Available online at www.sciencedirect.com
ScienceDirect
J. Eng. Technol. Manage. 23 (2006) 353–373
Journal of ENGINEERING AND TECHNOLOGY MANAGEMENT JET-M
www.elsevier.com/locate/jengtecman

# Modeling market information processing in new product development: An empirical analysis

Erik Veldhuizen [a,*], Erik Jan Hultink [a], Abbie Griffin [b]

[a] *Delft University of Technology, Faculty of Industrial Design Engineering, Landbergstraat 15, 2628 CE Delft, The Netherlands*
[b] *University of Utah, David Eccles School of Business, 1645 East Campus Center Drive, Office KDGB 209, Salt Lake City, UT 84112-9301, United States*

Available online 18 September 2006

**Abstract**

This research explores the antecedents and consequences of market information processing during the development process of new high-tech products. To this end, we develop and test a conceptual model for market information processing in three generic stages of the new product development (NPD) process (predevelopment, development and commercialization). In addition, we explore the relationships between market information processing, its antecedents, and product advantage and success. We test our model with responses from 166 NPD-managers in Dutch high-tech firms. The findings show that the market information processing variables are related differentially to new product outcomes, even when controlling for product advantage and product newness to the market. In addition, we found that companies can enhance market information processing for new high-tech products by influencing project priority and flexibility to new products, and by reducing interdepartmental conflict.


*JEL classification :* L15 Information and product quality; M10 Business administration; M31 Marketing

*Keywords:* New product development; Market information processing; High-tech products; Market orientation

## 1. Introduction

Market orientation has received much attention for its apparent positive effect on organizational performance (Narver and Slater, 1990; Jaworski and Kohli, 1993). Market orientation leads to superior organizational performance, at least in part, by aiding in developing

* Corresponding author.
*E-mail addresses:* H.G.Veldhuizen@tudelft.nl (E. Veldhuizen), H.J.Hultink@tudelft.nl (E.J. Hultink), abbie.griffin@business.utah.edu (A. Griffin).

0923-4748/$ – see front matter 
doi:10.1016/j.jengtecman.2006.08.005

successful new products (Gatignon and Xuereb, 1997). A market orientation is inherently a learning orientation (Slater and Narver, 1995) as it consists of information processing activities that organizations use to learn (Kohli and Jaworski, 1990; Kohli et al., 1993). These activities include market information acquisition, dissemination and use (Kohli and Jaworski, 1990; Baker and Sinkula, 2002).

Innovation is inherently an information processing activity (Leenders et al., 2003). An important element of information processing is the use of market information (Moorman, 1995; Ottum and Moore, 1997). Market information use has been defined as taking information about current and future needs of customers and external factors such as competition into account when making decisions (Moorman et al., 1993). Several studies have shown that the use of market information has a positive effect on the successful development of new products (Atuahene-Gima, 1995; Ottum and Moore, 1997). A market orientation is achieved, therefore, through market information processing.

However, organizations often fail to use market information that is available to them (Maltz and Kohli, 1996). Effective market information processing has been identified as a problematic area (Cooper, 2003), and many firms do not actively incorporate market information into their new products (Ottum and Moore, 1997).

Whereas market information is acknowledged for its important effect on both NPD and organizational performance for incrementally new products, the appropriate role for market information is less apparent for really new products (O'Connor, 1998; Veryzer, 1998a). According to some authors, too much emphasis on market information may lead to incremental product improvements rather than truly innovative products (Tauber, 1974; Bennett and Cooper, 1981). Two important questions, therefore, are why companies decide to process, or not to process, market information in their development projects, and how product newness to the market interacts with their level of market information processing, and ultimately the new product's success.

The purpose of this research is to investigate the antecedents and consequences of market information processing during the development of new high-tech products. To this end, we develop a conceptual model of market information processing across three generic stages of the NPD process (predevelopment, development and commercialization). In addition, the relationships between market information processing, product advantage and new product success are explored.

This study contributes to the existing literature in three ways. First, most market orientation studies have been conducted at the company level. The present study focuses on implementing a market orientation at the project level. Second, we investigate market information use across three different stages of the NPD process, and thereby show the consequences of market information use more granularly than previous studies. Finally, we investigate the effects of several antecedents of market information processing for new high-tech products, including the controversial issue of product newness to the market. While most studies in the past decade focused on the consequences of market information processing in NPD, few have investigated antecedents to market information processing. To our knowledge, no study has investigated several of the antecedents included here. We hope to fill a part of this gap in extant knowledge.

## 2. Literature review and hypotheses development

Fig. 1 presents our conceptual model of the antecedents and consequences of market information processing in high-tech NPD. Antecedents of market information processing were derived from the literature and 11 exploratory interviews with NPD-managers. The interviewees were professionals in marketing, R&D, design, and business development. The semi-structured interviews used open-ended questions focused on understanding (1) the organization, (2) the

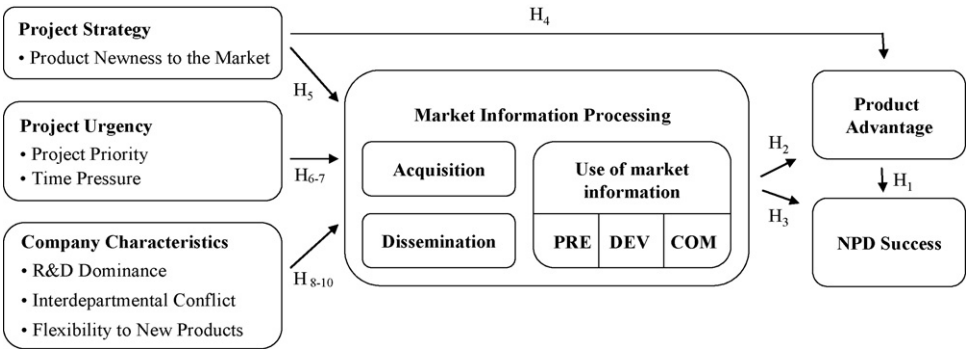


Fig. 1. Antecedents and consequences of market information processing.

respondent's role in the NPD project, (3) the NPD process, (4) acquiring information, (5) disseminating information, and (6) using market information during the NPD project, with managers elaborating on each topic.

From the literature and interviews, we identified three groups of market information processing antecedents: project strategy (i.e., product newness to the market), project urgency (i.e., project priority and time pressure) and company characteristics (i.e., R&D dominance, interdepartmental conflict and flexibility to new products). The literature suggests that product newness consists of several dimensions: market, technology, organization, and external resource fit (Green et al., 1995; Danneels and Kleinschmidt, 2001; Garcia and Calantone, 2002; Salomo et al., 2003). However, our interviewees suggested that it is especially the market dimension of product newness that is most strongly linked to market information processing and use. We therefore decided not to include the other dimensions of product newness in our research. Following the NPD-literature (Urban and Hauser, 1993; Crawford and Di Benedetto, 2002), the NPD process consists of three generic stages (predevelopment, development and commercialization). The present study considers the direct and indirect effects of product newness and market information use in the three generic NPD stages on success through generating product advantage. The next section develops hypotheses for the consequences of market information processing in high-tech NPD. Then, we turn to the hypotheses for the antecedents of market information processing.

### *2.1. Consequences of market information processing in high-tech NPD*

The goal of every NPD project is to commercialize a successful new product. According to Rogers (1995) the adoption of a new product by the market is positively influenced by the product's advantages over competing products. Customers are more willing to buy a new product when it has superior attributes. Creating new product advantage consistently has been found as a major success factor in NPD (Cooper, 1985; Montoya-Weiss and Calantone, 1994; Henard and Szymanski, 2001). Indeed, in their meta-study, Montoya-Weiss and Calantone (1994) identified product advantage as the factor with the strongest impact on new product performance of all those studied. We therefore hypothesize as follows.

**Hypothesis 1.** Product advantage is positively related to new product success.

A number of researchers have published on the relationship between information processing, in general, and product development performance. Tyler (2001) derived a model of the

association between cooperative capabilities, including information processing, and product development capabilities, from the theory of the resource-based view of the firm. More recently, Mohrman et al. (2003) empirically identified a direct association between effective information processing, change in performance and relative performance. These studies clearly would suggest that the broad processes of information processing are indeed related to product development outcomes.

However, research on the learning organization has shown that before information can be used in a development project, it first must be acquired and then disseminated to the right people (Sinkula, 1994; Sinkula et al., 1997; Baker and Sinkula, 2002). Several studies have focused on the details of how market information is processed in NPD. In their research, both Ottum and Moore (1997) and Akgün et al. (2006) found strong interrelationships across gathering, sharing and using market information. Moorman (1995) investigated the same relationships at the firm level and found that market information use mediates the relationships between information acquisition and dissemination, and new product success. Li and Calantone (1998) showed that using customer and competitor information by analyzing the information and integrating it into product design positively influences new product advantage. Kawakami and Song (2004) found that using customer information was associated with new product development performance and that that association was attenuated by the innovativeness of the product. These pieces of research suggest that the overall construct of market information processing consists of three tasks: acquiring information, disseminating it, and finally, using it.

On the micro level, Cooper (1992) identifies learning about customers as a major contributor to new product advantage. Sinkula (1994) suggests that market-directed organizational learning ''results in the fundamental bases of competitive advantage'' (page 37). According to Day (1994), effective learning about markets is a continuous process that pervades all decisions. Continuous market learning helps managers repeatedly anticipate market opportunities and respond before their competitors, providing the opportunity to create competitive advantage for the firm.

The NPD-literature generally considers the NPD process as consisting of three generic stages, each with several activities and decisions (Urban and Hauser, 1993; Crawford, 1994). The *predevelopment* stage contains strategic planning, business and market opportunity analysis, and new product idea generation and evaluation. Here, customer needs must be gathered and processed by the team, and matched with potential technical solutions (Dougherty et al., 2000). During the *development* stage attention turns to product specification. Product concepts are developed and prototypes are tested with potential customers. In this stage market research is needed to set product goals and make product feature trade-offs. In the *commercialization* stage product specifications are released to manufacturing and the sales force is trained. Market introduction of the new product is prepared and decisions on launch strategies and tactics are made (Hultink et al., 1998). Thus, market information can be used to make better decisions throughout the different stages of the NPD process, resulting in higher quality and product advantage (Calantone and di Benedetto, 1988; Rajatanavin and Speece, 2004), but different kinds of market information are required across the different stages of development (Zahay et al., 2004).

Combining the findings of researchers studying market information processing as a general process with those studying the phenomenon at the more granular level and with the need to use information across the different stages of the NPD process, we thus define market information processing for NPD as first acquiring, then disseminating, and finally using information in the predevelopment development, and commercialization stages of development. We then hypothesize as follows.

**Hypothesis 2.** Market information processing is positively related to product advantage.

**Hypothesis 3.** Market information processing is positively related to new product success.

Of course, another way of achieving product advantage is through specifically setting the project's initial strategy such that product advantage is achieved. One such strategy is to target the project to solve problems that have not been solved effectively before—essentially by developing products that are new and differentiated from those on the market (Porter, 1985). Most NPD research has found a direct relationship between product newness and success (Henard and Szymanski, 2001). However, some researchers have suggested that newness is indirectly linked to success, by creating a differentiated product advantage for customers (Cooper, 1999). In an empirical test of 382 NPD projects, Gatignon and Xuereb (1997) found that product similarity (the opposite of product newness to the market) was negatively related to product advantage, supporting the indirect relationship. Recognizing that we focus only on the market dimension of product newness, we thus hypothesize:

**Hypothesis 4.** Product newness is positively related to product advantage.

### *2.2. Antecedents to market information processing in high-tech NPD*

The literature and managerial interviews identified three sets of antecedents to market information processing in the NPD process: project strategy, project urgency and company characteristics.

#### *2.2.1. Project strategy: product newness to the market*

In the case of innovative products, some question the usefulness of using market information in NPD projects. On the one hand, potential customers for innovative products may be unable to articulate their needs or to understand the product concept adequately enough to evaluate it appropriately (Tauber, 1974; Von Hippel, 1988). Christensen (1997), for one, claims that markets for disruptive innovations cannot be predicted with great accuracy because they do not yet exist.

On the other hand, other researchers support the need for market information use in radical NPD. An in-depth study of eight radical innovation projects found that, while the processes used for learning about the market were different than those used in incremental projects, market information processing did occur for radical innovations (O'Connor, 1998). In all cases, the actual insight into the link between the technology and its possible use originated from the technologists involved in the project and their market understanding (O'Connor and Veryzer, 2001). Later findings in this longitudinal study showed that a lack of sufficient market understanding by these technologists early in the projects, and to the point of having to pick an application for the new radical technology, was later related to a failure to find or create new markets of a size that the firm expected for the investment (O'Connor and Rice, 2005). Chandy and Tellis (1998) also found that firms developing radical innovations paid close attention to potential future markets. Finally, in their empirical study, Gales and Mansour-Cole (1995) found that a higher number of users were contacted for market input in projects with higher uncertainty, defined as projects that were more differentiated from previous offerings, and with less stable technology bases.

While the previous research suggests that market information processing is needed, even for more innovative projects, other researchers have asserted that an inverted U-shaped curve is most appropriate for the relationship between product newness and the importance of market

information. The logic is that, for incremental new products the team understands how the product should evolve, and thus taking the time and expense to gather new market information may lengthen the time to market and decrease the return on investment for the project overall. Market information importance peaks for projects of moderate innovativeness, where teams require needs information to guide their development efforts, and confirmation that their concepts are on the right track. For radically new projects, on the other hand, potential users typically lack a useful frame of reference for evaluation (Veryzer, 1998b). Development processes for these products are more technically exploratory and less customer-driven (Veryzer, 1998a). While market information processing may not be zero for radical innovation, it is lower than for the more innovative projects, creating the inverted U-shaped curve for the relationship. In their empirical test of 55 NPD projects in the computer industry, Callahan and Lasry (2004) find support for the inverted U-shaped relationship between product newness and market information use.

An interesting question that arises about the relationships between product newness to the market, market information use and new product success is the form of that relationship. A number of researchers have hypothesized that product newness moderates the relationship between market information use and new product success. However, and importantly, none of the research testing that functional form has found a statistically significant effect (Atuahene-Gima, 1995; Ottum and Moore, 1997; Souder et al., 1998; Salomo et al., 2003). An alternative functional form that can be hypothesized is that market information processing mediates the link between product newness, and product advantage and success. That is, increased product newness to the market is associated with an increased need to process market information, which in turn ultimately is associated with increased product advantage and success. Supporting a mediating form of the relationship, Gatignon and Xuereb (1997) found that more uncertain environments (such as those where the product is newer to the market) create a need for more market scanning and networking with users to identify customer needs. It should be noted that they did not find an inverted U-shaped relationship between uncertainty and market information processing. As the only statistically significant empirical result on the relationship form supports a mediating role for market information processing, we hypothesize as follows.

**Hypothesis 5.** Product newness to the market is positively related to market information processing.

### 2.2.2. *Project urgency*

This set of antecedents was derived primarily from the interviews with developers of new high-tech products. These interviews indicated that the priority given to the NPD project, and the time-pressure felt during the project were important factors influencing market information processing.

The priority given to a project can influence whether NPD decisions are based on market information. When a project is of high importance to the company our interviewees indicated that more attention is paid to market information processing in the different stages of the NPD process. In addition, higher project priority may lead to more allocation of resources to market research. In prior studies, project priority has received much discussion, but little empirical support (Ottum and Moore, 1997). We propose the following hypothesis.

**Hypothesis 6.** Project priority is positively related to market information processing.

Time pressure is a common complaint during NPD projects that may inhibit market information processing. Time pressure is the extent to which team members believe that they have a shortage of time during a specific NPD project (Sethi, 2000). Consumer research has

demonstrated that time pressure effects information processing by consumers. For example, Wright (1974) found that subjects under high time pressure take fewer features into account when evaluating cars. We expect that high levels of time pressure also lead to less processing of market information by NPD-personnel. When time pressure is high, less time can be spent on the acquisition, dissemination and use of market information during NPD projects.

**Hypothesis 7.** Time pressure is negatively related to market information processing.

*2.2.3. Company characteristics*

The final set of antecedents that is proposed to affect market information processing pertains to company characteristics. These are characteristics that, while measured at the firm or business unit level, have the potential to influence behavior at the project level. Three factors influencing market information processing are considered: R&D dominance, interdepartmental conflict and flexibility to new products.

When marketing and R&D exhibit a ''balanced differentiation'' in their involvement with NPD decisions, Kawakami (2004) finds that the use of customer information in the NPD process increases. However, in high-tech firms (the sample used in this research), R&D often dominates marketing in influencing NPD decisions (Workman, 1993). Product managers with a technical background, engineers in management teams and a large number of technical employees indicate R&D functional dominance. The respondents to our qualitative interviews indicated that an engineering-driven culture could be an impediment to effective market information processing, as engineers tend to discount the utility of market information compared to technical information. Too much R&D dominance may lead to a strong belief in the technical superiority of the product, and to a lower allocation of resources to market research. Therefore, we propose the following hypothesis.

**Hypothesis 8.** R&D dominance is negatively related to market information processing.

Previous studies have considered interdepartmental conflict for its negative impact on a market orientation (Matsuno et al., 2002). Interdepartmental conflict is proposed to have a negative influence because low levels of connectedness between departments may inhibit effective information processing. When there is little or no contact among employees across departments, and department goals are not in harmony with each other, less market information is processed (Cummings and Teng, 2003). Therefore, we expect a negative relationship as follows.

**Hypothesis 9.** Interdepartmental conflict is negatively related to market information processing.

A company's ''willingness to cannibalize'' previously was found to be an important predictor of product innovation (Chandy and Tellis, 1998). In our interviews we discussed the role of the firm's ''willingness to cannibalize'' for effective market information processing. Several of our interviewees mentioned that it was not so much ''the firm's willingness to cannibalize'' but a related construct called ''the firm's flexibility towards new products'' that was important to explain market information use. If a company easily can switch from one technology to another, or easily can change its NPD organization, it is flexible towards new products. A flexible company is more adaptive to market developments. It will therefore gather, disseminate and use more market information for developing new products. We thus hypothesize as follows.

**Hypothesis 10.** Flexibility towards new products is positively related to market information processing.

Fig. 1 depicts the set of hypotheses that are tested empirically. As indicated previously, this research adds to extant knowledge by considering market information processing at the project level, by separating out information use by stage of the NPD process, and by investigating antecedents to information processing.

## 3. Methodology

### 3.1. Sample and data collection

The conceptual model was tested with data from a mail survey to Dutch high-tech industries. High-tech industries were selected because they depend on new products for continual growth and the subsequent high rate of new products introduced. The questionnaire asked respondents to select the most innovative product developed and introduced by the company in the last 3 years. The sample was drawn from the REACH (Review and Analysis of Companies in Holland) directory. Targeted industries included chemicals, electrical and industrial machinery, electronics, medical appliances and optical instruments, and information technology. We identified and pre-notified 550 potential respondents and then sent each the questionnaire. Non-respondents were called after 2 weeks to ask if they had received the questionnaire and to remind them of the importance of their co-operation. This step showed that our research instrument was not applicable for 37 respondents. After 3 weeks a reminder postcard was mailed to non-respondents. In total, 166 completed questionnaires were returned for an effective response rate of 32.4%. As an incentive, respondents could indicate whether they wanted to receive a summary of the research findings. Over 81% did, indicating the relevance of the study to the respondents. To ensure respondent suitability the survey asked them about their knowledge of the project (Kumar et al., 1993). On a five-point scale, the mean response was 4.42 ($\sigma = .68$), showing evidence of sufficient knowledge. Table 1 provides the sample characteristics.

To assess non-response bias we compared early respondents (29.5% of the sample) with late respondents (25.8% of the sample) as recommended by Armstrong and Overton (1977). The two groups did not have any significant differences in averages for our constructs. To evaluate respondent bias the responses obtained from persons with different functional backgrounds (e.g., marketing, production, R&D) and from different industries were compared. No significant differences emerged suggesting that these biases were not an issue.

Table 1
Sample characteristics

| Industry | No. of employees | Sales in Euros ($\times 10^6$) | Respondents |
|---|---|---|---|
| Chemicals (14.9%) | <51 (20.4%) | <2 (8.5%) | General management (15.6%) |
| Electrical and industrial machinery (47.6%) | 51–75 (17.7%) | 2–6 (13.1%) | Marketing/sales (25.3%) |
| Electronics (13.4%) | 76–100 (15.5%) | 6–10 (15.0%) | R&D (38.7%) |
| Medical applications and optical instruments (10.2%) | 101–150 (20.4%) | 10–15 (13.7%) | Production (16.1%) |
| Information technology (13.9%) | 151–300 (15.0%) | 15–25 (15.7%) | Finance (.5%) |
| | >300 (11.0%) | 25–50 (13.7%) | Else (3.7%) |
| | | 50–100 (11.1%) | |
| | | >100 (9.2%) | |

### 3.2. Measures

Our multi-item scales were drawn predominantly from prior studies, although some had to be newly developed or adapted from the organizational level to the project level. Unless noted otherwise, we used five-point rating scales ranging from 'strongly disagree' (1) to 'strongly agree' (5). The appendix provides a measurement summary with all remaining items and their sources.

To ensure that the content and meaning of the original items remained the same in Dutch, we used a double translation procedure from the original English. First, two experts in both languages translated all English items into Dutch. Two other experts translated the Dutch items back into English. Differences in translation were resolved by discussion. Finally, the translations were compared to the original English items for any inconsistencies, mistranslation, or different meaning.

The questionnaire was extensively pre-tested and revised accordingly. The first pretest was conducted with nine NPD-managers: one marketing, two R&D and three product managers, two managing directors, and one software developer. Interviewees filled out the questionnaire and elaborated on questions that were unclear or could be interpreted incorrectly. Feedback from this phase led to revisions to improve the structure, readability and wording. For the second pretest we distributed 150 questionnaires to test the initial properties of our measurement scales. After a reminder phone-call we received 46 usable questionnaires. All measures had Cronbach $\alpha$'s higher than .70, suggesting that they would be reliable in the final sample.

The 166 responses in the final sample were used to establish our measurement scales using exploratory and confirmatory factor analysis. Confirmatory factor analysis (CFA) was performed separately for the antecedent variables and the market information processing variables. A third confirmatory factor analysis was performed for the product newness, product advantage and success items. We included the product newness to the market items in this CFA to demonstrate discriminant validity between the newness and advantage scales. Table 2 presents summary statistics and an assessment of unidimensionality, reliability and convergent validity. Table 3 contains the correlation matrix for the final measures. All measures meet or exceed the recommended values.

Two constructs were more complex than initially hypothesized. Market information acquisition split into customer and environmental information acquisition. Information acquired about customers concerns the understanding of customer problems while the environmental items measure issues relating to the collection of competitor and general industry information. While the literature suggests that this full breadth of information is necessary for a market orientation (Kohli and Jaworski, 1990), our measures suggest that these two different components are collected differentially, and thus also may act differentially. New product success was also more complex than originally theorized, resulting in two separate factors: market/financial success and time/cost efficiency. In the hypothesis testing, we therefore investigate differential relationships with both success dimensions, and both types of information acquired.

Our initial conceptual model was tested using LISREL 8.50. The fit indices for the original model were not satisfactory: $\chi^2$/d.f. = 3.97; GFI = .94; CFI = .90; RMSEA = .137. We therefore explored alternative models across our constructs, while maintaining the overall logical structure of the theoretical development section. In addition to the indirect relationships we also considered direct relationships between antecedents of market information processing variables, and product advantage and success. We also added paths from the company characteristics to the product newness variable. Interestingly, these additions substantially improved the fit of our

Table 2
Assessment of unidimensionality, reliability and validity

| | Mean[a] | S.D. | No. of items remaining | Cronbach's $\alpha$ | Eigenvalue | Lowest $t$-value | Composite reliability |
|---|---|---|---|---|---|---|---|
| Antecedents[b] | | | | | | | |
| Project priority | 3.59 | .79 | 4 | .86 | 2.81 | 10.00 | .86 |
| Time pressure | 3.15 | .85 | 3 | .81 | 2.18 | 9.38 | .81 |
| R&D dominance | 3.51 | .88 | 4 | .81 | 2.58 | 7.18 | .82 |
| Interdepartmental conflict | 2.78 | .73 | 5 | .85 | 3.09 | 8.98 | .85 |
| Flexibility to new products | 3.05 | .79 | 3 | .74 | 1.98 | 7.57 | .74 |
| Market information processing[c] | | | | | | | |
| Acquisition of environmental information | 2.99 | .77 | 4 | .71 | 2.32 | 6.55 | .76 |
| Acquisition of customer information | 2.99 | .77 | 4 | .71 | 2.15 | 5.85 | .71 |
| Dissemination of market information | 2.78 | .75 | 4 | .74 | 2.25 | 6.56 | .74 |
| Use in predevelopment | 3.23 | .86 | 4 | .74 | 2.24 | 8.18 | .74 |
| Use in development | 3.19 | .77 | 4 | .71 | 2.13 | 7.01 | .70 |
| Use in commercialization | 3.15 | .81 | 4 | .71 | 2.17 | 7.55 | .72 |
| Product newness, product advantage and success[d] | | | | | | | |
| Product newness to the market | 3.60 | .86 | 4 | .78 | 2.44 | 8.48 | .78 |
| Product advantage | 3.92 | .70 | 4 | .80 | 2.51 | 7.83 | .81 |
| Time cost efficiency | 3.15 | 1.01 | 2 | $r = .54$ | 1.54 | 5.28 | .70 |
| Market financial success | 3.21 | .91 | 4 | .92 | 3.26 | 12.22 | .92 |

[a] Entries are based on a 5-point scale with '1' = completely disagree and '5' = completely agree.
[b] Evaluation model: $\chi^2$/d.f. = 1.59; GFI = .87; NFI = .84; NNFI = .92; CFI = .93; IFI = .93; RMSEA = .060.
[c] Evaluation model: $\chi^2$/d.f. = 1.40; GFI = .86; NFI = .84; NNFI = .93; CFI = .94; IFI = .94; RMSEA = .049.
[d] Evaluation model: $\chi^2$/d.f. = 1.45; GFI = .92; NFI = .91; NNFI = .96; CFI = .97; IFI = .97; RMSEA = .052.

model. The result is a complex depiction of how market information processing and its antecedents are associated with product advantage and success, both directly and indirectly. Table 4 presents the estimates for the statistically significant paths for our final model, which is depicted in Fig. 2. The fit statistics for this model indicated a good fit: $\chi^2$/d.f. = 1.59; GFI = .92; CFI = .93; RMSEA = .06. The next section discusses the results for the antecedents and consequences of market information processing during the development of new high-tech projects.

## 4. Discussion of the results

There are several major points to be made about the results. First, as previous authors have demonstrated empirically, success at the project level is a multidimensional construct (Griffin and Page, 1993, 1996; Hart, 1993), and product advantage is associated with both success dimensions. An important addition to knowledge from this research, however, is that each of the market information processing variables investigated is associated with success differentially, some directly and others indirectly, as will be discussed in more detail shortly. Another contribution of this study lies in the investigation of antecedents of market information processing for new high-tech products. Project priority, interdepartmental conflict and a company's flexibility to new products are related to different market information processing variables.

Table 3
$\alpha$'s and correlations of latent constructs

| | Constructs | Cronbach $\alpha$'s and correlations | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 1 | Product newness to the market | [.78] | | | | | | | | | | | | | | |
| 2 | Project priority | **.21**$^{**}$ | [.86] | | | | | | | | | | | | | |
| 3 | Time pressure | −.01 | **.30**$^{**}$ | [.81] | | | | | | | | | | | | |
| 4 | R&D dominance | **.30**$^{**}$ | .02 | −.02 | [.81] | | | | | | | | | | | |
| 5 | Interdepartmental conflict | −.13 | −.09 | **.16**$^{*}$ | −.07 | [.85] | | | | | | | | | | |
| 6 | Flexibility to new products | **.30**$^{**}$ | .07 | −.05 | **.23**$^{**}$ | **−.28**$^{**}$ | [.74] | | | | | | | | | |
| 7 | Acquisition of environmental information | .12 | **.24**$^{**}$ | −.01 | .06 | **−.25**$^{**}$ | **.18**$^{*}$ | [.71] | | | | | | | | |
| 8 | Acquisition of customer information | .04 | **.16**$^{*}$ | .05 | .11 | **−.27**$^{**}$ | **.17**$^{*}$ | **.54**$^{**}$ | [.71] | | | | | | | |
| 9 | Dissemination information | .06 | **.29**$^{**}$ | .05 | .14 | **−.26**$^{**}$ | **.23**$^{**}$ | **.53**$^{**}$ | **.51**$^{**}$ | [.74] | | | | | | |
| 10 | Use in predevelopment | .06 | **.21**$^{**}$ | .03 | .01 | **−.24**$^{**}$ | **.16**$^{*}$ | **.48**$^{**}$ | **.39**$^{**}$ | **.53**$^{**}$ | [.74] | | | | | |
| 11 | Use in development | .06 | **.20**$^{*}$ | .10 | .09 | **−.21**$^{*}$ | **.16**$^{*}$ | **.40**$^{**}$ | **.49**$^{**}$ | **.52**$^{**}$ | **.74**$^{**}$ | [.71] | | | | |
| 12 | Use in commercialization | .07 | **.17**$^{*}$ | .05 | .05 | −.18 | −.01 | **.30**$^{**}$ | **.37**$^{**}$ | **.46**$^{**}$ | **.41**$^{**}$ | **.64**$^{**}$ | [.71] | | | |
| 13 | Product advantage | **.52**$^{**}$ | **.25**$^{**}$ | .02 | **.18**$^{*}$ | −.15 | **.22**$^{**}$ | **.19**$^{*}$ | **.30**$^{**}$ | **.24**$^{**}$ | .14 | **.21**$^{**}$ | **.26**$^{**}$ | [.80] | | |
| 14 | Time cost efficiency | .09 | −.03 | **.20**$^{*}$ | −.03 | **−.23**$^{**}$ | .12 | .13 | .13 | .07 | .09 | .05 | −.01 | **.17**$^{*}$ | [−] | |
| 15 | Market financial success | **.19**$^{*}$ | **.24**$^{**}$ | −.07 | −.08 | −.13 | **.23**$^{**}$ | **.28**$^{**}$ | **.19**$^{*}$ | **.17**$^{*}$ | **.20**$^{*}$ | **.21**$^{**}$ | **.16**$^{*}$ | **.39**$^{**}$ | **.23**$^{**}$ | [.92] |

Bolded correlations are statistically significant. Numbers on the diagonal are Cronbach $\alpha$'s.
$^{*}$ $p < .05$.
$^{**}$ $p < .01$.

Table 4
Standardized estimates and *t*-values

| Relationships | Standardized estimate | *t*-Value |
|---|---|---|
| Use in predevelopment → market/financial success | .12 | 1.66 |
| Product advantage → market/financial success | .37 | 5.11 |
| R&D dominance → market/financial success | −.18 | −2.53 |
| Flexibility to new products → market/financial success | .18 | 2.41 |
| Product advantage → time/cost efficiency | .14 | 1.80 |
| Interdepartmental conflict → time/cost efficiency | −.21 | −2.79 |
| Use in commercialization → product advantage | .13 | 2.02 |
| Acquisition of customer information → product advantage | .24 | 3.59 |
| Product newness to the market → product advantage | .50 | 7.90 |
| R&D dominance → product newness to the market | .25 | 3.32 |
| Flexibility to new products → product newness to the market | .24 | 3.22 |
| Acquisition of environmental information → use in predevelopment | .28 | 3.96 |
| Dissemination of information → use in predevelopment | .37 | 5.23 |
| Acquisition of customer information → use in development | .25 | 4.62 |
| Use in predevelopment → use in development | .67 | 12.51 |
| Dissemination of information → use in commercialization | .20 | 2.98 |
| Use in development → use in commercialization | .55 | 8.34 |
| Flexibility to new products → use in commercialization | −.15 | −2.45 |
| Acquisition of environmental information → dissemination of information | .32 | 4.77 |
| Acquisition of customer information → dissemination of information | .32 | 4.81 |
| Project priority → dissemination of information | .17 | 2.56 |
| Flexibility to new products → dissemination of information | .12 | 1.81 |
| Project priority → acquisition of environmental information | .22 | 2.96 |
| Interdepartmental conflict → acquisition of environmental information | −.23 | −3.09 |
| Interdepartmental conflict → acquisition of customer information | −.27 | −3.49 |

*Note*: $\chi^2$/d.f. = 1.59; GFI = .92; NFI = .85; NNFI = .89; CFI = .93; IFI = .94; RMSEA = .061.

### 4.1. Consequences of market information processing in high-tech NPD

As NPD research has shown for many years (Cooper, 1985), this research also supports product advantage's association with new product success, supporting Hypothesis 1. Indeed, product advantage is positively associated with both dimensions of success: market/financial success ($b = .37$) and time/cost efficiency ($b = .14$). Thus, marshaling resources and adopting projects strategies to achieve new product advantage may be one of the most important ways NPD-managers can spend their time.

Hypothesis 2, the relationship between market information processing and product advantage, is partly supported by the data. We found that the use of market information in the commercialization stage is directly and positively associated with product advantage ($b = .13$). A potential explanation for this finding is that managers use market information in the commercialization stage to develop marketing communications platforms that allow them to differentiate their product from competing products in customers' eyes. In addition, acquiring customer information is associated directly with product advantage ($b = .24$). Somehow, just collecting information on needs directly from customers is sufficient to produce a product that offers benefits not available from competing products. After all, it is likely that both market

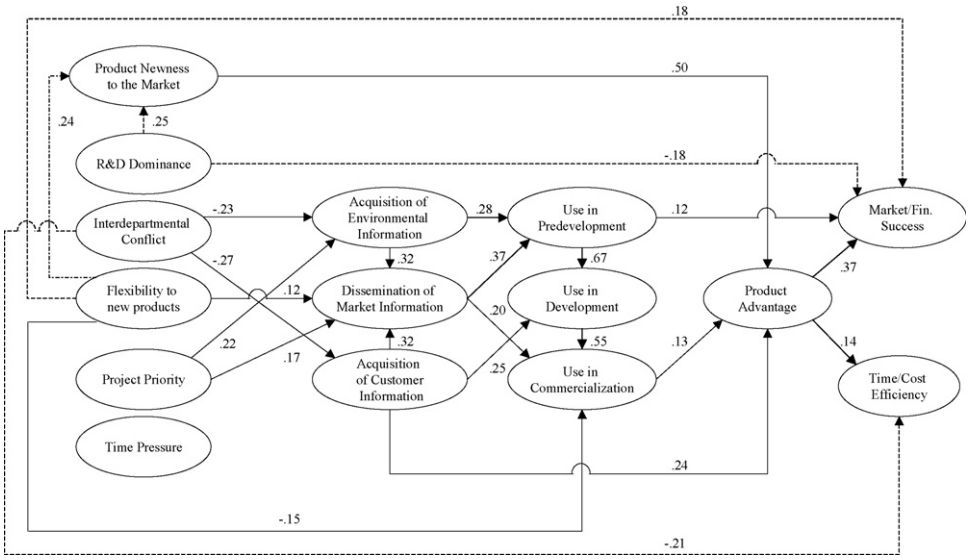


Fig. 2. Significant paths in final model for antecedents and consequences of market information processing (dotted lines are non-hypothesized paths). Fit statistics: $\chi^2$/d.f. = 1.59; GFI = .92; CFI = .93; RMSEA = .06.

research and interacting with potential customers (both items in the customer information acquisition scale) will allow a team to understand better how to achieve product advantage in the marketplace.

Our results also indicate that using market information in predevelopment is directly associated with market/financial success ($b = .12$), partly supporting Hypothesis 3. Market information used in predevelopment is for such things as segmenting customers, understanding needs, evaluating initial concepts and resolving potential problems with concepts prior to investing in their development. Product advantage is defined in performance and quality terms. This suggests that market-related information other than that which is used to improve the product contributes to market/financial success.

In addition to the direct relationships we also found indirect effects for several components of market information processing to both product advantage and new product success. Acquiring more environmental ($b = .32$) and customer ($b = .32$) information is associated with increased dissemination across the firm. In turn, increased market information dissemination is associated with increased information use in the predevelopment ($b = .37$) and the commercialization stage ($b = .20$). Therefore, acquiring and disseminating market information are indirectly related to product advantage and success through information use in predevelopment and commercialization, respectively. Thus, one goal of product managers may be to see that a sufficient amount of customer and environmental information is provided to or collected by the NPD team, such that it then can be used by the team. A second goal may be to see that a sufficient amount of customer and environmental information is disseminated across the firm.

An unexpected result is that just acquiring environmental information is associated with increased use in predevelopment ($b = .28$) and acquiring customer information is associated with increased use in development ($b = .25$). One potential explanation for this result could be that the team acquires some environmental and customer information directly, and thus there is no need to disseminate this information through the organization. Those who need it have gathered it.

Altogether, these results suggest that some market information is disseminated through the organization in routine manners while the team uses other market information directly without the need to disseminate it first.

Finally, increased use in predevelopment is associated with increased use in development ($b = .67$), which in turn is associated with increased use in the commercialization phase ($b = .55$). Turning this result around—if a team does not have information they cannot move it through the organization or use it. This result also supports taking the granular view of investigating market information processing—all three steps in the process need to be considered separately.

In summary, there are important differential effects of market information processing variables. This research shows the power of collecting needs and other diagnostic and evaluative information by the team directly from customers and the marketplace. Higher customer information acquisition is directly and indirectly associated with information use, and indirectly associated with both dimensions of success through product advantage. On the other hand, acquiring environmental information is both directly and indirectly associated with information use in the predevelopment stage, and indirectly related to use in the development and commercialization stage. In addition, using market information in the predevelopment stage is important, since it is related to use in later stages and directly related to market/financial success. Finally, product advantage is related to both dimensions of NPD-success: market/financial success and time/cost efficiency.

### *4.2. Antecedents of market information processing in high-tech NPD*

The results for the antecedents of market information processing in high-tech NPD add to the overall story of how to achieve new product success. Hypothesis 4, the relationship between product newness to the market and product advantage is supported strongly by the data ($b = .50$). This direct link was more important than the indirect link as product newness was not related to any of the market information processing variables. Therefore Hypothesis 5 was rejected.

Although prior studies found little empirical support for project priority, we found partial support for Hypothesis 6, project priority's relationship with market information processing. Project priority is positively related to both acquiring environmental information ($b = .22$) and disseminating market information ($b = .17$). If a project is important to a company, more effort will be put into the acquisition of information about competitors and the business environment. After verifying market conditions, the status of the NPD project may be justified and attention turns toward the dissemination of market information. In general, projects with a higher priority may receive more organizational resources, which may lead to more market information processing.

Contrary to our expectations and not supporting Hypothesis 7, time pressure is not related to market information processing variables or to product advantage and success. Perhaps for these companies pursuing high-tech products, the processing of market information is such an important part of the NPD process that it will be done even under conditions of limited time.

For the company characteristics, R&D dominance is not related to market information processing, rejecting Hypothesis 8. A potential explanation is that technical managers meet with customers, like marketing managers do. Although 'formally' they are not involved in the marketing function, they do process market information in NPD. On the other hand, we found that R&D dominance is negatively related to market/financial success ($b = -.18$). Putting too much emphasis on R&D alone does not lead to a financially successful product. In a way, emphasizing R&D during NPD is more cost-intensive, which may harm the ultimate financial

performance of a new product. However, R&D dominance was also positively related to product newness ($b = .25$), which has a direct positive relationship with product advantage.

Interdepartmental conflict is negatively related to the acquisition of both environmental information ($b = -.23$) and customer information ($b = -.27$). This finding provides partial support to Hypothesis 9 and corroborates findings from earlier market orientation studies (Jaworski and Kohli, 1993; Matsuno et al., 2002). In addition, in terms of direct effects between interdepartmental conflict and new product outcomes, interdepartmental conflict is negatively related to time/cost efficiency ($b = -.21$). Organizational actions should be directed towards decreasing conflicts and tension among different departments. If departments cooperate effectively, less time is wasted and products stay within budget.

Finally, a company's flexibility to new products is associated positively with disseminating market information ($b = .12$), partially supporting Hypothesis 10. Flexibility to new products also is related positively to product newness ($b = .24$) and market/financial success ($b = .18$). On the other hand, companies that are flexible to new products use less market information during commercialization ($b = -.15$). It seems likely that flexible companies can switch their attention to new projects during the final stages of a project, and use less market information then because they already have disseminated the needed market information widely.

To summarize, project priority is positively related both to acquiring environmental information and disseminating market information. Interdepartmental conflict is negatively related to acquiring both types of market information. A company's flexibility to new products is positively associated with disseminating market information and negatively associated with market information use during commercialization. In addition, there are direct effects of antecedents on new product outcomes. Interdepartmental conflict is negatively related to time/cost efficiency. Flexibility towards new products is positively related to product newness and to market/financial success. R&D dominance is negatively related to market/financial success but positively related to product newness, which has a positive impact on product advantage.

## 5. Conclusion

Although some authors have stated that market information use could be detrimental for developing new high-tech products, this research does not support those contentions. These results demonstrate important differential effects of market information processing variables, and that they should be considered separately.

For new high-tech products using market information is related to financial success in the predevelopment stage. At Sony, executives were skeptical about using market information, but the success of the Vaio-W computer showed that they were wrong. Sony developed the Vaio-W after market research in the predevelopment stage showed that Japanese consumers bought laptops because they took up a small amount of space. The result was a small computer that sold in a single day the volume expected for the first month of sales (Williams, 2002).

Using market information in commercialization is positively related to product advantage. This can be explained by the fact that market information during commercialization is used for positioning the product in the customers' minds within the right market segment. When they launched the new Beetle, Volkswagen carefully used information about potential customers to differentially position the car based on a nostalgia factor in the commercialization stage.

Acquiring customer information is associated directly with product advantage, without even having to disseminate or use the information in any of the NPD process stages. One potential explanation is that market information for new high-tech products may be used more intuitively

than formally during decision-making. By acquiring market information and interacting directly with customers, developers obtain an understanding of what customers want and integrate this information into the new product intuitively. As Christensen et al. (2002) noted: 'while the process that molds ideas into sustaining innovations can be deliberate, data-driven and analytical, the process for shaping disruptive businesses must be driven by intuitive understanding of the possibilities.'

The objectives for this study were to explore antecedents to and consequences of market information processing for new high-tech products. We found that project priority, interdepartmental conflict and flexibility to new products can enhance or reduce market information processing. Project priority is an important determinant of acquiring and disseminating market information. Portfolio management can be helpful for companies to prioritize the right projects (Cooper et al., 1999). If the right projects are selected, project priority stimulates the acquisition and dissemination of market information that may lead to product advantage. Interdepartmental conflict is negatively related to the acquisition of market information and time/cost efficiency. Companies should therefore focus on reducing interdepartmental conflict. Ottum and Moore (1997) suggest low-level conflict resolution methods for reducing interdepartmental conflict. Flexibility to new products is positively associated with the dissemination of market information, product newness and market/financial success, but negatively with the use of market information in the commercialization stage. Firms should therefore be flexible to new products, but at the same time be careful that this flexibility does not harm the commercialization of running projects. Finally, R&D dominance is negatively related to market/financial success but positively to product newness that has a direct impact on product advantage.

## 6. Limitations and future research

Several limitations should be considered when interpreting these results. Since all new products in this sample were launched in high-tech markets, whether these relationships hold for low-tech markets is unknown. Future research should therefore investigate differences in market information processing between high-tech and low-tech products. Related to this issue, different information acquisition techniques may be required for different types of innovations. For example, traditional marketing research techniques like focus groups and customer surveys may not be appropriate for developing high-tech products (Lynn et al., 1996). In future research, it would be interesting to know which techniques are used in different situations (for example, high-tech versus low-tech) and how these techniques impact the use of market information. In addition, some techniques are more expensive and time-consuming than others having consequences for the validity of some of our items, such as ''a lot of market research was done''.

This research used the key informant method, which has limitations (Phillips, 1981; Bruggen et al., 2002). Although the respondents were knowledgeable about the NPD projects, using more informants for each project may yield additional insights and a more balanced view. Future research should use multiple respondents with different functional backgrounds for each project.

Although the new products in our sample have been introduced in the last 3 years, their development likely started several years before. Therefore, informants may have had some difficulties providing accurate answers to some questions in the survey. In addition, since development may have taken several years, one may question whether the people involved in predevelopment were the same as the ones in development and commercialization. Especially in large companies, the composition of NPD-teams may change during NPD. We tried to solve this

issue by selecting key-informants that were knowledgeable of the whole NPD project. Future research may identify different informants for each stage in NPD.

## Appendix A. Measures, remaining items and sources

| Measures and remaining items | Source |
|---|---|
| Market/financial success | Griffin and Page (1993) |
| The new product attains unit sales goals | |
| The new product attains revenue growth goals | |
| The new product attains market share goals | |
| The new product attains sufficient sales as a percentage of total company sales | |
| Time/cost efficiency | Griffin and Page (1993) |
| The new product stayed under the development budget | |
| The new product had a short 'time-to-market' | |
| Product advantage | Cooper and Kleinschmidt (1987) |
| According to customers... | |
| The product had a higher quality than competing products | |
| The product was more innovative than competing products | |
| The product offered benefits that were not found in competing products | |
| The product was superior to competing products | |
| Use of market information in three generic stages | New: based on Deshpande and Zaltman (1982), Menon and Varadarajan (1992) and Ruekert (1992) |
| During predevelopment/development/commercialization... | |
| Market information was used in evaluating the new product | |
| Market information had an influence on product-related decisions | |
| Market information was used in solving project-related problems | |
| Market information was used to segment the market for the new product | |
| Dissemination of market information | Adapted to NPD, based on Jaworski and Kohli (1993) |
| During the NPD project... | |
| Employees spent time discussing customers' future needs | |
| Documents circulated periodically that provided information on our customers | |
| In a short period everybody knew about it, when something important happened to a major customer or market | |
| Data on customer satisfaction were disseminated at all levels on a regular basis | |
| Acquisition of environmental information | Adapted to NPD, based on Jaworski and Kohli (1993) |
| During the NPD project... | |
| We often talked with those who could influence our end-users purchases | |
| Different departments generated intelligence on our competitors | |
| We were quick in detecting fundamental shifts in our industry | |
| We periodically reviewed the likely effect of changes in our business environment on customers | |
| Acquisition of customer information | Adapted to NPD, based on Jaworski and Kohli (1993) |
| During the NPD project... | |
| Project members met potential customers to learn how to serve them | |
| A lot of market research was done | |
| We were quick in detecting changes in our customers' product preferences | |
| We polled end-users several times to assess the quality of our product | |

**Appendix A** (*Continued*)

| Measures and remaining items | Source |
|---|---|
| Product newness to the market | New: based on Ali et al. (1995) |
| When the new product was introduced to the market... | and Song and Parry (1999) |
| It had features that did not yet exist | |
| There were no comparable products on the market | |
| It was new for the product category | |
| It was innovative to the market | |
| Project priority | New: based on Ottum and |
| Priority was given to the project over other projects | Moore (1997) and interviews |
| Management considered the project more important than other running projects | |
| The project's success was of utmost importance to our company | |
| The project had a high status for our company | |
| Time pressure | Sethi (2000) |
| During the NPD project... | |
| Employees often wished they had more time to complete their work | |
| Employees believed they were under a lot of time pressure | |
| Meeting deadlines was every time a difficult task | |
| R&D dominance | New: based on |
| In our business unit... | Workman (1993) and |
| We have a lot of technical employees | Workman (1998) |
| The majority of our managers have a technical background | |
| Top management mainly consists of technical people | |
| Technical employees have more influence on decisions than marketing employees | |
| Interdepartmental conflict | Matsuno et al. (2002) |
| In our business unit... | |
| Employees feel that the goals of different departments are in harmony with each other[a] | |
| Protecting one's department turf is considered to be a way of life | |
| There is little or no interdepartmental conflict[a] | |
| Different departments cooperate effectively to achieve mutual goals[a] | |
| There is little or no tension among employees from different departments[a] | |
| Flexibility to new products | Chandy and Tellis (1998) |
| Our business unit... | |
| Supports projects even if they could potentially take away from sales of existing products | |
| Easily replaces one set of abilities with a different set of abilities to adopt a new technology | |
| Will pursue a new technology, even if it causes existing investments to lose value | |

[a] Indicates a reversed item.

## References

Akgün, A.E., Lynn, G.S., Yilmaz, C., 2006. Learning process in new product development teams and effects on product success: a socio-cognitive perspective. Industrial Marketing Management 35, 210–224.

Ali, A., Krapfel, R., Labahn, D., 1995. Product innovativeness and entry strategy: impact on cycle time and break-even time. Journal of Product Innovation Management 12 (1), 54–69.

Armstrong, J.S., Overton, T.S., 1977. Estimating non-response bias in mail surveys. Journal of Marketing Research 14, 396–402.

Atuahene-Gima, K., 1995. An exploratory analysis of the impact of market orientation on new product performance. Journal of Product Innovation Management 12 (4), 275–293.

Baker, W.E., Sinkula, J.M., 2002. Market orientation, learning orientation and product innovation: delving into the organization's black box. Journal of Market-focused Management 5, 5–23.

Bennett, R.C., Cooper, R.G., 1981. The misuse of marketing: an American tragedy. Business Horizons 24 (6), 51–61.

Bruggen, G.H.V., Lilien, G.L., Kacker, M., 2002. Informants in organizational marketing research: why use multiple informants and how to aggregate responses. Journal of Marketing Research 39 (4), 469–478.

Calantone, R.J., di Benedetto, C.A., 1988. An integrative model of the new product development process: an empirical validation. Journal of Product Innovation Management 5, 201–215.

Callahan, J., Lasry, E., 2004. The importance of customer input in the development of very new products. R&D Management 34 (2), 107–120.

Chandy, R.K., Tellis, G.J., 1998. Organizing for radical product innovation: the overlooked role of willingness to cannibalize. Journal of Marketing Research XXXV, 474–487.

Christensen, C.M., 1997. The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. Harvard Business School Press, Boston.

Christensen, C.M., Johnson, M.W., Rigby, D.K., 2002. Foundations for growth—how to identify and build disruptive new businesses. MIT Sloan Management Review 43 (3), 22–31.

Cooper, L.P., 2003. A research agenda to reduce risk in new product development through knowledge management: a practitioner perspective. Journal of Engineering and Technology Management 20 (1–2), 117–140.

Cooper, R.G., 1985. Selecting winning new product projects: using the NewProd system. Journal of Product Innovation Management 2 (1), 34–44.

Cooper, R.G., 1992. The NewProd system: the industry experience. Journal of Product Innovation Management 9 (2), 113–127.

Cooper, R.G., 1999. FROM EXPERIENCE: the invisible success factors in product innovation. Journal of Product Innovation Management 16 (2), 115–133.

Cooper, R.G., Edgett, S.J., Kleinschmidt, E.J., 1999. New product portfolio management: practices and performance. Journal of Product Innovation Management 16 (4), 333–351.

Cooper, R.G., Kleinschmidt, E.J., 1987. New products: what separates winners from losers. Journal of Product Innovation Management 4, 169–184.

Crawford, M.C., 1994. New Products Management, 4th ed. Irwin, Homewood, IL.

Crawford, M.C., Di Benedetto, A.C., 2002. New Products Management. McGraw-Hill, Irwin.

Cummings, J.L., Teng, B.-S., 2003. Transferring R&D knowledge: the key factors affecting knowledge transfer success. Journal of Engineering and Technology Management 20 (1–2), 39–68.

Danneels, E., Kleinschmidt, E.J., 2001. Product innovativeness from the firm's perspective: its dimensions and their relation with project selection and performance. Journal of Product Innovation Management 18, 357–373.

Day, G.S., 1994. Continuous learning about markets. California Management Review (Summer) 9–31.

Deshpande, R., Zaltman, G., 1982. Factors affecting the use of market research information: a path analysis. Journal of Marketing Research 19, 14–31.

Dougherty, D., Borrelli, L., Munir, L., O'Sullivan, A., 2000. Systems of organizational sensemaking for sustained product innovation. Journal of Engineering and Technology Management 17 (3–4), 321–355.

Gales, L., Mansour-Cole, D., 1995. User involvement in innovation projects: toward an information processing model. Journal of Engineering and Technology Management 12, 77–109.

Garcia, R., Calantone, R., 2002. A critical look at technological innovation typology and innovativeness terminology: a literature review. Journal of Product Innovation Management 19, 110–132.

Gatignon, H., Xuereb, J.M., 1997. Strategic orientation of the firm and new product performance. Journal of Marketing Research XXXIV, 77–90.

Green, S.G., Gavin, M.B., Aiman-Smith, L., 1995. Assessing a multidimensional measure of radical technological innovation. IEEE Transactions on Engineering Management 42 (3), 203–214.

Griffin, A., Page, A.L., 1993. An interim report on measuring product development success and failure. Journal of Product Innovation Management 10 (4), 291–308.

Griffin, A., Page, A.L., 1996. PDMA success measurement project: recommended measures for product development success and failure. Journal of Product Innovation Management 13 (6), 478–496.

Hart, S., 1993. Dimensions of success in new product development: an exploratory investigation. Journal of Marketing Management 9, 23–41.

Henard, D.H., Szymanski, D.M., 2001. Why some new products are more, successful than others. Journal of Marketing Research 38 (3), 362–375.

Hultink, E.J., Griffin, A., Robben, H.S.J., Hart, S., 1998. In search of generic launch strategies for new products. International Journal of Research in Marketing 15 (3), 69–285.

Jaworski, B.J., Kohli, A.K., 1993. Market orientation: antecedents and consequences. Journal of Marketing 57, 53–70.

Kawakami, T., 2004. Balanced differentiation as a determinant of utilization of customer information: an empirical study of Japanese electronics industry. In: American Marketing Association Conference Proceedings, vol. 15, Chicago, pp. 106–112.

Kawakami, T., Song, M., 2004. The moderating effect of product innovativeness on the relationship between utilization of customer information and new product performance. In: American Marketing Association Conference Proceedings, vol. 15, Chicago, pp. 52–53.

Kohli, A.K., Jaworski, B.J., 1990. Market orientation: the construct, research propositions, and managerial implications. Journal of Marketing 54, 1–18.

Kohli, A.K., Jaworski, B.J., Kumar, A., 1993. MARKOR: a measure of market orientation. Journal of Marketing Research 30, 467–477.

Kumar, N., Stern, L.W., Anderson, J.C., 1993. Conducting inter-organizational research using key informants. Academy of Management Journal 36 (6), 1633–1651.

Leenders, R., Th., A.J., Kratzer, J., 2003. Virtuality, communication, and new product team creativity: a social network perspective. Journal of Engineering and Technology Management 20 (1/2), 69–92.

Li, T., Calantone, R.J., 1998. The impact of market knowledge competence on new product advantage: conceptualization and empirical examination. Journal of Marketing 62, 13–29.

Lynn, G.S., Morone, J.G., Paulson, A.S., 1996. Marketing and discontinuous innovation: the probe and learn process. California Management Review 38 (3), 8–37.

Maltz, E., Kohli, A., 1996. Market intelligence dissemination across functional boundaries. Journal of Marketing Research XXXIII, 47–61.

Matsuno, K., Mentzer, J.T., Ozsomer, A., 2002. The effects of entrepreneurial proclivity and market orientation on business performance. Journal of Marketing 66 (3), 18–32.

Menon, A., Varadarajan, P.R., 1992. A model of marketing knowledge use within firms. Journal of Marketing 56 (4), 53–71.

Mohrman, S.A., Finegold, D., Mohrman Jr., A.M., 2003. An empirical model of the organization knowledge system in new product development. Journal of Engineering and Technology Management 20 (1/2), 7–38.

Montoya-Weiss, M.M., Calantone, R., 1994. Determinants of new product performance: a review and meta-analysis. Journal of Product Innovation Management 11 (5), 397–417.

Moorman, C., 1995. Organizational market information processes: cultural antecedents and new product outcomes. Journal of Marketing Research 32, 318–335.

Moorman, C., Deshpande, R., Zaltman, G., 1993. Factors affecting trust in market research relationships. Journal of Marketing 57 (1), 81–101.

Narver, J.C., Slater, S.F., 1990. The effect of a market orientation on business profitability. Journal of Marketing 54, 20–35.

O'Connor, G.C., 1998. Market learning and radical innovation: a cross case comparison of eight radical innovation projects. Journal of Product Innovation Management 15 (2), 151–166.

O'Connor, G.C., Rice, M. 2005. Towards a Theory of New Market Creation. Working paper. Rensselaer Polytechnic Institute.

O'Connor, G.C., Veryzer Jr., R.W., 2001. The nature of market visioning for technology-based radical innovation. Journal of Product Innovation Management 18, 231–246.

Ottum, B., Moore, W., 1997. The role of market information in new product success/failure. Journal of Product Innovation Management 14 (4), 258–273.

Phillips, L.W., 1981. Assessing measurement error in key informant reports: a methodological note on organizational analysis in marketing. Journal of Marketing Research 18, 395–415.

Porter, M.E., 1985. Competitive Advantage: Creating and Sustaining Superior Performance. The Free Press, New York.

Rajatanavin, R., Speece, M., 2004. The sales force as an information transfer mechanism for new service development in the Thai insurance industry. Journal of Financial Services Marketing 8 (3), 244–258.

Rogers, E.M., 1995. Diffusion of Innovations, 4th ed. The Free Press, New York.

Ruekert, R.W., 1992. Developing a market orientation: an organizational strategy perspective. International Journal of Research in Marketing 9, 225–245.

Salomo, S., Steinhoff, F., Trommsdorff, V., 2003. Customer orientation in innovation projects and new product development success—the moderating effect of product innovativeness. International Journal of Technology Management 26 (5/6), 442–463.

Sethi, R., 2000. New product quality and product development teams. Journal of Marketing 64, 1–14.

Sinkula, J.M., 1994. Market information processing and organizational learning. Journal of Marketing 58, 35–45.

Sinkula, J.M., Baker, W.E., Noordewier, T., 1997. A framework for market-based organizational learning: linking values, knowledge, and behavior. Journal of the Academy of Marketing Science 25 (4), 305–318.

Slater, S.F., Narver, J.C., 1995. Market orientation and the learning organization. Journal of Marketing 59, 63–74.

Song, X.M., Parry, M.E., 1999. Challenges of managing the development of breakthrough products in Japan. Journal of Operations Management 17 (6), 665–688.

Souder, W.E., Sherman, J.D., Davies-Cooper, R., 1998. Environmental uncertainty, organizational integration, and new product development effectiveness: a test of contingency theory. Journal of Product Innovation Management 15, 520–533.

Tauber, E.M., 1974. How market research discourages major innovation. Business Horizons 17, 22–26.

Tyler, B., 2001. The complementarity of cooperative and technological competencies: a resource-based perspective. Journal of Engineering and Technology Management 18 (1), 1–27.

Urban, G.L., Hauser, J.R., 1993. Design and Marketing of New Products, 2nd ed. Prentice-Hall, Upper Saddle River, NJ.

Veryzer Jr., R.W., 1998a. Discontinuous innovation and the new product development process. Journal of Product Innovation Management 15, 304–321.

Veryzer Jr., R.W., 1998b. Key factors affecting customer evaluation of discontinuous new products. Journal of Product Innovation Management 15, 136–150.

Von Hippel, E., 1988. The Sources of Innovation. Oxford University Press, New York.

Williams, M., 2002. Sony Scores Smash Hit With New Vaio W. IDG News Service.

Workman, J.P., 1993. Marketing's limited role in new product development in one computer systems firm. Journal of Marketing Research 30, 405–421.

Workman, J.P., 1998. Factors contributing to marketing's limited role in product development in many high-tech firms. Journal of Market Focused Management 2, 257–279.

Wright, P., 1974. The harassed decision maker: time pressure, distractions and the use of evidence. Journal of Applied Psychology 59 (5), 555–561.

Zahay, D.L., Griffin, A., Fredericks, E., 2004. Sources, uses and forms of data in the new product development process. Industrial Marketing Management 33, 657–666.