# How The Impact Of Integration Of Marketing And R&D Differs Depending On A Firm's Resources And Its Strategic Scope

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# How the Impact of Integration of Marketing and R&D Differs Depending on a Firm's Resources and its Strategic Scope

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**Abstract**

Increasing the integration of marketing and R&D is widely recognized as an approach to improve the new product performance (NPP) of companies. However, empirical evidence for the positive effect of integration on NPP, especially at the corporate level, is mixed. This study provides a comprehensive theoretical underpinning of the conditions that influence the benefits that can be obtained from more integration.

A model of the effect of integration on NPP, in conjunction with a company's resources and strategic scope, is developed and tested with data from a worldwide sample of companies in the pharmaceutical industry (n = 148). Our results show that the effect of integration is indeed dependent on the situation. In particular it depends on the company's underlying resources (i.e., specialized knowledge and assets): integration multiplies the positive effect of resources on NPP. The *strength* of the multiplication effect is in turn dependent on strategic scope. It is strong if the strategic scope is narrow, i.e., for companies with selective products in a few market segments. Our results imply that, when trying to improve NPP, management should not invariably think of increasing integration. Instead, they should evaluate the company's resource (dis)advantages, its strategic scope, and the level of integration. If the company scores low on resources, increasing integration should not be a high priority. Additionally, integration is most important for companies with a narrow strategic scope where the interdependency between marketing and R&D is relatively strong.

*(Marketing–R&D Interface; New Product Performance; Resources; Strategic Scope)*

## 1. Introduction

When companies focus on new products to grow their business, they are becoming aware that developing successful new products is not an easy matter. Many difficulties in new product development (NPD) arise from the fact that knowledge and skills from different parts of the organization, especially from marketing and R&D, have to be linked to be successful (e.g., Lawrence and Lorsch 1967, Gupta, Raj and Wilemon 1985, 1986, Griffin and Hauser 1996, Olson, Walker, Ruekert, and Bonner 2001). For example, when Motorola introduced its new mobile phones, the company missed the first wave in the cellular business due to problems with technology selection and subsequent market timing. The company was led to undertake a major restructuring to better coordinate marketing and R&D to prevent problems in the future (*Business Week, May 1998*). In the pharmaceutical industry, the company Allergan faced a big challenge when its best selling products went off patent and its new products showed disappointing performance because of stiff competition from new surgical techniques and other technologies. As a response, the company gave a lot of attention to further integrating marketing and R&D in order to develop more successful new products (*Scrip Magazine, March 1996*). At the same time, the benefits obtained from increased integration of marketing and R&D are not always clear to those involved. In the Scrip Magazine article, the R&D director of Allergan sounds skeptical when he states that: "Consulting battalions are wandering across the corridor, implementing a new order based on cross functional processes."

In general, the idea is widely accepted that increasing the integration of marketing and R&D, is beneficial to a company. Griffin and Hauser (1996), state after reviewing the literature that "The evidence is strong, consistent, common across a variety of methodologies, and seemingly applicable to both services and products and in

both consumer and industrial markets." As a result, stimulating the level of integration of marketing and R&D has become a very important management challenge.

In this study, we build on the literature that highlights the importance of integration of marketing and R&D for new product performance. The aim of this study is to address the following question: For what type of companies is integration most important? This question resulted from two observations. First, seminal organizational studies on integration such as Lawrence and Lorsch (1967) do not really support the broad claim that integration has a general positive effect on performance. Their study suggests that integration has specific benefits that are useful in particular situations. In the container industry, for example, there was no evidence that integration efforts served a useful purpose because there was little uncertainty in the environment that created a need to cooperate. Second, research on the effects of integration of marketing and R&D not always provides support for a robust positive effect on NPP (see for example Norton, Parry and Song 1994, Gatignon and Xuereb 1997, Henard and Szymanski 2001). Interestingly, this is often attributed to how integration is measured or the industry context in which it is studied.

We argue that there is a need for a comprehensive theoretical underpinning that helps to explain the range of empirical findings that have been reported so far. Our underpinning is based on applying the contingency approach. More specific, we argue that the effect of integration of marketing and R&D is inherently dependent on the properties of the underlying parts that are integrated. While there will be organizations for which more integration is very valuable, there will be others for which this is not the case. Increased integration could even result in lower performance if the benefits do not outweigh the costs or if the focus on integration distracts management from other more important issues.

**Defining Integration of Marketing and R&D**

Kahn and Mentzer (1998) show that there is a range of approaches to defining integration. At one side of the range, there are studies that define integration simply as communication or interaction frequency. This approach does not take into account the type of information that is shared and how the information is used. At the other side of the range, there is the view that takes a comprehensive approach to integration. For example, Gupta et al. define integration as information sharing and involvement and Kahn and Mentzer (1998) focus on cooperation and interaction.

In this study, we take a comprehensive approach and define integration as the degree to which there is communication, collaboration, and a cooperative relationship between marketing and R&D (cf. Pinto and Pinto 1990, Pinto, Pinto and Prescott 1993). In line with studies such as Pinto et al (1993), we consider this construct as a one-dimensional construct. This assumption will be validated in the empirical study.

The effect of integration of marketing and R&D can be studied at different levels in the organization, for example at the team level or at the corporate level. A team is a temporary organizational structure in which people from different functional areas are brought together to accomplish a specific set of goals. The team members are interdependent and each member needs to contribute in order for the team to reach its goal. Because of the obvious interdependencies, it can be expected that the positive effect of integration on new product performance is robust, although the level of innovativeness and the phase of the project may condition the relationship somewhat (Olson et al, 2001). On the other hand, a company as a whole offers a setting where a broad range of resources and goals have to be balanced. In such a setting, integration is likely to be only one of many determinants of new product performance. Apart from

investments in integration (for example, by means of physical relocation, cross functional team structures, and job rotation), companies can also change their NPD strategy or acquire new resources in factor markets (e.g., hiring top scientists in specific fields). Overall, we expect that the importance of integration at the corporate level (or the division or SBU level) is to a considerable extent dependent on specific conditions, possibly even more so than at the project team level.

Our research focuses on the corporate level but it is also of interest for the project team level because it provides a comprehensive understanding of how integration works. Apart from its broader application to other levels, research on the marketing – R&D interface at the corporate level is important because the decision to increase integration often involves the organization at large, as can be seen by the examples of Motorola and Allergan. Additionally, a considerable amount of NPD work does not take place in project teams but in other organizational settings such as functional or matrix structures where people of the same functional areas work together (e.g., Allen 1977). In addition, while it is interesting to know what determines the success of individual new products, it is also important to find out what makes the corporate portfolio of new products successful. The stock market, for example, values the performance of the company's whole flow of new products over a longer period of time.

The article is organized as follows. First, a comprehensive model is developed that describes how the marketing-R&D interface affects new product performance of companies. Next, the constructs in this model are defined and operationalized, and the research methodology and the data collection procedure are presented. We chose a particular industry – pharmaceuticals – as an empirical setting, and collected data through an international survey, with 148 responding companies worldwide. Finally, the

results and conclusions are elaborated upon and the managerial implications are discussed.

## 2. Earlier Research

A large stream of research on new product performance have shown that factors from both marketing and R&D are important (e.g., Zirger and Maidique 1990). Recently, Dutta, Narasimhan and Rajiv (1999) argued on the basis of an empirical study that companies need to excel at two things: the ability to come up with innovations constantly and the ability to commercialize these innovations into the kind of products that capture customer needs and preferences. As a result, they emphasize the importance of coordination between R&D and marketing.

In an early study, Gupta et al. (1986) already developed a conceptual model in which the marketing-R&D interface is linked to innovation success. They argued that there is a possible integration gap between marketing and R&D (a difference between the need for integration and integration achieved) that affects innovation success, and the larger the gap, the lower the innovation success. Note that the integration gap is the *only* factor that affects new product performance in their model. Empirical research verified the existence of the integration gap, which proved to be more the rule than the exception (Gupta et al. 1985, 1987).

After the integration gap was identified and analyzed, studies on different levels in the organization were conducted to link integration to new product performance. In project teams, the positive effect of integration is quite robust. Studies such as Pinto et al. (1993) found that higher levels of integration lead to better task outcomes and more desirable psychosocial outcomes. Souder (1988) found that the greater the harmony between marketing and R&D, the greater the likelihood of success. Song and Parry

(1997a) studied 788 new product projects in 404 Japanese firms. The results showed that integration had the largest total effect on new product success. In another study, Song and Parry (1997b) argue that “the results are consistent across U.S. and Japanese new product projects.” So, under a broad range of circumstances, achieving integration in teams seems to be important for the success of the team.

At the corporate level, the empirical research on the relationship between integration and new product performance is somewhat mixed. On the one hand, Cooper (1984) found support for a positive relationship between integration and performance. Parry and Song (1993) and Norton, Parry and Song (1994), however, provide mixed evidence for a positive relationship between integration and innovation success. These studies found a positive relationship only for specific groups of companies or for specific measures of integration and new product success. The results of Gatignon and Xuereb (1997) are not conclusive either. In a survey among companies in a broad range of industries, they found almost no indication for an effect of integration on innovation performance. They conclude that “the effect of inter functional coordination appears limited.”

Recently, Henard and Szymanski (2001) presented a review of 41 empirical studies covering both the project level and the corporate level that studied one or more antecedents to new product performance. Fifteen studies included a measure of integration and the corrected mean correlation between cross functional integration and new product performance was $r = .23$, not significant at a $p < .05$ level. They argue that the low impact of integration may be related to measurements (e.g., multi item versus single item, subjective versus objective, and short-term versus long-term data), and contextual factors (e.g., country, type of industry).

How can the different nature of the effects of integration be explained? Apart from the measurement issue, we argue that based on Dutta et al. (1999) one can ask the question: What if the marketing and/or R&D capability is poor? What if the company operates in a field where specialized capabilities such as top scientists are needed whereas the organization does not possess the resources to hire them? Integration of marketing and R&D might not be of great help in a situation where one or both of these two elements is too low. The research of Henard and Szymanski (2001) points to an additional explanation for the lack of observed effects of the integration between marketing and R&D. They state that the quality, focus, and timing of integration may be critical. Olson et al. (2001) and others have specified factors such as innovativeness and the phase in the NPD process as intervening factors that play a role. These studies argue that the degree to which marketing and R&D are interdependent relates to the level of uncertainty in the environment. For example, focusing on innovative new technologies increases the uncertainty and therefore the need for more integration (Griffin and Hauser 1996, Olson et al. 2001).

We conclude that there is mixed support for a positive relationship between integration and new product performance in the empirical literature, and that there is every reason to look for conditions under which this relationship holds and does not hold, respectively. In this study we focus on two variables that are relevant in this context: company resources (i.e. research capabilities) and R&D strategy (strategic scope).

## 3. The Model

Figure 1 presents the model that underlies this study. [1]

PLACE FIGURE 1 ABOUT HERE

New product performance is the dependent variable in the model. It is defined as the extent to which a company has a (proven) ability to generate, develop, and market new-to-the-company products, measured relative to similar companies in the industry over a period of several years (cf. Cooper 1984, Dess and Robinson 1984). The central independent variable, which is the focus of this study, is the level of integration of marketing and R&D in the company. The contingencies (i.e., resources and strategic scope) are included in the organizational context box on the left-hand side of the model. We note that all variables are to a large extent under the control of management. These factors are known to be most strongly associated with new product performance (Calantone, Schmidt and Song, 1996). Finally, the model will be tested in a single industry. This approach ensures that less controllable environmental factors, such as variation in market growth and competition, do not prevent us from accomplishing our main goal, which is to develop a clear picture of the interplay between the marketing-R&D interface and the organizational context that affects new product performance.

[1] In parallel with the theoretical development of the model, 30 exploratory interviews in 14 companies were conducted with a wide range of executives (R&D, marketing, CEO, sales, and business planning). The companies operated in several industries ranging from consumer electronics, aerospace, oil, paint, and food, to pharmaceuticals. The interviews offered support for the variables and the general underlying structure of the model. For example, several respondents indicated that there was an adequate level of integration in the company whereas new product performance was considered only modest. This indicates that factors outside the marketing – R&D interface may affect the relationship between integration and new product performance.

**The Effect of Integration on New Product Performance**

Does integration of marketing and R&D affect the performance of companies with respect to new products? Our answer to this question is "all other things equal, yes." NPD involves a cross-functional process in which marketing and R&D play an important role by providing input to many decisions and activities. Consequently, successful NPD requires interaction and a continuous flow of information, expertise, materials, and money between the two functions (cf. Griffin and Hauser 1996).

Creating a continuous flow between marketing and R&D is not an easy endeavor. There are many barriers related to language, knowledge, physical distance, and thought worlds (Saxberg and Slocum 1968, Souder 1988, Dougherty 1992). These barriers may result in flows that are incomplete, biased and/or arrive too late. Increasing the integration between functional areas may overcome these barriers, which could result in a higher success rate, a better time to market, and more profits (Griffin and Hauser 1996).

As stated before, the empirical NPD literature suggests that there is a positive effects of integration on new product performance, although we argue that it may be weak especially at the corporate level. Based on the considerations presented above, in our study we likewise expect a positive effect of integration on new product performance. This hypothesis is not a final destination; it is the first step toward a comprehensive discussion on how and when integration affects new product performance. For now, we state that, on average, more integration results in better new product performance for the company (dashed arrow in Figure 1).

**H1:** *There is a positive relationship between integration and new product performance of companies.*

Hypothesis 1 is a general hypothesis and we expect it to be supported. However, things are not equal for all companies, and for specific companies the effect may be different. Next, we introduce the contingencies and elaborate on the type of companies that benefit the most from increased integration.

**The Effect of Resources on New Product Performance**

The "resources" construct in the model presented in Figure 1 is defined as a company's specialized knowledge and assets that provide "depth" in NPD. The word "depth" is used to articulate the functional, instead of cross functional, nature of this resource variable.[2]

Dewar and Dutton (1986) reported that the more technical knowledge resources a company possesses, the more easily new technical ideas can be understood and incorporated into new practices and products. Song & Parry (1997) found that specialized NPD skills lead to higher proficiency of NPD activities and better product quality that leads to better new products. In addition, relationships with universities and other organizations can create a competitive advantage with respect to new products for such reasons as better knowledge diffusion and faster cycle times of products to market (Smith, Carroll, and Ashford 1995). With respect to the amount of resources, having slack resources allows an organization to purchase innovations, to absorb failure, and to explore new ideas in advance of an actual need in the market (Damanpour 1991). Since all components of the resources construct are related (e.g., if a company has slack resources, it can "buy" knowledge and assets), we consider resources as a one-

[2] These resources are so-called *component* competences whereas integration can be labeled as an *architectural* competence (Henderson and Cockburn 1994).

dimensional construct (cf. Gatignon and Xuereb 1997). We hypothesize a positive relationship between resources and new product performance.

**H2:** *There is a positive relationship between resources and new product performance of companies.*

Again this is not a new hypothesis and it has been supported in other studies. Next, we will specify for what type of company the effect is stronger or weaker. For that, we turn to the effect of integration in combination with the underlying resources. Lawrence and Lorsch (1967) describe the process of how organizations become segmented into units, dealing with specific domains that lie outside the firm. Marketing faces problems associated with the market, customers, and competitors whereas R&D deals with science, technology, and development. According to Lawrence and Lorsch, specialization alone is not sufficient for higher performance. The specialized parts need to be integrated to accomplish the organization's overall objectives (see also Wind and Mahajan 1997).

If a company has a poor resource position, it is questionable whether the company can compete successfully with new products. This disadvantage may lead to lower R&D proficiency and marketing proficiency, which may be difficult to overcome with more integration. Simply said, can a marketing person and R&D person with limited knowledge and money be successful by integrating more? The answer is: probably not in today's competitive market place.

We argue that integration alters the effect of resources on new product performance and vice versa. Integration is expected to be more valuable to a company if the company has better underlying NPD resources, since it is the combination of integration and (depth) resources that make a company successful. Integration not only increases the success rate and reduces the time to market, it also is likely to result in

unique new products that combine state-of-the-art technology and marketing capabilities with rapid and high quality development. In sum, we argue that integration affects new product performance because it makes the underlying resources more productive. As a result, integration is conceptualized as a moderator variable on the effect of resources on NPP.

A *moderator* variable affects the direction and/or strength of the relationship between an independent variable and a dependent variable. A moderator has to be distinguished from a *mediator*, which represents the generative mechanism through which a focal independent variable is able to influence the dependent variable (Baron and Kenny 1986). A mediating effect would suggest that a higher level of resources generates more integration, resulting in better new product performance. This is not, however, what we expect. We have the following hypothesis:

**H3:** *Integration of marketing and R&D has a moderating, reinforcing effect on the relationship between resources and new product performance. Integration multiplies the positive effect of resources on new product performance.*

Hypotheses 3 is formulated as an effect of resources that is moderated by integration and not the other way. This is the way the interaction is depicted in Figure 1. This is equivalent to a formulation where the effect of integration is moderated by resources. We decided to start from resources because Henard and Szymanski (2001) found in their meta study that resources are a more dominant driver of new product performance than integration.

**The Role of Strategic Scope**

The next question that we address is whether the strength of the multiplying or mitigating effect of integration on the underlying resources is the same for different type of companies. We argue that there may be differences, depending on the approach the company follows in NPD, i.e. the NPD strategy.

In prior research the concept of strategic groups has been developed. Strategic groups reflect an economic orientation to collectives of firms. The rationale behind the group concept is that firms observe each other to gain information about what works in the environment. As a result, firms are expected to converge toward specific strategic clusters (e.g. Cool and Schendel 1987, Bogner, Thomas, and McGee 1996). Cool & Schendel (1987) postulate that a company's strategic scope is an important dimension of a company's strategy. A narrow scope or a *convergent* NPD strategy (Cool and Schendel 1987, Ettlie 1998) involves achieving leadership in specific market segments with selected products. A broad scope or a *leverage* NPD strategy is defined as targeting a broad spectrum of customers with a great variety of products in different market segments.

In previous research, sometimes negative or inverted U-shaped relationships between scope and performance were found (e.g., Hoskisson and Hitt 1988). In other studies, little or no proof of a significant effect was reported (Cool and Schendel 1987). In the light of the present study, we argue that strategic scope should be considered in conjunction with other company characteristics, i.e., the marketing-R&D interface. In our model, we hypothesize that strategic scope affects the strength of the multiplicative effect of integration on the positive relationship between resources and new product performance (Figure 1).

Companies that have a narrow strategic scope, such as the Coca-Cola Company, Intel, and the Dutch pharmaceutical company Organon. To be successful with such a strategy, R&D and marketing need to coordinate many activities and decisions related to the selection of market segments, technologies, market research and feasibility studies, development, the selection of product features, packaging, launch, and product life cycle management. In this type of company, both marketing and R&D need to interact in a coordinated way and have a considerable influence in NPD, resulting in high levels of interdependence(Thompson 1967, Tushman 1979). As a result, we expect that the multiplying effect of integration of marketing and R&D on resources is strong for this group (see Figure 2).

PLACE FIGURE 2 ABOUT HERE

Firms that have a broad strategic scope rely relatively heavily on the opportunities that are created by the findings in their different areas of research. This requires high levels of scientific research expertise, but the role of marketing may be less key here. For example, if a company happens to find a medicine against Alzheimer, which has a high technological uncertainty, it is certain that it will sell and no sophisticated interface is needed to explain the marketing side to R&D and vice versa. There is a lower need for coordinated target market selection, idea generation, development and marketing in this case. This results in a weaker multiplying effect of integration of marketing and R&D on the positive relationship between resources and new product performance which implies an interaction between integration, resources and strategic scope which determines the effect on success. In sum, we hypothesize that:

**H4:** *There is a three-way interaction effect between integration, resources, and strategic scope on new product performance. For companies with a narrow strategic scope, there is*

*a stronger multiplying effect of integration on resources*

*than for companies with a broad strategic scope.*

The hypotheses will be empirically tested in the following sections.

## 4. Methodology

Companies in the pharmaceutical industry were selected as this study's research environment. New products play a very important role in this industry, and it is also a very competitive industry in which many companies are active. It is also a very transparent and well-documented industry, often used to study such phenomena as strategic groups and new product development (e.g., Cool and Schendel 1987, Henderson and Cockburn 1994).

Data were collected by means of an international mail survey of senior managers from pharmaceutical companies. We selected only senior managers with a marketing or R&D background because these people occupy roles that make them knowledgeable about the issues being researched (e.g., Campbell 1951, Seidler 1974).

A draft questionnaire was developed and extensively pre-tested among academics and pharmaceutical managers in different countries, resulting in small refinements before the 20-page questionnaire was finalized. In the pre-tests, we also used the procedure suggested by Anderson and Gerbing (1991) to check whether the respondents were able to link the items correctly to the constructs. This proved to be the case for 98% of all items, indicating a high substantive validity for the measurement scales. The items that were not adequately linked were changed or removed. In addition, to ensure comparability, considerable attention was paid to whether the items had the same meaning to marketing and R&D persons and to respondents from different

countries. This sometimes resulted in a change of wording. All questionnaires carried a stamped number for mailing purposes. During the whole procedure, the guidelines of Dillman (1978) were closely followed.

A random sample of 1000 managers from different companies was drawn from a database containing information on 3000 senior managers working in pharmaceutical companies (e.g., company name, employee name, address, and job title). This worldwide database was obtained from ESOMAR, the European Society for Opinion and Market Research. The mailing procedure included two waves plus a reminder, and a total of 211 questionnaires were returned unopened (wrong address, respondent moved, etc.). Therefore, the effective sample size is 789.

Respondents were asked to consider the pharmaceutical part of the company only (the respondents were always from the pharmaceutical part). A total of 148 usable, filled questionnaires were returned (19%). This response rate is satisfactory compared to other international surveys where response rates are “often in single digits” (Jobber, Allen, and Oakland 1985). 29.7% of the responses came from U.S. companies, 14.9% from the U.K., 12.8% from Japan, and 10.1% and 8.1% from Germany and Switzerland, respectively. The remainder came from other European countries. The companies that participated tended to be large, generating revenues of more than U.S.$3 billion on average.

Comparison of respondent profiles and company characteristics of early and late responses revealed no significant differences at a $p = .05$ level. A pooling test on all constructs in the model and on the characteristics of the companies such as revenues and the number of employees (means and variances) revealed no significant differences between respondents with a marketing background (61%) and respondents with an R&D background (39%). In addition, sample means seemed to resemble the population means

very well: the companies in the sample invest an average of 16% of sales in R&D and 33% of sales is generated by products introduced in the last five years, which is representative for the industry at large according to *Scrip Magazine's* annual review 1999,2000, 2001.

## 5. Measurements

We used existing scales as much as possible, adapted some existing scales from the literature, and developed new scales if adequate measures were not available. To measure *integration of marketing and R&D,* an existing scale developed by Pinto et al. (1993) for integration in teams was adapted to the company level and used in the questionnaire. This scale includes items on communication, collaboration, and having a cooperative relationship (see Appendix 1 for the items of all scales). To indicate the nature of the adaptations, we altered an original item like "A friendly attitude exists among project team member," to "*In my company*, a friendly attitude exists among *marketing and R&D*.". In earlier research, this scale proved to be one-dimensional (Pinto et al. 1993), which will be validated here. The *resources* of a company were measured in terms of the amount and quality of specialized knowledge and assets of the firm. Since there were no adequate measures in the literature (cf. Teece, Pisano, and Shuen 1997, Dutta et al. 1999), 10 items were generated to assess the resource advantage of a firm (see Appendix 1). The *strategic scope* measure is based on Cool and Schendel (1987) and previously used to cluster companies into strategic groups and to measure the scope of a pharmaceutical company's strategy. To measure *new product performance*, items were collected from the literature on new product performance measurement (e.g., Griffin and Page 1993). The 10 items span the entire NPD process, ranging from the generation of ideas, to the speed and quality of the development

process, to the (financial) performance of the new products in the market. Respondents were asked to assess the performance of their company over a period of five years (cf. Dess and Robinson 1984). The *Centralization* and *formalization* measures were taken from studies such as Hage and Aiken (1967) and Zaltman, Duncan and Holbeck (1984).

## 6. Results

### 6.1 Confirmatory factor analysis

To examine the reliability and validity of our measures, we first screened the item-item correlations and item-to- total correlations and they were all satisfactory, probably because we used existing measures as much as possible.

Confirmatory factor analysis was used to assess the overall measurement model. Our NPP measure fitted better with a two-dimensional factor structure, related to the *process* NPP and the *output* NPP, respectively, which is in line with other studies (e.g., Loch, Stein and Terwiesh 1996). Although both dimensions are highly correlated ($r$= 0.64), both measures will be used separately when we analyze the effects of integration.

The CFA containing all the independent measures and the process NPP measure resulted in a $X^2$=838.93, df=725, p=.002, RMSEA=.038, CFI=.93, TLI=.93 GFI=.74. The model has an adequate fit with the RMSEA indicating a close fit. The GFI index is somewhat low. The standardized loadings were all significant. However, the number of data points per parameter may result in estimates that are not trustworthy. To reduce the number of parameters, a partial disaggregated model was composed by averaging sets of items to obtain three items for the integration measure and three items for the resources measure (cf. Bagozzi and Edwards 1998). The GFI improved to .89 without

substantially changing the other fit measures such as the RMSEA of .045 still indicated a close fit. The CFA with the independent variables and output NPP fitted even better.

The discriminant validity was assessed by means of the inter-factor correlations and their confidence intervals. Setting the inter-factor correlations to 1 resulted in very poor fitting models in all instances. In addition, the confidence intervals for the $\phi$'s did not contain a value of 1.

To establish the internal consistency of the measures, we computed Cronbach's alpha coefficients to calculate the reliability of the scale. All scales exceed the .70 level set by Nunally (1978): Integration (15 items, $\alpha$=.91), Resources (10 items, $\alpha$=.89), Strategic Scope (3 items, $\alpha$=.81), Process NPP (6 items, $\alpha$=.89), Output NPP (4 items, $\alpha$=.83), Formalization (4 items, $\alpha$=.76), Centralization (6 items, $\alpha$=.78).

Since the number of items affect the alpha positively, sensitivity analysis was conducted on smaller sets of 3 items per scale. This indicated that the alpha coefficients still exceeded Nunally's criteria. Composites were calculated by averaging the scores.

### 6.2 Hierarchical moderated Regression Analysis

To test the hypotheses presented in Section 3, four regression models were estimated and the results are presented in Table 1. The regressions were structured in a hierarchical way (Cohen and Cohen, 1983, Jaccard et al. 1990). In Model 1, only integration was included to explain *process* NPP and *output* new NPP, respectively. If there is an empty space in the table, it means that the variable was not included in that particular analysis) In Model 2, the resources, strategic scope and the control variables are included. In Model 3 we entered the two-way interaction variable between integration and resources. In the final regression, Model 4, we estimated the complete

model by adding the three-way interaction variable together with the interactions that are nested in the three way interaction. To reduce multicollinearity, the variables used in interaction terms were mean centered (Jaccard, et al. 1990). The success of this procedure was verified by calculating the tolerances that proved to be all in the area of .80 to .95, which is very satisfactory. The models were estimated with *process* and *output* new product performance (NPP) as dependent variables to assess possible differential patterns of effects depending on the performance metrics. The correlations between the independent variables are presented in Appendix 2. Scatter plots showed no evidence of nonlinear relationships.

PLACE TABLE 1 ABOUT HERE

Table 1 gives the results. Model 1 is in agreement with Hypothesis 1. Integration has the expected positive and significant sign if it is the only independent variable in the equitation. Model 2 shows strong support for Hypothesis 2. Resources have a strong effect on NPP. With the additional independent variables in the equitation, the effect of integration is not significant anymore and this shows that you have to be careful with arguing that integration is beneficial to NPP. We note that the variables for centralization and formalization attain negative betas, mostly significant, which indicates that formalization and centralization have a negative relationship with NPP. This is in line with previous meta-studies ( e.g., Damanpour 1991). As expected, the beta coefficients for the strategic scope variable are not significant, indicating that both a narrow and a broad strategic scope can lead to successful NPD. Overall, up to 37% of variance in NPP is explained.

Hypothesis 3 states that integration moderates the effect of resources on NPP. To test for a moderating effect,[3] we used a hierarchical regression procedure (Cohen and Cohen 1983, Baron and Kenny 1986, Jaccard et al. 1990). In addition, we controlled for the main effects of the contextual variables. Table 1 shows (Model 3) that the two-way interaction effect of resources and integration is significant for both output and process NPP. The effect size, the increase in $R^2$, is the highest for process NPP ($\Delta R^2 = 0.05$) and both significant $p < .05$. It is important to note that in the case of interaction the betas related to the main effects that are nested in the interaction are not really meaningful anymore (e.g., Jaccard et al. 1990).

Figure 3 presents the relationship between resources and NPP for different levels of the moderator variable (i.e. integration). In Figure 3, the sample is split by means of a median split to illustrate the *nature* of the interaction. In addition, other levels for integration were also selected to validate our interpretation.

PLACE FIGURE 3 ABOUT HERE

The plots show that all regression lines have positive slopes: more resources lead to better NPP for companies with high integration as well as for companies with low integration. However, a given level of resources leads to *better* NPP if there is also a high level of integration in the company. The effect of integration is considerable. For a company with a resource score >4 (i.e., 20% of companies with most resources), it can mean the difference between performing just above the industry average (NPP score

[3] As stated in section 3, a mediating effect of integration was not expected. For mediation, higher levels of resources have to generate higher levels of integration. Given the relatively low correlation between integration and resources (see Appendix 2, $r$ =.21), this line of reasoning proves to be valid.

around 3) or belonging to the best performing 20% with respect to new products (NPP score >4). Hypothesis 3 is supported.[4]

Before we discuss the test of hypothesis 4, we will elaborate on the size of the multiplication effect of integration for a pharmaceutical company by translating the results into more concrete terms. This is done by means of a simplified version of the regression model, in which we use single item measures for resources (the number of R&D people) and the performance construct (sales of products introduced in the last five years). We expect a multiplication effect of integration on R&D personnel productivity with respect to new product sales.

Our results indeed show a significant interaction between integration and R&D people (RDP). After exploring the nature of the interaction, we found that the average difference in new product sales (ΔNPSAL) between the high and low integration group could be expressed by the following formula: $\Delta NPSAL_{\text{high integration versus low integration group}} = 28{,}000 * RDP$. In other words: each R&D worker, on average, produces $ 28,000 extra annual new product sales in the case of high integration, compared to the low integration group. So, a company with high integration that employs 2000 R&D people (mean in the sample was close to 2000) generates on average $56,000,000 more new product sales than a company with low integration with the same number of R&D people. Since the average new product sales in sample was 990 million, this is an increase of 6% in yearly new product sales. In terms of profit, the difference can be higher since the increase is not accompanied by strong cost increases. If we assume a

[4] Although we focus on the slopes and not on the absolute values to test our hypotheses, the figures show that there is a crossover in the resources domain [3.0 - 3.25]. Since there are a considerable number of companies with a resource score equal to or below 3.25, a negative effect of integration might indeed occur

profit margin of 20 % on all sales (the overall profit margin of Merck in 1998 was 20% as stated in their annual report) the increase in profit due to better integration would be in the order of magnitude of 30%.

*Three-way interactions*

Three way interactions play an important role in areas such as epidemiology and medicine. In behavioral science research, three-way or even higher order interactions are scarce. Cohen and Cohen (1983, p. 347) state that most of the theories are not of a degree of complexity such as to warrant positing relationships of that order and not many variables are measured with sufficient precision to demonstrate such relationships even when they are posited. In our case, we do think that the role of integration is quite complex and we benefit from the high reliabilites of our measures so that we can test it. The reliability of the three-way interaction can be estimated as follows. If the correlations between integration, resources, and strategic scope would be zero, the reliability of the interaction term would be the product of the separate alphas of integration, resources, and scope (.91*.89*.81), resulting in $\alpha_{\text{3-way interaction}} = .66$ (Jaccard et al. 1990). As the true correlation is above 0, the reliability of the three-way interaction is higher, satisfying Nunally's criteria.

To find out whether there was a significant three-way interaction, we again used the conservative hierarchical approach suggested by Cohen and Cohen (1983) and others. In addition, we controlled for all the other effects we found so far, together with the effects of the two-way interactions nested in the three-way interaction. This approach made sure that the three-way interaction explains unique variance not

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for companies with a very small amount of resources. These companies lack depth resources and would be better off concentrating on acquiring more resources before focusing on integration.

explained by other (combinations of) variables. The results are presented in Table 1 (Model 4).

Model 4 shows that the three-way interaction variable integration, resources, and strategic scope is significant for output NPP. Furthermore, the increase in explained variance ($\Delta R^2$) is .04, indicating a considerable and significant size of the effect ($p<$ .05). To visualize the nature of the interaction, we split the sample into companies with a narrow strategic scope and companies with a broad strategic scope (median split). For each sub-sample, the relationship between resources and NPP is presented for a group of companies with a high level of integration and a group with low integration. To find support for hypothesis 4, the increase in slopes (= Direction coefficients, Dc) of the regression lines between resources and NPP (when going from the *low* integration group to the *high* integration group) needs to be larger in the narrow strategic scope sample than in the broad strategic scope sample. The results are presented in Figure 4.

PLACE FIGURE 4 ABOUT HERE

Figure 4 shows that the increase in slope for the narrow strategic scope group was indeed largest. The increase in direction coefficient is very large for output NPP: $\Delta$Dc = .69 (277%). This indicates that, for a company in this group, being integrated had relatively high returns with respect to output NPP. For process NPP (not shown) the difference is also positive but not significant ($\Delta$Dc = .32 (53%)). The nature of the pattern is however the same for both dependent variable. So, having a narrow strategic scope increases the strength of the multiplication effect of integration on the relationship between resources on NPP. The lower part of Figure 4 shows that the multiplication effect of integration was weak for companies with a broad strategic scope. Although there is a slight increase of $\Delta$Dc = .10 (16%) for output NPP (and $\Delta$Dc =.02 (2%) for

process NPP), these differences are not significant, supporting our claim that companies with a broad strategic scope benefit less from integration. Dummies for geographical area and respondent background (marketing or R&D) did not substantially affect the results. This is in line with Song and Parry (1997) who found little differences between Japan and the U.S., indicating universal principals in NPD. Hypothesis 4 is supported for *output* NPP, probably of most interest to companies, and there is some support for the *process* measure. Beforehand we had expected the strongest effect on the process NPP because it may be more easily affected if integration is high. However, our results show that the speed and quality of the NPD process is relatively independent from the strategic scope variable which may indicate that the benefits for the combination of good resources, high integration, and a narrow scope comes from the 'what' instead of from the 'how' in NPD. In total, up to 43% of variance in NPP is explained, which is quite high compared to other studies (e.g., Gatignon and Xuereb (1997) were able to explain 37% of variance in innovation performance in their study).

## 7. Conclusion and Limitations

As the importance of new products for companies increases, so does the attention to the management of the marketing-R&D interface in academic research and the popular press. Both academic research and anecdotal evidence suggests that teams with more integration of marketing and R&D (communication, collaboration, and having a cooperative relationship) are more successful with their innovation and new product efforts. In addition, there is some evidence –albeit mixed – that more integration of marketing and R&D throughout the company leads to better new product performance of companies as a whole.

Our research confirms earlier findings that there is a positive effect of integration on new product performance: companies with more integration have better new product performance but this effect is not unconditional.

We found that specialized resources that provide depth in NPD (knowledge and assets) have a strong positive effect on new product performance of companies. In our empirical setting, resources by far had the largest effect on new product performance. The separate effect of resources is far greater than the effect of integration. This does not mean, however, that integration of marketing and R&D is not important for new product performance. First of all, we showed that integration *multiplies* the positive effect of resources on new product performance. In other words, integration produces better new product performance for the same amount of resources. So, integration and resources have to be considered jointly when studying and managing integration in the context of new product performance. If a company has few resources, investments in integration may not produce the desired effects.

Next we expected and found that the strategic scope of the company affects the *strength* of the multiplication effect of integration. Companies that do not have precise target markets and that spread their resources over many market segments and product groups will experience fewer benefits from increased integration than companies that compete in fewer segments with a selected number of products. The latter group has the highest level of interdependence between marketing and R&D and therefore the highest need for integration. In such a company with a narrow strategic scope, additional integration can result in very important increases in new product performance, if the company has sufficient resources.

In general, this study shows that the effect of the marketing-R&D interface has to be studied together with (1) the underlying resources and, (2) the strategic scope

(narrow versus broad). Therefore, any decision to increase integration should be considered in a broader perspective.

The present study, of course, has limitations. The single industry design applied to test our model implies that we have to be somewhat cautious with generalizing the findings to different industries. However, the positive side of concentrating on one industry is the opportunity to study the effect of company characteristics on new product performance in-depth, without too much interference from external "noise." Also, as mentioned earlier, the pharmaceutical industry has often served as a fruitful setting for testing theories in innovation and strategy. Furthermore, our model is general, not based on any industry-specific knowledge, and can easily be tested in a broad range of industries.

In the present study, we were able to explain up to 43% of variance in new product performance. This shows that there are other variables outside the model which affect new product performance. A large proportion of the other 57% of variance might be explained by factors such as specific entrepreneurial individuals, serendipity in the laboratory, and pure luck. So, there are natural limits of what can be explained in this type of research.

## 8. Managerial Implications

Our results have several implications for managers at different levels in the organization and for consultants working on improvements for new product performance of companies.

The main managerial implication is that management should not invariably think of increasing integration of marketing and R&D in case of poor new product performance. Instead, there are specific conditions with respect to resources and

strategic scope that determine what priority management should give to increasing integration. The conditions are presented schematically in Figure 5.

PLACE FIGURE 5 ABOUT HERE

Figure 5 shows a two by two matrix for a company's resources and strategic scope. Consider a company with a resources disadvantage and a broad strategic scope that wants to improve new product performance (lower left cell of Figure 5). Our study shows that, in such a situation, management must try to acquire resources first. Establishing more integration does not compensate for a lack of resources (we found no separate effect of integration on new product performance when studied together with resources). Therefore, in this case increasing integration has a low priority. On the other hand, for a company that scores high on resources, increasing integration is important to gain additional new product performance by multiplying the positive effect of resources on new product performance. The multiplication effect is strong, and integration should in particular have a high priority if the company also has a narrow strategic scope (upper right cell). The multiplication effect is somewhat weaker for companies with a broader strategic scope and integration should therefore have a medium priority (lower right cell). If a company scores low on resources and has a narrow scope (upper left cell), the benefits from integration are smaller and integration should have a medium to low priority. For such a company, the resource multiplication effect is strong but the amount of resources is small.

We conclude the discussion of managerial issues by referring again to the example presented in the first part of this paper. At Allergan, management did not seem to be very satisfied with the efforts to increase integration. Can we explain this dissatisfaction by means of our research? The answer is "yes." Allergan's annual report of 1998 (*SEC form 10-K*) stated several times that there are more and more companies

with more resources than Allergan (Annual report Allergan, 2001). In addition, it said that the company focused on specific segments for eye and skin care. Apparently the company was short on resources and had a narrow focus, which placed it in the upper left cell of Figure 5. For such a company, increasing integration of marketing and R&D becomes particularly worthwhile *after* it has acquired more resources, perhaps by means of a merger. In 2002, the company has been selling some additional parts of their non-core business and using the money to invest in eye and skin care, resulting in even more focus in their NPD strategy and additional specialized resources, which is likely to be beneficial if the company wants to harvest from its investments in the interface.

## 9. Future Research

Researchers have touched only the surface of what is to be known about the *combination* of factors that determine the performance of companies. So far, research has been dominated by studies that identify critical success factors (Montoya-Weiss and Calantone 1994, Henard and Szymanski 2001). However, effects on performance do not come from single factors. Depending on the specific situation of the company, factors can be more or less critical because it is a combination of factors that determines success (see also Olson et al. 2001).

In this study we shed some light on the specific role of the marketing-R&D interface in determining new product performance of companies. Here, too, more work is needed. First of all, the approach taken in this paper should be extended to different industries. An interesting question, for example, is whether the same relationships will be found in industries with a much lower R&D expenditures level, for example, in the fast moving consumer goods industry. For example, Henard and Szymanski (2001) propose that some factors such as market orientation may less important in low

technology markets compared to high technology markets. Second, as a follow-up on our survey research design, it might be worthwhile to gather additional insight in the role of the marketing-R&D interface by following actual efforts to achieve more integration of marketing and R&D in companies. Sometimes, companies make sudden changes in the way marketing and R&D are organized or physically located which offers possibilities of "natural experiments" (e.g., Van den Bulte and Moenaert 1998). Another possibility is to conduct experiments in a laboratory style setting, using high quality business simulations like MARKSTRAT (e.g., Van Bruggen, Smidts and Wierenga 1998) or MARKSTRAT PHARMA which has been developed using pharmaceutical data from the company IMS. Simulations with proper underlying models are more and more used for studying strategic decision making.

Finally, now that the question of how and when integration affects new product performance of companies has been addressed, an important question for future research emerges: "how can integration in a company be accomplished?" Many integrating mechanisms that are presented in the literature can be expected to lead to lower barriers between marketing and R&D, for example, relocation and physical facilities, informal social structures, specific organizational structures, incentives and reward systems, and formal integrative management systems (Griffin and Hauser 1996). More research is needed on whether and how these mechanisms are effective in bringing about integration, especially at the company level.

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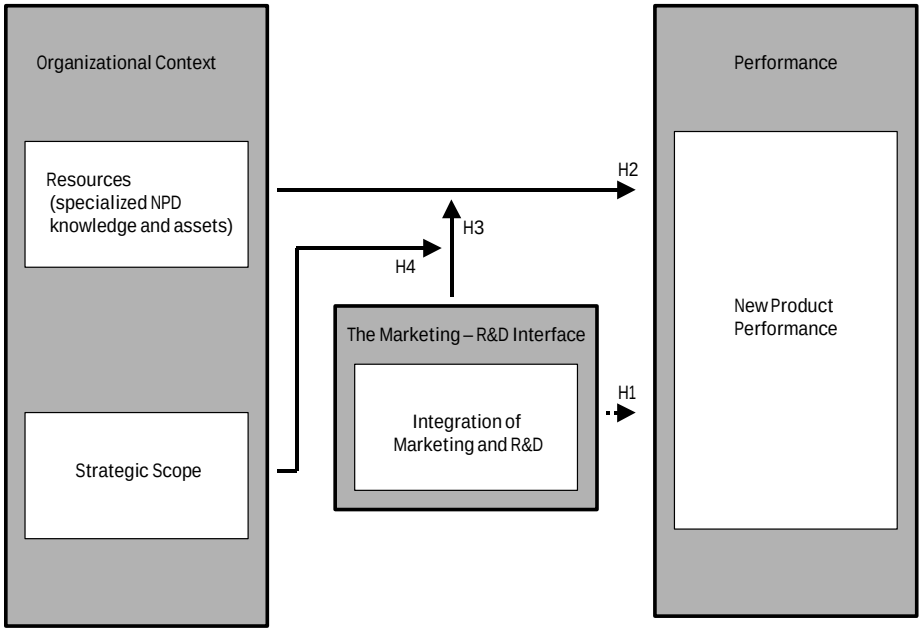



**Figure 1: The model that underlies this study**

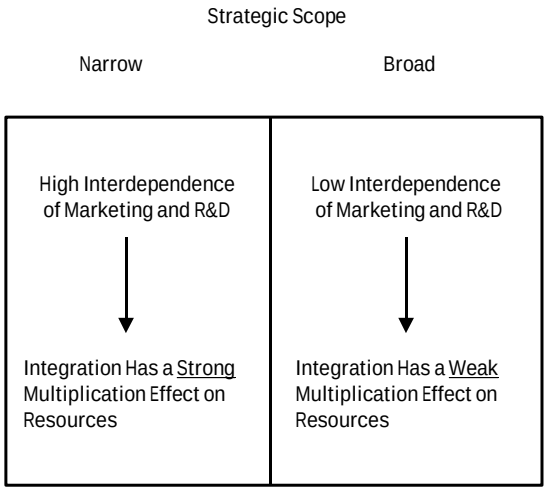
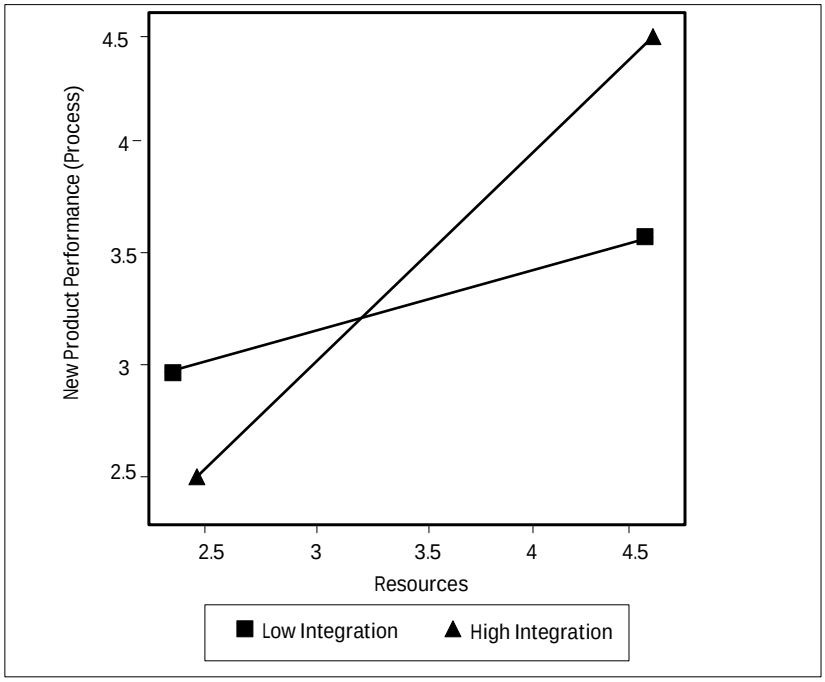



**Figure 2: Strategic scope and the interdependence of marketing and R&D**



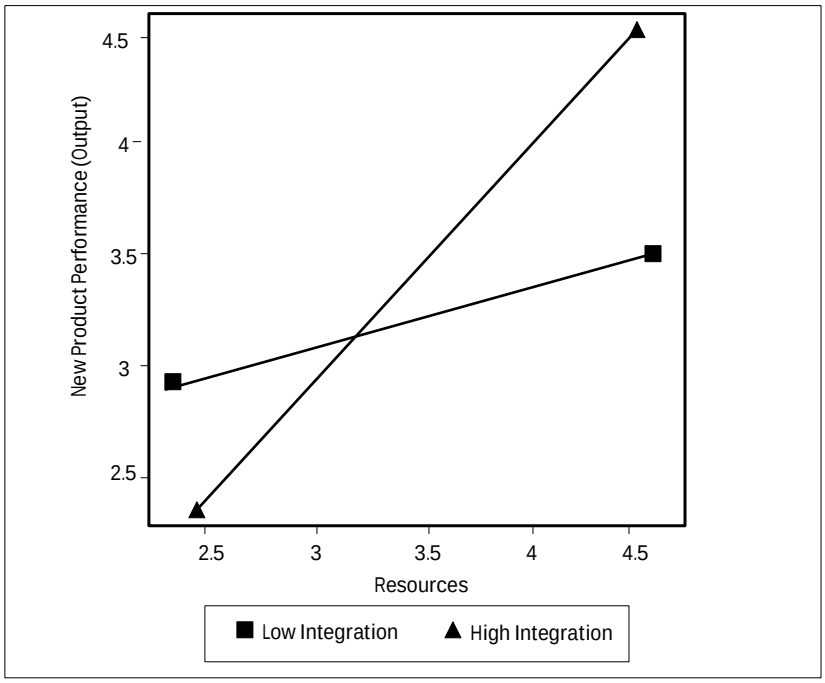
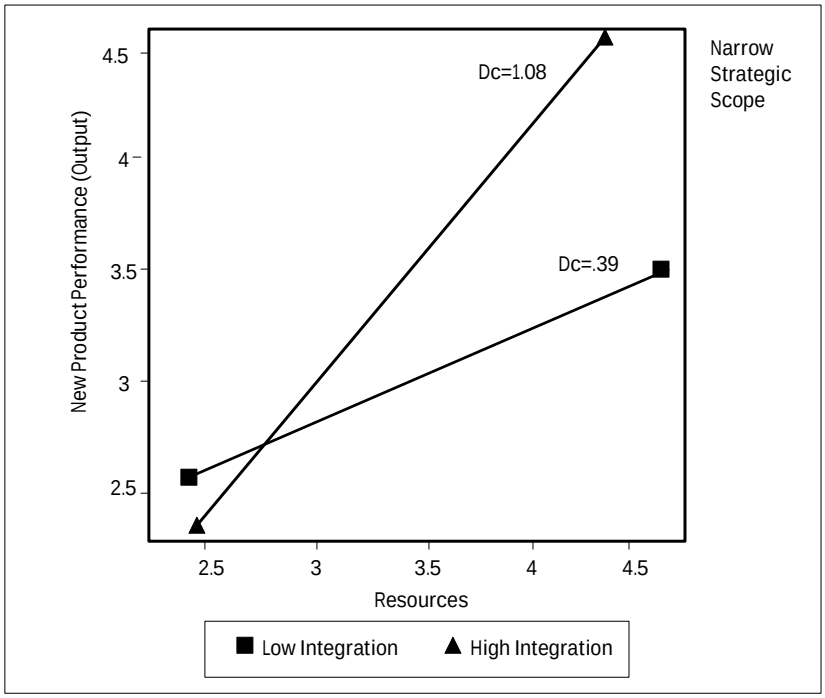




**Figure 3:The relationship between resources and NPP (process and output) for different levels of integration**



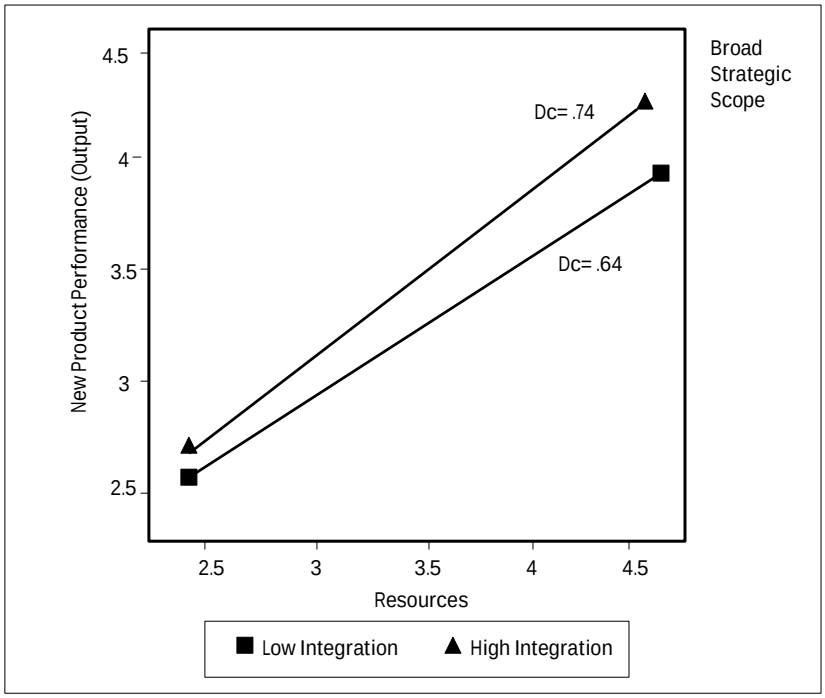




**Figure 4:The relationship between resources and output NPP for different levels of integration for companies with a <u>narrow strategic scope</u> (top) and companies with a <u>broad strategic scope</u> (bottom).**

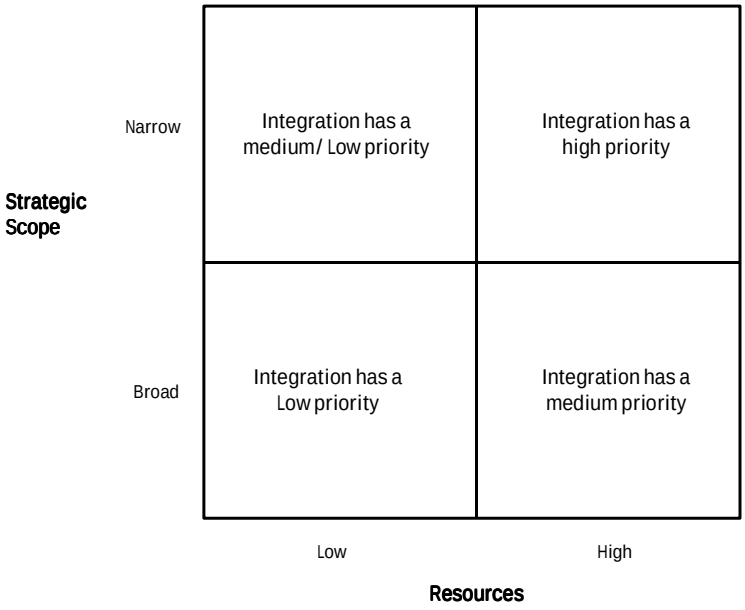



**Figure 5: A schematic picture of the priority that management has to give to increasing integration of marketing and R&D for better new product performance.**

**Table 1 Hierarchical regression models for process and output new product performance**

| | Dependent Variables | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ***Process* NPP** | | | | ***Output* NPP** | | | |
| | Model 1 beta | Model 2 beta | Model 3 beta | Model 4 beta | Model 1 beta | Model 2 beta | Model 3 beta | Model 4 beta |
| **Main** | | | | | | | | |
| Integrat (INT) | .16[b] | .00 | .01 | .03 | .20[b] | .07 | .08 | .11[c] |
| Resources (RES) | | .54[a] | .51[a] | .51[a] | | .50[a] | .48[a] | .41[a] |
| Stratscope (STR) | | -.00 | .02 | .01 | | .10 | .11[c] | .11[c] |
| Central | | -.14[b] | -.18[b] | -.16[b] | | -.01 | -.04 | -.05 |
| Formal | | -.12[c] | -.11[c] | -.13[c] | | -.19[b] | -.18[b] | -.20[b] |
| **Two-way** | | | | | | | | |
| INT*RES | | | .23[a] | .22[a] | | | .13[b] | .18[b] |
| INT*STR | | | | .06 | | | | -.03 |
| RES*STR | | | | -.03 | | | | .15[b] |
| **Three-way** | | | | | | | | |
| INT*RES*STR | | | | -.07 | | | | -.14[b] |
| N(listwise deletion) | 136 | 126 | 126 | 126 | 136 | 126 | 126 | 126 |
| $R^2$ | .03 | .37 | .42 | .43 | .04 | .34 | .35 | .39 |
| Adj. $R^2$ | .02 | .34 | .39 | .38 | .03 | .31 | .32 | .34 |
| F-value | 3.45[b] | 13.98[a] | 14.32[a] | 9.66[a] | 5.39[b] | 12.29[a] | 10.90[b] | 8.19[a] |

[a]Significant at p<.01, [b]Significant at p<.05, [c]Significant at p<.10

**APPENDIX 1: Measures used in study**

INTEGRAT (In my company, …. 1=strongly disagree, 5=strongly agree)

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

RESOURCES (1=part of 20% of companies of comparable size with least resources, 5=part of 20% companies with most resources)

The sophistication of R&D equipment.
Modern building and plants.
Database and library facilities.
Production capacity.
Worldwide market information.
Top scientists.
The financial reserves.
Cooperative R&D relationships.
Relationships with governmental bodies.
Knowledge of competitors.

STRATSCOPE (5-point semantic differential scale)

Narrow product range - Broad product range
Few market segment – many market segments
Small company – large company

FORMAL (1=strongly disagree, 5=strongly agree)

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

CENTRAL (1=strongly disagree, 5=strongly agree)

My company has a flat organizational structure. (R)
In my company, departments possess a large degree of autonomy. (R)
In my company, many decisions are taken low in the hierarchical structure of the organization.(R)
The organization of my company is very centralized.
Making decisions in my company is strongly bound to hierarchical lines.
In my company, most decisions have to be approved by higher management.

PROCPERF (1=part of 20% of companies of comparable size with least performance,
5= part of 20% of companies with most performance)
The speed of the NPD decision-making process.
The quality of the NPD decision-making process.
The speed at which new products are developed.
The commitment to translating NPD decisions into actions.
The cost efficiency of the development of new products.
The ability to react to new opportunities.

OUTPERF (1=part of 20% of companies of comparable size with least performance,
5= part of 20% of companies with most performance)
The performance of the products that have been launched.
The number of new products.
The number of breakthroughs.
The quality of the R&D pipeline.

**Appendix 2: Descriptive statistics and the correlations between the independent variables**

| Variable | | Mean | St.D. | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|---|---|---|
| (1) | Integration | 3.50 | .57 | - | | | | |
| (2) | Resources | 3.49 | .61 | .21[a] | - | | | |
| (3) | Strategic scope | 3.18 | 1.18 | .07 | .23[a] | - | | |
| (4) | Centralization | 3.13 | .66 | -.28[a] | -.18[b] | -.02 | - | |
| (5) | Formalization | 3.25 | .71 | .02 | -.03 | .16[b] | .42[a] | - |

[a] p<.01 [b] p<.05 [c] p<.10 (one tailed)

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