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1

Introduction and overview

1.1 Introduction

This study deals with the performance of companies with respect to new products and examines why some companies outperform others with their innovation activities. This is an important question because successful new products are crucial to the overall long-term success of companies (cf. Cooper 1979, Dougherty 1990, Maidique & Zirger 1990). Shorter product life cycles, changing customer needs, intense competition, and rapidly evolving technologies are a threat to a company's competitive advantage in the market place, thus creating a constant need for new products. In addition, a single new product can create enormous wealth for the company as a whole. For example, in the pharmaceutical industry, Glaxo became the world's number two pharmaceutical company in sales after turning the new product Zantac into a blockbuster. The fact that Zantac was a fast follower with respect to Tagamet of Smithkline Beecham only illustrates that highly successful new products need not be technological breakthroughs.

The need for new products and the revenues generated by blockbusters are one side of the new product development (NPD) story; the difficulties, risks, and failures are part of the other side. Several recent new product failures like Unilever's Omo Power, Philips' CD-I, and the Anglo-French Concorde are clear examples of this. Although it is somewhat simplistic to speak in terms of successes and failures, Cooper (1993) estimates, after reviewing several studies, that up to 35% of all new products fail after launch. Often these failures have very negative consequences. For example, in the case of Omo Power, Unilever had an estimated direct loss of $200-$300 million related to wasted R&D and marketing money (Riezebos & Waarts 1994). So, regardless of whether the success rate is more or less than 35%, the odds on mistakes are considerable and the figure is even worse if NPD failures before launch are also considered:

for every 11 new product ideas, about 3 enter development , 1.3 are launched, and about 1 succeeds (Page 1991, Cooper 1993). Recently, Stevens and Burley (1997) studied survival rates in different industries and found that up to 3000 raw ideas were needed to produce one economically profitable success.

Because of the many problems with NPD in practice, it is not surprising that academics, managers, and consultants have shown increasing interest in the question: 'What makes new products successful?'. In the present study, we present our contribution to the body of knowledge in this area by conducting an in-depth investigation into the relationship between *the marketing - R&D interface* - the area where marketing and R&D interact - and *new product performance of companies.* With 'new products' we mean new-to-the-company products, encompassing the complete portfolio of slight modifications to new-to-the-world innovations.

1.2 The relationship between the marketing - R&D interface and new product performance

The marketing - R&D interface has been recognized as a critical factor in the success of companies, especially with respect to new product performance (e.g., Gupta, Raj, and Wilemon 1986). In the interface, strategic new product development goals have to be set, trade-offs between technological sophistication and time-to-market have to be made, in-depth functional knowledge about markets and technologies have to be linked, and cultural and physical distances between functions have to be bridged. Proof that this is not always easy can be found in the following quotation from the CEO of Unilever related to Omo Power:

> *"Somewhere between research and marketing something went wrong under the normal pressure to be first to the market"*
>
> KOTLER, ARMSTRONG, SAUNDERS, AND WONG,
> PRINCIPLES OF MARKETING, EUROPEAN EDITION, 1996, P.132

In the literature, a growing number of studies focus on the marketing - R&D interface. Most of these studies examined the (lack of) communication, cooperation, and integration between functional areas in general and between marketing and R&D in particular.

Empirical research indicates that a lack of communication, cooperation, and integration is the rule, rather than the exception (Gupta et al. 1985, Griffin and Hauser 1996). The barriers range from 'personality differences', 'different thought worlds', 'different languages', 'different responsibilities', and 'physical distance' (Saxberg and Slocum 1968, Souder 1975, 1988, Dougherty 1992, Griffin and Hauser 1996). These barriers can in turn lead to a wide range of problems such as to 'the not invented here syndrome' that make that functional areas become too inward-oriented (Griffin and Hauser 1996, Moenaert and Souder 1996).

A reasonably solid conclusion from studies on the effects of low levels of communication, cooperation, harmony, and integration (indicated by the term 'integration' from now on in this study) is that it has a negative effect on new product performance (e.g., Gupta et al. 1985, 1986, Souder 1987, Pinto and Pinto 1990, Parry & Song 1992, 1993). After reviewing 15 studies, Griffin and Hauser (1996) state that the evidence is "strong, consistent, common across a variety of methodologies, and seemingly applicable in both consumer and industrial markets".

Earlier studies mainly relate to integration in cross functional *teams*. At the *company (SBU)* level, we define integration as a company state that encompasses cooperation and communication between marketing and R&D. So far, only a few studies have explicitly tested the relationship between integration and new product performance at a company level, and not all with confirmative results (e.g., Norton, Parry, and Song 1994, Gatignon and Xuereb 1997). We argue that it would be very valuable to know how companies can improve the performance of their overall new product portfolio, especially since stock markets value the performance of the flow of new products over a longer period of time. In addition, so far the question of *how* integration affects new product performance has not been addressed. Montoya-Weiss and Calantone (1994) state in this respect that studies on new product performance in general remain exploratory in nature

and that they focus on the identification rather than the explanation of factors. By studying the *how* question, we explicitly pay attention to *the conditions under which* integration is more or less useful. While it is probably beneficial for some companies to increase integration, we argue that there may be specific types of companies that are likely to benefit more from integration than others. There might even be companies for which integration has a negative effect.

There are four rationales for a more in-depth study of the effect of integration on new product performance in companies. First, companies have been spending huge sums of money on trying to integrate marketing and R&D further by means of for example physical relocation, cross functional teams, and information technology without proper insights into whether this money is well spent.[1] Second, we argue that the positive effect of integration is conditional on other factors in the company: apart from the integration of functional areas, sufficient 'depth' in each of the functional areas is also needed (Lawrence and Lorsch 1967, Wind and Mahajan 1997). If a company integrates poor functional resources, why should the result be that the company achieves better new product performance? In such a situation it might be better to invest in functional resources first. Third, companies have different strategies and specific NPD strategies might benefit more from integration than others.[2] Especially since increasing integration often involves considerable costs, higher integration might not bring the desired effect and could even lead to lower new product performance. Fourth, too much integration might lead to the 'too good friend

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1 A recent quote in this respect comes from the Vice President R&D of Allergan (UK), Dr. L. Herrero: "Consulting battalions are wandering around the corridors, implementing a new order (based on cross functional teams and new processes). The ratio of consultants to workers is approaching 1:1", *Scrip Magazine*, March 1996.

2 Some studies tried to acknowledge this by modelling the interface by means of a gap between 'integration needed' and 'integration achieved' (e.g., Gupta et al. 1986). However, very limited support has been found so far for such a gap model (cf. Griffin and Hauser 1996). As a result most empirical studies focused on one part of the gap variable: the amount of 'integration achieved' which proved to be positively correlated with new product performance. In the present study, we argue that the NPD strategy of a company determines the interdependence of marketing and R&D and therefore the benefits that can be derived from integrating marketing and R&D.

syndrome'. This state has already been found in teams where it was related to lower new product performance (Souder 1988). More research is needed on whether this is also the case with respect to integration at a company level.

Another important motive for the present study is that we argue that there is a need for further opening of the 'black box' of the marketing - R&D interface. We do not believe that the marketing - R&D interface is sufficiently covered by studying the role of integration alone. Apart from integration, which is related to the cooperative element in the relationship between marketing and R&D, we argue that the question of power and control has to be addressed. The NPD process resembles a channel (a 'funnel' according to Wheelwright and Clark 1992) where marketing and R&D have different amounts of power and control in specific decisions and activities that affect the outcome of decisions. This is an important issue because from the distribution channel literature it is known that the power and control achieved by some parties over selected decision variables is a major factor in the level of performance of the channel as a whole (Stern, El-Ansary, and Coughlan 1997, p.320). Furthermore, power and control on the one hand and integration on the other hand appear to be two independent factors, as becomes clear from the distribution channel literature (e.g., Andersen, Lodisch, and Weiz 1987, Mohr, Fisher, and Nevin 1996).

To give an overview, the following questions are addressed in the present study:

- Is there a positive effect of integration between marketing and R&D on new product performance (not in teams but in companies (SBUs) as a whole)?
- Are there other factors in the marketing - R&D interface that affect new product performance?
- Are these effects dependent on the organizational context, and if yes, how is new product performance affected?
- Given that integration or other factors in the marketing - R&D interface are important, how can they be managed?

In the following section we will further elaborate on the contributions of the present study.

1.3 The contribution of the present study

Despite continued scholarly effort in the past 15 to 20 years to understand the relationship between the marketing - R&D interface (i.e., integration) and new product performance, we argue that there is a need for a more in-depth research approach in this area. The contributions of the present study are the following.

First, we open the black box of the marketing - R&D interface at the company level and investigate two interface aspects: (1) integration between marketing and R&D in the company as a whole, and (2) relative influence of marketing and R&D in specific NPD decisions. **Integration** encompasses communication, collaboration and joint goals between marketing and R&D in the company as a whole. **Relative influence** is related to power (the ability to influence) and control (achieved influence) of R&D relative to marketing (and vice versa) in specific NPD decisions.

Second, we study not only the possible linear effects of integration (relative influence balance) on new product performance (more is better), but we also investigate whether new product performance reaches an optimum value at a certain level of interface variables. For example, we examine whether there are possible decreasing or negative returns on very high levels of integration related to the 'too good friends syndrome'.

Third, other factors outside the direct area of the marketing - R&D interface are included in the analysis. By including the organizational context (variables for resources, structure, and NPD strategy), we study whether organizational context factors affect the relationship between the marketing - R&D interface and new product performance, or, conversely, whether the interface affects the *relationship* between the organizational context and new product performance.

Fourth, we explicitly pay attention to the question of how the marketing - R&D interface (integration and relative influence) can be managed by means of managerial mechanisms like cross functional teams, job rotation, and new information technology. Additionally, we study which mechanisms are universally more effective than others.

Fifth, most empirical studies on the marketing - R&D interface have been carried out in either a cross-industry setting or in a very broad industry category. Although this has the advantage that the results are more generalizable, it has the

negative side-effect of de-emphasizing the internal characteristics that can affect new product performance because of environmental 'noise'. The present study tries to control for a considerable amount of this environmental noise by selecting only one industry as a research population.

Sixth, among the major limitations of previous research in this area are the poor conceptualizations and operationalizations of the variables. So far, there has been limited theoretical underpinning of the integration concept. Furthermore, new product performance is generally not conceptualized as a multi-dimensional construct. In the present study we will contribute to the theoretical underpinning of the integration concept by using insights gained from 'cooperation theory' (Deutsch 1949, Tjosvold 1984). In addition, the concept of relative influence will be further developed and a new measurement scale for relative influence in specific NPD phases will be constructed by using insights gained from influence measurement in other areas (e.g., power and control in distribution channels and decision-making in families). Finally, we will contribute to the ongoing discussion on new product performance measurement and develop several new multiple-item scales for different dimensions of success.

Seventh, this is the first study in this area in which subjective data, self-reported objective data, and, to a lesser extent, factual data are combined to measure constructs.

1.4 The research approach

In the present study, we develop a comprehensive model of the relationship between the marketing - R&D interface and new product performance in the broader organizational context. Literature on new product performance and its determinants, the marketing - R&D interface, distribution channels, decision-making as well as exploratory interviews in different industries was used as input to build the comprehensive model. The model is a *general* comprehensive model in the sense that it is not industry-specific.

The model fits within a broader stream of research that incorporates the Resource Based View (e.g., Penrose 1959, Wernerfeld 1984, Day and Wensley 1988, Barney 1991, Day 1994, Hunt and Morgan 1995). This view assumes that

firm resources play an important role in a firm's competitive position in the market place. Specifically, a key feature of the model is related to the interplay of functional 'depth' resources and cross functional interface resources in creating a competitive position with respect to a company's new products.

We decided to conduct an international survey within the pharmaceutical industry to test the comprehensive model. Three reasons lie behind our choice of the pharmaceutical industry. First, it is one where R&D and marketing play a very important role and where new products are crucial to a company's long-term success. Second, the *pharmaceutical industry* is a very 'open' one, in which a lot is known about (new) products in the market as well as in companies' R&D pipelines. This makes the measurement problem - which is often present in this type of research - less significant because respondents can compare the performance of their company with other companies in the industry. Third, the pharmaceutical industry is, economically speaking, a very important industry, generating US$ 290 billion in revenues in 1996. However, we realize that there are certain aspects in the pharmaceutical industry which are somewhat atypical. For example, customers are often general practitioners or specialists and the paying parties are often insurance companies. Notwithstanding this issue, there is a general consensus that the pharmaceutical business resembles closely a business to business market (Corstjens 1989).

To collect company data, we opted for an international pen-and-paper survey among companies. Knowledgeable managers (marketing and R&D managers) had to score the company for which they worked on a wide range of measures. Extensive pre-testing of the questionnaire resulted in a final 20-page questionnaire (see Appendix 1). Since the managers we interviewed in the pre-test were all confident that the respondents would have a good understanding of the English language, we decided not to translate the questionnaire. All questionnaires carried a stamped number which made it possible to collect additional factual data on the companies to validate certain measures (e.g., factual sales growth). A detailed description of the questionnaire, the response, the survey data, and the validation data is provided in Chapter 3.

1.5 Outline of the book

Chapter 2 elaborates on the earlier research on new product performance and the marketing - R&D interface. A comprehensive model is developed and hypotheses are formulated on how multiple factors in the marketing - R&D interface within a broader organizational context affect new product performance. This model is based on literature reviews in different management areas and to some extent on exploratory interviews.

In Chapter 3 the research design, the data collection, and the measurement scales are presented. As indicated earlier, we opted for an international survey in the pharmaceutical industry. Much attention will be paid to the measurement scales and specific measurement properties such as uni-dimensionality, reliability, and validity.

Chapter 4, 5, and 6 present the results of the study. These chapters represent different layers in the comprehensive model: i) the marketing - R&D interface, ii) the marketing - R&D interface and new product performance, and iii) the marketing - R&D interface and new product performance in the broader organizational context.

In Chapter 4, the black box of the marketing - R&D interface is opened. We pay attention to the relationships between the variables inside the marketing - R&D interface 'isolated' from the rest of the company. Special attention will be paid to two conceptually and empirically distinguishable constructs for integration and relative influence. In addition, the question of how integration and R&D's (and marketing's) relative influence can be managed will be addressed.

In Chapter 5, the relationship between the marketing - R&D interface and new product performance is studied. Here, we pay attention to the existence *and* nature of the effects of interface variables on new product performance.

Chapter 6 offers the most comprehensive analysis. The effect of the marketing - R&D interface on new product performance is studied in the broader organizational context. Much attention is paid to the question of *how* the marketing - R&D interface affects new product performance. To answer this question, the different roles of the marketing - R&D interface are investigated and tested. Section 6.3 looks at the effect of integration in combination with 'depth' resources. Section 6.4 elaborates on the effect of R&D's relative influence.

In Section 6.5, the generative effects of structural characteristics in the organizational context on integration are studied. Section 6.6 looks at two parts of a company's NPD strategy: marketing intensity and R&D intensity. We test whether integration has a moderating effect on the relationship between NPD strategy and new product performance. Consequently, we pay attention to whether there are NPD strategies for which integration is more (less) important than for others.

Chapter 7 contains the conclusions and implications. In addition, we discuss the managerial implications and offer some suggestions for future research.

PART I

THEORY
AND
DESIGN OF THE STUDY

2

The Model of the effect of the marketing - R&D interface on new product performance

2.1 Introduction

In this chapter we develop a model of the relationship between the marketing - R&D interface and new product performance. This chapter starts with the literature on the two main concepts of this study, namely *new product performance*[3] and *the marketing - R&D interface.* Our comprehensive model and a detailed description of the variables and the expected relationships are presented in Section 2.3. In Section 2.4, a brief summary of the chapter as a whole is given.

2.2 Review of the literature

2.2.1 New Product Performance

It is widely known that companies, particularly high technology companies, have to introduce new products on an ongoing basis to be successful (cf. Gupta et al. 1985, Zirger and Maidique 1990). To develop new products, companies have to undertake difficult and risky activities with high chances of failure (Booz,

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[3] In the literature the concept of new product performance is also called new product success/ failure or innovation success/ failure.

Allen, and Hamilton 1982). As a consequence, there has been considerable interest in new product performance in the literature. In this section we will focus on how new product performance is operationalized and measured.

From the late 60's, numerous studies have examined the determinants of the success and/or failure of new products (e.g., Myers & Marquis 1969, Cooper 1975, 1979, 1993, Rothwell 1972, Zirger & Maidique 1990, Song and Parry 1997). In these studies, researchers set themselves a dual task: identifying the determinants of new product performance *and* defining success (Craig & Hart 1992). Although these studies have offered valuable insights into the determinants of specific success measures, one major concern with the majority of these success/ failure investigations was that they have tended to treat new product performance as a single dimension, often measured with a limited number of items. In a typical study, performance is either classified in terms of success or failure (cf. Cooper & Kleinschmidt 1995).

There have been several studies that more explicitly looked at *measurement* of new product performance. For example, Cooper (1984) included eight measures for new product performance in his study to capture different facets of new product performance of a firm. Measures like 'The percentage of current company sales made up by new products introduced over the last five years', and 'The success of the program relative to competitors' are typical examples of these measures rated by informants. After factor analysis, the eight measures resulted in three independent dimensions of new product performance, namely: (1) impact of the new product development program on sales and profit, (2) success rate of the program (number of successful new products divided by the total number of new products), and (3) the performance of the program relative to objectives, competitors, and profit versus costs. The existence of these three dimensions helped to clarify the notion of 'performance' in the new product context. Specifically, it showed that it is simplistic to speak of a high-performing program without specifying the criteria that have to be taken into account. In other words, the question becomes: what types of performance? High impact, high success rate, or high relative performance? Success in one dimension did not necessarily mean success in the other two.

In a more comprehensive study of the dimensions of new product performance and of how to measure them adequately, 75 measures of new product

performance were studied to recommend a set of 'approved' measures for academic researchers and practitioners (Griffin & Page 1993). The measures resulted from a review of the literature and a small survey. In this study, the large number of measures was reduced to a set of 16 core measures that had been used in research *and* had been used by practitioners *and* were desired by practitioners. These core measures were divided into five general categories by experts: measures of firm benefit, program level measures, product level measures, measures of financial performance, and measures of customer acceptance. Statistical techniques like correlation analysis and factor analysis confirmed that the dimensions were almost completely independent and measured different aspects of new product performance. However, this is by no means the only grouping. Other groupings have also been suggested. For example, Codero (1990) developed a grouping based on a model of the causal relationships between new product performance measures: from the development process, to development output, to business success. Additionally, Loch, Stein, and Terwiesch (1996) divide the measures from Griffin & Page into *process* drivers and *output* drivers.

An important question is: what measures should be used in a study of new product performance? Craig and Hart (1992) argued that there are a number of factors which have to be taken into account in order to achieve a balanced approach to NPD performance measurement. On the basis of their study, four recommendations were given. First, the issue of the level of analysis, the source of data, the data collection method, and the type of measures have to be made explicit so that other researchers face a less confusing picture. Second, researchers are advised to combine financial and non-financial measures of success to make an overall assessment of NPD performance. Third, because success has different dimensions there is a need for research on the factors which contribute to specific dimensions of success. Finally, they argue that researchers should take into account that different companies have different objectives with respect to NPD.

In relation to the level of analysis, Damanpour (1991) stated that the selection of the research level is dependent on the goal of the researcher. Results of single innovation studies may reflect the attributes of the innovations more strongly than the characteristics of the organization. When multiple or even all innovations are considered, the role of the organizational characteristics becomes

more evident. So, if the goal of the researcher is to generate knowledge of the effects of organizational characteristics on new product performance, studying the new product development *program* over a certain period of time is most appropriate.

Dess & Robinson (1984) examined the usefulness of subjective performance measures. They found high correlations between subjective estimates of top managers and factual objective data. The study suggests that subjective measures are valuable in cases where objective measures are not available or cannot be obtained. To date, the findings of Dess & Robinson have been replicated several times (e.g., Venkatraman & Ramanujam 1986) and self-assessments are relatively well accepted. Gatignon & Xuereb (1996) even go a step further and argue that subjective self-assessments may be less problematic than more objective financial measures. Objective measures also can be biased because of the ulterior motives for which they are produced (cf. Saunders et al. 1992, p.184).

Conclusions

Recent studies acknowledge that new product performance is a multi-dimensional construct. Insights into the underlying dimensions of new product performance are emerging and future studies can build upon these insights. The different measures that are used so far include financial and non-financial measures. However, no universally accepted set of measures is available and it is questionable whether this will ever be accomplished. More research is needed before the dimensions of new product performance are established and before accurate measurement scales become available for new product performance on a project level as well as on a company (SBU) level.

As stated before, we will develop and use different multiple-item measures for different dimensions of new product performance. The measures will be checked for uni-dimensionality, reliability and content validity. As a data source, respondents (informants) and factual data will be used. Overall, the recommendations of Craig and Hart (1992) are followed and the insights gained in earlier research (e.g., Griffin and Page 1993) will be incorporated.

2.2.2 The marketing - R&D interface and new product performance

Until now, several studies have explicitly focused on the marketing - R&D interface as an important determinant of new product performance. In these studies, (a lack of) communication, collaboration, harmony, cooperation, and integration play a central role. Important pioneering studies identified difficulties with respect to integration and differentiation in general (Lawrence and Lorsch 1967), personality differences (Saxberg and Slocum 1968), physical distance (Allen 1970), and project selection (Souder 1975). Later, Gupta, Raj, and Wilemon (1985) studied the causes for the lack of integration. Based on the open-ended question in a survey: 'What do you personally consider to be the major barriers to achieving an effective integration between marketing and R&D during the new product development process in your organization?', five categories were mentioned most often: (1) lack of communication, (2) insensitivity to the other's point of view, (3) lack of top management support, (4) personality and cultural differences, and (5) lack of market knowledge. In addition, a 19-item measurement scale was used to study the gap between integration needed and achieved in high-tech US firms. R&D and marketing managers were asked to indicate the actual degree of integration achieved in their firm and the required level of integration as perceived by them. The 19 items were related to marketing's involvement with R&D, R&D's involvement with marketing, and information transfer between marketing and R&D. It was found that there existed an integration gap in all phases of the NPD process and that the achieved level of integration was systematically lower than the needed level of integration. This finding has been replicated in several other studies at different levels of the organization (e.g., Souder 1987, Parry and Song 1992, Carlsson 1991).

What are the determinants of integration between marketing and R&D?

Gupta et al. (1987) found that high levels of achieved integration were related to several factors such as an organizational structure that fosters clarity of roles, decentralized decision-making, increased participation, physical proximity, and the use of methods to organize new product activity cross-functionally.

In follow-up research on the effect of the organizational structure on integration, two important dimensions of organizational structure - formalization and centralization - have received considerable attention. For example, negative effects of formalization and centralization were postulated in the model of Gupta et al. (1986). In their empirical research, however, Gupta et al. (1987) only found a negative effect of centralization and they did not find support for a negative effect of formalization on integration. In addition, Parry & Song (1993) did not find support for a negative effect of either formalization or centralization. To date, several positive effects of formalization on integration have been reported, mainly in studies at the project level. For example, Pinto et al. (1993) found that project team rules and procedures had a significant positive effect on cross functional cooperation. Moenaert et al. (1994) found that formalization was positively related to communication. Recently, Ayers, Dahlstrom, and Skinner (1997) studied 19 projects in a single company. They hypothesized and found a positive effect of role formalization on integration between marketing and R&D and a negative effect of centralization on integration between marketing and R&D. In summary, centralization seems to have a negative effect on integration whereas formalization seems to have some characteristics that make it beneficial for integration in teams.

Recently, a few studies have paid attention to managerial mechanisms which can be used in companies to integrate marketing and R&D (Moenaert & Souder 1990, Ruekert & Walker 1995, Griffin & Hauser 1996). These managerial mechanisms have a narrower scope than formalization and centralization. One can think of mechanisms like physical facilities design, team structures, personnel movement, information technology, informal social systems, etc. These managerial mechanisms are expected to lower possible barriers between marketing and R&D (Griffin and Hauser 1996).

So far, empirical proof is light with regard to the effectiveness of managerial mechanisms in lowering the barriers between marketing and R&D. Only with respect to cross functional teams, has there been considerable empirical testing (for an overview, see Cohen and Bailey 1997). The results show that there are still many problems inside and outside the direct area of teams in companies that prevent teams from being effective. Recently, Ittner & Larcker (1997a, 1997b) elaborated on the effects of managerial mechanisms on performance in general

and on the relationship between product development cycle time and performance in particular. Interestingly, several mechanisms (e.g., the use of cross functional teams) were not related to performance at all. They did, however, find that cross functional teams and advanced design tools (e.g., QFD) interact with accelerated product development to improve performance. In addition, Griffin (1997) also focused on development cycle time reduction. She showed how using a cross functional team interacts with product newness, reducing cycle time when projects are dealing with new things. Furthermore, she showed how using a formal product development process interacts with product complexity in a way that it reduces cycle time when products are more complex (although not in the initiation phase).

To summarize, several determinants of integration in companies have been studied in earlier research. These determinants are related to the organizational structure (formalization and centralization), and managerial mechanisms. Specific variables in these categories will have to be included in a comprehensive study if the marketing - R&D interface is studied within a broader organizational context.

Is integration related to new product performance?

A considerable number of studies have found a positive effect of integration on new product performance on different levels of the organization (company and team level). Griffin & Hauser (1996) state after reviewing 15 studies on integration that 'the evidence is strong, consistent, common across a variety of methodologies, and seemingly applicable in both services and products and in both consumer and industrial markets.' However, we argue that these studies mainly focused on integration in teams. The studies that focused on integration in companies are less consistent.

At the company level, Song and Parry (1992) found that for many scale items, higher levels of achieved integration resulted in more successful new product development. However, there seemed to be differences in the relationship between integration achieved and new product success in different industries. In particular, they found a strong positive relationship in the Japanese electrical and industrial machinery industry, but a weak relationship in the chemical industry. In addition, by comparing Japanese and American chemical companies,

Norton, Parry and Song (1994) found that in their sample the link between integration and new product success was far weaker in Japanese chemical firms than in US chemical firms.[4] Recently, Gatignon and Xuereb (1997) found that the effect of interfunctional coordination (thus not explicitly focusing on integration between marketing and R&D) on new product performance was limited.

At the project team level, the positive relationship between concepts like integration and performance is more robust. Souder (1988) developed a 289-project database containing detailed descriptions and ratings of key events, attitudes and behavior of marketing and R&D personnel who worked on projects. It was found that harmony in the project team was positively related to new product development project success. Pinto and Pinto (1990) and Pinto et al. (1993) found that highly cooperating cross functional teams used more informal communication. Additionally, they found a positive relationship between cross functional cooperation and success. Recently, Song & Parry (1997) developed a comprehensive model of internal and external factors that affect the new product success of teams directly and indirectly. The model was tested with data from 788 new products developed and commercialized by Japanese firms. The results suggest that cross functional integration has the largest effect on new product success. This is one of the few studies that addresses the effect of integration in a broader context. More research is needed before these results can be generalized to other settings.

Apart from research on the marketing - R&D interface, research in other areas was reviewed. The concept of integration between marketing and R&D is related to one aspect of the relationship between marketing and R&D in new product development and marketing. To collect other relationship aspects, research on characteristics of relationships between actors in distribution channels was reviewed. In this literature, apart from factors that are related to integration (e.g., goal compatibility, trust, communication), the concepts of power and control

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The studies differed on several (other) characteristics. Therefore, the differences in the relationship between integration and new product performance are difficult to attribute to specific causes.

play an important role. We learned that power and control[5] (called relative influence from now on in the present study) and integration are two distinct aspects of a relationship that can change independently. Furthermore, both relationship aspects are known to be related to certain performance outcomes of processes (Mohr et al. 1996, Stern and El-Ansary 1996). In this light, it seems that until now the marketing - R&D interface has been too narrowly operationalized, especially since (aspects of) relative influence received so much attention in other management areas (e.g., Pfeffer and Salancik 1974, 1978).

Finally, studies of market orientation were reviewed. We learned that integration and market orientation are somewhat related concepts. One aspect of being market oriented is having good inter functional coordination (Narver & Slater 1990, Kohli & Jaworski 1990, Day & Wensley 1988, Day 1992, 1994, Hunt & Morgan 1995). Empirical research on market orientation has found support for a positive relationship between market orientation and performance (e.g., Narver & Slater 1990, Ruekert 1992, Despandeh et al. 1993). Interestingly, however, the positive relationship between market orientation and performance has been explicitly questioned by several researchers who studied possible moderating variables in the environment (e.g., market turbulence, technology turbulence, competitive hostility, and growth). The question in these studies was whether a market orientation is more or less important in specific environments. Until now, studies by Jaworski & Kohli (1993) and Narver & Slater (1994) have found very little or no support for such moderating effects. Even if a moderating effect had been found, they argue that the benefits of a market orientation are long term and environmental conditions are transient, and thus being market oriented is cost-effective in spite of any possible short-term moderating effects of the environment.

Conclusion

The effect of integration on new product performance has been studied at

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[5] Power is usually conceptualized as the ability to influence (e.g., El Ansary and Stern 1972), control as the achieved influence (Ouchi 1979, Mohr, et al. 1996). Sometimes these two influence concepts are treated as equivalent (Etzioni 1967).

different levels of the organization. In the few studies on integration at the level of the company, the positive effect of integration on new product performance is not so robust. Investigations of integration in project teams is more diverse, has depended on different methods, and has focused on several phenomena like cooperation, harmony, communication and knowledge linking. Here, a more robust positive relationship between integration and new product performance has been found.

We argue that further research on the marketing - R&D interface and new product performance is most interesting at the company level. In addition, the results at this level are inconsistent, which may partly be explained by the fact that the effect of integration on new product performance is often studied in isolation from the effects of other factors in the company. More research is needed in a more comprehensive setting where structure, resources, and NPD strategy are taken into account. Results from such studies may partly explain why integration is sometimes found to be related to new product performance and sometimes to be unrelated to new product performance.

In addition, the marketing - R&D interface is not adequately captured in the concept of integration. Beside integration, other factors like relative influence of marketing and/or R&D in specific NPD decisions is expected to play an important role. More research is needed on the broader content of the marketing - R&D interface and its effects on new product performance.

Finally, apart from studying the relationship between the marketing - R&D interface and new product performance, more research on the determinants of specific variables in the marketing - R&D interface (integration and relative influence) is needed. The role of structural characteristics like formalization and centralization and the effects of managerial mechanisms in affecting the marketing - R&D interface and new product performance need more attention.

In the next section, the model of the relationship between the marketing - R&D interface and new product performance in the broader organizational context is presented.

2.3 The model underlying the study

In Figure 2-1, the comprehensive model that guides this study is presented. This model is based on earlier research as well as on exploratory interviews with practitioners. Earlier research was used to detect important variables and to formulate expected relationships. The role of the interviews was also important because it provided insights into additional variables as well as into the importance of the myriad variables from the literature. In addition, it provided an overall test of the relevance of this study.[6]

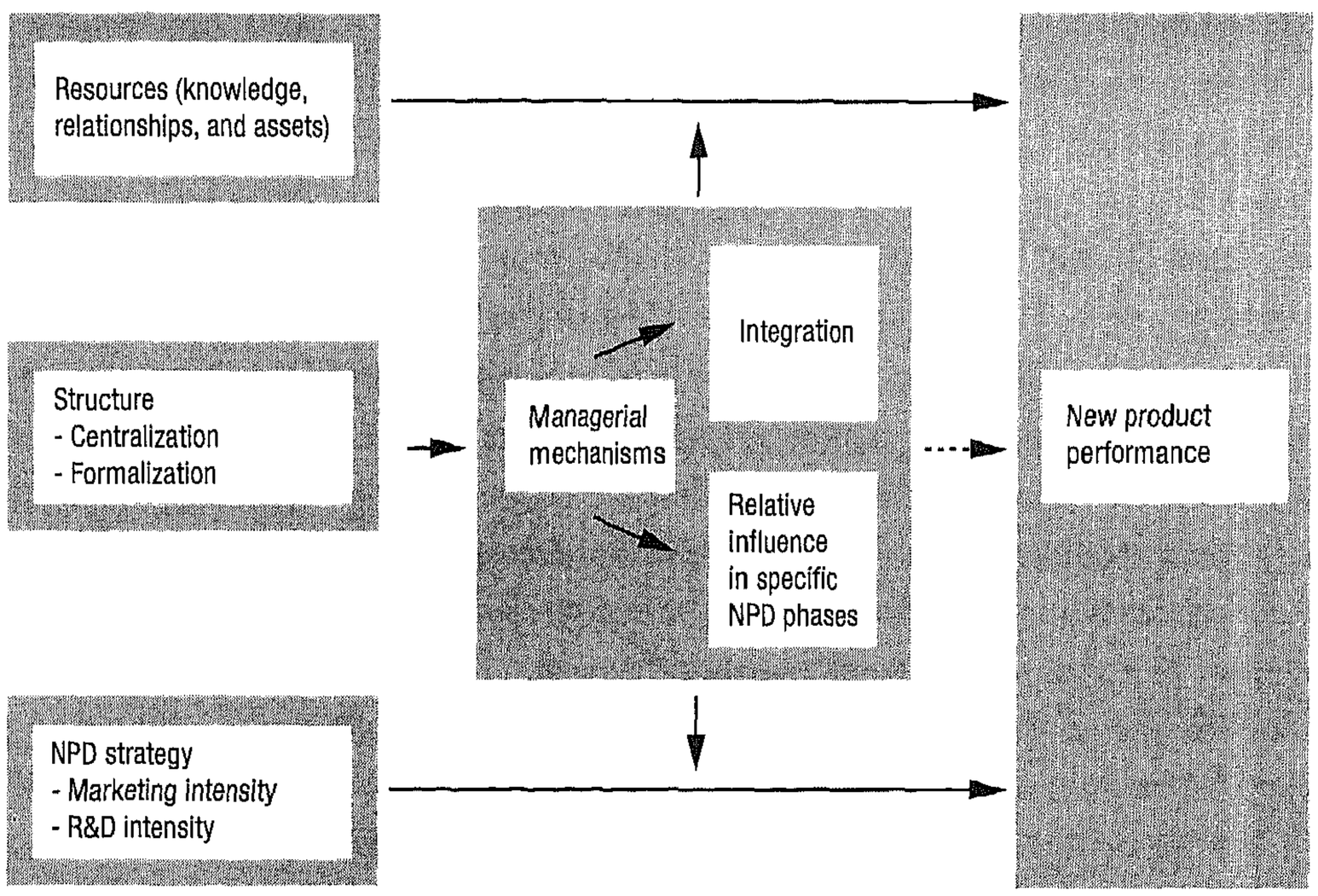

FIGURE 2-1: THE COMPREHENSIVE MODEL UNDERLYING THE STUDY (ARROWS GIVE AN OVERVIEW)

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6 We conducted 20 low-structured interviews in companies. In the interviews, the questions were related to the organization of R&D worldwide, the role of marketing in NPD, new product performance, and recent new product cases. Among other things, the interviews strengthened our belief that the marketing - R&D interface is of great concern to companies. Respondents in Philips, Unilever, MSD, Glaxo, Sandoz, Ericsson, Yamanouchi, and Akzo Nobel attributed many problems with respect to company performance to the marketing - R&D interface.

In the model, the marketing - R&D interface is the central element. In this interface, the following variables are distinguished: (1) integration between marketing - R&D, (2) relative influence of marketing and R&D in specific NPD phases, and (3) managerial mechanisms.

The dependent variable in the model is new product performance. We will include several different variables to emphasize the different facets of this construct (Craig & Hart 1992). With respect to the organizational context, a distinction is made between three types of characteristics: resources, structure (formalization and centralization), and NPD strategy (marketing intensity and R&D intensity).

The model focuses on company characteristics that explain new product performance. Since the external environment is not modeled explicitly, we will test the model in the relatively homogeneous environment of one narrowly defined industry, i.e., the pharmaceutical industry. The model is based on the Resource Based View of competitive advantage (Wernerfeld 1984, Day & Wensley 1988, Day 1994, Hunt & Morgan 1995). This view assumes that a firm's resources play an important role in its competitive position. Firm resources include resources like capital resources, human resources, organizational resources, etc. (Barney 1991). In this respect, the marketing - R&D interface can be conceptualized as a *cross functional* resource that can create a sustainable competitive advantage.[7] In contrast, the 'resources' variable in the organizational context is a *functional 'depth'* resources variable. By modeling the relationship between the marketing - R&D interface and new product performance in the way we propose, we have the opportunity to study how multiple variables in

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[7] Of course, the duration of the sustainability is dependent on factors both internal and external to the firm (cf. Hunt & Morgan 1995). Internally, a lack of understanding of the source of the advantage may be an important threat. Externally, the comparative advantage can be neutralized by government actions that affect the new product development process or because competitors change the rules of competition, etc. Notwithstanding these threats, there are many barriers that prevent companies from imitating processes in the marketing - R&D interface. The marketing - R&D interface is intangible, cannot be purchased, is socially complex in its structure, is highly interconnected, and might have an important tacit dimension. Therefore, there are good grounds for believing that a company with a high-quality marketing - R&D interface can enjoy a comparative advantage that can lead to a sustainable competitive advantage and superior new product performance for a considerable period of time.

the marketing - R&D interface together with factors outside the interface affect new product performance (the interplay of cross functional and functional resources). As a consequence, the direct effect of the marketing - R&D interface on new product performance can be explicitly questioned, as indicated by means of a dotted arrow between the interface and new product performance. The model will be discussed in more detail in the following sections.

2.3.1 The marketing - R&D interface

In this section we open the black box of the marketing - R&D interface. Three variables will be described in more detail below in the following order: (1) integration between marketing and R&D, (2) managerial mechanisms, and (3) relative influence of marketing and R&D. Additionally, the expected relationships between the variables will be presented as hypotheses.

Integration between marketing and R&D

Various terms have been used in earlier research to describe the notion of people working together to accomplish tasks. For example, terms like 'integration', 'collaboration', 'cooperation', and 'harmony' are used throughout the literature to label similar concepts. According to Pinto and Pinto (1990) the common denominator among these concepts is joint behavior toward some goal of common interest.

'Cooperation' as defined in cooperation theory (Deutsch 1949, Tjosvold 1984) refers to the interdependence of goals between individuals as well as between departments (Tjosvold 1984). In cooperation, people and groups perceive their goal attainments as positively related; one's movement toward one's goals facilitates the others' goals. According to Deutch, cooperation has a direct link to specific expectations, attitudes, and behavior:

- Expected and actual assistance. People expect others to help them to reach their goals and persons do actually assist each other.
- Communication. Communication tends to be accurate and problems are identified.
- Task orientation. People divide up tasks and encourage each other to complete them so that they can all move towards their goals.

- Friendliness and support. The positive value given to another's effective behavior is generalized to a positive attitude toward one other.

In defining and operationalizing integration, we will build on the above expectations, attitudes, and behaviors. The term 'integration' instead of cooperation will be used because the focus is on the company level (cf. Gupta et al. 1986).

Managerial mechanisms

Managerial mechanisms are used in companies to bridge the gap between marketing and R&D.[8] We use the term *managerial* mechanisms because the mechanisms can be manipulated by management. Examples are: the introduction of new information technology like e-mail between marketing and R&D, the organization of cross functional informal programs like survival sessions/ meetings, cross functional teams, using equal salary schemes and offering equal career opportunities.

In a recent conceptual study, Griffin and Hauser (1996) elaborated on integration mechanisms between marketing and R&D. Their conceptualization is similar to our concept of 'managerial mechanisms'. They distinguish six types of mechanisms: physical facilities design, personnel movement, informal systems, organizational structure, incentives and rewards, and formal integrative management processes. Each mechanism can be used to overcome one or more 'gaps' or barriers between marketing and R&D. Furthermore, management is able to implement the mechanisms in a relatively short period of time. Moenaert & Souder (1990) classified the same types of managerial mechanisms into three major categories, depending on whether they involve formal task specification, organization structure design, or organizational climate measures. However, in both studies a test of the mechanisms' effectiveness to produce integration between marketing and R&D is not provided.

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[8] As stated before, the gap between marketing and R&D ranges from personality differences (Saxberg and Slocum 1968), different 'thought worlds' (Dougherty 1992), different languages (Griffin and Hauser 1993), to physical barriers (Allen 1970).

We build on the earlier work of Moenaert & Souder and Griffin and Hauser to group the mechanisms with respect to their (dominant) active component: (1) control mechanisms, (2) interaction mechanisms, and (3) climate mechanisms.

Control mechanisms

Control mechanisms specify the various activities and roles to be performed by the parties inside the marketing - R&D interface. Rules are established that provide personnel with a general framework (Moenaert & Souder 1990). Certain forms of control enhance the creation of a common language and help to overcome the 'not-invented-here syndrome' (Griffin & Hauser 1993). Therefore we expect a positive effect of control mechanisms on integration although it must be noted that control in general is also known to have a general negative effect on communication (Aiken & Hage 1971). Examples of control mechanisms that will be considered in the present study are: formal stage gate systems (Griffin & Hauser 1996), formal control bodies like review boards (Cooper 1993), and liaison officers (Allen 1986).

Since all control mechanisms are expected to lower certain barriers between marketing and R&D (see for example (Griffin & Hauser 1996), we expect a positive relationship between this type of mechanisms and integration. A positive effect means that the (more extensive) use of a managerial mechanism leads to (more) integration between marketing and R&D.

H1a: There is a positive relationship between the use of control mechanisms and integration between marketing and R&D.

Interaction mechanisms

A large body of literature suggests that interaction among members of an organization fosters similarity among members' beliefs and values. Walsh and Ungson (1989) suggested that organizations themselves are networks of intersubjectively shared meanings that are sustained through everyday social interaction.

Thomas & Griffin (1991) wrote that as a result of face-to-face discussions of work events, groups grow more homogeneous in their views. Examples of mechanisms that stimulate direct interaction in the present study are; physical closeness of marketing and R&D (Allen 1970, 1986, Griffin & Hauser 1996,

Gupta et al. 1986), informal survival sessions (Griffin & Hauser 1996), job rotation (Griffin & Hauser 1996), and cross functional teams (Pinto & Pinto 1990). Since cross functional teams especially are such a complex mechanism, different aspects of cross functional teams will be considered. Interaction mechanisms are expected to lead to increased integration because of increased communication which fosters shared beliefs and values.

H1b: There is a positive relationship between the use of interaction mechanisms and integration between marketing and R&D.

Climate mechanisms

Climate mechanisms, as we define them, do not encompass direct interaction nor do they specify roles or exert formal control in the interface as is the case with control mechanisms. Instead, climate mechanisms are closely related to the social-psychological climate in the organization (e.g., perceived equal opportunities for marketing and R&D). We expect that climate mechanisms have a positive effect on integration although sometimes the impact may be low, mainly because they do not directly affect people's behavior. Examples of mechanisms included in the present study are: equal reward systems (Griffin & Hauser 1996) and statements by top management on the importance of interaction between marketing and R&D (Moenaert & Souder 1990). Since climate mechanisms lower social-psychological barriers, we expect a positive effect of these mechanisms on integration between marketing and R&D.

H1c: There is a positive relationship between the use of climate mechanisms and integration between marketing and R&D.

The second goal of this part of the study is to find managerial mechanisms that are more effective than others. The fact that there might be mechanisms that are in general more effective than others is supported by some earlier research (e.g., Souder 1987). For example, it was found that some mechanisms such as the interacting dyad are universally more effective than others. In addition, Moenaert & Souder (1990) gave another example that points in the same direction. They state that 'considering the turbulence inherent in technological

change, the success of *task specification* may be limited'. Unfortunately, an empirical test is not presented and with respect to other types of mechanisms they only state that they have been used successfully in specific cases.

In a more recent study, Dougherty (1992) studied the *general* underlying problems with respect to collaboration in new product projects. She further developed the concept of 'thought collectives' or 'thought worlds'. A thought world is a community of people engaged in a certain domain with a shared understanding of that domain. 'Thought worlds' from different domains cannot easily share ideas and have a common understanding. Since innovation requires insights from a wide variety of specialties, 'thought worlds' are an important barrier in innovation in general and between marketing and R&D in particular. Her analysis suggests that effective collaboration mechanisms affect 'thought worlds' by means of interaction through which it is possible to overcome the inward orientation of functional groups.

To summarize, there are indications in the literature that certain managerial mechanisms might be universally more effective than others. Furthermore, there seems to be a general underlying problem with respect to 'thought worlds' which results in inward orientation and a lack of collective activity. This suggests that managerial mechanisms that affect 'thought worlds' are more effective in general. Although we recognize that the theory is not well developed, we propose that mechanisms that stimulate direct interaction (physical closeness, cross functional teams, cross functional informal survival meetings, job rotation, e-mail, etc.) are more effective than mechanisms that do not.

H2: Interaction mechanism are more effective in producing integration between marketing and R&D than control and climate mechanisms.

From the exploratory interviews we learned that marketing and R&D also compete for scarce resources and that they have relationships where power and control play a role. Not much is known about these processes so far. Therefore, a variable for relative influence in specific phases of the NPD process is incorporated in this study.

Relative influence of marketing and R&D

Until now, research of the marketing - R&D interface has primarily paid attention to concepts like integration. In the present study we broaden the scope of the marketing - R&D interface by including relative influence in our comprehensive model. We define relative influence broadly as a combination of the *ability to influence* and the *achieved influence* of R&D relative to marketing (and vice versa). Relative influence in general is a concept that has been studied before in marketing and sociology but not in relation to new product development. In marketing, studies of family members' influence in family buying decision-making (Foxman et al. 1989, Beatty & Talpade 1994), influence in buying centers (Venkatesh et al. 1994), influence in distribution channels (Boyle et al. 1992) have focused on similar concepts. In sociology, research on subordinates' participation in decision making has a long tradition (Scandura 1986).[9]

Indications for the importance of relative influence in the marketing - R&D interface *besides* integration were obtained from the literature and from the exploratory interviews. In the channel literature for example, integration and certain forms of relative influence are studied next to each other. For example Anderson et al. (1987) viewed trust, communication, and goal compatibility (comparable to integration as we define it) *and* the ability to influence as important aspects of relationship quality. Recently, Mohr et al. (1996) distinguished both integration and achieved influence as important governance structures that regulate the conduct of parties in exchange relationships and decision-making. In the interface literature, Souder (1987) found that teams with harmony between marketing and R&D could enjoy a dominant functional area or have equal partnerships between the functional areas.

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[9] In sociology many studies have adopted the control graph. This measurement instrument has been used in many empirical studies to measure the influence of different hierarchical layers in the organization. Tannenbaum usually talked about control and power whereas Likert (who was director of Tannenbaum's institute at that time) called it influence. In this study we will use the term relative influence.

The NPD process consists of many different decisions and activities that are often grouped in different phases (Crawford 1996, p.43). Zaltman, Duncan, and Holbek (1973) and several others suggest that there are two important phases: (1) **the initiation phase**, and (2) **the implementation phase**. The initiation phase in general encompasses planning, concept generation, evaluation and concept testing. The implementation stage encompasses product development, test marketing, launch and commercialization. Since relative influence is connected to specific decisions and activities, we expect that the initiation phase and implementation phase will differ with respect to the level of relative influence of a functional area. R&D will be dominant in the initiation phase and marketing will be dominant in the implementation phase because those are the phases where most of their core activities lie.

H3a: R&D is dominant in the initiation phase.

H3b: Marketing is dominant in the implementation phase.

We expect that the use of managerial mechanisms will lead to more relative influence balance in specific phases. To balance relative influence between marketing and R&D, the degree of relative influence of the dominant functional group has to be lowered. Since all three types of managerial mechanisms (control, interaction, and climate mechanisms) are expected to decrease the 'gap' between marketing and R&D, we expect that all types of mechanisms will at least facilitate a balancing effect. Therefore we expect that managerial mechanisms will be negatively related to R&D's relative influence in the initiation phase (where R&D is expected to be dominant) and positively related to R&D's relative influence in the implementation phase (where marketing is expected to be dominant).

H4a: There is a negative relationship between the use of control mechanisms and R&D's relative influence in the initiation phase.

H4b: There is a negative relationship between the use of interaction mechanisms and R&D's relative influence in the initiation phase.

H4c: There is a negative relationship between the use of climate mechanisms and R&D's relative influence in the initiation phase.

H5a: There is a positive relationship between the use of control mechanisms and R&D's relative influence in the implementation phase.

H5b: There is a positive relationship between the use of interaction mechanisms and R&D's relative influence in the implementation phase.

H5c: There is a positive relationship between the use of climate mechanisms and R&D's relative influence in the implementation phase.

Although all managerial mechanisms are expected to be related to the relative influence balance in specific NPD phases, we expect that there will be differences in their degree of effectiveness in producing a more relative influence balance. The type of managerial mechanisms expected to be most directly related to relative influence are those in the category of control mechanisms. Control mechanisms encompass formalized responsibilities and formal control bodies which directly affect relative influence. So, we expect that control mechanisms are most effective in producing a balanced influence structure in all phases.

H6a: Control mechanisms have the strongest negative effect on R&D's relative influence in the initiation phase.

H6b: Control mechanisms have the strongest positive effect on R&D's relative influence in the implementation phase.

In the next section, we will step out of the black box of the marketing - R&D interface and formulate hypotheses on the relationships between the marketing - R&D interface and new product performance.

2.3.2 The effect of the marketing - R&D interface on new product performance

New product performance is the dependent variable in the comprehensive model that underlies this study. New product performance is defined as the (proven) ability of the company (SBU) to generate, develop and market *new-to-the-company* products such that similar companies in the same industry are outperformed over a certain period of time (five years). An SBU is defined as a business that sells a distinct set of products or services (cf. PIMS Data Manual 1978, Buzzell and Gale 1987)

Several studies have found that integration has a positive effect on new product performance. As mentioned before, Griffin & Hauser (1996) stated that the evidence is "strong, consistent, common across a variety of methodologies, and seemingly applicable in both services and products in consumer and industrial markets". Although Griffin and Hauser (1996) mainly refer to the marketing - R&D interface in project teams, a few studies at the level of the company support this finding to some extent (e.g., Norton et al. 1994).

Souder (1987) found that there are teams in which members are 'too good friends'. These teams suffer from some kind of 'dead-lock' because members share each other's view too much, which has a negative effect on performance. At the company level, this phenomena has not been studied. We expect however that diminishing returns or even negative returns on integration will not be present at the company level. In companies or business units as a whole, there is a much larger degree of diversity in goals, perceptions, and attitudes. In such an environment, a possible dead-lock is not likely to occur.

H7: There is positive monotonic relationship between integration and new product performance.

As stated before, integration and relative influence are expected to be two relatively independent concepts which are both expected to affect new product performance. From the distribution channel and organization literature, it is known that the distribution of relative influence over parties in specific decisions or activities is a major factor in the level of overall performance. An adequate

relative influence balance allows a more efficient and effective allocation of resources in the channel as a whole (Stern, El-Ansary, and Coughlan 1996, p.320). In line with this, we expect that the relative influence balance between marketing and R&D is related to new product performance of companies.

Our expectation with respect to the location of the optimal level of R&D's relative influence in a specific phase and to the nature of the relationship is presented in Figure 2-2 (curves give an indication).

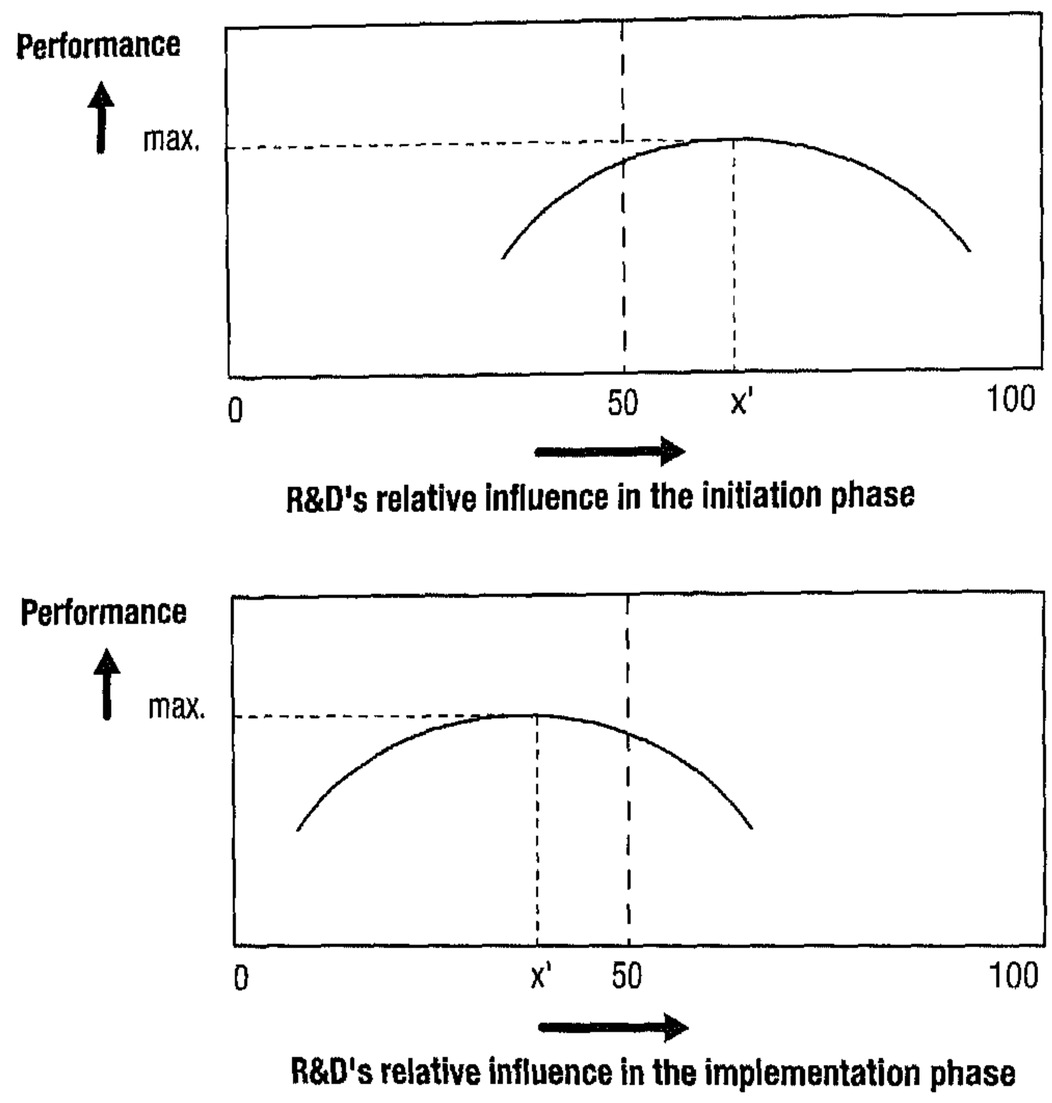

FIGURE 2-2: AN INDICATION OF THE RELATIONSHIP BETWEEN RELATIVE INFLUENCE AND NEW PRODUCT PERFORMANCE.

Figure 2-2 shows the expected relationship between R&D's relative influence in a specific phase and new product performance. As discussed before, we expect that it is optimal for a company if R&D is dominant in the initiation phase (see Figure 2-2, X'>50) and marketing is dominant in the implementation phase (see Figure 2-2, X'<50).

Apart from the location of the optimum value, we expect that relative influence is related to new product performance in a non-linear way. We expect that it is

optimal for a company if the dominant group in a specific phase allocates some relative influence to the less dominant group. However not too much because then the input of functional expertise could become problematic resulting in lower performance. Therefore, we expect an inverted U-shaped relationship between R&D's relative influence in the initiation phase and new product performance. We expect the same in the implementation phase, however with a different optimum value X' (see Figure 2-2).

H8a: There is an inverted U-shaped relationship between R&D's relative influence in the initiation phase and new product performance. The highest point of the curve lies in the area where R&D is dominant (right hand side of the 50-50 line)

H8b: There is an inverted U-shaped relationship between R&D's relative influence in the implementation phase and new product performance. The highest point of the curve lies in the area where marketing is dominant (left hand side of the 50-50 line)

In the next part of the study we will incorporate the organizational context in the analysis. In a more comprehensive setting we can answer the question of how does the marketing - R&D interface affect new product performance.

2.3.3 The effect of the marketing - R&D interface on new product performance in the broader organizational context

In this section we focus on the *joint* effects of the marketing - R&D interface and the organizational context on new product performance. We focus on (functional) 'depth' **resources**, two organization **structure** characteristics (formalization and centralization), and two aspects of **NPD strategy** (marketing intensity and R&D intensity).

Resources

The 'resources' construct is conceptualized as a functional 'depth' resource related to knowledge, relationships, and assets. The term 'functional' means that it is not a cross functional resource related to the marketing - R&D interface.

The first aspect of resources as we define it is related to technical and marketing knowledge in the company. Dewar and Dutton (1986) reported that the greater the technical knowledge resources of a company, the more easily new technical ideas can be understood and procedures for their development and implementation can be attained. In addition, Song & Parry (1997) in a study at the project level found that marketing and R&D resources lead to higher proficiency of NPD activities and better product quality which leads to more new product success.

The second aspect of the resources construct relates to inter-organizational relationships or 'organizational networks' within a specific functional area (e.g., R&D that teams with a biotech company). Networks can create a competitive advantage for reasons such as better knowledge diffusion and better appropriation of new product development efforts. Networks are an important resource in many different industries like the pharmaceutical industry, the semiconductor industry, and the furniture industry (Gemser, Leenders, and Wijnberg 1996).

The third aspect of resources includes the *amount* of financial resources and assets. Slack resources, such as financial reserves allow an organization to purchase innovations, to absorb failures, to bear the costs of instituting an innovation, and to explore new ideas in advance of an actual need in the market. Also 'size' has had much attention in the literature (e.g., Kimberly and Evanisko 1981, Freeman 1982). Since all components of the resources construct are closely related, we expect that the resources construct is one-dimensional. We hypothesize a direct positive relationship between resources and new product performance.

H9: There is a positive relationship between resources (knowledge, relationships, and assets) and new product performance.

Earlier research on the relationship between integration and new product performance has not paid attention to the fundamental issue of how integration is related to new product performance. At best, earlier studies have linked

measures of integration directly to measures of success. However, there are many factors in the organizational context outside the marketing - R&D interface that affect new product performance. The question we address here is whether there are factors that make integration more or less effective in producing new product performance.

Lawrence and Lorsch (1967) describe the process of how organizations become segmented into units. Each unit has as its major task the problem of dealing with part of the conditions outside the firm; marketing faces problems associated with the market, customers, and competitors. R&D deals with science, technology, and development. So, on the one hand there is a need for 'depth' in specific areas and on the other hand these parts have to be linked together to accomplish the organization's overall goals. In other words, it seems that integration alone is not enough. Apart from integration, sufficient 'depth' is also needed (Wind and Mahajan 1997). From a resource based perspective, the 'integration' resource is a *cross functional* resource. We argue that cross functional resources enable a productive integration of other underlying (functional) 'depth' resources. Therefore, we expect that integration multiplies or mitigates the positive effect of 'depth' resources on new product performance.

H10: Integration between marketing and R&D has a moderating effect on the relationship between resources and new product performance. Increased integration is related to improved new product performance if the company's resources are above a certain threshold.

Support for hypothesis 10 implies that there are companies for which stimulating integration has a negative effect on new product performance, specifically for those that score low on resources and spend money on integration.

We follow the same line of reasoning with respect to the way relative influence affects new product performance. An adequate relative influence balance in the company is a *cross functional* resource that can offer a competitive advantage because it enables a high-quality decision-making process. Especially since relative influence affects the allocation of resources (e.g., Pfeffer and Salancik 1974), an adequate relative influence balance is expected to be dependent on the amount

and quality of (functional) resources in the company: if the company has limited functional resources in the first place, adequate allocation of these resources alone will not be sufficient for success.

So, put conversely, the effect of R&D's relative influence in a specific phase on new product performance is dependent on resources. If the company has sufficient resources, new product performance will reach an optimum level at a certain relative influence point (an inverted U-shaped relationship between R&D's relative influence and new product performance).

H11a: R&D's relative influence in the initiation phase has a moderating effect (inverted U-shape) on the relationship between resources and new product performance: if a company's resources are above a certain threshold, increased marketing influence in the initiation phase is related to improved new product performance up to a certain point (inverted U-shaped).

H11b: R&D's relative influence in the implementation phase has a moderating effect (inverted U-shape) on the relationship between resources and new product performance: if a company's resources are above a certain threshold, increased R&D influence in the implementation phase is related to improved new product performance up to a certain point (inverted U-shaped).

Formalization

In this study, formalization is defined as an organizational routine that refers to the extent to which decisions and actions in the organization follow rules and formal procedures. In highly formalized companies there are explicit job prescriptions, many organizational rules, and clearly defined procedures covering work processes. Although there are several studies that found that specific *types* of formalization can be applied in a productive way for specific tasks (e.g., Zaltman et al. 1973, Ayers et al.1997), formalization as a company-wide characteristic is generally negatively related to new product performance (Burns & Stalker 1961, Aiken & Hage 1971).

We expect a negative relationship between formalization and new product

performance. Given this negative relationship which we will validate, the *generative mechanism* by which formalization influences new product performance will be studied (the mediating effect of a third variable (Baron and Kenny 1986)). Since earlier research has reported on the negative effects of formalization on flexibility, communication, and decentralized initiatives (Burns & Stalker 1961, Aiken & Hage 1971), we expect that integration is a mediator with respect to the relationship between formalization and a company's new product performance.

H12: There is a direct negative relationship between formalization and new product performance and there is an indirect negative relationship that runs through integration.

Centralization

Centralization is defined as an organizational routine that is related to the degree of concentration of decision-making authority in the organization. In centralized organizations, decision-making authority follows hierarchical lines and is concentrated in higher levels of the organization. We expect a negative relationship between centralization and new product performance although, as in the case of formalization, there are a few reports of a positive effect of centralization on performance (Egelhoff 1982). However, this is more an exception than a rule, and in a recent meta study a negative relationship is found between centralization and new product performance (Damanpour 1991). In addition, earlier research found a negative relationship between centralization and communication (Damanpour 1991). This implies that the negative effect of centralization is potentially caused by a mediator effect of reduced integration in the marketing - R&D interface.

H13: There is a direct negative relationship between centralization and new product performance and an indirect negative relationship that runs through integration.

NPD strategy

In earlier research into the effects of business strategy on the conduct and

performance of companies, firms are often clustered in different strategic groups (e.g., Cool & Schendel 1987, 1988, Thomas & Bogner 1996). With respect to the *NPD strategy* of companies, Cool & Schendel (1987, 1988) found that the strategic group concept can discriminate between firms that lead in the R&D field and those that rely more on marketing, imitation, and a broad product range. This distinction suggests that two dimensions are particularly interesting with respect to NPD strategies (we will use the term NPD *strategy* because of the relationship with strategic groups, another term like NPD *style* would also be appropriate): R&D intensity and marketing intensity.

The two NPD strategy dimensions - R&D intensity and marketing intensity - have been replicated in different studies (e.g., Cool & Schendel 1987, 1988, Bogner et al. 1996). Furthermore, Cooper (1993, p.301) explicitly makes a distinction between technologically sophisticated NPD strategies and marketing driven NPD strategies. Technologically sophisticated strategies are strongly R&D-oriented and they produce products that offer technologically advanced and unique features. Companies with a marketing-driven strategy are pro-active in need identification and marketing and sales.

In the present study, we expect that the effects of marketing intensity and R&D intensity cannot be assessed independently of each other. To our knowledge, the conditional nature of the relationship between a specific strategic dimensions and new product performance has not been studied before. According to conventional wisdom, an R&D-intensive NPD strategy has a positive effect on new product performance because products are more innovative and offer more technical benefits. A marketing-intensive strategy has a positive effect on new product performance because companies that adopt it can support their new products with more marketing power.

Since a marketing-intensive NPD strategy requires large investments in salesforce, advertising, etc., companies that adopt such a strategy need adequate products. This is more likely if the company is also R&D-intensive because the products are likely to be more technologically superior (Cooper 1993, Gatignon & Xuereb 1997). Because of this connection between marketing and R&D intensity, we hypothesize that there is a point where it is better for companies to invest in R&D intensity than in marketing intensity to generate more new product performance. Specifically, we hypothesize that the relationship between

marketing intensity and new product performance is moderated by R&D intensity (and vice versa).

H14a: The positive relationship between marketing intensity and new product performance is moderated by R&D intensity. Increased marketing intensity is related to improved new product performance if a company's R&D intensity is above a certain threshold.

So far, we have not paid attention to the joint effects of NPD strategy and integration. In the model of Gupta et al. (1986), organizational strategy is expected to affect the need for integration. In specific, their model suggests that innovative strategies result in the highest need for integration. However, the empirical evidence has been mixed (see for example Gupta et al. 1985, Parry & Song 1993).

In the comprehensive model we hypothesize a moderating effect of integration on the relationship between NPD strategy and new product performance. This moderating effect expresses our expectation that the benefits of integration differ for companies with different NPD strategies. However, in contrast to Gupta and colleagues, we do not argue that the effect is dependent upon innovativeness but on the amount of interdependence of marketing and R&D. For example, R&D-intensive companies often have considerable success without too much marketing involvement (see for example Workman 1993). In other words, the interdependence between marketing and R&D is low in these companies and therefore the effects of integration are expected to be small (group 2 in Table 2-1).

Table 2-1 shows a 2x2 matrix in which a typology is given of a company's NPD strategy. In each cell, the expected level of interdependence between marketing and R&D is described. In general it is argued that the more interdependent marketing and R&D are, the higher the benefits of integration will be.

TABLE 2-1: THE RELATIONSHIP BETWEEN INTERDEPENDENCE BETWEEN MARKETING AND R&D AND NPD STRATEGY

Marketing intensity	R&D intensity: Low	R&D intensity: High
Low	1 Low-on-innovation entrepreneurial marketer **Average interdependence**	2 Highly innovative, entrepreneurial R&D **Lowest interdependence**
High	3 Low-on-innovation marketing-driven **Highest interdependence**	4 Broad based, full R&D/ marketing **Average interdependence**

Table 2-1 shows that we expect only minor benefits from integration in the companies that operate in group 2. A manager during the exploratory interviews expressed it thus:

> *"Of course, a new and effective drug against Alzheimer will become a major blockbuster. For that, you do not need much integration between marketing and R&D."*

In contrast, high marketing-intensive and low R&D-intensive companies often focus on an imitation- and (re)development driven strategy. Here, low innovative new products are launched in selective markets accompanied by intensive marketing (Cool & Schendel 1987). We argue that this is the group with the highest interdependence of marketing and R&D and therefore with the highest benefits of integration (group 3, Table 2-1). Another manager during the interviews expressed it thus:

> *"We were late with our new cardiovascular product and now we are busy with clinical trials to be able to make additional claims, for example, that the drug can be used with alcohol and certain cara drugs. For this you need close cooperation between marketing and R&D."*

In summary, we expect that there are different levels of interdependence of marketing and R&D depending on the NPD strategy of the company (Thompson 1967, Tushman 1979). This interdependence is likely to affect the possible benefits of integration (cf. Wagner and Gooding 1987). Companies with a high R&D intensity and a low marketing intensity are expected to benefit least from integration. Companies with a low R&D intensity (more focused on development and redevelopment activities in their NPD portfolio) and a high marketing intensity are expected to benefit most from integration. In this latter group, marketing and R&D are highly interdependent because knowledge and tasks have to be combined to create new products for specific market segments that offer value for customers.

H14b: For the strategic group consisting of companies with a low marketing intensity and a high R&D intensity, there is the weakest positive or even negative relationship between integration and new product performance. For the strategic group consisting of companies with a high marketing intensity and a low R&D intensity, there is the strongest positive relationship between integration and new product performance.

Hypothesis 14b implies that if empirically confirmed, the negative impact of a low R&D intensity in combination with a high marketing intensity as formulated in hypothesis 14a can, to some extent, be compensated by high levels of integration between marketing and R&D.

In the following chapters we will first present the research design, data collection, and the scales used to measure the different constructs in the model. Then we will test the hypotheses presented in the previous sections and discuss some interesting findings in the side-line of this study.

2.4 Summary

In this chapter, the relevant literature was reviewed, insights from our exploratory interview were presented, and a comprehensive model was developed. The model

links different variables in the marketing - R&D interface to new product performance of companies (SBUs) in the broader organizational context.

In the model, the marketing - R&D interface is a central building block. The focus is on integration *and* on relative influence in different phases of the NPD process. In addition, we focus on how to manage these variables in the marketing - R&D interface by means of managerial mechanisms (control mechanisms, interaction mechanisms, and climate mechanisms).

We expect an effect of both integration and relative influence on new product performance. High levels of integration and an adequate relative influence balance between marketing and R&D are cross functional resources that can create a competitive advantage in the NPD process. However, we expect that this effect is only indirect. Specifically, integration and relative influence are expected to affect the relationship between (functional) resources and new product performance.

We also modeled the generative effects of formalization and centralization. Integration is expected to be a mediator in the relationship between structure (formalization and centralization) and new product performance. For example, we expect that a considerable part of the often-reported negative effect of centralization and formalization on new product performance is generated by its negative effect on integration which in turn has a negative effect on new product performance.

Finally, it is expected that there are companies with specific NPD strategies which benefit most from integration. Therefore, we expect that integration has a moderating effect on the relationship between NPD strategy and new product performance. Specifically, we expect that marketing-intensive companies with a low R&D intensity have the highest returns from integration with respect to new product performance.

3

Research design, data collection, and measurement scales

3.1 Introduction

To test the relationships between the variables in our comprehensive model, we opted for a study among companies (SBU's) in a particular industry with a global scope. To collect the data, we conducted an international survey among marketing and R&D executives (informants). In addition, follow-up research was conducted to relate some survey responses to factual performance indicators and other factual characteristics of the companies.

We will now elaborate on the study's design, the collected data, and the measurement scales used to measure the constructs outlined in the comprehensive model. In Section 3.2 a description of the population from which the sample was drawn will be given. The questionnaire, the sample, and the data set will be described in Section 3.3. In Section 3.4 and Section 3.5, the respondents and the companies for which they worked are described. In Section 3.6 attention will be paid to the operationalization of the variables and the measurement scales. We will end the chapter with a summary of the most important findings.

3.2 The research population

This study was conducted in companies operating in a specific industry. Although this limits the possibility for wider generalization somewhat, it offers opportunities for an in-depth analysis of the expected relationships. The industries we considered had to score highly on two criteria: (1) the importance

of marketing and R&D, and (2) the transparent nature of the industry (to facilitate accurate measurement of the variables).

On the basis of these two criteria, companies in the **pharmaceutical industry** were chosen as the domain for this study. In the pharmaceutical industry both marketing and R&D are extremely important (Corstjens, 1991). The importance of R&D is obvious, with R&D accounting for 15-20% of sales in most pharmaceutical companies (*Financial Times, March 1994*). The importance of marketing has been illustrated in several case studies on drugs like Zantac (Angelmar and Pinson 1991)[10] and surveys in the industry.[11] Furthermore, the pharmaceutical industry is highly 'transparent' and competitive (the largest company has a worldwide marketshare of less than 7%). Specifically, if respondents are used it is possible for them to compare their company accurately with similar companies in the industry since a lot of information on, for example, financial resources, R&D pipelines, (potential) new products, performance, etc. is publicly available.

3.3 Data collection

To test the model, two sources of data can be considered: (1) secondary data; not gathered for the immediate study at hand, and (2) primary data; originated by the researcher for the purpose of the investigation at hand. Since we are interested in internal company structures, interpersonal relationships, and communication in companies, our main source will be primary data. We will use managers' perceptions to measure constructs. We will also include additional secondary data from different sources to validate the scores on specific measures.

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10 Zantac is an H2 antagonist drug that came second to the market but became the world best-selling drug.

11 Another example of the importance of marketing was offered by a survey among managers in the biopharmaceutical industry (KPMG, Scrip magazine, March 1996). Of all managers, 23% indicated that marketing and sales would be most important in 1996 and 19% indicated that R&D would be most important in that same year (Strategy was on top with 33%).

In order to test the expected relationships in the comprehensive model, a questionnaire was developed for a mail survey. According to Churchill (1995), a questionnaire of some sort is often used for this type of research. We opted for a paper-and-pen mail survey instead of a telephone survey for several reasons: (1) we expected a high involvement of respondents with science in general and with this research project in particular. Therefore we expected that our survey would not suffer from very low response rates normal for mail surveys, (2) both techniques are equally suited to reaching a geographically dispersed population and acquiring lengthy information, however a mail questionnaire is cheaper to implement, (3) we could reduce the complexity of the questions by extensive pre-testing, and (4) respondents from several countries were expected to read better English than to speak it through the telephone. Although a survey has several advantages, it does not contain control incorporated in a field or laboratory experiment. We will try to compensate for this shortcoming by incorporating different personal and company covariables in the study for which the analysis can be controlled. Additionally, we conduct the study in a homogeneous group of companies in order to lower the amount of environmental noise.

The respondents to the mail survey were *key informants* chosen from the responding companies. These respondents were either senior marketers or senior R&D persons because these people occupy roles that make them knowledgeable about the issues being researched (cf. Campbell 1955). In addition, we did not explicitly sample multiple informants because we did not ask for complex social judgments of informants (Pennings 1973, Seidler 1974, Pillips 1980, 1981, John and Reeve 1982) and because companies, especially internationally operating companies, can be very differentiated across different locations which would be problematic with respect to aggregating the data (Ghoshal, Korine and Szulanski 1994). The sampling procedure will be described after the questionnaire has been discussed.

The Questionnaire

As stated before, a structured questionnaire was developed that contained questions on the organizational context, the marketing - R&D interface, and new product performance. The questionnaire was developed according to the guidelines of Dillman (1978). To measure the variables we used several existing

multiple-item scales and we developed several new multiple-item scales. For the newly developed scales, the pre-test methodology of Andersen & Gerbing (1991) was used to test for substantive validity of the items in the measurement scales. In this pre-test, the scales had a very high substantive validity with a match of 98% on average across five pre-test participants (respondent matching the items with the predefined construct correctly).

The questionnaire was not translated into different languages. The managers in the pre-test were fluent in English and they expected that all targeted respondents would be equally good at English.[12] In the questionnaire, the terms 'marketing' and 'R&D' were defined beforehand. 'Marketing' was defined as marketing and/or sales. 'R&D' was referred to as basic and applied research, development, and clinical testing, carried out in-house or in cooperation with other parties. All managers were asked to answer the questions with respect to the pharmaceutical part of their company and not to focus on other possible business units such as base chemicals or food. Furthermore, the questions on company characteristics, the marketing - R&D interface, and new product performance were widely dispersed throughout the questionnaire.

After extensive pre-testing, aimed at refining the measurement scales and the data collection instrument,[13] the final version of the questionnaire was arrived at. With knowledge of *industry-specific* issues we were able to improve certain measurement scales of specific constructs in the questionnaire. For example, specific new product development activities/ decisions could be labeled in more detail, such as 'clinical trials'. Also terms such as NCEs (new chemical entities) and blockbusters (> US$ 500 million in product sales) proved to be better than terms such as 'new products' and 'very successful products'. The final 20-page questionnaire (see Appendix 1) carried a decorative logo and a stamped

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12 Questionnaires in English when respondents are fluent in English are also used in other cross cultural studies (e.g., Hofstede 1976).

13 The draft questionnaire was sent to 3 R&D managers and 3 marketing managers in pharmaceutical companies. These managers completed the questionnaire and gave comments. In addition, the questionnaire was tested among 5 academics who also filled out the questionnaire and gave feedback. Follow-up discussions resulted in several small changes.

identification number. It took about 30 minutes to complete.

When the complete package was send out in March 1995, the questionnaire was accompanied by a (hand signed) cover letter and a (double hand signed) letter of recommendation from a marketing professor and a technology management professor. A reply envelope with the address of the researcher was included to facilitate easy handling by the respondent. The follow-up procedure consisted of two steps. First, a reminder was send after a week. About three weeks later a new letter accompanied by a replacement questionnaire was sent (cf. Dillman 1978).

The sample

The sample which was used for this study can be characterized as a probability sample that resulted from a *random sampling* procedure (Churchill 1995). The starting point was a database of 66,000 addresses and contact persons, gathered from a wide range of public sources in the period 1991 - 1993 by a small UK company specializing in pharmaceutical addresses. The records contained company name, contact person, job title, address, country, type of company, etc. Respondents were selected on the basis of certain characteristics relevant to the objective of our study. Specifically, respondents had to be able to evaluate the marketing - R&D interface, the company context, and new product performance in their firm. Therefore, we established the following selection criteria:

1) The companies had to be *pharmaceutical* companies as indicated in the database (companies focusing on specific businesses in the industry such as regulations and clinical trials were removed).

2) Respondents had to be located in a major pharmaceutical market (for Europe based on ABN AMRO investment research 1994 and for the rest of the world based on Scrip Annual Review 1994) so mainly focusing on Europe, the US, and Japan.

3) Respondent had to have knowledge of the processes in the marketing - R&D interface and therefore we selected people working in research, R&D, product development (and medical), marketing, market research, and new product planning.

The selection criteria resulted in a total of 3,000 records from which a stratified sample of 1,000[14] records was drawn at random based on the worldwide market shares of the companies from that particular region: 500 in Europe, 350 in the USA, and 150 in Japan. Only one respondent from a specific functional area in a specific company was selected. On the basis of this sampling procedure, 670 respondents could be characterized as 'marketing' executives and 330 as 'R&D' executives. We did not establish equal groups of respondents from each functional area (see also other studies like Moenaert & Souder 1996, Ayers et al. 1997). The respondents play the role of informant, and therefore we did not expect many a priori differences between marketing and R&D respondents beforehand.

The response

Of the 1,000 questionnaires that were sent out in March 1995, a total number of 211 unopened questionnaires were returned. This lowered the effective sample size to 789. After two waves and one reminder, 164 questionnaires were returned. This resulted in a response rate of 21% which is acceptable for surveys (Jobber, Allen, and Oakland 1985). Of the 164 returned questionnaires, 16 questionnaires were unusable and removed from the data set for different reasons. In six cases, it emerged that the respondent did not work for a pharmaceutical company but for a company that supplied chemicals to the pharmaceutical industry. Another important reason was related to the background of the respondent, which was sometimes 'operations' or 'finance'. In three cases, the availability of time to fill out the questionnaire was a problem, twice because of an ongoing merger.

We compared early and late respondents to find indications for possible response bias. Specifically, a comparison was made of: (1) the personal characteristics of the respondents, and (2) the characteristics of the companies of the respondents between the two time frames. These comparisons revealed no significant differences at a p=.05 level. Additionally, we compared the responding companies with a list

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[14] We selected a sample size of 1000. With reported response rates of 10-20% in other surveys this had to be sufficient to perform statistical techniques such as factor analysis and to perform breakdowns on the sample (e.g., between marketing and R&D respondents).

of the top 50 pharmaceutical companies in the world. It proved that of this list, 46 were present. More response checks will be presented in the following two sections. Overall, it seems that response bias is not a major problem here.

3.4 Characteristics of the respondents

In this section a description will be given of the respondents who participated in the study. In Table 3-1, the number of respondents within a certain age range is presented.

TABLE 3-1: NUMBER OF RESPONDENTS WITHIN A SPECIFIC AGE RANGE

Age	Number	Cum.%
26-30	2	1.4
31-35	19	14.5
36-40	27	33.1
41-45	27	51.7
46-50	38	77.9
51-55	21	92.4
56-60	8	97.9
61-65	3	100.0

Most respondents are in the 46-50 age range. The average age in the sample is 44.6. This is in accordance with our goal to reach 'senior' executives who have a better overview of the company as a whole. The reason for this seniority in the sample is related to the fact that the addresses in the database were collected from public sources. In such sources like annual reports, newspapers, and magazines, mainly senior management appears.

In the questionnaire, respondents were asked to write down their educational background and the functional area in which they worked. An overview is given in Table 3-2.

TABLE 3-2: CROSS TABULATION OF RESPONDENTS BY FUNCTIONAL AREA AND EDUCATION

	Present functional area of respondent		
	Marketing	R&D	Total (%)
Education			
Technical	55	55	110 (75.0%)
Non-technical	34	2	36 (25.0%)
Total (%)	89 (61.0 %)	57 (39.0%)	146 (100%)

Table 3-2 shows that 110 respondents have a technical educational background (technical, scientific, and/or medical) and 36 respondents have a non-technical educational background (economics, business, and other educational backgrounds such as psychology, art, and languages). The technical respondents are equally distributed among marketing and R&D (55 and 55). The non-technical respondents work mainly in marketing (34 out of 36). The two respondents that work in R&D with a non-technical background indicated that they worked in licensing and market research.

TABLE 3-3: CROSS TABULATION OF RESPONDENTS BY EXPERIENCE WITH JOB ROTATION AND FUNCTIONAL BACKGROUND

		Present functional area of respondent		
		Marketing	R&D	Total (%)
Experience with cross functional job rotation	Yes	50	25	75 (51.4%)
	No	39	32	71 (48.6%)
	Total (%)	89 (61.0%)	57 (39.0%)	146 (100%)

Table 3-3 shows that more than half the respondents (51.4%) indicated that they had worked in another functional area in previous jobs (experience with cross functional job rotation). In research, 25 respondents have experience with job rotation. In marketing, the number is 50. The larger proportion of managers with job rotation experience in marketing is not significant (X^2 test, p=.15 (two-tailed)).

In the present study, we primarily use perceptions of marketing and R&D managers to measure organizational characteristics. We checked for possible differences between the marketing managers and R&D managers with respect to involvement and earlier experiences because these issues can affect perceptions (cf. Steenkamp 1990). To this end, we incorporated several questions in the questionnaire (*Indicators for Involvement:* Interest in M-R&D interface (q-9), Frequency of thinking of M-R&D interface (q10), Number of personal roles in M-R&D interface (q11); *Indicators for earlier experiences:* Job rotation experience (q-4), Age (q-6), Other pharma company experience (q-7), Non-pharma experience (q-8)). The results showed that marketing respondents and R&D respondents did not differ significantly with respect to any of these indicators. This supports our a priori expectation that marketing managers and R&D managers are both equally suitable as informants.

3.5 Characteristics of the companies

In the previous section we gave a description of the characteristics of the respondents. In this section we will describe the characteristics of the companies for which they work.

TABLE 3-4: MEAN COMPANY CHARACTERISTICS REPORTED BY RESPONDENTS

Characteristics	Mean	Std. Dev.	N[15]
Company revenues($1,000,000)	3,240	5,801	84
Total number of employees	10,434	13,990	109
Number of sales employees	2,732	4,351	79
Number of marketing employees	1,095	2,225	87
Number of R&D employees	1,579	2,247	97
Annual marketing Budget($1,000,000)	519	730	55
Annual R&D Budget($1,000,000)	519	900	73
% of sales from new products (<5year)	33	23	123

Table 3-4 shows the self-reported characteristics of the pharmaceutical part (SBU) of the companies for which the respondents worked. In the columns, the company characteristics, the sample means and standard deviations, and the number of cases (N) are presented. The company characteristics are related to size and innovativeness. With respect to *size*, we conclude that the companies in the sample are typically large ones with more than US$ 3bn revenues and 10.434 employees. These large numbers were expected because of the scale intensity of the pharmaceutical industry. In addition, companies have on average a large sales force which is an extensively used marketing tool in the pharmaceutical industry (Corstjens 1991). On the basis of the minimum scores it emerges that both marketing and R&D are present in all companies. Companies have on average 1,095 marketing employees and 1,579 R&D employees. Finally, marketing and R&D have on average equal budgets of US$

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[15] Owing to the factual nature of these questions and sometimes to secrecy , the number of responses (N) is rather low.

519 mn.[16] With respect to innovativeness, it shows that 33% of sales is generated by relatively new products introduced in the last five years. This is normal for high technology industries (Cooper 1984).

In several analyses, the sample will be split in two parts based on the functional area of the respondents: marketing or R&D. We argue that possible differences between marketing and R&D respondents can be more strongly attributed to the functional background of the respondent if they work for companies with on average the same characteristics. Table 3-5 shows that this is the case. There are no significant differences between the companies in which a marketing respondent scored the company and those in which an R&D respondent scored the company (partly due to the large std.dev.).

16 When we divide the average R&D budget by the average amount of revenues we learn that, on average, 16% of revenues are spent on R&D. This is representative for the industry average (Financial Times, March 1994). The percentage of revenues spent on marketing is mostly not made public in the industry and therefore we cannot check this number.

TABLE 3-5: MEAN COMPANY CHARACTERISTICS (AS REPORTED BY R&D AND MARKETING RESPONDENTS)

Company characteristics	R&D sample Mean	Marketing sample Mean	p (t-test)
Company revenues ($1,000,000)	2,895	3,194	.70
Total number of employees	11,094	9,784	.64
Number of R&D employees	1,830	1,364	.32
Number of sales employees	2,467	2,838	.72
Number of marketing employees	773	1,256	.35
Annual marketing Budget ($1,000,000)	553	472	.69
Annual R&D Budget ($1,000,000)	399	606	.33
% of sales from new products (<5year)	31	34	.52

Because of the worldwide character of the pharmaceutical industry, companies from different countries are present in the sample. Table 3-6 shows the country of Headquarters (HQ) which was reported by the respondent and the number and percentage of respondents in the sample working in a company from that country. From this, we conclude that most respondents work for US companies (29.7%), UK companies (14.9%), Japanese companies (12.8%) and German companies (10.1%). These are also the countries with the largest pharmaceutical industry.

TABLE 3-6: COUNTRY OF HEADQUARTERS OF RESPONDENT'S COMPANY

Country of HQ	Number of respondents	Percentage
USA	44	29.7
UK	22	14.9
Japan	19	12.8
Germany	15	10.1
Switzerland	12	8.1
Belgium	11	7.4
Sweden	9	6.1
The Netherlands	6	4.1
France	5	3.4
Denmark	4	2.7
Total	147	100%

Overall, the average characteristics of the companies give us no reason to suspect major sampling biases.

3.6 Operationalization of the variables in the comprehensive model

This section is concerned with the way the variables outlined in the comprehensive model are operationalized and measured. First the operationalizations and measurements of the dependent variables will be discussed. Then, the operationalizations and measurements of the independent variables will be elaborated upon. The complete list of variables can be found in Appendix 3.

3.6.1 New product performance

Two types of new product performance measures will be used: *subjective* measures and *self-reported objective* measures. Additionally, factual figures on sales growth of the companies in the data set will be collected from public sources. These figures will be used as a factual indicator of new product performance to validate the content validity of the subjective and self-reported objective measures.

For the subjective measures we developed a new scale encompassing several new items and several existing ones already used in earlier studies (i.e., Cooper 1984, Dess and Robinson 1984, Griffin & Page 1993). The self-reported objective measures were obtained from earlier studies on new product performance (e.g., Griffin & Page 1993) and from the qualitative interviews and pre-tests. These measures can be used as separate indicators of new product performance but we will also conduct factor analysis to find the underlying dimensions. In addition, data on factual sales growth of the company was collected from public sources. We opted for sales growth (corrected for mergers) instead of profits because it is more exclusively related to (new) products. Profits are also influenced by incidental cost-cutting activities, investments, etc.

The subjective measures for new product performance

After screening the literature, we came to the conclusion that no adequate scale existed to measure the content of new product performance as we defined it. Therefore, we decided to develop a new scale by generating a set of items based on Cooper & Kleinschmidt (1993, 1995), Dess and Robinson (1984), and Griffin and Page (1993). Furthermore, the industry-specific nature of this study provided the opportunity to include specific measures particularly suitable for measuring new product performance in the pharmaceutical industry. These items resulted from the exploratory interviews and the pre-tests.

Table 3-7 shows the items that were included in the questionnaire to measure subjective new product performance. With respect to all items, we asked the respondent to compare the pharmaceutical part of the company with pharmaceutical firms of comparable size in the industry (1='lowest performing 20% of comparable companies', 5='highest performing 20% of comparable companies'). This format was chosen because Dess and Robinson (1984) found

high correlations between similarly structured subjective measures and factual data. In line with the earlier work of Cooper (1984), we took a time span of 5 years. The questions about current new product performance of the company were related to the past five years. The questions about the expected future new product performance (which we will discuss in the next part of this section) were related to the next five years.

TABLE 3-7: MEASUREMENT SCALE FOR CURRENT NEW PRODUCT PERFORMANCE

Items (time span of 5 years)	Source
1. The number of new products	Griffin & Page, 1993
2. The number of breakthroughs	Interviews
3. The quality of the R&D pipeline	Interviews
4. The speed at which new products are developed	Griffin & Page, 1993 Cooper, 1984, 1993
5. The cost efficiency of the development 1993 of new products	Griffin & Page, 1993
6. The number of new ideas and concepts in research	Interviews
7. The performance of the products that 1993 and have been launched	Griffin & Page, 1993 Calantone et al., 1997
8. The ability to react to new opportunities	Interviews
9. The speed of the decision-making process with respect to new products	Griffin & Page, 1993
10. The quality of the decision-making process with respect to new products	Griffin & Page, 1993
11. The commitment to translating decisions into actions with respect to new products	Interviews

After analyzing the distribution of the scores on the items (which were close to normal), we used factor analysis with maximum likelihood and oblimin rotation to find the underlying factors. This resulted in two factors based on the scree plot

and the eigenvalues. The two factors accounted for 64% of variance.

Table 3-8 shows the 11 items and the loadings on each factor. The first factor reflects the quality of the NPD *process*. Items like 'speed of the process', 'quality of the decision-making process', etc. load high on this factor. The second factor reflects the quality and quantity of the NPD *output*. Items like 'number of new products', 'number of breakthroughs', and 'the quality of the R&D pipeline', etc. load strong on this factor. These two dimensions show considerable overlap with the process dimension and firm/ program dimensions of Griffin & Page (1993) and the process and output dimensions of Loch et al. (1996). However, unlike the dimensions in the study of Griffin & Page (1993), the dimensions we find are not independent of each other. From the factor correlation matrix it becomes clear that both factors are strongly correlated (r=.630).

TABLE 3-8: FACTOR MATRIX FOR CURRENT NEW PRODUCT PERFORMANCE ITEMS

Items	Factor 1	Factor 2
The speed of the decision-making process	.834	.439
The quality of the decision-making process	.815	.495
The speed at which new products are developed	.814	.593
The commitment to translating decisions into actions	.776	.467
The cost efficiency of the development of new products	.660	.459
The ability to react to new opportunities	.653	.515
The number of new ideas and concepts in research	.573	.535
The number of new products	.494	.858
The number of breakthroughs	.526	.853
The quality of the R&D pipeline	.587	.723
The performance of the products that have been launched	.530	.579
Factor Correlation Matrix:		
Factor 1	1.00	
Factor 2	.630	1.00

The 7 items of the process new product performance measure and the 4 items of the output new product performance measure attained Cronbach α reliability coefficients of .89 and .83 respectively. The scores on the items were averaged to develop scores for the composite scales for PROCPERF and OUTPERF. PROCPERF and OUTPERF will be used as related measures of new product performance in this study. Both measures are uni-dimensional with similar factor patterns across functional areas (marketing and R&D respondents separately).

Apart from the questions related to *current* new product performance, we asked the respondent to make an estimation of the expected level of new product performance in the *future*. The first 7 items of the current new product performance scale presented in Table 3-7 were also addressed with respect to the respondent's **expectations** about new product performance in the next five years. We performed confirmatory factor analysis on the 11 items related to current new product performance together with the 7 items of the future new product performance scale. Most items related to future new product performance loaded on a different factor than the items related to current new product performance. Only two items of the future new product performance scale ('speed in which new products are developed' and 'cost efficiency of the development') loaded as strongly on current performance as on future performance. This is probably because it is difficult for the respondent to evaluate future speed and future cost efficiency of new product development efforts. To improve discriminant validity, we decided to delete these two items from the overall scale and we averaged the scores on the 5 remaining items (Cronbach α =.88) 'the number of new products', 'the number of breakthroughs', 'the quality of the R&D pipeline', 'the number of new ideas and concepts in research', and 'the performance of the products' to establish the score on the overall FUTPERF scale.

Self-reported objective measures

To measure the performance of the company from a self-reported objective perspective, questions were asked related to the project and program level of new product development in the company. The items are presented in Table 3-9. Unlike the subjective measures, these measures are not controlled for company size.

TABLE 3-9: SELF-REPORTED OBJECTIVE MEASURES OF NEW PRODUCT PERFORMANCE

Items	Source
1. Number of NCEs ready to market in next five years	Graves & Langowitz, 1993
2. Number of new compounds entering clinical trials	Griffin & Page, 1993
in last five years Interviews	Cooper, 1984
3. Number of new products in the last five years	Interviews Griffin & Page, 1993
	Cooper, 1984
4. Number of blockbusters in the last ten years	Interviews
5. Probability of producing a blockbuster	Interviews
in the next ten years	
6. Probability of producing three blockbusters	Interviews
in the next ten years	
7. Percentage of sales from new products	Griffin & Page, 1993
in last five years	

The self-reported measures described in Table 3-9 were collected from the literature and during the exploratory interviews. The first item is related to the number of new chemical entities (NCEs). NCEs are often used to measures new product performance in pharmaceutical companies because they are the central element of the new products which have to be approved by the FDA (Food & Drug Administration). The second and third measure are based on Cooper (1984) and Page & Griffin (1993) who used success rates as a measure of new product performance. However, instead of asking about the explicit success rate, we decided to ask for the number of compounds entering clinical trials (NEW_COMP) and the total number of new products that entered the market (NEW_PROD). From these two measures, the success rate can be calculated. The next three measures are related to blockbusters. Blockbusters are an important phenomena in the pharmaceutical industry because single products can account for more than half of total sales of large companies. To measure blockbuster variables, we decided to let the respondent evaluate the R&D pipeline with respect to potential blockbusters. The last measure,

percentage of sales generated by new products introduced in the last five years, was borrowed from Griffin & Page (1993). This was the only core firm level measure in their study.

To find the underlying factor(s)/ component(s) we performed principal component analysis with oblimin rotation. We opted for principal component analysis (although there were no major differences with other extraction techniques) because the questions are related to more 'objective' characteristics (Hair et al. 1995, p.375).

TABLE 3-10: FACTOR MATRIX FOR SELF-REPORTED OBJECTIVE NEW PRODUCT PERFORMANCE

Items	Factor 1	Factor 2
NEW_COMP	.765	.085
NCE	.598	.458
NEW_PROD	.516	-.154
P_BLOCK3	.056	.913
P_BLOCK1	.031	.840
BLOCKBUS	.129	.784
PERC_SAL	-.245	.544
Factor correlation matrix		
Factor 1	1.00	
Factor 2	.069	1.00

On the basis of the scree plot and eigenvalues, two factors (components) emerged that explained 58% of the variance. We interpret the two factors as 'diligence new product performance' (factor 1) and 'blockbuster new product performance' (factor 2). On factor 1, variables related to the number of NCEs, the number of new compounds, and the number of new products load high. So, the factor is only related to the quantity of the output. High levels of diligence (hard work) produce high levels of output. However, the quality of the output is not

incorporated in this measure. On factor 2, the variables related to financial performance load high with strong loading for blockbuster items and a somewhat weaker loading for 'the percentage of sales generated by new products'. Furthermore, the low inter-factor correlation of .069 shows that the *quantity* of the NPD output is almost completely independent of blockbuster performance which has high face validity.

We assessed whether the items could be reduced to two multiple-item scales by performing a factor analysis on the separate three and four items. The amount of variance extracted by the first factor was very low for the diligence measures (47.8%). Therefore, we decided to continue with the three single-item measures (NCE, NEW_COMP, NEW_PROD). For the blockbuster items, the fit was better. 61.6% of variance was extracted by the first factor (eigenvalue 2.46). Therefore, to develop a composite BLOCKPERF measure, we transformed all original scores to 4-point scales with an equal number of scores per answering category. We decided to opt for 4-point scales because the scores on all variables could be split into four answering categories with roughly equal number of companies in each category. The BLOCKPERF measure attained a Cronbach α of .73.

Validation with a factual new product performance indicator

As a factual proxy for new product performance, different indicators can be obtained from public sources (e.g., Annual Reports, Internet, Magazines). Since each questionnaire used in this study carried a stamped number, we could connect factual proxies to the data set.

We decided to focus on factual sales growth as an indicator of new product performance of companies. In the pharmaceutical industry, there is a strong relationship between sales growth and new product performance because intensive competition, shorter patent time, and increased price pressures make successful new products one of the few means to increase sales. Beforehand, we expected that new product performance as we measured it and the factual sales growth figures we obtained would be to some extent related. However, we recognize that factual sales growth is not a perfect indicator of all new product performance measures. Sales growth can also be related to other marketing mix instruments, for example. Additionally, we defined new product performance

in the light of the NPD process as a whole, not only performance in the market.

Notwithstanding the fact that sales growth is not a perfect indicator, there should be significant correlations with our composite subjective and self-reported objective new product performance measures, especially with the 'output measures' OUTPERF and BLOCKPERF.

The sales growth figures of companies in 1995 were collected from *Scrip Magazine*© and *Scrip on-line*. We found data for n=83 companies. The highest correlation with factual sales growth was attained by BLOCKPERF (r=.38, p<.01) , followed by OUTPERF (r=.36, p<.01), PROCPERF (r=.30, p<.01), and FUTPERF (r=.19, p<.10). These correlations show that these subjective and self-reported objective scales have good content validity. Especially, measures with the highest conceptual overlap have the highest correlation with factual sales growth. In contrast, the correlations with the diligence measures were very low, ranging from r=-.03 to r=.02. From this we conclude that the diligence measures are probably more R&D productivity measures than a financial new product performance measure in the market. As a result, we will base our analyses mainly on BLOCKPERF, OUTPERF, PROCPERF, and FUTPERF.

3.6.2 The marketing - R&D interface

Integration between marketing and R&D (INTEGRAT)

Pinto and Pinto (1990) developed a 15-item Likert scale based on the conceptual work of Tjosvold (1984) who suggested that there are several facets of cooperation which include communication, good interpersonal relationships, and joint task orientation. This measure was used in two earlier studies to measure cross functional cooperation at the team level in hospitals (Pinto et al. 1990, 1993). We interpret these facets as 'integration' when they are considered at the company level because they enhances all facets incorporated by Gupta and colleagues (1985) in their conceptualization of integration.

We adapted the original items from the Pinto & Pinto scale in the following way: *'A friendly attitude exists among project team members'* was transformed to *'A friendly attitude exists among marketing and R&D in my company'* (1='Strongly agree', 5='Strongly disagree'). The measurement scale that resulted is presented in Table 3-11.

TABLE 3-11: MEASUREMENT SCALE FOR INTEGRATION BETWEEN MARKETING - R&D

Items
1. A friendly attitude exists among Marketing and R&D.
2. Open communication of relevant information occurs among Marketing and R&D.
3. Marketing and R&D intentionally provide each other misleading information.
4. Marketing and R&D search for solutions that are agreeable to each other.
5. Marketing and R&D are more like teammates than competitors.
6. If disagreements arise, Marketing and R&D are usually able to resolve them.
7. Marketing and R&D openly share their ideas with each other.
8. Marketing and R&D help each other to more effectively perform their tasks.
9. Marketing and R&D often fail to communicate information to each other. (R)
10. Marketing and R&D are always blaming each other for failures. (R)
11. It is difficult for Marketing and R&D to contact each other. (R)
12. Conflicts between Marketing and R&D are of a constructive kind.
13. Marketing and R&D perceive their problems as mutual problems.
14. Marketing and R&D recognize each other's talents and expertise.
15. Marketing and R&D share resources to complete tasks.

Using factor analysis (After checking for normality we used the Maximum Likelihood algorithm with Oblimin rotation) only one main factor was found based on the scree plot. The vector of eigenvalues began: 6.6775, 1.1114, .9181, .8385, .7689, etc. and although the second eigenvalue was just above 1, we decided to continue with the complete scale because we could not interpret the second factor and we wanted to ensure that all facets of integration were incorporated. Furthermore, several additional factor analyses were performed on the data for separate samples of marketing respondents, R&D respondents, respondents in US-based companies, and respondents in European-based companies. For all these samples, only one main factor emerged with similar factor patterns across functional groups of respondents (although sometimes one or two eigenvalues were just above 1). Because of this reasonably robust unidimensionality and the relatively strong loadings of all items we will use all items

to develop the composite INTEGRAT scale. We recoded reverse questions and transformed all scores to 1= low and 5 = high. The INTEGRAT scale consisting of 15 items attained a Cronbach α reliability coefficient of .91. Furthermore, item analysis showed that this (already high) coefficient could not be substantially improved by removing items. The scores on all items were averaged to attain the score on the INTEGRAT scale. The INTEGRAT scale attained a correlation of r=.67, p<.001 with the scores on the question 'Taking everything into account, to what extent does integration between marketing and R&D exist in your company?'. This high correlation offers support for the content validity of the composite INTEGRAT scale.

Relative influence of marketing and/or R&D

Recently, there have been several attempts to develop multi-item scales to measure relative influence in different fields (see for an overview, Madrigal and Miller 1996). According to Patchen (1963), relative influence can be measured at different levels of specificity. The most general level is the global evaluation that asks respondents for an overall estimate of who has the greatest influence. A more specific level is one that measures influence on well-defined decision topics. The most specific level is one where questions are asked on sub-decisions of a large decision or specific stages in decision-making. As an example of this last category, Beatty (1994) developed a measurement scale for influence in the initiation stage of the buying process of families (consisting of several sub-stages) and a 5-item scale to measure influence in the implementation phase of the buying process (also consisting of several sub-stages). In general, the more specific the level at which influence is assessed, the greater the accuracy of the self-reports (Corfman 1991).

In the present study, we decided to develop a measurement scale for relative influence of marketing and R&D in specific decision stages of the NPD process. We generated decision stages after carefully studying the NPD literature in general as well as literature on specific characteristics of the NPD process in pharmaceutical companies (Spilker 1994). As answering categories, we used a constant sum scale in which 100 points had to be divided between marketing and R&D in terms of how the respondent perceived the impact of a particular functional area on a specific decision in the new product development process (cf. Corfman 1991).

Using principal axes factoring (because the distribution of the scores deviated

from a normal distribution), factor analysis produced two factors. Deleting items loading higher than .45 on both factors (suggested significance level for n=150, Hair et al. 1995, p.385), produced two distinctive factors. The rotated (oblimin) factor solution is presented in Table 3-12.

TABLE 3-12: FACTOR MATRIX FOR RELATIVE INFLUENCE

Decision items	Factor 1	Factor 2
Selecting therapeutic areas for research	.654	.009
Setting new product development goals and priorities	.624	.075
Generating new product ideas	.605	-.055
Pre-clinical development of new compounds	.502	-.164
Licensing in/ out decisions on R&D compounds	.467	.299
Developing and implementing a launch plan	.261	.732
Developing and implementing an advertising campaign	-.037	.780
Positioning the new product in the market	.343	.544
Generating feedback from customer feedback	-.175	.508
Management of the sales force	-.099	.471
Factor Correlation Matrix:		
Factor 1	1.00	
Factor 2	.036	1.00

The two factors show a clear distinction between phases in the NPD process. As in the study of Beatty & Talpade (1994), there is one factor on which items related to the initiation phase load high, and there is one factor on which items related to the implementation phases load high. This is very similar to the two phases Zaltman et al. (1973) defined. Both factors together explained 51% of variance which is rather poor. However, the two multiple-item scales each represent a single dimensional construct that can be interpreted as influence in the initiation phase (INITINFL, factor 1) and influence in the implementation

phase (IMPLINFL, factor 2). The composite measures attained a Cronbach α of .69 and .65 respectively. Both are satisfactory for this type of exploratory research (Hair et al. 1995). We constructed composite scores for R&D's influence relative to marketing in both the initiation phase and the implementation phase by averaging the scores on the items (INITINFL and IMPLINFL). From the factor correlation matrix it becomes clear that the two factors are almost completely independent of each other. So, in companies with a high level of R&D influence in the initiation phase, R&D's relative influence in the implementation phase can be high or low. In addition, factor analyses showed that the two factors had similar factor patterns across functional groups (responses of marketing and R&D respondents separately)

Managerial mechanisms

We distinguished specific managerial mechanisms in three categories: control mechanisms, interaction mechanisms, and climate mechanisms. To measure the use of these managerial mechanisms in a company, we asked the respondent to score his or her company with respect to the presence and intensity of use of a specific managerial mechanism. The mechanism names, a description, and the measurement scales are presented in Table 3-13. Certain answering categories have been transformed in order to make sure that a higher score on a particular managerial mechanism scale, represents a (more intense) use of that particular managerial mechanism.

TABLE 3-13: CONTROL MECHANISMS

Control mechanisms	Description	Measurement
CROSPAY	Salary of managers of dept. X paid by dept. Y	1='no', 2='sometimes', 3='often'
FORMPROC	Presence of formal NPD procedures	0='no', 1='yes'
LIAISON	Importance of formal liaison roles	1='no role' to 5='very important role'
MONBOARD	Presence of a cross functional R&D monitor board	0='no', 1='yes'
PRJMAN_M[17]	Proportion of cross functional project managers with experience in marketing	7-point scale
REVBOARD	Presence of a cross functional review board	0='no', 1='yes'

[17] The variable PRJMAN_R (proportion of cross functional project managers with experience in R&D) was omitted from the analysis because of a high negative correlation with PRJMAN_M.

TABLE 3-14: INTERACTION MECHANISMS

Interaction mechanisms	Description	Measurement
CROSTRAIN[18]	Composite cross functional training variable	Number of days
INFTECH	Use of new Information Technology like e-mail	1= 'very poorly' to 5= 'very effectively'
JOBROT_M	Proportion of marketing managers involved in job rotation	7-point scale
JOBROT_R	Proportion of R&D managers involved in job rotation	7-point scale
PHYSCLOS	Physical closeness of marketing and R&D in general	5-point scale[19]
PRJMEM _M	Proportion of marketing managers, member in a cross functional project	7-point scale
PRJMEM_R	Proportion of R&D managers member in a cross functional project	7-point scale
SURVIVAL	Proportion of managers sent on survival meetings/sessions	7-point scale

18 Cross functional trainings are an interaction mechanism because of the item 'joint seminars of marketing and R&D'.

19 1= 'Different countries' , 2='The same country, not the same location', 3='The same location, not the same building', 4='The same building, functional (grouped)' 5='The same building, cross functional (mixed)'.

TABLE 3-15: CLIMATE MECHANISMS

Climate mechanisms	Description	Measurement
EQCAREER	Equal career opportunities for marketing/ R&D	0='no', 1='yes'
EQCOSTC	Equal cost cutting for marketing/ R&D	0='no', 1='yes'
STATMENT	Top management statement on importance of marketing and R&D interaction	0='no', 1='yes'

Three cross functional training items: 'R&D training for marketers', 'marketing training for R&D', and 'joint training sessions' loaded strongly on a common factor. Therefore, we developed one composite scale in two steps. First, we transformed all scores to 5-point scales (equal number or responses in each category) and calculated the reliability coefficient (Cronbach α=.80). Second, we computed a composite score by averaging the transformed scores (CROSTRAIN). Given the low inter-variable correlations between the other managerial mechanisms and to preserve richness in the analysis, we decide not to reduce the data further.

3.6.3 The organizational context

Resources

A new multiple-item scale was developed to measure functional 'depth' resources. The scale encompasses items for relevant pharma resources like knowledge, relationships, and assets. Respondents were asked to compare their companies with similar firms (cf. Dess and Robinson 1984, Gatignon and Xuereb 1997). For the exact items, see Table 3-16. All items were accompanied by 5-point answering 1='lowest 20% of comparable companies', 5='highest 20% of comparable companies'). Table 3-17 also contains the factor matrix with the factor loading for each item on each factor (after verifying the normal distribution of the scores on the items of the resources scale, we used maximum likelihood and oblimin rotation).

TABLE 3-16: FACTOR MATRIX FOR RESOURCES

Items	Factor 1	Factor 2
The sophistication of R&D equipment	.812	.423
Modern building and plants	.754	.399
Database and library facilities	.710	.437
Production capacity	.693	.401
Worldwide market information	.686	.514
Top scientists	.669	.563
The financial reserves	.599	.294
Cooperative R&D relations	.471	.339
Co-marketing relations	.313	.149
Contacts with top universities in relevant fields	.468	.900
Contacts with top medical specialists in the world	.508	.870
Goodwill at medical institutes	.475	.721
Relations with governmental bodies.	.358	.672
Knowledge of competitors	.564	.592
Factor Correlation Matrix:		
Factor 1	1.00	
Factor 2	.565	1.00

On the basis of the scree plot and eigenvalues, two factors emerge which account for 56% of variance in all items. Table 3-16 shows that the first factor reflects hard, internal, financial and human assets including such assets as financial reserves, R&D equipment, R&D relations (e.g., licensed compounds), buildings and plants, top scientists, databases, production plants, and market information (e.g., market research). The second factor reflects soft, market knowledge and relationships. Only item 3, co-marketing relations, does not load significantly on either factor (suggested factor loadings >.45 for n=150, Hair et al. 1995, p.385). Afterwards, we learned that having many co-marketing relations is related to not

having many resources and therefore we concluded that this item measured a specific type of resource and therefore we decided to delete the item from the scale.

From the factor correlation matrix we learn that both factors are related (factor correlation of .565). From this we conclude that the concepts that are being measured are strongly related and have considerable overlap. The composite scales attain a Cronbach α reliability coefficient of .87 and .87 respectively. Item analysis showed that this coefficient could not be improved considerably by removing items. We averaged the scores on all items to construct an overall RESOURCES variable (Cronbach α =.89). Furthermore, we averaged to items related to specific factors to develop related measures for both dimensions.

Formalization (FORMAL)

Formalization is defined as a company characteristic that expresses the extent to which company activities and decisions follow formal procedures. An existing 4-item scale was translated from Dutch (de Jong, Huizingh, Oude Ophuis, and Wierenga 1994). The items are presented in Table 3-17 (1= 'strongly agree', 5='strongly disagree').

TABLE 3-17: MEASUREMENT SCALE FOR FORMALIZATION

Items
1. In my company, formal procedures are followed before making a decision.
2. In my company, many paper forms are used.
3. In my company, decision-making responsibilities within a job are described in detail.
4. In my company, employees have detailed task descriptions.

Factor analysis confirmed the uni-dimensionality of the scale across different sub-sample populations. The FORMAL scale consisting of 4 items attained a Cronbach α reliability of .76. Item analysis showed that this coefficient could not be improved considerably by removing items. After transforming all scores to 1= low formalization and 5=high formalization, we averaged the scores on

all items to attain a score on the composite FORMAL scale.

Centralization (CENTRAL)

Centralization in a company is related to division of decision-making authority. An existing 6-item scale was translated from Dutch (de Jong et al. 1994). The scale is presented in Table 3-18 (1= 'strongly agree', 5='strongly disagree').

TABLE 3-18: MEASUREMENT SCALE FOR CENTRALIZATION

Item
1. My company has a flat organizational structure.
2. In my company, departments possess a large degree of autonomy.
3. In my company, many decisions are taken low in the hierarchical structure of theorganization.
4. The organization of my company is very centralistic.
5. Making decisions in my company is strongly bound to hierarchical lines.
6. In my company, most decisions have to be approved by higher management.

Factor analysis confirmed the uni-dimensionality of the scale across different sub-sample populations. The CENTRAL scale consisting of 6 items attained a Cronbach α reliability of .78. Item analysis showed that this coefficient could not be improved considerably by removing items. After transforming all scores to 1= low centralization and 5=high centralization, we averaged the scores on all items for the score on the CENTRAL scale.

NPD strategy

We asked the respondents to make a profile of the pharmaceutical part of their company based on 8 items. These items are adopted from the study on strategic groups in the pharmaceutical industry of Cool and Schendel (1987, 1988). In addition, we make a distinction between research, development, and marketing intensity of companies. The items are related to the scope/technology/product/market (STPM) strategy of the respondent's company. The factor loadings (PAF) are presented in Table 3-19.

TABLE 3-19: FACTOR LOADINGS FOR NPD STRATEGY ITEMS

Items	Factor 1	Factor 2
Broad product range	.872	.004
Many markets	.857	.034
Large company	.647	.398
Marketing intensive	.439	.342
Prescription market	-.391	.239
Research intensive	-.084	.822
Development intensive	-.101	.821
Global company	.242	.600
Factor Correlation Matrix:		
Factor 1	1.00	
Factor 2	.150	1.00

The two factors (based on scree plot and eigenvalues) confirm the two dimensions presented in the literature. The first factor reflects a broad market(ing)-driven strategy (marketing-intensive strategy), contrasting such qualities as large size, a broad product range, presence in many markets, marketing intensive, and to a lesser extent active within non-prescription markets. The second factor reflects an R&D-driven strategy contrasting qualities such as research intensity, development intensity, and a global character of the company (R&D-intensive strategy). The two factors are relatively independent (correlation between factors r=.15). This means that the two strategies are not two extremes on a continuum but that there are companies that score high on the pull strategy factor which can score high or low on the push strategy factor. The R&D-intensive strategy (RDINTENS) measure attains a Cronbach α reliability coefficient of .66, the marketing intensive strategy measure (MKINTENS) attains a Cronbach α reliability coefficient of .70.

With respect to R&D intensity we had the opportunity to check the content

validity of this construct by linking the data set to factual data on the number of R&D compounds in the R&D pipeline of the company. Data from n=84 companies were collected. The analysis showed that the correlation with RDINTENS was r=.26 (p<.01). The correlation with MKINTENS was not significant. There is therefore considerable support for the content validity of our RDINTENS scale.

3.7 Summary of findings

In this chapter, we elaborated on the design of the study, the data collection, and the measurement scales. We opted for an international survey among companies in a single industry, specifically the pharmaceutical industry.

The survey attained a response rate of 21% (n=148). The response sample has favorable characteristics. Analyses of early and late responses revealed no significant differences and sample averages proved to be close to industry averages. Furthermore, the responding marketing and R&D managers proved to be mainly senior executives which is desirable because of their role as informants. In addition, the companies of the marketing respondents and the R&D respondents did not differ significantly with respect to important characteristics like size and innovativeness.

The variables in the comprehensive model were operationalized using several existing, adapted, or new multiple-item scales. We checked for unidimensionality of the measures and computed Cronbach α reliabilities. Then we developed composite scores for all constructs. The content validity of several scales was assessed by correlating the scores with other indicators. For example, we checked the content validity of the new product performance measures by means of a correlation analysis with factual sales growth figures of the companies in the sample. Overall, the measurement scales showed good measurement properties.

To summarize, we argue that the data resulting from the survey have favorable characteristics to enable us to answer the research questions generated in Chapter 1. In the following three chapters we will describe the results.

PART II

RESULTS

4

The marketing - R&D interface

4.1 Introduction

This chapter deals with the central element of this study: the marketing - R&D interface. In this interface, we will focus upon i) integration between marketing and R&D, ii) the relative influence of marketing and R&D in specific NPD phases, and iii) managerial mechanisms used in companies to bridge the gap between marketing and R&D. To begin with, these three concepts will be studied in 'isolation' from the rest of the company. This allows a more in-depth analysis of the processes inside the marketing - R&D interface. The variables and possible relationships are outlined in the Figure 4-1.

In the marketing - R&D interface, the expected relationships between managerial mechanisms and integration and between managerial mechanisms and relative influence are indicated by arrows. Although we expect that integration and relative influence are to a large extent independent constructs, we will also elaborate on the possible relationship between integration and relative influence.

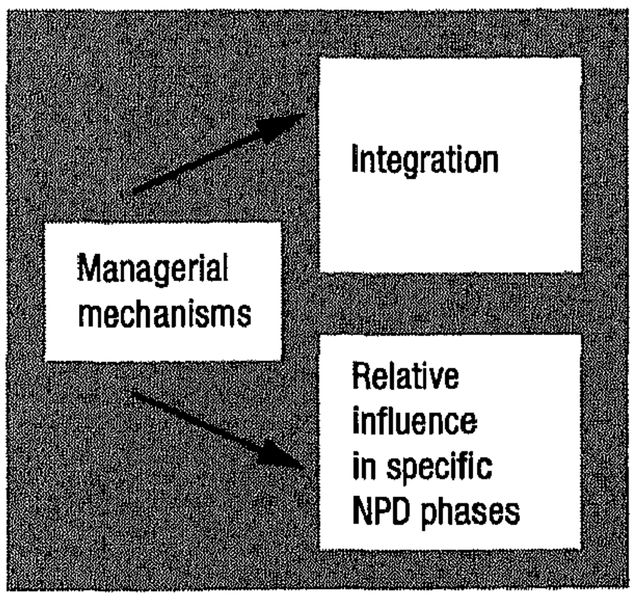

FIGURE 4-1: THE MARKETING - R&D INTERFACE (CENTRAL BUILDING BLOCK IN FIGURE 2-1, P.23)

This chapter is organized as follows: in Section 4.2 the level of integration between marketing and R&D in the companies as observed in the data set is discussed. Next, the relationship between managerial mechanisms and integration will be studied, first, we will elaborate on the use of managerial mechanisms in companies, second, the effects of managerial mechanisms on integration are investigated.

In Section 4.3, the variables for relative influence in specific NPD phases are introduced (operationalized as R&D's influence relative to marketing). Considerable attention will be paid to the possible link between managerial mechanisms and relative influence in specific NPD phases. Finally, a summary of the most important findings is presented in Section 4.4.

4.2 Integration between marketing and R&D

4.2.1 The amount of integration in companies

Earlier research on the marketing - R&D interface indicates that integration is an important aspect of the relationship between marketing and R&D. To measure integration between marketing and R&D, three scales have been used in the present study. The first measurement scale is the 15-item INTEGRAT scale described in Section 3.6.2. This is the main integration scale that will be used throughout this study because of its reliability and validity as shown in Chapter 3. The second measurement scale is a single-item scale which was formulated on the basis of the following question: 'Taking everything into account with respect to the overall level of integration in the company, to what extent does integration between marketing and R&D exist in your company?' (1 = very little to 5 = very much). With respect to the third scale, the same question was asked with respect to the level of integration between marketing and R&D four years ago. The two latter variables will be labeled TOTINT and TOTINT-4, respectively, and these variables will be used for validation and to generate additional insights into the effect of time.

TABLE 4-1: DESCRIPTIVE STATISTICS FOR THE AMOUNT OF INTEGRATION IN COMPANIES

Integration variable	Overall sample		Marketing sample		R&D sample	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Integration today (composite)						
INTEGRAT	3.51	.57	3.50	.56	3.55	.57
Integration today (single-item)						
TOTINT	2.93	.95	2.95	.97	2.89	.93
Integration four years ago (single-item)						
TOTINT-4	1.99	.85	1.92	.87	2.09	.83

Table 4-1 shows the mean and std. dev. for the three integration variables, for the overall sample and for the marketing and R&D sample separately. Interestingly, there is a large degree of agreement between marketing and R&D respondents. The nonparametric Mann-Whitney U test for significant differences between the marketing and R&D sample showed no significant differences for all variables. Clearly, the difference between integration today and integration four years ago shows that in the perception of the respondents, integration has increased significantly.

4.2.2 Managerial mechanisms and their effect on integration

In the present research, many different variables for managerial mechanisms were identified and measured. In this section, we will give an overview of the *use* of several managerial mechanisms in the companies as observed in the data set. The complete list of variable names and the descriptive statistics are presented in Appendix 2 and 3. Next, we will focus on the *effect* of managerial mechanisms on integration. It should be noted that scores on reverse questions have been transformed in order to make sure that higher scores on the managerial mechanism scales represent (a more intense) use of managerial mechanisms.

The use of managerial mechanisms

In this section, we examine the use of specific managerial mechanisms. The word 'use' must be interpreted broadly. For example, project teams are used in a company but a mechanism like 'physical closeness of marketing and R&D' implies that we want to know how marketing and R&D are generally located in the company. We will focus upon physical closeness, cross functional project teams, project management, job rotation, remuneration and career opportunities, and cross functional training.

Physical closeness of marketing and R&D

Integration between marketing and R&D, as we defined it, encompasses - besides good interpersonal relations and joint task orientation - accurate and timely communication between actors. Because of this conceptualization, physical closeness between marketing and R&D is expected to play an important role. Earlier research (e.g., Allen 1970) has shown that communication increases when the physical distance between people is reduced and when groups work in non-territorial spaces. In this respect, physical closeness is a managerial mechanism because physical closeness can to a certain extent be changed by management (in order to stimulate communication some firms are actively restructuring their physical facilities to reduce physical distance, arrange informal meeting places, place coffee machines in strategic places, etc.). To measure physical closeness between marketing and R&D, a question was asked on how marketing and R&D are generally located in the company. It should be borne in mind that the respondents play the role of an informant and score their company, not their own situation.

TABLE 4-2: THE LOCATION OF MARKETING AND R&D (GENERAL PHYSICAL CLOSENESS OF MARKETING AND R&D)

Marketing and R&D are generally located in:	Count	Percentage
Different countries	8	5.5
The same country, not the same location	20	13.7
The same location, not the same building	60	41.1
The same building, functional (grouped)	44	30.1
The same building, cross functional (mixed)	14	9.6
Total	148	100%

Table 4-2 shows that the opportunities for marketing and R&D personnel to meet in the corridor are still limited from a physical closeness perspective. Only about 40% of all respondents report that marketing and R&D are in general located in the same building. Even if marketing and R&D are located in the same location, often they are in separate buildings.

Cross functional project teams and project management

Cross functional project teams solve a number of integration problems like information exchange, joint goal orientation, and functional 'thought worlds' by creating a shared world (Dougherty 1992, Griffin & Hauser 1994). During our exploratory interviews we learned that many companies were actively involved in implementing cross functional project team structures. In order to study the use of this managerial mechanism further, we asked the respondents to answer a question on the proportion of *all* marketing and R&D employees that are **members** in one or more cross functional project teams. Next, we asked the respondent to answer the question: who is in charge of cross functional teams? Specifically, what proportion of all **project managers** have experience in marketing and what proportion have experience in R&D?

TABLE 4-3: PROPORTION OF MARKETING/ R&D EMPLOYEES WHO ARE MEMBERS OF A CROSS-FUNCTIONAL PROJECT TEAM AND THE PROPORTION OF PROJECT MANAGERS WITH EXPERIENCE IN MARKETING/ R&D (1: <5%, 2: 5-20%, 3: 20-40%, 4: 40-60%, 5: 60-80%, 6: 80-95%, 7: 95-100%)

Managerial mechanism	Overall sample Mean	Marketing sample Mean	R&D sample Mean	Sign. p (M-W)
Proportion of marketers participating in cross functional teams (PRJMEM_M)	3.86	3.98	3.67	.37
Proportion of R&D employees participating in cross functional teams (PRJMEM_R)	3.69	3.63	3.80	.45
Proportion of project managers with experience in marketing (PRJMAN_M)	2.99	3.17	2.73	.08*
Proportion of project managers with experience in R&D (PRJMAN_R)	4.25	4.04	4.57	.11

*p<.10 **p<.05 ***p<.01 (two-tailed)

Table 4-3 shows that the proportion of marketing personnel participating in cross functional teams is almost equal to the proportion of R&D personnel participating in cross functional teams (no significant differences, Wilcoxon Matched Pairs signed ranks test). However, when the project manager is considered, it is interesting to see that there is a larger proportion of project managers with experience in R&D (significant differences in all samples p<.05, two-tailed, Wilcoxon Matched Pairs signed ranks test, checked for ties). Furthermore, we see that marketing scores the proportion of project managers

with experience in marketing significantly higher (p=.08, two-tailed, Mann Whitney U test). Given the higher number of marketing respondents in the sample, the difference between the proportion of project managers with experience in marketing compared to the proportion with experience in R&D would have become even larger if sub-samples of equal size had been used.

Personnel movement

Personnel movement or job rotation between functional areas is thought to be effective in improving information flows across functional barriers. Personnel that moves from one functional area to another contributes knowledge, contacts, and jargon which can lead to better information use and eventually integration. To measure the intensity of job rotation between marketing and R&D, respondents were asked to answer two questions on the proportion of all marketing and R&D employees involved in cross functional job rotation in their company. Table 4-4 shows the results.

TABLE 4-4: PROPORTION OF MARKETING / R&D EMPLOYEES THAT HAVE BEEN INVOLVED IN CROSS FUNCTIONAL JOB ROTATION AS SCORED BY RESPONDENTS

	Proportion of all marketing employees involved in cross functional job rotation (JOBROT_M)		Proportion of all R&D employees involved in cross functional job rotation (JOBROT_R)	
Answering category	Count	Percentage	Count	Percentage
1. 0- 5%	69	48.6	98	68.5
2. 5- 20	51	35.9	35	24.5
3. 20- 40	15	10.6	7	4.9
4. 40- 60	3	2.1	3	2.1
5. 60- 80	2	1.4		
6. 80- 95	1	.7		
7. 95- 100	1	.7		
Total	142	100	143	100

Table 4-4 shows that cross functional job rotation of marketing (JOBROT_M) and R&D (JOBROT_R) is not a widely used managerial mechanism. More than 80% of all respondents indicates that only 20% or less of all marketing and R&D employees are involved in job rotation between marketing and R&D. The average scores are 1.77 and 1.41 with no significant differences between the scores of the marketing respondents compared to the R&D respondents (split samples will only be shown if there are significant differences between the marketing and R&D respondents). The finding that job rotation is not a widely used managerial mechanism - even in an industry where a large proportion of all marketing managers has a technical background - gives an indication of the difficulties involved in job rotation. Transferring personnel between two closely related disciplines is far easier than shifting personnel between marketing and R&D (Griffin & Hauser 1994). Furthermore, it is difficult to ensure that in-depth knowledge in a specific field is not eroded during the time in another functional area.

Remuneration and career opportunities

Hauser et al. (1994) showed that creating interdependence in rewards between functional areas increases firm profits. In the present research we focus upon whether the reward structures are, in general, equal between marketing and R&D. We focus on two criteria, namely remuneration and career opportunities. The two questions that we incorporated in the questionnaire were: 1) is remuneration (salary, etc.) in general equal for marketing and R&D?, and 2) are the career opportunities in general equal for marketing and R&D? Table 4-5 summarizes how the respondents scored the 'yes' or 'no' question.

TABLE 4-5: FREQUENCY TABLE OF THE NUMBER OF RESPONDENTS THAT OPTED FOR A 'YES' OR 'NO' ANSWER TO THE QUESTION ON EQUALITY OF CAREER OPPORTUNITIES AND REMUNERATION

	Overall sample		Marketing sample		R&D sample	
	Yes	No	Yes	No	Yes	No
Equal career opportunities (EQCAREER)	74 (54%)	64 (46%)	37 (45%)	46 (55%)	37 (68%)	17 (32%)
Equal remuneration (EQSALARY)	77 (56%)	61 (44%)	52 (62%)	32 (38%)	25 (47%)	28 (53%)

Interestingly, almost half of the respondents indicate that the career opportunities and salaries are not equal for marketing and R&D. Furthermore, a different pattern in the division between 'yes' and 'no' can be observed at the sub-sample level. In the marketing sample, a much larger proportion of respondents indicate that the career opportunities are not equal (X^2 =14.5, df=1, p<.01). In the R&D sample, a much larger proportion of respondents indicate that the remuneration is not equal (X^2 =7.1, df=1, p<.01). Next we will conduct an additional analysis of the direction of inequality in career opportunities and remuneration.

TABLE 4-6: MARKETING'S CAREER OPPORTUNITY INDEX AND MARKETING'S REMUNERATION INDEX (R&D=100), [A,B]= (A) THE NUMBER OF RESPONDENTS THAT GAVE MARKETING A SCORE LOWER THAN 100, AND (B) NUMBER OF RESPONDENTS THAT GAVE MARKETING A SCORE HIGHER THAN 100

	Overall sample	Marketing sample	R&D sample
Career opportunities for marketing (R&D =100)	index=114 [10,53]	index=116 [6,41]	index=109 [4,12]
Remuneration for marketing (R&D=100)	index=105 [22,42]	index=105 [14,24]	index=107 [8,18]

Table 4-6 shows that in the perception of the respondents, marketing has on average better career opportunities and a better salary. The higher salaries and the better career opportunity indexes for marketing are prominent in both the marketing sample and the R&D sample.

Cross functional training

Cross functional training can take different forms. During the exploratory interviews we encountered mechanisms like seminars, symposia, scientific conferences, marketing courses for R&D, and R&D courses for marketing. In the present study, we focus on two types of variables. Firstly, on a broad range of training forms where marketing and R&D are jointly present at the same time. Secondly, we measured a variable for marketing course days for R&D and R&D course days for marketing. Table 4-7 shows the results.

TABLE 4-7: CROSS FUNCTIONAL TRAINING (NUMBER OF DAYS IN THE COMPANY OF THE RESPONDENT)

Cross functional training (average number of days)	Overall sample Mean	Marketing sample Mean	R&D sample Mean	Sign. p (M-W)
Joint training sessions	6.69	6.57	6.99	.97
R&D training for marketing	4.01	4.16	3.83	.95
Marketing training for R&D	2.67	2.88	2.39	.30

Table 4-7 shows three points that are noteworthy. First, marketing and R&D spend a lot of time together attending some kind of training (average 6.69 days). Second, marketing spends more time on R&D training than R&D does on marketing training. A third interesting point is the agreement between the average perceptions of marketing and R&D with no significant differences between the two sub-samples (Mann Whitney U test, $p<.10$ (two-tailed)) .

The effect of managerial mechanisms on integration

Here we test hypotheses 1a - 1c and 2 by regressing integration on the variables for managerial mechanisms. Hypotheses 1a - 1c propose that there is a positive relationship between managerial mechanisms (control, interaction, and climate) and integration. Hypothesis 2 proposes that managerial mechanisms that directly stimulate interaction between marketing and R&D (interaction mechanism) are most effective in creating integration. The effectiveness of a particular mechanism is implied by a positive beta coefficient. A positive relationship means that a (more extensive) use of a mechanism leads to (more) integration. For example, we expect that more physical closeness between marketing and R&D leads to more integration. Because of the low correlations between predictor variables, multicollinearity is not a major problem here. We also studied the individual scatter plots to look for non-linear relationships in the data. However, we found no indications for other than linear effects. Table 4-8 shows the estimated standardized regression coefficients (betas) for the mechanisms in each category in order of effect size in the overall sample.

TABLE 4-8: REGRESSION MODELS WITH INTEGRAT AS CRITERION VARIABLE

	Overall sample		Marketing sample		R&D sample	
Variable	Beta	T	Beta	T	Beta	T
Control mechanisms						
PRJMAN_M	.20	1.96**	.39	3.31***	-.13	-.68
REVBOARD	.19	1.86**	.15	1.25	.15	.90
MONBOARD	.16	1.57*	.31	3.31***	-.09	-.46
CROSPAY	-.07	-.78	.07	.63	-.30	-1.66*
FORMPROC	-.05	-.51	-.10	-.89	.19	1.05
LIAISON	.04	.44	.23	2.20**	-.24	-1.34*
Interaction mechanisms						
PHYSCLOS	.30	3.07***	.32	2.46***	.37	2.26**
INFTECH	.19	2.05**	.28	2.45***	.14	.87
CROSTRAIN	.14	1.49*	.19	1.55*	.10	.65
PRJMEM_R	.07	.77	.08	.74	.09	.48
JOBROT_M	.06	.68	.15	1.31*	-.02	-.12
PRJMEM_M	.05	.48	.04	.27	.13	.63
SURVIVAL	.04	.44	-.26	-1.99**	.39	2.24**
JOBROT_R	.00	.02	-.02	-.15	.09	.48
Climate mechanisms						
EQCAREER	.23	2.48***	.23	2.12**	.14	.83
EQCOSTC	.13	1.39*	.14	1.14	.14	.77
STATMENT	.09	.94	.08	.70	-.06	-.35
n (listwise)	114		66		48	
R^2	.30		.55		.44	
Adjusted R^2	.18		.39		.12	
F-value	2.41***		3.41***		1.37 (ns)	

*p<.10 **p<.05 ***p<.01 (one-tailed)

The overall sample

Table 4-8 shows that eight beta coefficients related to managerial mechanism variables are significant in the expected direction. Seven other parameters have the expected direction but they are not significant. Two estimated parameters are in the opposite direction but also not significant. The significant betas cover all three types of managerial mechanisms (control, interaction, and climate) and thus we find considerable support for our first set of hypotheses (1a-1c). In particular, physical closeness of marketing and R&D is a mechanism that is strongly related to integration between marketing and R&D. Furthermore, equal career opportunities for marketing and R&D (EQCAREER), using cross functional teams that are being managed by marketing managers (PRJMAN_M), adopting new information technologies like e-mail (INFTECH), and cross functional monitor boards (MONBOARD), positively affect integration between marketing and R&D. To a lesser extent, but still significant, cross functional training (CROSTRAIN) and equal cost-cutting between marketing and R&D (EQCOSTC) are positively related to integration.

Several mechanisms do not attain a significant beta. This is surprising especially with respect to the widely used cross functional teams (see Table 4-3). With respect to the non-significance of cross functional teams (PRJMEM_R and PRJMEM_M), we refer the reader to recent empirical studies that acknowledge problems with respect to the *management* of the team and the *design* of teams (for an overview see Cohen and Bailey 1997). The problems are illustrated by the following two quotes by Dr. L. Herrero (Vice president R&D Allergan, *Scrip Magazine*, 1996):

> *"Everything has to be worked out in teams and there are lots of them about. The main problem with team religion is that it is part of a hierarchical church. There is a team (say, the 'project team') and the team that controls the team (a 'development committee' perhaps) and a team that overlooks the work of teams. It is worse than the old military hierarchical structure that the 'team-and-matrix' was supposed to cure."*

> *"Team religion deserves a whole book but let me focus on one of its*

multiple characteristics - the obsession with representation. Teams are not taken seriously if not all possible constituencies are represented. In the pharmaceutical arena, the spectrum goes from the chemist modeling drugs on the computer and the rat behavioral expert to medical advisors and salesmen. Such a diverse congregation is not likely to sing the same hymn but we still insist on having everybody around. What kind of special and differentiated skills does a toxicologist have that compel him to notice and broadcast that there is a misspelling on page three of a clinical protocol? It is a mystery to me.'"

Table 4-8 shows that the management inside the team is important. The fact that cross functional project managers come from marketing (PRJMAN_M) has a positive effect on integration (at least for the marketing respondents).

A mechanism that performs below expectations is job rotation. The explanation for the apparent low effectiveness might be related to the small number of people actually involved in job rotation (0-20% of all employees, see Table 4-4). Furthermore, recently, Moenaert & Souder (1996) elaborated on a serious negative side effect of job rotation if the job rotation periods are too short. Periods of about 2 to 3 years between two jobs are too short to build credibility in the eyes of the other party during information transfer for example. Since we did not measure job rotation periods, we cannot check for this effect.

The adjusted R^2 = .18. This shows that the model explains a modest amount of variance in integration. Overall, the fact that some variables do not attain a positive and significant beta might be related to the lower effectiveness of these mechanisms in producing integration between marketing and R&D. Another possible explanation might be that managerial mechanisms have different effects for marketing and R&D. In that case, there might, for example, be a positive effect in one functional area and a negative effect in the other. This could lead to a non-significant effect in the overall sample.

The marketing respondents

Eight variables for managerial mechanisms attain significant beta coefficients in the expected direction. Interestingly, the variable for job rotation of marketing

personnel and the variable for liaison officers attain a positive and significant beta. One variable for a managerial mechanism attains a significant and negative beta coefficient: SURVIVAL. More research is needed before we can explain this phenomenon. A possible explanation might be found in the *nature* of this particular mechanism. Maybe informal survival meetings are used more often when there are serious problems in the company e.g., in reaction to a dramatic lack of integration. The regression model explains 55 percent of variance in INTEGRAT (adjusted R^2 =.39). So, in the marketing sample we find a much stronger relationship between managerial mechanisms and integration than in the overall sample (and thus the R&D sample).

The R&D respondents

Only two variables for managerial mechanisms attain a significant beta coefficient in the expected direction, namely the variable for physical closeness of marketing and R&D (PHYSCLOS) and for cross functional survival meetings (SURVIVAL). Compared to the marketing sample, there is a weaker overall relationship between managerial mechanisms and integration. So, integration is explained much less by the mechanisms as perceived by the R&D sample than as perceived by the marketing sample. This is an important finding because it has to do with the fundamental issue of what makes a company integrated. To find a possible explanation, we look for large differences in the size of the beta coefficients between marketing and R&D. Table 4-8 shows that there are two mechanisms with a large positive beta for the marketing sample and a small and not significant beta for the R&D sample. These mechanisms are 'cross-functional project management from marketing' and 'formal monitor board'. These two mechanisms have in common that they are control mechanisms (formal control bodies). So, there seems to be a contribution to integration of this type of mechanisms in the eyes of the marketing people but not in those of the R&D people.

Opposite effects in different samples

There are two examples of opposite effects for marketing and R&D. SURVIVAL attained a significant and negative beta for the marketing sample and a positive and significant beta for the R&D sample. So, SURVIVAL is an example of a

managerial mechanism that seems to have a desired effect for R&D and an undesired effect for marketing. The same is true for the variable LIAISON but now the other way around. For marketing respondents, formal liaison roles make a positive contribution, for R&D respondents the effect seems to be negative.

CROSPAY attains a negative and significant beta in the R&D sample. This mechanism was encountered during the exploratory interviews in two companies. A possible explanation may be that this mechanism is used by marketing to exert more influence on R&D and to make them more short term oriented. This is not in line with R&D attitudes which are more long term oriented (Griffin & Hauser 1996). LIAISON is a managerial mechanism that attains a negative beta for the R&D sample and a positive and significant beta for the marketing sample. Dougherty (1992) already stated that the effectiveness of LIAISON roles was expected to be low because they do not directly stimulate contact between different 'thought worlds'. The results of the present study show that this is the case for the R&D sample (even a negative effect), but not for the marketing sample. Again, marketing seems to like the control properties of this mechanism. The regression model for the R&D sample explains 44 percent of variance in INTEGRAT (adjusted R^2 =.12). So, there is only a weak relationship between managerial mechanisms and integration in the R&D sample.

Validation of results

To explore the robustness of the previous sub sample findings, several additional regression analyses with a smaller number of managerial mechanisms were conducted (to increase the number of data points per variable). These analyses confirmed the previous picture: specific mechanisms in each of the three categories are effective and marketing appreciate control mechanisms much more than R&D. To summarize, there is a positive relationship between managerial mechanisms and integration for several managerial mechanisms in all three categories (control, interaction, and climate). However, the relationship seems to be weak or even non-existent for specific managerial mechanisms (i.e. formal statements by top management, a formalized NPD process, job rotation of R&D personnel, and project teams). Furthermore, the analysis shows that a managerial mechanism can work out differently depending on the informant's functional background. *Hypotheses 1a-1c are partially supported.*

The most effective managerial mechanisms

In this section, we test hypothesis 2 which proposes that interaction mechanisms are most effective in creating integration. We focus on the variables in Table 4-8 with significant beta coefficients to evaluate which of the managerial mechanisms explain most of the variance in the dependent variable. It shows that, for the overall sample, PHYSCLOS (interaction) is the most important variable in explaining variance in integration. EQCAREER (climate) and PRJMAN_M (control) are next in line. Overall, we see no clear grouping of managerial mechanisms in which interaction mechanisms attain the highest beta. Hypothesis 2 is not supported for the overall sample. There are very effective managerial mechanisms that are not interaction mechanisms. For the marketing sample, the most important managerial mechanisms are in order of importance: PRJMAN_M (control), PHYSCLOS (interaction), MONBOARD (control), INFTECH (interaction), SURVIVAL in the opposite direction! (interaction), LIAISON (control), etc. Clearly, there is no clustering of interaction mechanisms as the most effective ones. Marketers also perceive control mechanisms as very effective. For the R&D sample, the only two managerial mechanisms that attain significant regression coefficients in the expected direction are: SURVIVAL (interaction) and PHYSCLOS (interaction). Two control mechanisms attain a significant beta in the opposite direction (negative beta): CROSPAY and LIAISON. So, all large positive betas are attained by interaction mechanisms and R&D people do not favor control mechanisms. *Hypothesis 2 is supported for the R&D sample only.*

Two final remarks with respect to the three samples together. PHYSCLOS is the only variable that attains a significant and positive beta coefficient in all three samples. PHYSCLOS is the most important variable in the overall sample and the second most important variable in marketing and R&D sample. The high importance of PHYSCLOS was expected because of the importance of communication between marketing and R&D in the context of integration. The second remark is on the managerial mechanisms for which we found no significant effect on integration in each of the three samples (either positive or negative). These are STATMENT, FORMPROC, JOBROT_R, and PRJMEM_M/R. Of these five mechanisms, only FORMPROC is close to attaining a significant beta. Together with the mechanisms that have undesired

effects with respect to integration, these mechanisms need more study on questions like, 'why do we find no significant effects?',' how can they be used better?', 'do they have other desired effects?', etc.

Integration as we defined it refers to the *whole* NPD process. In the next section we will introduce the concept of relative influence. Relative influence is a new concept that was measured for *specific phases* in the NPD process. These decision points proved to load on two underlying factors which have been labeled 'R&D's relative influence (to marketing) in the initiation phase' and 'R&D's relative influence (to marketing) in the implementation phase'.

4.3 Relative influence of marketing and R&D

4.3.1 Relative influence in specific NPD phases

Apart from the measure for integration between marketing and R&D, a measure for relative influence of marketing and R&D is incorporated in the present study. We asked respondents to divide 100 points between marketing and R&D as to how they perceived that relative influence of marketing and R&D in a specific decision point is divided in their company.[20] The decision points are selected across the range of decisions from idea generation to commercialization in the NPD process. Hypothesis 3a states that R&D is dominant in the decisions in the initiation phase. Hypothesis 3b states that marketing is dominant in the decisions in the implementation phases. Table 4-9 presents R&D's relative influence for each decision point averaged across all respondents.[21]

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[20] Certain decisions involve many activities and therefore the terms 'decisions' and 'activities' can both be used in this respect.

[21] The relative influence score for marketing in a specific decision point can be constructed by subtracting R&D's relative influence score from 100.

TABLE 4-9: R&D'S RELATIVE INFLUENCE FOR SPECIFIC DECISION POINTS[22]

Item	R&D's relative influence	Std. Dev.	Dominant
1 Selecting therapeutic areas of Research	63.1	23.4	R&D
2 Setting new product development goals	59.4	21.8	R&D
3 Licence in/out of R&D compounds	45.0	24.2	Marketing
4 Generating new product ideas or NCEs	73.1	21.5	R&D
5 Pre clinical development	85.4	15.6	R&D
6 Clinical testing	75.1	19.2	R&D
7 Positioning the new product	22.0	16.5	Marketing
8 Developing and implementing launch plan	15.7	15.8	Marketing
9 Developing and implementing advertising c.	6.1	8.3	Marketing
10 Managing the sales force	.9	2.6	Marketing
11 Developing product line expansions	31.1	21.2	Marketing
12 Generating feedback from customers	13.4	15.1	Marketing
Overall average	41	8.7	Marketing

Table 4-9 shows that there are five decision points in which R&D is on average dominant. R&D is most influential in decision point 5 'Pre-clinical development of new compounds'. In contrast, there are seven decision points in which marketing is on average dominant. Marketing is extremely influential in decision point 9 'Developing and implementing advertising campaigns' and even more in decision point 10 'Managing the sales force'. Finally, there are two decision points with a relatively balanced relative influence division between marketing and R&D. We use the term balanced (symmetrical) when marketing (and R&D) has a relative influence score close to 50 like in the case of decision points 2 'Setting new product development goals and priorities' and decision point no.3 'Licence in/out decisions of R&D compounds'. The overall amount of R&D's

22 From here onward we will focus our discussion upon *R&D's* relative influence.This measure can be easily transformed into *marketing*'s relative influence

relative influence across all decision points is 41. This means that **in the above decision points**, on average, marketing is dominant in the companies in the data set.

From the factor analysis performed in chapter 3, we learned that the phase break between the initiation phase and the implementation phase is marked by decision point number 6 'Clinical testing'. Of the five decision points that load high on the initiation phase factor (see Section 3.6.2), there are four decision points where R&D is on average dominant. Only in decision point number 3 'licence in/out of R&D compounds' a dominant role for marketing is present. Marketing is on average dominant in all implementation phase decision points.

To check for 'over-estimation' of the amount of relative influence of the respondent's own functional area, we have split the average relative R&D influence scores into two columns. In the first column the average relative influence of R&D as reported by R&D respondents is described. The second column shows the average relative influence of R&D as reported by marketing respondents.

TABLE 4-10: MEAN RELATIVE R&D INFLUENCE SCORED BY MARKETING RESPONDENTS, MEAN RELATIVE R&D INFLUENCE SCORED BY R&D RESPONDENTS, AND CALCULATION OF OVER-ESTIMATION OF RELATIVE R&D INFLUENCE BY R&D RESPONDENTS COMPARED TO MARKETING RESPONDENTS

Items	*Marketing respondents* Mean R&D Influence	*R&D respondents* Mean R&D Influence	'Over-Estimation' Mean $_{R\&D}$-Mean $_{MKT}$	p(t-test)
1 Selecting therapeutic areas of Research	61.71	64.82	+3.11	.45
2 Setting new product development goals	57.26	62.36	+5.10	.18
3 Licence in/out of R&D compounds	42.94	48.80	+5.86	.17
4 Generating new product ideas or NCEs	69.05	79.26	+10.21	.01***
5 Pre clinical development	85.09	85.58	+ .49	.86
6 Clinical testing	73.67	76.82	+3.15	.35
7 Positioning the new product	18.93	27.00	+8.07	.00***
8 Developing and implementing launch plan	12.70	20.65	+7.95	.00***
9 Developing and implementing advertising camp.	3.68	9.83	+6.15	.00***
10 Managing the sales force	.49	1.51	+1.02	.05**
11 Developing product line expansions	29.94	33.37	+3.43	.36
12 Generating feedback from customers	11.35	16.85	+5.50	.05**
Composite measures (INITINFL & IMPLINFL)				
R&D's influence in the initiation phase	63.78	68.29	+4.51	.08*
R&D's influence in the implementation phase	9.29	15.14	+5.85	.00***

* p<.10 ** p<.05 *** p <.01 (two-tailed tests)

Table 4-10 shows that R&D respondents score their own functional area's relative influence somewhat higher than marketing respondents score R&D's relative influence with respect to *all* decision points. From this we get an indication that there is in general some over-estimation of relative R&D influence by R&D respondents and the same can be said for marketing respondents who score their own relative influence higher than R&D respondents (since we used a constant sum scale).[23] From the column 'over-estimation' we learn that decision point no. 4 'generating new product ideas or NCEs' attains the highest over-estimation in absolute terms (over-estimation = 10.21). In contrast, marketing and R&D agree most on the amount of relative R&D influence with respect to decision point no. 5 'pre-clinical development' (over-estimation = .49).

To test for significant differences between marketing and R&D respondents, we have split the two independent sample means per decision point and conducted t-tests. We recognize that the samples are not perfectly matched and therefore there can be small differences in the companies in the marketing sample compared to the R&D sample. However, these differences are small since the companies did not significantly differ from each other with respect to the descriptive statistics presented in chapter 3. The results of the t-tests are presented in p-values in the last column. From the p-values we learn that the amount of over-estimation is significant for 6 decision points (excluding the composite measures). Of course the amount of over-estimation of relative marketing influence by marketing respondents is identical and also significant for 6 decision points. Since the signs on all over-estimation items are positive, also a sign-test across items is significant at $p<.01$.

The last two rows of Table 4-9 show the two composite measures that were developed and described in Section 3.6.2. We conclude that the amount of over-estimation with respect to both composite measures for R&D's relative influence

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23 For example, in a hypothetical decision point R&D's relative influence is on average scored on 30 by R&D respondents and 25 by marketing respondents. In this case the over-estimation of R&D's relative influence by R&D is equal to 5. This is the same for marketing respondents who score marketing's relative influence on 75 (100-25) and R&D who score marketing's relative influence on 70 (100-30). The difference is again 5.

in the initiation phase and in the implementation phase is significant although the first only at a p=.08 level (two-tailed). Overall, we conclude in the side-line of this study that there is slight over estimation of 'own' relative influence by respondents.

To summarize, relative influence is not divided symmetrically between marketing and R&D in the initiation phase and in the implementation phase. R&D is often the main influential area in the initiation phases and marketing is the main influential area in the implementation phase.[24] Furthermore it is interesting to see that relative influence is divided more symmetrically between marketing and R&D in the initiation phase than in the implementation phase. Finally, there is in general over-estimation of a functional area's relative influence by respondents from that particular functional area.

So far, we have given a detailed analysis of integration and of relative influence in different NPD decisions. In the next section, we will analyze the relationship between relative influence and integration.

4.3.2 The relationship between relative influence and integration

Up till now, research on relative influence in marketing primarily focused on purchase decisions in non-firm contexts like families, or decision making in an inter firm context like supplier-buyer relationships in distribution channels. In the present study we build on this research by studying these concepts in a NPD setting.

Although there is to our knowledge no research on the effects of R&D's relative influence in a NPD context, we expect that relative influence and integration are

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[24] The influence symmetry - asymmetry dimension is often referred to as one along which relationships are thought to be dominant versus submissive. For example, parent-child and small manufacturer - powerful retailer often have an asymmetric relationship whereas close friends have a more symmetric relationship. Iacobucci & Ostrom (1996) suggest that the interaction between marketing and R&D in organisations is an example of a symmetric influence relationship. However, our data suggest that this is not the case. Within a specific decision point, the relationship is often asymmetric with R&D being dominant in the initiation phase and marketing being dominant in the implementation phase.

two distinct aspects of the relationship between marketing and R&D. In earlier research in other areas, concepts like integration and power and control are also studied as independent characteristics of relationships in channels (e.g., Mohr et al. 1996, Anderson et al.1987). Furthermore, Souder (1987) found that teams with harmony between partners could be in a state of equal partners or have a dominant partner.

R&D's relative influence in different phases

As stated before, we will primarily focus our discussion on two variables, namely: R&D's relative influence in the *initiation phase* and the R&D's relative influence in the *implementation phase.* In the previous section, we already found that R&D is on average dominant in the initiation phase and marketing in the implementation phase. In this section, we will investigate whether integration and relative influence are indeed relatively independent of each. To validate this, the following regression model was estimated:

$$\text{INTEGRAT} = \beta_0 + \beta_1\ \text{INITINFL} + \beta_2\ \text{INITINFL}^2 + \beta_3\ \text{IMPLINFL} + \beta_4\ \text{IMPLINFL}^2$$

The results are presented in Table 4-11. To reduce multicollinearity, variables used in quadratic terms are mean centered

TABLE 4-11: QUADRATIC REGRESSION MODELS WITH INITINFL AND IMPLINFL AS PREDICTORS OF INTEGRAT

Variable sample	Overall sample Beta	T	Marketing sample Beta	T	R&D Beta	T
INITINFL	-.08	-.93	-.18	-1.47*	.08	.57
$INITINFL^2$	-.12	-1.36*	-.17	-1.22	-.12	-.79
IMPLINFL	.18	1.73**	.13	1.01	.25	1.15
$IMPLINFL^2$	-.04	-.36	.00	.04	-.07	-.31
n	124		74		48	
R^2	.04		.05		.08	
Adjusted R^2	.01		.00		.00	
F	1.38 ns		.94 ns		.91 ns	

* p<.10 ** p<.05 *** p <.01 (one-tailed tests)

Table 4-11 shows that there is almost no sign of any significant relationship between INTEGRAT, INITINFL and IMPLINFL. None of the regression models is significant. Therefore, it can be concluded that integration and R&D's relative influence in specific phases are independent characteristics of the marketing - R&D interface. In addition, we conducted several other analyses. First, a variable for the average relative R&D influence *in the whole NPD process* was constructed and used in a similar regression. Again, almost no signs of a substantial relationship surfaced. Second, a sample was drawn with an equal number of marketing and R&D respondents. We found that also this did not result in significant differences compared to Table 4-11. Third, a number of variables for influence *differences* were constructed; for differences in specific NPD phases and for difference in the overall NPD process. In this analysis, we also found little proof of any significant relationships. In addition, we note that difference scores in general have been criticized because of several reasons. First, such scales have often high correlations with its component. In our case this is also true. Second, measures based on difference scores often have a lower

reliability (e.g., Peters et al. 1993). This proved also to be the case in our situation. Therefore, we conclude that integration and relative influence in specific phases are both conceptually and statistically distinct. Furthermore, it is best to focus on the untransformed influence scores and not on the influence difference scores.

4.3.3 The effect of managerial mechanisms on relative influence

In the previous sections we found that: (1) many control, interaction, and climate mechanisms produce integration between marketing and R&D, (2) specific types of managerial mechanisms (e.g., formal NPD procedures, job rotation, teams, and formal statements) are less effective, (3) the effectiveness of specific mechanisms differs between the sample where an R&D executive scored the company and the sample where a marketing executive scored the company, (4) interaction mechanisms have the strongest effect on integration in the R&D sample, whereas interaction and control mechanisms have the strongest effect in the marketing sample.

Remember that there is almost no relationship between R&D's relative influence in a specific phase and integration. In other words, the mechanisms that produce integration may or may not produce more relative influence balance in specific phases. To elaborate further on this, we will now focus on the question of whether managerial mechanisms have an effect on R&D's relative influence in a specific phase. Specifically, we will test hypotheses 4a-c and 5a-c. Hypothesis 4a-c proposes that managerial mechanisms lessen R&D's relative influence in the initiation phase. Hypothesis 5a-c proposes that managerial mechanisms increase R&D's relative influence in the implementation phase.

To test for the relative influence balancing-effect of managerial mechanisms, we estimated regression models with INITINFL as the criterion variable and regression models with IMPLINFL as the criterion variable. The managerial mechanisms were incorporated as independent variables. For hypotheses 4a-c to hold, managerial mechanisms should attain a negative and significant beta in the regression model. For hypotheses 5a-c to hold, managerial mechanisms should attain a positive and significant beta. Again we estimated the regression for the overall sample and for the marketing and R&D sample separately.

TABLE 4-12: REGRESSION MODELS WITH INITINFL AND IMPLINFL AS CRITERION VARIABLE (ONLY SIGNIFICANT BETAS PRESENTED)

	Criterion variable INITINFL			Criterion variable: IMPLINFL		
	Overall beta	Marketing beta	R&D beta	Overall beta	Marketing beta	R&D beta
Control mechanisms						
REVBOARD	-.28***	-.22*	-.44***	-	-	-
FORMPROC	-.21**		-.25*			
PRJMAN_M	-.23**	-.31**				
CROSPAY					.19*	
LIAISON						
MONBOARD				-	-	-
Interaction mechanisms						
PRJMEM_M	-.21**		-.40**			
CROSTRAIN	.13*		.28**	.22**		.27**
JOBROT_M	.13*	.29**		.24***		.32**
PHYSCLOS		-.26*		.19**		
JOBROT_R				.22*	.52***	
SURVIVAL						
INFTECH						
PRJMEM_R						
Climate mechanisms						
EQCAREER					.21**	
STATMENT		.22**				
EQCOSTC						.30**
n	108	64	44	111	65	46
R^2	.34	.30	.60	.23	.39	.39
Adjusted R^2	.22	.04	.35	.11	.20	.09
F	2.75***	1.14 ns	2.34**	1.91**	2.06**	1.30 ns

* p<.10 ** p<.05 *** p <.01 (one-tailed tests)

First we will discuss the results based on the regression models with INITINFL as criterion variable. Second we will elaborate on the regression models with IMPLINFL as criterion variable. Overall, it can be seen that there is a pattern in the data that managerial mechanisms attain a negative sign in the initiation phase and a positive sign in the implementation phase which is in accordance with our expectations. From this we conclude that managerial mechanisms in general lower R&D's relative influence in the initiation phase and increase R&D's relative influence in the implementation phase. So there is support for the idea that managerial mechanisms can reduce the amount of relative influence of the dominant functional area in a specific phase.

Regression results for INITINFL

The left-hand side of Table 4-12 shows that, for the overall sample, four variables for managerial mechanisms have significant standardized regression coefficients (betas) in the expected direction. The expected direction is negative because we expect that managerial mechanisms lessen the relative influence of R&D in the initiation phase. The mechanisms include *control* mechanisms and *interaction* mechanisms.

Two standardized regression coefficients, for interaction mechanisms (CROSTRAIN and JOBROT_M), are in the opposite direction and significant. So, reducing the use of these last two managerial mechanisms in the company seems to be related to an increase in R&D's relative influence in the initiation phase. This might be related to the fact that R&D can become more influential relative to marketing because of its increased marketing knowledge. More marketing knowledge in R&D can reduce the need for interaction between the two functional areas and therefore it can lead to an increase in relative R&D influence in the initiation phase. With respect to job rotation, a possible explanation might be that job rotation results in having less time to develop the skills and knowledge necessary to exert influence (Moenaert & Souder 1996). In addition, the analysis shows that job rotation of marketing leads to R&D having more relative influence in both phases. All the other standardized regression coefficients are not significant at a p=.10 level (one-tailed). So climate mechanisms seems to have very low effectiveness with respect to changing the relative influence structure in the NPD process.

Variables that attain the largest beta coefficient in absolute terms explain most of the variance in the criterion variable. Therefore, REVBOARD is the most important variable in the regression model. Two other control mechanisms also have strong positive effects. The amount of variance in INITINFL explained by the managerial mechanisms in the overall sample is 34% (adjusted R^2 =.22). Therefore we conclude that managerial mechanisms play a considerable role in explaining variance in INITINFL.

With respect to the marketing sample, three mechanisms attain a significant and negative beta. These mechanisms include control mechanisms and interaction mechanisms. CROSTRAIN is no longer significant in the opposite direction, which gives us the indication that marketing respondents do not perceive cross functional training as a mechanism that increases R&D influence in the initiation phase. STATMENT, which did not attain a significant beta in the overall sample, attains a significant and positive beta in the marketing sub-sample. This is contrary to our expectations. A possible explanation for the positive sign may lie in two areas. The first explanation is straightforward, namely, that a top management statement on the importance of interaction between marketing and R&D only articulates the problem but does not solve it (makes it even worse). Second, a cultural mechanism like STATMENT (see Souder & Moenaert 1990) is used more in companies where there are acute problems (in this case with too much relative influence of R&D in the initiation phase). This seems plausible, also because it is in the marketing sample that the positive beta is found. Finally, it should be noted that the adjusted R^2 is only .04 which is rather low. So, for the marketing sample there seems to be at best a very weak relationship between managerial mechanisms and relative influence in the initiation phase.

With respect to the R&D sample, three variables attain a negative and significant beta. Again, these mechanisms include control mechanisms and interaction mechanisms. JOBROT_M no longer attains a positive and significant beta as was the case in the overall sample. This offers the insight that only marketing respondents perceive job rotation of marketing personnel as a managerial mechanism that increases the relative influence of R&D in the initiation phase. CROSTRAIN has a positive effect on R&D influence in the initiation phase. So cross functional training leads to greater R&D influence in the initiation phase

in the R&D sub-sample. The amount of variance explained in INITINFL by the managerial mechanism variables for the R&D sample is 60% (adjusted R^2 = .35). The difference in adjusted R^2 between the two sub-samples shows that the regression models fit the data provided by R&D respondents better. So there seems to be a stronger relationship between managerial mechanisms and relative influence in the initiation phase if ratings of R&D managers are used, compared to the ratings of marketing managers.

Regression results for IMPLINFL

Table 4-12 shows that for the overall sample, four interaction mechanisms have significant beta coefficients in the expected direction. The expected direction is positive because we expect that managerial mechanisms increase the amount of relative influence of R&D in the implementation phase. All the other managerial mechanisms do not attain significant beta coefficients in the regression. The low number of significant betas might again be related to the lower effectiveness of managerial mechanisms in increasing the amount of relative R&D influence in the implementation phase. A total of 23% of variance in IMPLINFL is explained by the managerial mechanisms (adjusted R^2 = .11). In other words there is only a weak relationship between managerial mechanisms and relative influence in the implementation phase.

For the marketing respondents, three variables for managerial mechanisms attain a positive and significant beta. The beta for JOBROT_R is very high and significant (beta=.52, p=.0001). This indicates that marketing respondents perceive job rotation of R&D personnel as the key managerial mechanism that contributes positively to higher relative influence of R&D in the implementation phase. A total of 39% of variance in IMPLINFL is explained by the managerial mechanisms (adjusted R^2 =.20), which shows that there is a moderate relationship between managerial mechanisms and relative influence in the implementation phase as perceived by marketing respondents.

For the R&D sample, three variables attain positive and significant betas: two mechanisms belonging to the group of interaction mechanisms and one to the group of cultural mechanisms. This is the first time that a cultural mechanism is significantly related to relative influence in the expected direction. JOBROT_M is the most important variable (beta=.32). Interestingly,

JOBROT_R is not significant for the R&D sample. It seems that R&D respondents are not as optimistic about this mechanism as marketing respondents are. For the R&D respondents, a total of 39% of variance is explained (adjusted R^2 =.09), which shows that there is at best a weak relationship between managerial mechanisms and relative influence in the implementation phase as perceived by R&D respondents. This is interesting because in the regression models for INITINFL, the strongest relationship between managerial mechanisms and relative influence in the initiation phase was found for the R&D sample. So, in the initiation phase the R&D respondents seem to be more optimistic and in the implementation phase marketing seems to be more optimistic about changing the relative influence structure in the company by means of managerial mechanisms. Therefore, both sides expect the largest effect of managerial mechanisms on relative influence to be seen in their own domain.

H4a *(control mechanisms lessen R&D's relative influence in the initiation phase): Supported.* ***H4b*** *(interaction mechanisms lessen R&D's relative influence in the initiation phase): Supported.* ***H4c*** *(climate mechanisms lessen R&D's relative influence in the initiation phase): Almost no support*

H5a *(control mechanisms increase R&D's relative influence in the implementation phase): Almost no support.* ***H5b*** *(interaction mechanisms increase R&D's relative influence in the implementation phase): Strongly supported.* ***H5c*** *(climate mechanisms increase R&D's relative influence in the implementation phase): Almost no support*

The most effective mechanisms

Finally, we test hypothesis 6a which states that control mechanisms are most effective in changing R&D's relative influence in the initiation phase and hypothesis 6b that states that control mechanisms are most effective in changing R&D's relative influence in the implementation phase. From the analyses presented in Table 4-12, we conclude that control mechanisms are most effective in the initiation phase only. In the implementation phase, interaction mechanisms are most effective. *Hypothesis 6a is supported. Hypothesis 6b is not supported.*

4.4 Summary of findings

In this chapter, the relationships between the variables in the marketing - R&D interface were studied. The first variable is integration. The second variable consists of a set of different indicators for managerial mechanisms that are used in companies to bridge the gap between marketing and R&D. The third set of variables is for R&D's relative influence in specific NPD phases.

First we gave an overview of the use of specific managerial mechanisms in companies. We learned that there is typically a relatively large physical distance between marketing and R&D. Often when marketing and R&D are located on the same plant, they are situated in different buildings. Cross functional teams and cross functional training sessions are widely used in both marketing and R&D. In addition, cross functional teams are often led by managers with experience in R&D. Job rotation is not so widely practiced. In most companies, often less than 20% of all marketing and/ or R&D managers are involved in job rotation. Finally, marketing has slightly better career opportunities and better salaries.

We studied the effect of managerial mechanisms on integration. We found that all three types of managerial mechanisms (control, interaction, and climate) can be effective in producing integration. A very important mechanism is the 'physical closeness of marketing and R&D'. In addition, mechanisms like 'equal career opportunities', 'having a large proportion of project managers with experience in marketing (although R&D is less optimistic about this)', 'use of new information technology', 'formal control bodies', 'cross functional training', and 'equal cost cutting between marketing and R&D' also have a positive relationship with integration (see Table 4-8).

With respect to the most effective managerial mechanisms, we found in the marketing sample that apart from mechanisms which stimulate interaction, control mechanisms are also positively related to integration. In the R&D sample, only mechanisms that stimulate direct interaction are effective (physical closeness and joint survival sessions). Interestingly, we found that the use of survival sessions and cross functional salary payment had contrasting effects in different samples (negative in the marketing sample and positive in the R&D sample). A negative relationship was found between cross functional salary payment and

integration in the R&D sample (and a positive relationship in the marketing sample). A positive relationship was found between survival sessions and integration in the R&D sample (and a negative relationship in the marketing sample). Finally, to our surprise, two well-known managerial mechanisms, namely job rotation and cross functional project teams, were not significantly related to integration. The low effectiveness of cross *functional project teams* might be related to how the teams are composed and managed. With respect to job rotation, the duration of a specific job might be too short. We ended the section with a remark that, overall, the relationship between managerial mechanisms and integration is stronger in the marketing sample than in the R&D sample.

The third variable in the marketing - R&D interface was the relative influence of marketing and R&D. Relative influence is a new concept in the interface which has attracted some attention in other areas in marketing but not in new product development. Therefore, we first developed a measurement scale for R&D's relative influence in different phases of the NPD process.

The results showed that relative influence is not equally spread between marketing and R&D in specific phases of the NPD process. R&D is often more influential in the initiation phase and marketing is more influential in the implementation phase. In addition, we found that respondents from a particular functional area overestimate their own functional area's relative influence. Most importantly, we showed that R&D's relative influence in a specific phase and integration are to a large extent conceptually and statistically independent of each other.

The last two hypotheses stated that managerial mechanisms lessen R&D's relative influence in the *initiation phase* and increase R&D's relative influence in the *implementation phase.* We found considerable support for these hypotheses for specific control and interaction mechanisms (see Table 4-12 for the complete list). In the initiation phase, of the 15 significant betas, 10 took the expected direction. In the implementation phase, of the 10 significant betas, all 10 took the expected direction. Only climate mechanisms do not seem to be effective. This is maybe because they have too little impact to change power and control. In addition, R&D respondents seem to be more optimistic about lessening R&D's relative influence in the implementation phase. Marketing respondents seems to be more optimistic about changing the relative influence structure in

the implementation phase.

In the next chapter we will study whether and how factors in the marketing R&D interface are related to the next building block of our model: new product performance. According to common knowledge today, there is a positive relationship between integration and new product performance. We will explicitly test whether this is also the case in our empirical setting. In addition, we will study the relationship between relative influence and new product performance. In specific, the question will be: 'is there an optimal level of relative influence in a specific phase where new product performance is at a maximum?'. By studying both interface variables at the same time we can discover how important both aspects are and find out which variable is more important for new product performance.

5

The effect of the marketing - R&D interface on new product performance

5.1 Introduction

In Chapter 4 we studied the relationships between the variables *inside* the marketing - R&D interface. In the present chapter the relationship between the marketing - R&D interface *and* new product performance plays a central role. The part of the comprehensive model presented in Chapter 2 that reflects this relationship is presented in Figure 5-1. For now, we will study the effect of the interface on new product performance isolated from the effects of other company characteristics like 'depth' resources, structure, and NPD strategy.

It is important to realize that the previous findings on changing integration and the relative influence distribution by means of managerial mechanisms are only relevant if higher levels of integration and fine-tuning R&D's relative influence have a positive effect on desired outcomes. So far, we have implicitly made the assumption that this is the case. In the present

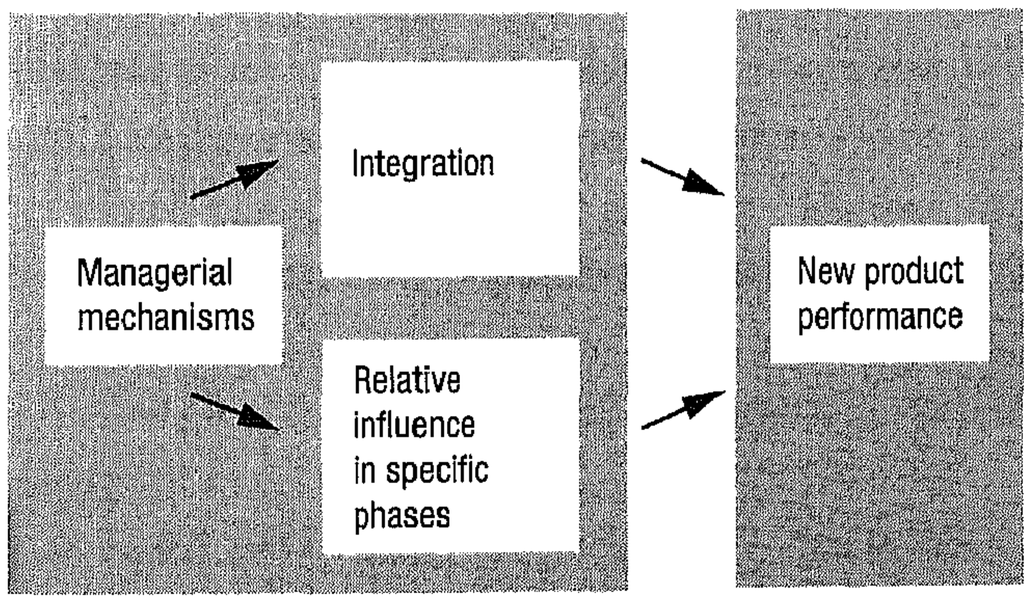

FIGURE 5-1: THE MARKETING - R&D INTERFACE LINKED TO NEW PRODUCT PERFORMANCE (ADAPTED FROM FIGURE 2-1, P.23)

chapter, we will explicitly test this assumption. We will focus upon new product performance of companies which is a specific performance outcome that is crucial for companies in general and for high technology companies in particular (e.g., pharmaceutical companies). We expect that companies with an integrated interface and an adequate level of relative influence of marketing and R&D in specific phases have high new product performance.

In Section 5.2 we will start with a detailed description of new product performance of the companies as observed in the data set. We will then develop more insights into how different new product performance measures are related to each other. In Section 5.3 we will test the hypotheses on the relationship between integration and new product performance. In Section 5.4, the relationship between relative influence in specific phases and new product performance is elaborated upon. In Section 5.5 the direct and indirect effects of influence differences - for which we transform the relative influence scale - on new product performance are discussed. Finally, a summary of the most important findings is presented in Section 5.6.

5.2 New product performance

To measure new product performance in companies, we used several measurement scales (see Section 3.6). We will describe the scores of the companies as observed in the data set. We start with the *subjective* new product performance measures. Then the *self-reported objective* new product performance measures will be looked at. Finally, we will pay attention to the correlates between the measures.

5.2.1 New product performance of the companies in the data set

The subjective measures

Table 5-1 gives an overview of the mean scores and the std.dev. of the subjective new product performance variables as observed in the overall sample, the marketing sub-sample, and the R&D sub sample.

TABLE 5-1: DESCRIPTIVE STATISTICS OF THE SUBJECTIVE MEASURES FOR NEW PRODUCT PERFORMANCE MEASURES (1=LOWEST PERFORMING 20% TO 5=HIGHEST PERFORMING 20%)

	Overall sample		Marketing sample		R&D sample	
Variable	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
PROCPERF	3.0	.8	2.9	.8	3.1	.9
OUTPERF	3.1	1.0	3.1	1.0	3.3	1.0
FUTPERF	3.4	.9	3.4	.9	3.5	.8

Table 5-1 shows the average scores are in the middle of the scale (about 3). Because of the answering categories (1 = 'lowest performing 20%' to 5 = 'highest performing 20%') this contributes to our confidence in the validity of the scales and the representativeness of the sample. Furthermore, we found that there are no significant differences between the marketing and R&D respondent samples (Mann Whitney U, test $p<.10$). This shows again that marketing and R&D work typically for companies with the same characteristics. FUTPERF is on average scored somewhat higher than the current new product performance variables. However, apart from the future time perspective, the FUTPERF scale is constructed of only a subset of the OUTPERF scale items (we also constructed comparable scales with similar items for the two time spans which showed that there was still a significantly higher expected future performance than current performance; so we argue that there is optimism with respect to future new product performance).

The self-reported objective new product performance measures

Table 5-2 gives an overview of the descriptive statistics of the self-reported objective variables for the overall sample, and for the marketing and R&D sample separately.

TABLE 5-2: DESCRIPTIVE STATISTICS OF THE SELF-REPORTED OBJECTIVE NEW PRODUCT PERFORMANCE MEASURES (ITEM DESCRIPTION AT THE BOTTOM OF THE TABLE)

	Overall sample		Marketing sample		R&D sample	
Items	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
BLOCKPERF (4-items)						
item 1	41.8	31.9	42.2	33.7	41.6	29.2
item 2	15.8	24.1	18.0	25.2	12.5	22.1
item 3	1.3	1.6	1.4	1.7	1.2	1.4
item 4	33.1	23.9	34.2	25.2	31.2	21.4
NCE	4.5	3.1	4.8	3.1	4.1	3.1
NEW_COMP	7.1	20.1	6.3	11.9	8.5	29.3
NEW_PROD	15.7	24.4	15.5	24.7	14.0	20.8

Item1='probability of producing 1 blockbuster in the next ten years', item2= 'probability of producing 3 blockbusters in the next ten years', item3= 'number of blockbusters in the last five years' , item4= 'percentage of sales generated by new products (<5years), NCE= 'number of new chemical entities ready for market in the next five years' , NEW_PROD= 'Number of new products produced in the last five years', NEW_COMP='number of compounds in the last five years'.

With respect to the items related to blockbuster performance, this shows that the probability of producing three blockbusters within ten years is smaller than the probability of producing one blockbuster (41.8% compared to 15.8%). In addition, the companies as observed in the data set produce on average more new compounds than New Chemical Entities (NCEs), and more new products than NCEs. These findings have face validity because during the development of NCEs, many compounds enter NPD phases and a large proportion of compounds will be rejected based on (pre-) clinical trials. In the end, the small number of NCEs that enter the market can be the basis for many new products. T-tests were performed to test for significant differences between the mean scores in the marketing sample and the R&D sample. We opted for a t-test because the scores have interval level characteristics. However, it showed that no mean differences were significant at $p<.10$ (two-tailed).

5.2.2 The relationship between the new product performance variables

Before we pay attention to the relationship between the variables in the marketing - R&D interface and new product performance, we will briefly elaborate on the relationships between the new product performance measures themselves. Table 5-3 shows the inter- variable correlations between the new product performance measures. Since the measures we include are all related to different aspects of new product performance, we expect these measures to be somewhat related (except for the single-item indicators for the diligence measures for new product performance).

TABLE 5-3 INTER-VARIABLE CORRELATIONS BETWEEN NEW PRODUCT PERFORMANCE MEASURES

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Subjective measures							
1. PROCPERF	1.00						
2. OUTPERF	.64***	1.00					
3. FUTPERF	.49***	.59***	1.00				
Self-reported objective measures							
4. BLOCKPERF	.39***	.50***	.49***	1.00			
5. NEW_COMP	-.03	.14	.17*	.18*	1.00		
6. NCE	.17*	.28***	.41***	.46***	.40***	1.00	
7. NEW_PROD	-.04	.03	-.02	-.01	.07	.10	1.00

* p<.10 ** p<.05 *** p <.01 (one-tailed tests)

The inter-variable correlations between the subjective new product performance measures range from r=.49 to r=.64 and they are all significant. This was expected on the basis of the inter-factor correlation between the *process* factor and the *output* factor, and the relationship between *current* and *future* new product performance. With a maximum correlation coefficient of r=.64, it also shows that the scales do not completely measure the same concept.

The correlations between the subjective measures and the self-reported objective measures for blockbuster performance (BLOCKPERF) are high and significant. This is an indication of two issues which are difficult to separate. First, two rather different measurement approaches - using subjective and self-reported objective measures - produce comparable results. Second, it proves that blockbusters play an important role in the performance of companies with respect to their new products.

As stated before, the diligence measures are more R&D productivity measures. Only the NCE variable has a weak to moderate positive correlation with the subjective measures and the blockbuster measure. In earlier research, the number of NCEs is often used as a proxy for new product performance (e.g., Graves & Langowitz 1993). This seems more acceptable for future new product performance but less so for current new product performance given the size of the correlation coefficients we find (r = .41 versus r = .28). Finally, the number of new products is not significantly correlated with any of the other new product performance measures.

5.3 The relationship between integration and new product performance

5.3.1 Is there a positive relationship between integration and new product performance?

What makes companies successful? This fundamental question plays an important role in management science today. In the present chapter, we focus on whether the marketing - R&D interface is a possible predictor for new product success. So, we address the question of whether specific states in the marketing - R&D interface are to some extent related to a high-quality NPD process, better new products that generate more revenues, more blockbusters, and higher expectations with respect to future performance.

First, we focus on the effect of *integration* on new product performance. Earlier research suggests that there is a positive relationship between integration and new product performance. Although we have formulated a hypothesis on the

moderating role of integration on the relationship between 'depth' resources and new product performance, we will first study the relationship between integration and new product performance 'isolated' from the rest of the company. Hypothesis 7 states that integration has a positive effect on new product performance. In order to test this expectation, we calculated the correlations between integration (INTEGRAT) and different variables for new product performance. The correlation coefficients are shown in Table 5-4.

TABLE 5-4: CORRELATIONS BETWEEN INTEGRATION (INTEGRAT) AND DIFFERENT NEW PRODUCT PERFORMANCE VARIABLES (INDEPENDENT VARIABLE ON TOP OF THE TABLE)

	Independent variable: INTEGRAT		
	Overall sample	Marketing sample	R&D sample
Dependent variables			
Subjective measures			
1.OUTPERF	.17**	.14	.26**
2.PROCPERF	.14*	.13	.11
3.FUTPERF	.29***	.36***	.16
Self-reported objective measures			
4.BLOCKPERF	.21**	.18*	.26*
5.NEW_COMP	.05	.20**	.01
6.NCE	.26***	.37***	.11
7.NEW_PROD	.03	.03	.03

*p<.10 **p<.05 ***p<.01 (one-tailed tests)

Table 5-4 shows that all correlation coefficients are positive although not all coefficients are significant. In the overall sample, five out of ten coefficients are significant. For the marketing sample, we find four significant coefficients and for the R&D sample two. So we find support for a positive, although not always very strong, relationship between integration and new product performance.

In addition, we tested whether the *relationship* between integration and new product performance is different in the marketing respondent sample compared

to the R&D respondents sample. Therefore we tested for an interaction effect of integration and functional background (dichotomous variable; 0='marketing' and 1='R&D') on the different new product performance measures. We found no significant interactions (two-tailed) for OUTPERF (p=.50), PROCPERF (p=.99), BLOCKPERF (p=.85), FUTPERF (p=.17), NEW_COMP (p=.83), NEW_PROD (p=.93). This convinces us that the respondents' functional background is unimportant and that the respondents scored their own company accurately. Only for NCE was the interaction just significant (p=.10): Marketing respondents perceive a stronger relationship between integration and the number of NCEs than R&D respondents do. Since we showed that marketing and R&D typically work for similar companies, the performance measure NCE might be somewhat more strongly influenced by the respondents' functional background than by the other measures.[25]

5.3.2 Does too much integration lead to lower new product performance?

Is the relationship between integration and new product performance monotonically increasing (more is better)? Or can there be too much integration? In that case, excessive integration in companies may be similar to the too good friends syndrome that Souder (1988) found which is known to be negatively related to new product performance in teams.

A priori we do not expect that the too good friends phenomenon exists in companies as a whole. Compared to NPD teams, companies are much larger and the knowledge base is much more diverse. New people enter companies at a day to day basis and new ideas are developed in all layers of the organization and in all departments. Integrating such diversity is not likely to lead to some kind of a 'dead-lock' as is the case with being too good friends in teams. So, although we do believe that the benefits resulting from increased integration in teams will reach its maximum and even become negative, we do not expect

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[25] From here onward, we will focus mainly on the four composite measures for new product performance (OUTPERF, PROCPERF, BLOCKPERF, and FUTPERF).

that this will occur when the group is as large and diverse as a company as a whole. To summarize, we expect integration to have a positive, monotonically increasing, effect on a company's new product performance.

To test hypothesis 7, we estimated four quadratic regression models with the new product performance variables as criterion variables and a linear (INTEGRAT) and quadratic ($INTEGRAT^2$) variable as predictor variables. For a positive linear effect to exist, the quadratic $INTEGRAT^2$ variable needs to attain a non-significant beta.

In addition, linear and quadratic variables for R&D's relative influence in specific phases are included to test hypotheses 8a and 8b which state that there is an inverted U-shaped relationship between R&D's relative influence in the implementation and in the initiation phase. We will pay attention to hypotheses 8a and 8b in the following section. All variables involved in quadratic effects were mean centered to reduce multicollinearity. The regression results are presented in Table 5-5.

TABLE 5-5: REGRESSION MODELS FOR NEW PRODUCT PERFORMANCE WITH LINEAR AND QUADRATIC INTERFACE VARIABLES AS PREDICTOR VARIABLES

	OUTPERF		PROCPERF		BLOCKPERF		FUTPERF	
	beta	T	beta	T	beta	T	beta	T
Independent variables								
linear terms								
INTEGRAT	.18	1.76**	.15	1.54*	.24	2.35**	.32	3.32***
INITINFL	.01	.06 ns	-.00	- .01 ns	.08	.82 ns	.03	.31 ns
IMPLINFL	.21	2.00**	.22	2.09**	.23	2.13 **	.14	1.41*
quadratic terms								
$INTEGRAT^2$	.08	.80 ns	.06	.57 ns	.12	1.17 ns	.07	.71 ns
$INITINFL^2$	.01	.09 ns	-.09	- .92 ns	.08	.78 ns	.09	1.00 ns
$IMPLINFL^2$	-.15	-1.43*	-.20	-1.97**	-.31	-2.90***	-.22	-2.27**
n	120		120		105		121	
R^2	.07		.09		.14		.14	
Adjusted R^2	.02		.04		.09		.09	
F-value	1.39 ns		1.85**		2.74***		3.05***	

*p<.10 **p<.05 ***p<.01 (one-tailed tests)

Table 5-5 shows that the answer to the central question in this section is clearly 'no': very high levels of integration do not lead to lower new product performance. In all regression models, the beta coefficients for the quadratic terms ($INTEGRAT^2$) are not significant. Furthermore, the signs are positive which indicates that it is more a U-shaped relationship than an inverted U-shaped relationship. *Hypothesis 7 is supported.*

5.4 The relationship between relative influence and new product performance

5.4.1 Is there an inverted U-shaped relationship between R&D's relative influence in specific phases and new product performance?

Table 5-5 is also used to test hypothesis 8a and 8b (see Chapter 2). Hypothesis 8a states that there is an inverted U-shaped relationship between R&D's relative influence in the initiation phase and new product performance and that the top of the curve lies in the area where R&D is dominant. Hypothesis 8b states that there is an inverted U-shape relationship between R&D's relative influence in the implementation phase and new product performance and that the top of the curve lies in the area where marketing is dominant.

Table 5-5 shows that the quadratic IMPLINFL^2 variable attains a significant and negative beta in all regressions. This indicates that the relationship between R&D's relative influence in the implementation phase and new product performance strongly resembles an inverted U-shape. We note that these results were strongly present in the marketing sample as well as in the R&D sample. So, higher levels of relative influence of R&D in the implementation phase seem to be related to increased new product performance, but only to a limited extent. At a given point on the relative R&D influence continuum the increase in new product performance as a result of an increase in R&D's relative influence might become very small or even negative. Furthermore, when we studied the unstandardized b-coefficients, it showed that the 'top' of the curves are located well before a relative influence score of 50 for R&D.[26] *H8b is supported.*

For R&D's relative influence in the initiation phase the picture is less clear and there are no significant negative betas for the quadratic INITINFL^2 variable. This indicates that R&D's relative influence in the initiation phase plays (almost)

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[26] For example, when using the unstandardized b-coefficients (not presented in Table 5-5), the highest point of the curve follows from the following equitation: $df_{outperf}/d(implinfl)=0$, <=> 0.026-0.0016*(implinfl)=0, <=> implinfl=17.

no role in addition to integration in the company and R&D's relative influence in the implementation phase. We conducted additional analyses on the sub-sample level to see whether the quadratic INITINFL^2 attained a significant beta in the marketing sample or in the R&D sample. Only for OUTPERF in the R&D sample did we find a negative and significant beta. *Hypothesis 8a is not supported.*

On the basis of the R^2's presented in Table 5-5, it can be concluded that the overall effect of the interface variables (integration and relative influence in specific phases) on new product performance is weak with adjusted R^2's ranging from .02 to .09.[27] The regression models with the diligence measures as criterion variable are not presented because all regression models proved to be non-significant.

Two questions arise from the above analysis. First, why is there only a weak relationship between the marketing - R&D interface and new product performance? Second, why are there almost no indications of either a linear or a quadratic relationship between R&D's relative influence in the *initiation phase* and new product performance? The first question is related to why we developed a comprehensive model to explain new product performance. We expected that the marketing - R&D interface would affect the *relationship* between contextual organizational factors and new product performance. Therefore, the joint effect of contextual variables and the interface have to be studied. This is the approach that will be followed in the following chapter. The second question may be answered more directly. We argue that - given the more equal influence balance between marketing and R&D in the initiation phase (see Table 4-10) - changing the amount of relative influence of R&D in the initiation phase does not have an effect on new product performance. The companies in the data set seem to be already at the top of the 'curve'.

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[27] We also tested for two-way and three-way interactions between the two relative influence measures and integration. However, we found no indication of any substantive interaction effects.

5.5 The relationship between influence differences and new product performance

5.5.1 Is there a negative relationship between relative influence differences and new product performance?

In the previous chapter we found that there is almost no sign of a significant relationship between integration and R&D's relative influence in a specific phase. Only with respect to influence differences in the NPD process as a whole did we find a modest significant relationship. In this section, we will explore - in a sideline to the present study- the relationship between influence differences and new product performance.

Influence differences between marketing and R&D have been operationalized as the absolute difference in relative influence between marketing and R&D across all NPD decision points. We expect influence differences to have a negative effect on new product performance. For example, from the Tannenbaum studies (summarized in van de Ven & Ferry 1980) we know that more equal amounts of influence among personnel over decisions increases performance. The explanation is that more equal influence results in a greater number of communication channels, more information transfer, and better conflict handling.

We calculated the correlations between INFLDIFF and the new product performance measures to study the relationship. The results are shown in Table 5-6.

TABLE 5-6: CORRELATION COEFFICIENTS BETWEEN INFLUENCE DIFFERENCES AND THE NEW PRODUCT PERFORMANCE VARIABLES (INDEPENDENT VARIABLE ON TOP)

	Independent variable: INFLDIFF		
	Overall sample	Marketing sample	R&D sample
Dependent variable			
Subjective measures			
1. OUTPERF	-.12*	-.10	-.16
2. PROCPERF	-.14*	-.05	-.17
3. FUTPERF	-.07	-.10	.01
Self-reported objective measures			
4. BLOCKPERF	-.17**	-.23**	-.09
5. NEW_COMP	-.02	-.11	-.03
6. NCE	-.19**	-.23**	-.15
7. NEW_PROD	-.06	.04	-.10

*p<.10 **p<.05 ***p<.01 (one-tailed tests)

Table 5-6 shows that there is considerable support for the existence of a negative relationship between influence differences and new product performance. All except two correlation coefficients are negative and six are significant.

5.5.2 Does the negative effect of influence differences on new product performance run through integration?

Given the factors that cause lower performance presented in the Tannenbam studies (e.g, less communication, worse conflict handling, etc.), the question emerges of whether integration might be an important mediator of the effect of overall influence differences on new product performance. This means that the effect of greater influence differences runs through a lowering effect on integration. However, here we encounter the problem that INFLDIFF is not a unidimensional construct. So, a low influence difference score can be related to an equal influence division between marketing and R&D across the initiation

and implementation phases, or it can mean that R&D is dominant in the initiation phase and marketing is equally dominant in the implementation phase. The scale that is used here cannot discriminate between these two situations and therefore the score only give a broad indication about the effect of perceived overall influence difference between marketing and R&D. In addition, the phase-specific measures were not significantly related to integration and therefore we do not expect a mediating effect there.

Knowing the limitations of the overall influence difference scale, we study the mediating role of integration in the relationship between INFLDIFF and new product performance by using a three-step approach described by Judd and Kenney (1981) and Baron and Kenny (1986). First, the mediator (INTEGRAT) is regressed on the independent variable (INFLDIFF). The independent variable must affect the mediator in the expected direction which is negative. The following regression model was obtained:

Step 1	INTEGRAT	=	4.28	-	.013 * INFLDIFF
			(p=.000)		(p=.000)

It shows that there is a significant and negative relationship between influence differences and integration. This is in accordance with our expectations.

Second, the dependent variable (OUTPERF, PROCPERF, BLOCKPERF, and FUTPERF) is regressed on the independent variable. Third, the dependent variable is regressed on both the independent variable and on the mediator. The independent variable must affect the dependent variable, and the mediator must affect the dependent variable. If these conditions all hold in the expected direction, then the effect of the independent variable on the dependent variable must be less in the third equation than in the second. Perfect mediation holds if the independent variable has no effect when the mediator is controlled (cf. Baron & Kenny 1986). The analyses necessary to test the second and third condition are presented in Table 5-7.

TABLE 5-7: THE EFFECT OF INFLUENCE DIFFERENCES ON NEW PRODUCT PERFORMANCE (STEP 2) AND THE EFFECT OF INFLUENCE DIFFERENCES WHEN CONTROLLED FOR INTEGRATION (STEP 3)

Step 2	OUTPERF		PROCPERF		FUTPERF		BLOCKPERF	
	Beta	T	Beta	T	Beta	T	Beta	T
INFLDIFF	-.12	-1.31*	-.14	-1.50*	-.07	-.80 ns	-.17	-1.71**
n	121		120		123		105	
R^2	.01		.02		.01		.03	
Adjusted R^2	.01		.01		.00		.02	
F-value	1.71*		2.23*		.65 ns		2.93**	

Step 3	OUTPERF		PROCPERF		FUTPERF		BLOCKPERF	
	Beta	T	Beta	T	Beta	T	Beta	T
INTEGRAT	.15	1.63*	.16	1.65*	.32	3.40***	.17	1.67**
INFLDIFF	-.06	-.62 ns	-.08	-.85 ns	.02	.18 ns	-.12	-1.15 ns
n	118		118		120		104	
R^2	.03		.04		.10		.05	
Adjusted R^2	.02		.02		.08		.03	
F-statistic	2.07*		2.46**		6.28***		2.88**	

*p<.10 **p<.05 ***p<.01 (one-tailed tests)

From the beta coefficients in the regression results in the second step presented in Table 5-7, we conclude that there is in general a negative, although weak, relationship between influence differences and new product performance This relationship is in accordance with our expectations. From the third step in Table 5-7 we conclude that there is indeed a mediating effect of integration on new product performance. It shows that all the beta coefficients (and also b-coefficients) for the influence difference variables are smaller when controlled for integration. The significant betas in the first regression (step2) are changed to a

non-significant beta in the second regression (step3). This indicates that the negative effect of influence differences on new product performance is almost completely caused by a negative effect on integration (Figure 5-2). Therefore, we conclude that integration is a mediator that generates the effect of influence differences on new product performance: influence differences lessen integration, which lessen new product performance.

With respect to the analyses in the next chapter, we conclude that the concept of influence differences offers few insights in addition to integration. In the next analyses we will only focus on integration and R&D's relative influence in specific phases.

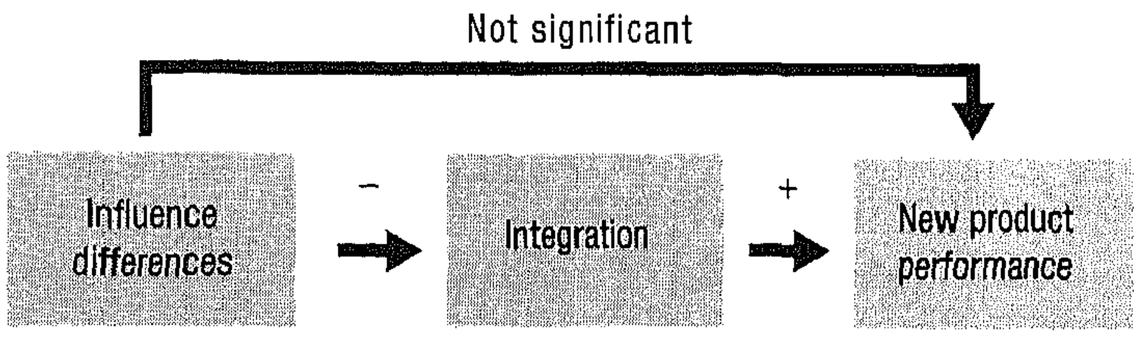

FIGURE 5-2: THE NEGATIVE INDIRECT EFFECT OF INFLUENCE DIFFERENCES ON NEW PRODUCT PERFORMANCE THAT RUNS THROUGH INTEGRATION.

5.6 Summary of findings

The purpose of this chapter was to explicitly test the relationship between specific factors in the marketing - R&D interface and new product performance. From the start, we recognized that new product performance is a multi-dimensional concept that is difficult to measure. Therefore, we developed multiple measurement scales to tap different aspects of new product performance of companies. The new product performance dimensions that we distinguished were related to the *output* (OUTPERF), the *process* (PROCPERF), the expectations about the *future* (FUTPERF) , and the performance with respect to *blockbusters* (BLOCKPERF). In addition, several diligence indicators for the *number of new compounds* (NEW_COMP), the *number of new chemical entities* (NCE), and the *number of new products* (NEW_PROD) were included.

A central variable in the marketing - R&D interface is integration. On the basis of earlier research, a positive relationship could have been expected between integration and new product performance. In the present study, we found indeed a significant but weak positive relationship between integration and new product performance. In other words, having more communication, collaboration, and joint goals (=integration) between marketing and R&D is related to improved new product performance.

In addition, we tested whether excessive integration could lead to lower new product performance. In earlier research at the team level, for example, the negative effects of 'too good friends' related to a lack of constructive criticism had been reported (Souder 1988). However, we did not find indications for any diminishing or even negative returns of integration in our study. So the **more** integration at the company level, the **better** these companies perform with respect to new products. However, the relationship is weak which indicates that there are other factors that play a role. We will focus on the inter-play between integration and these other factors in the following chapter.

In the second part of this chapter, we focused on the relationship between relative influence and new product performance. We hypothesized an inverted U-shaped relationship between R&D's relative influence in specific phases and new product performance. In the analysis, strong support was found for the proposed relationship in the *implementation* phase with respect to output-, process-, blockbuster-, and expected future new product performance. However, the hypothesis was not supported for the initiation phase of the NPD process. This was probably because the companies had a (near to) adequately balanced relative influence distribution in the *initiation phase.*

In the following chapter, the effects of integration and R&D's relative influence in specific phases will be studied further in their broader organizational context.

6

The relationship between the marketing - R&D interface and new product performance in the broader organizational context

6.1 Introduction

In Chapter 4 we opened the black box of the marketing - R&D interface and we studied the relationships between integration, relative influence, and managerial integration mechanisms. Among other things, we found that there is a positive relationship between the use of several managerial mechanisms and (1) integration between marketing and R&D and (2) a more balanced relative influence division between marketing and R&D in the initiation phase and in the implementation phase of the NPD process. This shows that integration and R&D's relative influence can to a certain extent be managed. In Chapter 5 we showed that integration and relative influence in a specific phase are significantly related to new product performance. An important finding was that there is a linear positive relationship between integration and new product performance and an inverted U-shaped relationship between R&D's relative influence in the implementation phase and new product performance. In addition, we found that integration and R&D's relative influence in specific phases are relatively independent constructs.

So far, we have studied the expected relationships inside the marketing - R&D interface 'box' and between this interface and new product performance isolated from the rest of the company. In the present chapter we go one step further by putting these relationships into a broader organizational context. By testing the

relationships in the *comprehensive* model, we extend the current research by addressing the following question: 'In what way do different factors in the marketing - R&D interface affect new product performance?' In Figure 6-1, the relevant variables and the expected relationships are presented (adapted from Figure 2-1, p.23).

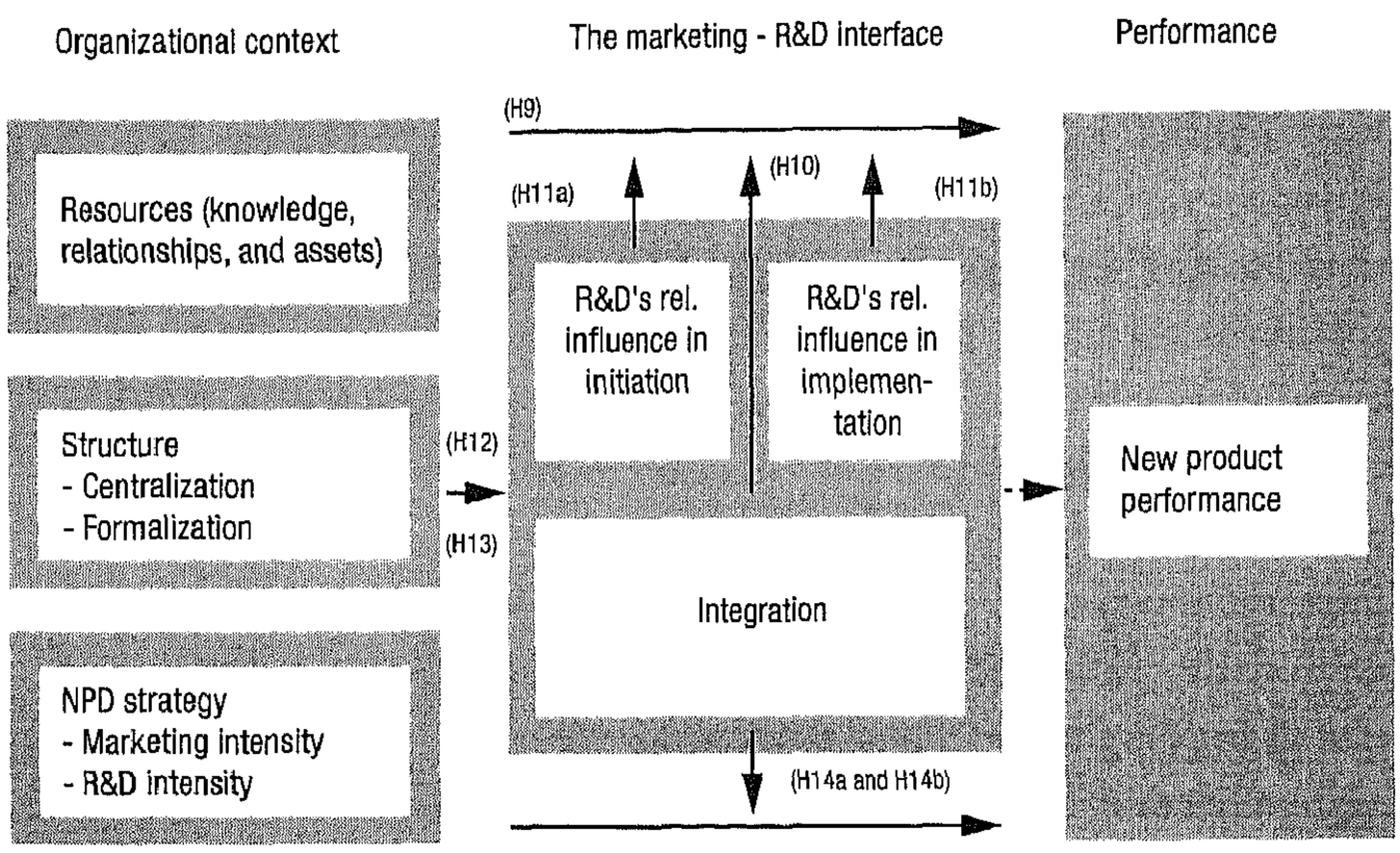

FIGURE 6-1: THE THREE BUILDING BLOCKS OF THE COMPREHENSIVE MODEL AND THE EXPECTED RELATIONSHIPS (ADAPTED FROM FIGURE 2-1, P.23)

In Figure 6-1, the variables in the marketing - R&D interface and in the organizational context affect new product performance. We visualized our expectations with respect to the relationships between the constructs by means of arrows.

First, we expect a direct positive effect of resources on new product performance (hypothesis 9). As outlined in Chapter 2, this effect is affected by integration in the sense that integration multiplies or mitigates the positive effect of resources on new product performance. In other words, a moderating effect of integration on the relationship between resources and new product performance is expected, which is described in hypothesis 10. Second, the same line of reasoning is followed for relative influence. Hypotheses 11a and 11b state that relative

influence in a specific NPD phase is a moderator of the relationship between resources and new product performance: resources are best transformed into new product performance at a specific level of relative influence of marketing and R&D. Third, we focus on the mediating role of integration. Specifically, we focus on how organizational structure (formalization and centralization) affects new product performance. Hypotheses 12 and 13 state that the (negative) effects of formalization and centralization on new product performance run partly through a lowering effect on integration. Fourth, we pay considerable attention to the different roles of integration in companies with different NPD strategies. Our expectations are presented in the lower part of Figure 6-1: it is hypothesized that there are companies with specific NPD strategies for which integration is more important than for other companies (Hypothesis 14a and 14b).

The organization of this chapter is as follows. In Section 6.2, the scores of the companies on the organizational context variables for functional resources, structure, and NPD strategy as observed in the data set are presented. In Section 6.3, the moderating effect of integration on the relationship between resources and new product performance is tested. In Section 6.4, the inverted U-shaped moderating effects of relative influence in specific phases are tested. The mediating role of integration with respect to the relationship between centralization and formalization and new product performance is studied in Section 6.5. In Section 6.6, the relationship between integration and new product performance is studied for companies with specific types of NPD strategies. In the last section the most important findings are summarized.

6.2 The organizational context

In this chapter we present the scores on the measurement scales for the variables in the organizational context as observed for the companies in the data set. A detailed description of the individual items of each composite scale can be found in Chapter 3. All contextual variables have been measured with multiple item scales and the scores have been averaged to establish the score on the composite scale. In Table 6-1 the mean scores and std. dev. of the contextual variables are

presented for the overall sample, and for the marketing and R&D sample separately. It should be remembered that the respondents played the role of informant and scored their own company.

TABLE 6-1: THE MEAN SCORES AND STD.DEV. FOR THE CONTEXTUAL VARIABLES OUTSIDE THE MARKETING - R&D INTERFACE

	Overall sample		Marketing sample		R&D sample		M-W
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	test
Resources (Q56)							
Resources	3.5	.6	3.4	.6	3.6	.6	p=.02
Structure (Q60-69)							
Centralization	2.1	.7	2.1	.7	2.1	.6	ns
Formalization	2.3	.7	2.3	.7	2.1	.7	ns
NPD Strategy (Q58)							
Marketing intensity	2.3	.8	2.3	.8	2.2	.8	ns
R&D intensity	3.0	.9	2.9	.8	3.0	.9	ns

All variables are composites (1=low, 5= high)

Questionnaire question number in parentheses

Table 6-1 shows that the marketing respondents and the R&D respondents score their company on average almost equally on all variables. Only for the resources variable (composite scale for hard and soft resources), do R&D respondents score their company somewhat higher than marketing respondents ($p<.03$, Mann Whitney U test, two-tailed). Further analysis showed that the differences were mainly related to soft resources like 'relationships with top universities' (Q56, item 12). R&D respondents probably perceive this resource differently.

6.3 The effect of integration on new product performance

In this section we perform an analysis and test our hypothesis on the moderating effect of integration on the relationship between resources and new product performance. In the next section, we will include the second interface variable: R&D's relative influence in specific phases. This two-step approach enables us to discuss the results on the effects of each interface variables in more depth. Furthermore, it allows for a detailed elaboration on the amount of variance explained by specific interface variables.

Hypothesis 9 states that 'depth' resources have a positive effect on new product performance. This can be tested by means of a simple multiple regression model. Hypothesis 10 states that integration moderates the effect of resources on new product performance. This moderating effect can be tested by means of a regression model with interaction terms (Jaccard et al. 1990).[28] Specifically, an additive effect of integration (main effect) will be tested against the alternative multiplicative effect of integration on resources (moderator), following a hierarchical regression procedure.

Table 6-2 shows the descriptive statistics and the inter-variable correlations between the contextual variables and the marketing - R&D interface. It shows that the correlation between functional resources in general and R&D intensity is relatively high with a correlation coefficient of up to $r=.5$, $p<.01$. From this we conclude that companies which score high on functional resources have often adopted an R&D intensive strategy. Finally, it shows that there is a considerable degree of correlation ($r=.42$, $p<.01$) between formalization and centralization. All the other correlations are smaller than $r=.4$.[29]

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[28] By interaction we mean a bilinear interaction unless mentioned differently. Bilinear means that linear effects are expected between the independent variable and the dependent variable under each moderating condition.

[29] When the composite measure for 'resources' is used, which incorporates both 'soft' and 'hard' factors, the amount of multicollinearity between the independent variables is acceptable for multiple regression analysis ($r<.5$)

TABLE 6-2: DESCRIPTIVE STATISTICS AND THE INTER-VARIABLE CORRELATIONS FOR THE CONTEXTUAL VARIABLES AND THE MARKETING - R&D INTERFACE

Variable description	Variable	Mean	St.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Functional resources	RESOURCES	3.49	.61							
(2) Centralization	CENTRAL	2.13	.66	.17**						
(3) Formalization	FORMAL	2.26	.71	-.03	.42***					
(4) Marketing intensity	MKINTENS	2.29	.96	.24***	-.02	.20**				
(5) R&D intensity	RDINTENS	2.95	.85	.50***	-.17**	.00	.34***			
(6) Integration	INTEGRAT	3.51	.57	.21***	-.28**	.01	.09	.24***		
(7) R&D's relative influence in initiation	INITINFL	65.59	14.36	.04	-.05	-.15*	.05	-.10	-.05	
(8) R&D's relative influence in implementation	IMPLINFL	11.49	8.23	.10	-.05	.05	.02	-.09	.17**	.17*

*p<.10 **p<.05 ***p<.01(two-tailed)

6.3.1 Does integration have an additive main effect on new product performance?

First, an *additive* regression model is estimated for different new product performance (NPP) variables with the organizational context variables and integration as independent variables:

$$\begin{aligned} NPP = \alpha + \beta_1 (RESOURCES) + \beta_2 (CENTRAL) + \beta_3 (FORMAL) \\ + \beta_4 (MKINTENS) + \beta_5 (RDINTENS) + \beta_6 (INTEGRAT)^{30} \end{aligned}$$

The schematic picture of this model is presented in Figure 6-2. In the model, all organizational context variables are included as controls.

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30 In this regression and in others to come, we also experimented with a dummy for the functional background of the respondent. However, no significant effects were found.

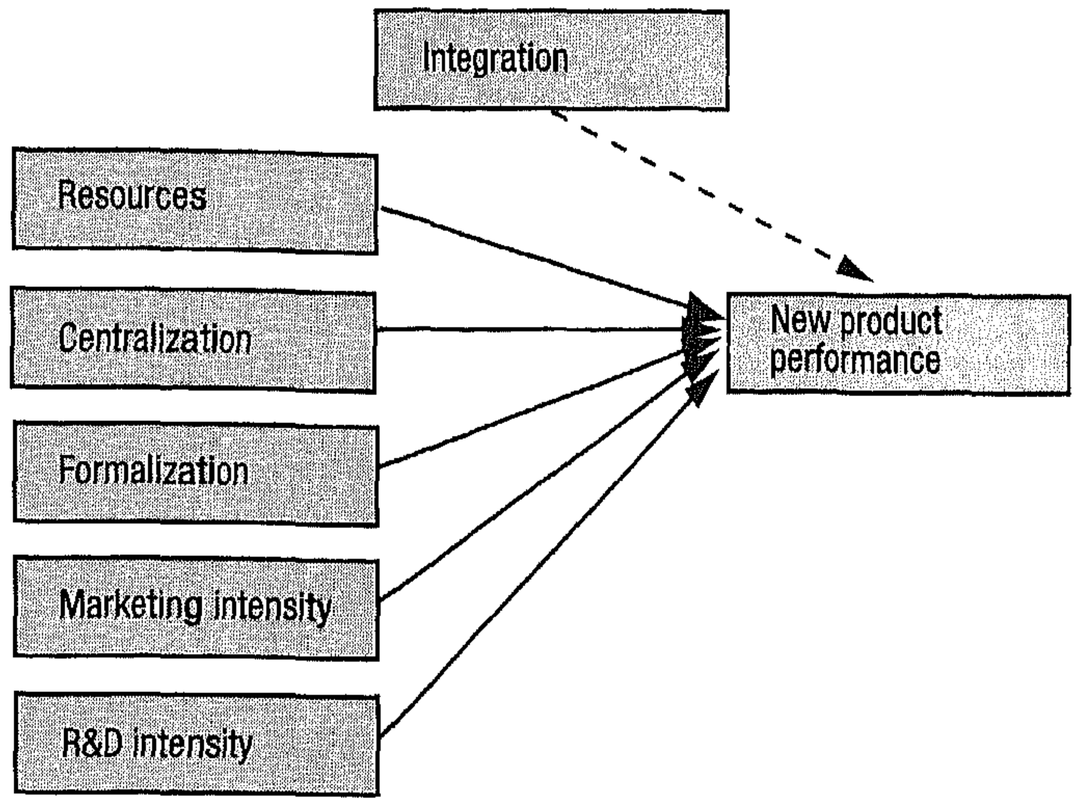

FIGURE 6-2: A POSSIBLE MAIN EFFECT OF INTEGRATION IN ADDITION TO THE MAIN EFFECTS OF THE ORGANIZATIONAL CONTEXT VARIABLES.

Table 6-3a and Table 6-3b show the unstandardized b-coefficients, beta weights, tolerances (check for multicollinearity), and T-values. As a variable for resources we used the composite measure which encompasses the two related dimensions: 'hard' and 'soft' resources.[31]

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31 When the separate variables for 'hard' or 'soft' resources were used, similar results were found.

TABLE 6-3A: ADDITIVE MAIN EFFECT REGRESSION MODELS FOR ORGANIZATIONAL CONTEXT VARIABLES AND INTEGRAT WITH NEW PRODUCT PERFORMANCE AS CRITERION VARIABLE

	Dependent variable: OUTPERF				Dependent variable: PROCPERF			
	b	beta	T-value	Tolerance	b	beta	T-value	Tolerance
Independent variables					**Independent variables**			
Contextual variables					Contextual variables			
RESOURCES	.86	.53	5.82***	.69	RESOURCES	.77	.57	6.54***	.72
CENTRAL	-.02	-.02	-.17	.74	CENTRAL	-.18	-.14	-1.60*	.72
FORMAL	-.23	-.16	-1.83**	.75	FORMAL	-.14	-.12	-1.43*	.75
MKINTENS	.12	.11	1.30*	.84	MKINTENS	-.01	-.01	-.11	.85
RDINTENS	-.02	-.02	-.19	.64	RDINTENS	-.04	-.04	-.44	.69
Interface variable					Interface variable				
INTEGRAT	.05	.03	.33	.88	INTEGRAT	.01	.01	.10	.88
n	120				n	122			
R^2	.35				R^2	.38			
Adj. R^2	.31				Adj.R^2	.34			
F-value	10.09***				F-value	11.51***			

*p<.10 **p<.05 ***p<.01 (one-tailed)

Table 6-3b: Additive main effect regression models for organizational context variables and INTEGRAT with new product performance as criterion variable

	Dependent variable: BLOCKPERF				Dependent variable: FUTPERF				
	b	beta	T-value	Tolerance		b	beta	T-value	Tolerance
Independent variables					**Independent variables**				
Contextual variables					Contextual variables				
RESOURCES	.29	.21	2.01***	.72	RESOURCES	.40	.29	3.33***	.74
CENTRAL	-.13	-.10	-1.02	.78	CENTRAL	.00	.00	.05	.75
FORMAL	-.17	-.15	-1.51**	.79	FORMAL	-.12	-.10	-1.18	.76
MKINTENS	.18	.21	2.23*	.86	MKINTENS	.04	.05	.61	.84
RDINTENS	.15	.16	1.50	.70	RDINTENS	.33	.33	3.71	.70
Interface variable					Interface variable				
INTEGRAT	.04	.03	.31	.87	INTEGRAT	.21	.14	-1.81**	.91
n	106				n	123			
R^2	.23				R^2	.36			
Adj. R^2	.19				Adj.R^2	.33			
F-value	5.05***				F-value	11.00***			

*p<.10 **p<.05 ***p<.01 (one-tailed)

The regression models in Table 6-3a and Table 6-3b show that resources have a strong positive effect on new product performance. *H9 is supported.* Furthermore, there is almost no support for the positive main effect of integration on new product performance *in addition* to the effects of other organizational context variables. The beta weights for integration are very low and not significant in three out of four regressions (for output, process, and blockbuster NPP). Since it can be observed that the tolerances of the INTEGRAT variable are high (ranging from .87 to .91), which indicates that multicollinearity is not a big problem, we conclude that integration does not explain additional variance in all current new product performance variables.

The fact that integration is significant with respect to *future* new product performance may be related to the softer nature of the scores on the measurement scale for future new product performance. Specifically, the respondent is asked to give an estimation of the *expected* new product performance of the company in the next five years. Therefore, it is understandable that we find a main effect because it is in accordance with prevailing wisdom today which is that integration has a positive effect on new product performance. A second possible explanation might be that integration *today* is a stronger predictor with respect to new product performance in the *future* than to current new product performance because of a time lag effect.[32]

Apart from the variables for resources and integration, the organizational structure variables for centralization and formalization and the NPD strategy variables for marketing intensity and R&D intensity are incorporated in the regression model. We will discuss these variables in more detail in the following sections. For now, we conclude that if the structure variables attain a significant beta, they are negative. For example, formalization leads to lower new product performance (output). Furthermore, if NPD strategy variables attain a significant

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[32] We performed several additional analyses on the (crude) single-item scale TOTINT-4 which stands for the amount of integration in the company four years ago (see 4.2.1, p.82). This analysis showed that for BLOCKPERF there was no significant effect of TOTINT-4 (T=.21, p=.83) in addition to the effect of for example RESOURCES (T=3.52, p=.000). However, for OUTPERF and PROCPERF, TOTINT-4 attained a small but significant beta, which shows that there are some indications that a time lag effect is occurring for the 'regular' NPD activities (not for blockbusters).

beta, it is positive. For example, marketing intensity leads to higher new product performance (blockbusters).

The overall fit of the regression model for blockbuster NPP is poorer than for the other new product performance variables. This indicates that the contextual variables and integration in the marketing - R&D interface have only a moderate effect on blockbuster NPP. This might be explained by the fact that coming up with a blockbuster, especially when it is a technological breakthrough, is largely dependent on luck, specific individuals like entrepreneurs or intrapreneurs, serendipity in the lab, etc. These factors can only be affected indirectly by the structures and processes we focus upon. In the following section, a multiplicative effect model will be tested.

6.3.2 Does integration have a multiplicative effect on resources?

From the analysis in the previous section, it becomes clear that there is almost no support for the main effect of integration on new product performance in addition to the organizational context variables. This does not mean that integration is not important. It should be remembered that when we estimated the effect of integration in isolation from the effects of the organizational context, we did find a significant positive effect. As described before, we expect integration to affect new product performance *in a different way.* Hypothesis 10 states that integration moderates the effect of resources on new product performance in such a way that the joint effect of resources and integration can be more strongly positive than the sum of the two effects. Hypothesis 10 is visualized in Figure 6-3.

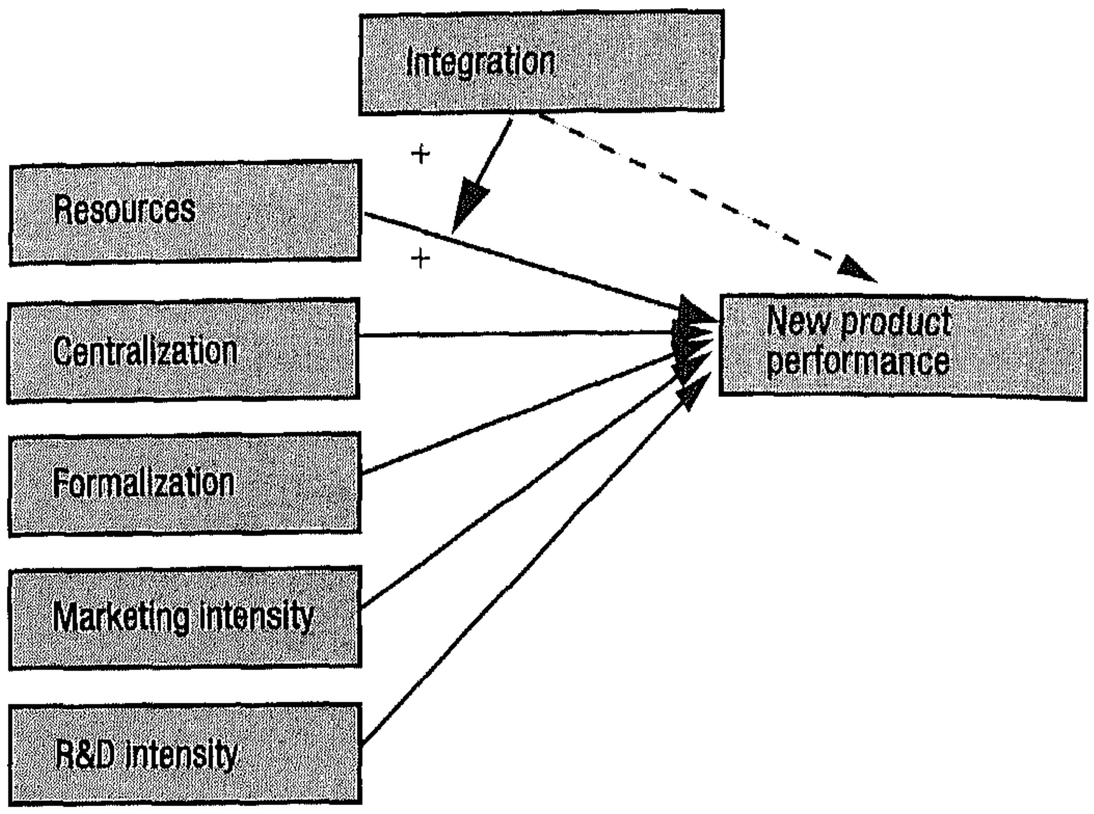

FIGURE 6-3: THE EXPECTED MODERATING EFFECT OF INTEGRATION ON THE RELATIONSHIP BETWEEN RESOURCES AND NEW PRODUCT PERFORMANCE.

To explore the expected moderating effect, the companies were split into four groups by means of median split on integration and resources (Jaccard 1990, p.48). Table 6-4 shows a cross tabulation of new product performance of companies with different levels of integration and resources.

TABLE 6-4: CROSS TABULATION OF THE AVERAGE LEVEL OF NEW PRODUCT PERFORMANCE FOR COMPANIES WITH DIFFERENT LEVELS OF **INTEGRAT** (MEDIAN SPLIT) AND **RESOURCES** (MEDIAN SPLIT)

		Integration between marketing and R&D			
		low		high	
Resources	Low	OUTPERF =	2.72	OUTPERF =	2.70
		PROCERF =	2.57	PROCERF =	2.51
		FUTERF =	3.05	FUTERF =	3.28
		BLOCKERF =	2.11	BLOCKERF =	2.12
	High	OUTPERF =	3.50	OUTPERF =	3.63
		PROCERF =	3.27	PROCERF =	3.37
		FUTERF =	3.67	FUTERF =	3.79
		BLOCKERF =	2.65	BLOCKERF =	2.60

In Table 6-4, the two levels of integration are presented in columns and the two levels of resources in rows. Reading Table 6-4 from top to bottom, it shows that the amount of new product performance of companies is higher for companies that possess more resources. However, more importantly, it shows that there is some support for the interaction between resources *and* integration on new product performance. In the upper half (low resources), the effect of integration on new product performance is very small or even negative (reading from left to right). In the lower half (high resources), the positive effect of higher integration seems larger for OUTPERF and PROCPERF (reading from left to right) than for FUTPERF and BLOCKPERF.

To *test* whether the expected moderating effect exists,[33] we use the guidelines of Cohen & Cohen (1983) and Baron & Kenny (1986) who describe that if the independent variable is denoted by X, the moderator as Z, and the dependent variable as Y, moderating effects are indicated by the significant effect of ZX

---

33 The alternative mechanism of 'mediation' was not expected. Integration and resources were expected to be relatively unrelated to each other. This expectation did not suggest an 'integration-generating effect' (=mediation) of resources. Given the low correlation between integration and resources (r=.18) this line of reasoning seems to be valid.

while X and Z are controlled for. In addition, we will also control for the main effects of the contextual variables for centralization, formalization, marketing intensity and R&D intensity in the regression model. To reduce multicollinearity, RESOURCES and INTEGRAT are mean centered (Cronbach 1987, Jaccard et al. 1990). The results are presented in Table 6-5a and Table 6-5b.

TABLE 6-5A: MULTIPLICATIVE REGRESSION MODELS WITH INTERACTION (INTEGRAT * RESOURCES) AS PREDICTOR VARIABLE FOR NEW PRODUCT PERFORMANCE (OUTPUT AND PROCESS)

	Criterion variable: OUTPERF			Criterion variable: PROCPERF		
	Beta	T	Tolerance	Beta	T	Tolerance
Predictor variables						
CENTRAL	-.04	-.50	.71	-.17	-2.05**	.71
FORMAL	-.14	-1.65*	.74	-.12	-1.41*	.75
MKINTENS	.12	1.45*	.84	.00	.00	.85
RDINTENS	-.02	-.21	.64	-.03	-.42	.69
RESOURCES	.52	5.72***	.68	.54	6.40***	.72
INTEGRAT	.02	.29	.88	.03	.43	.87
RESOURCES * INTEGRAT	.13	1.72**	.95	.20	2.67***	.95
n	120			122		
R^2	.37			.42		
Adj. R^2	.33			.39		
F-value	9.22***			11.87***		

*p<.10 **p<.05 ***p<.01(one-tailed)

TABLE 6-5B: MULTIPLICATIVE REGRESSION MODELS WITH INTERACTION (INTEGRAT * RESOURCES) AS PREDICTOR VARIABLE FOR NEW PRODUCT PERFORMANCE (BLOCKBUSTER & FUTURE)

	Criterion variable: BLOCKPERF			Criterion variable: FUTPERF		
	Beta	T	Tolerance	Beta	T	Tolerance
Predictor variables						
CENTRAL	-.13	-1.29	.76	-.00	-.02	.73
FORMAL	-.16	-1.62*	.79	-.10	-1.15*	.76
MKINTENS	.21	2.20**	.86	.05	.61	.84
RDINTENS	.18	1.71**	.70	.33	3.72***	.70
RESOURCES	.19	1.85**	.87	.14	1.82**	.91
INTEGRAT	.02	.23	.72	.28	3.21***	.72
RESOURCES * INTEGRAT	.17	1.93**	.96	.03	.44	.95
n	106			123		
R^2	.26			.36		
Adj. R^2	.21			.32		
F-value	4.99***			9.38***		

*p<.10 **p<.05 ***p<.01(one-tailed)

The analyses presented in 6-5a and Table 6-5b show that the interaction effect between resources and integration is significant for output, process, and blockbuster NPP. In other words, the joint effect of resources *and* integration differs from the two separate effects. The effect sizes, indicated by the increase in R^2 (compare Table 6-3a and Table 6-3b with Table 6-5a and Table 6-5b), are the highest for PROCPERF ($\Delta R^2 = 0.05$), followed by BLOCKPERF ($\Delta R^2 = 0.03$) and OUTPERF ($\Delta R^2 = 0.02$). The power of the regressions is good, given the fact that in our case an appropriate sample size of 100 to 110 respondents is necessary for achieving power of .80 for α=.05 (Jaccard et al. 1990, p.37). With respect to future NPP, integration has a significant and positive main effect on

new product performance and the interaction is not significant. As stated before, the scores on the future new product performance scale seems to reflect the common rationale today that integration has a positive effect on new product performance.[34]

Figure 6-4a presents a frequency plot of the number of companies with specific levels of resources. We present the original scores and not the mean centered values. It shows two important points: 1) there are only a few companies in the sample with a resource score below 2.50 or above 4.75, and 2) the resource scores follow a normal distribution quite well.

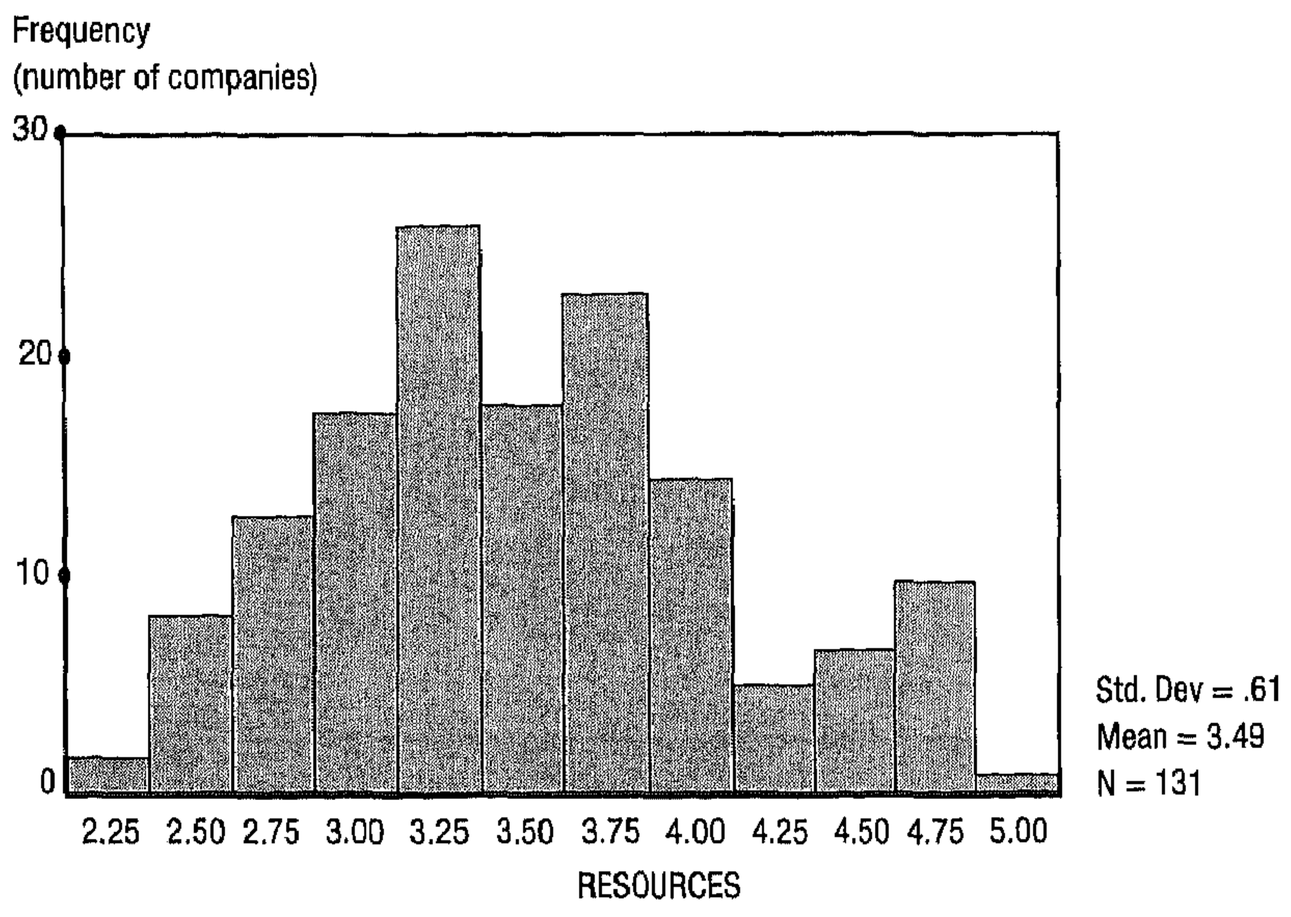

Figure 6-4a: Frequency plot of companies with certain levels of resources (std.dev, mean, and number of cases (N) are presented in the right border)

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[34] We also substituted INTEGRAT for the single-item scale for the amount of integration four years ago. The main effects was just significant for OUTPERF and PROCPERF (this has to be interpreted as an average effect across values of the other part of the interaction term: resources). The interaction between TOTINT-4 * RESOURCES was just not significant for OUTPERF ($p<.12$) and BLOCKPERF ($p<.17$). It shows that if a time lag effect occurs (no indications for such an effect with respect to BLOCKPERF), there are indications that it is accompanied by a multiplication effect on resources.

To offer more insight into the *nature* of the moderating effect, Figures 6-4b to 6-4e present the relationship between resources and new product performance for different levels of the moderator (=integration). The significant moderating effect of integration will result in asymmetrical regression lines for each moderator condition.

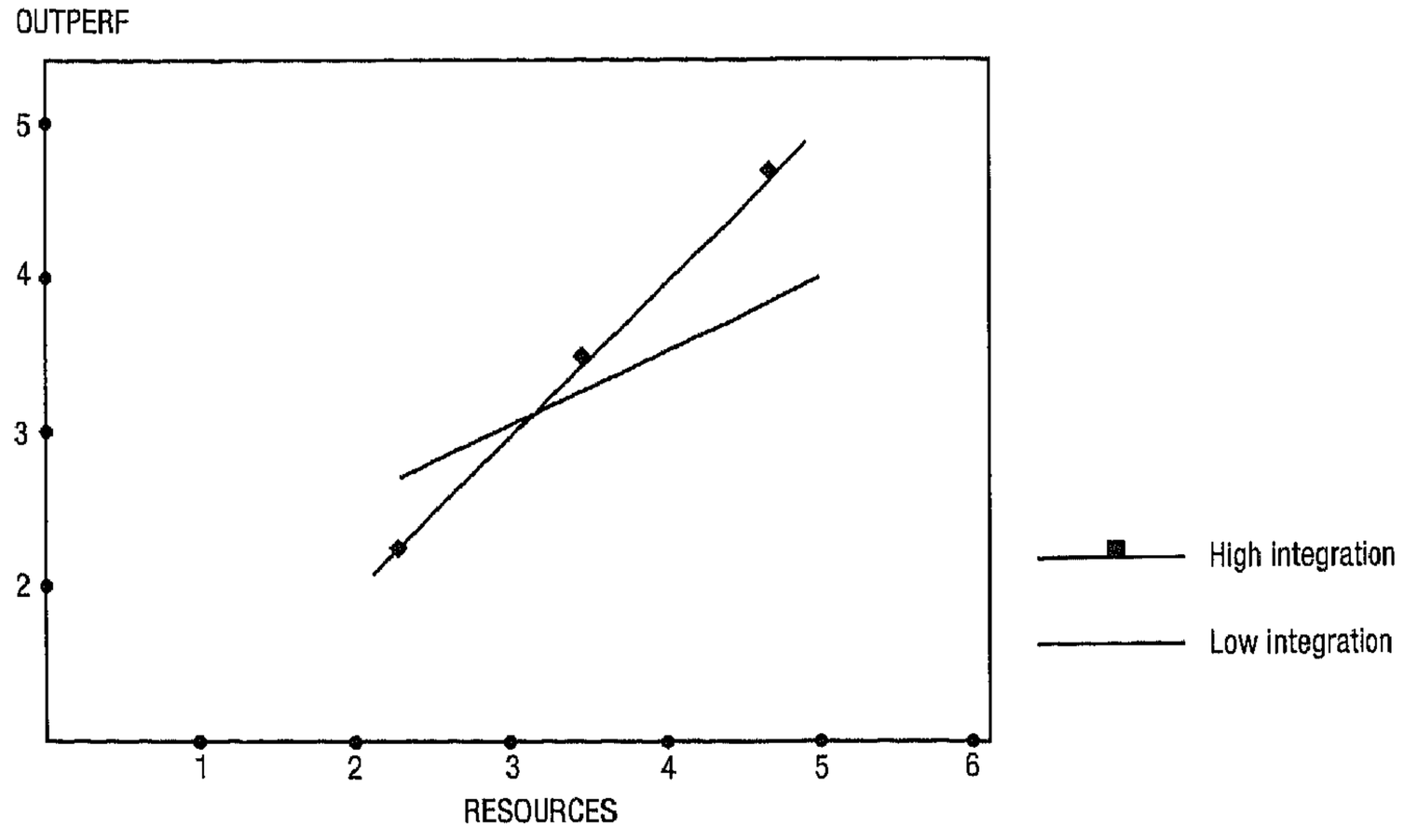

FIGURE 6-4B: RELATIONSHIP BETWEEN RESOURCES AND NEW PRODUCT PERFORMANCE (OUTPUT) FOR TWO LEVELS OF THE MODERATOR (HIGH INTEGRATION AND LOW INTEGRATION)

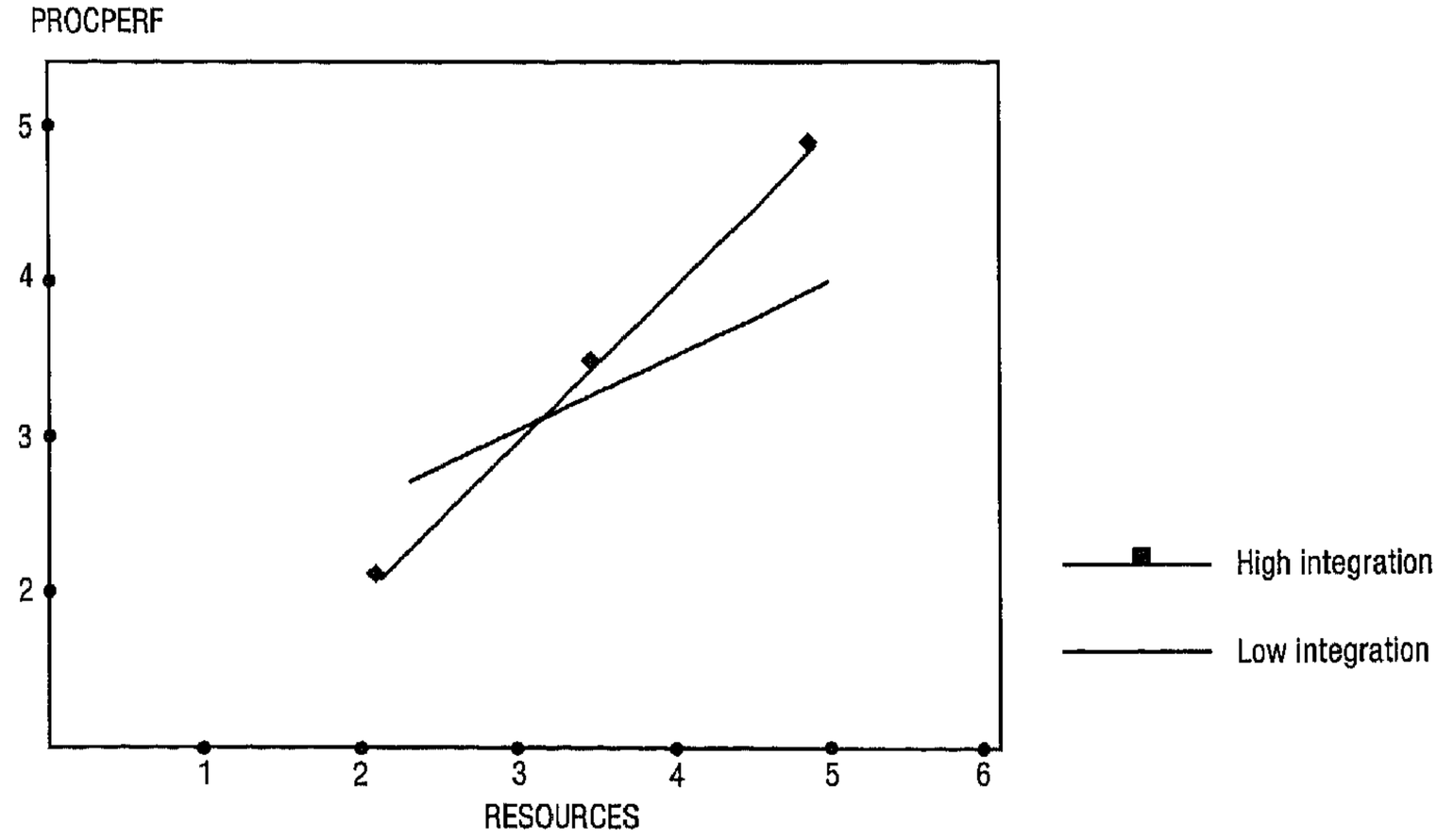

FIGURE 6-4C: RELATIONSHIP BETWEEN RESOURCES AND NEW PRODUCT PERFORMANCE (PROCESS) FOR TWO LEVELS OF THE MODERATOR (HIGH INTEGRATION AND LOW INTEGRATION)

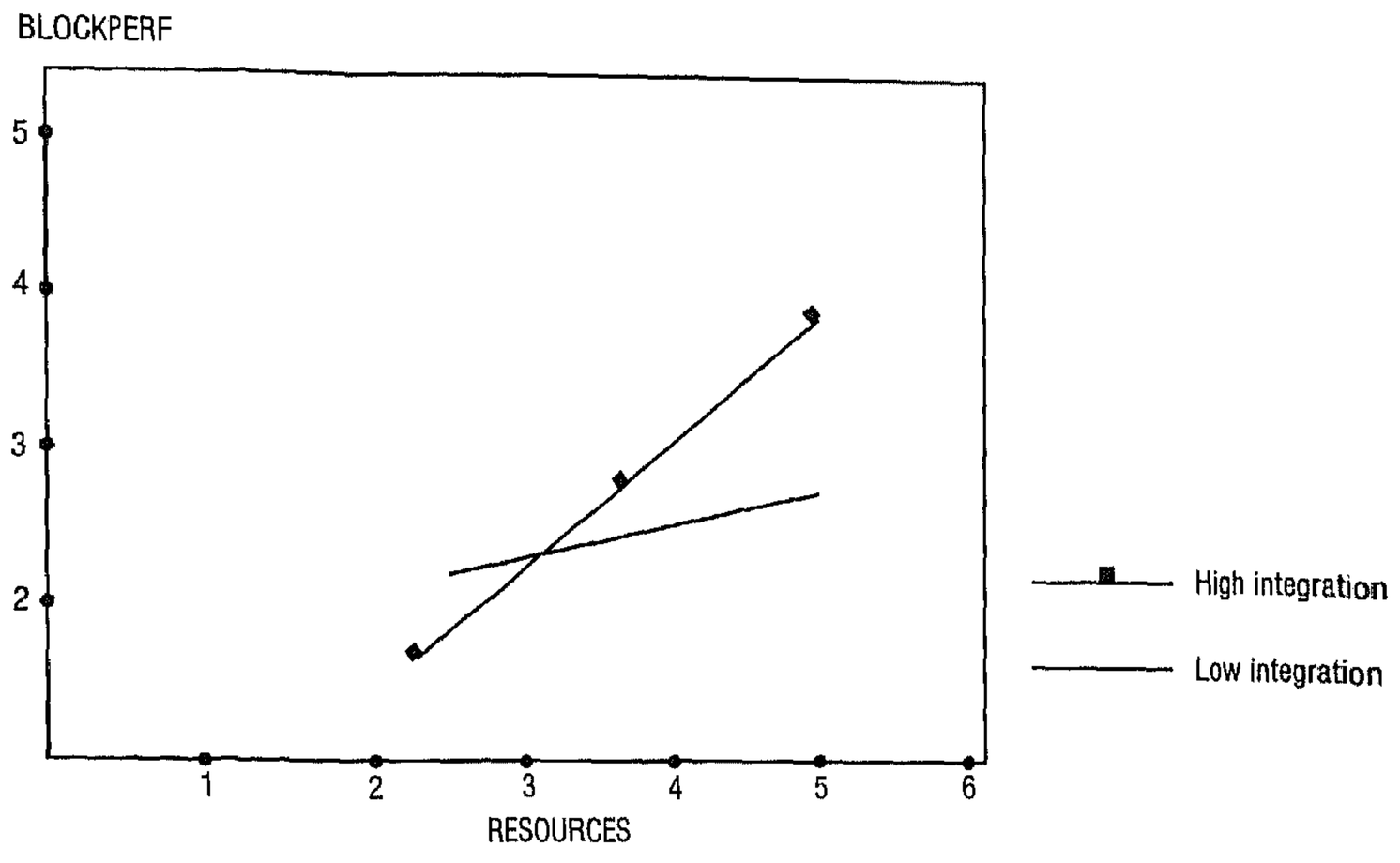

FIGURE 6-4D: RELATIONSHIP BETWEEN RESOURCES AND NEW PRODUCT PERFORMANCE (BLOCKBUSTER) FOR TWO LEVELS OF THE MODERATOR (HIGH INTEGRATION AND LOW INTEGRATION)

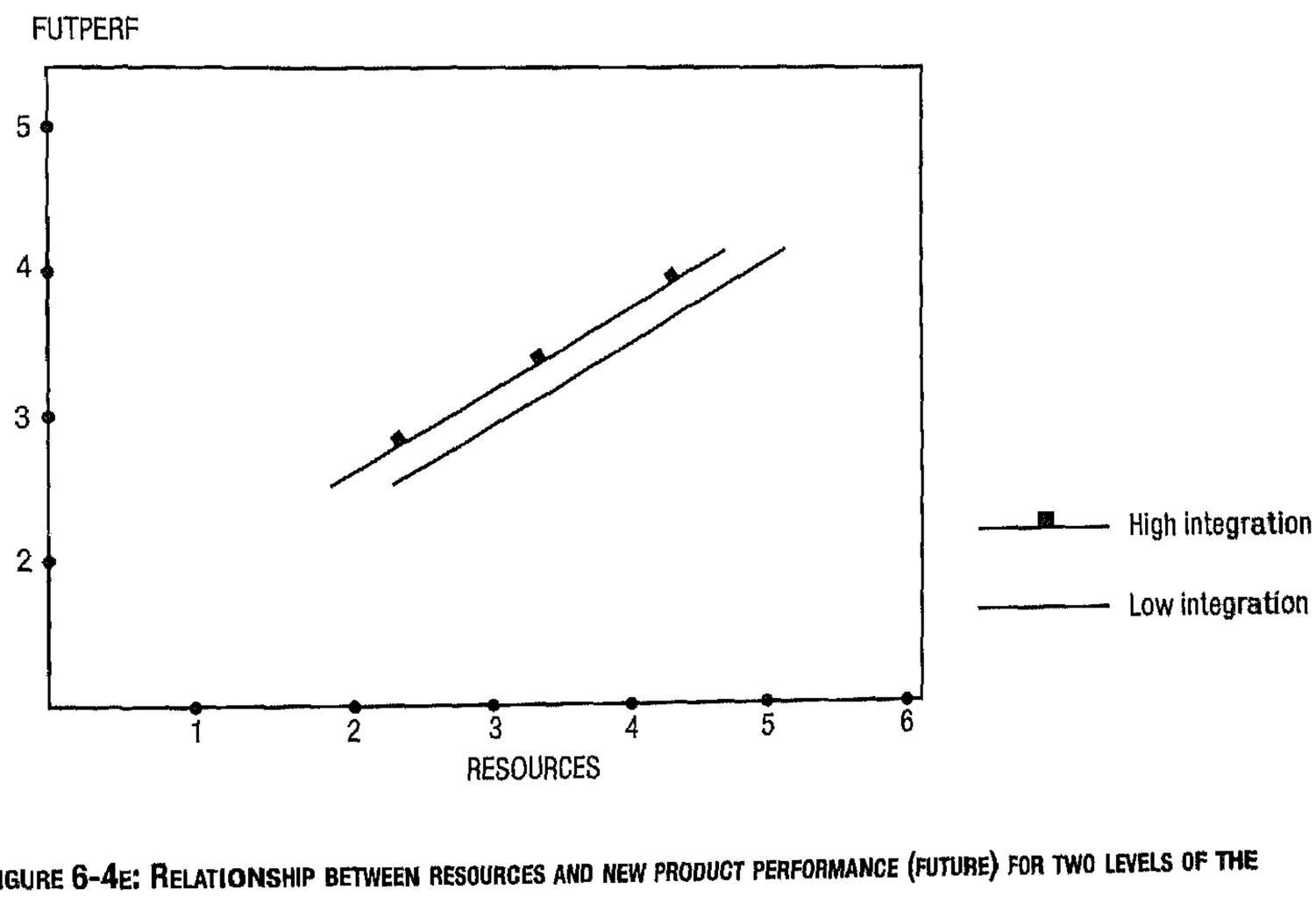

FIGURE 6-4E: RELATIONSHIP BETWEEN RESOURCES AND NEW PRODUCT PERFORMANCE (FUTURE) FOR TWO LEVELS OF THE MODERATOR (HIGH INTEGRATION AND LOW INTEGRATION)

The previous plots show that for OUTPERF, PROCPERF, and BLOCKPERF, the lines for each moderator condition cross in the resources domain [3.0 - 3.25]. Figure 6-4a shows that there is a considerable number of companies with a resource score equal to or below 3.25, which indicates that a negative effect of integration might indeed occur for companies with limited resources. This might be explained by the fact that these companies lack 'depth' and would be better off by concentrating more on acquiring more and better 'depth' resources. For FUTPERF, the moderating effect is not significant and the 'high' integration group shows more new product performance in general. *Hypothesis 10 is supported for all current new product performance measures but not for expected future new product performance.*

6.4 The effect of relative influence in specific phases on new product performance

Hypotheses 11a states that R&D's relative influence in the initiation phase has an (inverted U-shaped) moderating effect on the relationship between resources and new product performance. Hypothesis 11b states that R&D's relative influence in the implementation phase has an (inverted U-shaped) moderating effect on the relationship between resources and new product performance.

To test the above hypotheses, we estimated the multiplicative regression model presented below. Support for hypothesis 11a is indicated by a significant β_{13}, accompanied by a considerable increase in R^2 related to the $INITINFL^2$ * RESOURCES variable. The same counts for hypothesis 11b with respect to β_{15} and the $IMPLINFL^2$ * RESOURCES variable. The regression model was estimated with and without $INITINFL^2$ * RESOURCES and with and without $IMPLINFL^2$ * RESOURCES (hierarchical regression procedure, Jaccard et al. 1990)

$$
\begin{aligned}
NPP = \ & \alpha + \beta_1 (CENTRAL) + \beta_2 (FORMAL) + \beta_3 (MKINTENS) \\
& + \beta_4 (RDINTENS) + \beta_5 (RESOURCES) + \beta_6 (INTEGRAT) \\
& + \beta_7 (INITINFL) + \beta_8 (INITINFL^2) + \beta_9 (IMPLINFL) \\
& + \beta_{10} (IMPLINFL^2) + \beta_{11} (INTEGRAT * RESOURCES) \\
& + \beta_{12} (INITINFL * RESOURCES) + \beta_{13} (INITINFL^2 * RESOURCES) \\
& + \beta_{14} (IMPLINFL * RESOURCES) + \beta_{15} (IMPLINFL^2 * RESOURCES)
\end{aligned}
$$

All variables used in interactions are mean centered, including the linear and quadratic variables for INITINFL and IMPLINFL. Multicollinearity proved not to be a large problem here. The results of the estimation are presented in Table 6-6a and Table 6-6b.

TABLE 6-6A: REGRESSION MODELS WITH **INTEGRAT, INITINFL, INITINFL^2, IMPINFL, AND IMPLINFL^2** (WITH AND WITHOUT RESOURCE INTERACTION) AS PREDICTOR VARIABLES FOR NEW PRODUCT PERFORMANCE (OUTPUT AND PROCESS)

	Criterion variable: OUTPERF			Criterion variable: PROCPERF		
	Beta	T	Tolerance	Beta	T	Tolerance
Organizational context						
CENTRAL	-.04	-.44	.67	-.21	-2.53**	.69
FORMAL	-.15	-1.59*	.67	-.13	-1.55*	.70
MKINTENS	.13	1.49*	.80	.00	.04	.80
RDINTENS	-.01	-.10	.59	-.03	-.33	.61
RESOURCES	.45	4.44***	.59	.43	4.76***	.60
Interface						
INTEGRAT	.00	.00	.86	-.03	-.40	.81
INITINFL	-.04	-.52	.89	-.08	-1.09	.90
INITINFL^2	.01	.13	.93	-.10	-1.37*	.92
IMPLINFL	.16	1.65*	.67	.20	2.35**	.69
IMPLINFL^2	-.05	-.43	.48	-.23	-2.31**	.48
Context * interface						
INTEGRAT * RESOURCES	.15	1.80**	.83	.19	2.46***	.83
INITINFL * RESOURCES	.10	1.14	.85	.08	1.06	.84
INITINFL^2 * RESOURCES[a]	-.05	-.62	.86	-.22	-2.95***	.82
IMPLINFL * RESOURCES	.27	2.57***	.56	.27	2.97***	.57
IMPLINFL^2 * RESOURCES[b]	-.18	-1.48*	.52	-.33	-3.01***	.40
n	113			114		
R^2	.42			.52		
Adj. R^2	.33			.45		
F-value	4.61***			7.10***		

*p<.10 **p<.05 ***p<.01(one-tailed)

[a] : Increase in explained variance related to INITINFL^2 * RESOURCES
ΔR^2 (OUTPERF) = zero, ΔR^2 (PROCPERF) = .04.

[b]: Increase in explained variance related to IMPLINFL^2 * RESOURCES
ΔR^2 (OUTPERF) = .01, ΔR^2 (PROCPERF) = .04.

TABLE 6-6B: REGRESSION MODELS WITH **INTEGRAT, INITINFL, INITINFL^2, IMPINFL, AND IMPLINFL^2** (WITH AND WITHOUT RESOURCE INTERACTION) AS PREDICTOR VARIABLES FOR NEW PRODUCT PERFORMANCE (BLOCKBUSTER AND FUTURE)

	Criterion variable: BLOCKPERF			Criterion variable: FUTPERF		
	Beta	T	Tolerance	Beta	T	Tolerance
Organizational context						
CENTRAL	-.13	-1.28	.70	.02	.27	.68
FORMAL	-.13	-1.24	.70	-.14	-1.54*	.70
MKINTENS	.21	2.16**	.83	.01	.16	.80
RDINTENS	.19	1.72**	.60	.33	3.45***	.62
RESOURCES	.10	.89	.57	.21	2.19**	.62
Interface						
INTEGRAT	.01	.10	.77	.13	1.56*	.82
INITINFL	.07	.78	.83	.03	.40	.92
INITINFL^2	.06	.62	.93	.04	.52	.94
IMPLINFL	.24	2.33**	.69	.14	1.57*	.69
IMPLINFL^2	-.27	-2.04**	.43	-.26	-2.73**	.48
Interface * context						
INTEGRAT * RESOURCES	.16	1.52*	.71	.09	1.11	.86
INITINFL * RESOURCES	-.02	-.19	.76	.01	.18	.88
INITINFL^2 * RESOURCES [a]	.11	1.15	.76	-.08	-1.06	.88
IMPLINFL * RESOURCES	.15	1.15	.46	.24	2.43***	.56
IMPLINFL^2 * RESOURCES[b]	-.21	-1.37*	.33	-.36	-3.04***	.40
n	100			115		
R^2	.37			.45		
Adj. R^2	.25			.36		
F-value	3.25***			5.30***		

*p<.10 **p<.05 ***p<.01(one-tailed)

[a]: Increase in variance explained related to INITINFL^2*RESOURCES
ΔR^2 (BLOCKPERF) = zero, ΔR^2 (FUTPERF) = zero.

[b]: Increase in variance explained related to IMPLINFL^2 * RESOURCES
ΔR^2 (BLOCKPERF) = .02, ΔR^2 (FUTPERF) = .05.

First, the results related to the initiation phase are discussed. Then the results for the implementation are elaborated upon. Table 6-6a and 6-6b show that there are almost no signs of any significant relationships between R&D's relative influence in the initiation phase and new product performance (linear, quadratic, interaction, etc.). Only for PROCPERF was the beta related to $INITINFL^2$ * RESOURCES negative and significant, thereby supporting our hypothesis. We conclude that PROCPERF is most sensitive to changes in the level of R&D's relative influence in the initiation phase. *Hypothesis 11a is supported for the performance of the NPD process.*

The beta related to the interaction $IMPLINFL^2$ * RESOURCES is significant (and negative) in all regressions, even after controlling for main effects of IMPLINFL, $IMPLINFL^2$, RESOURCES, and the bilinear interaction IMPLINFL * RESOURCES. Together with the considerable increase in R^2s, this indicates that the interaction term explains variance in addition to the other predictors. So R&D's relative influence in the implementation phase is a strong inverted U-shaped moderator on the relationship between resources and new product performance. Interestingly, the main effect of IMPLINFL is significant in all regressions. This indicates that the relative influence balance in the implementation phase has a stronger direct main effect on new product performance than integration (average effect, keeping resources constant).

Comparing the earlier models (Table 6-5a and Table 6-5b) with the extended models that include the relative influence variables results in some valuable insights. It shows that the significant interactions between integration and resources are still significant in the extended models. The tolerances in the extended model are acceptable although they are a little lower because of the quadratic terms. Interestingly, the variable for resources does not attain a significant beta in the regression BLOCKPERF. Furthermore, the increase in R^2 that results from the relative influence variables (mainly related to variables encompassing IMPLINFL) is considerable. *Hypothesis 11b is supported.*

In the next part of this section we will investigate the nature of the interaction between (1) $INITINFL^2$ and RESOURCES with respect to PROCPERF and of (2) $IMPLINF^2$ and RESOURCES with respect to all new product performance measures. In Figures 6-6a to 6-6e, the companies are split into two groups: one group that scores high on resources, and one group that scores low on resources.

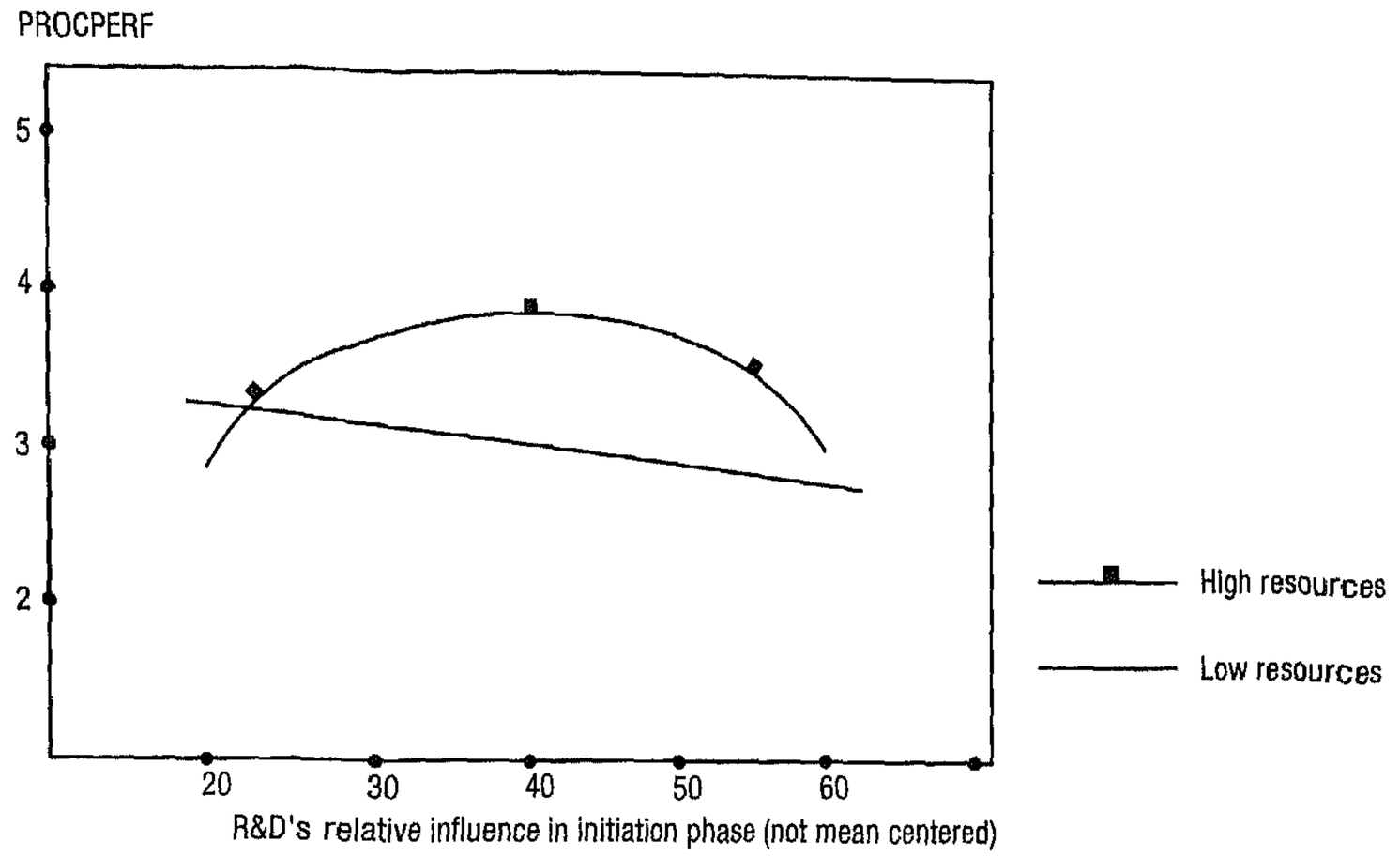

FIGURE 6-6A: THE RELATIONSHIP BETWEEN R&D'S RELATIVE INFLUENCE IN THE INITIATION PHASE AND NEW PRODUCT PERFORMANCE (PROCESS) FOR COMPANIES THAT SCORE HIGH ON RESOURCES AND COMPANIES THAT SCORE LOW ON RESOURCES (MEDIAN SPLIT)

FIGURE 6-6B: THE RELATIONSHIP BETWEEN R&D'S RELATIVE INFLUENCE IN THE IMPLEMENTATION PHASE AND NEW PRODUCT PERFORMANCE (OUTPUT) FOR COMPANIES THAT SCORE HIGH ON RESOURCES AND COMPANIES THAT SCORE LOW ON RESOURCES (MEDIAN SPLIT)

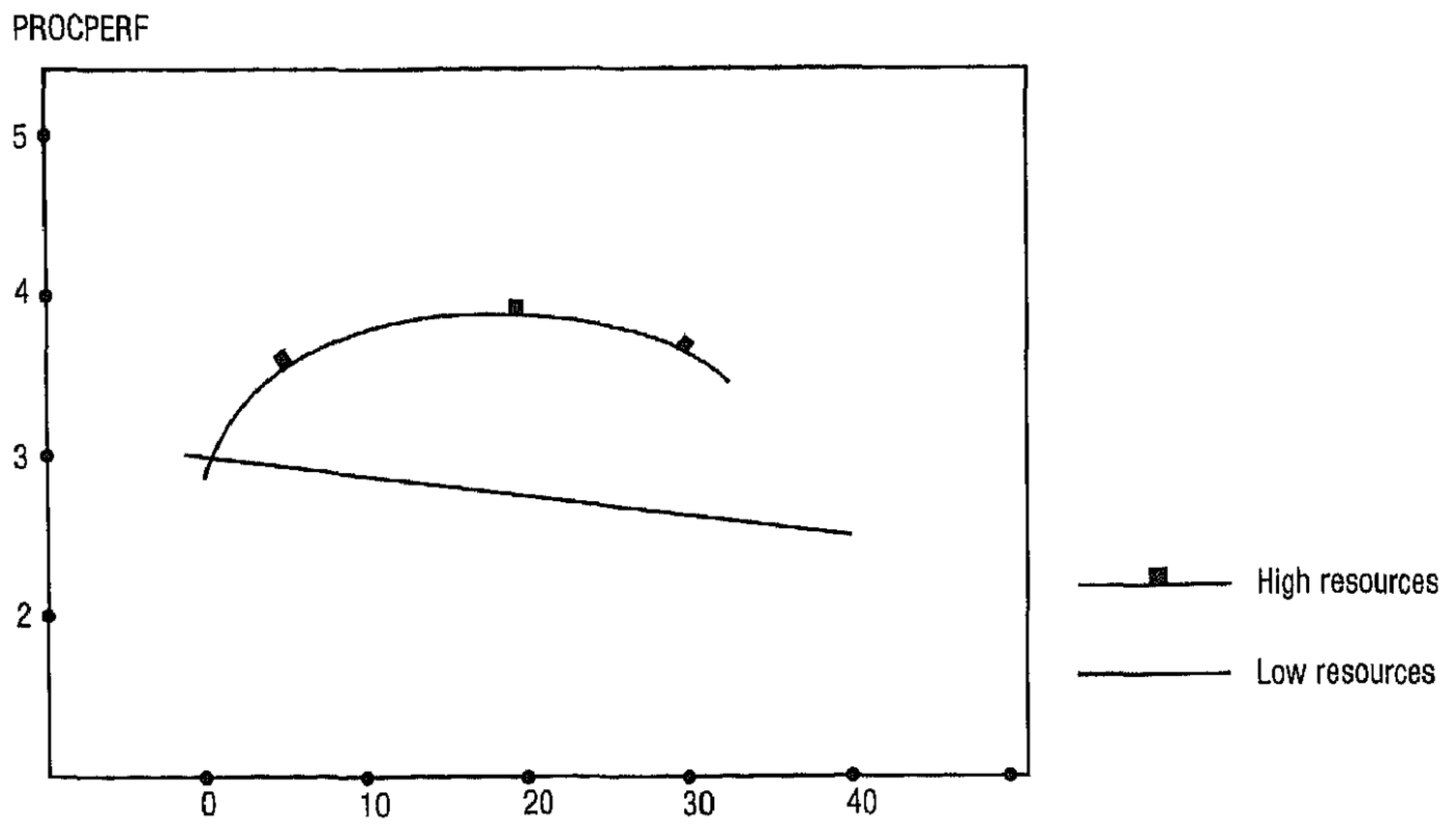

FIGURE 6-6C: THE RELATIONSHIP BETWEEN R&D'S RELATIVE INFLUENCE IN THE IMPLEMENTATION PHASE AND NEW PRODUCT PERFORMANCE (PROCESS) FOR COMPANIES THAT SCORE HIGH ON RESOURCES AND COMPANIES THAT SCORE LOW ON RESOURCES (MEDIAN SPLIT)

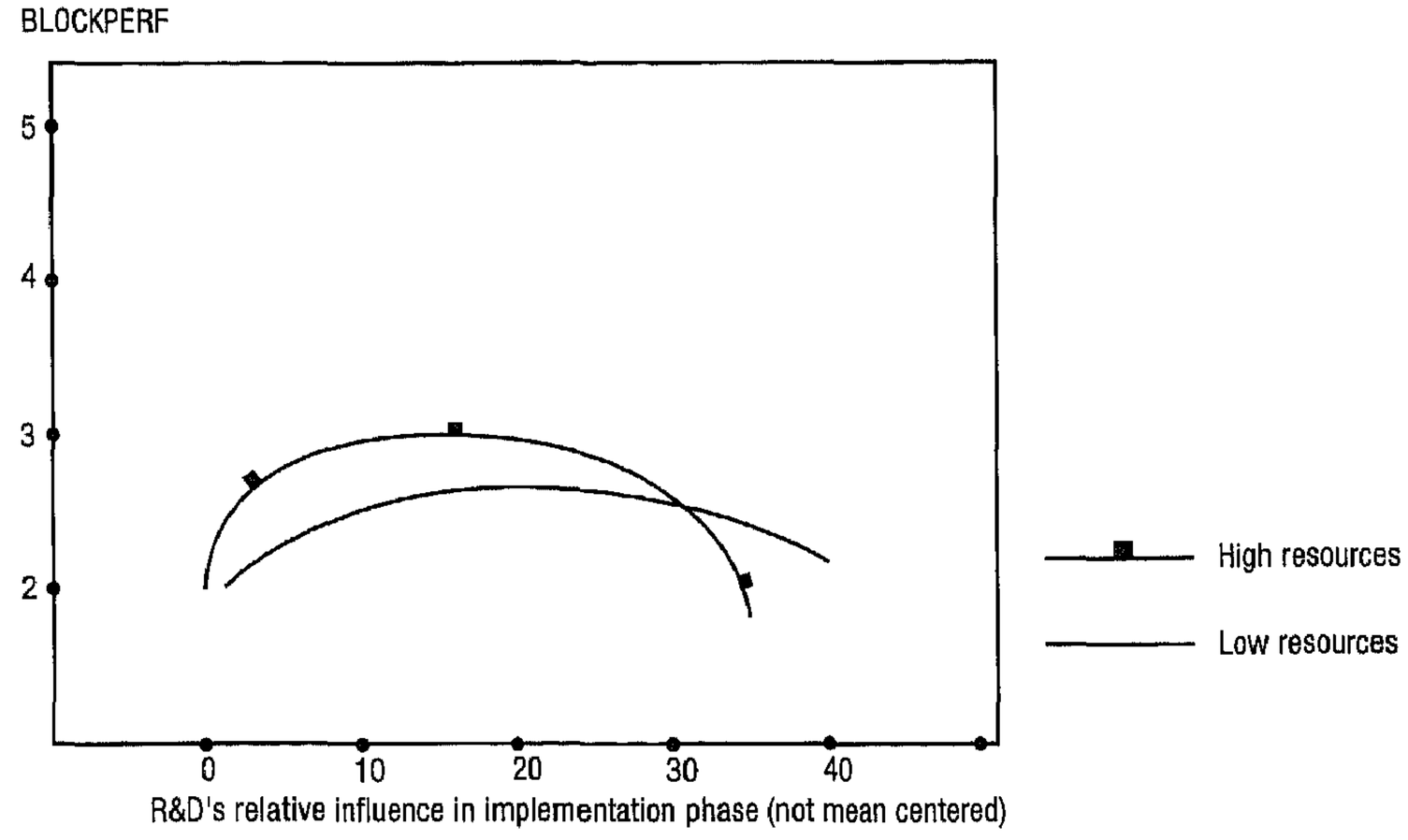

FIGURE 6-6D: THE RELATIONSHIP BETWEEN R&D'S RELATIVE INFLUENCE IN THE IMPLEMENTATION PHASE AND NEW PRODUCT PERFORMANCE (BLOCKBUSTER) FOR COMPANIES THAT SCORE HIGH ON RESOURCES AND COMPANIES THAT SCORE LOW ON RESOURCES (MEDIAN SPLIT)

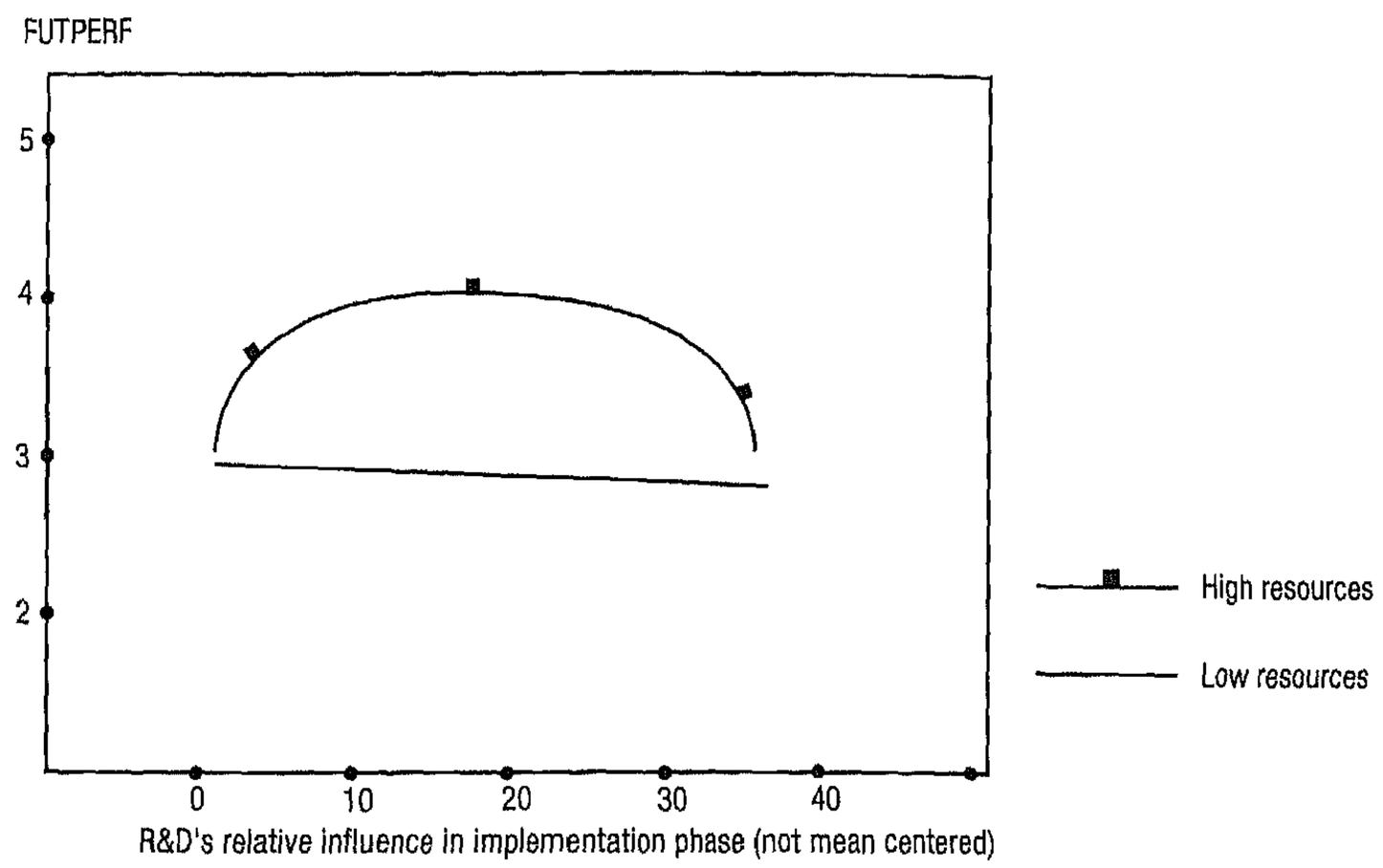

FIGURE 6-6E: THE RELATIONSHIP BETWEEN R&D'S RELATIVE INFLUENCE IN THE IMPLEMENTATION PHASE AND NEW PRODUCT PERFORMANCE (FUTURE) FOR COMPANIES THAT SCORE HIGH ON RESOURCES AND COMPANIES THAT SCORE LOW ON RESOURCES (MEDIAN SPLIT)

Figure 6-6a shows that the inverted U-shaped relationships between R&D's relative influence in the initiation phase and new product performance is present in the 'high resources' group with respect to OUTPERF. For the low resources group there is a weak negative linear relationship (just significant, p(one-tailed)=.08) which indicates that there are small penalties for high levels of relative R&D influence in the initiation phase. Figure 6-6b to 6-6e show that the inverted U-shaped relationships between R&D's relative influence in the implementation phase and new product performance are strongly present in the 'high resources' group. Except for the model for OUTPERF, all coefficients for the quadratic term are significant and negative for the high resources group. In the model for OUTPERF, the quadratic term is just not significant (p=.105). The quadric term in the model for Blockbuster performance is also significant for the 'low resource' group. The relationships of the 'low resource' group tend to be negative but they are all not significant.

From the location of the top of the curve, it can be concluded that the optimal level of relative R&D influence seems to lie in the area of 20. Since the average R&D influence in the implementation phase is about 14 in the sample, we

conclude that there is an opportunity for many companies to improve new product performance by increasing R&D's relative influence in the implementation phase. It should be remembered that we learned in Chapter 4 that specific managerial mechanisms which encompass interaction are appropriate for this goal.

6.5 The effect of structure on new product performance

In this section we contribute to the ongoing discussion of how organizational structure affects new product performance. Since we included the marketing - R&D interface in the study, we can focus on the **generative mechanism** in the interface through which structural characteristics of the organization affect new product performance. We focus upon centralization and formalization because these two variables are known to be important dimensions of organizational structures (Zaltman et al. 1973, Damanpour 1992, 1996 Gupta et al. 1986, Ayers et al. 1997).

In the present study, both centralization and formalization are defined as general and company-wide organizational characteristics, not restricted to smaller units like teams or specific processes like the NPD process. In this general perspective, there have been many studies which found that both centralization and formalization have a negative effect on new product performance. However, in contrast to the numerous studies on the direct relationship (main effect) between centralization and formalization on new product performance, the generative mechanisms or the process by which centralization and formalization affect new product performance is light. As stated in Chapter 2, it is hypothesized that the negative effects of centralization and formalization on new product performance run through a negative effect on integration. Specifically, hypothesis 12 states that integration is a mediator of the negative effect of *formalization* on new product performance. Hypothesis 13 states that integration is a mediator of the negative effects of *centralization* on new product performance. Figure 6-7 offers a schematic picture of the expected relationships.

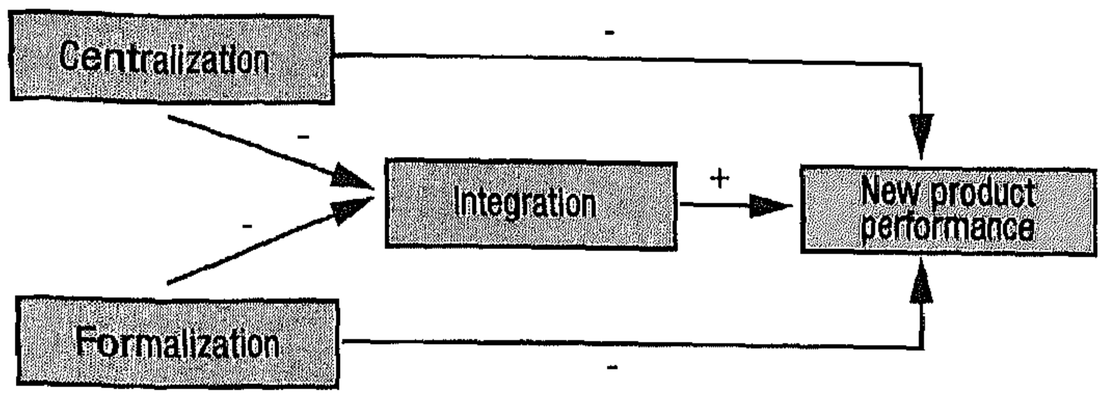

FIGURE 6-7: EXPECTED RELATIONSHIPS WITH INTEGRATION AS A MEDIATOR IN THE RELATIONSHIP BETWEEN BOTH CENTRALIZATION AND FORMALIZATION ON NEW PRODUCT PERFORMANCE.

To test the above model, a three-step approach to establish mediation as described in Baron and Kenny 1986 is followed (see also Chapter 5). In the first step, the mediator (integration) is regressed on the independent variable (centralization and formalization). If the independent variable affects the mediator in the predicted way, the dependent variable (new product performance) is regressed on the independent variable in the second step. If it shows that there is an effect in the expected direction, new product performance is regressed on both the independent variable and the mediator in the third and last step. The third step has to show that the main effect of the independent variable is less (cf. Baron & Kenny 1986) when the mediator is controlled for. This indicates that the main effect is taken over by the effect that runs through the mediator.

First, the mediator is regressed on the independent variable. This results in the following equations:

STEP 1

INTEGRAT = 3.56 + .01 * FORMAL
p=.000 p=.865

INTEGRAT = 2.85 - .24 * CENTRAL
p=.000 p=.001

This shows that the first condition to establish mediation holds for *centralization* but not for formalization. The b-coefficient for CENTRAL is negative and significant, which indicates that the expected negative effect of centralization on integration is present. The b-coefficient for FORMAL is however not

significant. This means that integration is not a mediator of formalization because formalization does not seem to have a negative effect on integration. *Hypothesis 12 is not supported.*

In a follow-up analysis, both formalization and centralization were used in a regression with integration as the dependent variable. The analysis resulted in a significant *negative* regression coefficient for centralization and a significant *positive* regression coefficient for formalization. In other words, formalization seems to be positively related to integration and negatively to new product performance. We further validated this finding by including the managerial integration mechanisms as predictors of integration in the regression as well (multicollinearity was not a major problem). Both parameters for formalization and centralization remained significant with the same sign and the effects of the mechanisms were comparable to those presented in Chapter 4. So, to summarize, our analysis shows that there are organizational characteristics (i.e., formalization) which can have a positive effect on integration and a negative effect on new product performance.

Next, mediator conditions 2 and 3 will be tested for centralization only.

TABLE 6-7: THE EFFECT OF CENTRALIZATION ON NEW PRODUCT PERFORMANCE (STEP2), AND THE EFFECT OFCENTRALIZATION ON NEW PRODUCT PERFORMANCE WHEN CONTROLLED FOR INTEGRATION (STEP3)

Criterion variable	OUTPERF		PROCPERF		BLOCKPERF		FUTPERF	
Step 2	**Beta**	**T**	**Beta**	**T**	**Beta**	**T**	**Beta**	**T**
Predictor:								
CENTRAL	-.23	-2.74***	-.29	-3.46***	-.24	-2.55***	-.22	-2.55***
n	130		130		112		134	
R^2	.06		.09		.06		.05	
Adj. R^2	.05		.08		.05		.04	
F-value	7.53***		12.00***		6.50***		6.50***	
Step 3	**Beta**	**T**	**Beta**	**T**	**Beta**	**T**	**Beta**	**T**
Predictors:								
CENTRAL	-.20	-2.27**	-.27	-3.01***	-.18	-1.94**	-.14	-1.66**
INTEGRAT	.11	1.26 ns	.07	.77 ns	.16	1.62*	.25	2.91***
n	127		128		111		131	
R^2	.07		.09		.07		.10	
Adj. R^2	.05		.07		.06		.09	
F-value	4.34***		5.94***		4.30***		7.26***	

*p<.10 **p<.05 ***p<.01 (one-tailed)

Table 6-7 shows that the last two steps to establish mediation also hold for centralization (although the mediating effect is relatively weak). First, there is a negative relationship between centralization and new product performance (step2). Second, the beta coefficient of centralization becomes smaller when

the mediator is added to the model (step3). The same effect was also found when we controlled for the use of managerial mechanisms. In addition, the absolute size of the unstandardized regression coefficients for centralization are smaller when the mediator is added to the regression (not presented in Table, Δb ranged from -.03 to -.09). Therefore, we conclude that the negative effect of centralization partly runs through integration in the marketing - R&D interface (cf. Baron & Kenny 1986). Integration is not a *perfect* mediator; centralization still has a negative effect on new product performance in addition to the path that runs through integration. *Hypothesis 13 is supported.*

The previous analyses showed that integration is a mediator in the relationship between centralization and new product performance but not between formalization and new product performance. The negative effects of centralization and formalization on new product performance are important because from Table 6-5a and Table 6-5b we learn that a weak to moderate negative effect remains after controlling for the other contextual variables (although this effect is not always significant). The findings suggest that management should focus on reducing the negative effects of centralization on new product performance and integration. Since the negative effect of centralization on new product performance is partly generated by a decline in integration in the marketing - R&D interface, the use of specific managerial integration mechanisms might compensate for particular negative side effects. With respect to formalization, the story is different. Formalization has a positive effect on integration and a negative effect on new product performance. Here, a focus for management should be to overcome the negative effects of formalization on new product performance while preserving the positive effect on integration between marketing and R&D.

6.6 The effect of NPD strategy on new product performance

In the present section, we direct our analysis towards the possible moderating role of integration on the relationship between NPD strategy and new product performance. We distinguish two dimensions of a company's NPD strategy: marketing intensity and R&D. An indication that the dimensions are relevant

in the pharmaceutical industry is present in earlier research (e.g., Cool and Schendel 1987,1988) and in the following interview in Fortune (June 1997) with Gordon Binder, CEO of Amgen:

> *"Most pharmaceutical companies and quite a few biotech ones as well are basically market-driven. They see that large numbers of people have a particular disease and gather scientists to do something about it. In contrast, Amgen does things differently, their starting point is brilliant science and their goal is to find unique use for it."*

Three research questions will be addressed in this section:

- How strong are the main effects of marketing intensity and R&D intensity on new product performance?
- Is the effect of marketing intensity moderated by R&D intensity?
- Does integration affect the relationship between NPD strategy and new product performance?

6.6.1 How strong is the main effect of NPD strategy on new product performance?

It can be expected that a more marketing-intensive strategy gives a company more market power and therefore better new product performance. Furthermore, Cooper (1993, p.301) states that companies which score high on a marketing-driven strategy, feature an NPD process that is strongly market-oriented where products are developed that are closely in tune with market needs in specific market segments. Companies with an R&D-intensive NPD strategy employ sophisticated development technologies and generate new product ideas proactively. This will lead to more innovative new products and therefore higher new product performance (Cooper 1993, p.301).

From Table 6-5a and Table 6-5b we conclude that there is modest support for a positive relationship between marketing intensity and new product performance and between R&D intensity and new product performance: five out of eight estimated relationships (betas) between marketing intensity/ R&D intensity and new product performance are positive, four of these are also significant.

Furthermore, we find no significant negative relationships. To summarize, there are several indications that the expected positive relationship between marketing intensity/ R&D intensity and new product performance exists, although sometimes the relationships are weak or even non-existent.

In the previous discussion, marketing intensity and R&D intensity were discussed as *separate effects*. In the following section we will go one step further by studying the joint effects of marketing intensity and R&D intensity on new product performance. Then, in Section 6.6.3, the combination of marketing intensity, R&D intensity, and integration will be studied.

6.6.2 Is the effect of marketing intensity moderated by R&D intensity?

Hypothesis 14a states that R&D intensity is a (bilinear) moderator of the relationship between marketing intensity and new product performance. To explore the relationship between R&D intensity, marketing intensity, and new product performance, Table 6-8 shows a cross tabulation of the relevant variables.

TABLE 6-8: CROSS TABULATION OF THE AVERAGE LEVEL OF NEW PRODUCT PERFORMANCE AND INTEGRATION FOR COMPANIES WITH DIFFERENT LEVELS OF R&D INTENSITY (MEDIAN SPLIT) AND MARKETING INTENSITY (MEDIAN SPLIT).

		R&D intenstity	
		low	high
Marketing intensity	Low	OUTPERF = 3.01 PROCERF = 2.93 BLOCKERF = 2.10 FUTERF = 3.13 *INTEGRAT = 3.43*	OUTPERF = 3.08 PROCERF = 2.94 BLOCKERF = 2.37 FUTERF = 3.51 *INTEGRAT = 3.50*
	High	OUTPERF = 2.71 PROCERF = 2.54 BLOCKERF = 2.26 FUTERF = 3.04 *INTEGRAT = 3.56*	OUTPERF = 3.73 PROCERF = 3.24 BLOCKERF = 2.92 FUTERF = 4.01 *INTEGRAT = 3.68*

Table 6-8 shows the two levels of R&D intensity in columns and the two levels of marketing intensity in rows. It indicates that the interaction between the two NPD strategy dimensions and new product performance is present. Specifically, from top to bottom in the left column for low R&D intensity, the effect of a marketing intensity on new product performance is negative (except for blockbuster NPP). In the right column for high R&D intensity, the effect of increased marketing intensity on new product performance is positive. This so-called crossover interaction is also visible the other way round (reading Table 6-8 from left to right): R&D intensity leads to no significant increase in new product performance unless the company has a high marketing intensity.

To give some additional insights, the average level of integration in the companies in each box is also presented. This shows that the level of integration changes only slightly between different boxes. Indeed, the differences in new product performance are larger. To summarize, we find a strong indication for a significant

interaction between marketing intensity and R&D intensity.
As a more stringent test of the interaction (moderating effect), the approach suggested by Baron & Kenny (1986) is followed and the regression models presented below are estimated in two steps:

Step 1: $$NPP = \beta_1 + \beta_{11}\,(MKINTENS) + \beta_{12}\,(RDINTENS)$$

Step 2: $$NPP = \beta_2 + \beta_{21}\,(MKINTENS) + \beta_{22}\,(RDINTENS) + \beta_{23}\,(RDINTENS*MKINTENS)$$

In the first step, an additive model is estimated which encompasses only main effects of marketing intensity and R&D intensity on new product performance. In the second step, the interaction variable between marketing intensity and R&D intensity is added to the regression. If the interaction is significant, the moderating effect is present. To reduce multicollinearity, the variables are mean-centered. For the time being, the moderator effect is studied in 'isolation'. which means that the other contextual variables and the interface variable are not included in the analysis yet. A more comprehensive analysis will be presented later.

TABLE 6-9A: REGRESSION MODELS FOR NEW PRODUCT PERFORMANCE (OUTPUT AND PROCESS) WITH MARKETING INTENSITY AND R&D INTENSITY AS PREDICTOR VARIABLES (STEP 1) AND WITH MARKETING INTENSITY, R&D INTENSITY, AND MARKETING INTENSITY * R&D INTENSITY AS PREDICTOR VARIABLES (STEP 2)

Criterion variables	OUTPERF			PROCPERF		
Step 1	**Beta**	**T**	**Tolerance**	**Beta**	**T**	**Tolerance**
Predictor variables						
MKINTENS	.07	.80	.87	-.02	-.24	.91
RDINTENS	.30	3.38***	.87	.25	2.78***	.91
n	132			132		
R^2	.11			.06		
Adj. R^2	.10			.04		
F-value	8.01***			4.06***		
Step 2	**Beta**	**T**	**Tolerance**	**Beta**	**T**	**Tolerance**
Predictor variables						
MKINTENS	.06	.66	.87	-.07	-.83	.86
RDINTENS	.29	3.33***	.87	.25	2.81***	.91
MKINTENS * RDINTENS	.17	2.07**	.99	.22	2.61***	.94
n	132			132		
R^2	.14			.11		
Adj. R^2	.12			.09		
F-value	6.90***			5.10***		

*p<.10 **p<.05 ***p<.01 (one-tailed)

TABLE 6-9B REGRESSION MODELS FOR NEW PRODUCT PERFORMANCE (BLOCKBUSTER AND FUTURE) WITH MARKETING INTENSITY AND R&D INTENSITY AS PREDICTOR VARIABLES (STEP 1) AND WITH MARKETING INTENSITY, R&D INTENSITY, AND MARKETING INTENSITY * R&D NTENSITY AS PREDICTOR VARIABLES (STEP 2)

Criterion variables	BLOCKPERF			FUTPERF		
Step 1						
	Beta	T	Tolerance	Beta	T	Tolerance
Predictor variables						
MKINTENS	.19	2.04**	.90	.05	.63	.89
RDINTENS	.26	2.76***	.90	.49	6.17***	.89
n	114			136		
R^2	.13			.26		
Adj. R^2	.12			.24		
F-value	8.58***			23.14***		
Step 2						
	Beta	T	Tolerance	Beta	T	Tolerance
Predictor variables						
MKINTENS	.19	1.99	.90	.02	.30	.87
RDINTENS	.26	2.83***	.89	.50	6.43***	.89
MKINTENS * RDINTENS	.10	1.19 ns (p=.12)	.99	.20	2.67***	.98
n	114			136		
R^2	.14			.30		
Adj. R^2	.12			.28		
F-value	6.21***			18.52***		

*p<.10 **p<.05 ***p<.01 (one-tailed)

Before the moderating effect is addressed, we will discuss the analyses in step 1. Table 6-9a and Table 6-9b show that there is a significant and positive main effect of R&D intensity on new product performance. The effect of R&D intensity is stronger than the effect of marketing intensity in all regression models.

Step 2 shows that the interaction variable (RDINTENS * MKINTENS) is significant for three new product performance measures, namely output NPP, process NPP, and future NPP. In the model for blockbuster NPP, the interaction is just not significant (p=.12). This might be related to the lower power of this regression compared to the other three. According to the guidelines of Jaccard et al. 1990, a minimum sample size of about 130 is needed to achieve a power of .80 for α=.05. The effect sizes, measured in terms of ΔR^2, range from 0.05 to 0.04.

The frequency plot in Figure 6-8a shows the number of companies with a specific level of marketing intensity. This plot must be kept in mind while interpreting the nature of the interactions. In Figures 6-8b to Figure 6-8e, the relationship between marketing intensity and new product performance is plotted for different levels of R&D intensity (moderator). The moderating effect results in asymmetrical regression lines for each moderator condition.

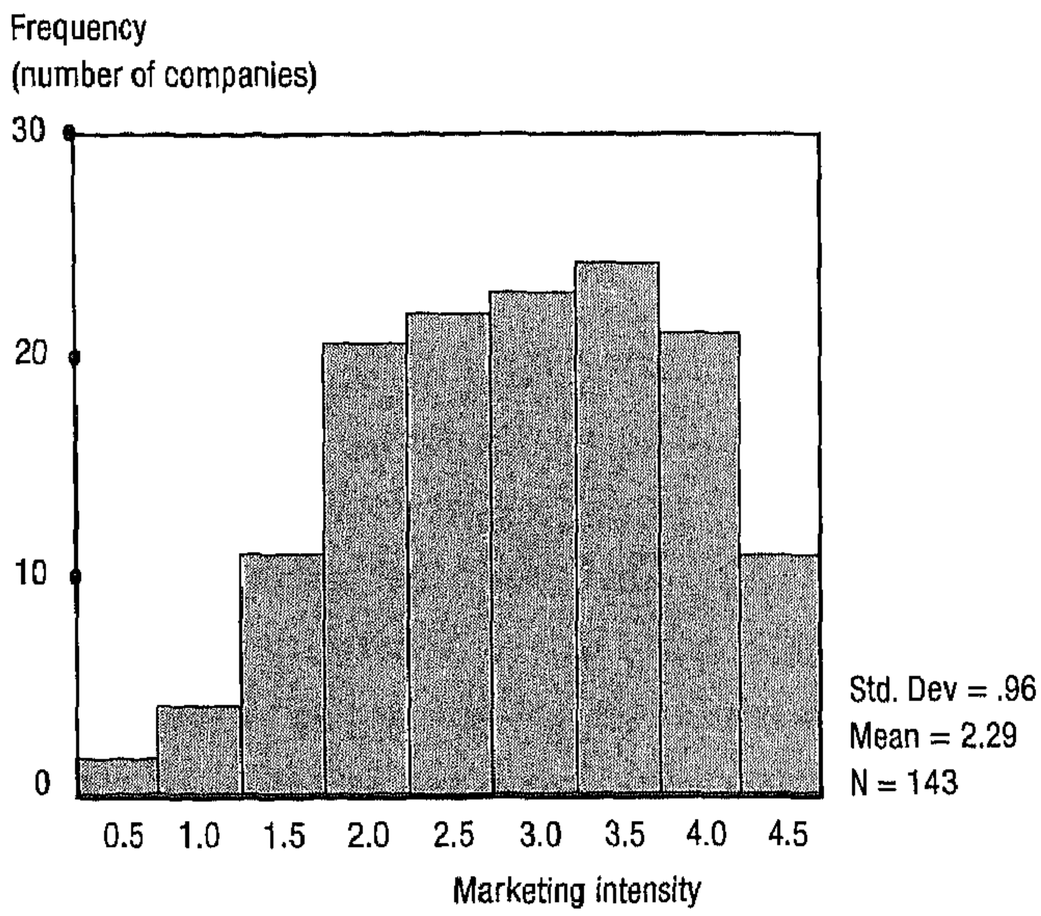

FIGURE 6-8A: FREQUENCY PLOT OF COMPANIES WITH CERTAIN LEVELS OF MARKETING INTENSITY (STD.DEV, MEAN, AND NUMBER OF CASES (N) ARE PRESENTED ON THE RIGHT OF THE CHART)

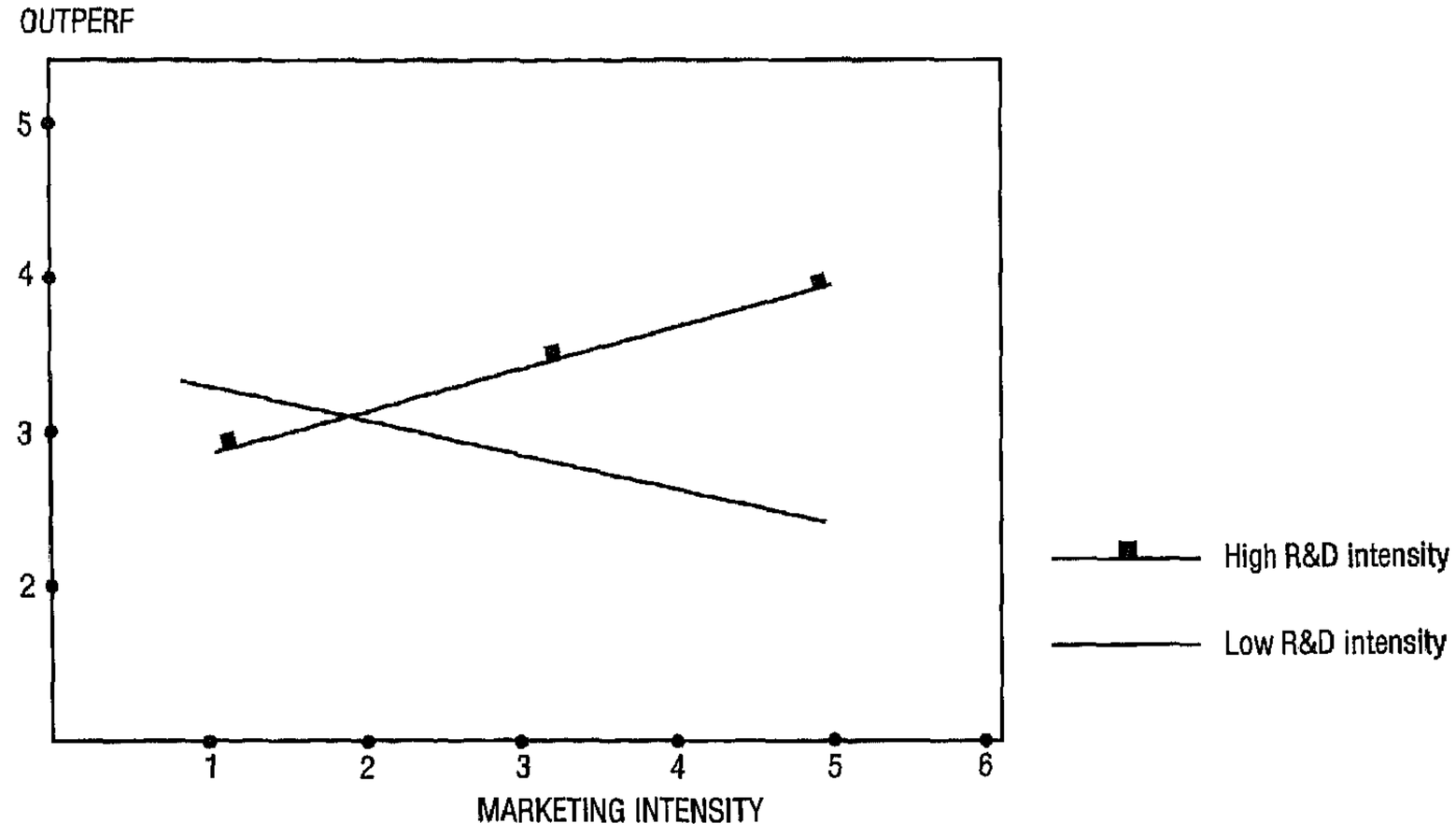

FIGURE 6-8B: RELATIONSHIP BETWEEN MARKETING INTENSITY AND NEW PRODUCT PERFORMANCE (OUTPUT) FOR TWO LEVELS OF THE MODERATOR (HIGH R&D INTENSITY AND LOW R&D INTENSITY)

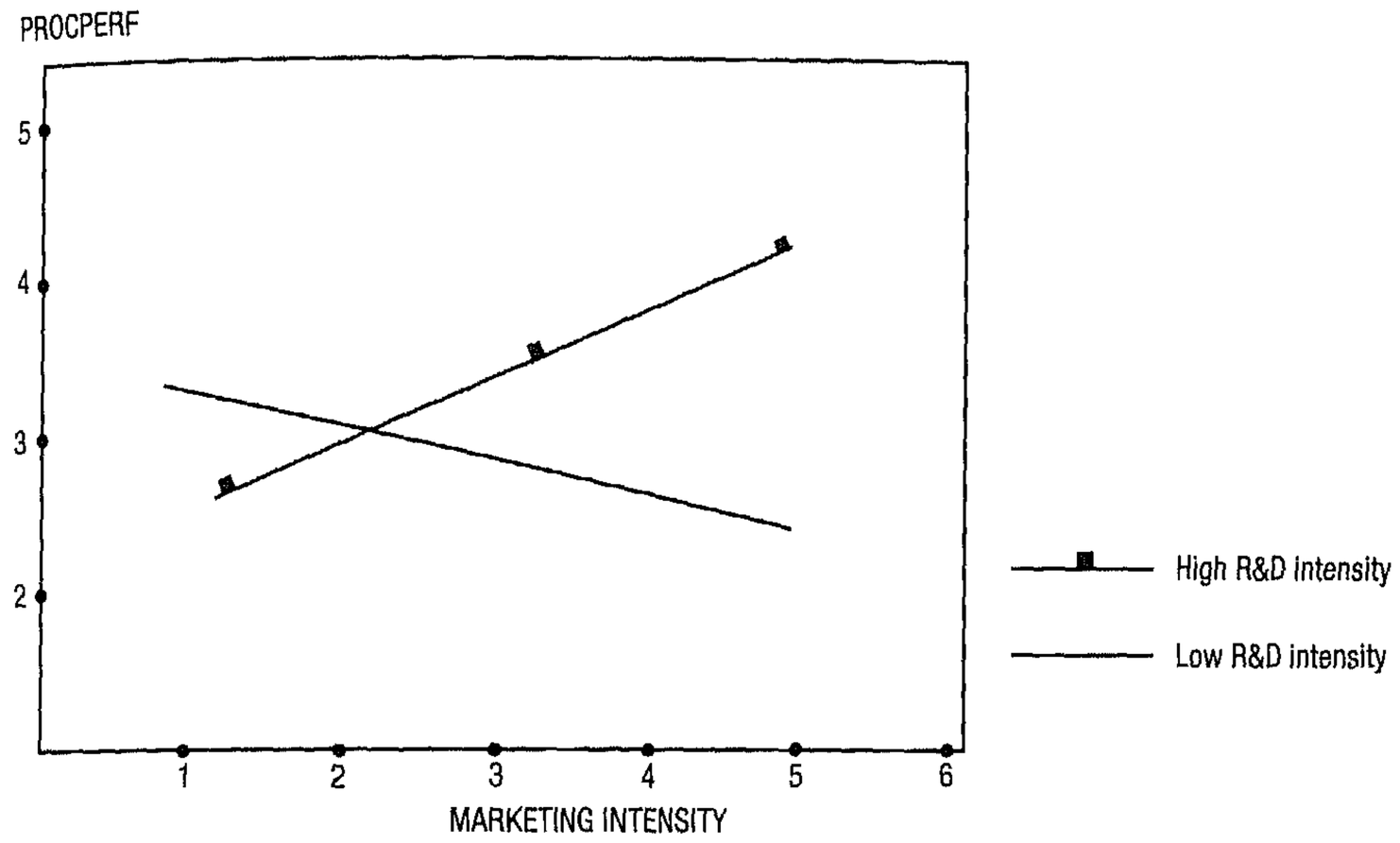

FIGURE 6-8C: RELATIONSHIP BETWEEN MARKETING INTENSITY AND NEW PRODUCT PERFORMANCE (PROCESS) FOR TWO LEVELS OF THE MODERATOR (HIGH R&D INTENSITY AND LOW R&D INTENSITY)

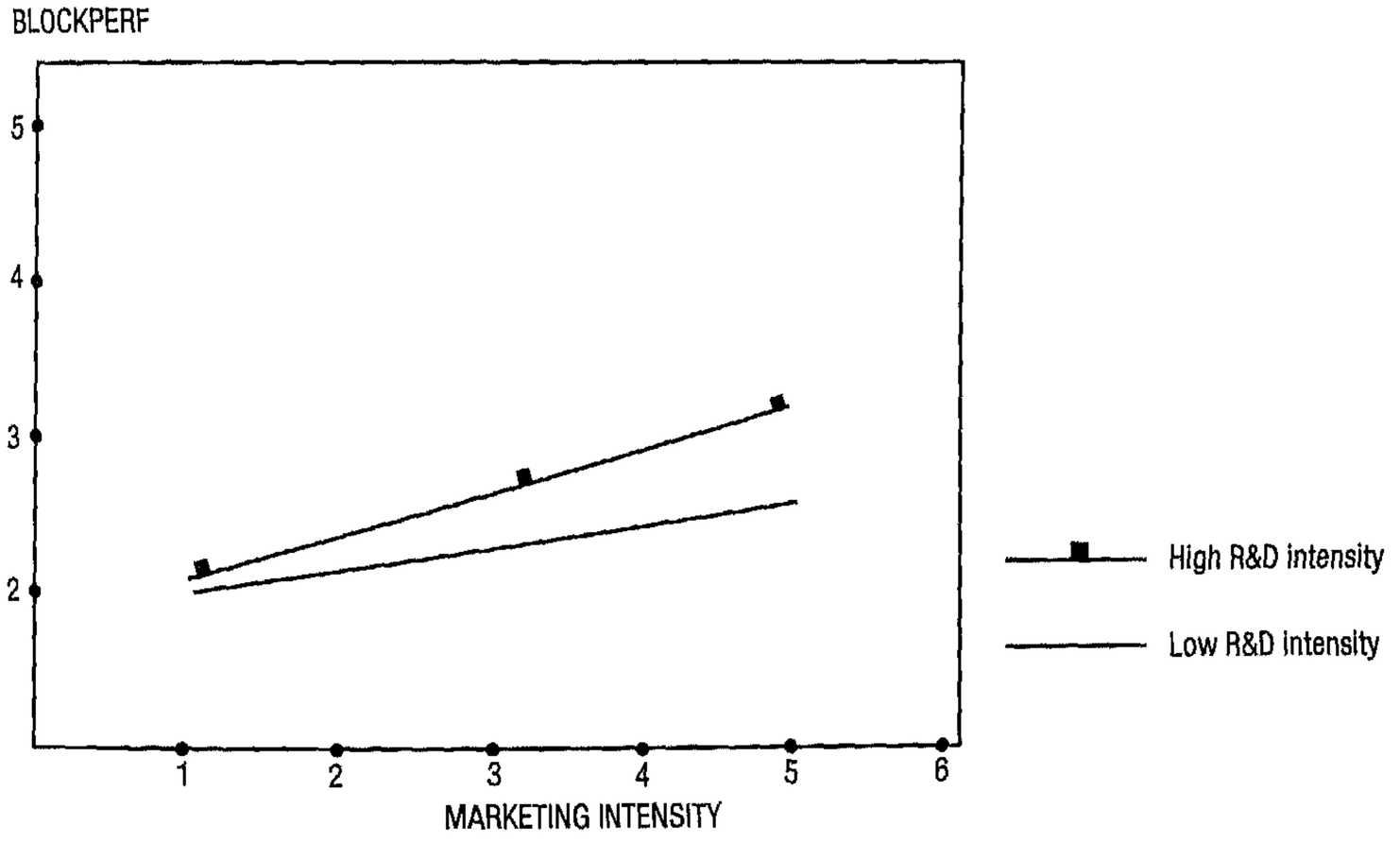

FIGURE 6-8D: RELATIONSHIP BETWEEN MARKETING INTENSITY AND NEW PRODUCT PERFORMANCE (BLOCKBUSTER) FOR TWO LEVELS OF THE MODERATOR (HIGH R&D INTENSITY AND LOW R&D INTENSITY)

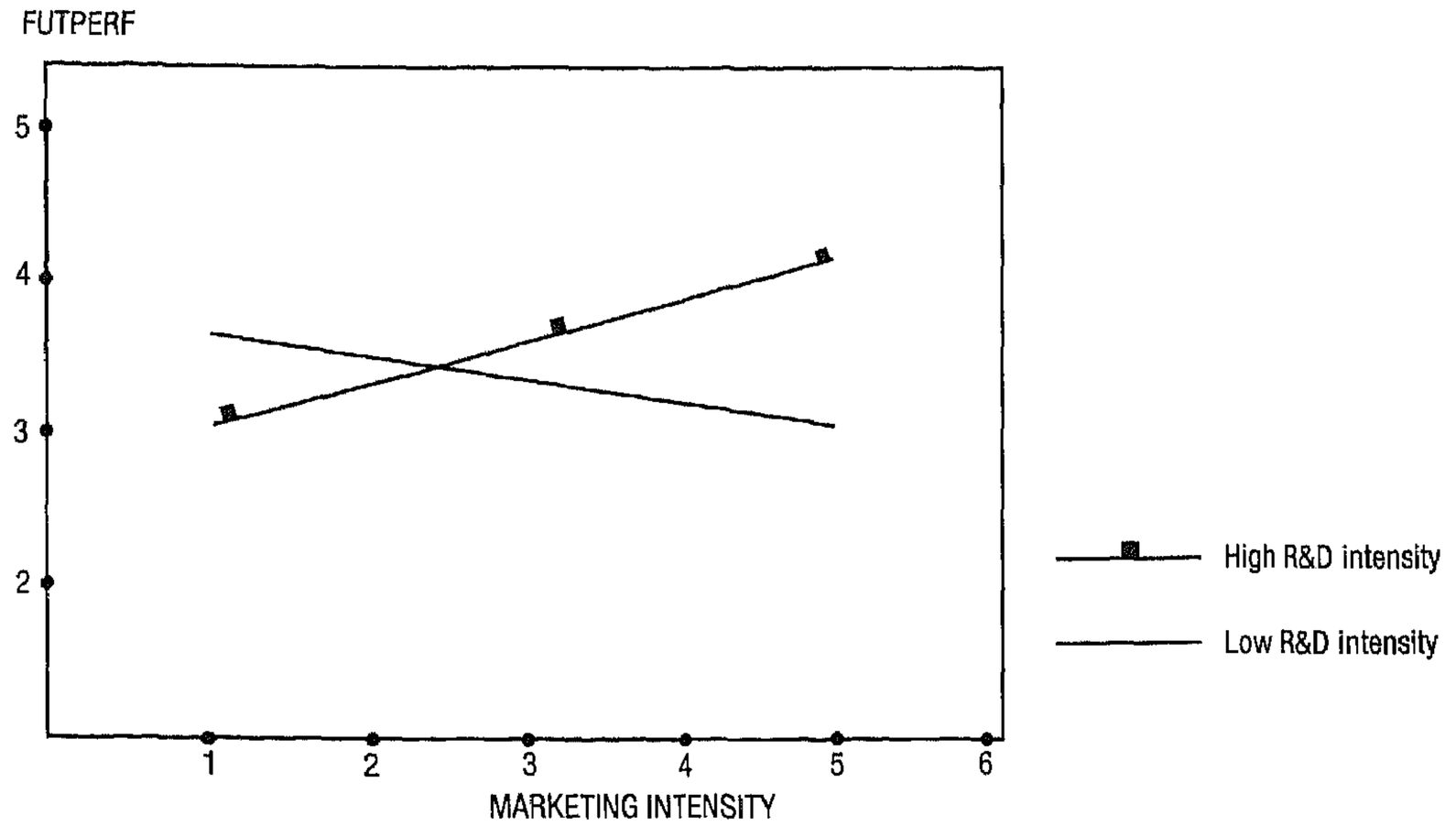

FIGURE 6-8E: RELATIONSHIP BETWEEN MARKETING INTENSITY AND NEW PRODUCT PERFORMANCE (FUTURE) FOR TWO LEVELS OF THE MODERATOR (HIGH R&D INTENSITY AND LOW R&D INTENSITY)

Two interesting facts emerge from the plots. First, the two lines are close to each other or cross in the area of low marketing intensity. So, for companies with a low marketing intensity, having a high or low R&D intensity does not make a strong difference with respect to new product performance. Here, one should remember the frequency plot from Figure 6-8a, which showed that there are only a few companies with a marketing intensity score smaller than 1.5. Second, for companies with a low R&D intensity, having a higher marketing intensity seems to lead to lower new product performance (output NPP, process NPP, and future NPP). The existence of this cross-over interaction can be explained by the fact that having a high marketing intensity involves high costs. To support such a high marketing intensity, the company needs to have commercially successful products. If the products have a technical advantage, success can be much easier achieved. *Hypothesis 14a is supported.*[35]

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[35] This might explain a strong trend in the pharmaceutical industry today: large pharmaceutical companies building new product development networks with innovative biotechnology companies that can deliver R&D intensity to the large marketing-intensive companies (Gemser, Leenders & Wijnberg 1996).

6.6.3 Do specific combinations of marketing intensity, R&D intensity, and integration have an additional effect on new product performance?

The basic premise we examine here is that marketing intensity, R&D intensity, and integration interact in determining new product performance. Specifically, we expect that, in addition to the effects on which we have elaborated before, the *combination* of marketing intensity, R&D intensity, and integration explains additional variance in new product performance. Hypothesis 14b states that there is an interactive effect on new product performance between the level of marketing intensity, R&D intensity, and integration.

6.6.3.1 Testing for the existence of a three-way interaction.

To test hypothesis 14b, the following two related approaches to operationalizing NPD strategy have been followed: 1) based on the use of the two continuous NPD strategy variables; marketing intensity and R&D intensity, and 2) based on the concept of strategic groups. The latter approach results in a distinction between companies in different strategic groups but not between companies within a strategic group. It involves dichotomizing marketing intensity and R&D intensity using median splits (or other cutting rules, cf. Jaccard et al. 1990).

Approach 1: *Testing for a three-way interaction between marketing intensity, R&D intensity, and integration by using continuous variables for aspects of NPD strategy*

In this first approach we test for a significant three-way interaction between marketing intensity, R&D intensity, and integration on new product performance by using continuous NPD strategy variables. The regression model that is used is based on the comprehensive model presented in Chapter 2. So, by studying the three-way interaction, we control for all the other effects we have found so far, together with the effects of two-way interactions which are nested in the three-way interaction. This approach ensures that we find out whether or not the three-way interaction explains unique variance which is not explained

by other (combinations of) variables. To reduce multicollinearity, variables used in interaction terms are mean-centered. The following regression model has been estimated for different NPP measures:

$$\begin{aligned} \text{NPP} = {} & \alpha + \beta_1 (\text{RESOURCES}) + \beta_2 (\text{INTEGRAT}) + \beta_3 (\text{IMPLINFL}) \\ & + \beta_4 (\text{IMPLINFL}^2) + \beta_5 (\text{CENTRAL}) + \beta_6 (\text{FORMAL}) \\ & + \beta_7 (\text{MKINTENS}) + \beta_8 (\text{RDINTENS}) + \beta_9 (\text{INTEGRAT} * \text{RESOURCES}) \\ & + \beta_{10} (\text{IMPLINFL} * \text{RESOURCES}) + \beta_{11} (\text{IMPLINFL}^2 * \text{RESOURCES}) \\ & + \beta_{12} (\text{RDINTENS} * \text{MKINTENS}) + \beta_{13} (\text{MKINTENS} * \text{INTEGRAT}) \\ & + \beta_{14} (\text{RDINTENS} * \text{INTEGRAT}) \\ & + \beta_{15} (\text{RDINTENS} * \text{MKINTENS} * \text{INTEGRAT}) \end{aligned}$$

The results are presented in Table 6-10a and Table 6-10b.[36]

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36 The variables for INITINFL, INITINFL^2, and INITINFL^2 * RESOURCES were included in first-cut analyses. However, except for PROCPERF, we did not find significant relationships. Furthermore, the results presented below were not affected by the additional variables. Therefore, we omitted the INITINFL variables from the analysis to increase the number of data points per variable.

TABLE 6-10A: COMPREHENSIVE REGRESSION MODELS FOR NPP (OUTPUT AND PROCESS)

Dependent variable: OUTPERF					Dependent variable: PROCPERF				
Independent variables	*b*	beta	T-value	Tolerance	Independent variables	b	beta	T-value	Tolerance
Main effects					*Main effects*				
RESOURCES (RES)	.69	.42	4.48***	.59	RESOURCES (RES)	.61	.45	5.01***	.61
INTEGRAT (INT)	.11	.06	.69	.69	INTEGRAT (INT)	.00	.00	.01	.68
IMPLINFL	.01	.10	1.14	.67	IMPLINFL	.01	.15	1.71**	.68
IMPLINFL^2	.00	.03	.34	.61	IMPLINFL^2	-.00	-.07	-.74	.60
CENTRAL	-.00	-.00	-.02	.58	CENTRAL	-.21	-.17	-1.87**	.61
FORMAL	-.27	-.18	-1.91*	.57	FORMAL	-.16	-.14	-1.58*	.63
MKINTENS (MKINT)	.09	.08	.95	.76	MKINTENS(MKINT)	-.03	-.03	-.36	.76
RDINTENS (RDINT)	-.01	-.01	-.06	.54	RDINTENS (RDINT)	-.03	-.03	-.28	.56
Two-way interactions					Two-way interactions				
INT * RES	.40	.13	1.52*	.70	INT * RES	.47	.22	2.17**	.69
IMPLINFL*RES	.04	.24	2.52***	.57	IMPLINFL * RES	.04	.26	2.82***	.57
IMPLINFL^2 *RES	-.00	-.14	-1.35*	.49	IMPLINF^2 * RES	-.00	-.21	-2.07**	.49
MKINT*RDINT	.29	.21	2.53***	.77	MKINT*RDINT	.14	.12	1.45*	.78
INT * MKINT	-.08	-.04	-.43	.71	INT * MKINT	.02	.01	.13	.75
INT * RDINT	-.05	-.02	-.23	.55	INT * RDINT	-.01	-.00	-. 04	.58
Three-way interaction					Three-way interaction				
INT * MKINT * RDINT	-.18	-.08	-.92 (p=.18)	.73	INT * MKINT * RDINT	.16	.08	.91 (p=.18)	.67
n	119				n	119			
R^2	.46				R^2	.49			
Adj. R^2	.38				Adi.R^2	.41			
F-value	5.80***				F-value	6.50***			

*p<.10 **p<.05 ***p<.01 (one-tailed)

TABLE 6-10B: COMPREHENSIVE REGRESSION MODELS FOR NPP (BLOCKBUSTER & FUTURE)

Dependent variable: BLOCKPERF					Dependent variable: FUTPERF				
Independent variable	b	beta	T-value	Tolerance	Independentvariable	b	beta	T-value	Tolerance
Main effects					Main effects				
RESOURCES (RES)	.13	.09	.85	.57	RESOURCES (RES)	.25	.18	1.98**	.61
INTEGRAT (INT)	.11	.07	.75	.72	INTEGRAT (INT)	.21	.14	1.66**	.73
IMPLINFL	.02	.21	2.15**	.72	IMPLINFL	.01	.13	1.49*	.67
IMPLINFL^2	-.00	-.26	-2.09**	.46	IMPLINFL^2	-.00	-.10	-1.12	.59
CENTRAL	-.11	-.09	-.82	.63	CENTRAL	.02	.02	.21	.62
FORMAL	-.24	-.20	-1.95**	.64	FORMAL	-.12	-.10	1.13	.63
MKINTENS (MKINT)	.21	.23	2.44***	.79	MKINTENS(MKINT)	-.03	-.03	-.38	.76
RDINTENS (RDINT)	.21	.23	2.40***	.55	RDINTENS (RDINT)	.32	.32	3.37***	.57
Two-way interactions					Two-way interactions				
INT * RES	.45	.16	1.66*	.74	INT * RES	.13	.05	.57	.72
IMPLINFL*RES	.03	.16	1.30*	.49	IMPLINFL*RES	.04	.22	2.32**	.56
IMPLINFL^2 * RES	-.00	-.25	-1.73**	.34	IMPLINFL^2 *RES	-.00	-.23	-2.26**	.49
MKINT*RDINT	-.03	-.03	-.32	.80	IMKINT*RDINT	.30	.26	3.30***	.82
INT * MKINT	.02	.01	.13	.76	INT * MKINT	.02	.01	.15	.78
INT * RDINT	.12	.07	.61	.60	INT * RDINT	-.17	-.09	-1.01	.60
Three-way interaction					Three-way interaction				
INT * MKINT * RDINT	-.48	-.25	-2.57***	.74	INT * MKINT * RDINT	.01	.00	.03	.74
n	103				n	120			
R^2	.39				R^2	.47			
Adj. R^2	.29				Adj.R^2	.39			
F-value	3.71***				F-value	6.08***			

*p<.10 **p<.05 ***p<.01 (one-tailed)

Table 6-10a and Table 6-10b show that the three-way interaction (INT * MKINTENS * RDINTENS) is significant in the regression model for blockbuster performance. In addition, the three-way interaction is close to being significant in the models for *output* performance and *process* performance (p=.16 and p=.19).[37] So we find considerable support for one aspect of hypothesis 14b, which is on the existence of a three way interaction. The effect size of the significant three way interaction for blockbusters is ΔR^2 =0.05. Overall the adjusted R^2s range from .29 to .41, which shows that a considerable amount of variance in new product performance is explained relative to number of variables included in the model.

Before we conduct additional analyses on the *nature* of the interaction, we will follow the second approach to test for a three-way interaction; by means of a distinction between strategic groups.

Approach 2: *Testing for a three-way interaction between marketing intensity, R&D intensity, and integration by means of a regression with variables for strategic groups*

After being introduced by Hunt (1972), the concept of strategic groups received much attention in the strategic management literature of the late 80's and early 90's. Its application has shown that the concept has potential to provide insight into the nature of the strategy performance relationship (cf. Cool and Schendel 1987). Nevertheless, many ambiguities still surround the concept and questions have been raised about the stability of groups over time and the theoretical underpinning of clustering companies.

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37 We conducted an additional analysis using two adjusted scales for marketing intensity and R&D intensity. We increased the reliability of the R&D intensity and marketing intensity scales by deleting items which were employed in the previously used composite scale. The resulting two 2-item scales, attained reliability coefficients of α=.70 and α=.85 (compared to α=.66 and α=.70, see chapter 3, p.76). The items were averaged to construct an MKINTENS' and an RDINTENS' variable. The new variables were mean-centered and used to construct interaction terms. Regression analysis resulted in similar results except for the model for output NPP: the three-way interaction did attain a significant beta coefficient for this criterion variable (T=-1.55, p=.06 (one-tailed)).

For our discussion of strategic groups in the pharmaceutical industry, we build on Cool & Schendel 1987 who studied the US pharmaceutical industry in the period 1963-1982 and on Bogner & Thomas (1996, p.142-144) who studied worldwide pharmaceutical companies in the US market in the period 1969-1988.

To cluster the companies in our sample into groups, we conducted a median split dichotomizing 'cutting' procedure (Jaccard et al. 1990, p.48). As described in 3.6.4, factor analysis confirmed that marketing intensity and R&D intensity are relatively independent of each other. The groups that result fit reasonable well in the frame of Bogner & Thomas. Furthermore, there are remarkable similarities to these groupings found in other industries like the brewing industry (Hatten et al. 1978).

TABLE 6-11: A TYPOLOGY OF NPD STRATEGIES OF COMPANIES (SEE ALSO CHAPTER 2)

Marketing intensity \ R&D intensity	Low	High
Low	1 Low-on-innovation entrepreneurial marketer **Average interdependence**	2 Highly innovative, entrepreneurial R&D **Lowest interdependence**
High	3 Low-on-innovation marketing-driven **Highest interdependence**	4 Broad based, full R&D/ marketing **Average interdependence**

Group 1: Low-on-innovativon/ entrepreneurial marketer (MLRL)[38]
Group 2: Highly innovative/ entrepreneurial R&D (MLRH)
Group 3: Low-on-innovation/ marketing-driven (MHRL)
Group 4: Broad based/ full marketing and R&D (MHRH)

[38] The symbols in parentheses indicate the M(arketing) intensity score (High or Low) and the R(&D) intensity score (High or Low). For example MHRH indicates the group that scores high on marketing and high on R&D.

We test hypothesis 14b which states that there is a specific interaction between integration and NPD strategy by estimating a regression model in which we substitute the continuous NPD strategy variables with strategic group dummies and interaction terms of dummies with integration. This tells us whether the role of integration differs for different strategic groups. Since we distinguish four strategic groups, we will use three group dummies and three interaction dummies with integration. The MHRH group (group 4) will be used as a base group. The results are presented in Table 6-12a and Table 6-12b. To reduce multicollinearity, variables used in interaction variables are mean-centered (including dummies).

The model can be expressed as follows:

$$
\begin{aligned}
NPP = \quad & \alpha + \beta_1\ (\text{RESOURCES}) + \beta_2\ (\text{INTEGRAT}) + \beta_3\ (\text{IMPLINFL}) + \beta_4\ (\text{IMPLINFL}^2) \\
& + \beta_5\ (\text{CENTRAL}) + \beta_6\ (\text{FORMAL}) + \beta_7\ (\text{RESOURCES} * \text{INTEGRAT}) \\
& + \beta_8\ (\text{IMPLINFL} * \text{RESOURCES}) + \beta_9\ (\text{IMPLINFL}^2 * \text{RESOURCES}) \\
& + \beta_{10}\ (\text{DUM\_MHRL}) + \beta_{11}\ (\text{DUM\_MLRL}) + \beta_{12}\ (\text{DUM\_MLRH}) \\
& + \beta_{13}\ (\text{DUM\_MHRL} * \text{INTEGRAT}) + \beta_{14}\ (\text{DUM\_MLRH} * \text{INTEGRAT}) \\
& + \beta_{15}\ (\text{DUM\_MLRL} * \text{INTEGRAT})
\end{aligned}
$$

Table 6-12a: Comprehensive regression models for NPP (output and process) with strategic group dummies

Dependent variable: OUTPERF					Dependent variable: PROCPERF				
Independent variables	b	beta	T-value	Tolerance	Independent variables	b	beta	T-value	Tolerance
Main effects					Main effects				
RESOURCES (RES)	.60	.37	4.12***	.63	RESOURCES (RES)	.63	.46	5.32***	.65
INTEGRAT (INT)	.03	.02	.25	.79	INTEGRAT (INT)	.03	.02	.23	.76
IMPLINFL	.01	.10	1.19	.67	IMPLINFL	.01	.14	1.63*	.69
$IMPLINFL^2$	.00	.02	.22	.61	$IMPLINFL^2$	-.00	-.08	- .84	.61
CENTRAL	-.10	-.07	-.72	.60	CENTRAL	-.23	-.18	-2.00**	.62
FORMAL	-.20	-.14	-1.47*	.58	FORMAL	-.15	-.13	-1.46*	.60
Two-way interaction					Two-way interaction				
INT * RES	.52	.17	2.02**	.70	INT * RES	.47	.18	2.17**	.70
IMPLINFL * RES	.05	.25	2.65***	.57	IMPLINFL * RES	.04	.26	2.79***	.57
$IMPLINFL^2$ * RES	-.00	-.13	-1.30*	.48	$IMPLINFL^2$ * RES	-.00	-.22	-2.20**	.48
Group dummies					Group dummies				
DUM_MHRL	-.74	-.27	-2.88***	.60	DUM_MHRL	-.22	-.09	-1.03	.62
DUM_MLRL	-.40	-.20	-1.95**	.50	DUM_MLRL	.07	.04	.39	.50
DUM_MLRH	-.64	-.25	-2.86***	.65	DUM_MLRH	-.09	-.05	-.51	.63
Dummy interactions					Dummy interactions				
DUM_MHRL * INT	.98	.19	2.16**	.64	DUM_MHRL * INT	-.16	-.03	- .37	.69
DUM_MLRH * INT	.63	.13	1.40*	.60	DUM_MLRH * INT	-.35	-.09	- .97	.57
DUM_MLRL * INT	.46	.13	1.25	.48	DUM_MLRL * INT	-.19	-.06	-.63	.48
n	119				*n*	122			
R^2	.47				R^2	.49			
Adi. R^2	.39				Adi.R^2	.42			
F-value	6.10***				*F-value*	*6.63****			

*p<.10 **p<.05 ***p<.01 (one-tailed)

TABLE 6-12B: COMPREHENSIVE REGRESSION MODELS FOR NPP (BLOCKBUSTERS AND FUTURE) WITH STRATEGIC GROUP DUMMIES

Dependent variable: BLOCKPERF					Dependent variable: FUTPERF				
Independent variables	b	beta	T-value	Tolerance	Independent variables	b	beta	T-value	Tolerance
Main effects					Main effects				
RESOURCES	.11	.08	.69	.54	RESOURCES (RES)	.42	.30	3.24***	.64
INTEGRAT (INT)	.00	.00	.02	.76	INTEGRAT (INT)	.18	.12	1.49*	.80
IMPLINFL	.02	.23	2.30**	.72	IMPLINFL	.01	.12	1.39*	.67
IMPLINFL^2	-.00	-.27	-2.13**	.46	IMPLINFL^2	-.00	-.16	-1.73**	.60
CENTRAL	-.14	-.11	-1.02	.63	CENTRAL	-.01	-.01	-.10	.62
FORMAL	-.22	-.18	-1.68**	.60	FORMAL	-.08	-.07	-.69	.60
Two-way interaction					Two-way interaction				
INT * RES	.54	.19	1.88**	.70	INT * RES	.12	.04	.50	.69
IMPLINFL * RES	.03	.18	1.46*	.50	IMPLINFL * RES	.04	.22	2.26**	.57
IMPLINFL^2 * RES	-.00	-.23	-1.57*	.34	IMPLINFL^2 * RES	-.00	-.21	-2.00**	.48
Group dummies					Group dummies				
DUM_MHRL	-.63	-.26	-2.15**	.48	DUM_MHRL	-.55	-.23	-2.39***	.59
DUM_MLRL	-.89	-.52	-3.90***	.40	DUM_MLRL	-.48	-.27	-2.61***	.49
DUM_MLRH	-.50	-.24	-2.11**	.55	DUM_MLRH	-.33	-.15	-1.63*	.62
Dummy interactions					Dummy interactions				
DUM_MHRL * INT	.40	.10	.86	.56	DUM MHRL * INT	-.33	-.08	- .82	.64
DUM_MLRH * INT	.40	.10	.86	.55	DUM MLRH * INT	-.77	-.19	-1.95**	.56
DUM_MLRL * INT	.08	.03	.20	.42	DUM MLRL * INT	.14	.05	.42	.47
n	103				n	120			
R^2	.37				R^2	.43			
Adj. R^2	.26				Adi.R^2	.35			
F-value	3.42***				F-value	5.29***			

*p<.10v **p<.05 ***p<.01 (one-tailed)

The regression coefficients for the **dummy interactions with integration** show that two variables attain significant betas in specific models. Significant betas are attained for the high marketing and low R&D group and the opposite group in the regressions for OUTPERF. In addition, the interaction in the low marketing and high R&D group is significant and negative in the regression for FUTPERF. So, compared to the role of integration in the base group (MHRH: high marketing intensity and high R&D intensity), integration has a different role in the high marketing and low R&D group and in the low marketing and high R&D group with respect to OUTPERF and in the opposite direction for the low marketing and high R&D group with respect to FUTPERF. When tested in hierarchical steps, it showed that the increase in variance explained attributable to the dummy interactions ΔR^2 was .02 in both cases.

The **main effects of the strategic group dummies** are significant for all new product performance variables except for PROCPERF. Furthermore, the signs are negative which indicates that the groups have lower new product performance than the base group. It has to be noted that these group effects are *average* effects across values of integration (Jaccard et al. 1990, p.14). Finally, it can be seen that the signs of the betas and significance levels for the coefficients related to variables other than the strategic group variables are comparable to earlier analyses. Compared to the first approach, the adjusted R^2 's are similar.

6.6.3.2 Further exploration of the nature of the three-way interaction

During development and redevelopment activities, important marketing knowledge and R&D knowledge have to be combined and coordinated activities have to be conducted to create a product with value for specific groups of customers. Therefore we expect that integration is most strongly related to new product performance for marketing-intensive companies with a low R&D intensity. These companies are expected to be present in many markets and to

be heavily involved in **D**evelopment (instead of **R&D**).[39] To interpret the three-way interaction, the regression coefficients between integration and new product performance (b's and betas) are presented *for each strategic group*. The results are presented in Table 6-13.

[39] We were able to test this expectation because in the questionnaire we asked the informant to score the Research intensity as well as the Development intensity of the company (Q58, item 3 and 4). This test showed that the proportion of companies with a D score higher than the R score was far greater for the low R&D-intensive group.

TABLE 6-13: REGRESSION COEFFICIENTS (B AND BETA) BETWEEN INTEGRAT AND NEW PRODUCT PERFORMANCE (OUTPERF, PROCPERF, BLOCKPERF, AND FUTPERF) IN SPECIFIC NPD GROUPS

Strategic Group 1

(Low marketing intensity/ low R&D intensity (MLRL))

OUTPERF		PROCPERF		BLOCKPERF		FUTPERF	
b	beta	b	beta	b	beta	b	beta
.20	.13 ns	.17	.14 ns	.15	.10 ns	.66	.47***

Strategic Group 2

(Low marketing intensity/ high R&D (MLRH))

OUTPERF		PROCPERF		BLOCKPERF		FUTPERF	
b	beta	b	beta	b	beta	b	beta
.43	.20 ns	-.06	-.04 ns	.09	.05 ns	-.23	-.17 ns

Strategic Group 3

(High marketing intensity/ low R&D (MHRL))

OUTPERF		PROCPERF		BLOCKPERF		FUTPERF	
b	beta	b	beta	b	beta	b	beta
.93	.56 ***	.27	.23 ns	.47	.42 **	.31	.19 ns

Strategic Group 4

(High marketing intensity/ high R&D (MHRH))

OUTPERF		PROCPERF		BLOCKPERF		FUTPERF	
b	beta	b	beta	b	beta	b	beta
-.23	-.14 ns	.35	.21 ns	.11	.08 ns	.33	.25*

*p<.10 **p<.05 ***p<.01 (one-tailed)

From Table 6-13 it can be concluded that there is a strong positive relationship between integration and OUTPERF and BLOCKPERF in group 3. This supports hypothesis 14b. Parenthetically, it can be seen that there is a significant positive relationship between integration and future new product performance for both group 1 and group 4. Obviously, in the mental model of the respondents, integration has a positive effect on **expected** future new product performance for companies with such NPD strategies. To conclude, we find considerable support for hypothesis 14b with respect to output new product performance (OUTPERF) and blockbuster new product performance (BLOCKPERF). *Hypothesis 14b is partly supported.*

6.7 Summary of findings

In this chapter we investigated the effect of the marketing - R&D interface on new product performance in the broader organizational context of the company (resources, structure, and NPD strategy). The analyses focused on (1) The moderating role of integration on the relationship between resources and new product performance, (2) The quadratic moderating role of R&D's relative influence on the relationship between resources and new product performance, (3) The mediating role of integration on the relationship between structure (centralization and formalization) and new product performance, and (4) The moderating effect of integration in the relationship between marketing intensity and R&D intensity on new product performance.

First, we found support for the moderating role of integration on the relationship between resources and new product performance. Specifically, above a certain threshold, integration multiplies the positive effect of resources on new product performance. Four regressions with four different composite measures of new product performance (output NPP, process NPP, blockbusters NPP, and future NPP) resulted in three significant multiplicative effects. Only for the dependent variable for *expected* future NPP was a main effect of integration found instead of a multiplicative effect on resources. This last finding probably reflects the common rationale today which is that integration is important because it is a determinant of new product performance.

Second, we showed that integration is not the only important variable in the marketing - R&D interface. R&D's relative influence (relative to marketing) is also important. It was expected that there would be a specific level of relative R&D influence where new product performance is at its highest point. However only if there are good and sufficient resources in the company.

Our analysis showed support for an inverted U-shaped moderating role of R&D's relative influence in the *implementation phase* but this was only marginally the case in the *initiation phase*. Especially in the implementation phase, we found that an adequate relative influence balance can generate an optimal level of new product performance. However, if the company has limited resources, new product performance is practically insensitive to changes in R&D's relative influence. Furthermore, even if the company has a high level of resources, more relative R&D influence in the implementation phase will not lead to increased new product performance indefinitely: the effect reaches a peak, after which the positive effect becomes non-existent or negative (too much relative R&D influence in the implementation phase).

Third, we showed that integration is a (weak) mediator in the relationship between centralization and new product performance. So the negative effect of centralization on new product performance is partly related to the negative effect of centralization on integration in the marketing - R&D interface. Interestingly, this mediating effect was not found for formalization. Although formalization in the organization seems to have a negative effect on new product performance (confirmed in our study), it does not have a negative effect on integration.

Fourth, we devoted attention to the two variables for NPD strategy: marketing intensity and R&D intensity. First, we showed that marketing intensity and R&D intensity have a positive although sometimes weak to non-existent effect on new product performance. Then, we found that R&D intensity moderates marketing intensity such that marketing intensity leads to lower NPP unless the company is also R&D-intensive. Only for blockbuster NPP was this last effect just not significant. Finally, marketing intensity and R&D intensity were expected to interact with integration to affect new product performance. We found a significant moderating effect of integration on NPD strategy with respect to blockbuster NPP and almost significant effects for output NPP (significant when using NPD strategy scales with higher reliabilities) and process NPP. The nature

of this moderating effect was investigated and it proved that the relationship between integration and new product performance was the strongest for the low R&D intensive/ high marketing intensive group. We argue that these companies have a greater need to transfer knowledge between marketing and R&D and to undertake coordinated activities to achieve better new product performance.

In the next chapter, we will synthesize the previous findings and elaborate further on what we learned from this study. Furthermore, we will pay attention to managerial implications and possible directions for future research.

PART III

CONCLUSIONS AND IMPLICATIONS

7

Conclusions, discussion, and suggestions for future research

7.1 Introduction

As companies - especially high tech companies - need more specialized knowledge and skills to develop successful new products, there is a growing danger that physical, cultural, organizational, and knowledge gaps between functional groups like marketing and R&D become a barrier to new product performance. A lack of new product performance is indicated by issues such as a limited number of new product ideas, a slow conversion of plans into NPD actions, a poor R&D pipeline, weak new product performance in the market, few blockbusters, and in general new product pessimism.

Until now in the literature, integration has been identified as a determinant of new product performance: higher levels of integration seem to be related to better new product performance. In some studies, however, this positive relationship was not found, especially when integration in companies was considered. In addition, during the exploratory interviews we encountered several companies with adequate integration but low new product performance.

So what does this mean? Does it mean that companies have to integrate? Are there companies that benefit more from integration than others? Are there companies for which more integration does not lead to better new product performance or even leads to lower new product performance? Is integration the only factor in the marketing - R&D interface that is important? These are clearly important questions that have been only marginally addressed in earlier

research.

The present study qualifies and extends the knowledge on the relationship between integration and new product performance of companies. Furthermore, we identify a new factor in the marketing - R&D interface: relative influence of marketing and R&D (power and control balance) in specific NPD phases. Finally, we devote attention to how to manage the interface.

In this chapter, we will summarize the major findings presented in the previous chapters. In Section 7.2, we will elaborate on the comprehensive model underlying the study and the most important findings with respect to the relationships between the marketing - R&D interface and new product performance. In Section 7.3, the relationships between managerial mechanisms and integration and between managerial mechanisms and relative influence are discussed. Section 7.4 presents some limitations of the present study. The managerial implications and suggestions for future research will be discussed in Section 7.5 and Section 7.6.

7.2 Major findings and conclusions

In the previous chapters, we developed and tested a comprehensive model in which multiple factors in the marketing - R&D interface are related to new product performance in the broader organizational context of the company (see Figure 7-1).

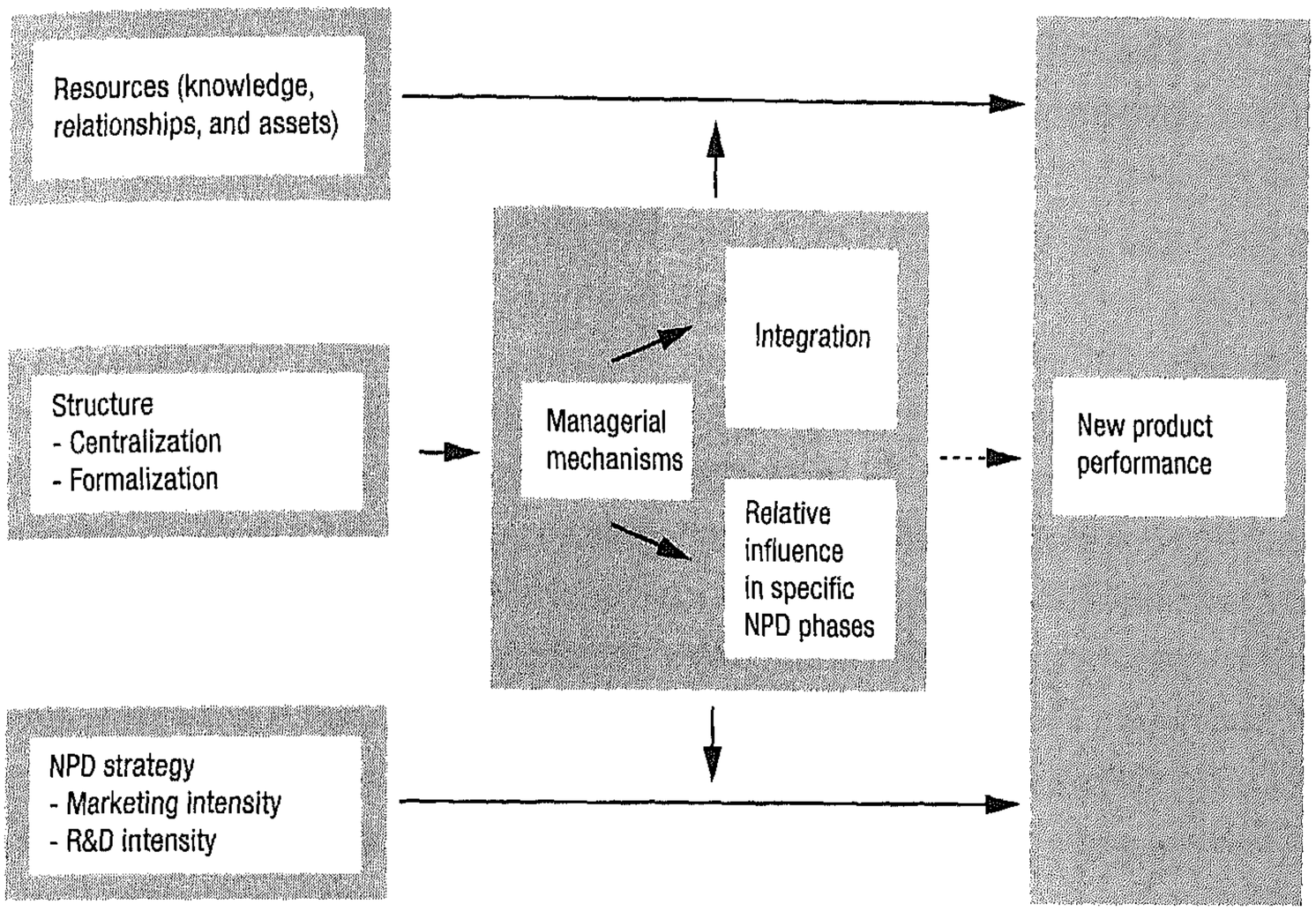

FIGURE 7-1: THE MODEL UNDERLYING THIS STUDY (SEE FIGURE 2-1, P.23)

The comprehensive model resulted from exploratory interviews and literature. The determinants of new product performance are organized in two building blocks: the marketing - R&D interface and the organizational context. Compared to earlier studies, this is the first model at the level of the company in which the marketing - R&D interface and the organizational context jointly affect new product performance.

The findings that resulted from an empirical test of the model are presented in the following sections. The results will, by and large, be presented in the order of the previous chapters. First, we will focus on the relationship between the marketing - R&D interface and new product performance 'in isolation' from the rest of the company (Chapter 4 and 5). Second, the relationship between the marketing - R&D interface and new product performance in the broader organizational context will be discussed (Chapter 6). One part of Chapter 4, namely where we empirically tested the effects of managerial mechanisms, will be discussed last because it is closely related to the managerial implications of the present study.

7.2.1 The effect of the marketing - R&D interface on new product performance

In the present study, we focused on *two* distinct factors in the marketing - R&D interface: integration between marketing and R&D *and* relative influence of marketing and/ or R&D.

The first concept, integration, had already been identified in earlier research as an important factor for new product performance. However, from the literature we also learned that not much attention had been paid to defining and measuring both integration and new product performance. Therefore, our first contribution was aimed at offering a theoretical underpinning of the concept of integration and developing adequate measures to validate the positive effect of integration on new product performance. Then, we elaborated on the question of *how* integration affects new product performance. This enabled us to explain why integration seems to have no effect in some companies by identifying factors that affect the relationship between integration and new product performance.

To study the effect on new product performance, we also had to develop adequate measures for specific dimensions of new product performance. New product performance has a multi- dimensional flavor which is still not widely spread (cf. Cooper and Kleinschmidt 1995). Furthermore, in earlier studies often single items were used as an indicator. We used literature (e.g., Cooper 1984, Dess and Robinson 1984, Griffin and Page 1993) and exploratory interviews to identify potential items and we used factor analysis to develop reliable multiple-item scales for specific dimensions of new product performance, for: (1) the speed and quality of the NPD decision making process (PROCPERF), (2) the performance of the *output* of the NPD *process* (OUTPERF), (3) the performance of the company with respect to producing *blockbusters* (BLOCKPERF), and (4) the expectations with respect to *future* performance (FUTPERF). Although it proved that the measures were somewhat related (correlations ranged from r=.39 to r=.64), they concentrate on different dimensions of the NPD process and its outcomes.

The second concept in the marketing - R&D interface, the relative influence of R&D versus marketing in specific NPD phases, is new to this area of research. We argued that in a specific situation where integration has no effect on new

product performance, it does not mean that the marketing - R&D interface as a whole has no effect. We expected beforehand that integration (communication, collaboration, and joint goals) and relative influence (power and control) would be two independent interface characteristics which both can affect new product performance. Therefore, our contributions in this area were aimed at defining and measuring relative influence in specific NPD phases, showing that integration and relative influence are indeed independent interface variables, and proving that there is an optimal balance of influence in a specific NPD phase that produces the highest new product performance. Finally, we used some insights gained on integration to elaborate on *how* relative influence affects new product performance as well.

As expected, we found that integration had a positive, monotonically increasing, effect on all new product performance measures.[40] In a regression analysis that contained both the linear as well as the quadratic terms of the interface variables, a positive and significant beta was found for the linear integration variables. Furthermore, there were no signs of a significant and negative quadratic integration variable which would have indicated diminishing or even negative returns on new product performance from very high levels of integration (the 'too-good friends syndrome', found at the team level by Souder 1988). These insights validate and extend prior knowledge on the effect of integration in companies.

As stated before, the concept of relative influence is new to the area of research on the marketing - R&D interface. We found that R&D's relative influence in the initiation phase is to a large extent independent of R&D's relative influence in the implementation phase. So if R&D is very influential in the initiation phase, R&D may also have either a lot of influence in the *implementation phase* or hardly any at all. Additionally, we found that R&D is typically dominant in the *initiation phase* and that marketing is typically dominant in the implementation phase. With respect to the relationship

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40 We will only elaborate on specific new product performance measures (i.e., OUTPERF, PROCPERF, BLOCKPERF, and FUTPERF) if there are differences in effects.

between relative influence and new product performance we expected an inverted U-shaped effect. This means that there is an optimal relative influence balance where new product performance is at its maximum. Our subsequent analyses showed that this was indeed the case in the implementation phase: new product performance reaches its maximum at a certain level of R&D influence relative to marketing; after that new product performance drops again when R&D's relative influence increases further. In addition, it showed that the optimum was located in the area where marketing is dominant, indicating that it is optimal for a company when marketing is dominant in the implementation phase. With respect to relative influence in the *initiation phase,* we found almost no signs of either a linear or a quadratic effect on new product performance. This is probably because the companies in the sample have a near to optimal relative influence balance between marketing and R&D in that particular phase.

Finally, an important finding was that the *strength* of the relationship between the interface variables (integration and relative influence) and new product performance was weak. Both interface variables were only able to generate a R^2 =.07 (for OUTPERF), R^2 =.09 (for PROCPERF) and R^2 =.14 (for BLOCKPERF and FUTPERF). The adjusted R^2s ranged from .02 to .09, which indicates that there are other factors affecting new product performance that have to be addressed in a more comprehensive analysis.

7.2.2 The effect of the marketing - R&D interface on new product performance in the broader organizational context

From our comprehensive model presented in Figure 7-1 it becomes clear that there are several factors outside the direct area of the marketing - R&D interface that can be expected to affect new product performance. These factors are resources, organizational structure (centralization and formalization), and NPD strategy (marketing intensity and R&D intensity).

In the first comprehensive regression analysis, the variables distinguished in the organizational context and integration were used as predictors of new product performance (see Table 6-3a and 6-3b, p.140-141). The results showed that

resources have a very strong effect on new product performance. In addition, we found that formalization and centralization had a negative effect, and that marketing intensity and R&D intensity had a positive effect, although all were relatively weak. Overall, the R^2 s attained values between R^2 =.23 (adj. R^2 =.19) and R^2 =.38 (adj. R^2 =.34) depending on the new product performance measure. However, more importantly, we also learned that the role of integration as a separate, independent variable in explaining variance in new product performance besides the variables in the organizational context was almost zero.

To study the effect of integration in the broader context further, another *type* of relationship between integration and new product performance was included in the analysis. Instead of an additive effect of integration where integration affects new product performance in addition to the effects of the organizational context, a *multiplicative* effect of integration on resources was proposed. This so-called moderating effect of integration on the relationship between resources and new product performance was tested by means of a regression model with interaction terms (Jaccard et al. 1990). We found strong support for the multiplicative effect of integration through a significant interaction term in the regressions and a considerable increase in R^2 . These ranged from ΔR^2 =.02 to ΔR^2 =.05, depending on the new product performance measure (see Table 6-5a and 6-5b, p.146-147 in comparison with Table 6-3a and 6-3b), which resulted in overall values between R^2 =.26 (adj. R^2 =.21) and R^2 =42 (adj. R^2 =.39). This shows that the effect of integration has to be considered in combination with the amount of (functional) resources in the company. Specifically, a follow-up analysis of two groups of companies - one that scored low on integration and one that scored high on integration - showed that the same score on resources results in more new product performance for the high integration group than for the low integration group. Interestingly, if companies scored *very* low on resources, higher levels of integration did not result in higher levels of new product performance at all. On the contrary, there were indications that more integration in such companies resulted in lower new product performance.

An important follow-up question in our research was whether relative influence - like integration - affects the *relationship* between resources and new product performance. In this respect, we formulated a hypothesis stating that the

relationship between R&D's relative influence and new product performance is affected by the amount of resources in the company.[41] Interestingly, our analysis showed support for this hypothesis, although mainly in the implementation phase. For the group that scored high on resources, we found a strong inverted U-shaped relationship between R&D's relative influence and new product performance. For the low resources group, this pattern was almost non-existent with much lower levels of new product performance across all relative R&D influence scores.

In the last part of this study, we focused on the relationship between specific NPD strategies of companies and the new product performance they display. In addition, we examined how this relationship is affected by more or less integration in the company. However before that, we performed an additional analysis on the positive effects of marketing intensity and R&D intensity on new product performance reported in earlier studies (e.g., Cooper 1993). We found that more marketing intensity is related to *lower* new product performance *if* the company has a low R&D intensity. This shows that market power is not sufficient for success with new products: some level of R&D intensity (innovativeness) is also required.

We then examined how integration affects the relationship between NPD strategy and new product performance. NPD strategies of companies differ widely and these strategies were expected to determine to a large extent the interdependence of marketing and R&D in the NPD process of companies. This interdependence was in turn expected to affect the extent to which integration affects new product performance. The strongest positive effect was expected for companies with a low R&D intensity (mainly D instead of R) and a high marketing intensity. The new products of this type of company have a low level of technological sophistication, which results in an urgent need for targeting

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41 The decision as to which variable is considered the moderator and which variable is the independent variable is in this type of research up to the researcher. Here, resources are considered the moderator for ease of interpretation because of the inverted U-shaped relationship between R&D's relative influence and new product performance.

specific market segments and (re)developing the product further for specific markets segments. For this, marketing and R&D knowledge and tasks have to be combined (high interdependence). In contrast, companies with a high R&D intensity and a low marketing intensity produce products with a high level of technological sophistication which do not necessarily need to combine technological knowledge and tasks with marketing tasks and knowledge to be successful with their new products (low interdependence).

Our analysis showed that there are indications that integration is indeed most important for companies with a high marketing intensity and low R&D intensity. In this group, we found the strongest correlations between integration and new product performance and the steepest slopes in the relationship between integration and new product performance, which indicates that an increase in integration generates the highest increase in new product performance (see Table 6-13, p.186). Especially with respect to blockbusters, we found strong support for the fact that high marketing-intensive and low R&D-intensive NPD strategies benefit the most from integration. A good example of this effect in the pharmaceutical industry is the success of Glaxo's Zantac. In a detailed case study (Angelmar & Pinson 1991), we learn how Zantac became a blockbuster. Although Zantac is just a single product that can be characterized as a 'me-too' product, it fits a high marketing-, low R&D-intensive NPD strategy very well. The product was launched about 6 years later than the innovator Tagamet of SmithKline Beecham which it quickly overtook. Zantac's producer Glaxo aggressively communicated technical benefits to the market and actively redeveloped the drug to low doses forms for new market segments. Clearly, this was only possible by means of an integrated effort of marketing and R&D.

The weakest effect of integration on new product performance was, as expected, found in companies with a high R&D intensity and a low marketing intensity. In our analysis, we found no significant relationship between integration and any new product performance measure for this group; there were even two negative beta for PROCPERF and FUTPERF (see Figure 6-13, p.186). The companies in this strategic group have built a strong technological base from which they generate new product performance without much marketing effort. An example is the US company Amgen which is a successful pharmaceutical company

focusing on biotechnology. According to the CEO in *Business week*, 1997 Amgen is successful despite the low priority it gives to marketing (and, we presume, marketing - R&D integration).

To summarize, the following insights are gained with respect to the effect of *integration* on new product performance.

1. A weak positive relationship between integration as such and different aspects of new product performance was found. In particular between integration and the speed and quality of the NPD process (PROCPERF), the quality of the output of the NPD process (OUTPERF), the performance with respect to producing blockbusters (BLOCKPERF), and the expectations with respect to future performance (FUTPERF).

2. A much stronger effect of integration was found when it was considered in conjunction with 'depth' resources. We learned that integration is not a factor that has an effect on new product performance in *addition* to factors like resources, structure, and NPD strategy. Instead, integration is a *multiplicative* factor that enables a company to get more (or less) new product performance out of its resources. We learned that there is an interplay of functional and cross functional resources that affects new product performance. In other words, a company needs good and sufficient functional resources and high integration.

3. Companies with a specific NPD strategy benefit the most from integration. Specifically, companies with a high marketing and low R&D-intensive NPD strategy have the highest returns on integration with respect to new product performance, especially with respect to producing blockbusters. We argue that these types of companies are constantly seeking market opportunities for existing or adapted products (with a major role for *development* and a lesser one for *research*), which makes integration very important.

So far, in the literature on the marketing - R&D interface, only the concept of integration has had serious attention. In our study we distinguish an important new concept in the interface: *relative influence*. The following insights were gained:

1. Relative influence in decision-making is an important factor in the marketing - R&D interface that is distinct from integration. Whereas integration is related to communication, collaboration, and joint goals, relative influence is related to power and control. Both factors are conceptually and statistically distinct, can be changed independently of each other, and both affect new product performance.

2. Companies with a high level of relative R&D influence in the *initiation phase* can have either a high or low relative R&D influence in the *implementation phase*. In addition, we learned that R&D is typically dominant in the initiation phase and that marketing is typically dominant in the implementation phase.

3. There is a significant inverted U-shaped relationship between R&D's relative influence and new product performance, especially in the implementation phase. This means that there is an optimal level of relative R&D influence where new product performance is at its maximum. Additionally, we learned that R&D's relative influence in the implementation phase is typically below the optimal level.

4. The relationship between R&D's relative influence and new product performance is also not unconditional. Companies that score low on resources will not benefit much from an upward change in the relative influence of R&D.

7.3 Can the marketing - R&D interface be managed?

Now that we know that there are at least two important factors in the marketing - R&D interface which affect new product performance, namely integration and relative influence, the question emerges of how these factors can be managed. The questions we addressed in our study were whether and how it is possible to: (1) increase integration between marketing and R&D, and (2) increase (or lower if there is too much) R&D's relative influence in a specific NPD phase.

7.3.1 The effect of managerial mechanisms on integration

From the exploratory interviews and literature review we learned that companies use different kinds of managerial mechanisms to improve the marketing - R&D interface (Allen 1986, Moenaert & Souder 1990, Ruekert & Walker 1987, Olsen et. al 1995, Griffin & Hauser 1996). However, until now not much is known about whether these mechanisms are really effective in producing integration. With respect to the use of managerial mechanisms in companies, Griffin & Hauser (1996) state: "we believe that one of the highest priority research topics is to determine the relative efficacy of the integration methods".

In the present study we explicitly tested the relative efficacy of specific managerial mechanisms in three different categories: control mechanisms, interaction mechanisms, and climate mechanisms. Beforehand, we expected that all mechanisms would be positively related to integration because all managerial mechanisms potentially bridge one or more gaps between marketing and R&D (see for example Griffin & Hauser 1996)). In addition, we hypothesized that interaction mechanisms would be most effective because they are best suited to overcoming 'thought worlds' (Dougherty 1992).

Our results showed that specific control mechanisms, interaction mechanisms, and climate mechanisms are effective (for an overview see Table 4-8, p.92). A large proportion of the mechanisms in all categories were positive and significant predictors of integration in companies. Physical distance between marketing and R&D was a very important factor: the larger the physical distance between marketing and R&D, the lower the level of integration in the companies. In addition, offering equal career opportunities (climate mechanism) and using

marketers to lead cross functional teams (control mechanism) both have relatively strong positive effect on integration (although we found a non-significant negative effect in the sample where an R&D respondent scored the company with respect to the last mechanism). Overall the managerial mechanisms were able to explain 30% of variance in integration (Adj. R^2 =.18).

Interestingly, several managerial mechanisms were not significantly related to integration. They were: the use of a formalized NPD process, the number of cross functional teams, the intensity of job rotation, and a top management statement. With respect to the mechanism 'having a formalized NPD process', the reason may be that this mechanism is too static and that it does not facilitate the flexibility needed for NPD (cf. Moenaert & Souder 1990). With respect to cross functional project teams, Ittner & Larcker (1997b) found a negative effect on overall company performance, suggesting that there are many pitfalls when using teams (cf. Cohen & Bailey 1997). With respect to the ineffectiveness of job rotation, we note that Moenaert & Souder (1996) have recently argued that the time period between two rotations is important. These periods should not be too short: instead of rotating individuals between marketing and R&D every two to three years, they argue that, to increase actual information utility, they should be on the job for at least five years. Finally, in our study we could not find a significant effect of a formal top management statement. This may be because climate mechanisms have little impact or that they are used more often in companies with acute interface problems.

In an exploratory follow-up analysis, the overall sample was split into two sub-samples: one sample where a marketing respondent filled out the questionnaire and one sample where an R&D respondent filled out the questionnaire. The sample split showed that managerial mechanisms explained most of the variance in integration in the marketing sample (Marketing sample: R^2 =.55, Adj. R^2 =.39, compared to the R&D sample: R^2 =.44 (Adjusted .12). In general, in the marketing sample, control mechanisms and interaction mechanisms are effective. In the R&D sample, only interaction mechanisms were found to be effective. This indicates that both marketing and R&D 'see' the benefits of interaction but that marketing has a higher need for formal control bodies that make sure that R&D is also driven by cross functional influences.

7.3.2 The effect of managerial mechanisms on relative influence

In our study we learned that relative influence is an important aspect of the marketing - R&D interface that can affect new product performance.

R&D's influence relative to marketing in the implementation phase proved to be an important explanatory factor for new product performance. With respect to the issue of changing R&D's relative influence in this phase, we learned that only interaction mechanisms were effective (i.e., joint training, job rotation, and physical closeness). Specifically, more use of interaction mechanisms led to more relative R&D influence in the *implementation phase*. Overall, the regression attained an R^2 of .23 (Adj. R^2=.11) which shows that the effects are modest (see Table 4-12, p. 107). In a regression where the managerial mechanisms were used as predictors of R&D's relative influence in the initiation phase, it showed that a relatively large proportion of the control mechanisms and interaction mechanisms attained significant betas. However, we note that in our study R&D's relative influence in the *initiation phase* is already often adequate. Only with respect to PROCPERF did we find sufficient companies with no optimal level to establish a significant inverted U-shaped relationship. Overall, climate mechanisms did not seem to be effective. This is probably because these mechanisms have too little impact to change the power and control structure. The regression attained a somewhat higher R^2 of .34 (Adj. R^2=.22).

Overall, the use of managerial mechanisms proved to have a balancing effect on the relative influence distribution between marketing and R&D, i.e. they *decreased* R&D's relative influence in the *initiation phase* (where R&D is often dominant) and *increased* R&D's relative influence in the *implementation phase* (where marketing is often dominant). Interestingly, two interaction mechanisms - cross functional training and job rotation of marketing personnel - had a positive effect on R&D's relative influence in *all* phases. So, since R&D is already often dominant in the initiation phase, this could be an undesired side effect. Possible explanations can be that R&D gains important marketing knowledge that results in more relative influence for R&D, whereas the R&D knowledge gained by marketing is more difficult to convert into more relative influence. With respect to job rotation of marketing personnel, we learned from our

exploratory interviews that marketers rotate very frequently, which may result in too little time to build power and control in any phase.

We conclude that specific managerial mechanisms can be used to change the relative influence balance between marketing and R&D in a specific phase. However, a relatively narrow range of managerial mechanisms is effective, which is sometimes compensated for by the fact that specific mechanisms have a relatively high impact on R&D's relative influence 'in the eyes of one side of the dyad'.

7.4 Scope and limitations of the study

The single industry design that was adopted to test the comprehensive model in the present study means that our findings cannot be directly generalized to a broad range of industries. We argue that this is not really a limitation: on the one hand it narrows the scope of the findings somewhat but on the other hand it provided us with an opportunity to study the effect of company characteristics on new product performance without too much interference from external 'noise'. Furthermore, since we developed a general model, not based on any industry-specific knowledge, we argue that the model holds in other industries as well, especially since we found considerable - to strong - support for several central hypotheses. However, since the industry that was selected was the pharmaceutical industry, the results can be most directly generalized to industries with similar characteristics (i.e., high tech, business-to-business, and global) such as telecom, aerospace, and specialized equipment and machinery industries.

In the present study, we were able to explain up to 52% of variance in new product performance. This shows that there are other variables outside the model which affect new product performance that were not included. We argue that a large proportion of the other 48% of variance is related to factors such as specific individuals who affect new product performance by their innovative actions, serendipity in the laboratory, and pure luck, suggesting that we are reaching the natural limits of what is possible in this type of research. In the light of earlier research, the 52% of variance (adj. R^2 =.42) can even be considered as good, which is related to three aspects of our study: a single industry research setting,

the focus on the marketing - R&D interface *and* the organizational context, and the different types of relationships (direct and moderators) that were studied.

In the present study, respondents were asked to score companies (respondents played the role of informants). Therefore, we dealt mainly with perceptions of key informants instead of factual data (see for example Pennings 1973, Siedler 1974, John and Reve 1982). Although perceptions are not necessarily worse than factual indicators (e.g., Saunders et al. 1992), we tried to compensate for this limitation by lowering the possible gap between perceptions and facts by selecting knowledgeable managers and emphasizing that they had to score their company and not their own attitudes, opinions, and feelings. In addition, we checked for possible effects of personal differences in functional background, experience, and involvement with the topic which could result in less accurate perceptions (cf. Steenkamp 1990). Finally, where possible we validated the scores with factual data.

A limitation of the present study is that the type of data collected at one point in time might give a somewhat static view of the relationships. We tried to compensate for this by asking respondents to score new product performance over a period of five years. By taking a time span of five years, together with considering new product performance at the level of the company's overall NPD program, we argue that our study includes the 'learning' dynamics between sequential and parallel projects over a certain period of time.

Finally, although we followed the guidelines of Dillman (1978), the response of 21% in our study is modest, which could lead to non-response bias. We argue that while it would have been better to reach a higher response, response sizes like ours are not unusual in these types of international studies. Even 'single digit' responses are not unusual (Jobber et al. 1985). Furthermore, we showed that the resulting sample had good face validity with respect to the pharmaceutical industry as a whole. We also showed that early and late responses did not differ significantly from each other, indicating that response bias is not a large problem here.

7.5 Managerial implications

The results presented in our study have several implications for managers at different levels in the organization and for consultants working on performance improvements of companies.

Our study shows that higher levels of integration between marketing and R&D have a positive effect on the new product performance of the company *only if* accompanied by good and sufficient functional resources. So if a company is underperforming with respect to new product performance, management should not directly think of trying to integrate the company further. The lack of new product performance should be considered in a joint review of the organizational context (functional resources, NPD strategy, and structure) *and* the marketing - R&D interface.

If a company is experiencing low new product performance, a possible explanation could be that the company scores low on functional 'depth' resources compared to competitors. In this case, top management must try to increase the amount and quality of the company's functional resources (market and technological knowledge, relationships, and assets) or prevent these resources from flowing to other business units. Integration cannot compensate for a lack of these types of resources and therefore increasing integration should not have the highest priority. If a company's resources have been brought to a higher level, increasing integration could become important again to gain some additional new product performance.

Another possible explanation for low new product performance could be the poor fit between the company's NPD strategy and the level of integration. If the company has adopted a high marketing-intensive and low R&D-intensive NPD strategy and suffers from low new product performance, lack of integration could be the cause. In that case, top management could focus on increasing integration, especially when the company lacks blockbusters. Where integration is adequate, top management can focus on increasing resources (as in the first approach) and/ or focus more on a strategic NPD move towards a high marketing and low R&D-intensive strategy, for example by strengthening areas like competitive intelligence and distribution and substituting basic science for a strengthening of applied development.

Finally, with respect to both options, some gains can also come from a reduction in formalization within the company. If the speed and quality of the NPD decision-making process must be increased, lowering centralization is also useful.

Apart from managing integration which is related to communication, collaboration, and joint goals between marketing and R&D, we learned that there is another factor which has to be considered: the relative influence of R&D in the implementation phase. Our study shows that NPD is more and more directed by the 'voice' of marketing. While this is probably a good thing, our study also showed that there are considerable opportunities to increase new product performance by increasing R&D's relative influence in the implementation phase (if there are good and sufficient resources in the company). Specifically, 84% of all companies in the sample attain a score below the desired level.

Our study also offers new insights for managers and consultants who are involved in actually 'improving' the marketing - R&D interface in the company by means of *managerial mechanisms* (cross functional teams, job rotation, the use of information technology, etc.). Overall, we found several managerial mechanisms that are capable of increasing integration or achieving a more balanced relative influence division between marketing and R&D in a specific phase. For example, specific control, interaction, and climate mechanisms have a positive effect on integration and several interaction mechanisms increase R&D's relative influence in the implementation phase. In particular, physical closeness between marketing and R&D has desirable effects on integration and relative influence. However, we also found that managerial mechanisms are at best only part of the solution since they only have a modest relationship with integration and R&D's relative influence in a specific phase. Furthermore, managerial mechanisms have to be picked with care, because several mechanisms seem not to be effective (or effective on only one side of the marketing - R&D dyad).

7.6 Suggestions for future research

In this section we will comment on the findings and put them into the broader

perspective of prior research in the field. Additionally, we will present several topics and approaches for future research.

In the present study, we used a survey to test the comprehensive model of the relationships between variables of the marketing - R&D interface and new product performance. As a result we focused on correlations instead of causalities. More experimental research is needed that should include a manipulation of specific independent variables to study causal effects on different performance measures (for example to study the effect of different combinations of integration and in-depth functional resources). Although this is difficult to accomplish in real companies, recent developments in high-quality business simulations make this possible in a laboratory-style setting (e.g., v. Bruggen, Smidts, and Wierenga 1996). For example, if a person with a marketing background and a person with an R&D background jointly run a company, integration can be manipulated (for example by means of communication constraints, physical distance, or opportunities to socialize) and functional resources can be manipulated (for example by giving specific companies more or less functional resources).

Another opportunity that could bring interesting new insights in this research area is the use of data of a different type. In the present study, an important reason for selecting the pharmaceutical industry was that it is a very 'open' industry. This enabled respondents (informants) to accurately compare their company with similar companies. Using informants is however not ideal and therefore we paid considerable attention to the validation of the scores on specific measures. New insights could come from studies that use mainly factual data to test interface - new product performance models. For example, if factual data is used for specific performance indicators and R&D resources are measured with *factual* indicators such as R&D budgets and number of R&D people it is possible to show the actual value of integration between marketing and R&D in terms of less functional resources needed to attain the same amount of new product performance.

Most earlier studies of the marketing - R&D interface focused on concepts like integration and they did not address the larger content of the marketing - R&D

interface. The present study identified *relative influence in specific* NPD phases as an important new factor in the marketing - R&D interface that operates alongside integration and that affects new product performance as well. More research is needed as to why we find limited evidence of a significant relationship between relative influence in the *initiation phase* and new product performance. Applying the same methodology to another industry where new product development times are shorter may result in more significant effects. In addition, using another research design that involves a manipulation of the relative influence variable (e.g., a field experiment) could result in more variation in relative influence in the initiation phase. In general, future studies should elaborate further on the concept of relative influence and study *how* relative influence is exerted and *how* it affects new product performance. For example, we learned that low levels of relative R&D influence can coexist with a high R&D intensity in the same company. So, in this situation, R&D plays an important role in a company's strategy without being very influential in the NPD process.

The present study focused on company characteristics that affect new product performance. Other factors that may affect new product performance may be located in the environment. Although the present study controlled for environmental differences between companies as far as possible, there is still some variation left in the sample. For example, we explored the effect of national culture indicated by the location of headquarters and the location of the respondent. In order to accomplish this, country scores on individualism, masculinity, power distance, uncertainty avoidance, and time orientation were added to the data set (Hofstede 1980, 1995, Nakata and Sivakumar 1996). The results were disappointing, although this is a finding as well. We found that almost no additional variance in new product performance was explained by Hofstede's cultural dimensions. We conclude that the factors which affect new product performance are more or less universal in global industries. It might be more interesting to study different practices, in the use of different managerial mechanisms in different countries for example.

Only recently has the effectiveness of managerial mechanisms received some empirical attention (e.g., Griffin 1996, Ittner and Larcker 1996a, 1996b). These

studies focused on the effect of managerial mechanisms on time to market and company performance. In addition, there are studies that have focused on the effects of *specific* mechanisms such as teams (for an overview see Cohen and Bailey 1997). Our research shows that several managerial mechanisms are effective in producing integration and changing the relative influence balance between marketing and R&D in specific phases. In future research, more attention should be paid to the effects of managerial mechanisms. Managerial mechanisms are used in almost all companies without proper insights into whether these mechanisms really work. Furthermore, new mechanism are 'invented' every day.

New insights into the effectiveness of managerial mechanisms could come from studies focusing on specific mechanisms and from studies that focus on a broader set of mechanisms. As for the possible differences in effects of managerial mechanisms between marketing respondents and R&D respondents, future studies could use a research design with matched pairs (marketing and R&D respondents from the same company). This would make any possible differences in effects of managerial mechanisms in the marketing respondent sample compared to the R&D respondent sample better attributable to the functional background of the respondent. In addition, using *factual* data on the use of managerial mechanisms could lead to a reduction of measurement error (cf. Pennings 1973, Siedler 1974, and John & Reve 1982).

Our study incorporates a variable for blockbuster performance whereas most studies do not pay attention to blockbusters as an aspect of new product performance. We argue that blockbusters are an important phenomenon in a wide variety of industries such as the motion-picture industry (e.g., the movie Titanic), toys, agriculture, and airplanes. We observed that blockbusters are often related to technological and/or marketing innovations and therefore the marketing - R&D interface plays an important role. More research is needed on this specific form of new product performance and how it can be established. On the basis of our findings, we argue that producing blockbusters depends on many different factors (we only found small betas for predictor variables and therefore we were able to explain less variance in this performance measure than for any other performance measure) and that it requires a different set of resources (only for

blockbuster performance the variable for functional 'depth' resources did not attain a significant beta). Maybe by incorporating variables for other types of (intangible) assets like risk-taking, weak signal amplification, and learning capabilities, new knowledge can be produced with respect to what it takes to produce blockbusters on a regular basis (see for example, Leenders and Janszen 1995).

Appendix I

Introduction letter, reminder, and questionnaire

Rotterdam, March 22nd 1995

Dear Sir or Madam,

As a member of a research team at the Erasmus University Rotterdam, the Netherlands, I am working on an international management study (thesis) entitled:

The interface between Marketing and R&D
in the development of new products.

We decided to choose the pharmaceutical industry as the domain for this study and your name appeared in a scientifically selected sample. Your answers are very important for the accuracy of our research. It will only take a short time to answer the questions using the enclosed questionnaire and to return it in the reply envelope.Of course all answers will be treated confidentially. The questionnaire has an identification number for mailing purposes only.

If you are interested in receiving a summary of the findings of this research, just write "copy of results requested" on the back of the return envelope, and print your name and address below it. Please do not put this information on the questionnaire itself. We will be glad to send you a complimentary report which will give you worldwide industry information about this topic.

Please return the completed questionnaire at your earliest convenience, but please send it to us before April 11th. I would be most happy to answer any questions you might have. Please write or call +31-10-4082383, fax +31-10-2120549, e-mail MLEENDERS@fac.fbk.eur.nl.

Thank you very much for your cooperation.

Sincerely yours,
Mark A.A.M. Leenders
Researcher (PhD Candidate)

March 31, 1995

Last week a questionnaire about the of level integration between Marketing and R&D in your company was mailed to you.

If you have already completed and returned it to us please accept my sincere thanks. If not, please do so today. Because it has been sent to only a small, but representative, sample of managers in the pharmaceutical industry it is extremely important that your answers are also included in the study.

If by some chance you did not receive the questionnaire, or it got misplaced, please let me know right now, and I will send you another one today. Please write or call +31-10-4082383, fax +31-10-2120549, e-mail MLEENDERS@fac.fbk.eur.nl.

Thank you very much for your cooperation.
Sincerely,

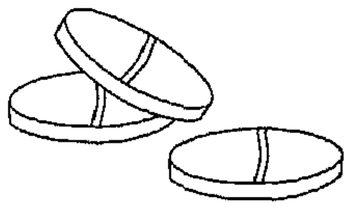
Mark A.A.M. Leenders
Researcher (PhD Candidate)

Worldwide Survey On Integration Between Marketing And R&D In Pharmaceutical Companies

This survey is developed to better understand how Marketing and R&D managers think about a wide variety of issues related to the level of integration between Marketing and R&D in their company. Please answer all of the questions. If you wish to comment on any questions or qualify your answer, please feel free to use the space in the margins. Your comments will be read and taken into account.

Thank you very much for your help.

Requested Time: less than 30 Minutes



Erasmus University Rotterdam
Rotterdam School of Management
Dept. Technology Management & Innovation F2.67
Dept. Marketing Management
3000 DR Rotterdam
The Netherlands

Terminology:

In different companies, different definitions are used to describe Marketing and R&D.

When we use the term Marketing we focus on Marketing and/or Sales. If there is no formal Marketing department in your company, then the Sales department is meant.

With the term R&D we refer to basic and applied research, development activities, clinical testing, etc. carried out in-house or in cooperation with universities, contract research labs, institutes, or small companies.

Before you start answering the questions, please take note of the following remarks:

With your company we only mean the pharmaceutical part of the company. (This is only relevant for companies with other divisions than pharmaceutics)

There are no right or wrong answers, so your first reaction will probably be the best one. Do not think too long.

We are not so much interested in exact numbers (e.g., percentages). Orders of magnitude are much more important.

We are interested in your opinion, do not ask yourself how other people will answer the question.

We are interested in the way the interface between Marketing and R&D operates in your company , so try to think further than the particular department or building you are in.
Did you read the definitions and remarks above? (circle number)

1 YES
2 NO

SECTION 1: PERSONAL BACKGROUND

First we would like to ask you a few questions about the company and yourself.

Q-1 What is the location of Head Quarters of your company?

PLACE_____ COUNTRY_____

Q-2 What is your educational background?(circle number)

1 TECHNICAL (& SCIENTIFIC)
2 ECONOMICS/ BUSINESS
3 TECHNICAL AND ECONOMICS/ BUSINESS
4 OTHER .(specify)_____

Q-3 To what functional area in your company do you belong today? (circle number)

1 MARKETING
2 DEVELOPMENT
3 RESEARCH
4 OTHER (specify)_____

Q-4 Did you work in another functional area before? (circle number)

1 YES specify)_____
2 NO

Q-5 What is your formal job title?

_____

Q-6 What is your age?

_____

Q-7 Did you work for another pharmaceutical company before? (circle number)

1 YES
2 NO

Q-8 Did you work for a non pharmaceutical company before? (circle number)

1 YES
2 NO

Q-9 How interested are you in the subject of the Marketing and R&D interface (tasks on the borderline between Marketing and R&D) ? (circle number)

1 NOT AT ALL INTERESTED
2 SLIGHTLY INTERESTED
3 MODERATELY INTERESTED
4 VERY INTERESTED

Q-10 How frequently do you find yourself thinking about the Marketing and R&D interface (tasks on the borderline between Marketing and R&D)? (circle number)

NEVER OR
ALMOST NEVER 1 2 3 4 5 VERY FREQUENTLY

Q-11 What role do you personally play in the Marketing - R&D interaction? (circle number)

(more than one category is possible)

1 MEMBER OF ONE OR MORE MULTI FUNCTIONAL PROJECT TEAMS
2 MULTI FUNCTIONAL PROJECT TEAM MANAGER
3 PROVIDE INFORMATION TO PEOPLE FROM OTHER FUNCTIONAL DEPARTMENTS
4 COLLECT INFORMATION FROM PEOPLE FROM OTHER FUNCTIONAL DEPARTMENTS
5 PARTICIPATE IN MEETINGS WHERE PEOPLE FROM OTHER DEPARTMENTS ARE PRESENT
6 NO ROLE
7 OTHER:

(specify)_____

SECTION 2: INTEGRATION BETWEEN MARKETING AND R&D (PEOPLE)

In this section we would like you to give your opinion on different aspects of integration in your company. Remember that we are only interested in the pharmaceutical part of your company.

To what extent do you agree or disagree with the following statements?

Q-12 A friendly attitude exists among Marketing and R&D.
(put an X in appropriate box)

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-13 Open communication of relevant information occurs among Marketing and R&D.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-14 Some Marketing and R&D people intentionally provide each other misleading information.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-15 When problems arise, Marketing and R&D search for solutions that are agreeable to each other.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-16 Marketing and R&D are more like teammates than competitors.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-17 If disagreements arise, Marketing and R&D are usually able to resolve them.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-18

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-19 Marketing and R&D help each other to more effectively perform their tasks.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-20 Marketing and R&D often fail to communicate information to each other.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-21 In my company, Marketing and R&D are always blaming each other for failures.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-22 In my company, it is difficult for Marketing and R&D to contact each other.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-23 In my company, conflicts between Marketing and R&D are of a constructive kind.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-24 In my company, Marketing and R&D perceive their problems as mutual problems.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-25 In my company, Marketing and R&D recognise each other's talents and expertise.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-26 In my company, Marketing and R&D share resources to complete tasks.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

To complete this section, we would like you to take an overall look at the level of integration between Marketing and R&D in your company.

Q-27a Taking everything into account, to what extent does integration between Marketing and R&D exist in your company? (circle number)

1 VERY LITTLE
2 SOMEWHAT
3 CONSIDERABLE
5 VERY MUCH

Q-27b Taking everything into account, what level of integration between Marketing and R&D was present in the past (more than 4 years ago)? (circle number)

1 VERY LITTLE
2 SOMEWHAT
3 CONSIDERABLE
4 MUCH
5 VERY MUCH

SECTION 3: ORGANISATIONAL ENTITIES

In this section we would like to know more about organisational entities like project teams, job rotation, training, etc.

First we would like to know more about project teams in your company. Let's take the activities that are undertaken in your company. In a project team, everybody brings in his or her expertise and is also responsible for the total performance of the project team. We use the term project team if people from more than one functional area participate in the project team.

Q-28 Considering our description of project teams, what proportion of all R&D people are members of one or more project teams?
(Please put an X in the appropriate box)

< 5%	5% - 20%	20% - 40%	40% - 60%	60% - 80%	80% - 95%	95%

Q-29 What proportion of all Marketing people are members of one or more project teams?

< 5%	5% - 20%	20% - 40%	40% - 60%	60% - 80%	80% - 95%	95%

Q-30 Of all the people that participate in one or more project teams, in how many project teams do they on average participate at the same time?

ON AVERAGE IN _____ PROJECTS

For the next two questions, we define the person with the overall responsibility of the team as the project manager.

Q-31 What proportion of all project managers have experience in Marketing?

< 5%	5% - 20%	20% - 40%	40% - 60%	60% - 80%	80% - 95%	95%

Q-32 What proportion of all project managers have experience in R&D?

< 5%	5% - 20%	20% - 40%	40% - 60%	60% - 80%	80% - 95%	95%

We would like to know more about job rotation that generally takes place inside your company.

Q-33 What proportion of Marketing personnel has held a job in R&D?

< 5%	5% - 20%	20% - 40%	40% - 60%	60% - 80%	80% - 95%	95%

Q-34What proportion of R&D personnel has held a job in Marketing?

< 5%	5% - 20%	20% - 40%	40% - 60%	60% - 80%	80% - 95%	95%

The next question deals with how different functional areas are physically located in your company buildings.

Q-35 Marketing and R&D are generally located in:
(circle number)

1 THE SAME BUILDING, CROSS FUNCTIONAL (MIXED)
2 THE SAME BUILDING, FUNCTIONAL (GROUPED)
3 THE SAME LOCATION, NOT THE SAME BUILDING
4 THE SAME COUNTRY, NOT THE SAME LOCATION
5 DIFFERENT COUNTRIES

The following questions deal with the remuneration system (salaries, etc.) and the career opportunities.

Q-36 Is the remuneration system in general equal between Marketing and R&D? (circle number)

1 YES, IT IS (ABOUT) EQUAL (GO TO 37)
2 NO, THERE ARE DIFFERENCES

Please make a comparison between the following functional areas.
The remuneration system for R&D is set at 100. So, how good do you think the remuneration system for Marketing is expressed as a number? The higher the number the better the remuneration system (100 = equal with R&D).

R&D 100
MARKETING____

Q-37 Are the career opportunities in general equal between Marketing and R&D?

1 YES, THEY ARE (ABOUT) EQUAL (GO TO 38)
2 NO, THERE ARE DIFFERENCES

Please make a comparison between the following functional areas. The career opportunities for R&D are set on 100. So, how good do you think the career opportunities for Marketing are expressed as a number? The higher the number the better the remuneration system (100 = equal with Research).

R&D 100
MARKETING____

The following question deals with how often people from different functional areas meet each other during training sessions (training sessions include: conferences, seminars, workshops, symposia, etc.)

Q-38 How many days a year does an average R&D and Marketing person have joint training sessions?

_____ DAY(S) A YEAR

Companies sometimes pay attention to giving courses to people from one functional area about topics and developments to people in another functional area.

Q-39 How many days a year does an average Marketing person have training sessions about R&D topics?

_____ DAY(S) A YEAR

How many days a year does an average R&D person have training sessions about Marketing topics?

_____ DAY(S) A YEAR

We are interested in whether or not there is a review board present with people from different functional areas to select and/or monitor R&D projects.

Q-40 Is such a review board present in your company that is in charge of selecting R&D projects? (circle number)

1 YES
2 NO (GO TO 41)

What impact does this review board have on the selection process compared to the influence of functional management? (circle number)

THE FUNCTIONAL MANAGEMENT IS THE MAIN DECISION MAKING BODY	1	2	3	4	5	THE REVIEW BOARD IS THE MAIN DECISION MAKING BODY

Q-41 Is a review board present in your company that is in charge of monitoring on-going R&D projects? (circle number)

1 YES
2 NO (GO TO 42)

What impact does this review board have on go/no-go decisions compared to the influence of functional management and project management? (circle number)

THE FUNCTIONAL MANAGEMENT IS THE MAIN DECISION MAKING BODY	1	2	3	4	5	THE REVIEW BOARD IS THE MAIN DECISION MAKING BODY

THE FUNCTIONAL MANAGEMENT IS THE MAIN DECISION MAKING BODY	1	2	3	4	5	THE REVIEW BOARD IS THE MAIN DECISION MAKING BODY

We would like to know more about the frequency of significant changes in the organisational structure.

Q-42 At what rate do significant changes in the formal structure take place in your company?

1 AT LEAST EVERY TWO YEARS
2 EVERY FOUR YEARS
3 EVERY SIX YEARS
4 EVERY EIGHT YEARS
5 EVERY TEN YEARS OR LESS

We would like to know more about employees that have the formal task to be a direct link (gatekeeper) between two, or three departments.

Q-43 Do such 'linking' people play an important role or do they play absolutely no role at all?

'LINKING' PEOPLE PLAY NO ROLE AT ALL	1	2	3	4	5	'LINKING' PEOPLE PLAY A VERY IMPORTANT ROLE

The following questions deal with whether or not the salary of a manager from one functional area is paid by another functional area.

Q-44 In your company, are managers from one functional area paid by another functional area? (circle number)

1 NO, NEVER
2 YES, SOMETIMES
3 YES, OFTEN

The next question is about sending personnel to a totally different environment to stimulate multi functional group dynamic processes. For example survivals, brainstorm sessions at a deserted location, etc..

Q-45 What proportion of all Marketing and R&D personnel in your company has participated in such activities?

< 5%	5% - 20%	20% - 40%	40% - 60%	60% - 80%	80% - 95%	95%

The following questions encompass a broad range of 'entities'.

Q-46 Have their been significant cost cutting activities in your company lately? (circle number)

1 NO (GO TO 47)
2 YES, MINOR
3 YES, MAJOR

Are the cost cutting activities in general spread equally between Marketing and R&D? (circle number)

1 YES, THEY ARE (ABOUT) EQUAL (GO TO 47)
2 NO, THERE ARE DIFFERENCES

Please make a comparison between the following functional areas. The cost cutting activities for R&D are set on 100. So, how heavy has Marketing been struck by cost cutting activities expressed as a number? The higher the number the heavier the cost cutting (100 = equal with R&D).

R&D 100
MARKETING____

Q-47 Has there been a formal statement by top management in your company concerning the importance of the interaction between marketing and R&D? (circle number)

1 YES
2 NO

Q-48 Are there formal procedures in your company that cover the new product development process from research to marketing? (circle number)

1 YES
2 NO (GO TO 49)

To what extent are these procedures being followed? (circle number)

NEVER 1 2 3 4 5 ALWAYS

The next question is about IT (information technology) related to communication like e-mail, teleconferencing, databases, internet, etc.

Q-49 In your company, is new IT used poorly or effectively? (circle number)

NEW IT IS USED VERY POORLY	1	2	3	4	5	NEW IT IS USED VERY EFFECTIVELY

In the last question of this section, we would like you to take an overall look at the organisational entities in your company.

Q-50 Taking everything into account, to what extent do all the organisational entities in your company stimulate integration between Marketing and R&D? (circle number)

1 VERY LITTLE
2 SOMEWHAT
3 CONSIDERABLE
4 MUCH
5 VERY MUCH

SECTION 4 DECISIONMAKING AND COOPERATION DURING DIFFERENT PHASES OF THE NEW PRODUCT DEVELOPMENT PROCESS

In this part of the questionnaire, different activities / decision points are listed and the following question is asked:

Q-51 Please divide 100 points between the following functional disciplines (R&D and Marketing) in terms of how you perceive the impact on decision making of a particular functional area.

	R&D		Marketing	
Format example	a	+	b	= 100
Selecting therapeutic areas of research	_____		_____	
Setting New Product Development goals and priorities	_____		_____	
Licence in/out decisions of R&D compounds	_____		_____	
Generating new product ideas or NCEs	_____		_____	
Pre-clinical development of new compounds	_____		_____	
Clinical testing	_____		_____	
Positioning the new products in the market	_____		_____	

Developing and implementing a launch plan	_____	_____
Developing and implementing an advertising campaign	_____	_____
Management of sales force	_____	_____
Developing product line expansions	_____	_____
Generating feedback from customers	_____	_____

With the following question we would like you to take a look at the power relations in the past (and in the future). With respect to all the people involved in new product development in the laboratory, what mix of influences has determined their eventual actions? Have they been guided by influences of their R&D peers or by information from the market as transmitted by marketing people?

You only have to answer this question as far back in time as you are able to.

Q-52 Please divide 100 points between the two categories (R&D peers and Marketing people) according to how you perceive the two forces in the new product development process have been (and will be) mixed in your company.

Format example:

a _____

b _____

100 (= a+b)

	PAST			FUTURE	
	-12 YEARS	-8 YEARS	-4 YEARS	TODAY	+4 YEARS
PEERS (R&D)	_____ :	_____ :	_____ :	_____ :	_____
MARKETING	_____ :	_____ :	_____ :	_____ :	_____
	100	100	100	100	100

SECTION 5: INNOVATIVENESS

Apart from integration between Marketing and R&D, we are interested in different aspects of innovative performance (innovativeness) of your company.

Q-53 Please compare your company with firms of comparable size in your industry. The questions about the performance of your company are related to the past five years.

Please circle a number (1=lowest 20% of comparable companies, 5=highest 20%).

	Your company compared to other companies of the same size				
	Lowest 20%				Highest 20%
The number of new products over the past five years has been among	1	2	3	4	5
The number of breakthroughs over the past five years has been among	1	2	3	4	5
The quality of the R&D pipeline over the past five years has been among	1	2	3	4	5
The speed in which new products are developed among	1	2	3	4	5
The cost efficiency of the development of new products among	1	2	3	4	5

The number of new ideas and concepts in research among	1	2	3	4	5
The performance of the products that have been launched over the past five years has been among	1	2	3	4	5
The ability to react to new opportunities over the past five years has been among	1	2	3	4	5
The speed of the decisionmaking process with respect to new products over the past five years among	1	2	3	4	5
The quality of the decision making process with respect to new products over the past five years among	1	2	3	4	5
The commitment to translate decisions into actions with respect to new products over the past five years among	1	2	3	4	5
The overall performance over the past five years has been among	1	2	3	4	5

In this part of this section we are interested in your opinion on the future performance of your company.

Q-54 Please compare the expected performance of your company in the future with the expected performance of comparable companies.

Please circle a number (1=lowest 20% of comparable companies, 5=highest 20%).

Your company compared to other companies of the same size	Lowest 20%				Highest 20%
The number of new products in the next five years will be among	1	2	3	4	5

The number of breakthroughs in the next five years will be among	1	2	3	4	5
The quality of the R&D pipeline in the next five years will be among	1	2	3	4	5
The speed in which new products will be developed in the next five years will be among	1	2	3	4	5
The cost efficiency of the development of new products in the next five years will be among	1	2	3	4	5
The number of new ideas and concepts in research in the next five years will be among	1	2	3	4	5
The performance of the products that will be launched in the next five years will be among	1	2	3	4	5
The overall performance in the next five years will be among	1	2	3	4	5

The following questions about innovativeness are not in comparison with other companies.

Q-55 Please make a characterisation of your company.

How many new compounds (make an estimation) have gone into clinical testing over the last five years?

_____ NEW COMPOUNDS

How many new products did your company produce in the last five years?

_____ NEW PRODUCT(S)

Please estimate how many new NCEs will become ready to market in the next five years.

_____ NEW NCE(S)

How many blockbusters have been produced by your company in the past ten years?

_____BLOCKBUSTER(S)

What is the probability of producing a blockbuster in the next ten years?

_____% PROBABILITY

What is the probability of producing 3 blockbusters in the next ten years?

_____% PROBABILITY

How much sales comes from products that have been introduced in the last five years?

_____% OF SALES

SECTION 6: COMPANY RESOURCES

To compare companies, we need some information about different kinds of company resources.

Q-56 Please compare your company with firms of comparable size in your industry. The questions below focus on the past five years.

With respect to the following resources, please characterise your company.

My company is among the lowest performing 20% (=1) up to my company is among the highest performing 20 % (=5) (circle number)

	my company is among lowest 20%			highest 20%	
The financial reserves	1	2	3	4	5
The sophistication of R&D equipment	1	2	3	4	5
Co-marketing relations	1	2	3	4	5

Cooperative R&D relations	1	2	3	4	5
Modern buildings and plants	1	2	3	4	5
Top scientists	1	2	3	4	5
Database and library facilities	1	2	3	4	5
The production capacity	1	2	3	4	5
Goodwill at medical institutes	1	2	3	4	5
Knowledge of competitors	1	2	3	4	5
Relations with governmental bodies	1	2	3	4	5
Contacts with top universities in relevant fields	1	2	3	4	5
Contacts with top medical specialists in the world	1	2	3	4	5
Worldwide market information	1	2	3	4	5

Q-57 Please make an estimation about the following resources of the pharmaceutical part of your company.

How many employees does your company have? (i.e. the pharmaceutical part)

_____ PEOPLE

How many marketing people does your company employ? (i.e. the pharmaceutical part)

_____ MARKETING PEOPLE

What is the size of the worldwide salesforce? (i.e. the pharmaceutical part)

_____ SALES PEOPLE

How many R&D people does your company employ? (i.e. the pharmaceutical part)

_____ R&D PEOPLE

What is the estimated yearly marketing budget (in million dollars)? (i.e. the pharmaceutical part)

_____ X MILLION DOLLARS

What is the yearly R&D budget (in million dollars)? (i.e. the pharmaceutical part)

_____ X MILLION DOLLARS

What is the total amount of assets that your company has (in million dollars)?

(i.e. the pharmaceutical part)

_____ X MILLION DOLLARS

What are the total revenues (sales) of your company? (i.e. the pharmaceutical part)

_____ X MILLION DOLLARS

SECTION 7: YOUR COMPANY

In this final section, we would like to get to know more about your company.

Q-58 Please make a profile of the pharmaceutical part of your company based on the following attributes. (circle number)

My company is competing in many market segments	1	2	3	4	5	My company is competing in a few market segments
My company is competing with a broad range of products	1	2	3	4	5	My company is competing with a small range of products
My company is a Research intensive company	1	2	3	4	5	My company is not involved in Research
My company is a Development intensive company	1	2	3	4	5	My company is not involved in Development
My company is a Marketing intensive company	1	2	3	4	5	My company is not involved in Marketing
My company is active on prescription market only	1	2	3	4	5	My company is active on non-prescription market only
My company is a large sized company	1	2	3	4	5	My company is a small sized company
My company is a global company	1	2	3	4	5	My company is a local company

Q-59 Looking at the innovation process in your company, from new idea to customer, what concept describes the way of operation in your company most accurately? Please divide 100 point between the following three categories.

FUNCTIONAL ORGANISATION: THE ACTIVITIES ARE DIVIDED INTO SUB ACTIVITIES THAT ARE HANDED OVER TO FUNCTIONAL DEPARTMENTS.

MATRIX ORGANISATION: A PROJECT MANAGER IS COUPLED TO A PROJECT AND HE IS, TOGETHER WITH A FUNCTIONAL MANAGER, RESPONSIBLE FOR THE PROJECT.

PROJECT ORGANISATION: A PROJECT MANAGER IS IN CHARGE OF A PROJECT TEAM THAT INCLUDE MEMBERS OF DIFFERENT FUNCTIONAL AREAS.

Total =100

The following questions are related to the level of formalisation and centralisation in your company.

Q-60 In my company, formal procedures are followed before making a decision. (put an X in the appropriate box)

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-61 In my company, many paper forms are used.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-62 In my company, decision making responsibilities belonging to a job are described in detail.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-63 In my company, employees have detailed task descriptions.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-64 My company has a flat organisational structure.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-65 In my company, departments possess a large autonomy.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-66 In my company, many decisions are taken low in the hierarchical structure of the organisation.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-67 The organisation of my company is very centralistic.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-68 Making decisions in my company is strongly bound to hierarchical lines.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Q-69 In my company, most decisions have to be approved by higher management.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

The last three questions deal with the extent to which your company is divided into smaller parts.

Q-70 How many units are located directly under the top management (chief executive) level of the pharmaceutical part of your company?

_____ UNITS

Q-71 Please make an estimation about the number of therapeutic areas (like cancer, cardiovascular, antibiotics, etc.) in which your company is active in R&D.

_____ THERAPEUTIC AREAS

Q-72 Please make an estimation about the number of therapeutic areas (like cancer, cardiovascular, antibiotics, etc.) in which your company is active in Marketing.

_____ THERAPEUTIC AREAS

Q-73 In how many places is your company physically located in the world (Marketing, Sales, R&D offices with more than 10 people)? (circle number)

1	A TOTAL NUMBER OF	1	-	5
2	A TOTAL NUMBER OF	5	-	10
3	A TOTAL NUMBER OF	10	-	25
4	A TOTAL NUMBER OF	25	-	50
5	A TOTAL NUMBER OF	50	-	75
6	A TOTAL NUMBER OF	75	-	100
7	MORE THAN 100			

Please feel free to give any comments.

Your contribution is greatly appreciated. If you would like a summary of the results, please print your name and address on the back of the return envelope (NOT on this questionnaire). We will ensure that it is forwarded to you.

Mark Leenders

Appendix II

Descriptive statistics for managerial mechanism variables

Descriptive statistics for managerial mechanism variables

Variable	Mean	Std.dev	1	2	3	4	5	6	7	8	9	10	11	12
1. PHYSCLOS	3.25	1.00	1.00											
2. INFTECH	3.09	1.03	-.07	1.00										
3. PRJMAN_M	2.99	1.72	.14	.03	1.00									
4. PRJMEM_R	3.67	1.52	.01	.09	-.03	1.00								
5. PRJMEM_M	3.86	1.88	.05	.11	.34	.40	1.00							
6. JOBROT_R	1.41	.68	.12	-.01	.15	.02	-.08	1.00						
7. JOBROT_M	1.77	1.02	-.05	.04	.03	.09	.21	.13	1.00					
8. EQCAREER	.53	.50	.12	-.02	-.02	.08	-.07	.14	.13	1.00				
9. EQSALARY	.56	.50	.11	.10	.19	.16	.18	.15	.14	.46	1.00			
10.EQCOSTC	.65	.48	.20	.06	.05	.02	.07	-.08	-.09	.16	.06	1.00		
11.REVBOARD	.83	.38	-.21	-.05	-.10	.05	.11	-.11	.06	-.03	-.08	.11	1.00	
12.FORMPROC	.84	.36	-.16	-.02	-.06	.04	-.05	-.06	-.11	-.15	-.13	-.10	.25	1.00
13.LIAISON	3.02	1.19	-.09	-.05	-.09	-.03	-.12	-.02	.12	.09	-.04	.06	.12	.25
14.CROSPAY	1.28	.49	.13	.04	-.07	-.04	-.02	.14	-.02	-.01	-.07	-.02	.10	.07
15.SURVIVAL	2.49	1.81	.11	.03	.18	.08	.32	.09	.06	.09	.04	.10	-.01	.01
16.STATMENT	1.71	.46	.08	.16	.04	-.04	-.05	-.01	-.21	-.11	.01	.08	.17	.29
17.MONBOARD	1.79	.41	-.11	-.00	-.13	.14	.07	.02	-.06	.00	.10	.00	.28	.29

(continued)

Variable	Mean	Std.dev.	13	14	15	16	17
13 LIAISON	3.02	1.19	1.00				
14.CROSPAY	1.28	.49	.08	1.00			
15.SURVIVAL	2.49	1.81	.11	.14	1.00		
16.STATMENT	1.71	.46	.00	.11	.00	1.00	
17.MONBOARD	1.79	.41	.19	-.11	.14	-.10	1.00

Appendix III

List of variables

List of variables

Variable name	Description	Question number
	Integration between marketing and R&D	
INTEGRAT	Composite variable for integration between marketing and R&D	Q12-26
TOTINT	Single item indicator for integration Q27a	
TOTINT-4	Single item indicator for integration four years ago	Q27b
Relative influence of marketing and R&D		
INITINFL	Composite variable for R&D's relative influence in the initiation phase (relative to marketing)	Q51
IMPLINFL	Composite variable for R&D's relative influence in the implementation phase (relative to marketing)	Q51
INFLDIFF	Composite variable for the overall influence difference between marketing and R&D in the NPD process	Q51

Managerial mechanisms (alphabetical order)		
CROSPAY	Use of cross functional payment systems	Q44
CROSTRAIN	Composite variable for cross functional training	Q38-39
EQCAREER	Equal career opportunities	Q37
EQCOSTC	Equal cost cutting	Q46
EQSALARY	Equal salary opportunities	Q36
FORMPROC	Presence of formal NPD procedures	Q48
NFTECH	Use of new Information Technology	Q49
JOBROT_M	Proportion of marketing managers involved in job rotation	Q33
JOBROT_R	Proportion of R&D managers involved in job rotation	Q34
LINKING	Formal liaison roles	Q43
MGREXP_M	Proportion of project managers with marketing experience	Q31
MGREXP_R	Proportion of project managers with experience in R&D	Q32
MONBOARD	Presence of a cross functional (CF) monitor board	Q41
PHYSCLOS	Physical closeness	Q35
PRJMEM_M	Proportion of marketing managers member of CF team	Q29
PRJMEM_R	Proportion of R&D managers member of CF team	Q28
REVBOARD	Presence of a CF review board	Q40
STATMENT	Top management statement	Q47
SURVIVAL	Proportion of managers sent on survival meetings	Q45
The organizational context		
CENTRAL	Composite variable for centralization in the company	Q64-69
FORMAL	Composite variable for formalization in the company	Q60-63
MKINTENS	Composite variable for the extent of marketing intensity in the company's NPD strategy	Q58
RDINTENS	Composite variable for the extent of R&D intensity in the company's NPD strategy	Q58
RESOURCES	Composite variable for the amount and quality of (functional) 'depth' resources	Q56

New product performance		
BLOCKPERF	Composite variable for the (proven) ability to produce blockbusters	Q55
FUTPERF	Composite variable for the expected future new product performance (next 5 years)	Q54
OUTPERF	Composite variable for the output of the NPD process	Q53
PROCPERF	Composite variable for the speed and quality of the NPD process	Q53
NEW_COMP	Number of new compounds entering clinical trials	Q55
NCE	Number of New Chemical Entities	Q55
NEW_PROD	Number of new products	Q55

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Samenvatting
(Summary in Dutch)

In deze dissertatie staat de relatie tussen de marketing - R&D interface - ofwel het raakvlak tussen marketing en R&D - en de prestaties van bedrijven met betrekking tot nieuwe producten centraal.

De marketing - R&D interface wordt in de literatuur gezien als een belangrijke factor die gerelateerd is aan het succes of falen van nieuwe producten. In het bijzonder, integratie tussen marketing en R&D wordt gezien als een factor die belangrijk is voor succes: de rationale van vandaag is dat hoe meer integratie tussen marketing en R&D, hoe meer succes.

In deze studie houden we ons bezig met de vraag *of* en *hoe* integratie en andere factoren in de marketing - R&D interface het succes van nieuwe producten beïnvloeden. Deze specifieke vraag wordt onderzocht op het niveau van het bedrijf en is belangrijk omdat er enkele studies zijn op dit niveau waaruit het positieve verband tussen integratie en het succes van nieuwe producten niet duidelijk naar voren komt. Blijkbaar zijn er andere factoren belangrijker en/of zijn er specifieke factoren die de relatie tussen integratie en succes beïnvloeden. Wat dit laatste betreft, besteden we in dit onderzoek aandacht aan het samenspel tussen 'diepte' resources in de specifieke functionele gebieden en 'integratie' tussen functionele gebieden. Verder worden bedrijven met verschillende strategieën bestudeerd waarbij gekeken wordt of er strategieën zijn met een dermate lage onderlinge afhankelijkheid tussen marketing en R&D dat integratie bijna niets toevoegt - of erger - meer kwaad doet dan goed met betrekking tot de prestaties van nieuwe producten (NPP).

Een tweede factor in de marketing - R&D interface die onderzocht wordt in dit onderzoek heeft te maken met 'macht' en 'controle' van marketing en R&D in verschillende fasen van het product ontwikkel proces. Uit onderzoek op het gebied van distributie kanalen en besluitvorming in groepen blijkt namelijk dat belangrijke aspecten van integratie zoals communicatie, samenwerking en het hebben van gelijke doelen in grote mate onafhankelijk zijn van macht en controle (relatieve invloed genoemd vanaf nu). Aangezien dit een nieuwe factor binnen

de interface betreft, ligt in deze dissertatie de nadruk op het meten van relatieve invloed en op het onderzoeken of er een relatie bestaat tussen relatieve invloed in specifieke fasen van het NPD proces en het succes van nieuwe producten.

Tenslotte wordt in deze dissertatie veel aandacht besteed aan de vraag hoe de marketing - R&D interface kan worden gemanaged. Hierbij staan management mechanismen centraal waarbij te denken valt aan gebruik van project groepen, functie rotatie, informatie systemen, informele bijeenkomsten in de vorm van brainstorm sessies en survivals, etc. (voor een volledig overzicht zie Appendix 3, er wordt een onderscheid gemaakt tussen controle mechanismen, interactie mechanismen en klimaat mechanismen).

In hoofdstuk 1 wordt de literatuur op het gebied van NPP en de marketing - R&D interface besproken. Hieruit komt naar voren dat het meten van het succes van nieuwe producten op veel problemen stuit. Duidelijk is wel dat het succes van nieuwe producten bestaat uit meerdere dimensies die eigenlijk naast elkaar bekeken moeten worden (in dit onderzoek kijken we naar proces, output, blockbusters en verwachtingen met betrekking tot de komende vijf jaar). Verder worden er in de literatuur verschillende conceptualiseringen en operationalisaties van integratie tussen marketing en R&D gebruikt die niet of weinig met theorie zijn onderbouwd. Wel is er een algemene tendens in de literatuur waar te nemen dat integratie positief is voor het succes van nieuwe producten. Vanuit de literatuur over distributie kanalen en besluitvorming in groepen blijkt verder dat macht en controle een effect hebben op prestaties in het algemeen (bijvoorbeeld de prestaties van een distributie kanaal zijn nauw gerelateerd aan de verdeling van macht en controle over de verschillende actoren in de keten).

In het model wordt de relatie tussen verschillende aspecten van de marketing - R&D interface (integratie en relatieve invloed) en de prestatie van bedrijven met hun nieuwe producten (NPP) geplaatst in een breder kader van factoren in de organisatorische context die ook NPP kunnen beïnvloeden ('diepte' resources, organisatie structuur en nieuwe product strategie, zie p.23).

In hoofdstuk 3 wordt de onderzoeksopzet gepresenteerd, de variabelen in het model geoperationaliseerd en de meetschalen op betrouwbaarheid en validiteit onderzocht. Als dataverzamelingsmethode is gekozen voor een internationale pen en papier survey in de farmaceutische industrie. Hierbij zijn senior marketing en R&D personen gevraagd om een vragenlijst in te vullen. Tevens waren de

vragenlijsten voorzien van een nummer zodat feitelijke gegevens over het bedrijf in een later stadium toegevoegd konden worden. Na twee mailings en een reminder was de uiteindelijke response ongeveer 21% wat bevredigend is voor dit soort onderzoek. Omdat er verder weinig aanwijzingen waren voor een problematische non-response bias werd de data geschikt bevonden voor het toetsen van het model.

Hoofdstuk 4 luidt het begin in van het tweede deel van de dissertatie: de resultaten. Eerst worden de relaties tussen de constructen in de marketing - R&D interface bestudeerd in 'isolatie' van de rest van het model. Daarbij wordt o.a. het effect van managerial mechanismen bestudeerd. Hieruit komen drie belangrijke conclusies naar voren: (1) zowel control, interactie en klimaat mechanismen vergroten integratie enigszins, (2) sommige mechanismen hebben een sterker effect dan anderen, (3) mechanismen kunnen verschillend werken voor verschillende kanten van de marketing - R&D relatie: wat marketing als positief ziet voor integratie, hoeft niet als positief gezien te worden door personen met een R&D achtergrond.

De tweede helft van hoofdstuk 4 beslaat de analyse met betrekking tot de relatieve invloed van marketing en R&D in verschillende fasen van het product ontwikkel traject. Hieruit blijkt dat R&D over het algemeen dominant is in de initiatie fase en dat marketing sterk dominant is in de implementatie fase van het nieuwe product ontwikkel proces. Verder is er een lichte overschatting van 'eigen' invloed door beide partijen. Daarna wordt ook het effect van management mechanismen op relatieve invloed bestudeert. Het blijkt dat management mechanismen in het algemeen (klimaat mechanismen in mindere mate) de hoeveelheid relatieve invloed van de dominante partij verminderen. Iets wat belangrijk kan zijn indien blijkt dat de marketing en R&D invloed in een specifieke fase te hoog, dan wel te laag is.

In hoofdstuk 5 worden de effecten van verschillende factoren in de marketing - R&D interface op het succes van nieuwe producten van bedrijven onderzocht. Tevens wordt gekeken of er niet-lineaire verbanden zijn voor zowel integratie als relatieve invloed. Uit de analyse blijkt dat er inderdaad een positieve relatie is tussen integratie en NPP. Deze relatie is echter niet erg sterk (maar wel lineair dus meer integratie is beter). Uit de analyse met betrekking to relatieve invloed blijkt dat - zoals verwacht - de nadruk ligt op niet-lineaire verbanden: er bestaat

een optimale verdeling van relatieve invloed tussen marketing en R&D, namelijk die waar NPP het hoogst is. Deze optimale verdeling is echter vooral waarneembaar in de implementatie fase. Tevens blijkt dat R&D's relatieve invloed in deze fase gemiddeld te laag is. In de initiatie fase is de relatie tussen relatieve invloed en NPP veel minder sterk: alleen voor de prestaties van het NPD proces (snelheid en kwaliteit van NPD besluitvorming) wordt een significante omgekeerde U functie gevonden. Gemiddeld is de relatieve invloed in deze fase in de bedrijven in de studie echter op een juiste manier verdeeld.

In hoofdstuk 6 wordt het complete model en de belangrijkste relaties daarin getest. Eerst wordt gekeken of het effect van integratie waarneembaar is naast de effecten van de factoren in de organisatorische context ('diepte' resources, structuur en strategie). Het blijkt dat dit niet het geval is. Hieruit concluderen we dat integratie geen additioneel effect heeft naast de effecten van deze contextuele factoren. Dit wil echter niet zeggen dat integratie niet belangrijk is: misschien werkt integratie op een andere manier. Om dit te testen is een multiplicatief model geschat met behulp van een regressie model met interactie termen. Integratie wordt gemodelleerd als zijnde een factor met een multiplicatieve werking op 'diepte' resources. Het blijkt dat de interactie tussen integratie en 'diepte' resources inderdaad significant is. Dit wil zeggen dat integratie een aanjaag functie heeft op resources waaruit geconcludeerd wordt dat indien een bedrijf laag scoort op 'diepte' resources, integratie geen effect heeft. Dit fenomeen blijkt zich ook af te spelen met betrekking to relatieve invloed in de implementatie fase waaruit geconcludeerd wordt dat in het algemeen het effect van factoren in de marketing - R&D interface beschouwd moeten worden in samenhang met 'diepte' resources. Daarna wordt het effect van integratie bestudeerd in relatie tot de product ontwikkel strategie van het bedrijf. We verwachtten van tevoren het sterkste effect van integratie op NPP bij bedrijven met een hoge marketing intensiteit en lage R&D intensiteit en het zwakste effect bij de omgekeerde groep. De verwachting was dat bij de bedrijven in de eerste groep de onderlinge afhankelijkheid tussen marketing en R&D het grootst zou zijn. Uit de analyse volgen sterke aanwijzingen dat het effect van integratie inderdaad verschilt per strategie (de drieweg interactie tussen marketing intensiteit, R&D intensiteit en integratie is significant). Voor een aantal prestatie maten is het interactie effect tussen integratie en NPD strategie (bijna) significant.

Na bestudering van de aard van de interactie blijkt inderdaad dat bij bedrijven met een combinatie van marketing intensief en niet-R&D intensief, het sterkste effect van integratie geconstateerd kan worden. Het effect van integratie is het zwakst en soms zelfs negatief voor bedrijven met een gecombineerde hoge R&D intensiteit en een lage marketing intensiteit. Kortom, deze vindingen geven een tweede indicatie waarom integratie soms geen effect heeft op NPP: de strategie van het bedrijf kan een dermate lage onderlinge afhankelijkheid van marketing en R&D met zich meebrengen dat integratie geen effect heeft of zelfs meer kost dan oplevert.

In het laatste deel van de dissertatie worden de resultaten van deze studie op een rij gezet en geïntegreerd. We concluderen dat de marketing - R&D interface - en in het bijzonder integratie en een adequate relatieve invloed verdeling tussen marketing en R&D - een positief effect hebben op NPP maar dat dit effect samenhangt met een aanjaag effect op 'diepte' resources. Verder wordt de rol van een bedrijf's NPD strategie in samenhang met integratie bekeken: er zijn strategische groepen waar integratie meer of minder effect heeft. We beëindigen het laatste hoofdstuk met enkele beperkingen van het onderzoek en de management implicaties. Verder worden enkele interessante gebieden voor toekomstig onderzoek besproken. Deze zijn te vinden op het gebied van andere onderzoeksmethoden zoals een experiment waarbij integratie en 'diepte' resources worden gevarieerd in een simulatie game waarin marketing personen en R&D personen beslissingen nemen, meer longitudinaal onderzoek naar dynamiek in interface processen en het gebruik van andere data (o.a. meer feitelijke indicatoren die de 'waarde' van integratie in termen van bijvoorbeeld geld weergeven). Ook is meer onderzoek nodig naar relatieve invloed. Deze interface factor is in het huidige onderzoek geoperationaliseerd en geïdentificeerd als een factor die mede NPP bepaalt. Meer onderzoek is nodig naar hoe relatieve invloed wordt uitgeoefend en via welke processen het een effect heeft op NPP.

Curriculum Vitae

Mark Leenders was born on 16th November in Veldhoven. He received his Atheneum-B certificate from the Jacob Roelants Lyceum in Boxtel in 1986. He studied Industrial Engineering and Management Science at the University of Technology in Eindhoven where he specialized in Operations Research and Statistics. His final project was on interface management at the Royal Dutch/ Shell company. In 1992 he started a Ph.D. project at the Erasmus University Rotterdam as a member of two departments: Marketing Management and Management of Innovation. Since 1996 he is Assistant Professor of Marketing Management specializing in design and marketing of new products. He teaches at the Faculty of Business Administration, the Rotterdam School of Management (RSM), the Maastricht Academy, the Leiden/Amsterdam Center for Drug Research, and the International Executive Development Center (Slovenia). His research interests lie in the areas of marketing strategy, marketing organization, new product performance, and new product design.

STELLINGEN

behorende bij het proefschrift

The Marketing - R&D Interface and New Product Performance

a study in the pharmaceutical industry

van

Mark A.A.M. Leenders

Erasmus Universiteit Rotterdam
25 juni 1998

I

Integratie tussen marketing en R&D als zodanig staat niet garant voor betere prestaties van bedrijven met betrekking tot nieuwe producten: integratie dient gecombineerd te worden met voldoende diepte resources binnen elk van de functionele gebieden.
(Dit proefschrift)

II

De mate waarin integratie meerwaarde heeft voor een bedrijf, is afhankelijk van de innovatie strategie van het bedrijf.
(Dit proefschrift)

III

Onderzoek naar integratie tussen marketing en R&D op bedrijfsniveau is ten onrechte achter gebleven bij onderzoek naar integratie binnen teams.
(Dit proefschrift)

IV

Behalve voor integratie is meer aandacht nodig voor de machtsbalans tussen marketing en R&D tijdens beslissingen en activiteiten in verschillende fasen van het innovatie proces.
(Dit proefschrift)

V

In de farmaceutische industrie dient R&D meer invloed te krijgen in beslissingen en activiteiten die gerelateerd zijn aan de marktintroductie en het management van nieuwe producten.
(Dit proefschrift)

VI

Begrippen zoals integratie en marktoriëntatie dienen eerst geoperationaliseerd, meetbaar gemaakt en onderzocht te worden voordat organisaties proberen veranderingen door te voeren op deze gebieden.
(Mede dit proefschrift)

VII

De file berichten in Nederland, waarbij files worden gespecificeerd in het aantal kilometers, zijn te product georiënteerd. Bij een marktgerichte, probleem oplossende aanpak zouden de effecten voor automobilisten centraal staan en zouden de meldingen zich richten op bijvoorbeeld de te verwachten vertraging en op geschikte alternatieven.

VIII

Het feit dat er beroepsgokkers zijn geeft aan dat het woord gokken vaak niet op zijn plaats is.

IX

De term Kop van Zuid is geen goede benaming en moet vervangen worden door Centrum.

X

De strategie van Philips waarop financiële analisten al enige tijd wachten is al jaren bekend: de Champions League, het landskampioenschap en de beker.

XI

Individuele beleggers en de beleggingswereld als geheel zijn intern georiënteerd.

XII

Differentiatie is een onvermijdelijk gevolg van integratie.