Holger Ernst, Wayne D. Hoyer, & Carsten Rübsaamen

Sales, Marketing, and Research-and-Development Cooperation Across New Product Development Stages: Implications for Success

Prior research has identified the integration of marketing with research and development (R&D) as a key success factor for new product development (NPD). However, prior work has not distinguished the sales and marketing functions, even though they are distinctive departments within an organization. Therefore, the authors extend prior research and examine the effect of cross-functional cooperation among sales, marketing, and R&D on NPD performance across multiple stages of the NPD process. The authors use multiple-informant data from 424 sales, marketing, and R&D managers as well as project leaders of 106 NPD projects to test several hypotheses. The results show that the cooperation between sales and R&D and between sales and marketing has a significant, positive effect on overall NPD project performance beyond marketing–R&D cooperation. The authors also find that the effect of cross-functional cooperation among sales, marketing, and R&D on overall NPD project performance varies across stages of the NPD process. More specifically, the authors find that sales–R&D cooperation in the concept and product development stages is critical for greater new product success. Sales–marketing cooperation is important in the concept development stage but has surprisingly less impact in the implementation stage.

Keywords: sales, marketing, research and development, cross-functional cooperation, new product development, success

Cross-functional integration, especially between marketing and research and development (R&D), has been widely recognized as a key success factor in new product development (NPD) both in the theoretical literature (Brown and Eisenhardt 1995; Griffin and Hauser 1996) and in empirical studies (Henard and Szymanski 2001; Song and Parry 1997; Troy, Hirunyawipada, and Paswan 2008). By integrating marketing and R&D, companies can enhance the flow of market information, which is critical to the success of new products, into the NPD process (Ottum and Moore 1997; Wren, Souder, and Berkowitz 2000). However, in general, prior empirical research on marketing and R&D integration has not distinguished the sales and marketing functions (Ruekert and Walker 1987a, b; Song and Parry 1997; Troy, Hirunyawipada, and Paswan 2008); rather, both groups have been treated as a single functional unit. This is a major shortcoming because it contrasts with the practitioner view that "as a rule…, they [marketing and sales] are separate functions within an organization" (Kotler, Rackham, and Krishnaswamy 2006, p. 68). This difference becomes clearly visible in the organizational charts of many companies in which sales and marketing are separate departments with different tasks and responsibilities (Workman, Homburg, and Gruner 1998).

The distinctiveness of sales and marketing is due to diverging departmental orientations or thought worlds (Dougherty 1992; Lawrence and Lorsch 1967). Recent work has shown that sales and marketing have different goal and time orientations, which can lead to interdepartmental conflict and hinder cross-functional integration (Homburg and Jensen 2007). Because NPD requires cross-functional integration, these differences in departmental orientations can be critical barriers to successful NPD (Dougherty 1992; Griffin and Hauser 1996). Thus, the role of sales in NPD needs to be explicitly examined beyond that of marketing. In other words, because sales and marketing have distinctively different functions and thought orientations, two further interfaces—between sales and R&D and between sales and marketing—must be considered to better understand the nature of effective cross-functional integration in NPD.

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Addressing the role of the sales function in NPD should expand existing knowledge on antecedents of new product successes and failures (Hultink and Atuahene-Gima 2000). Sales can potentially make complementary and valuable contributions that positively affect NPD performance. For example, organizations have experienced difficulties in generating high-quality ideas in the early stages of NPD (Khurana and Rosenthal 1998), and this difficulty has been frequently identified as a major cause of the notoriously high failure rates of new products (Nobelius and Trygg 2002). Because the sales function has the closest contact to customers (Kotler, Rackham, and Krishnaswamy 2006) and a strong customer orientation (Homburg and Jensen 2007), its involvement and information sharing with R&D and marketing should improve the process of finding, assessing, and selecting more and better ideas for NPD in these early phases. Therefore, the integration of sales with R&D and marketing could help lower new product failure rates (which are approximately 40%–75%; see Stevens and Burley 2003) and increase NPD performance.

Overall, this study addresses these existing research gaps and makes the following key contributions to the marketing and NPD literature: First, we focus on an important aspect of integration—namely, cross-functional cooperation—and examine the effect of sales–marketing and sales–R&D cooperation on NPD performance. This sheds light on the following question: To what extent does the integration of the sales function into NPD increase NPD performance? We simultaneously analyze the effect of cooperation between marketing and R&D on NPD performance. This enables us to examine the relative importance of the marketing–R&D versus the sales–R&D interface for NPD performance, which could lead to a reassessment of the existing claim in the literature that the quality of the marketing–R&D interface is the predominant driver of NPD performance.

Second, research is needed to determine whether the effect of cross-functional cooperation between sales and marketing and between sales and R&D on NPD performance varies across the different stages of the NPD process. Prior work on the cooperation between marketing and R&D suggests that the effect of integration on performance varies across these stages (Olson et al. 2001; Song, Thieme, and Xie 1998). Therefore, we adopt a process-oriented perspective in this study and investigate sales–marketing and sales–R&D cooperation and their respective impacts on NPD performance across multiple NPD stages.

Conceptual Framework

Conceptual Definition of Cross-Functional Cooperation

In previous work, scholars have proposed a variety of definitions for the cross-functional integration construct (for overviews, see Kahn 1996; Olson et al. 2001). Analogously, multiple terms, such as "cooperation," "interaction," "communication," and "coordination," have been employed in the context of studying the effects of interfunctional integration in NPD (Song, Montoya-Weiss, and Schmidt 1997). Furthermore, previous research in this area can be classified into two basic categories (Kahn 1996; Olson et al. 2001): a behavioral approach, which captures the level of interaction and information sharing between members from different departments simultaneously (Gupta, Raj, and Wilemon 1986; Song, Montoya-Weiss, and Schmidt 1997; Song and Parry 1992), and an attitudinal approach, which views integration as "collaboration" and defines it "as an affective, volitional, mutual/shared process where two or more departments work together, have mutual understanding, have a common vision, share resources, and achieve collective goals" (Kahn 1996, p. 136).

In this study, we focus on the behavioral dimension of integration, as Gupta, Raj, and Wilemon (1986), Olson and colleagues (2001) and Song and Parry (1992) suggest, because it is most consistent with our research objectives. Specifically, because we examine cross-functional integration with regard to specific NPD activities at the project level, we need to examine actual behavior rather than interdepartmental attitudes because attitudes are more intangible, more abstract, and largely independent of certain activities along the NPD process (Olson et al. 2001). Consistent with recent work (Olson et al. 2001; Song, Montoya-Weiss, and Schmidt 1997), we use the term "cross-functional cooperation." This definition implies that the measurement of cross-functional cooperation addresses the level of involvement and information sharing between members from sales, marketing, and R&D in NPD.

Cooperation of Sales, Marketing, and R&D in NPD

A considerable amount of conceptual and empirical research has been devoted to the cooperation between marketing and R&D because both departments are highly relevant for successful NPD (Griffin and Hauser 1996; Gupta, Raj, and Wilemon 1986; Song, Thieme, and Xie 1998; Souder 1988). The marketing function is responsible for a wide range of activities that provide relevant information for the entire NPD process. These activities include, among others, market trend analysis, opportunity assessment, market research, market segmentation, product positioning, and communication (Griffin and Hauser 1996; Rouzies et al. 2005). The R&D department is primarily concerned with the generation of new technological knowledge and applying this knowledge to design new products (Griffin and Hauser 1996; Souder 1988). Both sets of activities need to be aligned to share relevant information and to develop a new product that meets the market requirements and generates satisfactory financial returns to the firm. This is enhanced through a high level of cross-functional cooperation between R&D and marketing during the NPD process (Griffin and Hauser 1996).

As we mentioned previously, however, a key problem is that prior research on the effects of cross-functional cooperation has not explicitly distinguished the sales function and the marketing function. According to Homburg and Jensen (2007), sales and marketing are different with regard to two dimensions: orientation and competence.

First, sales and marketing differ in their goal orientation. Marketing focuses more strongly on the product, while sales concentrates more on the customer (Homburg and

Jensen 2007). This is because brand or product managers from the marketing department are usually responsible for a specific product or product portfolio, while sales is typically responsible for a certain set of customers in a specific geographical area or industry segment (Cespedes 1995; Rouzies et al. 2005). As a result, sales has a much stronger and more operational link to individual customers, while marketing has a more strategic focus on customer segments and the entire product business. Sales is also more short-term oriented than marketing (Homburg and Jensen 2007) because it is typically faced with direct and intensive pressures and demands from customers and is seeking fast solutions to these problems. Conversely, marketing examines the broader picture with its long-term implications for the overall business (Cespedes 1995; Weitz 1978). These differences in time and goal orientation can have an important effect on the assessment of investment decisions in NPD and on how the NPD task is understood in both departments, either in developing a product or in building a relationship with a customer (Dougherty 1992; Griffin and Hauser 1996).

Second, Homburg and Jensen (2007) find significant competence differences between sales and marketing. Sales has higher levels of specific market knowledge (i.e., about customers and competitors) than marketing. In particular, sales has unique information about customer needs that is relevant for other functions in the organization to carry out the NPD task effectively. Therefore, we expect the effect of cross-functional sales–R&D cooperation to be most relevant for aspects of NPD in which specific information about customer needs is required.

Because of their different departmental orientations, marketing and sales provide complementary information that is valuable for the NPD process. Marketing provides strategic market information, while sales provides specific customer information. Combining this information is critical because it helps avoid niche solutions for an individual customer that, in turn, neglect the attractiveness of larger market segments or market trends or are not aligned with the firm's overall product portfolio. Thus, sales–marketing cooperation should have a positive impact on NPD performance.

Hypotheses Development

From a theoretical perspective, hypotheses regarding the positive effect of cross-functional cooperation among sales, marketing, and R&D on NPD performance can be derived from resource dependence theory (Ruekert and Walker 1987b; Salancik and Pfeffer 1978). According to this theory, the degree of interdependence and the nature of interactions among functional specialists in an organization are influenced by the accomplishment of the collective task (Song and Swink 2002). The NPD processes involve a wide set of tasks that require the participation of various functional areas. Specialization leads to the need for integration among functions because each department holds a specific set of information required for the NPD process (Song, Thieme, and Xie 1998; Urban and Hauser 1993). This information needs to be effectively shared among multiple functions to achieve successful NPD. Therefore, cross-functional cooperation should increase NPD performance.

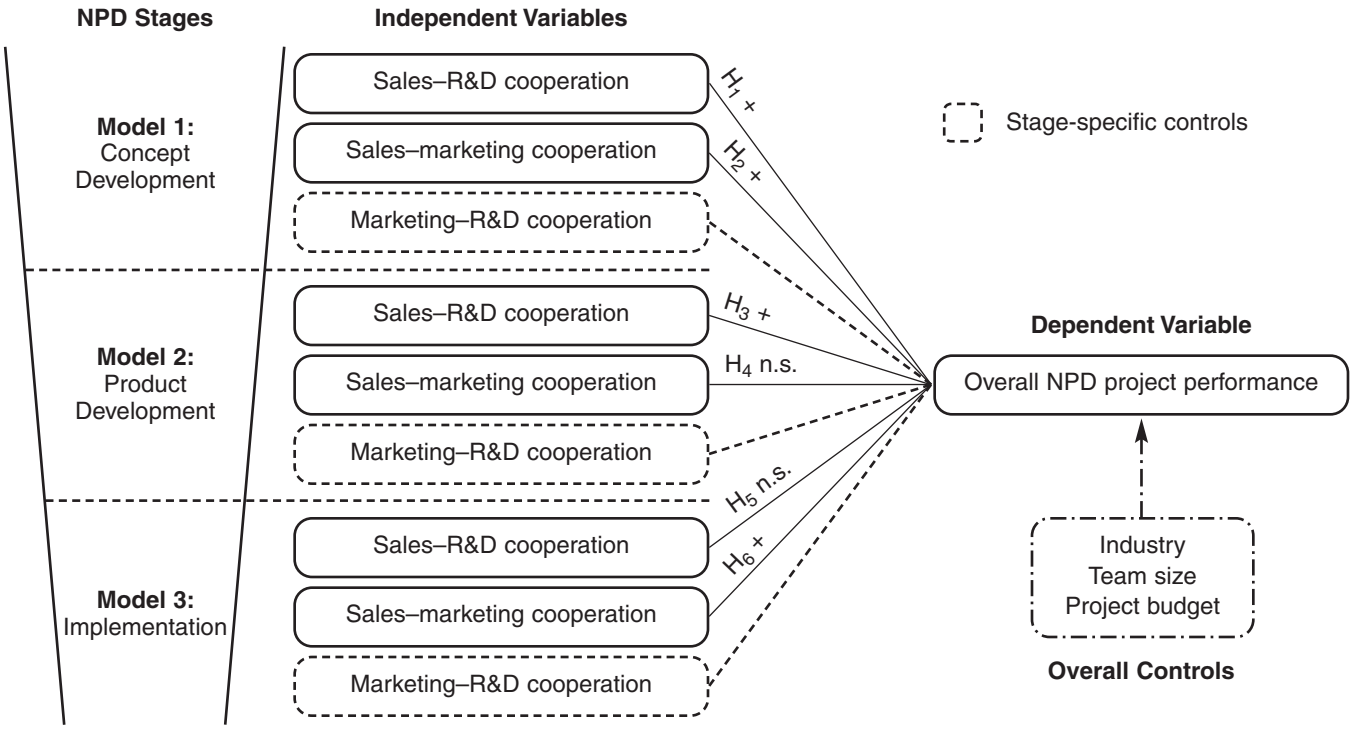
The interdependencies between functional departments, and therefore the performance effect of cross-functional cooperation between two departments, may vary across stages. As Song, Thieme, and Xie (1998, p. 289) point out, "new product success may be more likely when a firm employs function-specific and stage-specific patterns of cross-functional integration than it is when the firm attempts to integrate all functions during all NPD stages." Furthermore, the different functions are inherently more or less involved at different stages. For example, R&D has a less prominent role during the implementation stage, during which sales and marketing are more critical to an effective launch. This notion is also supported by resource dependence theory, which suggests that the relative importance of each function in NPD highly depends on the nature of tasks and activities. Because activities differ across NPD stages, information requirements to accomplish these tasks also vary across these stages. This leads to varying levels of interdependencies and, therefore, cross-functional cooperation among sales, marketing, and R&D (Olson et al. 2001). Thus, we propose that the cooperation of sales with R&D and marketing will not always have an equally strong impact on NPD performance during all NPD stages. To assess the phase-specific impact of sales–R&D and sales–marketing cooperation, we divided the NPD process into three distinct phases, in line with prior work on related topics (Song and Parry 1997): concept development (e.g., generation and refinement of new product ideas, market analysis, preparation of product concept), product development (e.g., actual technical product development, execution of prototype tests, test marketing), and implementation (e.g., market launch, training, after-sales support).

Because the effect of marketing–R&D cooperation on NPD performance has been extensively studied (Griffin and Hauser 1996; Olson et al. 2001; Song and Parry 1992), we focus primarily on the role of the sales function and develop hypotheses regarding the effect of cross-functional cooperation between sales and marketing and between sales and R&D on NPD performance. Nevertheless, we also empirically examine the level of stage-specific cooperation between marketing and R&D to test whether the sales and R&D cooperation on NPD performance has an effect beyond the effect of marketing and R&D cooperation on NPD performance. Figure 1 illustrates the research framework and the hypotheses.

Concept Development Stage

The concept development stage typically involves the generation and assessment of new product ideas and further refinement of the most promising ideas into new product concepts before they enter the development stage (Kim and Wilemon 2002). It is well established that the collection of customer information is critical in this early stage of NPD (Ottum and Moore 1997) because the level of uncertainty regarding customer requirements is high. Drawing on resource dependency theory, we argue that sales–R&D cooperation is important in the concept development phase because the involvement and information sharing between

FIGURE 1
Research Framework and Hypotheses for the Effect of Stage-Specific Sales–R&D and Sales–Marketing Cooperation on Overall NPD Project Performance



Notes: n.s. = not significant.

sales and R&D channels critical information regarding customer requirements into the NPD process. For example, in the case of idea generation, the involvement of sales with R&D is critical because it increases not only the number of new product ideas but also the likelihood that these ideas will be more in line with customer needs and wants. This increases the number of potentially successful ideas entering the NPD process and decreases the likelihood of R&D failing to recognize an important opportunity. In addition, it enables R&D to acquire immediate, valuable customer feedback on ideas generated internally. This reduces the risk that an internally developed idea that is not in line with customer needs is taken into the next stage of the NPD process.

Other critical activities in the concept development stage involve making decisions on both the product concept and the design before they are taken into the development stage (Ernst 2002). Afterward, a significant amount of R&D resources are committed to the NPD project, which then becomes difficult to terminate (Biyalogorsky, Boulding, and Staelin 2006; Boulding, Morgan, and Staelin 1997). Therefore, the level of risk involved at this critical stage of the NPD project is high. To ensure that the features of the product are aligned with customer requirements and that customers actually perceive the unique selling proposition in relation to competing products (which is an important antecedent of new product success; see Cooper 1980; Ernst 2002), sales needs to share its insights on customer requirements with R&D before the NPD project enters the development stage.

Thus, sales–R&D cooperation promises to increase the flow of critical customer information into the concept development stage of NPD, and R&D can use this information to better align its activities with customer requirements. Because the level of interdependence is high during the concept development stage (Kim and Wilemon 2002), sales–R&D cooperation is critical to the overall NPD project success. We postulate the following hypothesis:

> H_1: Sales–R&D cooperation in the concept development phase has a significant, positive impact on overall NPD project performance.

In addition to the sales–R&D interaction, sales–marketing cooperation in the concept development stage can have a positive impact on new product success. Because of their complementary orientations and knowledge base, sales–marketing cooperation can support the planning and formulation of the NPD goal and strategy (Homburg and Jensen 2007). A lack of cooperation at this early stage poses the danger that sales, because of its strong operational link with customers and short-term orientation to solve immediate customer problems (Homburg and Jensen 2007), may provide information for the NPD project that conflicts with a firm's overall strategic market goals. For example, strong ties to a limited number of key customers might lead to a bias in the ideas gathered in the marketplace. Such misleading ideas could incur high costs and risks for a company. They could further lead to the development of niche products or to the premature rejection of ideas outside the mar-

ket of existing mainstream customers (Bower and Christensen 1995; Dougherty 1992).

To overcome these problems, ideas and product concepts need to be assessed with regard to broader market requirements and the firm's overall NPD strategy. If the new product addresses the needs of broader market segments and/or fits into the firm's NPD strategy, it can create higher commercial and strategic value to the firm. Sales typically lacks this type of information (Homburg and Jensen 2007), and therefore sales–marketing cooperation is required to generate ideas with the highest market potential, align the ideas with a firm's NPD strategy, and effectively define the overall product concept and product features before the NPD project is taken into the development stage. In other words, information from marketing's strategy focus complements sales' knowledge of customers to more effectively align specific customer requirements with the needs of larger market segments during concept development. The more adequately the product concept is defined and aligned with customer, market, and strategic requirements in the early stage of NPD, the higher is the likelihood that the new product will become a commercial success (Cooper 2001). Thus, sales–marketing cooperation during concept development will increase overall NPD project performance. We propose the following hypothesis:

H_2: Sales–marketing cooperation in the concept development phase has a significant, positive impact on overall NPD project performance.

Product Development Stage

In terms of sales–R&D cooperation for the actual technical product development, what matters most is getting feedback from customers on the technical product design and testing the prototype with selected customers (Song and Parry 1997). Because of its intimate knowledge about customers, sales can help R&D select and access the most promising pilot or reference customers for testing the prototype. Getting access to the right customer for testing purposes often depends on personal contacts (Hansen, Mors, and Løvås 2005). Experienced salespeople often possess this kind of network and knowledge that enable them to contact customers and motivate them to cooperate, especially when it comes to innovative products that may initially face market resistance and involve high risks for the customer (Hauschildt and Kirchmann 2001). Thus, we propose the following hypothesis:

H_3: Sales–R&D cooperation in the product development phase has a significant, positive impact on overall NPD project performance.

In terms of product development, as we mentioned previously, this stage is primarily concerned with the development of the actual product, and this is mainly a task for R&D. In addition to the specific information acquired about customers from sales, R&D needs further information from marketing. Marketing needs to carry out test-marketing activities and to assess the overall market acceptance of the new product before actually launching it. This broader and more strategic market information needs to be shared with R&D in case modifications to the product design need to be made to increase the new product's market potential. Because of these interdependencies, R&D–marketing cooperation is important in the product development stage.

Thus, consistent with common wisdom, both sales and marketing play an important role at this stage of the NPD process (i.e., in terms of their cooperation with R&D). However, marketing–sales cooperation is less relevant here because specific information about individual customers provided by sales does not help marketing accomplish its main task (i.e., conducting broader test markets to assess the overall market acceptance and overall strategic and commercial benefits of the new product to the firm before launch). As a result, fewer interdependencies exist, and the cooperation is less important at this stage of the NPD process. Thus, we posit the following hypothesis:

H_4: Sales–marketing cooperation in the product development phase has no impact on overall NPD project performance.

Implementation Stage

The implementation phase typically involves activities such as market launch, product training, after-sales support, and monitoring of competitors' reactions (Song and Parry 1992). Sales would typically be involved with the market launch and monitoring of competitors' reactions. When R&D plays a role here, it typically involves direct interaction with customers to provide product training and support. In a few instances, R&D might provide information to sales to facilitate these activities. However, on a general level, these tasks do not require much *interaction* between sales and R&D. This notion was confirmed in exploratory interviews we conducted during scale construction for the study. Senior managers from the interviewed firms indicated that the provision of R&D support to customers is a standard service offered but does not really require much interaction between R&D and sales. Therefore, resource dependency theory would predict that cooperation between these departments has little effect on NPD performance at the implementation stage. Overall, we posit the following hypothesis:

H_5: Sales–R&D cooperation in the implementation phase has no impact on overall NPD project performance.

In contrast to sales–R&D cooperation, sales–marketing cooperation plays a critical role at the implementation phase. During this stage, both sales and marketing possess information that is particularly critical to NPD performance (Hultink and Atuahene-Gima 2000; Rochford and Wotruba 1996). Given the high failure rates of new products, the sales function shares a high degree of responsibility for new product success because it is ultimately responsible for selling the new product to the customer. A lack of sales' involvement in this critical stage of the NPD process could lead to the pursuit of an ineffective launch strategy or a low sales force commitment toward the new product. When this occurs, the likelihood that the new product will be successfully launched in the market is sharply reduced (Hultink and Atuahene-Gima 2000). This is especially problematic for very innovative new products, for which market resis-

tance is strong and a huge sales effort is needed to overcome this resistance.

Furthermore, because of its higher level of customer knowledge, sales can be instrumental in identifying and contacting certain customers who are crucial for the diffusion of new products in the market, such as opinion leaders, innovators, and early adopters (Gordon and Schoenbachler 1997; Rogers 1976). Marketing lacks this customer-specific information, and therefore involvement and information sharing with sales can provide useful input in the development of the implementation strategy. In addition, marketing depends on feedback from the sales department regarding product usability, acceptance, and after-sales support. Consequently, first-hand customer feedback from sales is of critical importance to the marketing department for the successful implementation of the new product. Thus, sales–marketing cooperation in the implementation stage should increase NPD performance. This leads to the following hypothesis:

H_6: Sales–marketing cooperation in the implementation phase has a significant, positive impact on overall NPD project performance.

Methodology

Sample

This study primarily focused on processes and outcomes associated with individual NPD projects rather than on the aggregate NPD performance of an entire firm or division. Consequently, the study examined the cooperation between pairs of functions over the course of an NPD project. Drawing from AMADEUS, a database that classifies German companies according to their sales volume, among other variables, we selected the top 300 companies in terms of revenues from multiple industry sectors.

We conducted Internet research and made exploratory telephone calls to determine whether the selected companies were generally appropriate for the proposed empirical study (i.e., we excluded companies with no internal R&D, sales, or marketing departments as well as pure sales companies) and to identify the right contact people from sales, marketing, and R&D within the selected firms. To avoid the problems of an informant and common method bias (Brown and Eisenhardt 1995), we collected data from multiple informants. Responses from the project manager and sales, marketing, and R&D managers who were closely involved in the NPD project were required for each NPD project data set to be complete. Project managers assessed the dependent variable (overall NPD project performance), and the level of cross-functional cooperation was evaluated independently by respondents from sales, marketing, and R&D. We administered the survey in such a way that all respondents answered the questions with regard to the same project. To ensure that this occurred, the name or the company-specific unique code of the respective project was always stated at the beginning of each individual questionnaire and appeared again on each page of the questionnaires.

In total, we contacted 199 companies and asked them to participate in the study. We guaranteed anonymity to all informants. After several reminder e-mails and multiple telephone calls to increase the response rate, we received 424 questionnaires from 106 NPD projects across 36 companies. A profile of the sample shows a reasonable split of projects across the industries: mechanical engineering (33), medical devices (23), automotive (19), consumer products (17), and software (14). With 36 of the 199 companies participating, the effective response rate of 18.1% can be considered satisfactory for subsequent analysis given the ambitious study design (Menon, Jaworski, and Kohli 1997).

Measures

Cross-functional cooperation. Following Song and Parry (1992), we identified 18 key activities along the entire NPD process that could potentially require the cooperation of sales, marketing, and R&D. Because this scale was initially developed to study the cooperation between R&D and marketing, we conducted 14 in-depth interviews with experts from academia and industry to ensure that this list of activities was appropriate for studying sales–marketing and sales–R&D cooperation.

For each of these 18 NPD activities, we asked respondents from sales, marketing, and R&D to assess the level of cooperation with the two remaining functions. The level of cooperation referred to the level of involvement and information sharing with the other department with regard to each of the 18 NPD 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). Using the multiple-item estimator for within-group interrater reliability (IRR), as James, Demaree, and Wolf (1984) propose, we found general agreement among the raters in terms of the level of cross-functional cooperation. The IRR values ranged between .70 and .77. Given this homogeneity of ratings at or above the level of the IRR threshold at .70, we aggregated the data by calculating the arithmetic mean. In line with Jarvis and colleagues' (2003) suggested criteria, we specified all constructs to be formative with causal indicators.

Overall NPD project performance. Overall NPD project performance captures the success of the completed NPD project. We followed previous NPD research and used a commonly applied subjective measure of new product success (Song and Parry 1997) (for a detailed description of the NPD performance measures, see the Appendix).

Controls. We included multiple control variables in the analyses. To assess the impact of sales cooperation with R&D beyond the effect of marketing–R&D cooperation, we controlled for the level of marketing–R&D cooperation in each NPD stage (for the measurement of marketing–R&D cooperation, see the Appendix). By including industry as an overall control variable, we were able to adjust for significant differences between industries with regard to new product performance. In addition, we included two well-established overall controls at the project level: project budget and team size. The size of a project team is an important structural variable with potential influences on the quality

of a team's joint task processes and project success (Campion, Medsker, and Higgs 1993; Gladstein 1984). The higher the project budget, the more senior management attention the project typically receives, and senior management support has been found to have a positive effect on NPD performance (Ernst 2002; Henard and Szymanski 2001). Table 1 summarizes descriptive information about all the variables and constructs used in the analyses.

Analysis Plan

We tested the research hypotheses using a multiple-indicator structural equation model. Because we used both reflective and formative specifications for the constructs, the commonly used covariance-based structural equation modeling (SEM) techniques, such as LISREL or AMOS, could potentially lead to "identification problems, the occurrence of implied co-variances of zero among some measured variable, and the existence of equivalent models" (MacCallum and Browne 1993, p. 540) in the course of analysis. Because this might have an undesirable impact on the findings (MacCallum and Browne 1993), we used partial least squares (PLS) because this is the most accepted variance-based distribution-free SEM approach. The PLS approach accommodates models that combine formative and reflective constructs (Chin 1998; Wold 1985). We used the PLS Graph software (Version 3.0) developed by Chin (1998) for the analyses. We calculated three independent PLS models for each of the three NPD stages. To evaluate the three PLS models, we followed Chin's recommendations and differentiated between reflective and formative constructs.

We tested the formative constructs for multicollinearity by calculating variance inflation factors on the item level (Im et al. 2003; Michael, Rochford, and Wotruba 2003) and condition indexes on the construct level (Belsley 1984). The results indicate no significant parameter distortion due to multicollinearity problems (variance inflation factor < 10). This finding is underscored by condition indexes ranging between 5 and 19, which are well below the upper threshold of 30 (Belsley 1984). Following Diamantopoulos and Winklhofer's (2001) suggested procedure, we included a reflective indicator to test the formative constructs for external validity. The relationships between the formative constructs and their reflective indicators are strong and highly significant ($p \leq .001$).

On the structural model level, we estimated R-square values and the Stone-Geisser criterion (Q^2). The adjusted R-square values range between .22 and .45 and indicate a satisfactory explanatory power for the models compared with previous studies on cross-functional cooperation in NPD projects (Olson et al. 2001). In PLS models, the Stone-Geisser test criterion (Q^2) is used as a measure for predictive relevance. The Q^2 values are all positive and indicate a sufficient level of predictive relevance (Fornell and Bookstein 1982).

We calculated path coefficients and levels of significance for control variables according to the group comparison method (Avolio, Howell, and Sosik 1999). For this procedure, we divided the sample into two subgroups and compared path coefficients for significant differences. Subsequently, we test the significances of the differences with a t-test (Keil 2000).

Results

Tests of Hypotheses: Overall NPD Project Performance

In this section, we present the results with regard to the effect of sales–R&D and sales–marketing cooperation on overall NPD project performance across multiple NPD

TABLE 1
Descriptive Statistics

Variables and Constructs	Number of Items	Number of Observations	M	SD	Minimum	Maximum
Overall NPD project performance	4	106	4.6	1.4	1.0	7.0
Market share	1	63	20.5	28.2	1.0	100
Stage 1[a]: marketing–R&D cooperation	7	106	3.9	1.5	1.0	7.0
Stage 1: sales–R&D cooperation	7	106	2.7	1.6	1.0	7.0
Stage 1: sales–marketing cooperation	7	106	4.5	1.5	1.0	7.0
Stage 2[b]: marketing–R&D cooperation	7	106	4.2	1.7	1.0	7.0
Stage 2: sales–R&D cooperation	7	106	2.4	1.5	1.0	7.0
Stage 2: sales–marketing cooperation	7	106	3.6	1.5	1.0	7.0
Stage 3[c]: marketing–R&D cooperation	4	106	4.7	1.5	1.0	7.0
Stage 3: sales–R&D cooperation	4	106	2.7	1.5	1.0	7.0
Stage 3: sales–marketing cooperation	4	106	3.7	1.5	1.0	7.0
Project budget	1	66	16.4	95.8	1.0	800
Team size	1	104	22.4	42.5	3.0	300
Mechanical engineering	1	33	—	—	—	—
Medical devices	1	23	—	—	—	—
Automotive	1	19	—	—	—	—
Consumer products	1	17	—	—	—	—
Software	1	14	—	—	—	—

[a]Concept development.
[b]Product development.
[c]Implementation.

process stages. The outcomes of the PLS analyses are in Table 2.

H_1 proposed that during concept development, sales–R&D cooperation has a significant, positive impact on overall NPD project performance. This hypothesis is supported because the path coefficient for sales–R&D cooperation in the concept development stage is positive (.26) and significant ($p \leq .01$). H_2, which pertains to sales–marketing cooperation in the concept development stage, is also supported. The path coefficient of .25 ($p \leq .05$; see Table 2) reveals a significant, positive relationship between the level of sales–marketing cooperation and overall NPD project performance in this stage.

H_3 pertains to the impact of sales–R&D cooperation on overall NPD project performance during product development. This hypothesis is also supported, with a positive, significant path coefficient of .36 ($p < .05$; see Table 2) for sales–R&D cooperation. As H_4 predicts, sales–marketing cooperation in the product development stage has no significant impact on overall NPD project performance (see Table 2).

Consistent with H_5, sales–R&D cooperation during the implementation stage does not have a significant impact on overall NPD project performance. More important, as H_6 predicted, the level of sales–marketing cooperation during the implementation stage has a positive but only weakly significant impact on overall NPD project performance (with a path coefficient of .29 [$p \leq .1$]; see Table 2).

The level of marketing–R&D cooperation has a positive impact on overall NPD project performance in all three stages. Team size tends to have a positive effect on overall NPD project performance; however, only the effect in the product development stage is significant. The coefficients for the industry dummies indicate differences in NPD performance; however, these differences are statistically not significant (see Table 2).

Further Analyses: Market Share

To cross-validate the subjective overall NPD project performance measure, we gathered German market share data from the respondents for the new product in Germany 18 months after its launch. We were able to collect these data for 63 of the 106 projects we had analyzed previously. We ran similar PLS models to those in Figure 1, but with market share as the dependent variable. As Table 3 shows, the key results of the study remain unchanged. The only notable differences appear with regard to the effect of sales–marketing cooperation in the product development stage. In contrast to our previous finding, the effect of sales–marketing cooperation on market share is positive and significant in the development stage. This finding contradicts H_4, which predicted no effect of sales–marketing cooperation in the product development stage on overall NPD project performance.

Discussion

To the best of our knowledge, this study is the first large-scale empirical examination of the impact of the cooperation between sales and marketing and between sales and R&D on NPD performance. As we mentioned previously, most previous studies in this area have grouped sales within the marketing function. However, the current findings support the notion that sales and marketing are distinct func-

TABLE 2
Results of PLS Analyses: Impact of Sales–Marketing and Sales–R&D Cooperation Across NPD Stages on Overall NPD Project Performance

Model/NPD Stage	Model 1: Concept Development		Model 2: Product Development		Model 3: Implementation	
Dependent Variable	Overall NPD Project Performance		Overall NPD Project Performance		Overall NPD Project Performance	
	Estimate	SE	Estimate	SE	Estimate	SE
Main Effects						
Sales–R&D cooperation	.26***	.17	.36**	.10	.07	
Sales–marketing cooperation	.25**	.17	.01		.29*	.14
Controls						
Marketing–R&D cooperation	.26***	.13	.27***	.15	.19*	.12
Project budget	–.07		–.05		–.11	
Team size	.09		.13***	.07	.22	
Automotive	.19		.22		.35	
Mechanical engineering	–.18		–.19		–.22	
Medical devices	–.08		–.07		–.15	
Consumer products	.10		.08		.03	
Software	–.03		–.04		–.09	
R^2	.31		.31		.25	
Q^2	.42		.42		.40	
N	106		106		106	

*$p \leq .1$.
**$p \leq .05$.
***$p \leq .01$.
Notes: We report standard errors only for significant effects (Reinartz, Krafft, and Hoyer 2004).

TABLE 3
Results of PLS Analyses: Impact of Sales–Marketing and Sales–R&D Cooperation Across NPD Stages on Market Share

Model/NPD Stage Dependent Variable	Model 1: Concept Development Market Share		Model 2: Product Development Market Share		Model 3: Implementation Market Share	
	Estimate	SE	Estimate	SE	Estimate	SE
Main Effects						
Sales–R&D cooperation	.30**	.18	.35*	.20	.27	
Sales–marketing cooperation	.34***	.13	.39***	.11	.16	
Controls						
Marketing–R&D cooperation	–.13		.28***	.20	.30**	.16
Project budget	–.02		–.12		–.02	
Team size	–.03		.09		–.05	
Automotive	–.06		–.12		–.15	
Mechanical engineering	.11		.02		.06	
Medical devices	.06		.18		.18	
Consumer products	.04		–.04		.07	
Software	–.12		–.08		–.07	
R^2	.24		.45		.22	
Q^2	N.A.		N.A.		N.A.	
N	63		63		63	

*$p \leq .1$.
**$p \leq .05$.
***$p \leq .001$.
Notes: We report standard errors only for significant effects (Reinartz, Krafft, and Hoyer 2004). N.A. = not applicable.

tions and have different roles in NPD. Thus, both sales–marketing and sales–R&D cooperation have a strong and positive impact on NPD performance beyond the well-known effect of R&D and marketing cooperation on new product success. The results further reveal that the effect of cross-functional cooperation between sales and marketing and sales and R&D varies across stages of the NPD process. These findings have important academic and managerial implications.

Academic Implications

Several researchers (Gordon and Schoenbachler 1997; Hultink and Atuahene-Gima 2000) have called for empirical evidence examining the effects of integrating sales with other functional departments during the entire NPD process. In this regard, this study makes several important research contributions.

First, we conceptualize and empirically investigate the cooperation of sales with marketing and R&D across the entire NPD process (i.e., concept development, product development, and implementation). Because the results show that sales–R&D cooperation is critical for NPD performance, we conclude that prior empirical studies on cross-functional integration have ignored an important contributor to new product success by subsuming sales and marketing broadly under the term "marketing organization." In contrast, the findings indicate that sales can make important contributions to NPD when interacting with R&D. Therefore, the sales function should receive distinctive attention in further NPD research.

Second, the phase-specific analyses show that sales–R&D cooperation has a significant, positive impact on new product success during the stages of concept and product development. These findings support the prediction from resource dependency theory because the level of interdependencies is highest in these stages of the NPD process (Kim and Wilemon 2002). Sales and R&D need to cooperate effectively in these stages to share relevant information to accomplish the joint NPD task (Ruekert and Walker 1978b). We also found that sales–R&D cooperation had no impact on new product performance at the implementation stage. However, this cooperation could be important for a few specific industries (especially those that involve complex and technical products). In these specific cases, R&D may need not only to support customers directly but also to educate the sales force in terms of technical details to allow them to provide better support to customers. This notion should be explored in future studies.

Third, the stage-specific analyses further reveal that sales–marketing cooperation in the concept development stage is critical for NPD performance. An advantage of sales–marketing cooperation during early NPD activities, such as idea generation, is that it brings together two important complementary perspectives (i.e., the customer perspective [sales] and the overall strategic product perspective [marketing]). Both perspectives are needed to identify and select the most promising new product ideas and to refine them into product concepts that are accepted by key customers and contribute to the firm's overall strategic and financial objectives.

The analyses produced mixed findings with regard to the effect of sales–marketing cooperation in the product development stage. When overall NPD project performance is the dependent variable, sales–marketing cooperation at this stage had no significant effect on new product success. However, when market share is the dependent variable,

sales–marketing cooperation in the product development stage had a strong and significant effect on success. This finding may indicate that sales should already be involved with marketing during the product development stage to adequately plan and prepare the actual launch process. However, note that, overall, NPD project performance and market share are different indicators of success. The NPD performance measure we use is more closely linked to the NPD process and captures different aspects of NPD performance in more detail; however, it is based on a judgment and therefore is more subjective. Conversely, market share is more objective and narrow, but it contains more "noise" (i.e., there are several other unaccounted-for factors that can influence it). In addition, our sample size for market share is smaller than that for overall NPD project performance, which could have affected the findings. Overall, further research is required to examine why these mixed findings occurred.

Finally, it is noteworthy that the sales–marketing cooperation had only a weak impact at the implementation stage. In general, when academics, salespeople, or sales mangers talk about the lack of cooperation between marketing and sales, they are referring to the implementation stage. A general belief is that a lack of cooperation at this stage can cause a "good" product to fail. This study finds a positive impact for both project performance and market share, but these relationships were either weakly significant or even nonsignificant. This may indicate that it is particularly during the earlier stages of NPD that sales–marketing cooperation is critical and that it has less of an impact during later stages of the NPD process.

Managerial Implications

Historically, the successful generation of new products has been linked to the effective cooperation between marketing and R&D. However, the results show that sales plays a vital role and that organizations need to carefully manage the cooperation of sales with marketing and R&D. The cooperation of marketing and R&D with sales conveys critical customer information to the NPD process, thus improving the likelihood of new product success. Therefore, managers should understand that integration of sales into the NPD process is an effective way to bring the "voice of the customer" into the firm.

This research further shows that managers need to foster cross-functional cooperation among sales, marketing, and R&D at specific stages of the NPD process. One finding is that the cooperation of sales with R&D and marketing is critical at the early stage of concept development. Up-front activities, such as generating and assessing ideas, deciding the critical product features, and determining the product's value proposition, should involve the sales function.

Sales–marketing cooperation is also important, particularly in the early stages of NPD. During concept development, sales–marketing cooperation is required to generate ideas that not only are closely aligned with customer needs but also have a high market potential. Sales–marketing cooperation in the later stages of the NPD process is less critical for new product success. Thus, managers are not well advised if they adhere to the popular view that fostering sales–marketing cooperation in the implementation stage is the key to success. Instead, managers need to focus on facilitating cooperation between sales and marketing at the beginning of the NPD process. A misalignment of marketing and sales in the early stages of NPD cannot be overcome later in the NPD process.

The results suggest that managers need to focus on improving the cooperation among sales, marketing, and R&D in the NPD process. However, diverging incentive systems and cultural barriers (Homburg and Jensen 2007) are only some of the challenges managers face when trying to integrate sales with other functional departments. Therefore, managers need to take proactive, strong measures to bring the sales function into the NPD process. A promising way could be to make representatives from sales part of a cross-functional team, at least for parts of the NPD process for which the cooperation within the triangle of sales, marketing, and R&D is critical. The benefits of the joint team with all three parts of the triangle should be greater than the sum of the one-by-one relationships.

Limitations and Further Research

This study has some limitations that offer opportunities for further research. First, this study examined specific NPD activities on a relatively broad level. Further research is needed to examine the specific processes by which these types of information are input into the NPD process. For example, some ways of collecting and reporting customer information from sales may be more effective than others.

Second, the study focused only on the cooperation among sales, marketing, and R&D. However, it is conceivable that the integration of other organizational functions, especially operations (e.g., purchasing, manufacturing, design), is also required for successful NPD. Therefore, subsequent studies should extend the framework proposed in this study and analyze the effect of sales cooperation with these other operational functions on NPD performance.

Third, although we sampled a variety of business-to-business and business-to-consumer industries, the sample included only German companies. Thus, further research is needed to determine the extent to which these findings extend to other countries. However, note that the hypotheses would be the same for other industrialized countries.

Finally, because cross-functional cooperation of sales with R&D and marketing matters for NPD performance, it is important for academics and managers to understand more about the antecedents that effectively integrate the sales function into the NPD process. Existing work on antecedents of cross-functional cooperation has focused entirely on the relationship between R&D and marketing (Griffin and Hauser 1996). Thus, conceptual and empirical work is required to identify effective mechanisms to foster cooperation between sales and R&D and sales and marketing. An appropriate empirical study would need to take a multilevel approach because some of the potential integration mechanisms, such as incentive systems, corporate culture, and organizational structure, are firm-level constructs that have an impact on cross-functional cooperation at the project level.

Conclusion

This research shows that it is necessary to distinguish the sales and marketing functions to better understand the link between the "market-oriented areas" and R&D in an organization with regard to NPD. Thus, the focus of research in this area needs to shift from studying the bilateral relationship between marketing and R&D to examining the triangle relationship among sales, marketing, and R&D to improve the NPD process. However, the effect of cross-functional cooperation among sales, marketing, and R&D varies across stages of the NPD process. Sales–R&D cooperation in the concept and product development stages is critical for successful NPD. Sales–marketing cooperation is important in the concept development stage and has surprisingly less impact in the implementation stage. These new and detailed insights will help academics better understand the nature and effect of cross-functional integration in NPD and will help managers take the appropriate and actionable measures to lower failure rates and to boost NPD performance.

Appendix
Description of Measures

Cross-Functional Cooperation

The scales for the cooperation between marketing and sales, marketing and R&D, and sales and R&D were formative constructs and were rated on a seven-point Likert scale, anchored by 1 = "strongly disagree" and 7 = "strongly agree." Cooperation was defined and explained to respondents as the level of involvement and information sharing.

A respondent from sales assessed his or her cooperation with R&D and marketing for Project X. A respondent from marketing assessed his or her cooperation with R&D and sales for Project X. A respondent from R&D assessed his or her cooperation with sales and marketing for Project X. The specific items were as follows:

In the NPD Project X, I (e.g., respondent from sales) cooperated with (e.g., R&D) during the following NPD 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. Implementation

- •Market introduction of the new product (selling, advertising, distribution).
- •Product training for customers.
- •Customer enquiries/after-sales support.
- •Monitoring competitors' reactions and their strategies.

Overall NPD Project Performance (adapted from Song and Parry 1997; Cronbach's α = .90)

Overall NPD project performance was assessed by a fourth and independent informant (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):

1. How successful was this new product from an overall profitability standpoint? (1 = "a great financial failure," and 7 = "a great financial success")
2. 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")
3. 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")
4. 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")

Market Share

What market share in Germany did the new product (Project X) achieve 18 months after its market introduction (approximately)?

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