

THE EFFECTIVENESS OF DIFFERENT MECHANISMS FOR INTEGRATING MARKETING AND R & D

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Abstract	<p>The integration of marketing and R&D is a major concern for companies that want to improve their new product performance (NPP). In order to integrate, companies are using mechanisms such as physical proximity, cross-functional teams, and job rotation. This study examines the relative effectiveness of these mechanisms by developing a model that distinguishes between indirect effects of mechanisms on NPP (i.e., through a higher level of integration) and direct effects. The model is tested with data collected from 148 pharmaceutical companies.</p> <p>By simultaneously studying a broad range of integrating mechanisms, we found that housing marketing and R&D closer to each other and using an influential cross-functional phase review board are highly effective mechanisms to increase integration. Using information and communication technology (ICT) more intensively, having equal remuneration and career opportunities for marketing and R&D and using more cross functional teams are also effective in producing more integration, although to a somewhat lesser extent. The effectiveness of personnel movement and informal social group events is rather low. Interestingly, ICT appears to be a very effective tool for enhancing NPP. ICT not only fosters integration, but in addition it has an independent direct positive effect on NPP, possibly through knowledge creation within marketing and R&D. We also found a direct effect on NPP of another mechanism: cross functional phase review boards. However, for this mechanism the direct effect is negative. So, notwithstanding its strong positive effect on integration, a price is paid in terms of NPP. This may be related to the amount of formalization and complexity accompanying this mechanism.</p>	
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**The Effectiveness of Different Mechanisms for Integrating
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The Effectiveness of Different Mechanisms for Integrating Marketing and R&D

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Abstract

The integration of marketing and R&D is a major concern for companies that want to improve their new product performance (NPP). In order to integrate, companies are using mechanisms such as physical proximity, cross-functional teams, and job rotation. This study examines the relative effectiveness of these mechanisms by developing a model that distinguishes between indirect effects of mechanisms on NPP (i.e., through a higher level of integration) and direct effects. The model is tested with data collected from 148 pharmaceutical companies.

By simultaneously studying a broad range of integrating mechanisms, we found that housing marketing and R&D closer to each other and using an influential cross-functional phase review board are highly effective mechanisms to increase integration. Using information and communication technology (ICT) more intensively, having equal remuneration and career opportunities for marketing and R&D and using more cross functional teams are also effective in producing more integration, although to a somewhat lesser extent. The effectiveness of personnel movement and informal social group events is rather low. Interestingly, ICT appears to be a very effective tool for enhancing NPP. ICT not only fosters integration, but in addition it has an independent direct positive effect on NPP, possibly through knowledge creation within marketing and R&D. We also found a direct effect on NPP of another mechanism: cross functional phase review boards. However, for this mechanism the direct effect is negative. So, notwithstanding its strong positive effect on integration, a price is paid in terms of NPP. This may be related to the amount of formalization and complexity accompanying this mechanism.

1. Introduction

To be successful in today's competitive marketplace, companies must continuously develop and market new products. In the US alone, more than 10,000 new products enter the market each year [10]. Unfortunately, these products often cannot live up to expectations and many new products fail in the market or never enter the launch phase at all [8, 9].

It is widely recognized that the marketing-R&D interface is a critical factor for success with new products. New product development involves a cross-functional process in which different functional areas have to cooperate to be successful [e.g., 17, 19, 41, 42]. However, often these functional areas - especially marketing and R&D - have grown apart in the organization [20]. Barriers such as physical distance, different responsibilities, different thought-worlds, and different languages often result in new products that arrive too late on the market, have cost overruns in the process, and/or do not offer significant benefits compared to existing products [14, 17].

To achieve higher levels of integration between marketing and R&D, companies are applying different approaches. These approaches include the building of physical facilities where marketing and R&D are housed close to each other, job rotation, the use of advanced information and communication technology (ICT), and cross-functional teams. For example, the company Pfizer employed a cross-functional team during the development of the new antibiotic Trovan[®]. The marketing people in the team were the ones who pressed for large-scale clinical trials of the new drug, much more extensive than required by federal rules. As a consequence, Trovan[®] won approval for 14 different types of infections, where the scientists had originally counted only one. A Pfizer Executive, quoted in *Forbes* (January 1999), attributes the success of Trovan[®], which is a commercially very successful

drug now, to the cross functional team mechanism at Pfizer fostering integration between R&D and marketing.

Given the increased use of integrating mechanisms in companies, we argue that there is a need to document and challenge the belief that all integrating mechanisms work as expected. In addition, Griffin and Hauser argue that it is “of the highest priority to determine the relative efficacy of integration methods” [17]. This requires several mechanisms to be studied simultaneously, which is exactly what is done in the present study. A lack of insight on the effectiveness of integration methods could result in the use of less effective or even counter-productive mechanisms and the loss of time and money.

In the present study, we examine: (1) the (relative) effectiveness of a broad range of integrating mechanisms in producing integration between marketing and R&D, (2) how these integrating mechanisms ultimately affect the new product performance (NPP) of companies, and (3) the role of a new integrating mechanism that is in the spotlight based on information and communication technologies (ICT) [cf. 49].

The next section of this paper provides a discussion on the role of integration in organizations. Section 3 presents a model of the effects of integrating mechanisms on integration and on new product performance. The data collection, sample and measurement scales are discussed in Section 4. Section 5 presents the results. Finally, the managerial implications and suggestions with respect to future research are presented in Section 6 and 7.

2. Integration and Integrating Mechanisms

In the literature, different terms are used to convey the meaning of integration between different functional areas in general, and between marketing and R&D in particular. Examples of such terms are coordination, collaboration, and cooperation. The common denominator of these concepts is the joint behavior toward some common goal [37]. As a result, integration is often measured in terms of the extent of communication, collaboration, and the existence of good relationships between different functional areas [38].

Achieving higher levels of integration in organizations is important for linking interdependent functions together and thus maximizing their joint contribution to the overall goals of the organization. People from different departments that are integrated seek and give information, divide labor effectively, and assist each other readily [37]. The benefits of more integration are that better new products can be developed more quickly, with less cost, and with higher profits [17].

After several studies on the relationship between integration and NPP [e.g., 17, 38, 42, 45], it is now generally accepted that, all else being equal, more integration between marketing and R&D leads to better NPP. It is this insight that creates the interesting issue of how to produce integration that is the focus of this study.

Mechanisms for Achieving More Integration Between Marketing and R&D

Griffin and Hauser [17] distinguish six types of integrating mechanisms that may overcome integration barriers between marketing and R&D:

- relocation and physical facilities design
- personnel movement
- informal social systems
- organizational structure
- incentives and rewards
- formal integrative management processes.

These mechanisms are expected to have a positive effect on integration between marketing and R&D since they overcome barriers such as physical separation, differences in responsibilities, and different ‘thought-worlds’ [cf. 14].

Several studies have empirically investigated the effects of individual mechanisms or a small set of mechanisms [e.g., 27, 28, 29, 33, 44, 48]. Three remarks have to be made. First, it can be noted that only a small portion of these previous studies examine the effect on integration. Sometimes they focus on time to market or performance in general. Second, some mechanisms have received more attention than others. Especially reward systems have received little attention, which is strange because it can stimulate specific behaviors [11]. Third, the mechanism variables studied are sometimes more general organizational characteristics such as formalization and centralization rather than integrating mechanisms [see for example 29].

In our review of the relevant literature, we focus on integrating mechanisms and their effects on integration or similar concepts. A representative but not complete overview is presented in Table 1 with some typical studies.

Place Table 1 about here

Table 1 shows that most studies find a positive effect of the integrating mechanism on integration. Therefore, conducting another study to verify this would not make much sense. However, as stated before, most studies only focus on one or two integrating mechanisms and therefore it is difficult to compare the *relative effectiveness* of the mechanisms. For example, from the earlier research we cannot learn how effective physical proximity is compared to job rotation. Maybe physical proximity can account for all the effects that job rotation has and then a focus on job rotation next to physical proximity would be a waste of time and money. Another problem with comparing the results across studies is that different dependent variables are used (e.g., cooperation and information utility) and that the effects are tested in different NPD settings. Finally, earlier research focuses on the effects of mechanisms on integration *or* a particular performance measure, not both [except 38], which limits our insight on how these mechanisms ultimately affect performance.

In sum, the present study contributes to this field of research in three ways. First, a broad set of integrating mechanisms is studied simultaneously, which enables us to learn more about the (relative) effectiveness of each mechanism. Second, we study both indirect effects (through integration) and direct effects of integrating mechanisms on NPP. This approach enables us to find out whether there are positive or negative side effects of individual mechanisms that affect NPP. Finally, an integrating mechanism of growing importance, namely ICT, is also included in the study. Advancements in new technologies such as internet and broadband communications are not explicitly taken into account in the taxonomy of Griffin and Hauser. These new technologies may give companies new opportunities to improve the marketing – R&D interface. We argue that ICT is sufficiently

different from the other mechanisms to warrant a new category. ICT is different from mechanisms such as “physical facilities” because the physical working environment need not be affected by ICT. This mechanism is different from “formal integrative management processes” because it is also often used as an informal communication tool.

3. The Model

Figure 1 presents the model that guides this study. The model shows how specific integrating mechanisms affect integration between marketing and R&D, and ultimately NPP.

Place Figure 1 about here

We focus on all the types of integrating mechanisms as summarized by Griffin and Hauser [17]. This study provides to our knowledge the most extensive overview of integrating methods: relocation and physical facilities, personnel movement, informal social systems, organizational structure, incentives and rewards, and formal integrative management processes. The variable ICT was added to this list. The expected effects of each mechanism will be discussed briefly.

Relocation and physical facilities design. Allen [1, p.239] found that communication drops off sharply with increased distance. Griffin and Hauser [17] argue that reducing the physical distance between marketing and R&D increases information transfer between functions [cf. 38]. Only few studies did not find support for this positive effect [e.g., 52].

Personnel movement. Moving personnel across functions reduces the probability of isolated thought worlds. Moenaert et al. [29] found that job rotation increased interaction and led to concomitant information flows and thus integration. A possible danger lies ahead if people rotate too quickly. Then they may not be able to get sufficient in-depth knowledge to gain credibility. This may hinder the relative effectiveness of this mechanism compared to other mechanisms.

Informal social systems. Informal social networks in organizations can be created by mechanisms such as informal group events and trips and they facilitate information transfer and information utilization [14]. By means of informal networks, individuals can locate the requisite expertise to solve a particular problem and they can keep in touch with work in progress in other areas.

Organizational structure. The structure that is most directly related to the marketing – R&D interface is the cross-functional project team. Project teams encourage information exchange, provide a degree of structure, and encourage cooperation by providing a forum in which conflicts are resolved without intervention from management [17]. Therefore, we expect that cross-functional project teams have a positive effect on integration.

Incentives and rewards. Incentives and rewards play an important role in stimulating specific behaviors within organizations. Previous research has shown that performance evaluations that recognize the interdependence between tasks of different employees stimulate group behavior guided by joint goals [cf. 17]. From an organizational instead of group perspective, this means that the remuneration and career opportunities have to be coordinated and equal for marketing and R&D personnel. Interestingly, this issue has received little attention in the context of the marketing – R&D interface so far. General

compensation researchers have shown that perceptions of inequity can result in undesirable behavior on the part of an individual [11]. Therefore, having equal reward systems and career opportunities for marketing and R&D contributes to more integration.

Formal integrative management processes. Phase review boards form the basis for most formal integrative NPD processes [7, 8, 17]. Managers from different functional areas are members of these boards and they review new product ideas and monitor the progress of NPD activities. These cross-functional boards usually have a very important say in go/no-go decisions and in resource allocation and they provide a way to solve cross-functional conflicts [17]. In the literature, evidence is found that the basic management process is enlarged by adding specific sub processes such as PACE (Product and Cycle-time Excellence) and QFD (Quality Function Deployment) [cf. 17]. The comprehensive nature of this mechanism leads us to believe that it has a relatively strong effect on integration.

Information and communication technology (ICT). Technologies such as e-mail, video conferencing and intranet provide an opportunity for contacting people easily and finding, processing, and sending information in an effective way [40, 32, 49]. So far, research on the effectiveness of ICT in the context of the marketing – R&D interface is just emerging, bringing a wealth of opportunities for research to the academic desk. Recent studies suggest that new ICT expedites communication among people who might otherwise communicate infrequently or not at all [e.g., 43]. This result may have important implications for the marketing – R&D interface, although barriers between functional areas may be more difficult to bridge than barriers between people that have a similar knowledge field or job.

Direct effects and indirect effects of integrating mechanisms on NPP

The integrating mechanisms examined in this study are used to increase the level of integration between marketing and R&D in companies. Since integration has a positive effect on NPP [cf. 17, 19, 42], these mechanisms - in an *indirect* way- are expected to produce beneficial outcomes for the company.

Apart from the indirect effect of integrating mechanisms, the mechanisms might also have a *direct* effect on NPP. Pinto et al. [38] found that team structures (operationalization of the organizational structure mechanism) had a positive effect on cross-functional cooperation and an additional *direct* positive effect on some task and psychological outcomes (not through increased cooperation). This is one of the few reporting both direct and indirect effects of mechanisms. The effect of the mechanisms on NPP was however not examined.

If a direct effect of an integrating mechanism on NPP exists, we generally expect it to be *positive*. The adoption of integrating mechanisms is likely to affect the general organizational climate and the motivation of personnel positively. For example, mechanisms such as informal trips, teamwork and job rotation may result in jobs that are more exciting and challenging in general and therefore create more productive employees and better new products

Particular mechanisms may have a *negative* side-effect on NPP. Some mechanisms may not result in more challenging tasks or they may lead to too high levels of formalization. Formalization reflects the emphasis in an organization on following rules and procedures. In the literature, many studies have found that formalization can have a negative effect on NPP [3, 12]. For example, in a meta-study of Damanpour [12] it was found that there is in

general a negative relationship between formalization and innovation performance and that high formalization discourages new ideas and innovative behavior [36]. As a result, specific integrating mechanisms may improve the operation of the marketing – R&D interface; however possibly at the expense of increasing the overall formalization and complexity of the new product development process.

In summary, we expect all integrating mechanisms to have positive effects on integration and, through integration, on NPP (H1a-f and H2 in Figure 1). In addition, if direct effects on NPP occur, they are expected to be positive although negative effects may emerge occasionally (H3 in Figure 1).

4. Data Collection and Measurements

The data for testing the relationships in the model were collected by means of an international mail survey in the pharmaceutical industry. In this industry, basic research as well as development play an important role next to marketing. This enables a true test of the mechanisms in an R *and* D setting. In addition, the pharmaceutical industry is a well-documented and relatively ‘open’ industry that is often used in marketing, innovation, and strategy research [6, 21, 22, 35].

In order to stay competitive, pharmaceutical companies need new products. On average, companies spend 15% of their sales on R&D and new products introduced in the last five years generate almost 30-40% of the revenues of the average company [30, p.71]. Finally, as in many other industries, pharmaceutical companies are actively organizing their

new product development efforts by means of integrating mechanisms to integrate marketing and R&D further to boost performance (e.g., *Forbes*, January 1999).

Questionnaire and procedure

Using literature and exploratory interviews, we developed a draft questionnaire containing sections on background, integration between marketing and R&D, integrating mechanisms, and NPP. Exploratory interviews were conducted among academics and managers in companies in different countries. Each interview started as an open interview on NPP and its determinants, in particular on integration and the mechanisms that can produce integration. Finally, the items of the scales and the lay-out were discussed. The interviews resulted in small refinements with respect to certain scales and the questionnaire in general. The final questionnaire was in English since we learned that the targeted senior executives are able to communicate perfectly in this language in all countries.

A random sample of 1,000 senior managers from different pharmaceutical companies worldwide was drawn from a large ESOMAR¹ database. As respondents we choose senior managers in marketing and/or R&D, because they were likely to be most knowledgeable about the topics in the questionnaire. With respect to the mailing procedure, we opted for a two-wave procedure plus a reminder after the first wave. During the whole procedure, the guidelines of Dillman [13] were closely followed.

¹ European Society for Opinion and Market Research. The database contained 3,000 records, encompassing fields such as company name, senior manager contact person, job title, and address.

A total number of 211 questionnaires were returned unopened (wrong address, respondent moved, etc.). Therefore, the effective sample size was 789. Given the response of 148 filled-out questionnaires, a response rate of 19% was obtained. This response rate is acceptable for an international business survey [cf. 24].

The average age of the respondents was 44.6 years; 61% worked in marketing and 39% in R&D.² In addition, 75% has a technical educational background and 25% has a non-technical educational background. Of all respondents, 51.4% has experiences with job rotation.

The companies for which the respondents worked tended to be large with an average of 10,434 employees and generating average total revenues of more than US\$ 3 Billion. All companies have marketing and R&D personnel with on average 1,095 marketing employees and 1,579 R&D employees. In the sample, 57.5% of the companies is European, 29.7% is from the US, and 12.8% is Japanese. The average percentage of revenues generated by new products introduced in the last five years is 33%, which is about average for high tech industries [8].

There were no significant differences for the company characteristics between the companies scored by senior marketing managers and those that were scored by senior R&D managers. Comparison of respondent profiles and company characteristics of early and late responses revealed no significant differences at a $p = .10$ level. Consequently, there are no indications of response bias because of non-response in our sample.

² This reflects the composition of the overall database with 33% of the managers from R&D and 67% of the managers with a marketing job.

Measurements

Integrating mechanisms. To measure the use of specific integrating mechanisms in companies, the different mechanisms were operationalized. We asked the respondent to score his or her company with respect to seven types of mechanisms. All mechanisms, their names and the measurement scales together with all the other constructs and their measures are presented in Appendix 1.

Most mechanisms speak for themselves. In the questionnaire, survival trips (part of informal social systems) were described as “sending personnel to a totally different environment to stimulate multi-functional group dynamic processes. For example, survivals, brainstorm sessions at a deserted location, etc.”. The answering categories are arranged in a way that a higher score on a particular mechanism scale represents a more intense ‘use’ of that particular integrating mechanism. For integrative management processes (i.e., review board) the score represents the importance of this mechanism in the organization, measured by its impact on the NPD process.

Factor analysis was used to verify whether specific items loaded on one dimension. This resulted in three multi-item scales for specific integrating mechanisms with satisfactory reliabilities, namely for organizational structure (2 items, Cronbach $\alpha = .56$), for incentives and rewards (2 items, Cronbach $\alpha = .65$), and for formal integrative management processes (3 items, Cronbach $\alpha = .80$). For each of these mechanisms, composites were calculated by averaging the scores of the items. The remaining four mechanisms are measured with single item indicators which is in line with earlier research in this area [23]. In addition, single item measures for mechanisms are not a serious drawback in this study since most of the

mechanisms are concrete (e.g., same building, different building, etc.). This measurement property does not create a need for multi item scales [cf. 39]. Finally, we note that although some scales are not strictly on an interval scale, empirical evidence support the treatment of ordinal measures as if they conform to interval scales [25]

Integration between marketing and R&D. A central construct in the present study is integration between marketing and R&D. An existing 15-item scale to measure integration in cross functional teams was slightly adapted and used to measure integration between marketing and R&D in a company [37, 38]. As an illustration of this adaptation, an original item like ‘A friendly attitude exists among project team members’, was changed to ‘*In my company, a friendly attitude exists among marketing and R&D*’. A confirmatory factor analysis using LISREL [46] showed that this integration measurement is one-dimensional $\chi(90) = 148.82, p = .001, RMSEA = .068, GFI = .88, CFI = .93$. The 15 items attained a Cronbach α reliability of .91. The scores on the items were averaged to compose the score on the overall scale for integration between marketing and R&D.

New product performance. To measure the performance of the company with respect to new products, a scale was constructed using items from the literature [18]. The six items (see Appendix 1) relate to the speed and quality of the new product development process. These items tap the product-level dimension of NPP according to the classification of Griffin and Page [18]. Confirmatory factor analysis revealed one underlying factor. $\chi(9) = 15.47, p = .08, RMSEA = .074, GFI = .96, CFI = .98$. The six items were averaged to develop a composite scale for new product performance (Cronbach $\alpha = .89$)

5. Results

Before the model is tested, a description of the ‘use’ of the integrating mechanisms by the companies in the data set will be presented. The mechanisms, their operationalization, mean scores, and standard deviations are presented in Table 2.

Place Table 2 about here

The use of integrating mechanisms in companies

Table 2 shows that the chances of marketing and R&D meeting each other on the corridor are still low. The average physical closeness of marketing and R&D lies between “the same location, not the same building” and “the same building, but functional grouping.” About 60% of all respondents state that marketing and R&D are located in different buildings or different locations. Job rotation is not widely used. Over 80% of the respondents report that less than 20% of all *marketers* have cross-functional job rotation experience and over 90% of the respondents state that less than 20% of all *R&D employees* have such experience. This may illustrate that even in an industry in which a large proportion of marketing managers have a technical background (62% in our sample), job rotation between functional areas is more complicated than transferring people between related disciplines [cf. 17]. Informal survival trips are quite popular. The descriptive statistics show that about 30% of all managers have experience with this mechanism. Cross-functional project teams are even more widely used. About 50% of all marketing and R&D employees are, or have been, members of a cross-functional team. The career opportunities and salaries of marketing and R&D are somewhat unequal, with marketing being slightly better off. On the career

opportunities scale marketing gets an average score of 114 and on the salaries scale 105 (In both cases R&D is set at 100). Formal integrative management processes are of some importance with an average score of 2.7 on a 5-point scale. Frequency analysis revealed that for 45% of the companies, formal integrative management processes are very important or the main decision-making body. Finally, there is considerable use of ICT with an average score of 3.09 on a 5-point scale but there is also room for more use with almost 70% of companies reporting average or below average use of ICT.

Integrating mechanisms and their effects

To study the effects of integrating mechanisms and to test our model, bivariate correlations, a multiple regression model and finally path analysis are used.

Place Table 3 about here

The correlation coefficients between the integrating mechanisms are given in Table 3. This table contains the following messages.

- All the integration mechanisms are positively correlated with integration (last-but- one row of Table 3). Except for personnel movement (job rotation), all these correlation coefficients are significant.
- Integration is positively correlated with NPP ($r=0.15$; $p=.04$). This confirms the results from earlier studies that integration has a positive effect on NPP.

- Several of the integrating mechanisms are significantly correlated with NPP (last row of Table 3), but some of these correlation coefficients are negative. We will come back to this in the next paragraph when we study direct and indirect effects simultaneously.
- The correlations between the mechanisms are rather low (this is in accordance with the findings of Ittner and Lacker [23]). These low correlations indicate that there are no systematic patterns in which companies combine integrating mechanisms.

Table 4 gives the estimation results of a multiple regression model in which integration is the dependent variable and the seven integrating mechanisms are simultaneously entered as predictors. Given the relatively low correlations between the independent variables ($r < 0.25$, see Table 3), multicollinearity is not a problem here.

Place Table 4 about here

The results show that the different mechanisms are effective in producing integration between marketing and R&D. All regression coefficients carry a sign in the expected positive direction and for five of the seven mechanisms the coefficients are significant.

Table 4 shows that the mechanism with the strongest positive effect (beta) on integration is physical proximity of marketing and R&D people: the closer marketing and R&D, the more integration. Thus, one very practical means to improve integration between marketing and R&D is to bring them in close physical proximity. This is possible because from Table 2 we learn that often marketing and R&D are located in different buildings. Besides the effect of other integration mechanisms, this way of increasing the chances of

meeting has an independent positive effect on integration. In this context it is interesting that Van den Bulte and Moenaert [52] did not find a reduction in communication between marketing and R&D when R&D moved to a different building. One explanation for this may be that, in their study, the R&D people already had a network with the marketers in place when they left the old building and moved to the new facility. New employees might be more isolated in the future and therefore their result may be a special case.

Formal integrative management processes have the second strongest positive effect on integration. This is in line with anecdotal evidence in the popular press and some exploratory work of academics [7]. This finding illustrates that some type of formal process helps to bridge the gap between marketing and R&D considerably.

The new mechanism ICT has a relatively strong positive effect on integration and scores third in the overall effect size after controlling for the effects of other mechanisms. The relative strength of the effect is even larger than the effects of well-known mechanisms like teams and job rotation.

Incentives and rewards can be used to strengthen integration when management ensures that they are spread equally between marketing and R&D. We find that equal salary and career opportunities for marketing and R&D are positively related to integration. This is in line with the general literature that suggests that collective reward motivates people whose tasks are interdependent [e.g., 5].

Organizational structures (i.e., cross-functional teams) are effective in producing more integration. However, the effectiveness is somewhat below our expectation. In addition, the possibilities for the average company to increase the use of teams are low because from Table 2 we learned that they are already widely used. Recently a lot of

attention has been paid to the effectiveness of cross-functional teams [see for example 5]. These studies focus on processes in and around teams that can make them effective. So, apart from the number of teams, which is the focus of this study, the internal and external processes must be watched closely when companies consider using this mechanism.

With respect to informal social systems (i.e., survival trips), the effect is also positive but not significant. So far, not enough empirical research has been carried out on this mechanism to be able to explain this finding. Interestingly, the only significant interactions between mechanisms are between this mechanism and ICT ($p=.03$, $\Delta R^2=.03$) and between informal social systems and organizational structure ($p=.08$, $\Delta R^2=.02$). After investigating the nature of the interactions, we learned that these interactions imply that informal social systems lead to more integration, only if there is little use of ICT and/or cross-functional teams (organizational structure). In other words, informal social systems seem to have no additional benefits when ICT and/ or teams are already used extensively. With respect to the benefits of ICT compared to informal social systems, it seems that ICT has the ability to build informal networks too and therefore there is less need for informal social systems in conjunction with ICT.

For personnel movement the beta is positive but also not significant. Although earlier research already mentioned some problems with respect to the effectiveness of this mechanism, this is also somewhat below our expectation. Moenaert and Souder [30] show that information received from people who recently moved into another position is perceived as less credible. For credibility, people need more time on the job, which is often not possible because the frequency of switching between jobs is high. Another possible explanation has to do with the low average use (and low variance in scores) by companies

of this mechanism, which may prevent a significant relationship from emerging in the regression. Overall, the mechanisms explain a significant proportion of variance in integration (24%, $F=5.68$, $p < .001$). The level of variance that is explained may be increased by adding other integrating mechanisms or factors such as leadership styles and centralization as predictors. Also in industries with less research and more development, the gap may be smaller and easier to bridge by using integrating mechanisms.

Additional analyses were carried out. For example, all possible two-way interactions between integrating mechanisms were explored, but no substantial interactions (apart from the ones just mentioned) were found. Additionally, the data was split into questionnaires from managers with a marketing background and those with an R&D background. Despite some differences in the sizes of the betas, the general pattern was very similar between the two groups. Overall, the results are robust and therefore we find support for H1a-f (although weak for b and c).

Testing direct and indirect effects simultaneously

In the last part of this section, the direct and indirect effects of integrating mechanisms are studied simultaneously. For this, we use path analysis [34].

Figure 2 presents the standardized beta coefficients and t-values for each mechanism. The model has a good fit, indicated by $\chi(5)=4.90$, $p = .43$, RMSEA= .01, GFI= .99, CFI= .99.

Place Figure 2 about here

The results show that all integrating mechanisms have a positive effect on integration, indicated by the positive betas in the different paths. Compared to the previous analysis, formal integrative management systems processes gain some effectiveness just surpassing the effectiveness of relocation and physical facilities. In the path model, integration has a significant positive effect on NPP ($p < .10$). H2 is supported. Through this positive relationship between integration and NPP, the different integrating mechanisms have a positive indirect effect on NPP.

Two mechanisms also have a significant *direct* effect on NPP: (1) formal integrative management processes and (2) ICT. For these two mechanisms, H3 is supported and integration is not a perfect mediator of the relationship between these mechanisms and NPP [2]. We are somewhat surprised by the strength of the negative effect of the phase review boards and the positive effect of ICT. We argue that our findings show that companies are not able to reduce potential negative side-effects of phase review boards, which may hinder employee initiatives and flexibility. The existence of the direct effect of ICT on NPP is very interesting and unexpected. Apart from using ICT to bridge the barriers between marketing and R&D, it shows that ICT has beneficial effects on the overall NPD process. This phenomena is also mentioned in other studies that hint to the fact that ICT not only facilitates the combination of knowledge but also the creation of it. No other mechanism has this type of dual benefit for NPP.

6. Conclusions and Managerial Implications

In the present study we investigated the effectiveness of seven different integrating mechanisms in organizations in order to find out which mechanism can be used as the most effective medicine to increase integration between marketing and R&D, and ultimately NPP.

All seven mechanisms examined in this study have a positive effect on integration, five of which have a significant impact. This is in line with earlier findings in the literature.

The first contribution of this study results from the fact that we compared the effectiveness of a broad range of mechanisms in the same study. By using this approach, we learned that relocation and physical facilities design and formal integrative management processes are most effective in producing more integration. Additionally, incentives and rewards, ICT and organizational structure are also effective but personnel movement and informal social sessions seem rather ineffective compared to the other mechanisms. Since the use of integrating mechanisms can be accompanied by considerable investments, this study offers insights into what mechanisms can be most valuable for the organization. For personnel movement (i.e., job rotation) and informal social systems (i.e., survival trips) no significant effects on integration were found although we found some indications that they may work in the absence, or modest use, of ICT and cross-functional teams.

The second contribution of this study comes from the fact that direct effects on NPP and indirect effects through integration are studied simultaneously. Path analysis showed that formal integrative management processes have a direct *negative* effect on NPP. So, notwithstanding the fact that this mechanism has strong beneficial properties that lead to

more integration, it has undesirable side effects. Since integration is not the goal per se, the overall effectiveness of this mechanism may be questioned. We argue that it may be possible to avoid this negative side effect by reducing the level of formalization and complexity, which usually accompanies this mechanism.

Our third contribution relates to our efforts to enlarge the set of integrating mechanisms of Griffin and Hauser [17]. The inclusion of the ICT mechanism has led to two interesting results. First, a relatively strong effect of ICT on integration was found. This effect appears to be stronger than highly acclaimed mechanisms such as cross-functional teams and personnel movement. Second, ICT is the only mechanism that has significant positive side effects on NPP. As a result, ICT can be a powerful medicine for the interface and NPP.

Managerial implications

From a managerial perspective, our study helps managers decide on how to improve the marketing – R&D interface and on what integrating mechanisms to focus first. By providing insights on the relative effectiveness of mechanisms, we help to prevent managers from focussing on less effective mechanisms and wasting considerable time and resources. In general, our study shows that, at least in the pharmaceutical industry, most mechanisms are effective but that some are more effective than others.

With respect to specific mechanisms, our research shows that physical distance is a simple but very effective integrating mechanism. Locating marketing and R&D close to each other has a strong positive effect on integration. There is room for improvement here because we learned that in about 60% of the investigated companies, marketing and R&D were housed in different buildings, even if they are working at the same site.

With respect to “formal integrative management processes” our study shows that managers have to exercise caution when using this mechanism. Although this mechanism has a strong positive effect on integration, the formalization and complexity that it often brings along may cause problems in other areas such as employee initiatives and flexibility. We would advise managers to monitor the number of new ideas, the motivation of NPD personnel, and the amount of paperwork in order to make sure that negative side-effects do not overshadow the integration benefits of this mechanism.

Our research shows that ICT is an important integrating mechanism that can produce a better interface between marketing and R&D. Apart from increasing the level of integration, this mechanism has other positive side-effects that affect performance. ICT not only helps to transfer knowledge between marketing and R&D, it can also support the creation of *new* knowledge. According to Nonaka et. al [32, p. 280], ICT may facilitate socialization and externalization processes that play an important role in the acquisition of tacit knowledge from customer and fellow researchers. Therefore, given the broader effectiveness of ICT in a new product setting, ICT may be given a high priority in any approach to improve NPP (not only through increased integration). According to Williams and Cothrel [49], executives in many industries have barely begun to grapple with new forms of online interaction. Their ability to create and manage internal online communities will become a distinguishing feature of nearly every successful business. At Ford Motor Co. they claim to have the ICT infrastructure in place that help functional specialists to reconnect, not so much in physical space, but as online communities [49]. Our study shows that this may even be possible between people from different functional areas.

7. Limitations and Future Research

Our study has limitations. First, the test of the model was conducted in the pharmaceutical industry. Although this approach enabled us to conduct an in-depth study and control for a considerable amount of environmental ‘noise’, it might limit our ability to generalize our findings somewhat. Although this should be the object of empirical verification, we do not see any a-priori reasons why the effects observed would be different in other industries. The actual effects might vary somewhat in size, depending on whether the industry is more *Development* oriented instead of *R&D* oriented, but we would expect the same pattern of indirect and direct effects of integrating mechanisms elsewhere.

Second, the present study used a survey to test the model. The resulting correlations support the expected relationships to a large extent, but they do not strictly prove causality. Future research may use experimental research to find further proof for the directions of the effects. For example, experiments could be conducted using the simulated environments of business simulations, such as MARKSTRAT [47] and manipulating for example the physical distance between team members. Another option would be to monitor organizations longitudinally when they are implementing – or increasing the use of – new integrating mechanisms.

Third, the mechanisms that were studied do not give a complete picture of all the mechanisms that are used in companies. In addition, our operationalization of the mechanisms have tapped only specific parts of the mechanism. More research using other mechanisms and other operationalizations is needed to extend our findings.

Fourth, the costs of specific mechanisms have to be included in order to make a judgement on the cost efficiency of each mechanism. Costs are likely to play an important role in any decision to implement or increase the use of an integrating mechanism. For example, we found that the relative effectiveness of survival trips and job rotation is low. However, given the fact that it may be much cheaper to send employees on a trip than it is to implement a system for job rotation, survival trips may be a more attractive option than job rotation.

Finally, our study shows that there are factors besides integrating mechanisms that affect integration (a considerable amount of variance still has to be explained). More research is needed on other organizational factors that have an effect on the level of integration in companies, for example, characteristics such as leadership styles, planning procedures and other factors related to organizational structure in general. Additionally, more attention should be paid to the relationship between integration and NPP and other factors that affect NPP [see for example 31]. We hope that our work has also triggered curiosity with regard to these factors.

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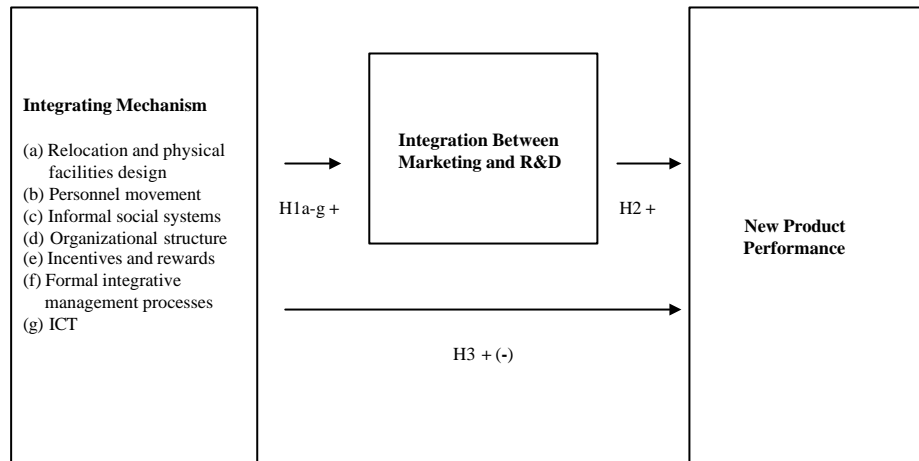


Figure 1: The model underlying the study

Table 1: Empirical research on the effectiveness of integrating mechanisms

Integrating Mechanism	Empirical study	Number of mechanisms in study ^a	Positive effect on M-R&D interface?	Effect on New Product Performance studied?
Relocation and physical facilities design	- Pinto et al., 1993	2	Yes, cooperation	No, but some beneficial task and psychological outcomes
	- Van den Bulte Moenaert, 1998	1	Mixed effects on communication	No
Personnel movement	- Souder, 1994	1	Yes, problem solving	No
	- Moenaert and Souder, 1997	1	Yes, information utility	No
Informal social systems	- Dougherty, 1992	2	Yes, decrease “thought-worlds”	Limited, success and failure distinction
Organization structure	- Dougherty, 1992		Yes, decrease “thought-worlds”	Limited, success and failure distinction
	- Pinto et al., 1993		Yes, cooperation	see above
	- Ittner and Larcker, 1997	3	Not studied	Not studied, marginal effect on overall business performance
Incentives and rewards	- Donnellon, 1993	1	Yes, cooperation	No
	- Ittner and Larcker, 1997		Not studied	see above
Formal integrative management processes	- Souder, 1977	1	Yes, integration, cooperation	No
	- Cooper and Kleinschmidt, 1986	1	No, but positive effect on task completion	Yes, higher likelihood of success
	- Ittner and Larcker, 1997		see above	see above

^a Sometimes more than one operationalization for a particular mechanism is included in the study.

Table 2: The use of integrating mechanisms in the pharmaceutical industry

Variable	Operationalization	Mean	St.Dev.
a. Relocation and physical facilities design	Physical closeness between marketing and R&D	3.25	.99
b. Personnel movement	Proportion of managers involved in cross-functional job rotation	1.77	1.02
c. Informal social systems	Proportion of managers that participate in informal survival trips	2.49	1.81
d. Organizational structure	Proportion of managers that participate in cross-functional teams	3.81	1.46
e. Incentives and rewards	Equal career opportunities and salaries for marketing and R&D ^b	86.7	23.4
f. Formal integrative management processes	Importance of cross-functional phase review boards	2.70	1.62
g. Information and communication technology	Use of ICT such as e-mail, video conferencing, internet, databases	3.09	1.03

^b Transformed scale. If the score < 100, marketing has better incentives and rewards. If the score > 100, R&D has an advantage.

Table 3: Inter-variable correlations

No.	Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1)	Relocation and physical facilities design (physical closeness)	-								
(2)	Personnel movement (job rotation)	-.06	-							
(3)	Informal social systems (survival trips)	.11	.06	-						
(4)	Organizational structure (cross-functional teams)	.01	.18**	.25***	-					
(5)	Incentives and rewards (equal incentives and rewards)	.03	.05	-.03	.04	-				
(6)	Formal integrative management processes (cross-functional phase review board)	-.13	-.06	.02	.12	-.06	-			
(7)	New information and communication technology (ICT)	-.07	.04	.03	.12	-.06	.02	-		
(8)	Integration between marketing and R&D	.23***	.10	.18**	.23***	.17**	.24***	.16*	-	
(9)	New product performance	.01	.11	-.15*	.04	.16*	-.15*	.20**	.15*	-

*p<.10

**p<.05

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

Table 4: Regression model for integration, with integrating mechanisms as independent variables

Independent variables		Dependent variable: Integration		
		b	beta	t
a.	Relocation and physical facilities design (physical closeness)	.16	.29	3.54***
b.	Personnel movement (job rotation)	.05	.04	.09
c.	Informal social systems (survival trips)	.02	.09	1.06
d.	Organizational structure (cross-functional project teams)	.06	.15	1.75*
e.	Incentives and rewards (equal incentives and rewards)	.004	.19	2.40**
f.	Formal integrative management processes (cross-functional phase review board)	.08	.22	2.75***
g.	Information and communication technology (ICT)	.11	.20	2.48***
R ²		.24		
Adj. R ²		.20		
N		134		
F		5.68***		

*p<.10

**p<.05

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

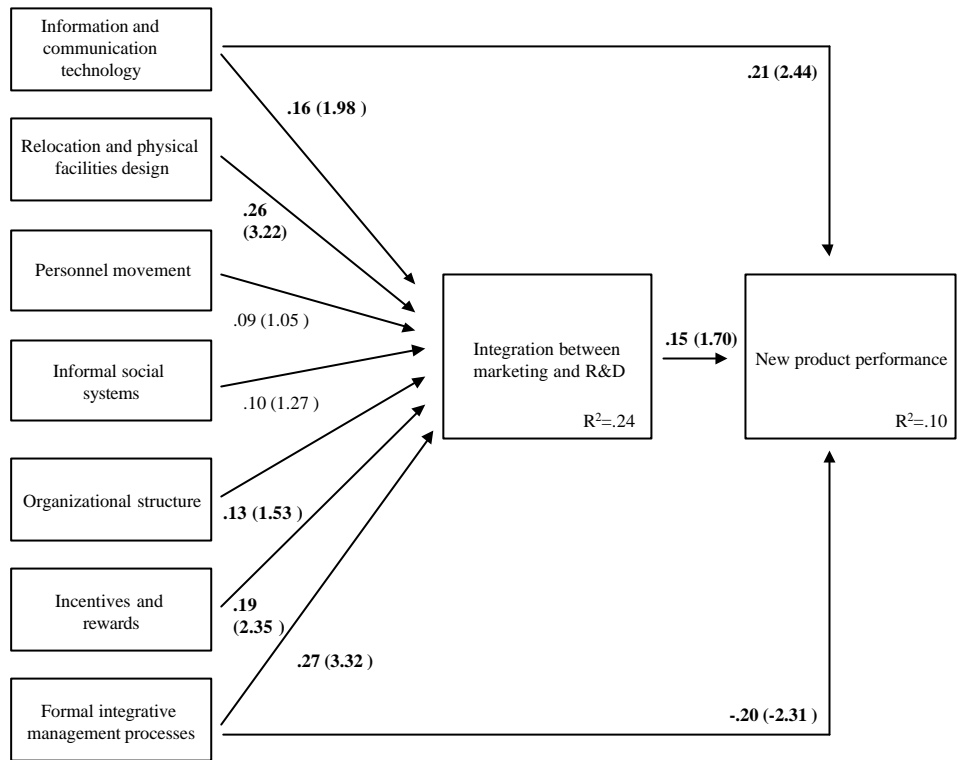


Figure 2: Estimated path model (standardized regression coefficients, t-values in parentheses, significant coefficients are in bold type, one-tailed tests)

Appendix 1: Measurement scales used in this study

Integrating mechanism

Answering categories

Relocation and physical facilities design

Physical closeness of marketing and R&D

5-point scale (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)")

Personnel movement

Proportion of managers with cross-functional job rotation experience

7-point scale (1="0-5%", 2="5-15%", 3="20-40%", 4="40-60%", 5="60-80%", 6="80-95%", 7="95-100%")

Informal social systems

Proportion of managers sent on survival meetings (group dynamic processes)

7-point scale (see above)

Organizational structure (2 items)

Proportion of marketing managers who are members of a cross-functional team

7-point scale (see above)

Proportion of R&D managers who are members of a cross-functional team

7-point scale (see above)

Incentives and rewards (2 items)

Remuneration of marketing

Number. Question to the respondent: if we take the number 100 for the remuneration of R&D employees, which number expresses the quality of remuneration of marketing employees?

Career opportunities of marketing

Number (similar format)

Formal integrative management processes (3 items)

Importance of cross-functional idea review board (versus functional management)

5-point scale, 1="functional management is the main decision making body", 5="cross-functional review board is main decision-making body"

Importance of cross-functional monitor board (versus functional management)

5-point scale (similar format)

Importance of cross-functional monitor board (versus project management)

5-point scale (similar format)

Information and communication technology (ICT)

Use of new information and communication technology such as e-mail, video conferencing, databases, internet

5 point scale, 1="used poorly", 5="used extensively"

Integration between marketing and R&D (INTEGRAT)

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 mutually agreeable.
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.

All the items are measured with 5-point Likert scales; 1=strongly disagree, 5=strongly agree.

New product performance (NPP)

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.

All the items are measured with 5-point scales using the following format: Compare your company with companies of similar size in the industry, 1=part of lowest performing 20% of companies, 5= part of highest performing 20% of companies.

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