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Cross-divisional innovation in large, multi-divisional firms:

Economic relevance and managerial actions

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INTRODUCTION

The ability to identify complementary resources in the business environment has proven to be a key success factor in global competition (Phene, Fladmoe-Lindquist, & Marsh, 2006; Rosenkopf & Nerkar, 2001). Firms with a narrow resource base gain access to distant resources only via alliances with other organisations, while multidivisional companies also have the option to recombine resources between divisions.

In the case of the electronics firm Philips, for example, the multimedia and lighting divisions jointly developed a new television set based on complementary divisional technologies. Industry experts consider this highly successful cross-divisional product a radical innovation in consumer electronics (Diederiks & Hoonhout, 2007). In the pharmaceuticals industry, Roche combines knowledge of its pharmaceuticals and diagnostics divisions to develop integrated healthcare solutions. Motorola managed to introduce the first commercial mobile phone in a cross-divisional venture between radio communications and semiconductor business units. The results of a patent analysis by Miller, Fern, and Cardinal (2007) even suggest that the combination of knowledge between divisions has a higher impact than knowledge recombination between different firms. These findings indicate that the multibusiness corporation can exploit valuable synergies if divisions cooperate in product development.

Yet, there is little research based evidence about what determines the emergence of cross-divisional innovation in the large corporation. Researchers have examined topics such as cross-divisional resource reconfiguration (Galunic & Eisenhardt, 2001; Galunic & Rodan, 1998), knowledge transfer (Allen, James & Garnlen, 2007; Hansen, 1999; Tsai, 2001), or formal research and development structure (Argyres & Silverman, 2004; Eto, 1991). At the project level, Martin and Eisenhardt (2010) examine the key differences between successful and failed cross-

divisional projects. Kleinbaum and Thusman (2007) develop a theoretical model on the relevance of social networks for cross-divisional innovation.

Therefore, we address the following research questions from a corporate perspective: *(1) What is the role of the early stages of innovation in cross-divisional ventures?* In this section of the process, ideas and first concepts for innovations are gathered, evaluated and selected. Furthermore, product definitions are derived and go/no-go decisions on new product development projects are made. Hence, we assume that exchange between divisions in this stage will strongly influence the number and value of cross-divisional ventures. This leads us to our second question: *(2) How can corporate managers stimulate cross-divisional collaboration in the front end of innovation?*

With this paper, we contribute to the existing literature by developing a conceptual framework on the emergence of joint projects and the functions of instruments to facilitate cross-divisional collaboration. We employ a mixed methods approach, comprising a large-scale survey in 126 multidivisional firms as well as a case study. Our large-scale survey allows us to assess the interrelationships in our model via statistical means. The subsequent case study provides us with the opportunity to gain a deeper understanding of how these interrelationships work.

Our paper is structured as follows: In the next section, we start with a discussion of possible reasons for the perceived lack of research and management attention for resource combination between divisions. In the following section, we derive arguments for the relevance of cross-divisional innovation from a theoretical perspective. In the fourth section, we design a research framework and derive propositions. In the fifth section, we present our empirical analysis' methodology and results. The paper closes with a discussion.

CROSS-DIVISIONAL INNOVATION – A NEGLECTED PHENOMENON?

Cross-divisional products from firms such as Philips, Motorola, or Roche indicate the relevance of joint product development initiatives in company success. Strategic management literature even provides the first scientific evidence (Miller, Fern, & Cardinal, 2006). However, it is surprising that, 45 years after Ansoff's (1965) seminal work on synergy, so few publications have examined the potential of cross-divisional innovation. Before we discuss its impact in the following section, potential reasons for the perceived lack of research and management attention are presented.

First, the multidivisional organisation seeks to optimise divisional dependencies around products or technologies by allocating specific activities to specific divisions (Kleinbaum & Tushman, 2008). Although synergies between organisational units have been subject to research (Ansoff, 1965), scholars have mainly focused on resource sharing, rather than resource *combination* (Campbell & Goold, 2000; Gupta & Govindarajan, 1986).

Second, the idea of divisional profit and loss responsibility is a key characteristic of the multidivisional concept. This may lead divisions to compete and even cannibalise each other, thereby allowing the corporation to improve its future orientation (Chandy & Tellis, 1998) and to further stimulate innovation dynamics. Consequently, the idea of cooperation seems to be contrarian. Cooperation between autonomous divisions must be managed along divisional initiatives. The corporate level may play a role as an active broker or investor, but should not play a top-down role.

Third, a project launch requires all autonomous divisions to see a clear benefit in that project. As illustrated in figure 1, it might be unclear how involved divisions benefit from a joint idea. If, for instance, the future product has a strong business case but does not fit into the existing product portfolio, a future home for that product needs to be defined. It may be one of the involved

divisions, a new unit or even a start-up company. The process of finding this new home will be challenging and time-consuming as both cross-divisional support for the project and success of the launched product need to be ensured. If divisional shares are clear but project results are positive for one division and negative for the other a cross-divisional agreement on profit and loss sharing or a corporate center intervention is needed. Both cases will drive coordination efforts and thus impact the attractiveness of a joint project.

Insert Figure 1 about here

Fourth, interdivisional cooperation is even more difficult to achieve than cooperation between complementary functions such as R&D, marketing, and production as this additional ‘dimension’ is added. R&D activities now have to be coordinated between different functions of different divisions. Therefore, cross-divisional interaction may rarely occur and, if so, may face many obstacles. With a lack of top divisional commitment, very high coordination costs or even failing project champions, it seems advisable not to cross divisional boundaries. In short, efforts appear to offset the benefits of cross-divisional ventures, discouraging researchers from investing much time in such a topic.

WHY CROSS-DIVISIONAL INNOVATION MATTERS

The go or no-go decision for a cross-divisional project is basically determined by its costs and impact. On the cost side, firms are very likely to face higher coordination efforts, as the divisional structure is not intended to facilitate cross-divisional links (Kleinbaum & Tushman, 2007). However, the internet economy has significantly lowered transaction costs for knowledge exchange. For example, R&D employees can easily search the web for relevant information, and many corporations implemented knowledge management tools to handle the vast amount of information more efficiently.

Nevertheless, costs will be higher in interdivisional projects. To create additional value and offset these costs, the impact of joint innovation needs to be higher than that of intra-divisional ventures. In this regard, Henderson and Clark (1990) suggest that the ability to combine distant and previously unconnected resources is decisive for innovation. Patent analysis data provides empirical evidence for this notion by demonstrating that highly relevant patents tend to be based on different organisational or technological domains (Miller, Fern & Cardinal, 2006; Rosenkopf & Nerkar, 2001). Hence, literature on dynamic capabilities emphasises that a company's success depends on its abilities to build, adapt, integrate, reconfigure, and release resources (Helfat & Peteraf, 2003; Teece, Pisano & Shuen, 1997). Scholars further emphasise – in line with Henderson and Clark – that firms need to overcome local search and must explore the business environment to identify and seize new opportunities (Teece, 2007). Other studies have similarly emphasised the relevance of a firm's capacity to absorb external knowledge (Bröring & Leker, 2007; Cohen & Levinthal, 1990; Jansen, van den Bosch & Volberda, 2005; Lichtenthaler, 2010; Tsai, 2001).

To overcome local search and gain access to complementary assets, organisations with a narrow resource base need to establish alliances with other companies. By way of contrast, the increasing

size and diversification of multidivisional corporations provide these organisations with unique opportunities to discover completely new ways for resource recombination. Compared to interorganisational arrangements, higher secrecy, better access to information, and a broader range of available coordination instruments provide additional advantages. Scholars for example emphasise the value of integrated systems solution in converging technologies (Davies, Brady & Hobday, 2007; Page & Siemplenski, 1983). The definition and implementation of interfaces in these solutions are best managed through interdivisional cooperation.

First descriptive evidence for multidivisional companies from Germany, Austria and Switzerland reveals that more than half of these companies attach a high strategic importance to cross-divisional innovation (Grote, Herstatt & Gemünden, 2010). In short, the option to recombine highly diversified resources between divisions is very likely to result in a considerable value for large corporations. However, we pointed out in the previous chapter that cooperation is difficult to achieve. Agreements are needed that ensure a benefit for all involved divisions. The ability to meet these agreements certainly depends on various factors such as continuous cross-divisional exchange and clear processes. This leads us to our research framework.

RESEARCH FRAMEWORK

In our paper, we focus on the early stages of innovation, ranging from idea generation to project planning (Cooper, 1988; Kim & Wilemon, 2002). This stage includes tasks such as idea selection, product definition, and project planning (Khurana & Rosenthal, 1998), suggesting that their appropriate execution is strongly connected to the amount and value of cross-divisional products in the corporate innovation portfolio. As the nature of the future product is still unclear at the beginning of this stage, actors face a high level of uncertainty and dynamism (Murphy & Kumar, 1997; Verworn, Herstatt & Nagahira, 2008). Therefore, the early stage of innovation is

also well known as the so called fuzzy front end. In order to reduce uncertainty and dynamism, actors involved in the process need to gather information and engage in learning (Teece, 2007). Similar to interfirm alliances, cross-divisional activities require actors to learn about resources and challenges in other divisions (Dougherty, 1992; Kale & Singh, 2007; Knudsen, 2007). The likelihood to generate superior cross-divisional products ideas, for example, will be much higher if employees from division A are aware of the latest technological developments in division B. Works in the field of network theory emphasise that knowledge transfer between organisational units heavily depends on interaction between actors (Hansen, 1999; Tsai, 2000, 2002). For instance, employees from division A will gain a much better understanding for technological developments in division B once they have had the opportunity to ask questions and discuss these technologies' functionality with members of division B.

A key barrier to deliberate cross-divisional learning activities, and thus the launch of joint projects, is that communication channels evolve around the interactions that are critical to effective design (Henderson & Clark, 1990). For example, new product development requires interaction among different functional units such as R&D and marketing (Gupta, Raj & Wilemon, 1986). Consequently, social linkages will emerge between the R&D and marketing personnel involved in a common project. In contrast, R&D and marketing managers rarely exchange information with employees from other divisions, if at all.

Fortunately, the question of how to stimulate cross-unit interaction in general has been discussed intensively in the innovation management and organisation literature in the past 30 years (e.g., Argyres, 1995; Galbraith, 1973; Goold, Campbell & Alexander, 1994; Gulati & Singh, 1998). Much of this work is based on information processing theory, which postulates that a fit between information processing demand and capacity is needed. These capacities are provided via organisational structure or via coordination and control mechanisms (Daft & Lengel, 1986;

Tushman & Nadler, 1978). As divisional structure is a given in our study, we focus on the latter. A vast number of empirical studies have investigated the impact of coordination and control mechanisms on cross-unit interaction (e.g., Hill, Hitt & Hoskisson, 1992; Jansen, van den Bosch & Volberda, 2005; Leenders & Wierenga, 2002; Persaud, 2005; Persson, 2006). Coordination and control mechanisms comprise a range of different instruments that can be categorized into hierarchy, rules and procedures, integration mechanisms and incentives (Galbraith, 1973, 1994; Tushman & Nadler, 1978).

As previous work suggests, we focus on integration mechanisms and incentives (Gupta & Govindarajan, 2000; Jansen, van den Bosch & Volberda, 2005) thus excluding hierarchy as well as rules and procedures. Coordination via hierarchy would mean that corporate top management or a dedicated team would have to decide on the large number of potential cross-divisional projects and – what is even more important – identify and stimulate these projects. Similarly, standardized rules and procedures will most probably not help to stimulate efficient knowledge exchange between employees from different divisions and the generation of joint ideas.

Integration mechanisms include all instruments that help to establish communication channels between separated units. We suppose that corporate management can utilise interdivisional integration mechanisms to facilitate exchange in front end activities. For instance, a cross-divisional innovation manager committee allows those responsible for different divisions to meet regularly and to exchange information about new ventures or customer desires. Hence, we propose our first hypothesis:

Hypothesis 1: *The use of cross-divisional integration mechanisms positively influences the degree of cross-divisional collaboration in early stages of innovation.*

In the traditional multidivisional design, divisions are provided with profit and loss responsibilities (Birkinshaw & Lingblad, 2005). Hence, actual cooperation will depend on divisions' motivation to cooperate. Senior executives will decide by comparing benefits and costs (Porter, 1985). These benefits and costs might be unevenly distributed between the involved parties from different divisions. Furthermore, non-routine cross-divisional exchange seems to be more demanding than intra-divisional one. Divisional managers might need to invest a considerable amount of time in searching for relevant contacts in other divisions or convincing people to collaborate (Teece, 2007). They will bear these additional burdens if project results outweigh the efforts. However, project results are unclear as the future product still needs to be defined and questions on the business case are to be answered during the early stages of innovation. In short, managers will face additional efforts on one side and a considerable lack of information on project returns on the other.

This suggests that corporations in search of cross-divisional innovation need to incentivize cross-divisional activities in order to improve the equation above. For example, incentives such as an innovation award for cross-divisional products will motivate employees from one division to exchange knowledge with employees from another. Empirical studies on regional or cross-functional cooperation clearly support this notion by demonstrating that rewards influence knowledge exchange (Björkman, Barner-Rasmussen & Li, 2004; Fey & Furu, 2008; Hauptman & Hirji, 1999; Persson, 2006).

Additional incentives are, of course, needed for different hierarchical levels of an organization. For instance both decision makers in senior divisional management and R&D experts need to have appropriate incentives. Hence, we propose the following hypothesis for our research framework illustrated in Figure 2:

Hypothesis 2: *The use of rewards for cross-divisional exchange positively influences the degree of cross-divisional collaboration in the early stages of innovation.*

Prior research has emphasized the impact of knowledge flows between distant areas on performance (See chapter 2). Knowledge flows between different divisions in the early stages of innovation might lead to new project ideas for resource combination in order to solve customer problems or improve existing solutions, for instance. In their case study on cross-business projects, Martin and Eisenhardt (2010) confirm that deliberate learning activities in cross-divisional teams prior to a project decision are key to success.

Furthermore, a divisional commitment to allocate the required resources needs to be established in the early stages. This commitment very much depends on the existence of individuals with the respective organizational power to protect the innovation against resistance. Previous research underlined the relevance of these so called power promotors (Witte, 1977) on innovation success (Gemünden, Salomo, & Hölzle, 2007; Hauschildt & Kirchmann, 2001). A key challenge for cross-divisional projects can certainly be seen in the necessity to have power promotors in all participating divisions in order to ensure unanimous commitment. These promotors need to interact and align activities prior to project launch. Once their support is ensured, cross-divisional projects may have a significant advantage compared to intra-unit ventures due to the existence of multiple power promotors. Hence, we argue that establishing stronger links between divisions will affect the impact of cross-divisional projects on corporate success, measured by overall success:

Hypothesis 3: *The degree of cross-divisional collaboration in the early stages of innovation determines the impact of joint innovation on corporate success.*

Insert Figure 2 about here

EMPIRICAL ANALYSIS

Methodology

In the previous sections, we developed a corporate level framework based on theoretical insights and empirical findings from related research fields. As this framework may be assessed via standardised measures, a large-scale survey is possible. However, nothing is known about how the different elements in our framework are interconnected and which barriers are faced by cross-divisional project teams. To answer these questions, we decided to choose a mixed methods approach, comprising a large-scale survey and a case study (Miles & Huberman, 1994). Such an approach has various advantages. First, we are able to gain a holistic view of the topic (Jick, 1979). For example, a quantitative survey allows us to assess our hypotheses for a large sample. Thus, generalisation is easier than in small-sample research. The subsequent descriptive case study allows us to gain a better understanding for the relationships we assessed. Secondly, the use of different measurement instruments allows us to assess the validity of these instruments (Greene, Caracelli & Graham, 1989). Case study interviews, for example, may show whether we really have assessed the full scope of our constructs.

In order to identify multidivisional companies in Austria, Germany, and Switzerland, different databases (including Hoppenstedt, Firmendatenbank, and Creditreform) were used. In a first step, we selected all firms with more than 1,000 employees, thus yielding a sample of more than 2,600 organisations. Next, we validated whether companies had a multidivisional structure by visiting company websites or contacting these firms. This led to a sample of 734 multidivisional firms. With regards to respondents, our explorative interviews had shown that members of the top

management team or executives in the corporate development or innovation management departments were usually the most knowledgeable individuals to answer the questionnaire. Thus, we identified members of the top management team or, if the company had an innovation management in place or corporate development departments, executives from these departments. To check whether these respondents did actually fill out the questionnaire, an additional question concerning the respondent's position was included.

The questionnaire was developed over several stages. In an extensive literature review, we identified previous concepts and operationalised scale items. In explorative interviews, relevant aspects of the latent variables were discussed in order to ensure appropriate measurement. The questionnaire was validated in pre-tests with managers from three large multidivisional firms. Due to the lack of prior empirical research on cross-divisional innovations, we included room for respondents to provide additional information on relevant issues.

We collected questionnaire data from February to April 2008. This led to a total of 133 participating firms. With respect to our respondents being top management members, the 18% response rate is satisfying. Seven cases were eliminated due to missing or questionable data. Of the remaining 126 firms, 110 reported cross-divisional innovation. They represent the sample for the subsequent analysis.

To test for non-response bias, we compared early and late respondents (Armstrong & Overton, 1977). A t-test revealed no significant results between both groups. As the survey is based on a single informant design, we further tested for common method variance. Besides ensuring an appropriate questionnaire design, we used the Harman one-factor test (Podsakoff & Organ, 1986). Factor analysis yielded five factors that explaining 68% of variance, with the first factor accounting for 39%. As various factors are identified and the first factor does not account for the

majority of explained variance, we assume that common method variance was not an issue in this survey.

In order to test our hypotheses, we used the PLS approach, employing SmartPLS 2.0 (Ringle, Wende & Will, 2005). In contrast to covariance-based procedures, this approach allows for the estimation of relationships between latent variables for small sample sizes (Chin, 1998). Furthermore, formative measurement models can also be used in PLS, along with reflective measurement models. While reflective indicators of the same latent variable represent interchangeable measures of the same phenomenon, formative indicators measure different facets of the underlying construct and thus are not necessarily highly correlated. While changes in reflective indicators are caused by the underlying construct, formative indicators determine the latent variable (Bollen & Lennox, 1991). As PLS estimates path weights for each indicator, the formative index represents a weighted linear combination of its indicators. Thus, the contribution of each indicator to the composite score can be assessed (Lohmöller, 1989).

For the subsequent case study, we identified those companies in our sample that (1) had a moderate or even high share of cross-divisional innovation and (2) were representative. We contacted three of these companies and conducted first interviews with our respondents. As these companies did not differ much with regards to our research framework factors, we decided to focus on one company with more than 30,000 employees. This company consists of five divisions that have diversified in many businesses such as manufacturing and energy industries. In our embedded case study, we focused on the corporate level and on three different innovation projects. These projects served as units of analysis (Yin, 2003). We conducted interviews with senior managers at the corporate level and project team members from three different cross-divisional projects. In total, 21 employees were interviewed.

Measurement and validation of constructs

In the following section, measurement models for each construct are derived. These models are used in the questionnaire as well as the case study. To assess integration mechanisms, a formative measure is developed. Galbraith (1994) distinguishes three types of lateral organisation: mechanisms to foster informal networks, committees, and permanent units. In line with previous measurement models (Gupta & Govindarajan, 2000), cross-divisional groups and permanent units are assessed via single items. However, our explorative interviews have shown that it requires more than one item to measure the first mechanism's entire scope. Based on expert statements and previous research, we decided to focus on job rotation and information technology, due to their relevance (Barczak, Hultink & Sultan, 2008; Gupta & Govindarajan, 2000; Hauptman & Hirji, 1999; Leenders & Wierenga, 2002; Sicotte & Langley, 2000). In order to ensure that all facets are covered, measures were validated with managers from three multidivisional firms. In contrast to Gupta and Govindarajan (2000), we did not weight each indicator. As the PLS algorithm allows us to assess the contribution of each indicator by estimating individual weights, evidence on the impact of the different types is provided.

The reward system is assessed with three items. Based on Armstrong's (2007) conceptualisation of the corporate reward system and previous findings, we focus on two variable incentive types. The first item relates to divisional target setting. Various studies have investigated whether these objectives are linked to divisional or corporate performance (e.g., Fey & Furu, 2008; Hill, Hitt & Hoskisson, 1992). We also assessed whether employees receive any variable rewards linked to corporate performance. With these two items, we focus on monetary incentives. As the relevance of non-monetary rewards has recently been noted (Ellingsen & Johannesson, 2007), we include a third item to cover this potential facet of the reward system.

Referring to Wagner, Rink, and Ernst (2008), we measured collaboration in the early stages of innovation by assessing cross-divisional collaboration for basic front-end activities such as idea generation or assessment. These activities have been derived based on the model of Khurana and Rosenthal (1998). We ensured that this measure was valid for different industries. All formative constructs were measured on 5-point Likert scales.

In order to examine the contribution of cross-divisional innovation to overall firm success, we generated an item pool, as suggested by Parkhe (1993), who assessed alliance performance by asking for fulfilment of different strategic needs. In our survey, these strategic needs comprise the contribution of cross-divisional innovation regarding corporate competitive advantage, access to existing and new markets, and the creation of internal know-how. This construct was assessed via a five-point Rating scale. In addition, we employed a single indicator to measure the contribution of cross-divisional innovation as a percentage of corporate sales revenues. This item provides us with the opportunity to cross-validate results on our endogenous variable, as both measurement models differ in their level of abstraction: In order to assess the contribution of cross-divisional innovations to overall company goals, respondents need to engage in higher-order cognitive processes. In comparison, the assessment of a sales percentage is easier to estimate (Podsakoff & Organ, 1986). However, we need to bear in mind that our second measure represents only a single monetary dimension of our original measure.

These measures were used as items in our large-scale survey as well as interview guidelines in our case study (Yin, 2003). To ensure reliability and validity in our large-scale survey, we conducted the following analysis. For our formative scales, traditional statistical measures cannot be used due to their conceptual difference (Jarvis, Mackenzie & Podsakoff, 2003). Instead, indicator weights and t-values reveal which indicators contribute to the composite score (Chin, 1998). As PLS does not underlie any distribution assumptions, the bootstrapping resampling

technique (Efron & Tibshirani, 1993) is used in order to obtain t-values. We also assess the variance inflation factor (VIF) and the conditioning index (Belsley et al., 1980), to ensure the absence of multicollinearity. As formative indicators of one construct account for different facets, multicollinearity between indicators would distort results on the influence of individual indicators and, thus, facets. We considered two further recommendations regarding validity assessment. Some authors argue that a validation of formative measurement models needs to include the use of additional global measures for each construct. The formative indicators that correlate with the construct are considered valid (Diamantopoulos & Winklhofer, 2001). In contrast, Albers and Hildebrandt (2006) argue that formative latent variables cover different facets. Hence, not all formative indicators need to correlate with the external variable. We followed Anderson and Gerbing's (1991) suggestion by asking researchers as well as experts from multidivisional companies to assign given indicators to constructs.

Table 1 presents the evaluation results for our formative measurement models. All weights in our index on integration mechanisms have positive signs. However, the item on organisational units is not significant. Concerning the reward system, the indicators related to annual objectives (β = .61, $p < .001$) and non-monetary incentives (β = .59, $p < .001$) show large and significant weights while the indicator weight for monetary incentives is low and not significant (β = .09, $p > .05$). With regards to our measurement model on collaboration in the early stages, estimated indicator weights of the *product strategy* item (β = .45, $p < .001$) and *idea generation* (β = .31, $p < .05$) are positive and significant. The weight relating to *project planning* is well above 0.20, but not significant (β = .21, $p > .05$). The items on *idea evaluation*, *feasibility studies*, *product concepts*, and *project planning* have weights below 0.20 and are not significant. The maximum VIF within the models is 2.6, which is well below the threshold of 10. Further along, values for the conditioning index are below the required value of 30.

Insert Table 1 about here

We assessed reliability for the reflective measurement model by first calculating Cronbach's α. With a value of .81, it is above the threshold level of .70 (Nunnally, 1978). For this reason, the item-to-total correlation was not assessed. Factor loadings show values above .70 except for the item *access to new markets* (.64). We examined convergence validity through exploratory factor analysis, in which only one factor was extracted. Extracted variance and construct reliability exceed thresholds. Based on these results, the item *access to new markets*, which is well above the common threshold of .40, is kept in the measurement model (Hulland, 1999). In addition, the average extracted variance is higher than any squared correlation with other constructs (Fornell & Larcker, 1981). Thus, the measurement model can be regarded as reliable and valid. Table 2 illustrates the validation results for the reflective measurement model.

Insert Table 2 about here

In order to account for additional correlations with other variables, we examined the following potential influences: As collaboration between divisions tends to be more difficult in larger firms, we assessed firm size by number of employees and sales (Tsai, 2002). Further, the role of the corporate centre is likely to influence collaboration (Goold, Campbell & Alexander, 1994). Accordingly, respondents were asked to indicate whether corporate centre controls divisions via definition of financial or strategic objectives. Finally, we assessed whether divisional boundaries were drawn related to product segments, industries, or other criteria.

To ensure reliability and validity in the subsequent case study, various measures were taken based on Yin's (2003) suggestions. Concerning reliability, we used interview protocols and a

database for our results. Validity includes construct validity as well as internal and external validity. To secure construct validity, three steps were taken: First, we based our interview guideline on the validated measurement models we used in the preceding quantitative study. Second, we conducted interviews with several people at the corporate and project level. Triangulation of interview results improved validity (Jick, 1979). Third, we discussed the interview results with key informants. To ensure internal validity, we assessed our hypotheses based on the conceptual framework. Concerning external validity, as the last type, we compared three different innovation projects with each other.

Analysis and results

Table 3 shows the descriptive statistics and correlations prior to PLS analysis. It is interesting to note that especially the mean for integration mechanisms is quite high (3.58 on a 5-point scale) for the sample of firms that innovate across divisions.

Insert Table 3 about here

To test our hypotheses, we start with an assessment of the path coefficients and their t-values from the quantitative survey.

Our first hypothesis, on the impact of integration mechanisms, is confirmed with a significant correlation in the expected direction (β = .24, p < .05). To gain a better understanding for this relationship in our case study, we discussed the general issue of barriers to knowledge exchange and gathered an overview on the use of particular integration mechanisms.

Project managers named various challenges, most of them referred to the isolation of information within divisional boundaries. One project manager described how his search for a contact in

another division led him up to a divisional board member who then forwarded the request to another division's management board. After several weeks, the right contact was found.

The project manager clearly stressed out the need for electronic yellow pages or a similar IT tool that helps to increase transparency. In the later process stages prior to project execution, deliberate learning and knowledge exchange were perceived as key success factors. For instance, one employee stated:

"To execute a joint innovation project, it is critical to get all involved parties together. You would need kind of committees to assess joint ideas. Thus, good ideas could get the go decision for an innovation project quicker."

Innovation managers at the corporate level further illustrated the relevance of integration mechanisms in order to overcome knowledge isolation. For instance, a regular meeting between the R&D directors of each unit allowed for knowledge exchange on the latest product development projects. As this committee also had members decide on joint activities, no additional meetings needed to be arranged or contacts identified.

With regards to our second hypothesis on the reward system, the path coefficient pointing from reward system to collaboration in the early stages of innovation is positive and significant (β = .44, $p < .001$). Thus, hypothesis 2 is confirmed. Discussions with respondents in our case study illustrated the strong impact of incentives on collaboration between divisions:

"As soon as employees in one division note a potential to gather profit, they start to become active. But if that division got the feeling that it's too much effort, it won't do anything at all."

Interviews we held with employees in different positions illustrated that this challenge needs to be addressed on all hierarchy levels. Several examples were provided for a lack of senior management support, which eventually led to significant delays or even project failure. As one senior manager stated, no difference is made between profits resulting from a cross-divisional or

a divisional project but the efforts to execute the cross-divisional one are considerably higher. Thus, it is difficult to ensure senior management's support for a cross-divisional project. On the project level, a workshop with experienced managers revealed in a similar way the need for cross-divisional incentives to facilitate cooperation: Some of the managers who had already steered a cross-divisional project complained about the lack of appraisal for this complex and demanding task. In face-to-face interviews, we asked these managers to think about ways to improve the situation. The answers were quite surprising for us as the project managers mentioned various non-material incentives and only few monetary options like bonus payments. For instance, our respondents highly appreciated a distinct project manager certificate, an existing innovation award and special articles in the employee magazine.

In summary, our results confirm that incentives are required to overcome divisional self-interest (Argyres, 1995; Martin & Eisenhardt, 2010).

With regards to our third hypothesis, we obtained a very strong relationship for the impact of cross-divisional collaboration in the front end on the degree to which joint innovations contribute to company success ($\beta = .73$, $p < .001$). The assessment of our alternative endogenous variable on the revenue share of cross-divisional innovation supports this result. For the interrelationship between the degree of cross-divisional collaboration and revenue share, a path coefficient of 0.35 ($p < .001$) is estimated in SmartPLS. In our case study, a comparison of the three innovation projects further illustrates this strong relationship. For instance, divisions did not collaborate intensively to assess the idea's potential, which resulted in a significant delay. In the third innovation project, employees from different divisions collaborated from the outset. This helped align activities and prevented redundant work by autonomous divisions.

Our quantitative survey further allows us to assess how much variance of the endogenous variables is explained via our exogenous factors. This analysis is especially important for the

impact of cross-divisional collaboration on success, as we assume a high relevance for the fuzzy front end in cross-divisional ventures. Integration mechanisms and the reward system account for 38% of the variance of cross-divisional collaboration. This result can be interpreted as satisfying, as it exceeds the widely acknowledged threshold of 30% (Chin, 1998). Regarding the impact of cross-divisional innovation on company success, an R^2 of 54% is estimated in PLS. Further, 12% of variance is explained for the alternative measure. As the share of revenue represents one facet of our basic measurement model, this result is convincing.

To assess predictive relevance for our endogenous measure *contribution to company success*, we calculated Stone Geisser's Q^2. Given a value of .30, it is well above zero, thus indicating predictive relevance for the structural model.

Table 4 presents additional results for the assessment of individual construct effect sizes. They reveal how much an exogenous construct contributes to explained variance of endogenous constructs. For integration mechanisms, we find a small effect size of .06. In contrast, the reward system reveals to have a medium effect (.20).

Insert Table 4 about here

Finally, we added the described control variables to our basic model. None of the PLS estimates leads to significant path coefficients for the control variables ($p > .05$). Thus, a relevant impact of these variables can be ruled out.

DISCUSSION OF RESULTS

Use of integration mechanisms

The results presented in the previous section reveal that cross-divisional collaboration in the front end of innovation can be stimulated by the use of appropriate instruments. Both in quantitative and qualitative study, the use of cross-divisional integration mechanisms had a significant influence on collaboration in front end activities. As we model this construct in a formative way, the indicator weights allow us to interpret the impact of each instrument on collaboration. The largest weights are obtained for *job rotation* between divisions and the *use of information technology*, whereas the indicator on *cross-divisional organisational units* is not significant. This finding is certainly surprising, as scholars have noted that committees have a larger integration potential than instruments chosen to facilitate social networks. Our case study interviews with project team members and corporate experts helped us find an explanation for this result. In this company, information technology and job rotation were used to foster cross-divisional networks. Furthermore, a corporate innovation management department had dedicated resources to support activities in business areas relevant for two or more divisions. This department was supporting innovation project A. Interviews with employees involved in front end activities and those responsible from the department showed that their support activities had a strong influence on the execution of activities. This corporate manager, for example, structured tasks, defined responsibilities between divisions, and arranged meetings to discuss issues. However, the impact of this department on overall performance of cross-divisional projects is strongly limited, as members of this department are not able to support hundreds of projects.

The strong impact of mechanisms to foster cross-divisional networks emphasises the importance of integration mechanisms and the relevance of the social structure in organisations (Kleinbaum & Tushman, 2007). With regards to the identified barriers of knowledge isolation and

coordination costs, especially mechanisms that foster social networks help spread knowledge across divisions. Cross-divisional committees and permanent organisational units also help transfer knowledge, but too a much lesser extent. One project member explains:

"You can't have committees for every single activity that may lead to a cross-divisional venture. To exchange knowledge, our intranet is the tool of choice. It's easy to find out who's involved in a project or which studies have been already conducted by whom in R&D."

Both committees and permanent organisational units are rather valuable instruments to reduce coordination costs between different divisions.

Reward system

The formative indicator weights reveal that non-monetary incentives and annual divisional objectives largely contribute to the composite score in our model. They help overcome divisional self-interest at different hierarchy levels. Whereas divisional objectives address top management motivation, non-monetary incentives are relevant for experts as well as senior management. With regards to the large indicator weight of *non-monetary incentives*, our case study revealed valuable insights. The project members we interviewed considered cross-divisional projects as much more complex than divisional ones. Thus, team members need to be rewarded if they decide to join or even initiate cross-divisional activities. For instance, one project team was proud to mention that it received an annual innovation award and that the corporate employee magazine had published an article on their work.

In comparison to integration mechanisms, the reward system had a higher impact on collaboration. However, a finding presented by Hansen and von Oetinger (2001) suggests that moderating effects might exist between these two variables. The authors describe how a large multidivisional company established peer groups for managers from different units engaged in

similar businesses. However, these groups' productivity was limited, until senior management defined specific objectives. Besides confirming our finding, this example further leads to the alternative explanation of a moderated relationship between integration mechanisms and reward system orientation. We therefore analysed the relationship between each interaction term and cross-divisional collaboration. Contrary to Hansen and von Oetinger's finding, our analysis resulted in a non-significant relationship ($p > .05$) for our modified model.

Cross-divisional collaboration

Our results show that collaboration in the front end positively affects the impact of cross-divisional innovations to company success. The explained variance underlines the impact of close collaboration between divisions in these phases. As such, this study confirms Martin and Eisenhardt's (2010) findings regarding the impact of respective activities in the innovation process. The indicator weights for cross-divisional collaboration suggest that joint product strategies, idea generation, and project planning appear to be activities where collaboration is of major importance. For product strategies and project planning, case study interviews revealed potential reasons. Team members from the different innovation projects emphasised that product strategies and roadmaps have a significant influence on the level of transparency. Further, joint strategies allow for structuring of divisional activities and make it easier to make decisions for new ideas. If it is not clear whether an idea fits into the company's product portfolio, decision-making will be far more difficult.

Indicator weights for the items related to *idea assessment*, *feasibility studies*, the *definition of product concepts* and *project planning* are non-significant and near zero. Having said this, our finding is not completely in line with the impression we gathered in our interviews. Here, *joint idea assessment* appeared to be very important, whereas *idea generation* was not. Asked for

potential factors that prevented to complete the project on time, one project member stated for example:

"A joint assessment of the idea between all involved people never took place. We would have needed to sit together and discuss that idea. It's not about the methodology, but more about gaining a shared understanding in order to decide whether or not the idea is worth it."

The ideas for all three projects were generated on the customer side. However, it must be noted that the company did not organise regular joint idea generation workshops.

The key results of our mixed methods survey are summarised in Figure 3.

Insert Figure 3 about here

CONCLUSION

Implications

Our study has various implications for research on innovation and synergies in the multibusiness firm. Concerning innovation, this study extends open innovation and organisation literature by showing that multidivisional firms are provided with a unique intra-firm opportunity to overcome local search and to combine distant resources. This "semi-open innovation" type bears various advantages such as higher secrecy, better access to information, and a broader range of available coordination instruments.

Our results on the impact of collaboration in the early stages of innovation support previous works that underline the relevance of this process stage (Khurana & Rosenthal, 1998; Langerak, Hultink & Robben, 2004; Verworn, Herstatt & Nagahira, 2008). Furthermore, we extend previous conceptual work and qualitative findings that address the role of knowledge exchange (Martin & Eisenhardt, 2010; Kleinbaum & Tushman, 2007; Tsai, 2001). Our empirical findings

indicate that cross-divisional interaction has a profound influence on the successful execution of activities in the front end. Furthermore, our mixed method approach helps to explain *how* integration mechanisms and incentives determine collaboration. These results may also deepen our understanding on triggers for inter-firm cooperation.

As we focused on how corporate management can facilitate interdivisional innovation, our survey has the following managerial implications. Interdivisional collaboration in activities such as idea generation and selection or product definition strongly influences the value of joint innovation at a company level. Hence, corporations that pursue a cross-divisional innovation strategy need to consider the front end of innovation as a decisive part in the process. To facilitate collaboration in this early stage, integration mechanisms and incentives need to be linked to this strategy. With regards to integration mechanisms, the impact of instruments to facilitate interdivisional networks should not be underestimated. The effort to implement job rotation offers or yellow pages on an intranet is much lower than the resulting benefits. These instruments help establish communication channels between divisions and thus contribute to a large degree to the overcoming of divisional boundaries. Furthermore, committees and permanent organisational units should be used to reduce coordination costs between divisions and to create communication channels in key areas. For instance, all divisional R&D directors and the chief technology officer in our case study company meet regularly to decide on strategic interdivisional issues and to exchange information about division activities. Concerning incentives, managers need to ensure that the corporate reward system is aligned with a cross-divisional innovation initiative. In this respect, especially divisional target-setting and non-monetary incentives strongly influence the motivation to collaborate in the front end. Concerning divisional targets, corporate management needs to include cross-divisional goals in divisional objectives. For instance, if divisional performance is assessed via revenue growth, an additional revenue growth target with cross-

divisional innovation could be included. Our findings concerning non-monetary incentives indicate the relevance of symbolic appraisal of cross-divisional activities. For instance, one cross-divisional project was well known in the organisation due to articles in the employee magazine, among others. Members from this team had a very positive attitude towards cross-divisional collaboration and were even engaged in various activities with members from other divisions. Companies can appreciate cross-divisional collaboration, for example, with an annual innovation award for joint products or a special status for cross-divisional project managers in the company's career track.

Limitations and future research

Specific limitations are worth noting. Due to the availability of the chosen target group of top management members in the large-scale survey, measurement models were kept as short as possible. More detailed measurement models for the presented constructs might lead to additional valuable insights. For instance, measuring integration mechanisms as a second-order construct may provide further evidence on its impact. Furthermore, a single-informant design was chosen. Although we included several steps to ensure valid responses and also questioned the quantitative assessment results in our subsequent case study, the potential risk of a common method bias in the large-scale survey must be taken into account. Robustness of results could be further improved by involving multiple informants at the company and project levels.

In our survey, we focused on the early stages of innovation and were able to provide evidence for its significant impact. Having said this, we do not suggest that the later stage is any less important. Discussions with project managers revealed various decisive factors in the later stages. For instance, project managers need to coordinate divisional interdependencies, in addition to cross-functional interdependencies.

Furthermore, we have addressed the question whether multidivisional companies can facilitate cross-divisional collaboration via integration mechanisms and incentives. Further research is needed with regards to those factors that determine a firm's potential to recombine resources from different divisions. Research is therefore needed on the characteristics of combined resources. Previous research on synergies suggests that the relatedness between divisions with regards to product technology (Pehrsson, 2006) or knowledge (Tanriverdi & Venkatraman, 2005) influence performance.

We also encourage scholars to extend prior research on the structure of informal networks and the existence of role models in cross-divisional efforts (Hauschildt & Kirchmann, 2001; Markham & Griffin, 1998). In our interviews, we noticed that the people who successfully drive cross-divisional activities were well connected or knew a vast network of people. This finding indicates that individual characteristics of team members matter to success of cross-divisional ventures. Previous research has for example demonstrated that the presence of individuals that create external linkages affects performance (Gemünden, Salomo & Hölzle, 2007; Richter, West, van Dick & Dawson, 2006). Finally, we recommend to further address the relationship between organizational size and the ability to innovate across divisions. For instance, the number of social ties between divisions and the potential of cross-divisional resource recombination might differ depending on organizational size.

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Table 1: Evaluation of the formative measurement models

Indicator	Weight	VIF	CI max.
Integration mechanisms			
We promote cross-divisional information exchange by the use of information technology	0.40*	1.27	11.03
Job rotation between our divisions is fostered	0.46*	1.24	
Permanent committees exist for cross-divisional R&D topics	0.38*	1.36	
Specific cross-divisional units exist for cross-divisional R&D topics	0.26	1.26	
Reward system			
The reward system for our employees is mostly based on corporate performance	0.09	1.06	8.44
Non-monetary incentives are provided for cross-divisional collaborations	0.51***	1.10	
Annual objectives agreed upon with our divisions promote the emergence of cross-divisional collaborations	0.69***	1.11	
Cross-divisional collaboration in the fuzzy front end			
We define cross-divisional product strategies and roadmaps	0.45***	1.48	14.55
Our divisions generate and collect ideas for cross-divisional innovation	0.31*	1.91	
These ideas are evaluated in cross-divisional groups	0.05	2.37	
Prior to the start of a cross-divisional innovation project,			
…our divisions collaboratively conduct feasibility studies.	0.16	2.55	
…our divisions collaboratively develop product concepts.	0.08	2.43	
…the innovation project is planned between the divisions in question.	0.21	2.46	

*$p < .05$
**$p < .01$
***$p < .001$

Table 2: Evaluation of the reflective measurement model

Indicator	Standard factor loading (≥0.70)	Cronbach's α (≥ 0.70)	Construct reliability (≥ 0.70)	Average variance extracted (≥ 0.50)	Fornell/ Larcker (AVE > Corr²)
Please indicate to what extent cross-divisional innovations contribute to company success regarding…					
…profit objectives	0.79				
…competitive advantage	0.90				
…growth in existing markets	0.73	0.81	0.87	0.59	0.58 > 0.54
…access to new markets	0.64				
…new know-how	0.72				

Table 3: Descriptive statistics and correlations

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10
Use of integration mechanisms (1)	3.58	0.76										
Reward system orientation (2)	3.17	0.77	0.55									
Collaboration in the FFE (3)	3.25	0.95	0.47	0.51								
Contribution to success (4)	3.12	0.83	0.42	0.52	0.66							
Percentage of sales (5)	1.76	1.08	0.19	0.38	0.32	0.49						
Employees (6)	2.44	1.66	0.15	-.009	-0.02	0.00	-0.14					
Financial control (7)	0.97	0.18	-0.18	0.05	-0.03	-0.02	0.02	0.01				
Strategic control (8)	0.59	0.49	0.37	0.27	0.29	0.27	0.25	0.01	-0.15			
Divisions: Products (9)	0.70	0.46	0.01	-0.02	0.03	0.03	-0.07	0.13	0.16	0.16		
Divisions: Industries (10)	0.24	0.43	0.07	0.07	0.01	0.01	0.10	-0.12	0.09	-0.12	-0.85	
Divisions: Others (11)	0.06	0.25	-0.15	-0.07	-0.07	-0.08	-0.04	-0.03	-0.15	-0.10	-0.15	-0.40

Table 4: Effect sizes for the endogenous construct *collaboration in the fuzzy front end*

Construct	R^2_{incl}	R^2_{excl}	f^2
Use of integration mechanisms	0.38	0.34	0.06
Reward system orientation	0.38	0.25	0.20