Diffusion of open innovation practices in Danish SMEs[1]

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Abstract

Within a short timeframe, the notion of open innovation has been established as an important, if also contentious, topic for both researchers and practitioners. Thus some observers have suggested that open innovation is the next big thing in innovation, while others argue that it is merely old wine in new bottles. This paper investigates the extent and diffusion of open innovation practices in small and medium-sized Danish manufacturing firms, while hinting at some relations with innovative performance. Both quantitative survey data and qualitative interview data are used for analysing the extent of open innovation in Danish SME's. The paper finds that many firms are rather narrow in their adoption of open innovation whether defined as relationships or as open innovation practices. However, the paper also finds that there is a complementarity effect rather than a crowding out effect of utilising both inter-organizational relationships and open innovation practices. The paper discusses these stimulating findings in the conclusion.

1. Introduction

Within a short timeframe, the notion of open innovation has been established as an important, if also contentious, topic for both researchers and practitioners. Thus some observers have suggested that open innovation is the next big thing in innovation (Docherty, 2006), while others argue that it is merely 'old wine in new bottles' (Trott & Hartmann, 2009). The concept serves not only as a theoretical pipe-dream, but has also inspired to an upsurge of empirical analyses investigating open innovation practices in, primarily, large and multinational corporations. So far, little systematic evidence has been presented on the diffusion into small and medium-sized firms or the effects of adopting open innovation practices in such firms on innovative performance. This paper aims at investigating the extent and diffusion of open innovation practices in small and medium-sized Danish manufacturing firms, while hinting at some relations with innovative performance. However, the paper does not make explicit analyses on the direct statistical relationships between diffusion of open innovation and innovative performance.

The open innovation paradigm assumes 'that firms can and should use external as well as internal ideas, and internal and external paths to market' (Chesbrough, 2003). The paradigm thus departs in and broadens the traditional view of innova-

tion, where companies establish a strong internal R&D capability enabling them to generate and commercialize innovations on their own without any participation of external actors. Within the open innovation paradigm companies exploit ideas and technologies developed outside the company (the inbound perspective), as well as allow unused ideas and technologies (e.g. through licensing) to flow to the outside (the outbound perspective). It is important to stress that a firm needs to build on existing research, development and innovation capabilities to engage in open innovation; the decision to open is therefore not an 'either/or', but an 'and'. The innovation activities of firms can thus be diversified and enriched by adding insights, ideas and solutions from a wide range of activities or practices. Typically, the literature mentions dyadic inter-organizational relations with external actors, collaboration with internal actors located in other departments or subsidiaries, and a set of practices like buying and utilizing intellectual property rights from other firms as examples of open innovation practices. The main managerial challenge therefore becomes to identify, utilise and adopt the relevant practices for the particular problem that the organisation faces, and to coordinate external inputs with the particular developments in the specific project. An important point is therefore that open innovation is not a generic practice, but an opportunity to fertilise the internal activities with input from outside the project.

Most of the current literature on open innovation has focused on large multinational corporations such as IBM, Cisco or Procter & Gamble (Dittrich, 2008; Dodgson, Gann, & Salter, 2006). By comparison only a few studies have exclusively analysed open innovation in small and medium-sized enterprises (SMEs) (Knudsen & Mortensen, 2011; Vrande, Jong, Vanhaverbeke, & Rochemont, 2009). This is unfortunate because research indicates that the challenges SMEs face in managing innovation activities are inherently different from those faced by larger companies. Due to the resource constraints and scale limitations from which most SMEs suffer they have to reach beyond their own boundaries to gain access to knowledge and key resources required for innovation (Mesquita & Lazzarini, 2008). Thus, innovation processes often unfold differently in SMEs compared to larger companies implying that open innovation is handled accordingly. First, few SMEs have specialists solely dedicated to the innovation process alone, rather innovation is typically a set of activities that unfold in parallel and is strongly connected to day-to-day business operations. Second, innovation activities primarily progress in an incremental manner in relation to specific customer relationships rather than as basic research and development activities. Third, SMEs are typically managed by their owners (Bougrain & Haudeville, 2002), who are often risk-averse (Donckels & Fröhlich, 1991) and inclined to pay close attention to the financial stability of their operations, and therefore consider innovation activities as costs rather than as investments. Because of these differences, research is needed to directly investigate the specific SME context and establish appropriate implications for managers of these firms.

This paper approaches this issue by investigating the *research questions*: Who are the primary actors that Danish SMEs collaborate with for innovation and what open innovation practices do Danish SMEs use?

2. Methods

The paper investigates the use of open innovation from two different viewpoints. The first approach to open innovation is the use of inter-organizational relationships and is investigated both within a qualitative and a quantitative framework. The qualitative data collection took place in 2008 in seven companies through interviews. The aim was to investigate the types of relationships SMEs engage in and the variation in use of inter-organizational relationships for product development activities. The extent of use was subsequently examined in a survey that was carried out in 2010 amongst small and medium sized manufacturing companies. The second approach is to view open innovation as the use of a set of open innovation practices. These practices were identified by screening the literature, leading to a compiled and extensive list of practices. These were then included in the quantitative data collection in 2010.

Qualitative case studies

The study commenced by conducting seven exploratory case studies in order to develop a preliminary understanding of the use and practice of open innovation in Danish SME's. Theoretical sampling was used to select cases that differed with regard to the size of the company (both small and medium-sized companies) and type of industry (both the food and high-tech industry) (*table 1*). Companies were selected from both these very different industries to obtain some variation. Food companies are generally known for a large number of fairly low-tech, incremental innovations and high-tech companies for more radical, technology driven innovations. Semi-structured interviews were conducted with key informants with a deep understanding of the company's innovation processes in each case. The interview guide consisted of three parts. The first part revolved around a description of a typical innovation process at the company and the involved external actors in the innovation process. The second part explored the involvement of each of the mentioned external partners in more detail. The final part focused on network characteristics that had not been covered in the two preceding parts of the interview.

All interviews were recorded and transcribed verbatim. The transcripts were analysed iteratively through a running exchange between theory, analysis and data collection (Orton 1998). Analysis involved identifying, coding and categorising patterns found in each case, across cases and across the two industries using the Nvivo software.

Quantitative survey

The quantitative data collection took place as an online survey in the period from August to November 2010. The population was drawn from a nationwide Danish database consisting of firms in the manufacturing industries (NACE 10-33 and 72) with 5-499 employees (SMEs). The population contains 3086 firms of which 1241

Table 1: Companies interviewed for the initial qualitative study*

Company alias	Industry	Position of informant	Size (no of employees)
Food and beverages			
Alpha	Beverages	Quality manager	50-99
Beta	Beverages	Innovation manager	200-499
Gamma	Food	Owner-manager	5-9
Delta	Food	R&D manager	100-199
High-tech industries			
Epsilon	Machinery	Product manager	200-499
Zeta	Optical instruments	Developer	10-19
Eta	Electronics	CEO	100-199

* The names of the companies have been changed to ensure confidentiality.

accepted to receive a questionnaire after an initial phone contact that explained the main purpose of the survey. The phone call also obtained the name of the person responsible for innovation, either the R&D or the innovation manager. In the case of small businesses without these job titles/functions, we asked for the business owner.

In a few cases, we obtained only the general company email, from which the questionnaire was then distributed on within the firm. In total, 1241 e-mails were distributed in August 2010 and 355 usable responses were received, resulting in a response rate of 28.6% based on the distributed surveys, and 11.5% based on the original population.

Typically, the results from Community Innovation Survey in Denmark show that around half the firms have launched new products within the past 3 years; 42% in 2008 and 46% in 2007. For this study the share of all firms that are innovative is high, namely 77% as a result of our screening out companies which have no innovative activities.

Table 2: Distribution of firms on size

	All companies (%)	Innovative companies (%)
Micro < 10 employees	27.9	72.7
Small < 50 employees	46.8	74.1
Medium < 250 employees	20.6	83.6
Large 251-500 employees	4.8	94.1
Total	100	

Table 2 illustrates that firms grow more innovative with size from the average of 76.6% for all firms being innovative to 94.1% of the largest firms. As shown in *table 3*, the majority of firms participating in the study are medium tech firms (either high or low) equalling 64.6%. However, there is no direct relationship between the degree of technology intensity and innovativeness, which may be explained by the fact that firms may easily introduce new products that are not technology driven.

Table 3: Distribution of firms on OECD technology sectors

	All companies (%)	Innovative companies (%)
High tech	8.9	80.6
Medium high tech	31.0	84.3
Medium low tech	33.6	71.8
Low tech	26.4	75.0
Total	100	

3. The inter-organisational perspective

As stressed above, it is reasonable to distinguish between the use of external partnerships for innovation and other open innovation practices. Danish SMEs collaborate with different external actors and this section presents our findings with regard to the types of actors they collaborate with and to some extent the nature of these relationships. The results of our preliminary case studies indicate that Danish SMEs differ significantly on all three counts. Alpha, Beta and Eta engage in no or only one close innovation-related relationship with external partners, while Gamma and Delta engages in a large number of relationships, many of them quite close (*table 4*). Customers and suppliers are the most common partners for our cases, while only some of our case companies have relationships with universities and consultants, and then primarily for in-bound open innovation purposes.

Table 4: Type and number of external partners (of which close relationships)

	Food industry				*High-tech industry*		
	Alpha	*Beta*	*Gamma*	*Delta*	*Epsilon*	*Zeta*	*Eta*
Customers	3	3	6 (3)	6 (3)	1 (1)	1 (1)	5
Suppliers	1	3	3	3	4 (1)	6 (3)	3
Universities	-	-	3	3 (3)	1	-	1
Competitors	-	-	-	-	-	-	-
Consultants	-	3	-	-	3	-	-
Others	1	-	3	2 (1)	-	3	3
	5 (1)	9 (0)	15 (3)	14 (7)	9 (2)	10 (4)	12 (0)

Gamma, a small, specialized food producer, is an example of a quite open company that has experience with both inbound and outbound open innovation with a variety of different partners. Gamma distinguishes itself from the other cases by having developed a product technology that can be applied within a number of product categories and industries. As examples of inbound open innovation, the company has worked with several universities to refine its technology and uses customers as a source for new product ideas. The company also engages in outbound open innovation, as it is very interested in exploring new applications of its technology with current and potential customers. Gamma does so despite having experienced opportunistic behaviour from a customer that exploited the company's knowledge. However, this has not kept Gamma from forming new relationships with other external partners. The reason for this may be related to the restricted resources and capabilities of Gamma, but more importantly our analysis suggests that the owner-manager inherently trusts most external partners and enjoys discussing technical issues related to applying and improving the company's technology with them. This case therefore seems to support that open innovation must be supported and facilitated by core individuals.

The other cases covered by the qualitative study are not as open as Gamma. Typically they only engage in open innovation with a limited number of key suppliers or customers and these relationships are sometimes quite superficial with limited information sharing due to lack of trust. For instance, Beta, a medium-sized manufacturer of fruit juices and soft drinks, is very reluctant to involve customers in its innovation activities due to a lack of trust. On several occasions, Beta has experienced that retailers have launched private label products that were very similar to products that Beta had presented to them in confidence. Beta is therefore now careful not to divulge sensitive information at too early a stage of product development.

On the other hand, Epsilon has a very good relationship with a supplier of a key technology used in its products (aids for visually impaired persons). From the early stages of the relationship, the supplier demonstrated trust in Epsilon by sharing sensitive technical information about a new component before it was released. This enabled Epsilon to get a head start over competitors in developing a new product and thus to gain a competitive advantage. Subsequently, Epsilon has become involved in the supplier's innovation activities and the relationship thus involves both inbound and outbound open innovation activities. Finally, our cases indicate that relationships with particular actors can limit companies' ability to be involved in open innovation activities with other actors. Thus both Epsilon and Zeta have close relationships with key customers and suppliers that constrain their possibilities to work closely with other partners.

Overall, our case studies suggest that Danish SME's engage in a rather narrow range of inter-organisational relationships. In terms of inbound open innovation relationships, the companies studied work with suppliers and key customers to develop new products. Universities are sometimes (but not very often) used to solve technological problems. Only rarely are external actors used for process innovation purposes. With regard to outbound open innovation relationships, these mainly involve becoming involved in customers' innovation processes. None of our cases have been active in networks where companies can post problems and offer solutions to other companies' problems (such as InnoCentive.com) or have made own innovations available to others, either for free or for a fee.

A further view on the frequency of use of different types of external partners, our survey results demonstrate that suppliers and customers are indeed the most frequently used partner types and therefore the results corroborate our qualitative findings. Competitors are used least frequently and to a very low extent. Less than a third of the firms have collaborated with competitors and the extent is only at 1.62 on a 7-point scale. This implies that firms do not trust competitors enough to collaborate with them and even the most offensive firms use competitors very sparsely. These findings therefore support the results of the qualitative study, and earlier studies on the use of inter-organizational relationships for product development performance in Danish SME's (Knudsen & Mortensen, 2011). Nevertheless, these results do not indicate the extent of diffusion of other open innovation practices.

Table 5: Does your company collaborate with external partners in your own innovation process, and if yes, to what degree?

External partners used for innovation (survey results)	% yes	Degree (scale 1-7)
Suppliers	92	4,48
Customers	93	4,60
Competitors	31	1,62
Consultants	76	2,97
Universities	53	2,42

4. Open innovation practices

The diffusion of open innovation practices in Danish SMEs is investigated using a list of 16 practices related to openness. These practices were identified through an extensive review of the open innovation literature (*table 6 and figure 1*).

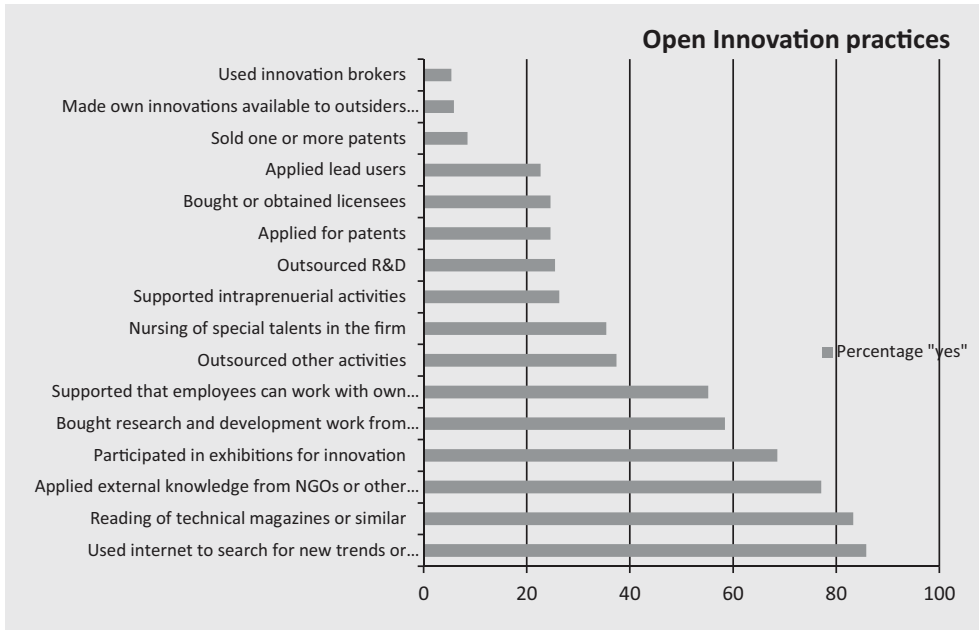
Table 6: Use of inbound and outbound open innovation practices among Danish SMEs

Construct	Practices	N	%
Inbound open innovation practices	Used the internet to search for new trends or technology	303	86%
	Used information from trade organizations	272	77%
	Participated in innovation related fairs or shows	242	67%
	Purchased R&D work from others	206	58%
	Outsourced R&D (totally or partially)	90	25%
	Purchased licenses, patents or know-how	87	25%
	Worked with lead users	80	23%
Outbound open innovation practices	Supported that employees work with own ideas	195	55%
	Actively participated in other's innovation projects	186	52%
	Supported entrepreneurial activities in the company	93	26%
	Sold patents, licenses or know-how	30	8%
	Made own innovations available to others free of charge	21	6%

In the following, the extent of use is illustrated in two ways; first as the number of practices applied and the relationship to innovation, and second as the use of inter-organizational relationships in combination with the practices. Some open innovation practices, e.g. *innovation brokers, making own innovations available to others and selling patents* were used by very few companies, while six practices were used extensively by more than half of the companies (*internet, technical magazines, fairs, allowing that employees can work with own ideas, and buying R&D work from e.g. consultants*). These practices transcend from open innovation practices to more traditional methods of collecting information, as it also was the purpose of the survey to capture as many practices as possible in order to thoroughly investigate the extent and use of open innovation practices. However, it is also obvious that the extent of commitment of resources using the different practices is rather diverse.

The literature separates open innovation practices into inbound and outbound practices. *Table 6* shows that SMEs have a general tendency to use more inbound than outbound open innovation practices. To estimate the extent of use, we look at the summarized number of practices utilized by the firms. Very few firms use a large portion of the practices as illustrated in *table 7*, and around 16% use less than 4 practices. The three most frequently used practices for the firms using the least practices are reading of technical magazines (50,9%), using the Internet to search for new trends and technologies (38,6%) and use of information from business associations and similar actors (36,8%). These firms therefore not only use few, but also primarily practices that require fairly low commitment and are available without additional investments or resources. Furthermore, the table dem-

Figure 1: Use of open innovation practices among Danish SMEs



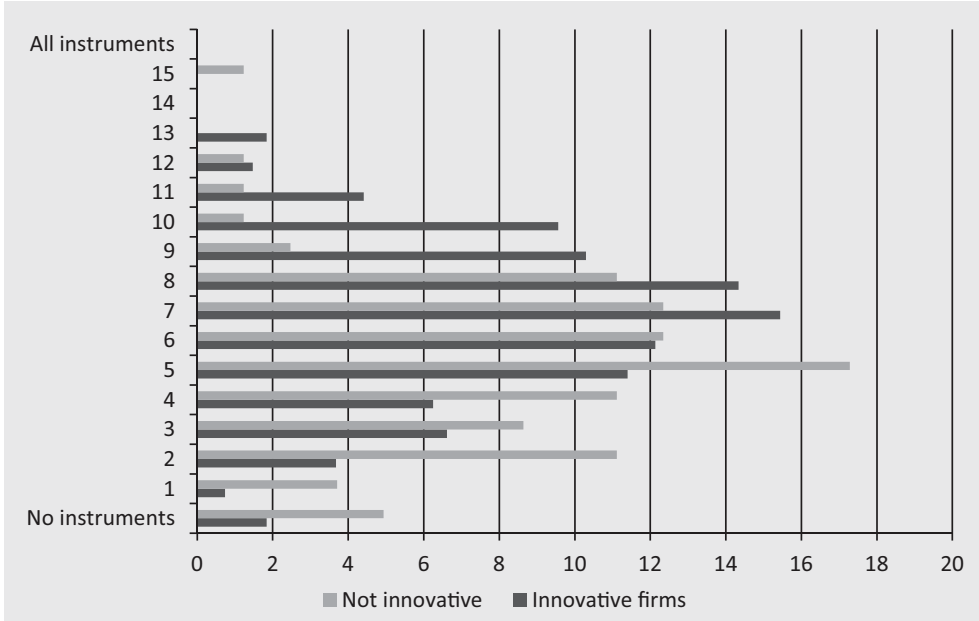
onstrates that there is a direct relationship between utilization of open innovation practices and the degree of innovation. More practices are also related to a higher share of the firms being product innovative. Although, firms may use the practices mentioned without actually having introduced new products in the last 3 years.

Table 7: Use of open innovation practices

	Frequency	All	Innovative companies
0-3 practices	57	16.4	61.4
4-6 practices	114	32.8	71.1
7-9 practices	129	37.1	83.7
10 or more practices	48	13.8	93.8
Total	348	100	

The average number of practices used for all companies is 6.45 (mode = 7), while the innovative firms (6.84) use a significantly higher number of practices compared to the non-innovative firms (5.14) (*figure 2*).

Figure 2: Breadth of use for innovative and non-innovative firms.



Frequently, the literature has used the breadth in firms' use of external partners as a proxy for open innovation. Our survey's measures for inter-organizational relationships are only available for the innovative firms, which means fewer cases are available, and it is furthermore not possible to distinguish the effect on innovation.

The relationship between the use of open innovation practices and the use of intra- and inter-organizational practices is rather pervasive. For all the relationship types studied in the survey (from intra-organizational to inter-organizational) the results show an increasing degree of use with increasing utilization of open innovation practices (*table 8*). For instance, 3.8% of the firms using 0-3 practices (more closed innovation) have connected with universities for the most important product development project, whereas 44.4% of the firms using the open innovation practices most extensively have connected with universities. Similar patterns are seen for use of consultants (from 3.8 to 61.1%) and for use of employees that are without daily contact to product development (from 57.1 to 94.4%). These results therefore seem to indicate that the use of the open innovation practices is strongly related to the use of inter-organizational partnerships for product development, but in particular firms with more open strategies are also using the more rare types of external partners (see section 3).

Table 8: Use of open innovation practices and inter-organizational relationships

	0-3 practices	4-6 practices	7-9 practices	10 or more practices
Intra-organizational relationships				
Employees with daily contact to NPD	67.9	90.5	96.0	100
Employees without daily contact to NPD	50.0	83.0	87.8	95.2
Other employees in e.g. subsidiaries	31.8	52.6	71.1	91.2
Inter-organizational relationships				
Suppliers	38.8	55.3	77.5	89.6
Customers	43.9	53.5	77.5	87.5
Competitors	8.8	16.7	23.3	43.8
Consultants	14.0	38.6	69.8	83.3
Universities	5.3	19.3	50.4	72.9

Another example illustrates this point. Universities were used in general (*table 5*) by 53% of the firms. But this masks a difference when analysed on the number of practices of 5.3% for the firms with use of least open innovation practices, increasing to almost 73% for those firms that utilise the most open innovation practices (*table 8*). Therefore, the findings on the inter-organizational relationships (*section 3*) are now further crystallised by combining them with the open innovation practices.

5. Conclusion

A high proportion of companies in our survey are innovative (77% have introduced new products within the last 3 years) and these innovative companies have a clear tendency to use more open innovation practices than the non-innovative. Although, we find non-innovative firms that are using open innovation practices and this seems as a contradiction of terms, it only indicates that the use of open innovation practices in firms conceals more complex patterns of innovation practices.

Our empirical results demonstrate a complementarity effect between open innovation practices and intra- and inter-organizational relationships indicating that the different initiatives that can lead to opening up the innovation process do not compete for attention or resources. Rather, the results demonstrate that practices and relationships complement each other since the companies that use most open innovation practices also use both internal and external actors the most. This means that we cannot identify a crowding out effect, since those companies using

the most practices are not doing this instead of focusing on important relationships – they are doing both.

Albeit our analyses merely include the quantity of practices used and do not take the quality (in terms of what advantages the practices can provide) into account the results are rather thought provoking. A general pattern seems to emerge specifying that a large portion of Danish SME's are rather closed in their innovation processes, and that this tendency has direct implications for the firm's ability to introduce new products on the market and ultimately their competitiveness. This is further supported by the finding that many of the firms – although they use inter-organizational relationships – seem to partner with the "easy" types namely suppliers and customers, whereas the more demanding partner types like competitors and universities are used much less frequently. This result is mirrored by the more extensive use of traditional practices for collecting information. There is thus a tendency that firms using less open innovation practices also choose the easiest collaboration partners, opting for the easy way out in both areas. This however, is paralleled by the fact that the firms utilizing more open innovation practices also tend to collaborate extensively with more types of actors.

Obviously, these findings need further validation in terms of the benefits obtained from open innovation practices and inter-organizational relationships separately and in combination. An interesting question is therefore whether winning combinations can be identified linking the practices and the relationships. At this stage, the paper does not attempt to build recommendations for managers rather we attempt to present new and inspiring findings that should be further validated before recommendations are developed in particular taking into account the benefits of open innovation for these particular firm types.

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Notes

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