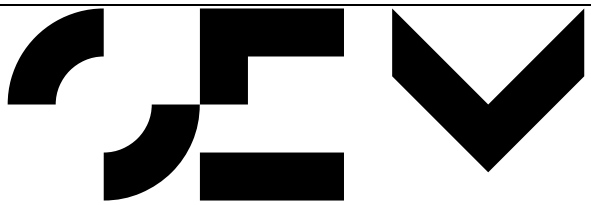

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Information paradox of new product development: A case of decision-makers' focus of attention

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Abstract

Drawing on theory of bounded rationality and the attention-based view of the company, decision-makers' focus of attention is examined within the new product development process. Attention, defined as something which occupies individual consciousness, should be directed at selecting development activities and applying information resulting from these activities to go/no-go decision-making. Based on the information behavior of 42 development managers collected through a virtual role-play simulation of new product development, this research finds two information paradoxes of new product development. First, competitive behavior makes decision-makers apply logic of reassurances in their implementation of NPD activities. Second, the information processing competence of decision-makers is unbalanced as information increases uncertainty in the concrete decision-making situation.

Keywords: Decision-maker attention, information processing, decision-making, new product development.

1. Introduction

New product development (NPD) research states that new-product success rates reflect competent information processing meaning that information generated through NPD activities is applied to NPD decision-making (Danneels, 2002; Krishnan & Ulrich, 2001; McCarthy, Tsinopoulos, Allen, & Rose-Anderssen, 2006). As noted by research, new product success rates are problematic. From the 1950s to the 2000s success rates of new product have been steady at 60 percent in empirical evidence from research (Stevens & Burley, 2003). Companies' information processing is worrying if it reflects the same stability as the success rates over 50 years when considering technological progress.

This focus on and importance of information processing in NPD literature is stressed by the emergence of knowledge performance as a new performance measure of NPD (Ahn, Lee, & Lee, 2006). Knowledge performance measures the level of explorative NPD activities performed in NPD. Development activities listed as necessary to perform if new products are to act as vehicles of learning in organizations (Danneels, 2002; J. G. March, 1991; Zahra & George, 2002). Literature suggests several explanations of companies' and decision-makers' information processing. First, companies are found to vary in their sophistication as regards the integration of information sources into the NPD process (Zahay, Griffin, & Fredericks, 2004). Second, research often finds that the aims of information acquisition include scanning, symbolic use, second-hand learning, or habits (Anderson, Glassman, McAfee, & Pinelli, 2001; Huber, 1991; Lynn & Akgün, 2000; Menon & Wilcox, 1994). Third, the noise and signals that information carries are factors that lead companies to conservative information bases of decision-making (Leenders & Voermans, 2007). Fourth, automatic and non-automatic information processing are contrasted in the discussion of mindfulness and mindlessness information behavior of decision-makers (D. Levinthal & Rerup, 2006). Fifth, a

review of marketing and innovation management literature suggests that companies are struggling with the implementation of NPD activities (Hauser, Tellis, & Griffin, 2006).

Parallel to this, two central theories of decision-makers' and organizations' information processing are the theory of bounded rationality and the attention-based view of the company. Theory of bounded rationality states that each decision-maker has a bounded information capability and the information competence of an organization is the sum of capabilities of its members (Simon, 1947). Building on the premises that the whole determine its parts, the attention-based view of the company states that to explain company behavior is to explain how companies distribute and regulate the attention of their decision-makers (Ocasio, 1997). When bounded rationality and the attention-based view meet, the theoretical consensus is that some sectors receive more attention than others (Cho & Hambrick, 2006). Researchers agree that the business context, i.e. the degree of complexity and technological change, enforces different information requirements on decision-making due to the various levels of uncertainty and equivocality facing decision-makers (Anderson, Glassman, McAfee, & Pinelli, 2001; Koufteros, Vonderembse, & Doll, 2001). A context that resides both internal and external to the organization according to research on new product success factors (Henard & Szymanski, 2001). The theoretical difference of the two research streams resides in whether the attentiveness stems from the individual decision-maker (bounded rationality) or the company organism (attention-based view).

In a NPD context this translates into that decision-makers have a personal filter on development activities performed in each stage of the NPD process and that this attention to information affects their new-product project evaluations (bounded rationality). At the same time, the NPD context of the organization affects decision-makers choice of NPD activities to perform as well as the new-product gate evaluations (attention-based view).

As research has been concerned with the necessary information inputs to NPD, this paper aims at unfolding <u>how</u> decision-makers' attention is directed to information from development activities in

the NPD process both in the selection of NPD activities and in the new-product project evaluations (go/no-go) from end-to-end in the NPD process. New-product project evaluations are an interesting unit of analysis, because these decisions are shared by chaotic, sequential, ad-hoc and stage-gate frameworks (McCarthy, Tsinopoulos, Allen, & Rose-Anderssen, 2006). Furthermore, new-product evaluations embrace the locus of innovation in organizations as this level of NPD actions are decided by NPD middle managers (Day, 1994; Yadav, Prabhu, & Chandy, 2007). Therefore, the research questions investigated in this paper are:

1. Whether the attention to information generated by selected NPD activities is influenced by an attention to NPD context (internal and/or external).
2. How decision-makers' attention (information, internal NPD context, and/or external NPD context) influences new-product project evaluations between NPD stages.

This paper contributes to marketing literature on information processing, bounded rationality, attention-based view of the company and NPD by demonstrating two information paradoxes of NPD: The logic of reassurance and the unbalanced information processing capability.

The logic of reassurance in NPD is the behavior of decision-makers when they are skipping NPD activities in the NPD process. Research on NPD speed has addressed this phenomena and found managers to skip NPD activities to increase speed (Lumpkin & Dess, 2001; Lynn, Abel, Valentine, & Wright, 1999). I offer another explanation. Decision-makers are skipping NPD activities when competition acts as anticipated and follow the same new-product trajectory. The behavior of competition becomes reassurance of new-product potential. This logic of reassurance also extend insights on cognitive and behavioral perspectives on action and learning denoted as mindful, appropriate and mindless behavior (D. Levinthal & Rerup, 2006; Sternberg, 2000). As I vary experimentally competitive behavior in my study and thereby distinguish between anticipated and

unanticipated context behavior, reassurance becomes a fourth mode of cognitive and behavior when selecting and using NPD activities in the NPD process.

The combination of theory of bounded rationality and the attention-based view of the company offers an opportunity to address decision-makers' information processing competence. Information processing is a competence with benefits to new product performance if decision-makers' competently handles information generation, dissemination and use (Moorman, 1995). A review of marketing literature find that organizations are struggling with the implementation of NPD activities (Hauser, Tellis, & Griffin, 2006) or have different levels of information source sophistication (Zahay, Griffin, & Fredericks, 2004). I offer an explanation to this experienced struggle with NPD activities in companies. Decision-makers' have an unbalanced information processing competence. NPD activities are selected, but information is increasing rather than decreasing uncertainty in go/no-go decision-making. The competence to extract meaning from and to apply information to decision-making is weak. Without a balanced information processing competence at every gate evaluation, new product success cannot be expected to follow from research guidelines.

The study followed research recommendations and developed a Web-based simulation of NPD to take advantage of the customer active-paradigm and to engage research participants in a new way (Englis & Solomon, 2000; Hauser, Tellis, & Griffin, 2006; Slater & Narver, 2000). The participants were NPD development practitioners who had NPD decision-making responsibility in their respective companies. The sample consisted of large international companies whose NPD units were located in Denmark. Research has confirmed the similarities of NPD practices between Scandinavian and US companies (Kleinschmidt, 1994; Souder & Jenssen, 1999). The origin of data was therefore not regarded as a bias in the paper's discussion and comparison of results with NPD literature in general. Results are generated through multiple regression analysis and findings are discussed, before the conclusion and implications are stated.

The paper is organized as follows. First, attention is conceptualized. Thereafter follows the development of the conceptual framework and hypotheses. The methodology and analysis of the study is then presented. The results are stated and discussed where after a conclusion and implications are provided.

2. Attention as a concept

The attention of decision-makers is important in the individual decision-making process. Theory of absorptive capacity refers to it as recognizing the value of information (Cohen & Levinthal, 1990). Management literature on CEO roles and communication conceptualize it as focus and discretion (Yadav, Prabhu, & Chandy, 2007). Literature on organizational learning defines attention as emphasis on events that have locus inside and/or outside the organization (D. Levinthal & Rerup, 2006). The attention-based view describes it as the distinct focus of time and effort (Ocasio, 1997). The more general psychological view of attention is the occupation of the individual's consciousness by events (Cho & Hambrick, 2006). Following these theoretical considerations and taking into consideration the context of new product development, I use the conceptualization that:

> *Attention is the degree to which something (an activity, event, opportunity, threat, category, process, project, procedures, skills, etc.) with locus inside and/or outside the company occupies the consciousness of individuals.*

Furthermore I find on basis of the conceptualizations in literature that attention has direction and emphasis. The direction of attention can be positive as in turning toward something and negative as in turning a way from something. The significance of the direction of attention is tied to the

emphasis the decision-makers place on something, i.e. high emphasis means a strong attention. Negative attention does not necessarily mean that something is cognitively disregarded. How far away something is in the individual's consciousness depends on emphasis, the larger the emphasis the more negative attention can be interpreted as a total disregard by the decision maker.

3. Conceptual framework

The importance of decision-makers' attention to achieve performance can be related back to the introduction of bounded rationality of decision-makers, linking individual information processing and behavior to organizational behavior (Simon, 1947). The information ability of the individual decision-makers sums to the information competence of the company. Theory of bounded rationality stated early on that the scarce resource in companies was not information, but the capacity to attend to information. The upper echelon theory is a further development of this perspective. In this the theory, mangers attend to information on basis of a cognitive filter matching the situation they face (Cho & Hambrick, 2006). Also focusing on the individual decision-maker, but building on the premises that the whole determine its parts, the attention-based view of the company states that to explain company behavior is to explain how companies distribute and regulate the attention of their decision-makers (Ocasio, 1997). In other words, though individuals ultimately do the attending, individual attention is situated in the context of firm's activities and procedures. Figure 1 displays the conceptual framework. Concepts and hypotheses are developed in the following.

>> inset figure 1 here <<

3.1. Attention to information

In the new product development process the information inputs stems either from previous development projects by a product manger or from activities carried out in the stages of the NPD process with regard to a new-product project. Psychological literature distinguishes between automatic and active awareness to information. Automatic awareness refers to reliance on information that was suitable in the past to the context in which they find themselves. Active awareness to information is openness to new information and willingness to view a context from other than past perspectives (D. Levinthal & Rerup, 2006). The theory of exploitation and exploration shares this perspective of information (J. G. March, 1991). A review of current research shows that several fields address active attention to information in companies in relation to new product development. Exploitation and exploration are distinguished as different orders of knowledge competence (Danneels, 2002). The innovator's dilemma has been readdressed in the light of decision-makers' information ability (Henderson, 2006). Market orientation is positioned as a resolution to the capability-rigidity paradox (Atuahene-Gima, 2005). The ambidexterity of knowledge as a concept for innovativeness has evolved as a research field (Jansen, Van den Bosch, & Volberda, 2005). Anchored in this literature, attention to information is conceptualized as the relative amount of NPD activities carried out in the stages of the NPD process. The higher the relative number of NPD activities, the more active attention to information and opposite the more automatic attention to information.

Performed NPD activities generate information summarizing the status of the project at each stage as well as the consequences of different options. Through these NPD activities the uncertainty about a new-product's potential is reduced. (Crawford & Di Benedetto, 2002; Thomas, 1993). As a direct consequence of the information accumulated throughout the NPD process, decision-makers should

become better to evaluate the potential performance of the new-product project through the NPD stages (Zahra & George, 2002). Thus:

H1. The more attentative to information (NPD activities), the less volatile the new-product project evaluations from one stage of the NPD process to the next.

3.2. Attention to internal NPD context

In NPD and marketing management research two dominant internal NPD context characteristics of organizations are the technological sophistication and innovativeness (Robert G. Cooper, 1984; Hart, Tzokas, & Saren, 1999; Lukas & Ferrell, 2000; Slater & Narver, 1993; Urban & Hauser, 1993; Wind, 1982). Product characteristics have been treated as variations in the NPD process pertaining to the product being of high or low technological sophistication (Barczak, 1995; Diamantopoulos & Hart, 1993; Hanna, Ayers, Ridnour, & Gordon, 1995; Karakaya & Kobu, 1994; Koku, 1998; Olson & Bakke, 2001; Souder & Song, 1997; Stewart-Knox & Mitchell, 2003; Urban & Hauser, 1993). Technology focus is singled out by research as influencing value creation in the organization (Mizik & Jacobson, 2003). Technological sophistication of NPD has two forms. Either the end-product is technological sophisticated or the manufacturing process is technological sophisticated. In this regard, it is useful to distinguish between product-innovation focus and production focus (Baker & Sinkula, 2002; McKee, 1992). A production focus is characterized by an internal concentration on performance measured by unit cost and a limited attention to the product market. This focus has an internal view of information. Existing and known information sources are exploited in the development of a new product. Market and technical information is acquired within the company, but focus is on technology related sources. A product-innovation focus has an external perspective with performance stressing customer benefits. Information sources both market

and technology related are explored for new and unknown information in the development of a new product.

With regard to new-product project evaluations, research on new-product decay curves find that companies in technological sophisticated industries have a relative steep decay curve (Jespersen, 2007). New-product evaluations have a higher relative consistency through the NPD stages as the decision to launch or not is made early in the NPD process. Thus:

H2a. The higher the technological sophistication of end-product, the lower the information attention in each stage of the NPD process.

H2b. The higher the technological sophistication of production process, the lower the information attention in each stage of the NPD process.

H2c. The higher the technological sophistication of end-product, the less volatile the new-product project evaluations from one stage of the NPD process to the next.

H2d. The higher the technological sophistication of production process, the less volatile the new-product project evaluations from one stage of the NPD process to the next.

Innovativeness is often referred to as a key characteristic of an organizations' NPD strategy. Prospectors are more innovative than defenders (Dröge & Calantone, 1996; Slater & Mohr, 2006). The development process varies with the innovativeness of a new-product project (Urban & Hauser, 1993). Within information search literature information choice and innovation is linked by referring to whether the information sources chosen are internal/external, personal/impersonal and whether the information chosen is summarized/detailed and market/product related. The higher the level of

innovativeness, the information sought for decision-making was external, impersonal and product/market related (Aguilar, 1967; Glazer, 1991; Ross & Robertson, 1990). The strategic profiles for NPD are related to this conceptual work through the expected newness of a product developed by companies with a prospector, analyzer or defender strategic profile (Gatignon & Xuereb, 1997; Lukas & Ferrell, 2000). Prospectors are more innovative and generate new products with a higher innovativeness. These companies are characterized as risk averse and proactive. Hence, product innovativeness is expected to influence decision-maker's attention to information and new-product project evaluations.

H3a. The higher innovativeness of organizational product development, the higher the information attention in each stage of the NPD process.

H3b. The higher innovativeness of organizational product development, the less volatile the new-product project evaluations from one stage of the NPD process to the next.

3.3. Attention to external NPD context

A recently developed perspective of the NPD context external to the organization emphasizes the competitive pressure facing companies (see Industrial Marketing Management 2002 special issue 4). Focus is on how product development cycle time is reduced to beat competitors without compromising or missing out on information (Carneiro, 2000; Flint, 2002; Griffin, 2002; Koufteros, Vonderembse, & Doll, 2002; Lukas, Menon, & Bell, 2002). Research find that reducing the information level to increase NPD speed raises uncertainty and stress (Lukas, Menon, & Bell, 2002). Irrespective of the competitive pressure it is important to pay attention to NPD activities (Calantone, Schmidt, & di Benedetto, 1997). First-mover and innovative advantages are kept by a

high level of attention to information (Garcia & Calantone, 2002). Though other companies' experiences are important information sources, uncertainty is relatively higher under conditions of high competitive pressure than low competitive pressure (Ahn, Lee, & Lee, 2006; Kim & Miner, 2007). Thus:

H4a. The higher the level of competitive pressure, the higher the information attention in each stage of the NPD process.

H4b. The higher the level of competitive pressure, the more volatile the new-product project evaluations from one stage of the NPD process to the next.

4. Methodology

4.1. Methodological choice

This study is based on a virtual, simulated NPD process; an approach that combines several methods. The designed simulation of an NPD process exploits the advantages of the role play[1] and the scenario[2] while maintaining the quality of data collected with a questionnaire (reliability and

[1] The advantage of role playing is that roles influence a person's perception of a situation. More importantly, the similarity between laboratory research and role playing is well documented
Dabholkar, P. A., (1994), Incorporating Choice into an Attitudinal Framework: Analyzing Models of Mental Comparison Processes, *Journal of Consumer Research*, 21 (June), 100-118.

[2] The scenario is the situation in which the role play is acted out by the participants and is therefore the heart of the simulation. The advantage of using scenarios as frames for the decision-making process is that they make the respondents relate more directly to the posed subjects and make it possible to create a realistic context. Also, when respondents are presented with a scenario before decision-making, their attention is guided to the relevant problem area. As all respondents are provided with a standard stimulus, the results are to a high degree more accurate responses
Frederickson, J. W., (1984), The Comprehensiveness of Strategic Decision Processes: Extension, Observation, Future Directions, *Academy of Management Journal*, 27 (3), 445-466,
Frederickson, J. W., (1985), Effects of Decision Motive and Organizational Performance Level on Strategic Decision Processes, *Academy of Management Journal*, 28 (4), 821-843,
White, J. C., Varadarajan, P. R. and Dacin, P., (2002), The Effect of Cognitive Style and Perceived Organizational Culture on Managers Interpretation of and Response to Marketing Information, *Journal of Marketing*, . The key is to

comparability) as well as the dynamics offered by experimental design. Using the Internet as medium, these four business research methods were combined and applied as the backbone of the simulation. The aim of the simulation was to have NPD practitioners go through the interactive process of selecting NPD activities and evaluating a product from idea to launch based on the information generated by the selected NPD activities. Table 1 presents how the methodologies acted as the building blocks of the designed, virtual NPD process.

>>> insert table 1 here <<<

4.2. The data collection process

The basic structure of the data collection process is illustrated in figure 2. The questionnaire contained measures of NPD following the PDMA investigations (Griffin, 1997), the MORTN Scale (Deshpande & Farley, 1998), innovation orientation (Robert G. Cooper, 1984; Siguaw, Simpson, & Enz, 2006) and questions on their NPD budget.

The basic structure of the simulation was that the NPD practitioners were asked to initiate NPD activities for the purpose of evaluating a new-product project as it evolved through the NPD process. At each stage NPD practitioners were given a short description of the latest progress followed by a list of NPD activities for that specific stage. Participants rated these and decided which NPD activities to perform. A list of the selected NPD activities then appeared, and the participants accessed the information output of each. Based on their newly gathered information, participants were asked to evaluate the new-product project for its potential before continuing to the next stage of the NPD process. The simulation ended with a decision whether to launch or not. For

structure the scenario in accordance with the decision process under investigation in order to maintain the realism of the simulation. Research has applied the scenario method to NPD strategy.

details on the NPD activities see appendix A and consult appendix B for detailed information about variable measurements. For a full account of the data collection process consult (Jespersen, 2005, 2006).

>>>> insert figure 2 here <<<

4.3. Sample

The sample consisted of large international companies whose NPD units were located in Denmark. Companies were identified through database searches. The selection criteria of the targeted companies were reasonable size, consumer products and NPD in Denmark. The sample covered product groups such as food, telecommunication, personal computers, kitchen hardware, speakers, washing machines, dryers, and headphones.

Participants were found through organizational charts and interviews with companies to determine the person in charge of the company's NPD decision-making. The participant's position in the company was not of the essence; rather the significant criterion was the person's decision-making competence with respect to the company's NPD decision-making. A total of 42 NPD practitioners took part in the data collection process.

4.4. External data validity

Despite the many benefits derived from a simulation, respondents nonetheless enter a constructed reality. This constrains the analysis results and introduces the risk that nothing but the behavior in the simulation in question is explained. To counter this, the external validity of the virtual NPD process was addressed *explicitly*. Particular efforts were made to prevent that the information items would obscure the participants' decision-making.

The *budget* was validated by having the participating companies state their usual information budget (Griffin, 1997), and having them evaluate a 93,000 EURO budget on a Likert scale where 1 = very small relative to company budget and 5 = very large relative to company budget. The majority of the decision-makers stated that the budget was similar to or a little higher than their usual budget. Analyses show that although the participants were given an above usual budget, they did not spend it. The participants' average investment in information was 50-60 percent of the budget. Hence, information acquisition in the virtual NPD process resembles information acquisition in the sample companies.

The *price* (resources/cost) of each information item was determined based on interviews with market research companies in Denmark as well as on the genuine comprehension that explorative activities are more resource demanding than exploitative activities (J. G. March, 1991). The match between the average importance of an information item and its average acquisition percentage shows that there are no outliers demonstrating a price effect on the importance-buy relationship in the simulation.

The *utility* of the information output from the NPD activities selected by the participants is very important in terms of the validity of the designed NPD process simulation. The information utility was measured on the dimensions: relevance, quality and newness of the information. The measures were taken from Deshpande and Zaltman (1982, 1984, 1987) as this scale seemed appropriate due to its extensive use in research on information utility (Menon & Varadarajan, 1992; Menon & Wilcox, 1994; Moorman, 1995). Initially, seven questions from the Deshpande and Zaltman scale were chosen; these were reduced to three – one for each dimension – out of concern for the fatigue factor as participants had to measure item utility for each information item acquired in the simulation. For each statement the participants indicated their agreement or disagreement on a five-point Likert scale (1 = 'highly disagree' to 5 = 'highly agree'). With the high average ratings for all

36 information items (see appendix A), it was concluded that the output of each NPD activity was very realistic.

The *participants evaluated the simulation* on four dimensions (coherent and easily comprehended process, realistic contents, exciting participation, and time consuming) measured by five items on a five-point Likert scale (1 = 'strongly disagree to 5 = 'strongly agree'). The feedback from the participants was very positive with averages above 4 on the scale. The only negative aspect was, as expected, the time spent on participation (mean = 2.88), but still it seems that sixty minutes are acceptable. In general, the simulation was found fun to do and very realistic.

4.5. Analysis

The analysis of data was performed in two steps. First, each form of decision-maker attention was investigated. The internal NPD context is described across the sample and an analysis of the mean differences of technological sophistication and innovativeness was conducted. Describing review NPD decisions had the purpose of establishing whether the stage-to-stage NPD changes were significant. Paired-sample t-tests to compare means were therefore performed on the level of go/no-go and change in go/no-go from stage-to-stage. Decision-maker's attention to information is described through a rotated hierarchical cluster analysis of selected NPD activities by participants in each NPD stage.

Second, decision-makers' focus of attention in new-product project evaluations was established by multiple regression models. The influence of context on attention to information has information attention (info) as the dependent variable, and technological sophistication (tech), innovativeness (innova), and competitive pressure (CP) as independent variables. The sign of coefficient signify the direction of decision-makers' attention when selecting NPD activities in NPD stages and the

size of the coefficient states the impact on attention to information caused by context. The regression model is:

$$Info_{ij} = \beta_0 + \beta_{1k}\, tech_{kij} + \beta_{2l}\, innova_{mij} + \beta_3\, CP_{ij} + \varepsilon_{ij}$$

$\beta_{1\text{-}2}$: attentiveness to internal NPD context

β_3: attentiveness to external NPD context

i = NPD practitioner

j = NPD stage

k = measurement variable of technological sophistication

m = measurement variable of innovativeness

The guidance of attention on new-product project decisions has the change in go/no-go as the dependent variable (evaluation), and technological sophistication (tech), innovativeness (innova), information attention (info), and competitive pressure (CP) as independent variables. The sign of the coefficients is not suitable for interpretation as evaluation is the numerical change from stage-to-stage. The coefficients sizes state the change in the evaluation from stage-to-stage in the NPD process due to the focus of attention. The regression model is:

$$Evaluation_{ij} = \beta_0 + \beta_1\, info_{ij} + \beta_{2k}\, tech_{kij} + \beta_{3l}\, innova_{mij} + \beta_4\, CP_{ij} + \varepsilon_{ij}$$

β_1: attentiveness to information

$\beta_{2\text{-}3}$: attentiveness to internal NPD context

β_4: attentiveness to external NPD context

i = NPD practitioner

j = NPD stage

k = measurement variable of technological sophistication

m = measurement variable of innovativeness

5. Results

5.1. Descriptive statistics

The internal and external NPD contexts of the sample are illustrated in table 2. The levels of competitive pressure are distributed equally across the sample. Medium competitive pressure has a stronger representation of electronic product producers and low competitive pressure has a stronger representation of food processing companies. Though technological sophistication of food production process can be high, the characteristics of the sample companies is that electronic product developing companies are more technological sophisticated on both end-product and production process. This sample skewness is considered if these levels of external NPD context direct decision-makers focus of attention in the conceptual framework. Despite the difference in technological sophistication, the degree of innovativeness is fairly similar across the sample.

>>insert table 2 here <<

5.2. Attention to information

The cluster analysis of NPD activity selection in the simulation divided the NPD practitioners into three subgroups[3]. The three clusters differ in the amount of NPD activities that the participants solicited in the virtual NPD process (see table 3). Cluster 1 initiated many NPD activities throughout the NPD process and demonstrated a preference for internal information sources. The information attention ratio is high throughout the NPD process and may be characterized as primarily exploitative. Cluster 2 and 3 initiated fewer NPD activities than cluster 1. Cluster 2 favors external information sources that capture market/user perspectives of a new-product project in preference to internal information sources. The information attention ratio of this cluster varies across the NPD stages and is most intensive in the concept and commercialization stages. The explorative profile is not consistent through the NPD process. Cluster 3 shows a preference for internal information sources and selects a substantial amount of NPD activities at the front-end. The selection of NPD activities, however, becomes scarcer in the remainder of the NPD process resulting in an overall low amount of selected NPD activities. The information attention ratio illustrates this behavior of cluster 3. Decision-makers' attention to information differ in its characteristics of NPD activity selection. The results show that many activities not necessarily leads to knowledge exploration in the NPD process (cluster 1). Also, a low number of activities do not necessarily signify a disregard of explorative knowledge (cluster 2).

>>insert table 3 here >>

The theory of bounded rationality suggests that the difference in attention to information by the three clusters may be a result of individual information capacity. For this to be true, decision-

[3] The cluster sizes in the form of participants were: $n_{cluster1} = 11$, $n_{cluster2} = 16$ and $n_{cluster3} = 15$.

makers' information attention should not be influenced by the company NPD context as forwarded by the attention-based view of the company. Table 4 shows the decision-maker's focus of attention when selecting NPD activities in each stage of the NPD process. High innovativeness increases the attention to information in the idea stage. Otherwise it is high competitive pressure that significantly increases decision-makers' attention to information. Consequently hypothesis 2a, 2b and hypothesis 3a are rejected whereas hypothesis 4a is supported. As high competitive behavior had an equal split between electronic and food products in the sample, the result is not biased.

The results show that NPD activity selection is a result of individual information capacity and competence when the external NPD context acts as anticipated. When companies show experiences that leads these companies down another product innovation trajectory then attention to information is raised by decision-makers. Learning from other companies is important (Kim & Miner, 2007). Whether or not this form of learning affect decision-makers' attention to information depends on whether or not behavior of other companies (competition) is as anticipated or not.

In combination with high innovativeness, the results suggest three interesting aspects. First, a higher amount of information is accumulated in the NPD process if uncertainty is high. Second, competitors following the same product innovation trajectory are regarded as reassurance thereby not affecting individual information attention. Third, the uncertainty stemming from the internal NPD context is not affecting information attention. The internal NPD context is part of the decision-makers' taken-for-granted reality (D. A. Levinthal, 1997).

>>insert table 4 here >>

5.3. Decision-makers' attention and their go/no-go evaluations

The new-product project evaluation averages given by the sample in each stage are shown table 5. Paired-sample t-tests find that the likelihood of 'go' changes through the NPD stages in the simulation. 'Go' increases from upfront through the concept stage, then levels out, before it decreases from the test-stage to commercialization.

>>> insert table 5 here <<<

Table 6 shows decision-makers' focus of attention in new-product project evaluations throughout the NPD process. Decision-makers pay *attention to information* in the idea, test and commercialization stages. Contrary to expectations of information reducing uncertainty, the attention to information increases the volatility of new-product project evaluations. Consequently, hypothesis 1 is partly supported. Research notes that companies and decision-makers are struggling with the implementation of best practices (Hauser, Tellis, & Griffin, 2006). The presented results suggest that the issue may not be to select and perform specific NPD activities, but to apply and use the information output of the selected activities in NPD decision-making. In other words, the information capability and competence of decision-makers is significant. The simple explanation of the results is that the information items in the simulation did not fulfill the decision-makers' expectations. Although this may be true, it should be mentioned that all information outputs in the simulation were given high utility ratings by participants.

With regard to NPD context, *internal* NPD context influences decision-makers' new-product project evaluations whereas *external* NPD context do not (table 6). Hypotheses 2c, 2d and 3b are supported but hypothesis 4b is not. Decision-makers use the experience from the internal NPD context in their new-product project evaluations. High technological sophistication ad high

innovativeness creates minor volatility in new-product project evaluations. These characteristics of the internal NPD context introduce decision-making uncertainty as expected and theorized in NPD and marketing literature.

>> insert table 6 here <<

6. Discussion

The aim of this paper was to address decision-makers' focus of attention in the selection and use of NPD activities. Figure 3 illustrates how decision-makers attend to information and NPD context within the NPD process. The dots in figure 3 represent the behaviour of the sample.

>> insert figure 3 here <<

Decision-makers' focus of attention has been related to organizational learning (D. Levinthal & Rerup, 2006). Literature theorize three forms of attention: mindful, appropriate, and mindless. Decision-makers are mindful when they are attentive to their context and have capacity to respond to unanticipated signals (Langer & Moldovenau, 2000; D. Levinthal & Rerup, 2006; Sternberg, 2000). Decision-makers who are attentive to context have a set of routines to apply for a given situation, i.e. the organizational routines regarding NPD activities in new-product projects. As the context fulfil anticipations decision-makers would apply the logic of appropriateness stemming from these routines (D. Levinthal & Rerup, 2006). Decision-makers with an internal focus without reaction to external changes are conceptualized as mindless (Langer & Moldovenau, 2000; Yadav, Prabhu, & Chandy, 2007).

An important distinction of the three forms is the anticipated behavior of context. Figure 3 shows how external NPD context can be used to divide the three forms into four thereby extending insights

on organizational learning and attention. Appropriate information attention may be divided into two segments: One defined by research and one defined by management practice. In NPD process literature research conceptualize appropriateness through best practices with regard to NPD activities (Henard & Szymanski, 2001). The recommendations are strongly to perform a substantial amount of activities to ensure fulfilment of user needs and timely product introduction (Avlonitis & Gounaris, 1997; Robert G. Cooper & Kleinschmidt, 1987; Griffin, 2002). The empirical found managerial response to competitive behaviour is that of skipping NPD activities. As a result new product success becomes rarer (Lumpkin & Dess, 2001). The results support that decision-makers are skipping NPD activities, but I pose that this decrease in information attention in NPD is a result of decision-makers applying logic of reassurance in the NPD process. Reassurance about the new-product project is not needed from users as it is given freely by competition that follows the same new product trajectory, i.e. anticipated context behavior. The information paradox in this context is that there is no guarantee of competition being right. Most likely competition is also applying logic of reassurance. This leaves two scenarios to come true. One is that both the decision-maker and competition do not hold valid knowledge about user need, and therefore, the product ends up having poor market performance. The other scenario is that competition holds valid user knowledge from having applied logic of appropriateness or being mindful; and the product end up having good market performance. Reassurance is therefore a fourth form of decision-maker focus of attention.

Another aspect of information attention is its strength (force). Both mindful behaviour and appropriate behavior has high levels of information attention. Decision-makers exhibit mindful information behavior because they experience high levels of uncertainty. Decision-makers exhibit logic of appropriateness, because organizational routines prescribe a certain amount of NPD activities as standard. There is a tendency in NPD and marketing literature to focus on the amount of NPD activities in the explanation of NPD performance, but as theory account for ‘more is not necessarily better’ (D. Levinthal & Rerup, 2006; J. March & Simon, 1994).

The result account for this by finding that high information attention increases the fluctuation in new-product evaluations. Contrary to expectation a high level of accumulated information leads to increased rather than decreased uncertainty about potential product performance. Two explanations may be offered to this result. One is the often replicated statement in literature that this is due the selection of the wrong NPD activities (R.G Cooper, 2008) or because decision-makers apply exploitative rather than explorative knowledge (J. G. March, 1991). The other explanation provided by the results in this paper is that it is not just a matter of selecting NPD activities; it is also a matter of individual information capacity and information competence. Theory of bounded rationality supports the former and the information paradox in this context resides in the latter. Decision-makers are selecting NPD activities, but irrespective of it being exploitative or explorative activities (Danneels, 2002), the generated information increases uncertainty in the NPD decision-making situation at evaluation gates of the NPD process, because decision-makers' information competence is out of balance.

An information competence is to understand how an issue is approached, which questions to ask and how to deduce meaning from the input (Arbnor & Bjerke, 1997). An information competence is a broad methodological insight into procedures and techniques for generating, analyzing, reflecting on and assessing information as well as for disseminating this information into business decision-making processes. Of the three elements information collection is most often in focus. Companies collect information, they state their openness to the external environment by asking questions in interview and/or questionnaire form. Information collection has to some extent become a symbol of listening and hearing market needs and of seeing technological opportunities. It is an important step-stone to collect information, but competent information use required also an understanding of the information approach in form of the premises by which information is collected as well as an ability to analyze and comprehend incoming information (Jespersen, 2008). Without the ability to deduce meaning from collected and analyzed data then high attention to information in the NPD

process cannot be transformed into sound gates evaluations and a better resource allocation between 'go' and 'no-go' projects (Tidd, 2000).

7. Conclusion and implications

The purpose of the paper was to address how decision-makers' focus of attention is directed in their determination of go/no-go of new product between NPD stages. The conclusion of the conducted study is that information paradoxes of NPD exist. Decision-makers' apply logic of reassurance when competition satisfies behavior anticipations and decision-makers' demonstrate an unbalanced information processing competence.

This has many implications; one is that it is a challenge for NPD activities to create new-product value. If competition behaves as anticipated then NPD activities are skipped and when NPD activities are undertaken, decision-makers lack the competence of applying information to go/no-go decisions. In both cases, information from NPD activities is out of the decision-making loop. This implies that new products may take organizations in unwarranted directions with a lower performance rate. This information paradox offers an explanation to why companies are struggling with the implementation of NPD activities (Hauser, Tellis, & Griffin, 2006) and have developed misconceptions about the stage-gate framework (R.G Cooper, 2008).

Another implication is that go/no-go decision-making remains a black box. When information from NPD activities raises uncertainty about potential what are then grounds for decision-making at NPD gates? Research has covered the applied decision-criteria (Carbomell, Escudero, & Aleman, 2004; Hart, Hultink, Tzokas, & Commnadeur, 2003), but there is a lack of knowledge on mechanism surrounding these criteria and go/no-go decisions. This implies that gates in the NPD process have to be designed carefully and have to be given internal power and resources.

A third implication is that information processing competences are to be given attention like other organizational competences, i.e. sales, development, production, logistics, management, etc.

Solemnly focusing on the creation of information through NPD activities does not guarantee higher performance. Performance derives from the ability to deduce meaning from collected and analyzed information and to use this in decision-making. For this purpose the organization needs a basic understanding of information processing similar to other competences. Information collection about market and users are often outsourced and with good reason, but companies should have demands regarding information type and information analysis, rather than relying on the competences of external partners to analyse and interpret company users and markets. The innovativeness of new-product projects in a company is impacted by the information competence held by NPD decision-makers and the organization (Danneels, 2002).

Appendix A
Details on the NPD activities in the virtual NPD process.

NPD activities	Mean importance	S.D	Selection percentage	Participant rated item utility*		
				Relevance	Quality	Novelty
Idea stage						
Market potential	4.29	1.160	0.5260	4,45	4,05	3,35
The sales force says …	3.68	1.254	0.5000	4,22	4,28	3,61
Technological evaluation	3.68	1.254	0.3950	4,42	3,92	2,50
Comments from developers	3.79	1.018	0.4740	3,86	3,79	3,21
Talking to customers	4.24	0.971	0.5260	4,29	4,06	2,88
Profile of company's present markets	3.55	1.083	0.2370	4,58	3,53	3,42
Strategic considerations	4.00	1.040	0.447	4,00	4,00	3,63
Trends & lifestyle changes	3.97	0.677	31.60	4,63	4,06	3,19
Concept stage						
Vendor co-operation	3.89	0.963	0.4570	3,69	3,69	3,21
Competitive analysis	3.57	0.810	0.2860	4,53	3,69	3,53
Technology considerations	4.09	0.981	0.4740	4,60	4,20	3,89
Is there an unused position on the market	4.00	1.029	0.400	3,75	3,38	3,80
The opinion of customers	4.43	0.778	0.5430	3,50	3,40	2,70
The need fulfillment by the product idea	4.37	0.690	0.2860	4,16	3,79	2,58
Sales expectations/forecasting	4.17	1.034	0.5430	4,19	3,94	3,56
Design stage						
Technical prototype testing	4.15	0.667	0.3940	4,92	4,38	3,77
Financial review of cost/cash flow	4.79	0.485	0.7880	3,53	3,40	3,20
Profile of present markets	3.67	1.051	0.1820	3,83	3,75	3,50
The sales force says …	4.21	0.992	0.4550	4,60	4,32	3,68
Utility of product attributes	4.30	0.810	0.3940	4,75	4,75	3,88
Production process testing	4.24	0.867	0.4850	3,80	3,80	3,60
Profile of prototype on significant parameters	3.85	1.034	0.4550	4,43	4,50	4,00
Test stage						
Production control methods	4.25	0.762	0.5310	4,63	4,31	4,00
Technological evaluation	4.03	0.822	0.3440	4,50	4,17	3,78
Comments from developers	3.97	1.048	0.4520	4,00	3,50	2,33
Advertising test	4.06	1.014	0.3750	4,42	4,42	4,42
Product test by potential users	4.44	0.716	0.5650	3,94	3,94	2,76

Appendix A *(continued)*

Trends & lifestyle changes	4.69	0.535	0.5000	3,55	3,36	3,36
Purchase testing among customers	3.44	1.105	0.1880	3,07	2,86	2,36
Commercialization stage						
Price analysis	4.43	0.817	0.6670	3,85	3,55	3,15
Distribution channels	4.30	0.877	0.5000	4,50	4,00	3,71
After-sales service	4.07	0.828	0.3000	4,87	4,87	4,60
Comments from developers	4.57	0.679	0.5670	4,56	4,33	4,22
Financial review of cost/cash flow	4.20	0.887	0.5330	4,56	4,38	4,25
Production process testing	3.97	0.999	0.3330	3,40	3,00	3,10
Buying behavior analysis	4.37	0.765	0.4670	4,38	4,06	3,81

*On a five-point Likert scale (1 = 'highly disagree' to 5 = 'highly agree') participants answered the questions: 'the information was related to the decision at hand' (Relevance), 'the information item was worth the money spent on it' (Quality), and 'information addressed issues that were unexpected' (Novelty) (Deshpande & Zaltman, 1982, 1984, 1987).

Appendix B Variable measurements

Information attention

Research on absorptive capacity theorizes that an information efficiency factor is the ratio of information use over information generation (Zahra & George, 2002). As absorptive capacity has evolved from theory of bounded rationality (Cohen & Levinthal, 1990), the reasoning of the information efficiency factor is used for the calculation of information attention.

For each NPD stage, information attention of a respondent is calculated as the number of selected NPD activities over the total NPD activity options in the same stage of the NPD process. NPD activities can be a market analysis, a conversation with a colleague or a technical test of the product's functionality. This does not imply that information can be created only through these recommended activities, but the present paper had only data for this set of NPD activities (see appendix 1). The selection of an NPD activity was measured on a nominal scale (0='not selecting', and 1 = 'selecting'). The amount of information products available in each stage of the simulation is depicted in appendix A.

Technological sophistication

Based on the work of Cooper (1984) and Siguaw (2006), *technology sophistication* was measured by the following constructs: 'the company develops technologically sophisticated products' (technology products) and 'the latest development and production technology is applied in the development process' (technology production). On a five-point Likert scale (1 = 'never' to 5 = 'to a very high degree') participants evaluated to what extent each statement characterized the development of new products in their company. This measurement took place in the questionnaire before the participants entered the simulated NPD process.

Innovativeness

Innovativeness is a self-reported measure applied from (Robert G. Cooper, 1984; Firth & Narayanan, 1996). On a five-point Likert scale ('1 = never' to '5 = to a very high degree'), participants evaluated to what extent the innovativeness in their company could be characterized by 'a new product is primarily an adjustment of existing products' (low innovativeness) and 'new products take the company into new markets' (high innovativeness). As a company portfolio holds both types of products including both aspects was found more expedient than a dichotomous variable. This measurement took place in the questionnaire before the participants entered the simulated NPD process.

Competitive pressure

To simulate environmental turbulence, competitive pressure was designed experimentally as a rumor that a competitor was launching a new product similar to the one being developed in the simulation. The rumor was introduced at the point of information acquisition in the concept and prototype stages. The experimental factor was timed taking into account that the NPD process was

underway, so that the product idea would not be disregarded up-front due to the experimental manipulation.

Competitive pressure was manipulated at three levels in the simulation. At the lowest level (the base) there were no changes in the environment relative to the role-play description. At the medium level, a rumor about a major competitor launching a product similar to the one under development was introduced at the concept stage and confirmed at the design stage. To raise the competitive pressure further at the highest level, the rumor was introduced at the concept stage, but then not confirmed at the design stage. So the NPD agent still did not know what the competitor was up to. This increased insecurity intended to raise the experienced level of environmental turbulence. For analysis, competitive pressure was captured in two dummy variables (binary variables).

New-product project evaluation

NPD review decisions were measured using the likelihood of continuance (go/no-go) of the project in the simulation. At the end of each stage, decision-makers stated in percent (from 0 to 100) the likelihood of continuing the new-product project. For the analysis, new-product project evaluations were measured as the numeric change in the likelihood of continuing from one stage to the next.

Fig. 1. Conceptual framework

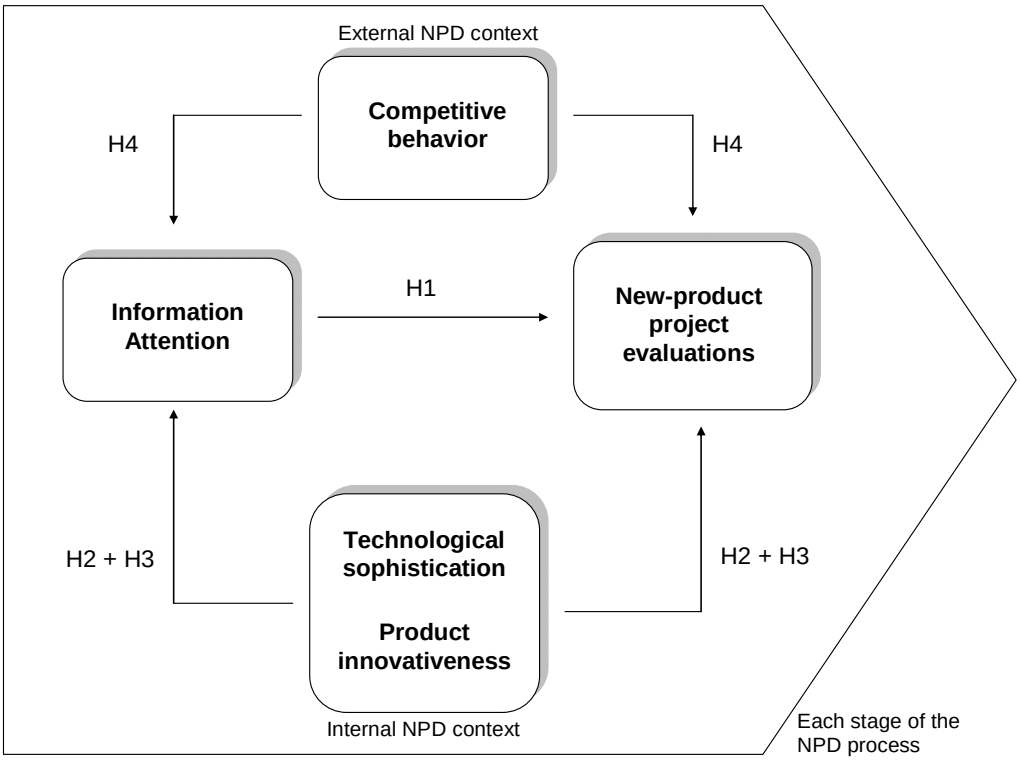

Table 1
Methodologies and simulation elements in detail.

Questionnaire	Scenario	Roleplay	Experiment
Background characteristics of participant and organization	Status for each stage of the NPD process	Job description	Competitive pressure
Importance of each NPD activity at each stage	NPD activities	The company's internal business environment	
Selecting a NPD activity	The new-product project	The company's external business environment	
Information utility of each NPD activity		The company's information acquisition budget	
New-product project evaluations			

Fig. 2. Overview of the simulation steps.

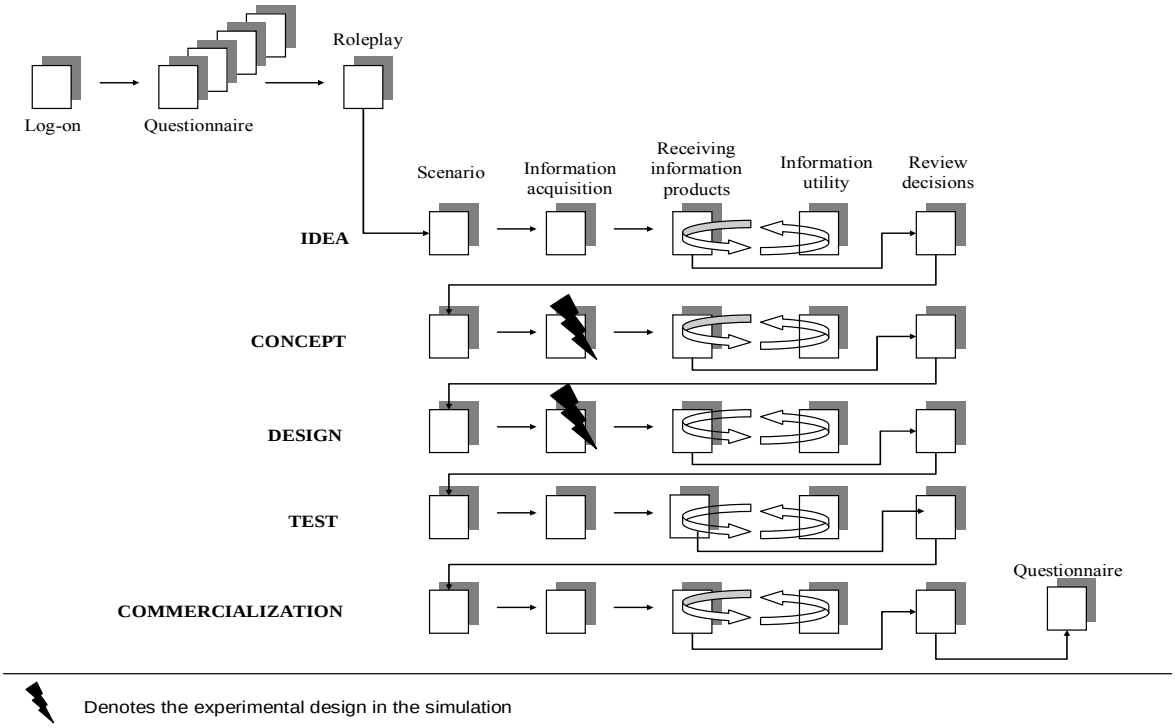

Table 2.
Descriptives and t-tests of NPD context of sample companies.

		Electronic products	Food products	Total
Environmental NPD context (percent)				
Competitive pressure	High	35.3	34.6	36.4
	Medium	47.1	26.9	34.1
	Low	17.6	38.5	29.5
Organizational NPD context (averages)				
Technology product		3.89*	2.52*	3.09
Technology process		3.94**	2.80**	3.26
Low innovativeness		3.06	3.16	3.12
High innovativeness		2.67	2.72	2.70

* $t_{41} = 4.180$; $p = 0.00$
** $t_{41} = 3.588$; $p = 0.001$
Table 3

NPD activity selection and information attention

NPD stage	Information output of NPD activity	NPD activity-selection cluster 1	2	3
Idea	Market potential		x	x
	The sales force is saying	x		x
	Technological evaluation	x		
	Comments from developers	x		x
	Talking to customers		x	
	Profile of present markets		x	
	Strategic considerations	x		
	Trends & life style changes			x
	Information attention	**0.50**	**0.375**	**0.50**
Concept	Vendor co-operation	x		
	Competitive analysis	x		
	Technology considerations	x	x	
	Is there an unused position on the market	x		
	The opinion of customers	x	x	
	The need fulfillment by the product idea		x	
	Sales forecasting	x	x	
	Information attention	**0.837**	**0.571**	**0.00**
Design	Technical prototype testing			
	Financial review of cost/cash flow	x	x	x
	Profile of present markets			
	The sales force is saying	x		
	Utility of product attributes	x		
	Production process testing	x		
	Prototype profile on significant parameters			x
	Information attention	**0.571**	**0.143**	**0.286**
Test	Production control methods	x		x
	Technological evaluation	x		
	Comments from developers			x
	Advertising test		x	
	Product test by potential users	x	x	
	Trends & life style changes	x		
	Purchase testing among customers	x		x
	Information attention	**0.714**	**0.286**	**0.429**
Commenrcialization	Price analysis	x	x	
	Distribution channels	x		
	After-sales service	x		
	Comments from developers	x		
	Financial review of cost/cash flow	x	x	
	Production process testing	x		x
	Buying behavior analysis		x	
	Information attention	**0.857**	**0.429**	**0.143**

Table 4
The influence of NPD context on decision-makers' attention to information

	Information attention				
	Idea	Concept	Design	Test	Commerc-icalization
Internal NPD context:					
Technology product	0.062	-	0.031	-	-
Technology process	-0.045	-	-0.045	-0.04	-0.055
Low innovativeness	-	-	0.036	-	-
High innovativeness	**0.092****	-	0.023	-	-
External NPD context:					
High competitive pressure	- [b]	**0.176****	**0.196***	**0.154****	**0.255****
Medium competitive pressure	- [b]	-	-0.099	-	-
F	2.669	4.150	4.194	2.575[a]	3.202
R^2	0.195	0.112	0.492	0.155 [a]	0.192

** p<0.01; * p<0.05; [a] p < 0.10;
[b] Competitive pressure was first introduced in the concept stage.

Table 5
Review NPD decision-making descriptives

Averages	Go/no-go level	Numeric change in go/no-go level
Upfront	46.29[a]	-
Idea	52.06	14.118
Concept	57.35[a]	17.500
Design	54.06	10.625
Test	58.13[b]	12.000
Commerc.	45.67[b]	15.000

[a] t = -2.002; p< 0.05
[b] t = 2.604; p< 0.01

Fig. 3. Forms of information behavior

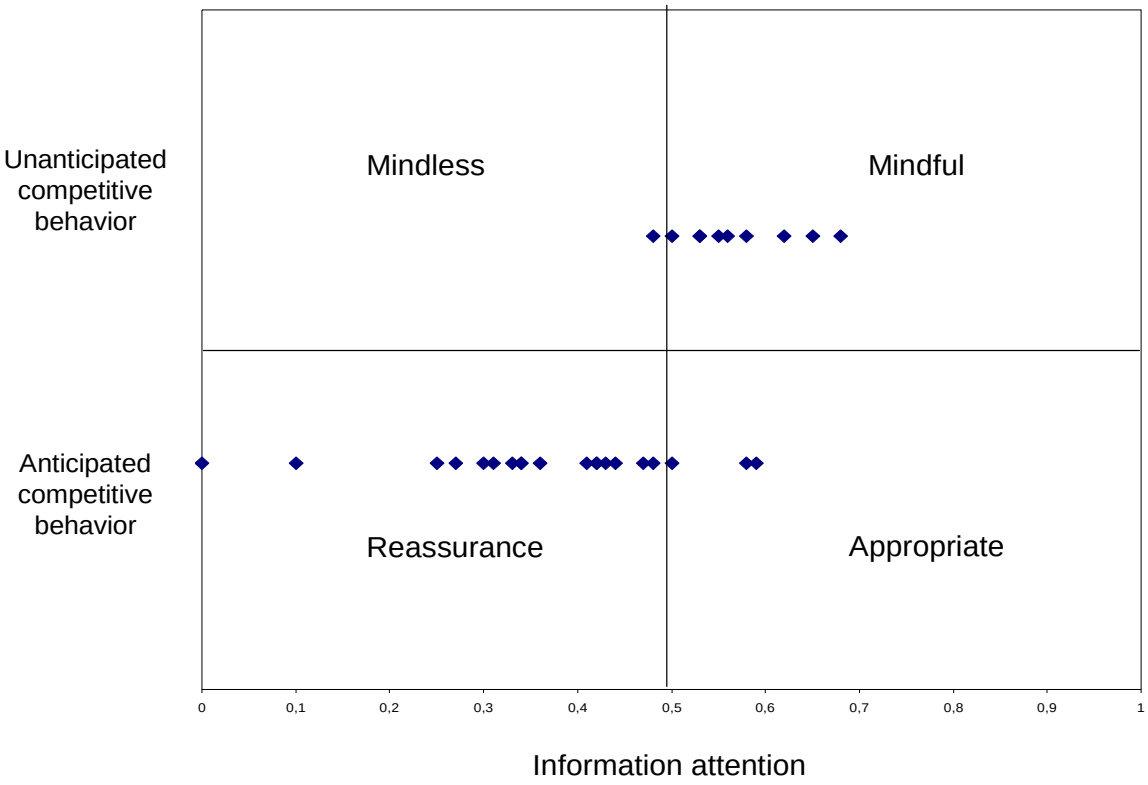

Table 6
Decision-makers' focus of attention in new-product project evaluations (regression analysis)

New product evaluations	Information attention	New product development context						F^b	R^2
		Technology product	Technology process	Low innovativeness	High innovativeness	High competitive pressure	Medium competitive pressure		
Idea	25.592*	-7.129**	9.037**	-1.299	6.662*	-	-	4.808	0.555
Concept	8.610	-7.967**	10.182**	5.838[a]	-6.786*	-11.242	-9.827	2.627	0.414
Design	-	4.671*	-	3.933	-2.395	-	-	2.631	0.220
Test	15.889[a]	2.483	-3.866[a]	-	-	-	-	2.846	0.240
Commercialization	26.133*	-1.508	-	-	-7.918*	-9.319	-10.013	2.591	0.360
Hypothesis support	Yes, partly	Yes	Yes	Yes, partly	Yes, partly	No	No		

* $p < 0.05$; ** $p < 0.01$; [a] $p < 0.10$
[b] The regression models are significant with $p < 0.05$

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