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INTEGRATION OF MARKETING AND R&D IN NEW PRODUCT DEVELOPMENT

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Tuotekehitys on yksi tärkeimpiä menestystekijöitä usealle organisaatiolle. Tuotekehityksen tehokas organisointi johtaa parhaimmillaan lyhyempiin projekteihin, alhaisempiin kustannuksiin ja parempiin lopputuotteisin.

Markkinoinnilla on paljon annettavaa tuotekehitykseen ja sitä koskevaan tutkimukseen. Tässä pro-gradu tutkielmassa perehdytään aiempaan tuotekehitystä sekä erityisesti markkinoinnin ja tuotekehityksen integraatiota koskevaan tutkimukseen. Teoriaosuuden pohjalta rakennetaan 418 yritykselle toimitettava kysely, jonka avulla kartoitetaan erilaisia suomalaisissa yrityksessä käytettyjä tapoja organisoida markkinointi ja tuotekehitys.

Tutkimus toteutetaan käyttäen klusterianalyysiä. Yritykset jaetaan neljään klusteriin, jotka kuvaavat erilaisia arkkityyppisiä lähestymistapoja markkinoinnin ja tuotekehityksen yhdistämiseen. Tutkimus on luonteeltaan exploratiivinen. Sen tulokset toimivat pohjatyönä ilmiön paremmalle ymmärrykselle ja mahdolliselle jatkotutkimukselle. Luokittelu voi lisäksi auttaa yrityksiä tarkastelemaan oman tuotekehityksensä organisointia suhteessa muihin yrityksiin.

ABSTRACT

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New product development has been generally accepted as a key success factors in modern markets. Systematical new product development processes have led to shorter development cycles, reduced costs, and better products.

Marketing and R&D are two of the most important functional areas when it comes to new product development. The purpose of the exploratory research is to build a taxonomy description of different configurations of marketing and R&D that are used during new product development in Finnish companies. To achieve this goal, a survey is distributed to 418 companies, and the results are analyzed using cluster analysis.

The observations are divided into four clusters, which represent different archetypical approaches to the integration of marketing and R&D. These configurations serve as a groundwork for further research, and could also help managers to reflect the configuration of their product development in relation to other companies.

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1. INTRODUCTION

Today's organizations face a market environment that is more competitive and challenging than ever before. Shorter product life cycles and increasing demands from customers have pushed companies to integrate different functional departments both within and between organizations. This thesis focuses specifically on intraorganizational integration of marketing and R&D, which has received substantial interest both in research and in practice due to its importance during new product development (NPD) projects. Today, cross-functional product development teams are a common way to increase the performance of product development, but individuals from different functional backgrounds tend to have different and sometimes conflicting perspectives on key issues. To get the best results out of teams, organizations need to address and resolve these differences and conflicts that might arise from them.

The information that is readily available today is reshaping the role of marketing. For example, Webster (1997) points out, that the skill of managing cross-functional relationships will be a necessary skill for future marketing managers. With easy access to vast amount of customer information, marketing has almost endless possibilities in determining customer's preferences and meeting their needs. One of the main goals of this thesis is to study how this opportunity is taken advantage of during NPD in different kinds of companies in Finland.

In the past, product development used to be reactive: new products were developed in response to competition and the work was done by engineers and other R&D specialists. Today companies are faced with fierce competition, and new product development is ideally carried out proactively. Many companies have systemically structured their product development process and integrated it with other functions such as production, purchasing and marketing. Despite positive progress, cooperation of people from different functional backgrounds continues to cause issues within companies.

1.1. Background of the research

Pertti Aimonen, chief executive officer of OptoFidelity, stated in 2016 that marketing is about the leadership of product development and understanding the customer: ”It is not about making brochures” (Kauppalehti, 2016). Yet, NPD is often perceived as engineers’ responsibility, whereas marketing departments are more focused on customer acquisition and promotion of the products. The idea for this thesis emerged from the dilemma between those viewpoints, and real life challenges that marketing and R&D personnel face when working together to create new products.

Innovation has been studied for decades with great attention given to new product development. Griffin et al., (2013) state that marketing as a discipline has a lot to give to the innovation research; as the representative of the customer, marketing department provides market intelligence that is essential for successful new product development. Sethi (2000) points out, that studying how team-related factors affect new product quality is important to both marketing practice and theory. Marketing should therefore take a more active part in new product development research.

The idea to create a taxonomy description of R&D/marketing interface is inspired by the research of Homburg et al. (2008), who created a taxonomy description of different configurations between marketing and sales. Even though R&D/marketing interface is one of the most widely studied interfaces of marketing, there is no similar archetypical classification of different configurations between the interfaces. The purpose of this thesis is to lay the groundwork for further research by creating a taxonomic classification of the R&D/marketing interfaces of Finnish companies.

1.2. Research questions and objectives

By conducting a cluster analysis, the objective of this research is to develop an archetypical classification of R&D/marketing interface during new product development in Finnish companies. The objective requires the adoption of an exploratory research approach, which is useful when the goal of the research is to develop a better understanding of a phenomenon (Hair et al. 2009). To determine meaningful variables for the analysis, a thorough familiarization to the literature is necessary. Main concepts and theories of the relevant literature are examined in the theoretical part of this thesis in chapters two and three.

The main research question of this thesis is:

1. *How are marketing and R&D functions integrated in Finnish companies during NPD?*

To achieve the classification, the following sub-questions need to be answered:

2. *What are the roles of marketing and R&D in NPD?*
3. *What are the characteristics of the R&D/marketing interface?*
4. *What kinds of configurations of R&D and marketing are used in NPD of Finnish companies?*

To answer the main research question, the primary objective of this thesis is to develop a taxonomy description of different configurations of R&D/marketing interfaces during NPD in Finnish companies. First, a theoretical conceptualization of the R&D and marketing interface is developed. In order to build the taxonomy, theoretical constructs of the R&D/marketing interface are then recognized from the literature. Based on those constructs, a Likert-scale survey is built and distributed to Finnish companies that conduct NPD in-house. In chapter four, research methodology of this thesis is explained in detail, the conceptualization of the R&D/marketing interface is presented, and the domains and constructs of

R&D/marketing interface are summarized. Findings of the survey and cluster analysis are then presented in chapter five along with the final taxonomy description.

1.3. Literature review

NPD refers to the development of original products, product improvements, product modifications, and new brands through firm's R&D efforts (Kotler and Armstrong 2010). It is a major concern for organizations, because their survival often depends on their ability to develop new products and introduce them to market (Owens, 2007). Successful NPD process should lead to new products that support firm's strategic goals, making the best possible use of the resources and strategic competencies that are available (Nikolaos et al., 2004). The focus of NPD literature has shifted multiple times during its lifespan: the spotlight has been on the product (Henard & Szymanski, 2001; Decker and Scholz, 2010), development process (Cooper, 2009; Gerwin & Ferris, 2004) and the consumer (Hoffman et al., 2010).

Especially in large organizations, the need for cross-functional integration has been known for decades (Ansoff & Stewart, 1967; Lawrence & Lorsch, 1969). One of the most common ways to improve cross-functional cooperation especially during NPD project is to use cross-functional teams (Edmondson & Nembhard, 2009; Griffin & Hauser, 1992; Song et al., 1997). Other integration mechanisms include, for example, implementation of different kinds of management processes, power decentralization, physical relocation of people, and developing market-based reward structures (Garvin 1988; Griffin and Hauser, 1996; Hackman & Wageman, 1995; Menon et al., 1997).

Compared to other functional interfaces, R&D/marketing interface has received substantial attention in the literature (Bonett, 1986; Gupta & Wilemon, 1988b; Gupta & Wilemon, 1990; Millman, 1982; Moenaert & Souder, 1990; Monteleone 1986; Yao et al., 2014). According to both theoretical literature and empirical studies, a well-functioning R&D/marketing interface is of one of the most significant drivers of success in NPD projects (Brown & Eisenhardt, 1995; Griffin & Hauser, 1996; Henard

& Szymanski, 2001; Kahn and McDonough, 1997; Moenart et al., 1994; Song & Parry, 1997). The long lasting managerial and academic interest in the R&D/marketing integration has led to the development of multiple integration mechanisms for the interface (Crawford, 1983; McTawish, 1984; Moenaert & Souder, 1990; Weinrauch & Anderson, 1982).

Despite the interest of the many researchers, there is no multidimensional taxonomy that would describe different configurations of the interface. While this research aims to identify such archetypical interfaces, it also studies whether different configurations follow the expectations se by the literature by examining constructs that are identified in prior research.

1.4. Theoretical framework

Theoretical foundation for cross-functional integration that is used in this thesis is based on contingency theories. Contingency theorists argue that different companies have varying integration needs; cross-functional integration can only lead to increased performance when the integration requirements of a given company are met with right level of achieved integration.

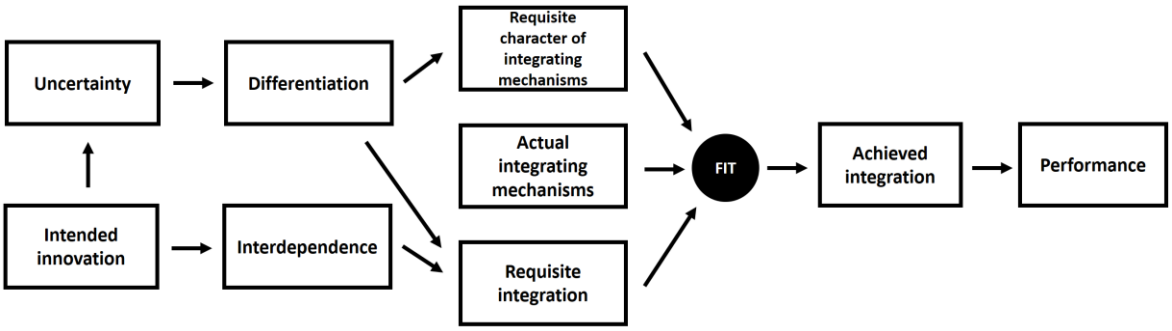

Figure 1: Theoretical framework (Modified from Donaldson, 2001)

In the model by Donaldson (2001), cross-functional integration is perceived from information processing viewpoint. According to the framework, level of intended innovation leads to differentiation and interdependence, which together dictate the requisite level of integration. The level of integration that is achieved is a result of

the fit between three factors: the requisite character of the integration mechanisms, the specific integration mechanisms that are used by the firm, and requisite integration. Finally, the achieved level of integration is directly associated with performance (Donaldson, 2001). This framework is also the conceptual basis of the specific model for R&D marketing interface (Gupta et al., 1986), which is also presented in this thesis.

1.5. Delimitations

This thesis studies NPD and integration as internal mechanisms within a company. There is also significant body of research on external relationships, such as industry level co-innovation (Lee et al., 2012; Romero & Molina, 2011) and customer involvement in NPD (Kaulio, 1998; Lagrosen, 2005), which are excluded from this paper. This thesis is based on the study of physical goods, not services. Still, even though there is a lot of specific research on new service development (Cowell, 1988; Edvardsson & Olsson, 1996), much of the information on this thesis is applicable to services as well. Similar to the approach of Brown and Eisenhardt (1995), this paper studies NPD and cross-functional integration on project level. This thesis mainly focuses on the R&D/marketing interface. Other interfaces of marketing such as the manufacturing/marketing interface (Chen et al, 1992), marketing/finance interface (Lim and Reid, 1992) and sales/marketing interface (Ernst et al., 2010) are not studied independently.

2. NEW PRODUCT DEVELOPMENT

This section provides a theoretical background of new product development (NPD). It aims to provide a basic understand of the mechanisms and challenges that arise from the literature. In this section, 8 theory-based stages of the NPD process are also identified, which are then used in the empirical part of this thesis to study the power balance of marketing and R&D in different clusters.

In many cases, the long-term viability of a business is dependent on the ability to develop new products and introduce them to market, which is why NPD is a major concern for many companies (Owens, 2007). According to Kotler and Armstrong (2010), NPD is defined as creation of new products or brands, and product improvements and modifications through firm's R&D efforts. In both business and engineering literature, product development is more broadly defined as "the transformation of a market opportunity and a set of assumptions about product technology into a product available for sale" (Krishnan & Ulrich, 2001). NPD literature and definitions around it are quite fragmented; NPD has long been an important topic for multiple disciplines including operations management, marketing, organizational theory, psychology, and strategy. Still, there is no unifying "theory of new product development". Instead, NPD related literature includes many topics, such as strategy, resource allocation, and cross-functional integration. For the purposes of this thesis, most important theoretical contributions come from marketing and operations management literature.

The development of new products is recognized as key basis of competitive advantage. Global competition and rapid developments in technology make continuous investments in NPD a compelling option for companies. (Gerwin & Ferris, 2004) In globalized economy, technological advances happen fast and product life cycles are often short. New product development helps companies to renew themselves, diversify their offering, and adapt to the ever-changing marketplace (Brown & Eisenhardt 1995). Due to these benefits, companies need to have a solid NPD strategy and focus on the future. Under such conditions, knowing

and understanding what drives successfulness of new products becomes increasingly important (Roenrich, 2004).

The literature on product development is varied and rich, yet fragmented, consisting of multiple theories, case studies, and managerial guidelines. Brown and Eisenhardt (1995) have developed a focal framework that is used to categorize project-level NPD research. Each of these streams evolves from one or two pioneering studies, on top of which other researchers have later cumulated more information (Brown and Eisenhardt, 1995). The framework divides the academic NPD literature into three separate research areas:

1. NPD as a rational plan,
2. NPD as a communication web, and
3. NPD as disciplined problem solving.

These main streams include overlapping themes and concepts, but the core research within each stream centers around particular aspects of NPD. Product development as a (1.) rational plan studies the indicators of financial performance within projects. It emphasizes that successful product development is a result of both thorough planning, and well-coordinated execution of the plan by cross-functional teams with support of senior management. (2.) The communication web research stream, on the other hand, concentrates on the nature and role of information, and effects of communication on project performance. Common areas of interest include the important actors and processes of information generation, dissemination, and sharing. The last stream of research, (3.) the disciplined problem solving, evolves from studies of Japanese product development practices. It mostly studies the operational outcomes and decision making processes. Within disciplined problem solving stream, NPD is seen as process of finding balance between four actors: more or less autonomous problem solving that is carried out by the project team, the discipline of their leader, strong top management, and product vision. (Brown and Eisenhardt, 1995) By combining insights from these three perspectives, it is possible to study how marketing and R&D personnel interact during the stages of NPD process and how that affects the final NPD project performance.

Ulrich and Eppinger (2008) divide product design and development projects into four main categories:

1. New product platforms,
2. Derivatives of existing product platforms,
3. Incremental improvements to existing products and
4. Fundamentally new products.

The first category is the most extensive of the four. Developing a (1.) new product platform includes undergoing a considerable project to create a novel product line that forms the foundation for a new product platform from which additional products can be launched. These products are usually launched to markets that are already familiar to the company (Meyer et al., 1997). Second type, (2.) derivatives of existing product platform projects, broaden an already established product family with new products. The goal of such project is also to target markets that are already familiar and established. (Ulrich & Eppinger 2008) An example of derivative product would be a new cost-reduced version of an existing product (Wheelwright & Clark, 1992). In projects that (3.) incrementally improve existing products, companies add or modify some features of their existing products in order to keep the products competitive and up to date. At the other end of the spectrum are (4.) fundamentally new product projects, where the goal is to develop entirely novel products or production technologies. Target markets can also be unfamiliar for the company. Such projects usually involve high risk, because they aim to archive long-term success with breakthrough products. (Ulrich & Eppinger 2008)

2.1. Process view of new product development

New product development process is ideally driven by the strategic goals of the firm, aligning company's NPD efforts with the underlying strategic needs of that company. (Hargadons, 2003) When successful, the NPD process should lead to new products that are in line with the strategic objectives of the company while utilizing the strategic competencies it possesses (Nikolaos et al., 2004). Balancing customer needs with firm's strategy and capabilities is not easy. Many companies that use a formal NPD process have adopted some form of so-called stage-gate models. Stage-gate models break the new product development process into predetermined stages (Barczak et al., 2009):

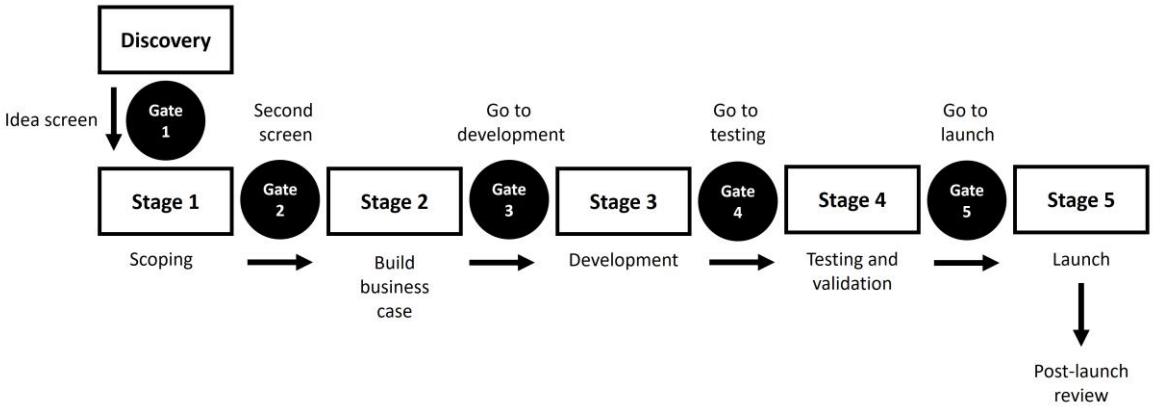

Figure 2: Stage-gate model (Cooper, 2009)

Companies tend to use different names for their own stage-gate models, and on paper the models may appear to be unique. In practice, however, they are very similar to each other and have many parallels. (Cooper, 1999) In essence, these process models are meant to help companies to focus on the process itself, and thereby help them to improve the outputs of the process. The work is done during the stages, and the gates are meant to ensure that the quality is sufficient (Cooper, 2009). A phase review is conducted in each stage gate in order to evaluate the successfulness of the previous stage. When the review is positive, the work continues in the next phase. In case there are unresolved issues, the work continues within the current phase until the gate is successfully passed (Cooper, 1999).

In one of the traditional widely quoted NPD processes, Kotler and Armstrong (2010) divide NPD projects to eight separate stages:

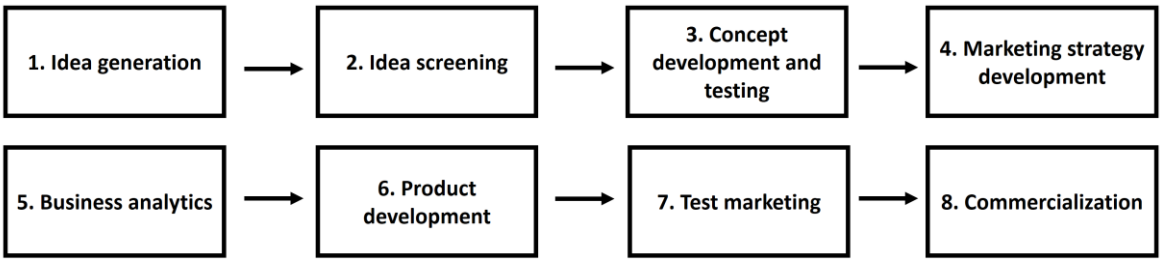

Figure 3: NPD Process (Kotler and Armstrong, 2010)

Because this process description is simple and universally understandable, it is also used in the questionnaire and empirical research of this thesis.

Researchers have also questioned the validity of NPD processes and stage-gate models. For example, Wind & Mahajan (1988) have called for a reexamination of the entire process, stating that despite the sophisticated new product development processes, the percentage of successful new product introductions has not improved significantly. Their findings indicate, that NPD process is inadequate for many challenges that modern organizations face (Wind & Mahajan, 1988). Gupta & Wilemon (1990) also suggest, that corporate NPD processes need reassessing. Models have also been criticized for being too rigid and linear (Peez & Louw, 2008). Despite the critique, formal NPD processes are still widely used in businesses. According to a study by PDMA, as many as 69% of companies use a formalized process in their NPD projects (Barczak et al., 2009).

2.2. Challenges in new product development

Many factors pose challenges to NPD projects. In his study on UK SME's, Owens (2007) mapped different reasons that cause delays in NPD:

1. Poor definition of product requirements,
2. Technological uncertainties,
3. Lack of senior management support,
4. Insufficient resources, and
5. Poor project management.

Most common issue that companies face is (1.) poor definition of product requirements (Owens, 2007). This finding highlights the importance of marketing during NPD process, because marketing can help R&D to better understand the customer requirements and market forces, thus generating better market driven definition of product requirements. Early involvement of marketing and other functional departments can lead to increased commitment and better product definition of product requirements (Cooper, 2001). (2.) Technological uncertainties are also a common cause of product delays. Implementing new technological improvements mid-way of the NPD process can severely delay the project (Owens, 2007). (3.) Senior management needs to understand the importance of NPD. If the set expectations are unrealistic and the staff feels like the management is not aware of their challenges, it can seriously hinder NPD success. It is also important, that NPD has (4.) sufficient resources committed to their work. This is closely related to senior managements understanding of NPD. Finally, (5.) poor project management was found to cause development delays. On the other hand, some respondents expressed resistance to formal management practices. (Owens, 2007)

Main problems recognized in the study also include the management style, organizational structure, poor attention of detail, lack of support for innovation, poor strategic thinking, and limited manufacturing capabilities. The findings are similar to those of Gupta & Wilemon (1990), whose research revealed multiple critical factors

that lead to delays and failures in NPD projects. They divide the challenges into four groups:

Reasons to Accelerate Product Development • Increased Competition (42%) • Rapid Technological Changes (29%) • Market Demands (11%) • To Meet Growth Objectives (11%) • Shortening of Product Life Cycle (8%) • Senior Management Pressure (8%) • Emergence of New Markets (5%)	**Reasons for Product Development Delays** • Poor Definition of Product Requirements (71 %) • Technological Uncertainty (58%) • Lack of Senior Management Support (42%) • Lack of Resources (42%) • Poor Project Management (29%) • Other (20%)
Team Members' Major Concerns During the NPD Process • Management Style (53%) • Lack of Attention to Details (47%) • Limited Support for Innovation (32%) • Lack of Strategic Thinking (18%) • Poor Manufacturing Facilities (16%)	**How Functional Groups Delay the NPD Process** • Failure to Give NPD Program Priority (58%) • Continually Changing Requirements (58%) • Poor Intergroup Relations (34%) • Slow Response (26%)

Figure 4: NPD process assessments *(Gupta & Wilemon, 1990, p.29)*

New product development is complex by nature. When NPD projects face problems such as delays or overrun budgets, complexity is often directly linked to the experienced issues. Sources of complexities can include organizational, intraorganizational and technological factors. Multidisciplinary nature of the NPD process, which is discussed in more detail in the third and fourth chapters of this paper, is one common source of complexities. In order to successfully manage NPD, it is necessary to assess the complexity of specific projects. In order to do so, it is important to understand the origins of complexity and prepare accordingly. (Kim & Wilemon, 2003)

Kim & Wilemon (2003) recognize six major sources of complexities:

1. Technological complexities,
2. Market complexities,
3. Development complexities,
4. Marketing complexities,
5. Organizational complexities, and
6. Intraorganizational complexities.

Uncertainties around (1.) technologies and technological approaches are among the most common sources of complexity (Kim & Wilemon, 2003). As Owens (2007) points out, lack of understanding of new technologies can severely delay NPD projects. Demands and expectations of the customers are changing faster than ever, which is why (2.) market complexities or environmental complexities pose serious challenges to NPD. Lawrence & Lorsch (1968), were among the first to note the importance of environmental complexities and propose that improved interfunctional integration could be the solution to the issue. (3.) Development complexities are the complications in the R&D process itself. (4.) Marketing complexities are most relevant, when a new product is developed to meet the needs of unfamiliar markets. In those cases, companies and marketing departments face marketing novelty, involving market study and consumer tests. (Kim & Wilemon, 2003) (5.) Organizational complexities become especially important to take into consideration during cross-functional NPD, where different organizational functions work together. Different kinds of organizational structures and integration mechanisms are needed in different kinds of situations. Lastly, (6) intraorganizational complexities include issues such as interdependency problems, conflicts, communication problems and finding the right degree of formality. (Kim & Wilemon, 2003)

Marketing and R&D personnel often have significant perceptual gaps and contrasting perspectives on the complexities that are involved in a given NPD project. Kim & Wilemon (2003) state that complexity in a NPD process cannot be effectively resolved until all participants understand and share the challenges of the

project. Different participants need to understand the difficulties of each functional group and appreciate the interrelationships among complexity sources (Kim & Wilemon, 2003). Marketing and R&D personnel are likely to have to deal with every above-mentioned source of complexity during NPD projects. These issues will most likely arise in most development projects, and it is important for organizations to recognize them and be prepared to deal with them. In order to accomplish that, companies need to have functioning structures and working style that encourages cooperation and open exchange of information.

2.3. Roles of marketing and R&D in NPD

The roles of marketing and R&D vary greatly depending on the industry and individual company. Even though the transformation towards cross-functional coordination has been visible for a long time, many companies still make clear distinctions between their marketing and R&D departments. This thesis is written from the point-of-view of marketing. Marketing literature tends to have a somewhat polarized perspective on R&D compared to technical fields. For example, Kotler (2003) colorfully states that "R&D is staffed with scientists and technicians who pride themselves on scientific curiosity and detachment, like to work on challenging technical problems without much concern for immediate sales payoffs, and prefer to work without much supervision or accountability. - - Marketers see the R&D people as maximizing technical qualities rather than designing for customer requirements. R&D people see marketers as gimmick-oriented hucksters who are more interested in sales than in the product's technical features." The goal of this chapter is to study the roles of R&D and marketing functions during NPD process. Understanding what is expected from each function is beneficial to understanding what causes issues when the departments work together.

Traditionally, R&D used to be a stand-alone function, that performed company's technological activities and was often perceived as an unstructured creative process, that was hard if not impossible to manage and control. The growing multi-disciplinarily of technological innovation and the need to specialize due to fast

technological developments have made R&D an inter-organizational group-effort that is executed in diverse networks consisting of different kinds of firms backed by universities and research institutions. (Groen et al., 2002) Due to complexity and industry specific knowledge, measuring the productivity and performance of an R&D organization can be extremely tricky (Pappas & Remer, 1985).

Research and development can be divided into five categories (Pappas & Remer 1985):

1. Basic research,
2. Exploratory research,
3. Applied research,
4. Development, and
5. Product improvement

Basic research, exploratory research, and applied research are traditionally mainly carried out by universities and research institutes. Companies, on the other hand, tend to be mostly concerned with development and product improvement projects, which is also the focus of this thesis.

Marketing provides multiple contributions to NPD (Cooper, 1990; Griffin et al., 2013):

1. Improving the understanding about the customer's needs,
2. Empowering the social network as a source of innovation,
3. Moving innovation towards a total solution perspective,
4. Strategic orientation of NPD, and
5. Cross-functional communication and collaboration.

American Marketing Association (2004) defines marketing research as "the function that links the consumer, customer, and public to the marketer through information -- information used to identify and define marketing opportunities and problems; generate, refine, and evaluate marketing actions; monitor marketing performance; and improve understanding of marketing as a process. Marketing research specifies

the information required to address these issues, designs the method for collecting information, manages and implements the data collection process, analyzes the results, and communicates the findings and their implications.“ To sum up, the main role and responsibility of marketing is to make sure that the product that is developed is fitting to the market and provides maximal value to the company and its customers. Interestingly, marketing is also often perceived to be responsible for cross-functional collaboration.

In the end, marketing and R&D work towards similar goals when it comes to NPD: they attempt to create change trough new products and new technologies. The key difference is, that R&D is usually focused on and new products. Their incentives often reflect that, as they are mostly rewarded based on product attributes. Marketing, on the other hand, is more interested and in creating and maintaining market opportunities and keeping the customers satisfied. Accordingly, their reward mechanisms tend to be based on market attributes. (Song et al., 1997) If the reward mechanisms and areas of focus are so different, how should these functions be integrated and work together towards common goals?

3. R&D/MARKETING INTERFACE

The need for interorganizational integration has been identified a long time ago, and multiple methods can be used to leverage cooperation between different organizational departments. Cross-functional relationships of marketing have been in the spotlight and received special attention from researchers. Out of all marketing's relationships, the impact of R&D/Marketing interface has been studied significantly more than, for example, the marketing-production interface or the R&D production interface (Moenart et al., 1994). Numerous authors have studied the impact that the interface has on commercial success of products. In many organizations, R&D and marketing share common responsibilities in multiple areas during NPD. For example, they are both expected to participate into setting goals and finding opportunities for future products. It is often necessary to resolve tradeoffs between engineering design and customers' needs, which also requires input and mutual responsibility from both functions. (Griffin & Hauser, 1996)

A new product development process is successful, when a novel technical solution meets the needs of the market. R&D/marketing interface is crucially important in achieving that, because marketing is responsible of representing the customer within the firm (Griffin & Hauser, 1996), whereas R&D works to combine available resources and technological knowledge to create competitive new products (Day & Wensley, 1988). Major issues in the cooperation are related to communication and information flow in general. For example, Gupta et al. (1985) found out that poor communication is the biggest barrier that prevents companies from achieving integration between marketing and R&D departments. Early research on the interface, which is mostly written from marketing's perspective, focuses on the one-way transfer of market information from marketing department to the technical staff. Recent studies have shifted away from marketing-centric view and adopted more holistic a view on communication and transfer of knowledge. The change is merited by empirical data, because a deeper cross-functional relationship has been found to increase new product performance compared to simple information flow between the two departments. (Kahn & McDonough, 1997) Before diving deeper into R&D/marketing interface literature, this thesis provides a review of the general

cross-functional integration literature, which is also the foundation of most studies that specifically focus on the R&D/marketing interface.

3.1. Cross-functional integration

The literature is filled with different terms, such as coordination, cooperation, and collaboration, that are used to convey the basic message of integration between different functional areas. Integration can be defined in terms of accomplishing a "unity of effort" between different organizational subsystems. (Lawrence & Lorsch, 1969) Moreover, integration can be perceived as a process, but also as an outcome; it is a process of reaching effective cooperation and the outcome in the form of changes in information sharing, communication between individuals, coordination, and level of cooperation and joint involvement. (Song et al., 1997) For the empirical part of this thesis, a broad conceptualization of integration by Leenders & Wierenga (2002), will be used: “Integration (is the) degree to which there is a communication, collaboration, and a cooperative relationship between marketing and R&D.”

Teamwork and effective integration in NPD are more important than ever. Knowledge evolves rapidly and short product life cycles create pressure to get the product to the market as fast as possible (Edmondson & Nembhard, 2009). R&D personnel struggle with evolving demands of knowledge and expertise, whereas time-to-market is traditionally more of a headache for marketing. However, cross-functional integration causes definitive functional boarders to lose meaning. Marketing, for example, as an independent function could become less important, because other departments become equally focused on delivering customer value. NPD becomes a team effort where the shared goal should be to deliver the most suitable products to the right customers at the right time.

Due to jargon and vast amount of field-specific knowledge, it can be hard to follow emerging technological fields. Most highly specialized professionals can find themselves in need of collaboration to carry out development projects. A traditional approach where managers plan every step of the NPD project might be too slow

and clumsy. Instead, simultaneous cooperation on tasks that are related can be collaboratively coordinated. Nowadays new product development is a flexible cross-functional process, where teams can easily outperform structured functional organizations. (Edmondson & Nembhard, 2009)

Modern organizations widely depend on teams in an attempt to improve product quality, productivity, and working environment (Guzzo et al., 1995). Cross-functional teams usually include members from varying backgrounds including for example marketing, engineering, purchasing and production. Such teams have an easy access to information derived not from only from their own functional areas, but also from extended personal networks. (Edmondson & Nembhard, 2009) Cross-functional integration encourages horizontal communication, but might also make the team to turn inward looking, (Griffin & Hauser, 1992) which can hinder the team's performance. The fact that teams have become such a prevalent way of conducting new product development and increase performance leads to questions surrounding the composition of teams in order to maximize the new product success. (Henard & Syzmanski, 2001) Many researchers (e.g. Menon et al., 1997) agree that communication between different departments is among the most important drivers behind product innovation and introduction of new products to the market. It is therefore imperative for companies to understand the functional dependency between marketing, R&D and product development teams.

Benefits of cross functional integration seem undeniable. However, Turkulainen & Ketokivi (2012) point out that despite positive connotations, how exactly cross-functional integration improves performance is not yet adequately understood: "Research on integration is voluminous, but at the same time, empirical results are inconclusive and at times, contradictory." Furthermore, Swink (1999) argues that the need of interfunctional integration and the benefits that can be reaped from it vary between organizations, even within the NPD context. Is cross-functional integration beneficial in all new product development projects?

3.1.1. Contingency theory

Contingency theory is one of most common ways of studying companies, their structures, and strategies. Contingency theory sees a company as an “information-processing network”. In companies, organizational design is used to search the balance between the information-processing requirements and capabilities of the firm (Galbraith 1977). Contingency theory is tightly linked with organizational design. According to Galbraith (1977), organizational design can be perceived as the “search for coherence between strategy, organizing mode, integrating individuals, and designing a reward system.” Contingency theorists argue, that integration mechanisms are a result of strategic interdependence and interfunctional collaboration within the organization (Kumar & Seth, 1998). Structural contingency theorists (e.g. Donaldson, 2001) generally divide integration into three dimensions:

1. Achieved integration,
2. Integration mechanisms, and
3. Requisite integration

The level of (1.) integration that is achieved is the actual state of affairs between different functions, and is related to the idea of organizational conflict: Organizational tasks and environments vary between different functions. Each department has an organizational sub-environment, and information that is specific to that sub-environment. Integration mechanisms are management’s tools that are used to achieve organizational integration. (Lawrence & Lorsch, 1967) (2.) Integration mechanisms generally increase the information processing within an organization by two primary mechanisms: They enable the processing of more information, and increase the richness of that information. (Galbraith, 1973) The last dimension, (3.) requisite integration basically means the perceived need of integration within an organization (Lawrence & Lorsch, 1967). The following conceptual framework of Donaldson (2001) captures the main ideas of contingency theories:

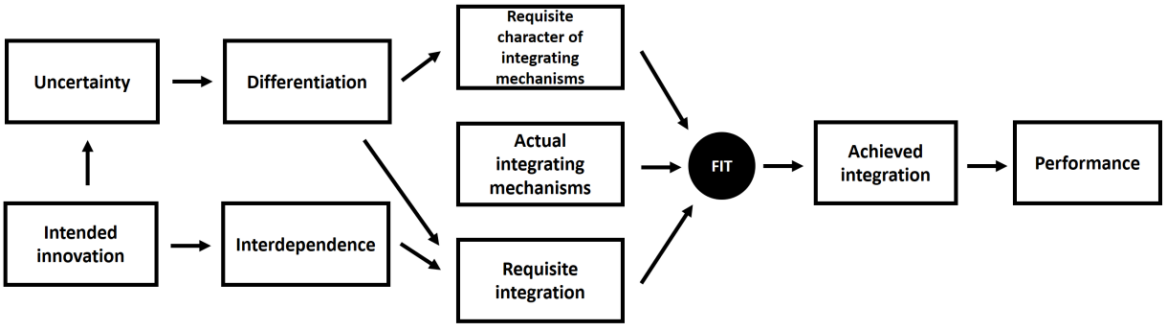

Figure 5. Concluding framework (Modified from Donaldson, 2001)

The framework distinguishes between requisite character of integration mechanisms, actual integration mechanisms, requisite (i.e. required) integration and achieved (i.e. actual) integration. The contingency is the intended level of innovation that organizational structure needs to fit in its differentiation and integration (Donaldson, 2001). According to the framework, differentiation and interdependence are the results of the level of intended innovation. Together, they lead to requisite integration. Achieved integration is a result of the fit between the requisite character of integration mechanisms, actual integration mechanisms, and requisite integration. Finally, the achieved level of integration is directly associated with performance. In general, the model hints that centralized structures that use planning and formal procedures are most effective for low level of innovation, whereas a decentralized structure that encourages participation works best for high level of innovation. (Donaldson, 2001) This framework has been used as the basis of research on top of which the conceptualization of the R&D/marketing interface presented in the empirical part of this thesis is built.

3.2. Integration of R&D and marketing

Integration is market information and technological capabilities is crucial, which is why the interface of R&D and marketing has been studied more extensively than other functional interfaces (Griffin & Hauser, 1998; Souder et al., 1988). The evidence from prior studies suggests that integration of marketing and R&D improves NPD and leads to better results during different stages of product development, commercialization, and overall project successfulness (Griffin &

Hauser, 1998; Song & Parry, 1993; Souder et al., 1988). Different perspectives on key issues can create conflicts between R&D and marketing thus hindering performance. At the very least, conflicts can make the effective integration of R&D and marketing more difficult, and in worst cases, they migh even contribute to business failures (Fisher et al., 1997). In their study, Krishnan & Ulrich (2001) compare perspectives between marketing, organizations, engineering design, and operations management research communities. For the purposes of this study, it is useful to compare the viewpoints of marketing and engineering design:

Table 1: Perspectives of the academic communities (Modified from Krishnan & Ulrich, 2001)

	Marketing	Engineering Design
Perspective on product	A product is a bundle of attributes	A product is a complex assembly of interacting components
Typical performance metrics	Market fit, Market Share, Consumer utility, Profits	“Form and function”, Technical performance, Innovativeness, Direct cost
Dominant representational paradigm	Customer utility as a function of product attributes.	Geometric models. Parametric models of technical performance.
Example decision variables	Product attribute levels, price	Product size, shape, configuration, function, dimensions
Critical success factors	Product positioning and pricing, collecting and meeting customer needs	Creative concept and configuration, performance optimization

These differences in perspectives can also be reflected to companies, and they can certainly lead to conflicts and misunderstandings. It is important, that these differences are understood and discussed within teams and especially the R&D/marketing interface. Both can be equally important in successful products; if

the new product is perfectly positioned for the market, but lacks in technical performance, it will almost certainly not achieve long-lasting success. Griffin & Hauser (1996) summarize differing orientations of marketing and R&D from prior studies:

Table 2: Differences between Marketing & R&D (Griffin & Hauser, 1996)

	Marketing	R&D
Time Orientation	Short	Long
Preferred projects	Incremental	Advanced
Tolerance of ambiguity	High	Low
Departmental structure	Medium	Low
Bureaucratic orientation	Medium	Low
Orientation to others	Permissive	Permissive
Professional orientation	Market	Science
Professional orientation	Less	More

In general, compared to marketing, R&D personnel favor innovations that are technologically advanced or radical. They also usually have longer time horizon and more and are oriented more scientifically. Marketing personnel, on the other hand, often favor incremental innovations over those that take long time to finish, tend to have a short time horizon and are more market than science oriented. (Souder, 1987) In the last 10 years, some of these orientation might have shifted, and there might also be differences between different countries and cultures (i.e. Garrett et al., 2006). Nonetheless, they offer a useful snapshot and starting point to thinking about different perspectives that traditional marketing and R&D personnel face when working together. These differences in personal orientations are used as descriptive variables for the cluster analysis in the empirical part of this thesis.

Even though Emerson noted already in 1962, that a high level of interdependence between marketing and R&D is critical in tasks related to both marketing and R&D, the definitive connection between the quality of R&D/marketing interface and product performance is somewhat unclear. (Wang & Montaguti, 2002) The need of integration becomes increasingly important in novel and complex projects, such as development of new product platforms. Studies have shown that in general, the more innovative the NPD project, the more R&D/marketing integration is required (Olson et al., 1995). That is also implied contingency theory, on top of which Gupta et al. (1986) developed a model specifically design to represent the R&D/marketing interface.

3.3. Theoretical model of R&D/marketing interface

Contingency theorists pointed out already in the 70's, that organizational strategy and environmental uncertainty determine the amount of coordination that is needed. (Galbraith, 1973) The following framework by Gupta et al. (1986) is the most used model in the literature to study the R&D/marketing interface:

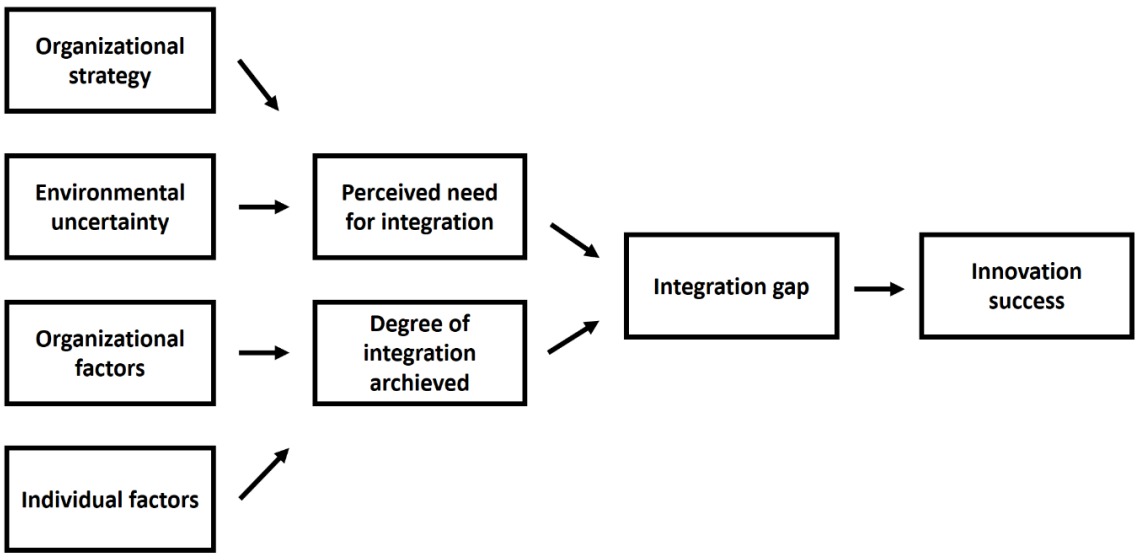

Figure. 6. Model of the marketing/R&D interface (Gupta, et al., 1986)

The model of Gupta et al., (1986) shares clear similarities to the concluding framework by Donaldson (2001), which was presented in chapter 3.1. The main proposition of the model is that strategy and environmental uncertainty influence the perceived need of integration. Organizational factors such as organizational design and senior management support, and individual factors such as sociocultural differences, both affect the level of integration that is achieved. The diffrence between the level of integration needed and the degree of integration achieved directly influences the successfulness of innovation. (Gupta, et al., 1986) In the model, R&D/marketing interface is considered to be an information processing sub system of the organization, and its main goal is to decrease customer uncertainty, market uncertainty, and technological uncertainty in the new product development process. (Moenart & Souder, 1990)

3.3.1. Perceived need for integration

Organizational strategy and perceived environmental uncertainty determine organizations need for integration. Gupta et al. (1986) propose, that the required degree of integration correlates with the strategy of the company: more aggressive the strategy, more R&D/marketing integration is required. For example, if the company wants to be the first one to enter new markets with new products, it will most likely need more integration between marketing and R&D. Similarly, the need for integration declines as the company shifts from active opportunity-seeking towards more reactive strategy. (Gupta et al., 1986)

Like organizational strategy, environmental uncertainty also affects the need for R&D/marketing integration. It refers to the degree of predictability of competitors, consumers' actions, and technological developments. Gupta et al. (1986) suggest that as environmental uncertainty rises, the perceived need for integration in NPD projects also increases. During NPD projects, companies have to make many decisions that are dependent on their competitors' and customers' actions, and technological developments. The more prominent the changes, the more challenging these decisions became. (Gupta, et al., 1986) Since the early studies

regarding NPD, the increased global competition has led to a business environment where companies must remain constantly innovative in order to stay on top of their game. Companies that are fastest to react and adapt will be most successful.

3.3.2. Degree of achieved integration

Individual factors and organizational factors such as organizational structure and the role of senior management should determine the final degree of achieved integration. The degree of achieved integration can be increased by informalizing the NPD process, decentralizing power within the organization and increasing employee participation in product-related decision-making. At the same time, management practices can increase integration. For example, senior management that encourages risk-taking and recognizes the need for R&D/marketing integration naturally enables employees to work together. Early and continuous joint involvement is important factor that leads to increased integration. It is supported by reward systems, which should be based on new product success, harmonizing the goals that marketing and R&D work towards. (Gupta, et al., 1986)

Individual factors refer to sociocultural differences between individuals. Similar professional/bureaucratic orientation between R&D and marketing managers, compatible tolerance for ambiguity, similar perspectives on time, and preference towards similar types of projects increase the integration that can be achieved. (Gupta, et al., 1986) As discussed earlier, the study about the perspectives of academic communities by Krishan & Ulrich (2001) showed, that there are often major differences in perspectives of engineering design and marketing professionals. Those differences can easily lead to conflicts. In order to increase the integration between marketing and R&D, the differences must be discussed and conflicts resolved as they emerge. If the issues are left unresolved, it becomes increasingly hard to find common grounds and work towards same objectives. Studies have also linked the achieved level of R&D/marketing integration to so-called organizational climate. For example, Souder (1981) reported that NPD

success was highest when R&D-marketing interface reflected communal trust, respect, and joint-commitment.

3.3.3. Integration gap and innovation success

Key conclusion that can be drawn from the model of Gupta et al. (1985), is that as the gap between the degree of integration that is required and the degree of integration that is achieved widens, the probability of innovation success diminishes. Therefore, the model suggests that in order to improve the probability of NPD success, the integration gap should be minimized. (Gupta, et al., 1986) If achieved level of integration is lower than the required amount of integration, uncertainty does not decrease sufficiently, which compromises the successfulness of the NPD project. In practical terms, information sharing remains at sub-optimal level, which leads to both technical and market uncertainties.

Model does not propose that integration would always lead to better performance itself. Unnecessary integration would lead to a mismatch between the perceived need for integration and actual level of integration achieved, which could lead to unnecessary conflicts and delays. Griffin & Hauser (1996) point out, that with too much integration, team members might lose sight of their functional tasks due to irrelevant information flow. The R&D/marketing interface must be managed in a way that minimizes the gap between ideal and achieved levels of integration. It is therefore important to try out different integration mechanisms and find out what works in any given conditions. Management should understand how to manage integration and find the right balance between different functions.

3.4. Improving the R&D/marketing interface

Marketing and R&D have grown apart in many organization (Gupta et al., 1986). Personality differences, function-specific jargon, different organizational responsibilities, and different reward systems create further barriers between the functions, which can lead to conflicts and hinder cooperation during the NPD process. Interfunctional conflicts arise from perceived differences in goals and orientations of independent functions that interact together (Xie et al., 1998) These underlying differences can lead to different kinds of conflicts within organization, teams and individuals. In order to figure out how to improve the R&D marketing interface, it is essential to understand what kind of underlying conflicts are likely to emerge. Conflicts between marketing and engineers slow the new product development down and decrease the successfulness of projects (Gupta & Wilemon, 1986; Song & Thieme, 2006). Ruekert & Walker (1987) studied common conflicts between marketing and R&D personnel. In the study, marketing experienced the following causes of conflict:

1. Lack of customer orientation from the R&D personnel,
2. Too slow reaction to changes in the marketplace by R&D staff,
3. Technical staff's failure to provide support for marketing, and
4. Unclear definition of departmental goals, objectives and functional responsibilities.

At the same time, the same list from the perspective of R&D personnel's looks as follows:

1. Marketing personnel are too quick in their response to the marketplace,
2. Marketing department's inability to provide technical staff with needed support, and
3. Unclear definition of departmental goals, objectives, and functional responsibilities.

Even though these results cannot be widely generalized, they provide interesting insight into the interaction and conflicts between marketing and R&D. The areas of conflict are clearly the opposites of one another, which suggests they have risen from underlying differences in perspectives and habits. Functions that are clearly separated don't share common perspectives and goals. As suggested by contingency theory, different integration mechanisms should be used depending on organizations strategy and levels of external uncertainty. According to Jehn & Mannix (2001), cross-functional conflicts can be divided into groups as follows:

1. Task conflicts,
2. Relationship conflicts, and
3. Process conflicts.

Task and process conflicts are external, whereas relationship conflicts tend to be more personal. Still, task conflicts often share similarities to relationship conflicts. Jehn (1995) makes a distinction between different conflict types: task conflict is a perceived disagreement of individuals about the contents of their decisions. It can develop from different viewpoints, opinions and orientations. Relationship conflict, on the other hand, is perceived animosity between personalities. It typically leads to personal tension between individuals. The last conflict type, process conflict, is defined "an awareness of controversies about aspects of how task accomplishment will proceed" (Jehn & Mannix, 2001). All three conflict types recognized by Jehn & Mannix (1991) are also present in the findings of Weinrauch & Anderson (1982), who explicitly studied the conflicts between marketing and R&D.

The most basic source of conflict between R&D and marketing seems to be differences in tasks, goals, and objectives. These differences can lead to arguments and escalate into conflicts. Some researchers have suggested, that R&D should become more marketing oriented or multidisciplinary in order to narrow down the differences, whereas others argue that the diffusement of the functional tasks could by itself lead to further conflicts. Weinrauch & Anderson (1982) note, that conflicts between R&D and marketing often arise from polarization of behavior. More precisely, they refer to the fundamental difference that marketing usually prefers

customized products whereas engineers usually tend to favor standardization. Other sources conflicts include stereotyping, overestimation of the level of competition and environmental turbulence, and failing to understand the difference in organization between the functions. (Weinrauch & Anderson, 1982)

According to Xie et al. (1998), conflict resolution methods identified in conflict management studies include:

1. Avoidance,
2. Accommodation
3. Competition,
4. Collaboration,
5. Compromise, and
6. Hierarchical resolution.

Conflict and its effect on performance has been widely studied. Different resolution methods seem to work differently in different environments and organizations. The empirical work by Xie et al. (1998) hints, that even though interfunctional conflict can lead to decreased successfulness of new products, it is not always the case. In fact, conflict can also be beneficial if dealt with appropriately. Different conflict resolution methods are not equally effective or useful either. (1) Avoidance refers to an approach, where conflicts are avoided rather than confronted. For example, the lack of debate and critical assessment between marketing and R&D can lead to waste of resources on impractical solutions. In (2.) accommodation, one function submits to the wishes of the other, which can lead to one sided decisions and lack of real collaboration. Both of these approaches are passive ways of dealing with conflict. They can be harmful to NPD and lead to increased tension within individuals. Third method, (3.) competition refers to the use of power regardless of the wishes of the counterparty. There is countering evidence when it comes to competition as a conflict resolution method, because even though it can leave one party with no say to important matters, it can also lead to efficient decision making under a lot of pressure. None of these three resolution mechanisms facilitate integration, and are usually perceived to be negative. (Xie et al., 1998)

In (4.) collaboration, individual work together towards a solution that is desirable to both parties. Collaboration facilitates cross functional learning, harmony, and integration of diverse skills, resources, and perspectives. On the other hand, the quest for harmony can often be time consuming. (5.) Compromise refers to the settlement at an intermediate point between the preferred positions of opposing views. Even though it can be less time consuming than real collaboration, compromise could lead to receded innovativeness and be less likely to lead to breakthroughs. Finally, in (6) hierarchical resolution, opposing parties appeal to a joint superior when they are unable to resolve disagreements themselves. It can be time consuming for the top management, and effectively silence valid perspectives. (Xie et al., 1998)

All in all, the lesson seems to be, that conflicts are bound to arise during any kind of teamwork. They cannot be completely avoided. It is, however, important to acknowledge the existence and sources of conflict, detect them early, and resolve them before they can seriously damage working environment and hinder efficiency. Teams should therefore attempt to address their conflicts early, and team leaders should pay attention the work environment and encourage individuals to resolve their conflicts.

3.5. Integration mechanisms

This section studies the concrete integration mechanisms that teams and management can use to achieve much-needed integration of marketing and R&D. Several studies (e.g., Gupta et al., 1986; Song & Parry, 1993) have shown that effective R&D/marketing interface is usually has the following characteristics:

1. Little formalization,
2. Selective decentralization,
3. Mutual adjustment as a coordinating mechanism, and
4. Distributed decision making

To achieve these goals, companies can use different kinds of integration mechanisms. Griffin & Hauser (1996) distinguish mechanisms from previous research that are used to integrate marketing and R&D during NPD:

1. Relocation and physical facilities design,
2. Personnel movement,
3. Informal social systems,
4. Organizational structure,
5. Incentives and rewards, and
6. Formal integrative management processes.

Different approaches work in different situations. The goal of (1.) relocation and physical facilities design is to reduce the distance between marketing and R&D functions, which increases communication and enables better information transfer between the functions (Griffin & Hauser, 1996). Even though physical relocation can lead to successful outcomes, other means to encourage communication and foster cross-functional relationships are also needed to spark real integration (Souder & William, 1987). (2.) Personnel movement or job rotation essentially has a similar goal to facilities redesign. Working in the same space reduces differences in though worlds between people from different functional backgrounds. (Griffin and Hauser, 1996) Job rotation increases interaction and leads to better integration trough

continuous information flows (Moenart et al., 1994). (3.) Informal social systems are born from informal group events and activities. They create breeding ground for information transfer and new ideas, and help people to keep in touch and learn about the expertise and skills of each other's. Multiple studies have also shown that important product decisions are often done informally instead of formal NPD processes. (Griffin & Hauser, 1996)

Similarly, (4.) informal organizational structures such as cross-functional teams have been found to be most effective way to organize R&D and marketing in many situations. At the same time, there is evidence to support that formalization is also needed – clear performance standards and responsibilities help teams to work more effectively. (Gupta & Wilemon, 1988) Even within teams, (5.) incentives and rewards are needed to encourage specific behaviors and motivate people to work towards common objectives. Equal market oriented reward systems between marketing and R&D contribute to better integration. Finally, companies use (6.) formal integrative management processes such as the stage-gate model by Cooper (2001) as a way to improve processes by defining what tasks are completed when and by who. (Griffin and Hauser, 1996) In a way, formal management processes can seem counter-intuitive in team work, but they can help to clarify what is expected and when from the team. Technology based integration tools have also emerged and gained popularity among organizations and teams. These include different kinds of software solutions that are designed to improve communication and project management.

Formal processes might suit some organizations, whereas others might want to let teams lead themselves and figure out what works best. All the mechanisms above are used as descriptive variables in the empirical part of this thesis to see, how they are used in different companies.

4. EMPIRICAL RESEARCH

The goal of this research is to study the integration of marketing and R&D during new product development in Finnish companies. More specifically, the aim is to achieve an archetypical classification of R&D/marketing interfaces by using cluster analysis together with a taxonomic research approach. This is achieved by conducting a survey with respondents from different kinds of companies with in-house product development. As such, this study can be classified as exploratory research with quantitative data collection.

4.1. Research methodology

In general, taxonomy is a form of classification scheme used to group related things together. More specifically, it is an empirical classification of objects based on their characteristics, that is achieved by the application of different kinds of grouping methods. (Hair et al., 2009) It is used to classify complex problems to a set of conceptual domains and dimensions (Patton, 2002). Numerical taxonomy is applicable to many classification problems in marketing research, because it can clarify multidimensional issues (Frank & Green, 1968). It can therefore provide new insight into the interface of R&D and marketing across different companies. To reach the taxonomy description, cluster analysis is used as a descriptive method for gauging the similarities of objects in a sample (Romesburg, 2004).

Cluster analysis is an umbrella term for multiple mathematical grouping methods (Romesburg, 2004). It is most commonly used as a classification tool to separate subjects into groups in which each subject is more similar to others in the same group than to those that are outside that group (Hair et al., 2009). In general, it is a useful way to simplify complex phenomena into easily approachable groupings. Cluster analysis is traditionally used in marketing research to develop groupings of persons or products. These classifications help companies to make better decisions, and can serve as the groundwork for further analysis (Punj & Stewart, 1983). In this

thesis, cluster analysis is used for taxonomy description of the R&D/marketing interface.

It is important to take into account, that as a descriptive and explorative research method, cluster analysis is atheoretrical and non-inferential. Therefore, there is no statistical basis on top of which to draw conclusions from the sample to the larger population. In general, cluster analysis will always yield a result, which is why researchers must not assume the existence of structures within the data based on the analysis. Strong conceptual support and validation are needed to show the relevance and meaningfulness of the clusters. (Hair et al., 2009)

Conducting a cluster analysis includes the following stages:

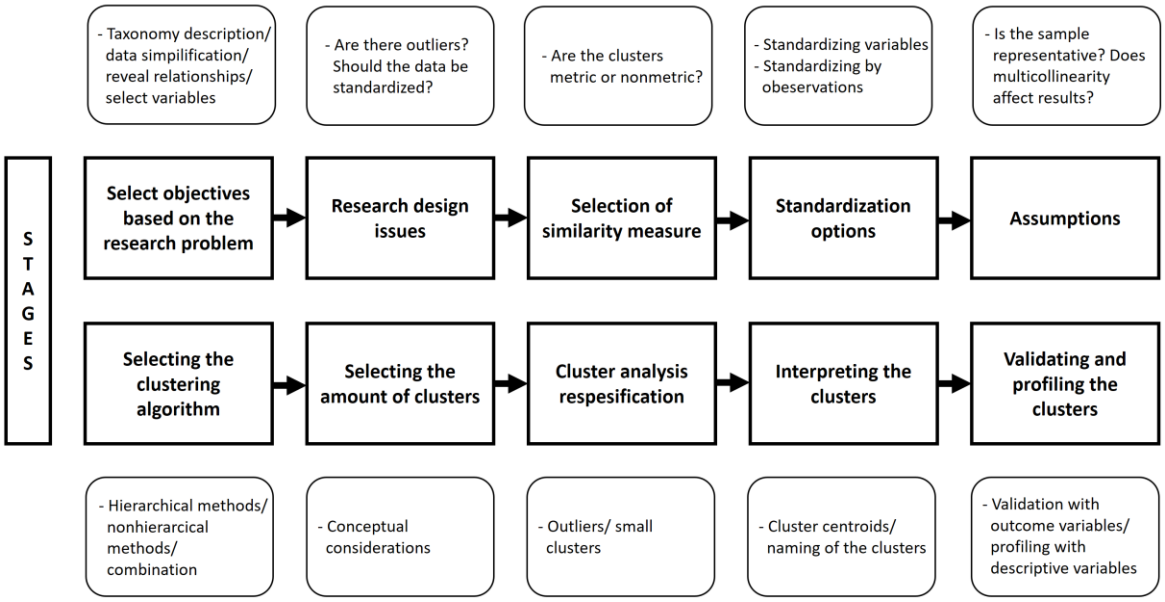

Figure 7: Cluster analysis decision process (Modified from Hair et al., 2009)

The design of cluster analysis includes data partitioning and selection of clustering algorithm, interpreting the clusters to understand their characteristics, naming or labeling the clusters based on those characteristics, and validating the results of final cluster solution (Hair et al., 2009). First five steps of the process are selection of objectives, research design issues, selection of similarity measures, standardization, and assumptions. The objective of cluster analysis in this thesis is taxonomy description. For this purpose, a structured five point Likert scale

questionnaire was created and submitted to appropriate respondents. As all of the clustering variables are already on the same scale from one to five, and the data is in metric form, there is no further need to standardize the variables. Companies that were approached with the questionnaire are from multiple industries and from companies of varying sizes, which should guarantee a representative sample for studying the phenomena at hand. The data gathering is described in greater detail in chapter 5.4. of this thesis. The latter 5 stages of the clustering process are explained in the following chapters.

4.1.1. Clustering method

There is a large amount of different clustering algorithms, and new ones are still being developed and refined. Different algorithms are most commonly divided to hierarchical and nonhierarchical algorithms. Hierarchical algorithms consist of a series of n – 1 clustering decisions that combine observations into a treelike structure, whereas nonhierarchical procedures do not involve the treelike construction process. Instead, nonhierarchical methods assign objects into clusters once the researcher defines the number of clusters. (Hair et al., 2009)

Usually, the algorithm should be selected with consideration regarding the dataset and the purpose of the analysis (Dolnicar, 2002). For the purposes of this research, nonhierarchical approach is more appropriate. There are many nonhierarchical algorithms, most common of which include sequential, parallel and optimization. These algorithms all belong to a group called K-means. They work by partitioning the data into predefined number of clusters, which are then iterated and reassigned to clusters until numerical criterion is met. More recently, so called two-step algorithms, which combine the benefits of both hierarchical and nonhierarchical methods, have been developed. (Hair et al., 2009) They are, however, more appropriate to large sample sizes (Hair et al., 2009), which is why it is more applicable to use K-means clustering for this study. In K-means, a population of n elements described by m attributes is partitioned into K clusters. The vector of the

m attributes of element i is represented by $X = (x_{i1}, x_{i2}, \dots x_{im})$. (Kim & Ahm, 2008) The clustering process consists of 4 stages (Kim & Ahm, 2008):

1. Initial seeds with a chosen number of clusters K are selected, and an initial partition is built by using the seeds as the centroids of the initial clusters.
2. Each record is assigned to the nearest centroid, thereby forming a cluster.
3. Keeping the same number of clusters, the new centroid of each cluster is calculated.
4. Steps 2 and 3 are iterated until the clusters stop changing or stop conditions are satisfied.

For K-means and other nonhierarchical clustering methods, there are two main approaches to determining the number of clusters (Dolnicar, 2002):

1. Repetition of calculations with varying numbers of clusters and evaluation of the results, and
2. Calculation of solutions with different numbers of clusters and interactive selection with management according to corporate criteria.

The number of clusters affects the results of the analysis significantly. Still, the selection of the number of clusters remains to be a consideration of the researcher, which is why it is always somewhat subjective. (Dolnicar, 2002) In this thesis, the first approach is used, initially conducting the analysis with 3, 4, and 5 clusters.

4.2. Input variables

The selection of variables along which to group the observations is the most fundamental part in the application of cluster analysis. (Ketchen and Shook, 1996) Research shows, that close attention on the selection of input variables is highly important, because irrelevant variables could easily distort an otherwise meaningful classification. Rationale for selection of variables for cluster analysis may grow out

of explicit theory or be based on a hypothesis. (Punj & Stewart, 1983) According to Ketchen et al. (1993), usual ways to identify appropriate input variables are:

1. Inductive,
2. Deductive, and
3. Cognitive.

In (1) inductive approach, multiple variables that the researcher deems important are considered. Before the analysis, the researcher cannot to know which variables differ among observations, so as many clustering variables as possible are used to maximize the changes of finding meaningful differences. (Ketchen & Shook, 1996). Unlike inductive approach, (2) Deductive approach ties the number of clustering variables and groups to theoretical foundation. The underlying idea of deductive selection of variable is, that irrelevant variables can decrease the validity of the clusters. (Punj and Stewart, 1983; Ketchen & Shook, 1996) Lastly, in (3) cognitive approach, in a manner similar to inductive approach, the researcher avoids theory-based predictions. Instead, expert informants are used to define the clustering variables. (Ketchen & Shook, 1996) In exploratory research such as this thesis, Ketchen & Shook (1996) recommended using inductive or cognitive approach and selecting variables “in a way that fosters rich description of a sample’s characteristics” and matches the purpose of the study. Because inclusion of inappropriate clustering variables can have significant effect on the results of the analysis, variables that do not significantly differ between groups and contribute to the analysis should be eliminated (Hair et al., 2009).

For the purposes of thesis, concepts and constructs that are recognized in the theoretical part will be used for the cluster analysis, thus ensuring the relevance of the variables. This provides conceptual support which is needed to create meaningful clusters. R&D/marketing interface has been studied mainly from two different perspectives: trough different managerial typologies, integration mechanisms and their outcomes, or trough social perspective, conflicts and their effects on business performance. The empirical part of this thesis focuses on

different integration mechanisms and their perceived outcomes. Based on previous literature, the R/D/marketing interface in NPD can be conceptualized as follows:

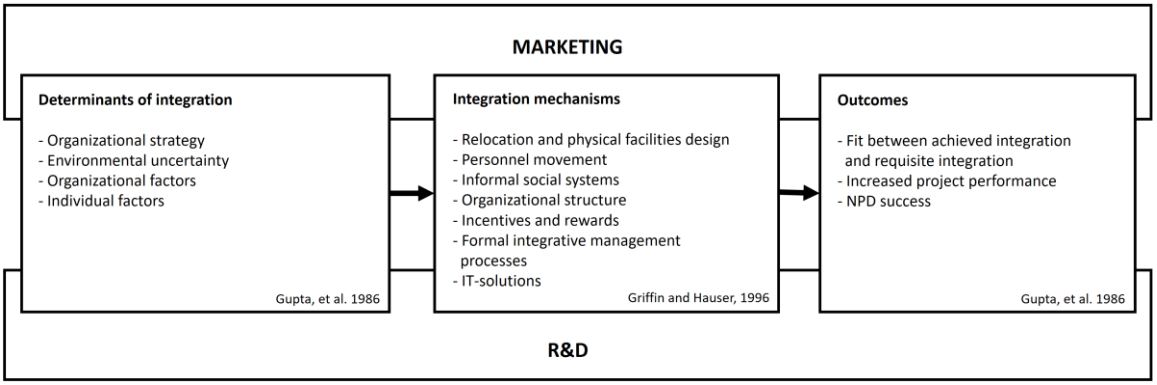

Figure 8. Conceptualization of the R&D marketing interface

Integration mechanisms are not exclusive; different combinations of integration mechanisms and organizational practices are likely to lead to different kinds of outcomes. By studying the use of integration mechanisms with cluster analysis, it is possible to recognize archetypical integration configurations, and evaluate their effect on the NPD performance. In addition to integration mechanisms, other differentiating constructs that are recognized in the theoretical part of this thesis are also brought to inspection. According to the model of the marketing/R&D interface (Gupta et al., 1986), the fit between requisite integration and achieved integration is met, when organizational strategy and environmental uncertainty are met with right organizational factors (i.e. Organizational design, senior management support) and individual factors (i.e. sociocultural differences between managers).

4.2.1. Domains and constructs of the R&D/marketing interface

In the following table, each conceptual domain is decomposed into constructs that can be measured using a questionnaire. The hypothetical effect on integration is also presented for each construct.

Table 3: Domains and constructs of the R&D/marketing interface

	Domains	Constructs	Hypothetical effect
Organizational strategy	Aggressiveness of the strategy	Long term goals of the company	More aggressive the company's strategy, greater degree of R&D/marketing integration is required
Environmental uncertainty	Unpredictability of changes in the environment	Changes in competitors' product designs, consumers' demands for new products, and technology	More environmental uncertainty, more integration is needed.
Organizational factors	Organizational structure and the role of senior management	Formalization, concentration of power, employee participation in decision making	Low formalization, low concentration of power, and employee participation increase integration.
Individual factors	Sociocultural differences	Professional orientation, tolerances for ambiguity, perspectives on time, and preferred types of projects	Sociocultural differences between managers decrease integration
Integration mechanisms	Relocation and physical facilities design	Facilities that encourage communication and cooperation by removing physical barriers	Relocation and facilities that encourage communication and cooperation increase integration
	Personnel movement	Movement of individuals between functional groups	Personnel movement increases integration
	Informal social systems	Informal contact and social networks	Informal contact and social networks increase integration
	Organizational structure	Functional organization versus harmonious operation across functions	Informal teams increase innovation
	Incentives and rewards	Functionally based performance rewards versus shared rewards	Shared rewards increase integration
	Integrative management processes	Use of formal NPD process	Integrative management processes increase innovation
	IT solutions	Use of IT solutions to improve internal cooperation	Use of appropriate IT solutions increases integration
NPD performance	Performance of the product development	A technological solution that works as intended and meets market needs	NPP is positively correlated with high levels of integration
Level of integration	State of R&D/marketing interface	The level of cooperation and integration between marketing and R&D	

The main domains are divided into constructs that measure four separate dimensions:

1. External drivers of integration,
2. Determinants of integration,
3. State of integration, and
4. Outcomes of the configuration.

(1.) External necessity of integration is measured trough unpredictability of changes in the environment, (2.) determinants of integration are measured trough organizational factors and individual factors, (3.) the actual state of integration is measured trough integration mechanisms and power balance, and the (4.) outcomes of the configuration are measured with NPD performance and level of the interface. Each of the constructs is measured using survey questions that are specified in table 7.

4.3. Data collection and sample composition

Data used in this thesis is collected from a structured questionnaire sent privately via email to a sample of 418 manually selected Finnish companies. A pre-screening of each company is done to ensure that they conduct their own product development. The goal is to get approximately even sample of companies from industries. Within these companies, contact details of the managers responsible for marketing are gathered from company websites and business directories. Using this method, 318 individual respondents were identified and contacted. In addition, 100 companies that did not publish the contact details of their marketing directors are contacted via general company email address, and asked to forward the message to most appropriate respondent within the company. Out of these companies, a total of 72 responses are recorded with a response rate of 17,2%. The questionnaire was first sent to a test group of 25 respondents, who have a change to give feedback about the questionnaire to ensure all the questions are understood. The feedback from this group was positive and was no need to modify the questionnaire. Final respondents represent important export industries in Finland, including:

Table 4: Industries of the respondents

	%	*Count*
Chemistry	11.3%	8
Electronics	12.7%	9
Forest/paper/packaging	11.3%	8
Metal/machinery	25.4%	18
Software/games	8.45%	6
Food/beverage	8.45%	6
Other	22.5%	16
Total	100%	71

The goal of manually selecting companies is to find a representative group of different kinds of companies. The division of companies based on their size is satisfactory in the sample:

Table 5: company sizes

	%	*Count*
1-49 employees	22.5%	16
50-99 employees	22.5%	16
100-499 employees	35.2%	25
over 500 employees	19.7%	14
Total	100%	71

Respondents come evenly from companies of different sizes and industries. Within these companies, the questionnaire is directed to people in charge of marketing with knowledge of R&D. Therefore, respondents mostly come from educational business background:

Table 6: Educational background of the respondents

	%	*Count*
Business oriented	54.4%	37
Technology oriented	33.8%	24
Other	11.8%	10
Total	100%	71

A total of 25 respondents hold a position of chief marketing director or equivalent. In the cover letter, it is noted that if the recipient feels he/she is not the best person to answer the questionnaire, it can be forwarded to a more suitable person within the company. All of the companies that participated in this research did not have a person explicitly in charge of marketing, which is why the respondents also include 8 sales directors, 9 chief executive officers and 29 respondents with other positions including business director, development director, R&D director, product manager, etc. Using the data, the goal of this research is to group companies into clusters based on their R&D/marketing interfaces. For some of the measurements, the respondents are asked to reflect the questions to a NPD project that took place within 3 years and was important to the company. The cluster analysis is conducted using IBM SPSS Statistics 23.

4.4. Limitations

Cluster analysis refers a wide set of different kinds of methodologies that have been developed in different fields, which is why information regarding different methods, their operational definitions, and their use is fragmented (Punj & Stewart, 1983). Different algorithms can lead to different kinds of clustering solutions, and it is up to the researcher to decide which algorithms to use. Because there is no definitive rule about the sample size necessary to conduct a cluster analysis, it is possible to apply the analysis uncritically with insufficient amount of observations to get meaningful results. To make the cluster analysis as relevant as possible, a rule of thumb proposed by Formann (1984) is used in this study to calculate the appropriate amount of cluster variables in relation to the sample size: the amount of

observations should be at least a 2^k, where k refers to the number of variables (Dolnicar, 2002). Following this rule, the cluster analysis in this study is conducted using six theory-based clustering variables consisting of organizational factors and sociocultural differences.

Cluster analysis does group any data into clusters, and it is up to the researcher to interpret whether the results of the analysis are meaningful. Due to the nature of cluster analysis, any generalizations to a larger population from which the sample is obtained should be based on analogies, not on inferential statistics (Romesburg, 2004). The K-means clustering algorithm used in this study has also been criticized, because outliers can affect clustering results. Results can also be dependent on the initial seeds, and there is no mechanism to optimize them. (Kim & Ahn, 2008) In the data used in research, there were no clear outliers that would have hampered the analysis.

5. FINDINGS

The questionnaire measured multiple dimensions of the R&D/marketing interface and NPD. This sections presents the overall findings from the questionnaire, composite variables that were created from the data, results of the cluster analysis, and validation of the results. Then, a taxonomy description of the R&D/marketing interface is presented individually for each cluster. Table 7 summarizes the questionnaire statements, and provides total means and standard deviations for them.

Table 7. Questionnaire statements

Domains	Constructs	Statements	Mean	σ
Aggressiveness of the strategy	Long term goals of the company (1 Strongly disagree – 5 Strongly agree)	Our company aggressively pursues to develop new products	3,66	1,17
Unpredictability of changes in the environment	Changes in competitors' product designs (1 Strongly disagree – 5 Strongly agree)	Our competitors regularly come up with new products	3,68	0,98
	Consumers' demands for new products, and technology (1 Strongly disagree – 5 Strongly agree)	Our customers constantly expect new products from us	3,79	1,12
		The demands of our customers are increasing	4,11	0,84
Organizational structure and role of senior management	Formalization (1 Strongly disagree – 5 Strongly agree)	Our company has a formal NPD process	3,61	1,13
		In our product development, we rely on formal managerial processes	3,22	1,03
	Concentration of power (1 Strongly disagree – 5 Strongly agree)	Key decisions during product development are top managements responsibility	3,59	1,27
	Employee participation in decision making (1 Strongly disagree – 5 Strongly agree)	Our marketing employees are involved in decision making during product development	3,66	1,18
		Our R&D employees are involved in decision making during product development	3,99	0,85
Sociocultural differences	Professional orientation (1 product attributes – 5 market reaction)	Our marketing department evaluates the successfulness of product development based primary on	4,10	1,00
		Our R&D department evaluates the successfulness of product development based primary on	2,93	1,09
	Time orientation (1 long term – 5 short term)	Our marketing department is focused on goals that are	2,79	1,13
		Our R&D department is focused on goals that are	2,99	1,27
	Preferred types of projects (1 radical – 5 incremental)	Our marketing departments generally prefers projects that are	2,54	1,12

		Our R&D departments generally prefers projects that are	2,94	1,05
Relocation and physical facilities design	Facilities that encourage communication and cooperation by removing physical barriers (1 Strongly disagree – 5 Strongly agree)	Our physical facilities are built in a way that encourages cooperation between marketing and R&D	3,30	1,24
Personnel movement	Movement of individuals between functional groups (1 Strongly disagree – 5 Strongly agree)	Our marketing personnel occasionally works in R&D related tasks	3,76	1,21
		Our R&D personnel occasionally works in marketing related tasks	3,30	1,35
Informal social systems	Informal contact and social networks (1 Strongly disagree – 5 Strongly agree)	Our employees have informal social gatherings with each other's	3,83	1,12
		Personal networks are efficiently used in our product development	3,30	1,21
Organizational structure	Functional organization versus harmonious operation across functions 1 Informal teams – 5 Functional silos	The organization of our product development is best characterized by	2,57	1,06
Incentives and rewards	Functionally based performance rewards versus shared rewards (1 product based – 5 market based)	Our marketing department is mainly rewarded for	3,79	0,85
		Our R&D department is mainly rewarded for	2,83	1,12
Integrative management processes	Use of formal NPD process (1 Strongly agree – 5 Strongly disagree)	In our product development, we rely on formal managerial processes	3,22	1,03
IT solutions	Use of IT solutions to improve internal cooperation (1 Strongly agree – 5 Strongly disagree)	We use efficiently use different kinds of IT solutions for internal communication and cooperation	3,66	1,00
Level of the interface	The level of cooperation and integration between marketing and R&D (1 Strongly agree – 5 Strongly disagree)	R&D and marketing personnel worked together during the project	4,01	1,01
		R&D and marketing work together seamlessly	3,65	1,02
		Our marketing personnel occasionally works in R&D related tasks	3,76	1,21
		Our R&D personnel occasionally works in marketing related tasks	3,30	1,35
Performance	New product performance (1 Unsuccessful – 5 Successful)	The product that was developed turned out to be a commercial success	3,83	0,96
		The product that was developed was successful from a technical point of views	4,44	0,53
	NPD performance (1 Unsuccessful – 5 Successful)	We are better at developing new products compared to our competitors	3,45	0,98
		We have managed to get more new customers than our competitors	3,66	0,97
		We can react to new opportunities faster than our competitors	3,63	0,87
Marketing vs R&D power	Responsibilities during NPD (1 Marketing's responsibility – 5 R&D's responsibility)	Think of the same R&D project. During that project, who was primary responsible for the following steps of the product development project:		
		idea generation; idea screening; concept development;	3,21 3,11 2,89	0,94 0,77 1,09

	product strategy;	2,58	1,02
	business analytics;	2,21	0,98
	product development;	4,01	0,80
	test marketing;	2,21	0,78
	commercialization	1,96	0,90

Some of the observations do not follow the expectations set by the literature. These discrepancies could possibly be explained by cultural factors and might be an interesting point of further study. For example, in the sample, marketing personnel prefer more radical innovations than their R&D counterparts, even though prior research suggest the opposite. Similarly, on average, respondents perceive marketing's time horizon to be longer than R&D's.

Due to a limited number of respondents, the dataset is not sufficiently large for exploratory factor analysis (Kaiser-Meyer-Olkin < 0,6 in principal component analysis), which could be used to identify correlated variables. Instead, the composite variables presented in table 8 are created based on the literature, and their reliability is verified using Cronbach's alpha. Rest of the data is treated as single-item variables.

Table 8. Composite variables

Variable	Measurements	α
Unpredictability of changes in the environment	1. Our competitors regularly come up with new products 2. Our customers constantly expect new products from us 3. The demands of our customers are increasing	0,691
Formalization	1. Our company has a formal NPD process 2. In our product development, we rely on formal managerial processes	0,724
Marketing vs R&D power	Think of the same R&D project. During that project, who was primary responsible for the following steps of the product development project? 1. idea generation; 2. idea screening; 3. concept development; 4. product strategy; 5. business analytics; 6. product development; 7. test marketing; 8. commercialization	0,775
Level of the interface	1. R&D and marketing personnel worked together during the project 2. R&D and marketing work together seamlessly 3. Our marketing personnel occasionally works in R&D related tasks 4. Our R&D personnel occasionally works in marketing related tasks	0,698
Performance	1. The product that was developed turned out to be a commercial success 2. The product that was developed was successful from a technical point of views 3. We are better at developing new products compared to our competitors 4. We have managed to get more new customers than our competitors 5. We can react to new opportunities faster than our competitors	0,698

These six variables all have satisfactory internal validity, and based on their reliability measures, they are acceptable to be used as variables for the purposes of this thesis. Out of the composite variables, formalization is used as a clustering variable, and rest are used as descriptive variables to enrichen the analysis.

5.1. Cluster analysis

Initially, the analysis was conducted three times with 3, 4 and 5 clusters. A four-cluster solution turned out to be most insightful, because a three-cluster solution did not distinguish between clusters 2 and 3, which have significant differences between each other's. A five-cluster solution, on the other hand, did not reveal new insights about the data, decreased the differences between the clusters, and led to redundant fifth cluster with few observations.

Table 9 shows the statistical description of each cluster. The six clustering variables that are used to classify the observation are highlighted in the table. Other clustering variables were considered as well (i.e. professional orientation of marketing and R&D), but because they did not differ significantly between the clusters, they were eliminated and replaced with other variables as suggested by Hair et al. (2009). The final clusters differ significantly with respect to all of the cluster variables (sig = ,000). The rest of the measurements were not used as cluster variables. Instead, they are used to study differences between the clusters.

Table 9. Statistical description of clusters

			Cluster number			
			1	2	3	4
Background information	Firm size	1-49 employees	50%	19%	25%	6%
		50-99 employees	44%	31%	6%	19%
		100-499 employees	32%	16%	16%	36%
		over 500 employees	14%	14%	21%	50%
	Industry	Chemistry	38%	25%	25%	13%
		Electronics	44%	11%	33%	11%
		Forest/paper/packaging	38%	13%	25%	25%
		Metal/machinery	28%	33%	11%	28%
		Software/games	33%	0%	33%	33%
		Food/beverage	33%	33%	0%	33%
		Other	38%	13%	6%	44%
Clustering variables	Organizational factors	Formalization	3,58	3,36	3,92	2,60
		Concentration of power	4,16	4,21	4,00	2,20
	Sociocultural differences	Preferred projects of marketing	2,36	1,79	4,08	2,35
		Preferred projects of R&D	2,32	3,71	3,42	2,90
		Time orientation of marketing	1,96	4,14	3,33	3,25
		Time orientation of R&D	1,92	3,07	3,42	3,30
Descriptive variables	Marketing vs R&D power	Idea generation	3,32	3,14	2,75	3,40
		Idea screening	3,08	3,00	3,00	3,30
		Concept development	2,56	2,86	2,67	3,45
		Product strategy	2,40	2,57	2,75	2,70
		Business analytics	1,96	2,50	2,42	2,20
		Product development	4,00	3,93	4,00	4,10
		Test marketing	2,00	2,29	2,42	2,32
		Commercialization	1,72	1,64	2,55	2,16
	Use of integration mechanisms	Physical facilities design	3,52	3,21	3,14	3,15
		Personnel movement of marketing	3,92	3,64	3,50	3,80
		Personnel movement of R&D	3,48	3,07	3,17	3,30
		Informal social systems	3,80	3,50	3,21	3,53
		Organizational structure	2,68	2,14	2,83	2,56
		Incentives of marketing	3,60	3,85	4,36	3,61
		Incentives of R&D	3,00	2,62	2,91	2,75
		IT solutions	3,56	3,64	3,75	3,75
	Perceived need for integration	Unpredictability of changes	3,92	3,95	3,47	3,97
		Aggressiveness of strategy	3,88	3,79	3,00	3,70
	Professional orientation	Orientation of marketing	4,00	4,07	4,25	4,15
		Orientation of R&D	2,72	3,00	3,17	3,00
	Outcome variables	NPD performance	3,92	3,50	3,82	3,78
		Level of the interface	3,87	3,45	3,50	3,71

Overall, most of the companies involved in this study seem to foster relatively high levels of integration between marketing and R&D. Respondents, on average, also perceived their NPD performance to be relatively high. These results, even though definitely positive, must also be taken with a grain of salt, because the sample size and response rate were relatively small. It is possible, for example, that companies with high levels of integration are more likely to answer to the questionnaire, whereas those with minimal integration might just pass it as unrelated to their company. It is also noteworthy, that NPD performance was measured with qualitative assessments of the managers, who might over-estimate the performance of their companies. Still, the results seem to ascertain some main expectations set by the literature. For example, the cluster with lowest level of the interface also had the lowest NPD performance and the lowest level of integration mechanisms in use. Similarly, the cluster with the highest level of interface also had the highest NPD performance and the highest level of integration mechanisms in use. Contingency theory suggests, that the level of integration should be aligned with environmental uncertainty and strategic goals of the company. These dimensions are therefore also reflected to each cluster in the taxonomy description.

The next step of the analysis is to study the characteristics of the clusters, and validate whether they have meaningful interpretations (Hair et al. 2009). Each cluster is also given a name based on their archetypical features. Because the data size is limited, and respondents come from wide range of different industries, the amount of data is not sufficient to draw any meaningful conclusions between cluster membership and industry of the respondents. Industry-variable is therefore removed from further analysis. Table 10 transforms the statistical descriptions of clusters into verbal descriptions. Verbal descriptions and cluster names should be treated as simplifications of the data. They are used to highlight archetypical differences between the clusters.

Table 10. Verbal cluster description

Construct	Measurement	Cluster number			
		1	2	3	4
Firm size	Number of employees	Dominantly small	Medium-small	Equally divided	Dominantly large
Organizational factors	Formalization	Formal	Average-formal	Formal	Average-Informal
	Concentration of power	Concentrated	Concentrated	Concentrated	Shared
Sociocultural differences	Preferred projects of marketing	Radical	Radical	Incremental	Radical
	Preferred projects of R&D	Radical	Incremental	Average-incremental	Average
	Time orientation of marketing	Long term	Short term	Medium-short	Average
	Time orientation of R&D	Long term	Average	Medium-short	Average
Marketing vs R&D power	Idea generation	Shared responsibility	Shared responsibility	Shared responsibility	Mostly R&D's responsibility
	Idea screening	Shared responsibility	Shared responsibility	Shared responsibility	Shared responsibility
	Concept development	Mostly marketing's responsibility	Shared responsibility	Shared responsibility	Mostly R&D's responsibility
	Product strategy	Marketing's responsibility	Mostly marketing's responsibility	Shared responsibility	Shared responsibility
	Business analytics	Marketing's responsibility	Mostly marketing's responsibility	Mostly marketing's responsibility	Marketing's responsibility
	Product development	R&D's responsibility	R&D's responsibility	R&D's responsibility	R&D's responsibility
	Test marketing	Marketing's responsibility	Marketing's responsibility	Marketing's responsibility	Marketing's responsibility

	Commercialization	Marketing's responsibility	Marketing's responsibility	Mostly marketing's responsibility	Marketing's responsibility
Use of integration mechanisms	Physical facilities design	High	Average	Average	Average
	Personnel movement of marketing	High	High	Average-high	High
	Personnel movement of R&D	Average-high	Average	Average	Average-high
	Informal social systems	High	Average-high	Average	High
	Organizational structure	Average-low	Low	Average	Average-low
	Incentives of marketing	Market oriented	Market oriented	Market oriented	Market oriented
	Incentives of R&D	Average	Average-product oriented	Average	Average
	IT solutions	High	High	High	High
Perceived need for integration	Unpredictability of changes	Unpredictable	Unpredictable	Average	Unpredictable
	Aggressiveness of strategy	Aggressive	Aggressive	Average	Aggressive
Professional orientation	Orientation of marketing	Market oriented	Market oriented	Market oriented	Market oriented
	Orientation of R&D	Product oriented-average	Average	Average	Average
Outcome variables	NPD performance	High	Medium-high	High	High
	Level of the interface	High integration	Medium-high integration	Medium-high integration	High integration

Based on the constructs, each cluster is given a name that describes different characteristics that separate them from one another. Fist cluster is called “Small high-performers, because consists dominantly of small firms with high level of integration and high NPD performance. Second cluster has a marketing and R&D departments with different sociocultural characteristics and low level of integration with lowest NPD performance. It is therefore called “Conflicting functions”. Third cluster is the opposite of the second when it comes to sociocultural differences: R&D and marketing employees share similar time horizon and preferred types of projects. They both prefer incremental projects in their product development, and have the least aggressive NPD strategy, which is why the cluster is called “Like-minded and passive”. Final cluster, similarly to the first, has high levels of integration and high NPD performance. Unlike the first cluster, it consists dominantly of large companies. Accordingly, the cluster shall be named “Large high performers”.

5.2. Taxonomy description

In this chapter, each cluster is studied individually in more detail. At the same time, they are compared to one-another in order to identify differences and similarities between the clusters. Possible causalities between the variables that might give further insights to the clusters and their characteristics are also discussed. At the same time, the findings are reflected to the NPD and R&D/marketing literature.

5.2.1. Cluster 1 (“Small high-performers”)

The first configuration is most clearly characterized by the fact that the observations consist mostly of small and mediums sized companies. In fact, 50% of all the companies of 1-49 employees, and 44% of all the companies of 50-99 employees belong to this cluster. The fact that companies are divided so clearly based on their size is interesting, especially since the firm size was not one of the actual clustering variables. This suggests there might be a correlation between organizational factors, sociocultural differences, and firm size.

Companies in the first cluster have rather high level of formalization and concentration of power. This is typical especially to small firms, where the CEO or the owner often holds significant amount of power and has the final responsibility over key decisions. At the same time, the sociocultural attributes of marketing and R&D are by far the most similar in this cluster – both prefer radical innovations and have a long-term time horizon. According to the literature, this should drive cooperation and lead to high levels of integrations and harmonious cooperation. Looking at the power balance of marketing and R&D, “Small high performers” have the most marketing driven NPD. It is, however, worth noting that the differences in the overall power balance are relatively small between the clusters.

Indeed, the outcome variables seem to confirm the expectation that was set by the clustering variables: “Small high performers” have the highest level of the interface and the best NPD performance of all the clusters. When looking at the different individual integration mechanisms, “Small high performers” are taking advantage of multiple mechanisms more effectively than their counterparts: they have the most integrative facilities, and the highest level of personnel movement of both marketing and R&D. They also measure the highest score for informal social systems. These results might be explained, at least in part, by small company size, which could lead to “accidental” integration and “forced“ cooperation due to shared facilities and limited number of employees. The level of integration is this also aligned with both the environmental turbulence and the aggressiveness of organizational strategy: “Small high performers” operate in unpredictable business environment and have, on average, the most aggressive NPD strategies. Overall, these companies seem to have a R&D/marketing interface that is very suitable to their business environment and strategic goals.

5.2.2. Cluster 2 ("Conflicting functions")

The second configuration is also more prevalent in small and medium sized companies. However, the most characteristic feature of this cluster is remarkable differences in sociocultural attributes between marketing and R&D. Similarly with "Small high performers, cluster two also has rather formal organizational structure and high concentration of power, which supports the assumptions that these variables might be at least somewhat related to firm size.

In "Conflicting functions", the marketing departments prefer radical NPD projects, whereas the R&D departments tend to prefer incremental projects. Interestingly, this is in opposition to the expectations set by the literature, which suggests that marketing managers tend to prefer incremental innovations whereas R&D is usually more interested in technologically radical projects. The differences in time orientation are also most prevalent of all the clusters: In "Conflicting functions", marketing has a short-term time horizon, but R&D is much closer to average. According to the literature, these differences in key perspectives can hamper NPD performance and lead to conflicts between marketing and R&D.

Again, the outcome variables are consistent with previous research: "Conflicting functions" measure lowest of all the clusters on both the NPD performance and the overall level of the interface. On average, they also have the least efficient utilization of integration mechanisms: R&D personnel is the least involved in marketing related activities of all the clusters, the gap between the reward mechanisms of marketing and R&D is the second largest of all the clusters, and the organizational structure of the companies is the most heavily characterized by functional silos. Interestingly, "conflicting functions" do have aggressive NPD strategies and highly unpredictable business environment, which according to literature suggests they would benefit from high levels of R&D/marketing integration. Also, as their NPD performance is currently worst of all the clusters, this cluster might really benefit from increased integration between marketing and R&D.

5.2.3. Cluster 3 ("Like-minded and passive")

Cluster 3 does not exhibit the connection between the clustering variables and company size, which seems to be prevalent in all the other clusters. Instead, like the first cluster, it is characterized by similar sociocultural attributes of R&D and marketing. However, both R&D and marketing seem to have opposite preferences compared to the first cluster: In "Like-minded and passive", both R&D and marketing prefer incremental projects and have a medium-short term time horizon. They also have the most formalized organization of NPD and highly centralized power.

The attitudes or R&D and marketing seem to be reflective of the NPD strategy and perceived environmental uncertainty: Companies that belong to "Like minded and passive" operate in most predictable business environment of all the clusters, and have the least aggressive NPD strategy. Looking at the outcome variables, the "Like minded and passive" seem to have high NPD performance but rather low level of integration. This is consistent with the literature, because low level of environmental uncertainty and preference for incremental product development should decrease the need for integration. High NPD performance could also be at least partially explained by similarities in the sociocultural attributes between marketing and R&D. This improves to cooperation and decreases the risk of conflicts.

Cluster 3, together with cluster 4, is taking the biggest advantage of integrative IT solutions. At the same time, they have the least integrative facilities, least personnel movement of marketing, their reward systems of marketing and R&D are the farthest apart, and their utilizations of informal social systems is the lowest of all the clusters. Still, it seems reasonable to assume, that "Like minded and passive"-configuration is suitable for the businesses in the cluster. If the level of competition is low, and radical innovations are not needed to survive, there are no drivers to increase the integration of marketing and R&D.

5.2.4. Cluster 4 (”Large high performers”)

The last configuration is, in one regard, the opposite of the first. It the observations in the cluster consist dominantly of large companies. 50% of all the companies of over 499 employees, and 36% of all the companies of 100-499 employees belong to cluster 4. The cluster has distinguishable differences to all of the other clusters, some of which can most likely be explained by firm size. Firstly, “Large high performers” is the only cluster with notably low concertation of power. It is also characterized by the lowest level of formalization. In general, it seems reasonable that for large companies, some of which work in multiple business areas, efficient division of power is essential.

R&D and marketing in “Large high performers” have relatively matching sociocultural attributes. Even though marketing prefers more radical projects than R&D, they share a similar (average) time horizon. Average time horizon is interesting, when compared to “Small high performers” where both marketing and R&D have a longer time horizon. It could be, that large companies, many of which are listed in a stock exchange, must finish their NPD projects in tighter time frames.

Out of the individual integration mechanisms “Large high performers” do not really stick out in any way. They have the highest use of IT solutions along with cluster 3, but other than that the use of integration mechanisms is comparable to the other clusters. External variables are aligned with the literature: “Large high performers” perceive their environmental uncertainty to be the highest compared to other clusters. Accordingly, they also have a relatively aggressive NPD strategy. The outcome variables show, that this configuration is suitable for their need: The level of the R&D/marketing interface is high, and their NPD performs well – even though slightly worse than clusters 1 and 3. In general, this could be explained by the fact that large companies often must undertake more complex and radical NPD project compared to smaller firms.

6. DISCUSSION AND CONCLUSIONS

The empirical part of this thesis is the foundation for the first multidimensional taxonomy describing the different R&D/marketing configurations that are actually used in companies. These archetypical interfaces can be reflected to different organizations and used to evaluate the outcomes of different combinations. Succesfull NPD leads to new products that support the strategic goals of the company and make the best possible use of available comptencies and resources (Nikolaos et al., 2004). To archieve this goal, it is imperative that companies can get their employees from different functions to organize and work together effectively. According to prior research (i.e. Brown & Eisenhardt, 1995; Gupta et al., 1986; Kahn & McDonough, 1997), the relationship between marketing and R&D contributes significantly to new product performance and thereby to the long term profitability of a business.

Especially in highly competitive markets, deep integration has a direct effect to NPD performance (Song & Parry, 1993; Souder et al., 1988). Indeed, the taxonomy description developed in this thesis seems to support this assumption: the perceived level of the interface in each cluster is aligned with the overall NPD performance. It is important to note, that increased integration is not a cure-all by itself. Instead, it is important to find the R&D/marketing configuration that is most suitable to the business environment and the strategic goals of the firm. The findings of this thesis support the basic assumptions of contingency theories (i.e. Gupta et al., 1968; Donaldson, 2001): NPD is successful, when the gap between the perceived need for integration and the degree of actual integration is minimized. According to prior research, the benefits of cross-functional integration vary between different kinds of organizations (Swink, 1999). Interestingly, the taxonomy shows that the high performers – clusters 1 and 4 – consists of very different kinds of organizations. At the same time, the most striking similarity between them is that the companies operate in unpredictable business environments, have an aggressive NPD strategy and a high level of perceived integration. These findings highlight the importance of integration and information sharing in such circumstances regardless of company size or other internal differences. In general, the findings of this thesis suggest that

even though the methods for achieving successful cooperation vary between organizations, the integration of R&D and marketing seems to be strongly linked to NPD performance.

In the questionnaire, the respondents had a change to leave feedback and comment the thoughts that the survey raised. The following comments summarize some of the key points that arise from this thesis and might evoke new ideas about the integration of R&D and marketing:

- *"For a NPD project to be successful, it is crucial to have efficient internal communication. Customer needs must be understood to create the right product specifications."*

- *"This questionnaire touches many important issues. The Finnish machinery industry is still a decade away from understanding the role of marketing. The direction is changing, but large ships can be slow to turn."*

- *"In gaming and digital service industries, constant measurement of activates is a day-to-day activity. Usually, data is the undeniable truth, which brings out different perspectives and intuitions of teams and aligns those with the realities of the marketplace."*

- *"R&D and marketing approach projects from different perspectives. - - The most important thing is to work together and understand the underlying shared objectives."*

Overall, the average respondent of the survey feels, that the level of R&D/marketing interface in their firms is relatively high. At the same time, many respondents highlighted the importance of integration in the feedback. There has, indeed, been a lot of discussion about the integration of marketing and R&D since the 1990's. The lesson that marketing should be involved in NPD seems to have been taken to heart by many managers, which could fare well for Finnish companies in the future.

6.1. Managerial implications

Managers would likely want to get answers to questions such as “what should the organization of marketing and R&D look like to improve the performance of NPD and thereby the firm. This paper alone cannot give definitive answer to such questions. Due to the exploratory research approach and relatively small sample, the taxonomy description is not generalizable to the wider population by itself. However, when reflected to the literature, some suggestions can be given with relative confidence.

Companies should pay attention to the integration of marketing and R&D, attempting to find the most suitable configurations for their strategic goals and competencies (Hargadons, 2003). From a practical perspective, the taxonomy presented in this thesis can help managers to study and better evaluate the R&D/marketing interface of their company in relation to others. At the same time, studying the taxonomy can lead to new ideas about the configuration that might most suitable for each organization. In general, the most important contribution of marketing during NPD is to represent the customer (Griffin and Hauser, 1996). As pointed out, both the taxonomy developed in this thesis and prior research seems to support the expectation that deeper integration of marketing and R&D can really bring out the voice of customer during NPD, and thereby help companies to develop products that are more successful in the market.

One thing that is noteworthy, is that none of the clusters, on average, had shared reward mechanisms for marketing and R&D. Instead, reward mechanisms of marketing are mainly market based, whereas R&D is mainly rewarded based on product attributes. Common incentives based on new product success or other shared performance measurements, as suggested by the literature (Galbraith, 1977; Griffin & Hauser, 1996; Song et al., 1997), could harmonize cooperation and give the employees common goals thus improving cooperation and performance.

6.2. Research suggestions

Some compromises had to be made in this thesis. As stated in the limitations-chapter, the number of respondents in the survey was on the low side. Larger data set would have opened more possibilities for clustering and interpretations. For example, more meaningful composite variables could have been used to deepen the analysis in increase its validity. Similarly, it would have been possible to select additional clustering variables which could have led to different kinds of results. It would be interesting to replicate the core idea of this thesis, and widen the scope to include respondents from other countries. On the other hand, the opposite approach – focusing on a single industry – might also reveal interesting insights about the configurations of R&D/marketing interface within that environment.

Furthermore, the use of quantitative measurements for NPD performance (i.e. changes in turnover) could yield more reliable results, as they would eliminate possible bias that the respondents might have. Also, widening the scope to include other interfaces or dimensions such as customer involvement might be an interesting research topic for further research. It is also worth noting, that many of the respondents expressed interesting thoughts about the topic of this thesis by giving feedback of the survey. These perspectives could be studied in more detail by, for example, conducting qualitative case studies about the interface between marketing and R&D in selected companies.

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