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COLLABORATIVE INNOVATION: INTERNAL AND EXTERNAL INVOLVEMENT IN NEW PRODUCT DEVELOPMENT

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Abstract. Industry and academia alike are increasingly becoming aware of the fact that innovation does not take place in isolated cells or functions within the firm. During the last the years the term open innovation has emphasized the importance of internal and external collaboration in order to increase the competitiveness of companies. Although the idea of involving internal and external actors in the new product development (NPD) process is not new, the knowledge about the benefits and pitfalls is still limited. This paper aims to contribute to refining the concept of open innovation, by investigating how strategic priorities influence the degree of external and internal involvement in the NPD process, moderated by contextual factors.

Results based on analyses of 584 companies from the International Manufacturing Strategy Survey (IMSS) 2005 indicate that suppliers are heavily involved in the NPD process in firms in B2C markets aiming at increasing the innovation volume. For B2B companies the reverse picture emerges. However, when the aim is to increase the radicality of new products, suppliers and customers are heavily involved for firms in B2B markets. Further, market uncertainty, and to some extent company size, seems to moderate the relationships between strategy and involvement considerably.

Keywords: Strategic priorities, NPD collaboration, survey.

1 BACKGROUND

The term ‘open innovation’ was introduced by Chesbrough (2003), suggesting that innovation does not and should not take place on isolated islands within a company, but rather involve actors broadly both internally and externally to the company.

Chesbrough (2003) argues that a shift from closed to open innovation principles is necessary for business survival.

However, the idea of involving internal and external actors in the innovation processes of companies is hardly new. Rothwell (1994) argued that '[t]hese practices include internal organizational features, strong inter-firm vertical linkages, external horizontal linkages' (Rothwell 1994). Internally, collaboration between production and R&D to avoid the 'throw over the wall' problem has been on the agenda for a long time, through concepts such as integrated problem solving (Wheelwright and Clark 1994), design-for-manufacturing (DFM) (Susman 1992), computer aided design/manufacturing (CAD/CAM) systems, and concurrent engineering. Externally, market-pull and customer involvement in NPD, including lead user involvement (von Hippel 1998), have been proposed to counteract the dominant technology-push paradigm and to ensure that the NPD process develops products the market actually requests.

Several researchers have focused on cooperation between different business functions, such as R&D, marketing, manufacturing and engineering, in product development projects within an organization (i.e. Griffin and Hauser 1996; Adler, 1995), or investigated a broad spectrum of cooperative relationships with such diverse partners as customers, suppliers, research institutes, competitors, co-suppliers, and distributors (Anderson et al. 1994; Gemunden et al. 1996; Hagedoorn 1993), to enhance success in product development.

Some of the benefits with external collaboration are that close linkages with suppliers can reduce development cost and increase development speed (Rothwell 1994, p. 18). Further, accessing external know-how can also speed up new product development, as can buying or licensing-in existing technology. In cases of technology fusion, external alliances should, on the face of it, help to reduce both the time and the cost of developing radical new products (Rothwell 1994, p. 20).

Powell et al. (1996) argue for networks as the locus of innovation, through access to complementary competence and resources. 'Rather than using external relations as a temporary mechanism to compensate for capabilities a firm has not yet mastered, firms use collaborations to expand all their competencies' (Powell et al. 1994, p. 143). This study was performed based on a sample of more than 200 biotech firms, primarily from the US.

Other authors argue that inter-organizational collaboration might imply access to complementary assets, foster knowledge transfer and spreading R&D costs (Faems et al. 2005). Studying 221 Belgian manufacturing firms Faems and colleagues (2005) find that the more firms engage in a variety of different inter-organizational collaborations, the more likely they are to create new or improved products that are commercially successful. Moreover, this study shows that collaboration with different types of partners coincides with different types of innovation outcomes.

Investigating eight in-depth case studies O'Connor (1998) finds that customers play an important role in providing input for incremental product development, but do not usually know the requirements for radically new products. She claims that conventional market research techniques focusing on product level problems, rather than application market level, may discourage major innovations. This is also in line with

Christensen (1997), who argues that existing customers in general contribute with knowledge related to the existing product paradigm, but do not contribute with knowledge related to disruptive innovations.

Connor (1999) argues that information from the market and customer is important for various types of innovations to take place. Slater and Narver (1998, 1999) also recognize the importance of customer and market input, but emphasize the importance to distinguish between the two by stating that innovative firms need to be market-led rather than being customer-led. Being customer-led is, according to Slater and Narver (1999), to satisfy the buyers' expressed needs. Being market-led is to develop products with superior benefits, by trying to discover the customers' latent needs beyond what the customers are able to express and specify. Market-led companies, however, do not ignore the expressed needs of the existing customer base, but dedicate a considerable proportion of their activities on understanding the latent needs of the customers (Slater and Narver 1999).

All of the above show that rather than depicting open innovation as a radically new idea, it is more appropriate to consider it as a phenomenon that has organically developed and matured over a considerable period of time. The concept of open innovation condenses, to the extent that it has recently started to generate quite some attention in both industry and academia, mostly triggered by Chesbrough's (2003) work. However, despite its popularity, the concept of open innovation is not coherently well-developed and operationalized in scientific terms, and the benefits have hardly been rigorously documented and tested empirically.

Considering the statement that open innovation is necessary for business survival, Chesbrough (2003) implicitly suggests that internal and external involvement in innovation processes affects a firm's strategic outcomes. There is evidence, as outlined above, that internal and external collaboration may lead to improved performance or innovation outcome. However, there are weaknesses related to some of these studies considering sample size, industry representativeness, geographical selection, and so on. Further, we are not aware of studies that empirically investigate how the pattern of external and internal collaboration in NPD relates to the strategic priorities of firms. Insight into the link between strategic priorities, and external and internal collaboration would help researchers and managers to develop an understanding and knowledge about how to effectively manage and organize NPD efforts and innovation processes by designing effective internal and external relationships. The main purpose of this paper is to explore the relationships between opening up the NPD process to actors internal and external to the firm and their competitive strategy. We therefore investigate the following research questions:

RQ 1: How does firms' competitive strategy relate to collaboration with internal and external partners in the NPD process?

RQ 2: How do contingencies influence these relationships?

2 METHODS USED

2.1 DATA

To analyze the research question we use data from the International Manufacturing Strategy Survey (IMSS IV) database. The database consists of 711 companies in 23 countries representing a wide range of manufacturing and assembly industries (ISIC 28-35). We removed outliers based on company size, which reduced the sample to 628 companies.

2.2 OPERATIONALISATION OF VARIABLES

STRATEGIC PRIORITIES

The responding companies' competitive strategy is operationalized in the questionnaire through the companies' order-winners, measured on five-point Likert-scales. We ask the respondents to indicate the current importance of 11 strategic priorities, ranging from 'Not important' (1) to 'Very important' (5). From these we focus on four priorities closely linked with innovation activity and strategy. These are 'superior product design and quality', 'wider product range', 'offer new products more frequently', and 'offer more innovative products'.

INVOLVEMENT

Furthermore, the questionnaire contains questions prompting the respondents to indicate to what extent the marketing and manufacturing departments, suppliers and customers are involved in the NPD process. The degree of involvement is measured on five-point Likert-scales, from 'no collaboration' to 'high collaboration'.

POSITION IN THE SUPPLY CHAIN

To investigate possible effects from the companies' position in the supply chain, we split the sample into two groups indicating whether the companies operate in business to business (B2B) or business to consumer (B2C) markets. Companies with a proportion of sales larger than 60 % to system integrators and finished products manufacturers are categorized as B2B (N = 234). Companies with a proportion of sales larger than 60 % to wholesalers/distributors and end users are categorized as B2C (N = 350). 44 companies could not be classified based on these criteria and were left out of the analyses.

CONTEXTUAL CONTINGENCIES

Company size was measured as number of employees in the plant.

Market uncertainty was measured as the average value of one variable measuring market span and one variable measuring market dynamics, both by using five-point Likert-scales. Market span ranging from 'few segments' to 'many segments', market dynamics ranging from 'declining rapidly' to 'growing rapidly'. Before the merging of the variables these were transformed into three-point scales. For market span val-

ues 1 and 2 were set to 1, the value 3 to 2, and the values 4 and 5 to 3. For market dynamics the values 1 and 5 were set to 3, the values 2 and 4 to 2, and the value 3 to 1, in order to capture the degree of change irrespective if this is decline or growth.

2.3 ANALYSES

We analyze the relationships between the variables using regression analyses, where the order-winners (representing a company's competitive strategy) are used as independent variables, and the degree of internal and external involvement is used as dependent variables. We also control for the direct and moderating influence of the two contextual factors, company size and market uncertainty. We did the analyses separate for B2B and B2C environments in order to capture the possible effects of this contingency.

3 RESULTS

3.1 B2B

For companies in B2B markets we find mixed and insignificant relationships between pursuing product design or wider product range as strategic priorities and the involvement of internal or external parties. Companies competing on launching new products frequently have a negative relationship with the involvement of suppliers ($\beta = -0,741$, $p < 0,1$), and negative and insignificant relationships with the other actors. For companies competing on launching more innovative products the reverse picture emerges. The relationships with involvement of suppliers and customers are positive ($\beta = 0,723$, $p < 0,05$, and $\beta = 0,586$, $p < 0,1$, respectively). The relationships with manufacturing and marketing involvement are positive but insignificant.

Considering the influence of contingencies we do not find company size or the degree of market uncertainty to have a significant direct influence on any of the collaboration parties, except for marketing involvement in highly uncertain markets ($\beta = 0,751$, $p < 0,1$).

Table 1: Results of the regression analyses. The standardized coefficients (beta) are reported. Sig. level: * = $p < 0,1$, ** = $p < 0,05$, *** = $p < 0,01$

	B2B (N = 234)				B2C (N = 350)			
	Suppliers	Manufacturing	Marketing	Customers	Suppliers	Manufacturing	Marketing	Customers
(Constant)				**	**	***		***
Product design	-,060	,127	,211	,104	-,004	-,325	,081	-,163
Product range	,293	,084	,424	-,221	-,568**	-,461*	-,246	-,006
New products more frequently	-,741*	-,368	-,186	-,626	,504*	,877***	,560*	,118
More innovative products	,723**	,452	,389	,586*	,016	,170	,417*	,007
Company size	,643	,364	,285	-,132	-,400	,001	,417	,091
Market uncertainty	,017	,312	,751*	,210	-,063	,008	,408	-,360
Product design * Size	-,630	-,166	,324	,321	,209	,182	,304	,206
Product design * Uncertainty	,584	-,031	-,412	-,274	,049	,499	-,096	,408
Product range * Size	,230	,006	-,236	,084	,490*	-,012	-,135	-,456
Product range * Uncertainty	-,511	-,004	-,378	,103	,640*	,652*	,392	,246
New products more frequently * Size	,541	,211	-,181	-,289	-,399	,075	-,314	-,100
New products more frequently * Uncertainty	,943*	,386	,394	,961*	-,660*	-1,166***	-,496	-,290
More innovative products * Size	-,696*	-,381	-,192	-,023	,232	-,256	-,275	,168
More innovative products * Uncertainty	-,954*	-,560	-,384	-,609	,108	-,173	-,369	,049
r^2	<i>0,099</i>	<i>0,058</i>	<i>0,121</i>	<i>0,126</i>	<i>0,067</i>	<i>0,044</i>	<i>0,108</i>	<i>0,036</i>
<i>Sig.</i>	<i>0,106</i>	<i>0,603</i>	<i>0,030</i>	<i>0,020</i>	<i>0,078</i>	<i>0,427</i>	<i>0,001</i>	<i>0,630</i>

These contingencies do not moderate the relationships between the strategic priorities product design and wider product range, and the involvement of internal and external parties in NPD, either. However, the relationship between frequent launch of new products and involvement of suppliers and customers are moderated positively by market uncertainty (beta=0,943, $p<0,1$, and beta=0,961, $p<0,1$, respectively). These findings indicate that companies with a strategic focus on launching new products frequently actively involve external parties in the NPD process when market uncertainty is high. Further, the relationship between launching more innovative products and involving suppliers is moderated negatively by company size (beta=-0,696, $p<0,1$), indicating that large companies involve their suppliers less in the NPD process when pursuing this strategic priority. The moderating effects from size on involving the other actors are negative but insignificant. The same pattern holds for the moderating effects of market uncertainty. Firms pursuing a strategy of more innovative products are less likely to involve suppliers in the NPD process in highly uncertain markets (beta=-0,954, $p<0,1$).

3.2 B2C

For B2C companies we do not find any significant relationships between product design strategy and the involvement of internal or external parties in the NPD process. Offering a wider product range has negative relationships with the involvement of suppliers and manufacturing (beta=-0,568, $p<0,05$, and beta=-0,461, $p<0,1$, respectively). Launching new products frequently has positive relationships with the involvement of suppliers, manufacturing and marketing in the NPD process (beta=0,504, $p<0,1$, beta=0,877, $p<0,01$ and beta=0,560, $p<0,1$, respectively). Launching more innovative products has a positive relationship with the involvement of marketing (beta=0,417, $p<0,1$).

Size and market uncertainty do not have significant direct relationships with the involvement of internal or external parties in NPD. Further, the relationships between product design strategy and involvement in NPD are not moderated significantly by size or market uncertainty. The relationship between wider product range and involvement of suppliers in NPD is moderated positively by company size (beta=0,490, $p<0,1$). Market uncertainty moderates the relationships between wider product range and the involvement of suppliers and manufacturing (beta=0,640, $p<0,1$, and beta=0,652, $p<0,1$, respectively). Market uncertainty negatively moderates the relationships between a strategy aimed at launching new products frequently and the involvement of suppliers and manufacturing (beta=-0,660, $p<0,1$, and beta=-1,166, $p<0,01$, respectively). The relationships between launching more innovative products and involvement of internal or external actors are not moderated by size or market uncertainty.

4 DISCUSSION

Companies competing on superior product design do not seem to have any particular degree of involvement of internal or external parties in the NPD process. This finding indicates that internal and external parties are involved to some extent in the NPD process, but to a varying degree and without a consistent pattern among the respondents. An explanation could be that some companies involve other actors actively, while others leave the responsibility to the NPD function to maintain the issue of product design.

In B2B markets we do not find any significant degree of involvement of external or internal actors in the NPD process for companies focusing on developing a wider product range, indicating that internal and external actors are to some extent involved in NPD but without any clear pattern. In B2C markets however, we find low involvement of suppliers and manufacturing. This finding indicates that the NPD function for broadening the product range takes place without involving these actors. An explanation for this could be that developing a wider product range is based on further exploitation of existing product platforms, and this is a task which primarily requires technical modifications of the existing portfolio. For such products, incoming parts and materials are most likely similar to the existing product portfolio, so close collaboration with suppliers should not be necessary. Similarly, manufacturing should be aware of the challenges of the manufacturability of the existing products, so there should be no strong needs to involve manufacturing actively.

Suppliers are to a very low degree involved in NPD by companies in B2B markets aiming at launching new products more frequently. The involvement of the other actors is also low, but these relationships are insignificant. These findings seem to suggest that the NPD function is responsible for increasing the volume of innovation and does not seek advice or competence in other internal functions or external actors, in particular so for suppliers. The reverse picture emerges for companies in B2C markets. Here we find a high involvement of all actors, except for customers. An explanation for this could be that companies search more broadly for new ideas to be able to develop new products on a regular basis. The marketing function could provide market information and market needs that NPD can transform into new products. Instead of involving the customers directly in the NPD process, which could be difficult in B2C markets if there are many customers, the marketing function may aggregate customers input to information useful for NPD. This could explain low direct customers involvement. Manufacturing could on the one hand suggest modifications on the existing product portfolio and through that contribute in the innovation process. On the other hand, manufacturing may have to be more involved when the volume of innovations increases, in order to ensure the manufacturability of the new products. Earlier research (Laugen and Boer, 2007) suggests that the importance of involving manufacturing in the NPD process increases with the volume of new products launched, and that it becomes affordable to establish processes and organizational arrangements for this when higher volumes. Why we do not find a similar finding of manufacturing involvement for B2B markets is not clear.

In B2B markets suppliers and customers are heavily involved in NPD for companies focusing on launching more innovative products. This finding suggests that B2B companies search the expertise among external actors in order to develop more radically innovative products. This is at odds with some literature arguing that customers and suppliers generally are unable to provide input and knowledge about radical and disruptive new products (Christensen 1997, O'Connor 1998). This issue will be discussed more thoroughly in section 4.2 below. In B2C markets, however, we only find a strong involvement of the marketing function. These findings seem to confirm the arguments of (Christensen 1997, O'Connor 1998), on the lack of contribution from suppliers and customers in radical innovations. The high involvement of the marketing function could indicate that market information is important for development of radical new products, but not the type coming from existing customers. The difficulties in sharing information between the two functions have been widely acknowledged in the NPD literature (Brown and Eisenhardt, 1995; Griffin and Hauser, 1992; Li and Calantone, 1998; Song and Dyer, 1995). Marketing and NPD usually have different objectives, and may thus value different forms of information (technological vs. market) in developing new products differently. Innovativeness, though, should enhance the firm's internal alignment between NPD and marketing. Innovativeness is based on a shared vision, support for new ideas, and risk taking behavior. Thus, innovativeness eliminates the cross-functional communication barriers and coordinates the activities of NPD and marketing (Brown and Eisenhardt, 1995). Our findings seem to confirm Brown and Eisenhardt (1995), namely that marketing is actively involved in the NPD process when the aim is to develop more radically new products.

4.1 INTERACTION EFFECTS FROM CONTINGENCIES

The relationships between product design strategy and involvement do not seem to be moderated by company size or market uncertainty.

The same is the case for developing a wider product range strategy for companies in B2B markets. In B2C markets though, we find that larger companies involve suppliers to a higher extent in NPD than smaller firms. Companies pursuing a strategy for a wider product range also involve suppliers and manufacturing function actively when the market uncertainty is high. Growing markets and exposing the business to many segments could imply the need to producing higher volumes of both existing and new products. An explanation for involving suppliers more could be that the companies need stable deliveries of materials and components, and involving the suppliers in the NPD process could reduce the risk of unstable deliveries. Manufacturing would need to be involved to handle different products in manufacturing and maybe also because the production volume needs to be scaled up due to growing markets and larger market span.

In B2B markets, companies focusing on new products more frequently tend to involve suppliers and customers in the product development if there is high market uncertainty. For companies in B2C markets, however, the reverse picture emerges. Pursuing a strategy of launching new products more frequently is significantly negatively related to the involvement of suppliers in the NPD process, if high market un-

certainty. The same is the case for involvement of manufacturing. These findings seem to suggest that there are considerable differences among B2B and B2C companies, in terms of how they involve internal and external parties in the NPD process.

In B2B markets, supplier involvement seems to have a negative relationship with more frequent launch of new products, while supplier involvement seems to be more important in uncertain markets. First mover advantage or short time-to-market becomes more important in uncertain markets and requires companies to increasingly involve their supply chain and suppliers in the launch of new products.

4.2 INVOLVEMENT IN NPD IN B2B VS. B2C MARKETS

According to literature, customer and supplier involvement is regarded more important in B2B than B2C markets (Campbell and Cooper, 1999; Hartley et al. 1997; Ragatz et al. 2002). Our findings seem partly to confirm existing theory. It seems to be the case for companies aiming at developing more innovative products, which could suggest that suppliers and customers could provide ideas for more radical products. Regarding suppliers this could be through providing new technological solutions which could lead to the development of radically new products. Customers could contribute to radically new ideas by providing information about new needs. Our finding is also in line with Rothwell (1994), who argues that external alliances can reduce time and cost of radical product innovation projects. B2B market can be regarded as more professional markets than B2C, some customers can probably be regarded as lead users (von Hippel 1988). Tassarolo (2007) argues that firms in a B2B context, its suppliers, and its customers usually share a mainly cognitive and technical approach to the product - as opposed to the mainly perceptive perspective of the customer in a business-to-consumer context. Furthermore, each supply chain actor is technically qualified since it has its own development processes and can easily share what it knows and wants with the other entities (i.e., customers and suppliers) involved in the process. In other words, the type of information exchanged, which usually entails the exchange of e.g. CAD drawings or well-defined product metrics (e.g., technical specifications for the product or process, performance requirements), is easily understood by all three players, and the media used for the exchange (e.g., e-mail, network-enabled electronic data interchange (EDI) systems, face-to-face meetings) are well established and familiar to all three players. (Tassarolo 2007). In B2C markets, on the contrary, our findings suggest that external actors do not seem to be heavily involved in the NPD process when the companies aiming at developing radically new products. This is in line with much literature stating that suppliers and customers do not provide input suitable for developing radical type innovations (Christensen 1997, O'Connor 1998).

However, customer and supplier involvement does not seem to be important for B2B companies aiming at developing new products more frequently. This finding, thus, is at odds with the existing literature (Campbell and Cooper, 1999; Hartley et al. 1997; Ragatz et al. 2002). Although, when companies in B2B markets aiming at developing new products more frequently in markets with high market uncertainty they tend to rely on the involvement of suppliers and customers. So, our findings refine the

literature regarding involvement of external actors in the NPD process for companies in B2B and B2C markets, by adding the element of strategy as a determining factor, as well as market uncertainty and size as a moderating variable.

5 CONCLUSION

5.1 CONTRIBUTION

The paper contributes to refining current contributions on open innovation by providing empirical evidence of how collaboration in the NPD process relates to the strategic order-winners of firms. Supplier involvement appears to be negatively related to the frequency of launch of new products as an order winner in B2B markets, while involving suppliers is positive in B2C markets. However, in markets with high uncertainty the reverse picture emerges for both B2B and B2C companies. Firms aiming at developing more innovative products involve external actors actively in the NPD process in B2B markets. These relationships are moderated negatively in markets with high uncertainty.

In B2C markets the marketing function is heavily involved for companies aiming at developing new products more frequently or more innovative products. Manufacturing involvement is considered negative to develop a wider product range, while positive for developing more new products. In B2B markets, we find no clear pattern on the internal involvement in NPD.

The findings raise interesting questions as to when and where the use of open innovation is appropriate; a discussion of these questions which will facilitate a much needed detailing of the open innovation proposition.

5.2 MANAGERIAL LESSONS

The findings in this paper lead to a set of suggestions for managers. First, the degree of internal and external involvement in NPD depends largely on the firms' strategic priorities. If the aim is to increase the volume of development of new products, or if the aim is to increase the innovativeness of the products, companies should choose two different paths in selecting what actors to involve in NPD. Further, depending on the position in the supply chain, B2B or B2C, the degree of involvement differs considerably between the strategic priorities. Finally, market uncertainty is an important moderating factor for the relationships between strategies and involvement and must be taken into consideration by managers when dealing with these issues.

5.3 LIMITATIONS AND FURTHER RESEARCH

In this paper we investigate a set of innovation-related strategic priorities, and investigate the relationships with involvement of internal and external actors in the NPD process. Although the innovation-related strategy measures are relevant, there are of course several other strategic priorities that might influence the choice of in-

involvement in NPD. There are reasons to believe that both external and internal actors can be involved in order to reduce cost and development time, and to increase the firms' quality and flexibility. Further investigation into how a broader set of strategic priorities relate to involvement in NPD could reveal this.

Further, we investigated the involvement of manufacturing and marketing, and suppliers and customers. These actors are in the literature considered to be highly important to involve in the NPD process, but there are other both internal and external actors that could be taken into account.

We investigated the direct and indirect influence of size and market uncertainty on the relationships between strategic priorities and involvement, in addition to the separate analyses for B2B and B2C markets. Other contingencies, such as innovativeness, industry type and production process, could contribute to an increased understanding of the relationships.

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