

Engineering, operations management, and nearly all processes in a company are driven by the growing request for sustainability (Sarkis et al. 2011), since economic, social, and ecologic factors are relevant across the entire company. Focusing on engineering, there are entire product life cycles from design to disposal affected by sustainability (Graedel and Allenby 2009). This trend toward being sustainable is caused by the rising demand of consumers for sustainable products, as well as by pressure from nongovernmental organizations, and respective legislation (Bevilacqua et al. 2007). Research in corporate sustainability has attracted a large community in academic literature (e.g., Sarkis 2001; Wilkinson et al. 2001; Hult 2011; Seuring 2011) caused by its high managerial and strategic relevance for process improvement (Bateman and David 2002; Schneider and Meins 2012). Nevertheless, there is little academic literature on the interface between new product development (NPD) and sustainability (Ferguson et al. 2010), although the opportunity to influence a product's performance is seen as prevalent in the design phase, which holds for cost (Hoffman 1997) as much as for sustainability (Evans et al. 2007). New product design and development predetermine the sustainability performance over the whole product life cycle (Gmelin and Seuring 2014a, b).

Green products, green product development (Bansal and Roth 2000; Baumann et al. 2002; Golden et al. 2011), and green supply chain management (Simpson et al. 2007; Seuring and Müller 2008; Vachon and Klassen 2006) have been researchers' focus in order to respond to an increased attention to environmental regulations (Albino et al. 2009). In today's competitive global market, however, enterprises ought to design, manufacture, and deliver products both providing new value to the customer and being sustainable (Esslinger 2011). Sustainability is referred to the triple bottom line (TBL) of an organization (Elkington 1997; Dyllick and Hockerts 2002; Kleindorfer et al. 2005), which encompasses the three dimensions of economic, social, and ecologic sustainability. Green products without social or economic factors are therefore not sufficient anymore. Henceforth, NPD needs to be addressed with a cross-disciplinary sustainability point of view and not solely from a green perspective. By focusing on sustainability in new product development, the call for a more holistic focus on product sustainability is followed (Golden et al. 2011).

This leads to the research question addressed: How do companies integrate the strategy-oriented sustainability dimensions into the complex activities of new product development? In this chapter we seek to answer this question by drawing on insights from five case studies in the automotive industry. This industry is known for complex products and processes (Thun and Hoenig 2011) as well as for strong sustainability efforts (Hootegetem et al. 2004; Simpson et al. 2007) so that robust data are expected. The intention of this research is to connect NPD and sustainability on grounds of NPD success factors being linked to the TBL dimensions of sustainability. This connection is addressed by drawing on a multi-case study research design. Given the early stage of research in this field, we would argue that a step toward (pre-)theory building is taken, so that a first conceptualization is offered (Meredith 1993).

The remainder of the chapter is structured as follows. Section 13.2 introduces the literature on (1) new product development and (2) sustainable development. This is then integrated into a research framework. In Sect. 13.3, the methodology of the case study is described and justified. Section 13.4 presents the findings from the cases, while Sect. 13.5 provides the discussion. The conclusion and further research opportunities are given in Sect. 13.6.

13.2 Literature Review

13.2.1 *New Product Development*

Research in new product development (NPD) has been of interest for several decades (Griffin 1997; Everaet and Bruggeman 2002; Richtner and Ahlström 2010) with the following academic communities dominating marketing (Ernst et al. 2010), operations management (Hill 2001; Ferguson et al. 2010), and engineering (Danese and Filippini 2010).

New product development means a “transformation of a market opportunity and a set of assumptions about product technology into a product available for sale” (Krishnan and Ulrich 2001, p.1) with quick development cycles (Atuahene-Gima and Murray 2007). Quick development cycles are an essential aspect with regard to time-to-market pressures in NPD (Afonso et al. 2008). In order to mitigate this pressure, globally acting companies depend on quick information flows among development partners (Parker et al. 2008).

The currently dominating research in NPD is given by green product development, in which several terms such as green design, ecological design, and design for environment are used for similar concepts. Design for environment signifies the systematic process of developing a product in an environmentally conscious way (Sroufe et al. 2000). One of the most important tools to evaluate environmental design is seen in life cycle assessment (LCA) (Baumann et al. 2002), which helps to make decisions toward an environmental-friendly design (Fullana et al. 2011). In

connection with LCA, the cradle-to-grave approach is often mentioned (Hoffman 1997; Sarkis 2001) indicating that a LCA has to incorporate all life cycle stages from design to disposal (Rebitzer et al. 2004). The concept of cradle-to-grave approach has been extended to a cradle-to-cradle approach in order to reach zero emissions and eco-efficiency (Braungart et al. 2007) so that material flows are in regenerative closed-loop cycles (McDonough et al. 2003). The cradle-to-cradle approach is therefore seen as one step toward a product design for the next generation of green product development (Rossi et al. 2006) to reach a sustainable product development.

NPD defines the success of a product across the entire life cycle and lays the foundation of a company's success (Hult 2011). Developing products is costly and risky (Everaet and Bruggeman 2002; Marion et al. 2012); thus companies are eager to find approaches in minimizing the risk of failure. Consequently, NPD success factors have been developed, which have been condensed and justified over the time in NPD research papers, so the following ones are established (Griffin 1997; Cooper 2001; Marion et al. 2012): (1) cross-functional work, (2) top-management support, (3) market planning, and (4) formalized processes. Details to the success factors can be seen in Table 13.1. These success factors cover the two fundamental aspects for mitigating successful products of (1) doing the project right and (2) doing the right project as indicated by Cooper (2001). Cross-functional work and formalized processes support doing the project right, and top-management support and market planning focus on doing the right project (Marion et al. 2012). Against the analysis of Cooper (2001) and Marion et al. (2012), it can be said that all relevant success factors for a NPD are covered in this study. The single factors will be explained in greater detail below, when their integration with sustainability is discussed.

Table 13.1 NPD success factors

Success factor	Description	Examples
Cross-functional work	People from different functional areas work jointly toward a new product	Pagell and Wu (2009) Wang et al. 2009
Top-management support	Sponsorship by company's senior staff to enable NPD activities	Salomo et al. (2010) Slotegraaf and Atuahene-Gima (2011)
Market planning	Evaluation of the current market needs with the company's capabilities to fulfill these needs	Lambert et al. (1998) Hult (2011) Esslinger (2011)
Formalized processes	Well-defined routines toward a dedicated output being agreed by all development partners	Singhal and Singhal (2002) Grieves and Tanniru (2008)

Based on Cooper (2001) and Marion et al. (2012)

13.2.2 Sustainable Development

The Brundtland Commission defined sustainable development as “a development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987, p. 42). It is often seen as a very broad definition (Callens and Tyteca 1999), so that it gives room for interpretation. One of the most accepted interpretations is the TBL approach in economic profitability, respect for the environment, and social responsibility (Elkington 1997; Dyllick and Hockerts 2002; Kleindorfer et al. 2005). The connotation of each TBL aspect is provided in Table 13.2. Companies are able to gain competitive advantages through sustainability (Campbell 2007) by implementing business practices aiming for positive sustainable reputation, success, and operation management (Kleindorfer et al. 2005; Schneider and Meins 2012). Corporate sustainability has not merely a positive impact on the company but also on all involved collaboration partners (Vachon and Mao 2008; Jeffers 2010; Seuring 2011). It is even stated that a company is dependent on the sustainability efforts of their business partners (Ron 1998), because a company can only be sustainable if the suppliers also provide sustainable products or components (Pagell and Wu 2009).

The need for green products has led to the emerging area of eco-innovation (see, e.g., papers in Azevedo et al. 2014). However, focusing on sustainable NPD, it is necessary to also incorporate the social factor and not only the environmental aspect (Aguilera et al. 2007). Previous studies in marketing already addressed social factors in NPD (Varble 1972); however that research led into the area of social competency in NPD (Mu et al. 2011).

Table 13.2 The triple bottom line

Triple bottom line	Description	Example
Social	Skills, motivation, and loyalty of employees and business partners	Elkington (1998)
	Integration of public services	Dyllick and Hockerts (2002) Kleindorfer et al. (2005)
Environmental	Reduction of the consumption of natural resources below the natural reproduction	Elkington (1998)
		Dyllick and Hockerts (2002) Kleindorfer et al. (2005)
Economic	Guaranteed cash flow at any time while producing return to shareholders	Elkington (1998)
		Dyllick and Hockerts (2002) Kleindorfer et al. (2005)

Based on Dyllick and Hockerts (2002)

Table 13.3 Sustainable NPD matrix

	Social	Environmental	Economic
Cross-functional work	Employee skill enhancement by cross-functional work	Joint development actions for environmentally friendly products	Joint development actions for cost-efficient products
	Employee motivation by new cross-company integration		
Top-management support	Approval for intense product test toward safer products	Internal pressure for environmental-friendly design	Approval for higher investments in sustainable design
	Initiation of employee-friendly working conditions	Approval of costly eco-design	Approval of external NPD/sustainability experts
Market planning	Development of necessary products within the firm’s community	Evaluation of internal capabilities for environmental design	Evaluation of potential new market share
	Local employee sourcing		Evaluation of external expert availability
Formalized processes	Employee-friendly process design to protect their health	Design for environment	Clear process sequences for quick development cycles
		Cradle-to-grave approach	
	Employee-friendly process design to protect their physical health	Cradle-to-cradle approach	

13.2.3 *Toward a Sustainable New Product Development*

The purpose of this study is to link new product development and sustainability; hence the approach is to connect NPD success factors from previous studies with the TBL dimensions. This serves as conceptual integration among the so far separate fields. The resulting matrix is shown in Table 13.3, which provides details on the intersection of the TBL and NPD.

The following sections will explain the intersections of the sustainable NPD matrix and their justification. The sections will be led by the NPD success factors as the challenge is to incorporate the TBL in NPD.

13.2.3.1 Cross-Functional Work

The importance of cross-functional work is seen as a major improvement in effectiveness and efficiency in NPD (Marion et al. 2012). Cross-functional work does not only imply collaboration across internal functions to enhance team effectiveness (Maylor 1997; de Bakker 2002); it also integrates suppliers into NPD in order to achieve a sustainable product design (Becker and Zirpoli 2003). Cross-functional work is vital to achieve sustainability in NPD (Daily and Huang 2001) because all departments and partners involved are required to follow the same sustainability requirements.

Social cross-functional work influences the skills of a company's employees, because the employees can enhance their skills by learning from other companies' employees (Kale and Singh 2007). By working together with different functions, the employee's skills and capabilities are improved. Besides the knowledge enrichment, the motivation of an employee is enforced due to the opportunity to work together with new partners (Chabowski et al. 2011). Subsequently, the employee's satisfaction rises and its willingness to contribute to a successful NPD.

From an environmental perspective, it can be said that cross-functional work supports idea generation for environmentally friendly design solution (Daily and Huang 2001). New ideas are an important cause for NPD to provide product improvements (Bunduchi 2009; Danese and Filippini 2010) and to follow customers' requirements. Relying solely on ideas within one department can block creativity and innovation competencies.

Cross-functional work can positively impact the economic part of a company (Brettel et al. 2011). On the one hand, there are development partners to share the development costs with. On the other hand, there are further resources with additional capabilities that can provide development solutions without having to source costly external experts (Cousins and Lawson 2007).

13.2.3.2 Top-Management Support

Exhaustive product tests can maximize a product's safety for users and herewith improve a product's social characteristics. However, these tests are linked with higher development costs for which the top-management approval is vital (Salomo et al. 2010). In addition, for improving internal working conditions, the top-management has to drive organizational changes (Carter and Easton 2011). Other employees would not have the organizational execution power.

Internal pressure exists for environmental-friendly products because the reputation of a company is one of the most important factors a top-management has to take care of (Baumann et al. 2002). With regard to environmental aspects, top-management is very cautious of environmental figures that need to be presented (Rebitzer and Buxmann 2005). Achieving lower performance than competitors may risk reputational damage and result in a loss of market share. Nevertheless, reaching

good environmental results necessitates investments in eco-design causing costs, which need top-management approval.

Both social and environmental involvement cause higher costs, due to that they impact the economic factor. Consequently, top management has to justify higher development costs due to a sustainable NPD against shareholders and has to support internal functions in executing a sustainable NPD (Slotegraaf and Atuahene-Gima 2011). The support includes the approval of external experts when qualified capabilities are not available internally. Nevertheless, external experts can also foster knowledge creation for a sustainable NPD (Koners and Goffin 2007; Richtner and Ahlström 2010).

13.2.3.3 Market Planning

NPD has to be based on the market demand so that product planning is essential for a successful product launch and market acceptance (Cooper 2001).

Dyllick and Hockerts (2002) state that social sustainable companies are furthering the societal capital of the communities they operate in. It can be said that focusing on local employee sourcing supports this aspect. The aspect of market planning also directs toward discovering a potential new market (Marion et al. 2012). In combination it would mean that companies need to analyze what products are needed in their community, evaluate if they can fulfill this need, and finally start developing products for this region.

The company needs to have the capabilities to develop environmental-friendly products (Esslinger 2011). That means the company needs to be able to source environmental-friendly components, design it, and be able to evaluate environmental impacts. Sustainability already starts with environmental-friendly sourcing (Vachon and Klassen 2006). This emphasizes the previously mentioned point of ensuring sustainable suppliers (Pagell and Wu 2009).

Besides ensuring the internal capabilities of an environmental NPD, companies need to evaluate the market if it necessitates sustainable products. Thus, if there is no market potential, companies should rather neglect the investment for not doing misinvestments. This requires the awareness of sustainable products and the willingness of market participants to buy these products even for higher prices (Huang and Rust 2011). The evaluation of the internal capabilities can also have an impact on the economic aspect. External experts need to be detected if the internal evaluation was not successful.

13.2.3.4 Formalized Processes

Formalized processes in NPD aim to reduce time and cost (Al Shalabi and Rundquist 2009). The aspect of time to market is of growing importance today (Afonso et al. 2008).

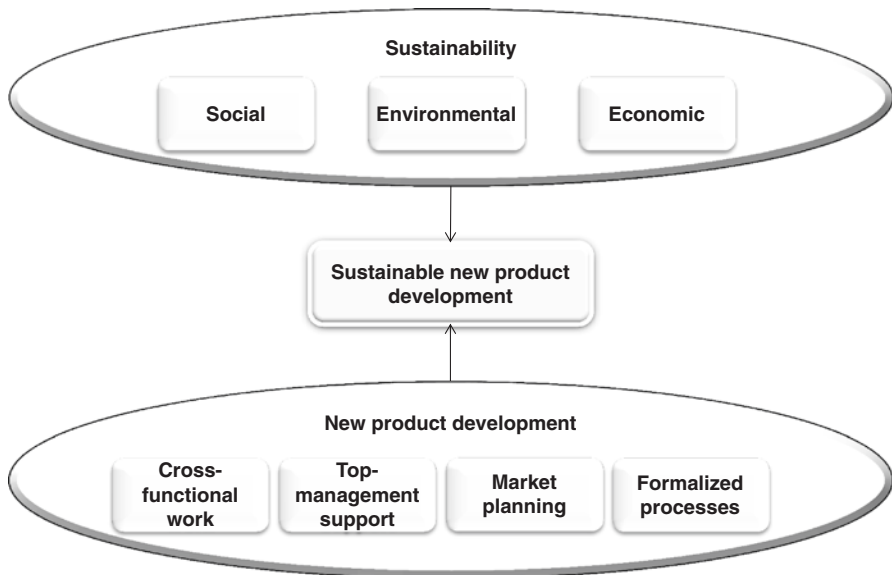


Fig. 13.1 Sustainable NPD research framework

Social processes have to be integrated with manufacturing aspects so that manufacturing processes are not harming the employees' health; thus noxious substances have to be avoided, nor should they impact their physical health negatively (Braungart et al. 2007). Negative physical impacts can be circumvented by processes not asking the employee to carry heavy things or having to work overhead.

Environmental processes can be formalized by implementing design for environment or cradle-to-grave approaches (Shrivastava 1995; Graedel and Allenby 2009). Design for environment incorporates the environmental conscious design of a product and process to avoid pollution across the life cycle-based evaluations. Besides design for environment, the cradle-to-grave approach focuses on ensuring the recyclability and disposal of substances used in a product (Braungart et al. 2007). Consequently, product developers have to ensure that the designed product can be recycled when being disposed.

Formalized processes represent clearly structured process sequences; thus each involved development partner knows exactly the next tasks. This prevents developers from executing tasks too early, which might cause rework and additional costs. By establishing clear sequences and tasks, the development process can be accelerated, and herewith development cycles can be quicker.

Figure 13.1 provides a framework based on the previous sections. This is intended to be justified and refined with the help of the case studies.

13.3 Research Methodology

13.3.1 Research Design

The objective of this study is to explore how companies combine the complex activities of NPD with sustainability. As presented in the previous sections, this connection has not been analyzed in depth before; however, it reflects a contemporary circumstance. The use of case studies has been encouraged as a method of choice when studying a phenomenon in the real-life context (Yin 2013; Voss 2009). Case studies are well suited for complex structures, since they allow intense interaction with the informant, which is not possible for, e.g., surveys (Eisenhardt and Graebner 2007), and they draw on multiple sources of information leading to robust data. Interaction with an informant helps to reduce misunderstandings and antagonizes social-desirability bias in the sustainability topic (Bagozzi 2011). The intention of our research is directed toward exploring the interconnection of sustainability and NPD and herewith to drive related theory (Marion et al. 2012).

13.3.2 Case Selection

The focus of the study lays on the automotive industry for the following reasons. Firstly, new product development is of strategic relevance in this industry because it decides on the future success of the company. Secondly, green approaches have been of interest in that industry due to the high amount of users and the herewith connected pollution potential. Thirdly, to remain competitive in this vastly competitive market, companies are forced to establish a positive sustainability image and innovation. Thus, they need to incorporate the TBL of sustainability. Lastly, the automotive industry has been in focus for NPD studies before (Petersen et al. 2003; Becker and Zirpoli 2003; Hootegem et al. 2004).

A multilevel case selection process was followed in order to get robust case data to gain sufficient insights while minimizing the number of cases (Perry 1998). Based on the reviewed literature and expert information, a sampling frame was developed. Companies were selected being recorded in the Dow Jones Sustainability Group Index (DJSI) or FTS4Good (López et al. 2007) in order to comply for sustainability. Following the sampling criteria, the leading worldwide acting automotive companies were approached via email or business platforms (Brettel et al. 2011) and follow-up phone calls. Five companies agreed to take part in our study, providing access to the relevant interview partners within NPD and sustainability, as

Table 13.4 Case characteristics

Firm	Alpha	Beta	Gamma	Delta	Epsilon
Firm size [employees] ¹	~30.000	~100.000	~250.000	~8.000	~100.000
Informant job title	Product data manager	Process manager	Product data manager	Sustainability manager	Process manager
	Project manager	Controlling manager	Product development manager	Process manager	Product and process manager
	Sustainability manager	Product data manager	Sustainability manager	Project manager	Sustainability manager
		Project manager	Process manager	Product data manager	
Sustainability manager					
Executed interviews	3	5	4	4	3
Company type	OEM	OEM	OEM	OEM	OEM

¹Approximated figures due to confidential restrictions

well as in further departments, like controlling, to receive multiple points of view. Further companies did not take part in the interviews because of lack of resources, sensitivity of the topic, or that they generally do not take part in studies. Details on the participating case companies and the interview partners can be seen in Table 13.4.

Data collection can be stopped when no significant new insights can be taken (Yin 2013). This however is a qualitative criterion and cannot be pinned down by a certain number of cases. Other researchers argue that a multi-case analysis providing four to ten cases provides a good research basis (Eisenhardt 1989; Gibbert et al. 2008).

13.3.3 Data Collection

Primary data collection was executed in two phases in order to follow a theoretical sampling approach (Eisenhardt 1989). The interviewees were asked to complete a basic pre-interview informative questionnaire with questions regarding their role, tasks, and structure of the NPD and sustainability departments. This approach provided first information of the interviewees, e.g., their hierarchical position within the company, their experience with sustainability-related processes and functions, as well as their experiences in NPD. Subsequently, Perry's (1998) approach was adopted, so that guiding questions for the semi-structured interviews based on the interviewees' responses were developed. Thus, the interview subject was thoroughly outlined (Voss et al. 2002). At least 3 interviews were conducted per

Table 13.5 Validity and reliability details

Criteria	Case research phase			
	Design	Selection	Collection	Analysis
Reliability	Develop case study protocol	Selection based on notation in DJSI and FTS4Good	Pre-interview questionnaire and semi-structured interview	Involvement of authors who did not gather data
Internal validity	Theoretical research framework	Sampling criteria recorded in case study protocol	Recording of interview details	Triangulation of multiple data sources
Construct validity	Adaption of constructs from previous works in NPD and sustainability	NA	Multiple sources of information	Chain of evidence
External validity	Sampling within automotive industry	Description of case context	NA	Cross case analysis

Based on Yin (2013)

company with a maximum of 5; hence 19 interviews are the basis for the case study. The interviews were conducted on site in order to gain deeper insights of survey results and lasted between 60 and 90 min.

A case database was established with interview notes, pre-interview questionnaire data, content from the company's websites, annual reports, and sustainability reports (if not included in the annual reports) to account for reliability (Gibbert et al. 2008). In the case of inconsistencies between the data sources, clarification was given in follow-up phone calls with the case contacts. This approach is based on the recommendations by Yin (2009) in order to comply for data triangulation (Gibbert et al. 2008). The incorporation of secondary data is important as it is more objective and counters interviewee bias (Busse 2010). The use of multiple data types and respondents helps to mitigate social-desirability bias and single-informant bias (Eisenhardt and Graebner 2007). Validity and reliability aspects are summarized in Table 13.5.

Once all primary and secondary data were collected, the available information was structured according to the mentioned framework. The same procedure was executed for all cases. The overall data analysis was accomplished in two phases. Within-case analyses have been conducted to develop individual profiles in order to become acquainted with each case. Then, the cross-case analysis has been executed

to detect communalities and differences in NPD and sustainability behavior across the studied cases (Eisenhardt and Graebner 2007).

13.4 Findings from the Case Studies

In order to elucidate the findings from the case study and to facilitate the readability of the paper, the following sections are divided into the subsection already being used in Chap. 2.3. That means the intersections of the sustainable NPD matrix (see Table 13.3) are addressed by following each NPD success factor along the TBL dimensions.

13.4.1 Case Analysis of Cross-Functional Work

- Social

Social cross-functional aspects are rather underrepresented in the case companies. At *Gamma* and *Epsilon*, the opportunity to learn from cross-functional collaboration is seen as relevant. During the interview *Beta*'s project manager realized that cross-company collaboration could be used more for skill enhancement. Fewer actions are seen in employee motivation. Only *Gamma*'s project manager confessed that some employees are proud of representing the company and are more motivated. Nevertheless, all case companies stated that they need to talk to their employees on that point to get further insights.

- Environmental

At all five case companies, the informants highlighted that an environmental NPD is today hardly possible without cross-functional work. Cross-functional work includes joint development actions with suppliers (all case companies). At *Beta* they claim that for new product development processes, their IT department has to provide a data management application being able to store all product relevant information to the business. This department is herewith seen as a very important collaborator to gain advantages in environmental data provisioning. *Alpha*, *Beta*, *Gamma*, and *Epsilon* integrate customers in their design process through workshops providing feedback to the current and planned products. By doing so, they integrate even customers in the NPD process to receive future requirements.

- Economic

The core aspect for all case companies is sustaining economic success. *Delta*'s product manager brings it to the point: "Social engagement and environmental protection is important, but in the end it is all about making money." This expression is supported by the other case companies arguing that new product development is

from their point of view not merely directed toward developing new products for the market, but also reducing development costs and development time to be able to push a product to the market early. *Beta* and *Gamma* emphasize that short time-to-market cycles are only reachable since the development teams consist of all necessary departments. *Beta's* sustainability manager states that there is no department blocking the development process when they are all responsible for the development success. Despite that, cross-functional work with suppliers may also reduce costs. *Epsilon's* process manager reported from strong initial discussions with suppliers regarding collaborative NPD. With an ex post reflection, he thinks that the effort has paid off as all development partners can nourish from it by sharing knowledge and saving costs.

13.4.2 Case Analysis of Top Management

- Social

The case companies kept a low profile regarding the social contribution of the top management. All case companies assured to execute product tests but did not want to specify this topic. Employee-friendly working conditions are of course relevant, indicates *Epsilon's* sustainability manager. However, if they are really initiated by top management is difficult to say. He furthermore states that a driving factor for employee-friendly working conditions is the worker's council.

- Environmental

Top management is eager to provide good environmental figures in the annual report; hence investing in good environmental actions is of strategic relevance, states *Gamma's* product development manager. On the one hand, top-management wants good figures, but on the other hand, they have to save costs. This trade-off cannot be done in the product development department; it must be decided by top management (all case companies).

- Economic

Sourcing components in a socially fair way and meanwhile saving the environment during production and product usage requires high investments (*Beta's* product manager). Having the sustainability and product development manager in the board of directors supporting the development ideas is of great help, reports *Epsilon's* product manager. Without top-management approval and support, they could not spend that amount of money they have to for being more social and ecologic. *Alpha's* product manager explains that an environmental NPD approach requires top-management involvement, since environmentally friendly components are often impacting financials. The trade-off between cost-sensitive NPD and consumers' requests for eco-friendliness cannot be made by product design independently (*Gamma's* product manager).

13.4.3 Case Analysis of Market Planning

- Social

The development of products being needed in the company's community sounds nice, however is not practical, *Gamma's* project manager says. Products are sold all over the world and cannot be solely focused on a small region (*Gamma* and *Epsilon*). The market would be too small. Besides that, it is each company's intention to employ people living closely to the company. If employees have to travel long distances, they are already tired and unmotivated, declares *Beta's* project manager. Thus, it is a company's intention to employ local employees (*Gamma's* sustainability manager).

- Environmental

While *Beta* and *Epsilon* involve the users directly in their market planning activities, *Alpha*, *Gamma*, and *Delta* mainly rely on market analyses. At *Beta* the perception of a direct exchange of market demand and planned supply with the customer is seen as highly valuable. For them it is a first evaluation of the market reaction for a new product, especially regarding their plans for electro-mobility. Environmental aspects can herewith be discussed and also explained to the customer. The customer himself can directly provide feedback to the plans.

- Economic

Sustainable economic success in a market is regarded as the core factor a company has to strive for (*Gamma's* sustainability manager). Competitors and the threat of new entrants, especially from India and China, are watched thoroughly. Strategies are being developed how to distinguish from them and sensitize the market to sustainable products. Unfortunately, due to confidentiality of these strategies, further insights of these differentiating approaches in new product development were not received. Nevertheless, *Beta* and *Epsilon* nourish from external expert knowledge. *Delta's* product manager affirmed that using new materials like carbon without experts would be too complex and risky.

13.4.4 Case Analysis of Formalized Processes

- Social

Alpha focuses on establishing safer production processes; hence employees are more preserved from accidents. Healthier processes are the intention at *Gamma* and *Delta*, so that substances harmful to the employees' health are avoided as much as possible. *Beta* otherwise sets the main focus on user safety in making the car safer

during usage for the driver and the people being around. In order to reach safer cars, *Beta* invests into technological support like computer-aided design and finite element method to simulate component and product characteristics in accidents. Based on these simulations, they improve the automobile to be safer. Automobiles producing less unhealthy particulate matter or less noise can be tested and improved virtually. Real tests would be too costly and time consuming, says *Beta's* sustainability manager.

- Environmental

Environmental formalized processes are present at companies for quite a while. Even before the sustainability discussion appeared, design for environment was used (all case companies). For reaching green products, you need to follow a design for environment approach, *Gamma's* product data manager argues. In the case of cradle-to-cradle approach, not all case companies are really involved. *Alpha*, *Delta*, and *Epsilon* have heard of it but are not familiar in what way it should be used. *Beta* and *Gamma* otherwise see some potential in it, however are not sure if it is not just another nice name for a concept companies already follow.

- Economic

All case companies stated that social activities in NPD and social impacts depend on cost and time. Additional safety applications are costly, can influence an automobile's design, and impact the price of an automobile. *Beta's* process manager also adds that these additional factors need to have support in the market and that internal marketing has to praise it for sales.

After having presented all intersections of Table 13.3 with regard to the case companies' results, a cross-case comparison table is given in Table 13.6. The table shows the case companies supporting the sustainable NPD matrix in each intersection. Due to indistinct feedback from the interviewees, the intersection of social and top-management support is marked with no result.

The interconnections of NPD success factors and the TBL dimensions as illustrated in Fig. 13.2 are derived by merging the findings from the case study with the research framework of Fig. 13.1.

13.5 Discussion

As a result, this chapter contributes to the existing literature on the interface of sustainability and NPD by integrating the dimension of both concepts with each other. Based on the extant literature in each area, the sustainable NPD matrix has been developed. The connection to real cases from the automotive industry gives the opportunity to reflect the theoretical framework.

The case studies illustrate that the integration of internal as well as external development partners in a cross-functional collaboration is vital from several aspects (Maylor 1997; Daily and Huang 2001). On the one hand, the integration

Table 13.6 Cross-case comparison

	Social	Environmental	Economic
Cross-functional work			
Top-management support	n/a		
Market planning			
Formalized processes			

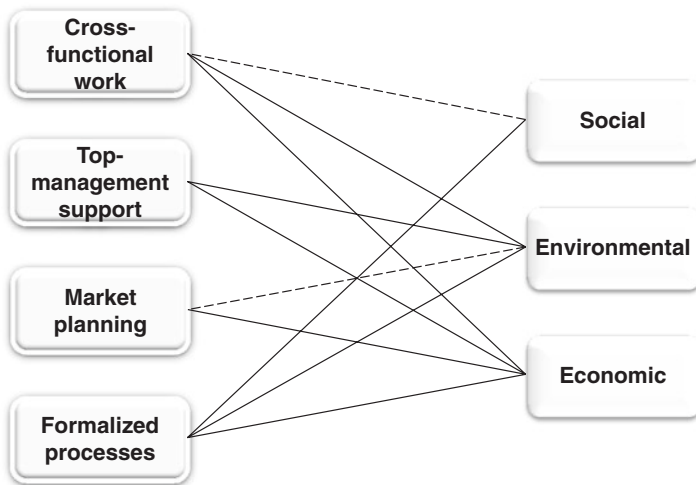


Fig. 13.2 Interconnections of NPD and sustainability

provides clear product data for environmental assessments of all components including supplied ones. These assessments help to sell the product in the market. On the other hand, the case studies show that integrating suppliers into the development process and herewith sharing the responsibility of the product's success reduce development time and development costs because all parties commonly want the

success. Cost targets and time-to-market pressure have already been high in NPD (Everaet and Bruggeman 2002). Hoffmann (2008) focuses in her study on the consumer integration, which is helpful in order to guide the customers toward sustainable products. However, more focus should be set to collaborative NPD activities with suppliers. Despite supplier integration in NPD (Danese and Filippini 2010) and supplier relationships in green supply chains (Simpson et al. 2007), little can be said on the integration of suppliers in sustainable NPD. Research by Pagell and Wu (2009) suggests incorporating partners into a sustainable supply chain, whereas the research study presented here specifically requests this behavior for a sustainable NPD. A sustainable NPD has to be established before a sustainable supply chain management can be reached.

Consumer safety and the reduction of health-impacting effects are often mentioned. One could argue that this has been in focus for years but not been emphasized. Nevertheless, technology has improved in that way that virtual simulations are possible and more effort can be put into these aspects. Thus, the ability for these tests requires technology being able to create competitive advantages (Jeffers 2010). Crash tests were and are expensive and need to be done, but virtual pretests provide the chance for a better user protection with reduced costs. Hutchins and Sutherland (2008) did not include the user in their subthemes of social sustainability, nor did Labuschagne et al. (2005). From our point of view, it is relevant and important as the case studies show.

In the majority, the case companies thoroughly watch the market and the actions of their competitors. This seems to be reasonable since each company strives for competitive advantages in the market place. Green practices used to create competitive advantages (Daily and Huang 2001; Simpson et al. 2007). Sustainable activities provide a source for a new way to gain a competitive advantage (Kleindorfer et al. 2005). Thus, companies compare their developments and market acceptance with each other. In our case, they compare their products with each other. It can be questioned if this is the right way to evaluate sustainability efforts in the automotive industry, because relative measurements are used and therefore a relative measure of sustainability. If companies are only in competition with direct competitors, sustainability improvements will probably be just marginal. They will probably only invest in sustainability improvements for just being better than the competitors. However, they do not have pressure for larger improvement steps. Constraints from customers as well as from legislation can establish objective factors and measurement. However, ways need to be found to make regulations binding for everyone to keep market conditions equal.

Summing up, it can be stated that a sustainable NPD is dependent on cost awareness, quality, flexibility, and environmental issues plus the awareness of social attributes. While these insights might almost seem straightforward, no related empirical research and no conceptual framework have been presented addressing this intersection. As already pointed to in the introduction, we are well aware that this would only be a first step in building respective theory. This is in line with the arguments put forward by Meredith (1993), and our study might serve as a first step.

With regard to the research question and research design, case study research was seen as being well suited to investigate how companies manage the integration of sustainability requirements in the complex structures and processes of product development. However, we are aware that limitations exist and encourage further research. One limitation is that the case studies were only focusing on the automotive industry, which limits the generalizability of the study. The framework of a sustainability-driven NPD should therefore be analyzed in other industries, too.

13.6 Conclusion and Further Research

This chapter presents the approaches of five global automotive manufacturing companies to continuously meet the challenge of satisfying sustainability requirements in NPD. In particular, it examines how they integrate the TBL in their NPD processes. The contribution of the paper is twofold. Firstly, it elaborates on the NPD processes and on sustainability from an operations management perspective by developing a sustainable NPD matrix. By doing this the call for more information in the interface of NPD and sustainability has been followed (Ferguson et al. 2010). Secondly, by means of the case study, practitioners can realize that a cooperation of sustainability and NPD is important in order to follow customer's demand for sustainability in the sense of the TBL of sustainability.

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