

**LINKING CUSTOMER INTERACTION AND INNOVATION:  
THE MEDIATING ROLE OF NEW ORGANIZATIONAL PRACTICES**

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**Abstract**

The notion that firms can improve their innovativeness by tapping users and customers for knowledge has become prominent in innovation studies. However, the literature fails to deal with the fact that firms that engage in this practice must design their internal organization to support it. Specifically, we argue that new organizational practices, notably intensive vertical and lateral communication, rewarding employees for sharing knowledge, and a high degree of delegation of decision rights, can leverage knowledge absorption from customers in the context of innovation. Six hypotheses are developed and tested on a dataset drawn from a survey of 169 Danish private firms which was implemented in 2001 among a sample of the largest Danish firms.

**Keywords**

Interaction with customers, innovation, absorptive capacity, new organizational practices.

## INTRODUCTION

Ever since Burns and Stalker (1961) the identification of intra-organizational antecedents to innovation has been a central theme of research in diverse research streams in organization studies, technology management, and strategic management ( e.g., Allen 1977; Allen and Cohen 1969; Dougherty 2001; Dougherty and Hardy 1996; see, Damanpour 1991 for a meta-analysis of the early organizational literature). Most of this research concerns how a firm can best leverage knowledge that it already controls in-house for the purpose of innovation. In contrast, the literature does not address how the firm's organizational design can positively influence the sourcing of knowledge held by *external* parties, such as users and customers, and its subsequent use for innovation.<sup>1</sup> The purpose of this paper is to explore this issue theoretically and empirically.

Research accumulated over the last three decades points to the importance of users and customers in bringing about product and process innovation (von Hippel 1976, 1988, 2005). Also, it is well-established that firms can gain in terms of innovation performance from working with users and customers. Indeed, the user innovation literature (Lilien et al. 2002; Neale and Corkindale 1998; Rosenberg 1982; Urban and von Hippel 1988) and substantial parts of the open innovation literature (Chesbrough 2003; Laursen and Salter 2006; Lichtenthaler 2008)<sup>2</sup> argue that established firms can improve their innovation performance by working closely with users and customers in the innovation process. Because these literatures take the relation between a

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<sup>1</sup> In contrast, there is a substantial literature on how firms should adapt their organizations in response to the adoption of already existing innovations (see for instance, Bresnahan et al. 2002; Leonard-Barton and Sinha 1993).

<sup>2</sup> The open innovation literature looks at customers and users as one (important) external source of innovation in addition to other sources, including suppliers, competitors, universities, technology consultants etc.

focal firm and its users and other external knowledge-holding parties as the unit of analysis, they have not explored how firms' organizational designs—for example, the allocation of decision rights (“authority”), reward structures, and communication channels—may impact their sourcing and use of knowledge that is initially externally held.

However, firms seem aware that their organizational designs play influence their sourcing of external knowledge. For example, Dougherty (2001: 625) cites a marketing manager at Texco reflecting on organizational changes designed to accomplish this aim:

I came to this business seven years ago. It had a traditional organization with director of development [technology] and a bunch of engineers, and a marketing manager and salesmen. The salesmen would go and find customers and get a quote on a product, and bring it back and drop it in a box, and the engineers would pick them up and do them. The salesman would go back to the customer and show it to them and say “is this OK?” We were doing hundreds of these costings, and very few of them would get to the sample stage, and of those, very few succeeded. Our hit rate was very low . . . Everything the engineers worked on was screened through the sales people, and they never heard the voice of the customer. . . . Now the new ventures team develops new markets and innovations, and pulls in people from across the organization. . . . [Consider] the weaving, dyeing and finishing plants. We help them understand the needs and the wants, do the QFDs, have the manufacturing people help with the QFDs, and the development engineers take the process engineers to several customers.

In this example, decision rights to “pull in people from across the organization” have been delegated to a new ventures team, and development engineers have been given rights to “take the process engineers to several customers.” The reason for this reallocation of decision rights

explicitly is to improve the sourcing and use of knowledge held by customers.

In the following, we theoretically and empirically address how firms' organizational designs can influence their sourcing and use of external knowledge. We focus on a specific set of organizational practices, namely what is often called "new organizational practices" (e.g., Colombo and Delmastro 2002; Hamilton et al. 2003; Ichniowski and Shaw 1999; Ichniowski et al. 1997; Mendelson 2000; Mendelson and Pillai 1999; Zenger and Hesterly 1997). The practices that we focus on include (extensive) delegation of decision rights, intensive vertical and lateral communication, and rewards for sharing knowledge. Evidence suggests that firms have increasingly changed their internal organization in ways that may generically be summarized in terms of increased delegation, an emphasis on knowledge sharing, and high-powered performance incentives (*idem.*). For example, Zenger and Hesterly (1997) explain how the ongoing tendency to "corporate disaggregation" may be understood in terms of increasing delegation of decision rights combined with a more widespread use of high-powered rewards.

There are many drivers behind these changes in internal organization, such as ICT and improved measurement methods. However, some scholars suggest that the changes are partly prompted by attempts to increase the number of "contact points" with the external environment for the purpose of improving the sourcing of external knowledge (e.g., Knudsen and Levinthal 2007). We pick up on these suggestions, and build theory on how firms may design their organization to increase the probability of getting access to and leveraging customer knowledge in the context of innovation. Specifically, we advance that extensive delegation of decision rights increases the probability that external knowledge is brought inside the boundaries of the firm; knowledge sharing programs and job-rotation increases the probability that knowledge, once brought inside the firm, is disseminated to the rest of the firm; and rewarding employees for their

knowledge sharing behavior increases the probability that employees will actually engage in knowledge sharing. Based on our theoretical discussion, we derive a set of related hypotheses. The empirical analysis draws on a survey of 169 Danish private firms. The survey was implemented in 2001 among a sample of the 1000 largest Danish manufacturing and service firms. This paper is, to our knowledge, the first attempt in the literature to explain how organization design matters to the use of customer knowledge in the context of innovation.

## **USER INNOVATION, ABSORPTIVE CAPACITY, AND NEW ORGANIZATIONAL PRACTICES**

### **Context: The Role of Users and Customers in Product Innovation**

The ability of firms to innovate is a central component in processes of gaining and sustaining competitive advantage (Dierickx and Cool 1989; McEvily and Chakravarthy 2002; Nelson and Winter 1982; Teece et al. 1997; Zott 2003). Empirical studies demonstrate that innovative firms tend to have higher rates of profits, greater market value, better credit ratings, higher market share and higher probabilities of survival in the market (Banbury and Mitchell 1995; Blundell et al. 1999; Cefis and Marsili 2005; Czarnitzki and Kraft 2004; Geroski et al. 1993; Hall 2000). In order to capture the benefits from being innovative, firms increasingly attempt to improve innovation capacity by tapping into external knowledge sources (Chesbrough 2003; Laursen and Salter 2006). That interaction with customers (and users who may not be customers) can be a crucial antecedent to innovation has been recognized for more than three decades (Freeman 1968; Linder 1961; Rosenberg 1982; von Hippel 1976). von Hippel (1976) documented the importance of the phenomena and showed that more than 80 per cent of innovations in the scientific instrument industry were invented, prototyped, and first field-tested

by users of instruments rather than by an instrument manufacturer. Subsequently, an important literature has emerged that analyzes key benefits from and obstacles to user involvement in the innovation process (see for instance, Henkel and von Hippel 2005, for an overview).

In this paper we focus on firms that introduce innovations to the end-market. A substantial part of the user innovation literature has, however, been occupied with understanding under which circumstance users may be the initiators of what later become innovations in the market (von Hippel 1976, 1988, 2005). Indeed, von Hippel (2005) describes how user-inventions are often invented, prototyped, and field-tested by users, but later streamlined and introduced to the general market by established firms. Another part of the literature, with which the present paper is closely aligned, has taken more of a strategic management perspective in being concerned with how established firms can best leverage interaction with users to increase innovation performance (e.g., Lilien et al. 2002; Neale and Corkindale 1998; Urban and von Hippel 1988). In this context, von Hippel and colleagues focused their research on lead users, that is, users who perceive needs earlier in time than other users, and at the same time are positioned to benefit considerably by obtaining a solution to those needs. According to the literature on firms' use of external knowledge sources for innovative purposes, interaction between firms and their (knowledgeable or "tough" to please) customers improve products or processes when the customer provides important knowledge and information to the producer or directly participates in innovative activity (Lilien et al. 2002; Lundvall 1988; Rosenberg 1982). In general, the user innovation literature takes such interaction as the unit of analysis, and examines, for example, how cooperation improves both the capacity of the customer firm to transmit knowledge that may be useful in the innovation process as well as the capacity of the established firm to absorb

such knowledge.<sup>3</sup> The open innovation literature (Chesbrough 2003; Fey and Birkinshaw 2005; Gassmann 2006; Laursen and Salter 2006; Lichtenthaler 2008) explores how firms more generally can make use of external knowledge for improving their innovation performance.

However, these literatures are not forthcoming with respect to what kind of internal organization firms need to adopt when they interact with firm-external entities, such as customers, in the context of innovation. In other words, while it has been known for a long time that producer firms need a certain degree of absorptive capacity to benefit from externally developed knowledge—including users’ knowledge—the internal organization dimensions of such absorptive capacity remain unclear.

### **Absorptive Capacity and New Organizational Practices**

In their seminal contribution Cohen and Levinthal (1990: 128) identify absorptive capacity as a determinant of innovation performance, defining it as the “ability to identify, assimilate, and exploit knowledge from the environment.” Most subsequent research on absorptive capacity has focused on knowledge-related antecedents of absorptive capacity (e.g., investments in R&D), and very little work has examined how absorptive capacity relates to organizational design issues, including new work practices and other aspects of firms’ internal organization (Volberda, Foss, and Lyles 2008; but see Janssen, van den Bosch, and Volberda, 2005). While Cohen and Levinthal (1990: 131) suggest that organizational practices may matter to the identification, assimilation, and exploitation of external knowledge, they do not analyze *how and why* such practices may matter — a primary purpose of this paper. However, they introduce a useful distinction between “inward-looking” and “outward-looking” absorptive

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<sup>3</sup> It may be hypothesized that the composition of the user/customer group that the firm interacts with may influence the absorptive capacity that the firm build and ultimately its innovation performance.

capacity, the former relating to the firm's efficiency of internal communication, while the latter refers to its points of contacts with external sources of knowledge (Cohen and Levinthal 1990: 133). This provides a possible starting point for relating organizational practices to the absorption of external knowledge. Specifically, organizational practices may be thought of as having an inward-looking or outward-looking dimension, because some practices are designed to enhance the efficiency of internal communication and some practices help to establish points of contacts with external sources of knowledge. The dimensions are likely to be complementary, as introducing outward-looking work-practices makes it more profitable (within limits) to introduce inward-looking work-practices and *vice versa*.

This reasoning suggests that customer interaction may be linked with innovation performance partly through organizational practices. While traditional dimensions of internal organization (e.g., specialization, departmentalization, liaison groups, hierarchical layers, etc.) are by no means irrelevant, we argue that in the context of being open to external sources of knowledge for innovation, new organizational practices are adopted to cope with the challenges to firm-level absorptive capacity raised by an increasing amount of diverse external knowledge sources.

The practices identified in the literature on "new work practices" can be seen as organizational mechanisms that have the potential of improving productivity (e.g., Datta et al. 2005; Ichniowski et al. 1997), innovative performance (e.g., Laursen and Foss 2003), and profitability (e.g., Huselid 1995). A central argument of the new work practices literature is that this potential can only be released when firms introduce a full set of mutually reinforcing (i.e., complementary) bundles of organizational practices that include practices aiming at delegating decision rights, supporting vertical and lateral communication, and incentivizing knowledge

sharing. A central idea in this literature is that of delegating decision rights in such a way that they are co-located with relevant knowledge for making decisions at lower levels of the organization. Much of this knowledge may be inherently tacit and thus require decentralisation for its efficient use. However, to be valuable, the knowledge that is developed locally needs to be diffused through communication and knowledge sharing mechanisms. Since some of these practices are, moreover, associated with extra effort or with disutility of changing to new routines, employees will have to be somehow rewarded.

We build on these insights and posit that new organizational practices have a further reach: In particular, we argue that a set of complementary organizational practices— including some of the same ingredients as those found in the new work practice literature—can also help firms to better identify, assimilate, and exploit knowledge from the external environment to become more innovative.

### **THEORETICAL MODEL AND HYPOTHESIS**

In the following, we develop a set of hypotheses concerning the mediating role of new organizational practices with respect to linking knowledge initially held by the firm's customers and its innovation performance. The theoretical model presented in Figure 1 summarizes our key constructs and the hypotheses we develop concerning their relations.

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Insert Figure 1 here  
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### **Interaction with Customers and Innovation Performance**

While our focus in this paper lies in understanding how firms can design their organization to better tap and exploit knowledge that initially resides with customers, the part of the sources of innovation literature that focuses on user-driven innovation is also important because it helps in explaining why users, including customers, can often play a central role in the first stages of the innovation process. According to this stream of research there are two overall reasons why users/customers may contribute to the innovation process. First, in many cases they are the main beneficiaries of the innovation (von Hippel 1988). For example, an airline may gain competitive advantage by being the first adopter of a newly developed fuel-efficient airplane. In such a situation the airline has an incentive to co-develop the airplane with the producer (cf. Rosenberg 1982).<sup>4</sup> Second, customers often possess “sticky” knowledge (i.e., knowledge that is costly to transfer) (von Hippel 1998).

Stickiness may be caused by various attributes of knowledge itself, such as the way it is encoded (in the form of tacit or codified knowledge), or it may be caused by the attributes of the agents seeking or providing knowledge (e.g., their cognitive capacity and motivation). Thus, the airline may possess knowledge about the performance and operating characteristics of a plane that may turn out to be an essential input in the modification of the airplane. However, such knowledge is likely to be dispersed among a number of employees of the airline (who may lack

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<sup>4</sup> von Hippel (1988, 1994) establish that when users often initiate innovations it is because they have the incentive and knowledge to do so, while the established firms do often not have the incentive and knowledge. This may be seen to contradict the idea that established organizations collaborate with users to develop new products. However, von Hippel (2005) points out that very often established firms commercialize the end-product despite the fact the product was a user innovation in the first crucially important stages of development. One important reason why established firms often end up commercializing user-inventions may have to do with the complementary assets possessed by the established manufacturers (Teece 1986).

motivation to share it), and will probably have a considerable “tacit” component (that impedes articulation). Mobilizing this knowledge so that it can be used as input in the innovative process requires direct collaboration between the airline and the producer (Rosenberg 1982: 124). Seen from the point of view of the producer-firm, the stickiness of knowledge implies that it will be advantageous to collaborate with customers (and users more broadly) as such collaboration allows for access to knowledge that the focal firm would be unable to produce in-house — knowledge that often prove to be critical for innovation success (Gardiner and Rothwell 1985; Neale and Corkindale 1998; Pavitt 1984; Rothwell et al. 1974) and for subsequent competitive advantage of the firm (Desouza et al. 2008; Lilien et al. 2002). However, getting access to this knowledge requires the honing of capabilities for cooperating (e.g., Dyer and Nobeoka 2000; Dyer and Singh 1998). We build on these strategic management oriented arguments in the user innovation literature, and accept that customers are an important source of knowledge that forms the basis of innovation. This overall insight motivates the following hypothesis:

*Hypothesis 1. The more the focal firm engages in interaction with customers, the better its innovation performance.*

#### **New Organizational Practices: The Link between User Interaction and Innovation Performance**

It is generally recognized that “[i]nformation and knowledge are at the heart of organizational design” (Holmström and Roberts 1998: 90), and that firms can design their organizations to promote the sharing and recombination of knowledge resources. Thus, attention has often been concentrated on how organizational practices, such as extensive delegation of decision rights, high-powered performance incentives, as well as intensive communication — that is, new organizational practices — can promote knowledge building and sharing in firms (Foss 2003; Laursen and Foss 2003; Mendelson and Pillai 1999; Nickerson and Zenger 2004;

Osterloh and Frey 2000). As pointed out earlier, we extend this perspective to the context of customer innovation.

The increasing reliance on external sources of knowledge as inputs to firms' innovation processes challenges absorptive capacity: As firms become dependent on a larger number of heterogeneous external parties, identifying, assimilating, and exploiting external knowledge become more taxing activities. However, firms can partially meet these challenges by means of the design of their internal organization. In the following we discuss how various new organizational practices may assist firms in leveraging knowledge held by customers in the context of innovation.

***Delegation as an Outward-Looking Organizational Practice.*** The literature provides a number of reasons why firms delegate decision rights to employees. Cognitive as well as motivational reasons are given. Thus, according to classical organizational theory, delegation economizes on managers' scarce mental resources, and reduces the costs of transmitting, receiving, and processing information (Galbraith 1974). Relatedly, delegation may co-locate rights to make decisions with those who possess the knowledge about what decision should (optimally) be made (Jensen and Meckling 1992); communicating such knowledge to hierarchical superiors may be too costly or slow. The argument is often made that a fast-moving external environment makes extensive delegation increasingly pressing because slow decision-making will be punished in such environments (Mendelson and Pillai 1999; Zenger and Hesterly 1997).

A further reason why firms engage in extensive delegation of decision rights is represented by interaction with customers for the purpose of gaining access to valuable customer knowledge. Sometimes employees automatically possess rights to interact with outside parties by virtue of

their job descriptions. Managers who are responsible for customer relations have such rights. Moreover, firms often have “gatekeepers” (Allen 1977; Allen and Cohen 1969; Tushman and Katz 1980) that have emerged to connect a research team with external sources of knowledge, while also filtering out noise. Delegation of responsibility is important when processing and absorbing knowledge and information from customers, because in information-rich environments, gatekeepers—and other staff working with customers—need to be granted decision rights with respect to the direction of an innovation project, since they are the ones who are best able to judge, absorb, and pass on the inputs from customers.

In other words, one reason for delegating decision rights to employees working with customers/users is that such employees will often have specific knowledge concerning customers and their ideas that is superior relative to that of the firm’s management team. As such, delegation is an outward-looking organizational practice. Firms that wish to expand outward-looking absorptive capacity may actively encourage employees other than gatekeepers and technical staff to seek information about market and technological trends and disseminate such knowledge internally (Matusik 2002), notably by interacting with customers.

With respect to the motivational aspects, delegation is often argued to raise the intrinsic motivation of many (if not necessarily all) employees (e.g., Deci 1975; Gagner and Deci 2005; Porter and Lawler 1968). Delegation thus has the double effect that it empowers employees to make active efforts to identify and assimilate external knowledge, and gives them the motivation to actually engage in such activities. In sum, and as clarified above, extensive delegation of decision rights is one such new organizational practice that firms can implement in order to improve the identification of potentially valuable external knowledge. This reasoning motivates the following hypothesis:

*Hypothesis 2. The more the focal firm interacts with its customers, the more it will delegate responsibility.*

***Communication and Knowledge Sharing as Inward-Looking Organizational Practices.***

Interaction with customers in the context of innovation involves the transfer or exchange of often large amounts of knowledge and information that is initially held by customers. It is often crucial that the knowledge or information transferred into the firm is distributed to other parts of the firm. Apart from the obvious case of best-practice transfer, one reason lies in the need for transferring knowledge of modifications in a complex technical product that relate to several different components in that product (i.e., “transformation” in the terminology of Zahra and George, 2002). The need for intensive internal sharing and communication of knowledge that stems from customers would seem to be particularly pressing in the case when the knowledge concerns product architectures.<sup>5</sup> Knowledge that is transferred between a customer and a firm and which concerns a complex product and/or has architectural elements is likely to require a substantial interaction between the two parties, but may also require substantial interaction within the firm. Such interaction necessitates internal communication of not only knowledge that relates to individual components, but also knowledge about how components relate in an architecture.

Save for the rare cases where those who identify potentially valuable external knowledge are completely identical to those who can apply such knowledge in actual innovation, the relevant knowledge will have to be communicated to other units, departments and persons involved in the innovation process. In other words, outward-looking knowledge absorption

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<sup>5</sup> Henderson & Clark’s (1990) study of the semiconductor photolithographic alignment equipment industry demonstrates how firms may have difficulties understanding the architectural dimensions of innovations.

complements inward-looking knowledge absorption. This implies that firms that adopt outward-looking organizational practices (i.e., delegation of responsibility) should also adopt inward-looking organizational practices. Two central new organizational practices can be hypothesized to add positively to inward-looking absorptive capacity, namely 1) internal communication in the vertical as well as in the horizontal dimension, including knowledge sharing and 2) rewarding employees for knowledge sharing behavior. Thus, given that the adoption of outward-looking organizational practices (delegation of responsibility) positively affects the adoption of outward-looking organizational practices, we put forward the following two hypotheses:

*Hypothesis 3: The more the focal firm delegates responsibility, the more it will link salaries to knowledge sharing behavior*

*Hypothesis 4: The more the focal firm delegates responsibility, the more communication will take place inside it.*

Kogut and Zander (1992) argue that innovations are the product of a firm's "combinative capabilities" to generate new applications from existing knowledge where the working of such capabilities is mediated by the presence of shared knowledge (cf. Dougherty 2001). In this view, firms can gain competitive advantage by being able to create and share knowledge more efficiently than competitors. A pressing issue therefore becomes how firms can design internal organization so that knowledge creation and sharing is promoted.

A large, recent literature builds on network theory and the concept of social capital to examine how intra-organizational channels of communication positively mediate the relation between knowledge and outcomes such as product innovation (Hansen 1999; Tsai 2001; Tsai and Ghoshal 1998). Another research stream looks specifically at product innovation and examines the impediments to knowledge transfer among subunits within the firm (Henderson

and Cockburn 1994; Leonard-Barton and Sinha 1993; Szulanski 1996). It is argued that close and frequent interactions between R&D and other functions, teams and other subunits leads to superior innovation performance, because such interactions lead to better integration and coordination of different bodies of knowledge (cf. Aoki 1986). Accordingly, we hypothesize:

*Hypothesis 5: The more the focal firm engages in internal communication, the higher its innovation performance.*

### **Paying Employees to Share Knowledge**

Knowledge sharing behavior has increasingly become part of the performance measurement and reward system in many firms (Laudon and Laudon 2002). Sometimes this is part of a formal knowledge management system, but often it is not. The underlying reasoning is, of course, that if employees are rewarded for sharing knowledge, they will do so, and may also try to seek out shareable knowledge (e.g., from customers).<sup>6</sup> Rewarding knowledge sharing behavior compensates for the effort of sharing knowledge, seeking knowledge that can be shared with other employees, and perhaps also for giving up potentially valuable bargaining chips (Brynjolfsson 1994). To the extent that such rewards have the intended effect, they may be seen to be outward- as well as inward-looking work practices, because they not only motivate employees to share knowledge they already hold, but also to identify and assimilate new

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<sup>6</sup> Theoretical arguments (Osterloh and Frey 2000) as well as empirical evidence (Brock et al. 2005) suggest that paying employees for sharing knowledge may lead to a motivation crowding effect (Deci 1975; Gagner and Deci 2005): To the extent that such rewards are perceived as being controlling, this may crowd out the intrinsic motivation that, some argue, is crucial for the efficient functioning of communication and knowledge sharing inside firms (Osterloh and Frey 2000). While the jury is still out on this issue, psychology-based arguments suggest that rewarding for sharing knowledge is an organizational instrument that should be used cautiously.

knowledge (that they can later share). Accordingly—while noting the possible crowding of motivation—we conjecture the following two hypotheses:

Hypothesis 6: *The more the focal firm links salaries to knowledge sharing, the higher its innovation performance.*

## METHODS

### Sampling and Data

Our sampling frame is Danish firms. The data collection was conducted as a survey in 2001 among the largest firms in Denmark. Specifically, the questionnaire was submitted to the 1,000 largest firms in Denmark. Although smaller firms also engage in interactions with customers, in the context of the present paper, a focus on the largest firms makes particular sense because the largest firms in Denmark are arguably disproportionately more engaged in innovation activities and more likely to have adopted organizational practices of knowledge sharing, delegation, and incentive pay in order to facilitate innovation.

The research team developed the questionnaire over the period January to June 2001. To the extent that it was possible, we based our questions on previous studies of human resource management practices, notably on scales developed by Lawler, Mohrman, and Ledford (1998: 200-223). After the initial completion, the questionnaire was submitted to a private consultancy firm (PLS Rambøll), which had the questionnaire pre-tested in June 2001. On this basis, the research team revised some of the questions for clarity and the questionnaire was subsequently submitted by PLS Rambøll in August 2001 to the 1,000 target firms. After two reminders, a total of 207 firms had responded to the survey, providing a response rate of 21 percent. However, because of missing answers, only 169 responses were usable for statistical analysis. The

questionnaire was submitted to the CEO of the firm, who responded in the majority of cases. In some cases, however, the response came from an HRM manager or another top-manager. The 169 firms included in the data set have 1,811 employees on average, with a large variation between some very large firms in one end of the spectrum and a number of medium sized firms with approximately 350 employees in the other end. On average, the firms generate 28 percent of their sales abroad, which indicates that they are very internationally oriented.

Non-response biases were evaluated by comparing the industries represented in the sample with the population sample used. Applying a chi-square test, we cannot reject the hypotheses that the distribution of firms across industries is equal between our sample and the overall population at any reasonable level of significance (both at the one and two digit Danish industry code level). In addition, we applied *t*-tests comparing our sample mean to the population mean with respect to variables such as total sales (a measure of firm size) profits, and the year the firm was founded. With respect to total sales we found that the two groups are virtually identical, while for profits there is a slight tendency for respondents to be less profitable than the non-respondents (significant difference only at the 10% level). Similarly, on average, there is a weak tendency (significant difference only at the 10% level) for responding firms having been established slightly earlier (1956) than non-respondents (1964). Nevertheless, overall, there seems to be broad correspondence between the underlying population and our sample.

With respect to common method bias, the performance variables were placed after the independent variables on the questionnaire in order to diminish, if not avoid, the effects of consistency artifacts (Salancik and Pfeffer 1977). In addition, we performed Harman's one-factor test on the items included in our model to examine whether common method bias may augment the detected relationships. Since we found multiple factors, and since the first factor did not

account for the majority of the variance (the first factor accounts for 32 percent of the variance only), potential problems associated with common method bias are not indicated by the test (Podsakoff and Organ 1986).

### **Measures and Operationalization**

We used perceptual measures for operationalization of all variables in this study. In the following, we describe the operationalization of the constructs, and then evaluate the different forms of validity.

***Interaction with Customers.*** This construct mirrors the extent to which the focal firm involves customers in its innovation activities. It includes three items measured on a 7-point Likert-type scale from 1 (not at all) to 7 (to a very large extent). For the first two items, we asked managers to what extent they were 1) involving customers in close collaboration on development projects, and 2) communicating intensively with customers. For the third item, we asked to what extent the overall strategy of the firm emphasizes close collaboration and dialogue with customers. Taken together, the responses indicate the degree of involvement of customers in innovation activities.

***Delegation.*** Delegation reflects the extent to which responsibilities and decision rights are delegated to employees. The construct is based on two items. For the first item we asked to what extent employees can influence their own job (measured on a 7-point Likert-type scale: 1= not at all and 7 = to a very large extent). The second item is a measure of the number of employees that are engaged in teams with a high degree of autonomy (1=0%, 2=1-25%, 3=26-50%, 4=51-75%, 5=76-99% and 6=100%). The first item captures delegation of responsibility towards the individual, while the second item speaks to delegation at the level of the team/group. Together, these two items form a construct for the level of delegation in the firm.

***Salaries Linked to Knowledge Sharing.*** This construct measures to what extent employees' salaries are associated with knowledge sharing, that is, to what extent the salary is used to create incentives for knowledge sharing. It is based on two items, where managers are asked to indicate on a 7-point Likert-type scale (1= not at all and 7 = to a very large extent) the extent to which 1) an employee's salary is linked to the ability and willingness to share knowledge, and 2) the salary is linked to the willingness to improve skills and upgrade knowledge. The latter item speaks more to the issue of searching for rather than sharing knowledge (improving skills and upgrading knowledge is more an issue of receiving knowledge than of transferring knowledge). However, successful skill improvement and knowledge upgrading will usually require some degree of knowledge sharing (e.g., as in an apprenticeship) (see, e.g., Dyer and Nobeoka 2000). Moreover, we expect that in an organizational setting, the sharing of and the searching for knowledge are related in the sense that successful search for knowledge is to some extent a positive function of the extent to which one shares knowledge with other employees. Thus, this reciprocity assumption motivates the inclusion of the second item.

***Internal Communication.*** This constructs mirrors the communication inside the firm, across the lateral as well as the hierarchical dimension. It is measured by two items where respondents were asked to indicate the extent to which 1) employees exchange information between different functional departments, and 2) there is communication between management and employees. Both items were measured on a 7-point scale going from 1 = not at all to 7 = to a very large extent.

***Innovation Performance.*** This construct is based on two items. Managers were asked to indicate the performance of the focal firm compared to the competitors on the following two

dimensions: 1) innovation capacity, and 2) profitability (both measured on a 7-point scale going from 1 = far below average to 7 = far above average). The argument for including profitability as an item for measuring innovation performance is that the Schumpeterian (1912/1934) notion of innovation not only pertains to the capacity to introduce “new combinations” for instance in terms of new products, but also to the economic significance of those new products. Such success will be reflected in higher profits. Moreover, the empirical literature also points to the fact that innovations and profitability are intrinsically linked (see for instance, Geroski et al. 1993).

### **Construct Analysis**

The hypotheses are tested in a LISREL model that allows for simultaneous formation of underlying constructs (the measurement model) and test of structural relationships among these constructs (the structural model). The advantage of applying a LISREL model as the vehicle for estimation, rather than regression analysis, is twofold. First, the model allows us to deal with complex mediated relationships. Dealing with these relationships — that are central to this paper — is very cumbersome in a regression set-up. Second, unlike regression analysis, a LISREL model accounts for measurement error in the presence of latent variables represented by a set of items. One disadvantage of using LISREL-models is that control variables cannot be included in the conventional way as in regression models. For instance, dummy variables cannot be included, and it is practically impossible to include control variables that contribute little to the overall model (Fletcher et al. 2006). However, group analysis can be conducted in order to test for interaction effects of group variables (Jaccard and Wan 1996) — as will be done later in this paper. The validity of LISREL models is estimated by the validity of the entire model, that is, by its nomological validity. However, before estimating the nomological validity of the model with

the causal relations specified, it is important to judge its convergent validity, that is, the homogeneity of the constructs included in the model, and its discriminant validity, that is, to what extent the constructs are independent (Campbell and Fiske 1959).

**Measurement Model.** We create a measurement model in order to assess convergent and discriminant validity. Appendix A reports the means, standard deviations, and correlations between all variables. The correlations provide initial evidence of a high convergent (i.e., high correlations among items belonging to the same construct) and discriminant validity (i.e., lower correlations with items belonging to other constructs). In fact, the coefficients among items belonging to the same construct vary between 0.38 and 0.64 (highlighted in bold), while none of the other coefficients exceed 0.34.

**Convergent Validity.** To ascertain whether the constructs were internally coherent we report several tests of convergent validity in Table 1. The table is based on the saturated measurement model where all interfactor correlations are specified (Jöreskog and Sörbom 1993). First, the strength of the linearity in relations between constructs and items — the R-squared values — is shown in Table 1. In all cases the strength of the linearity is relatively strong with a R-squared value of 0.36 or above. This is clearly above the usual threshold of 0.20 for the R-squared value (Hair et al. 1995). From Table 1 we can also conclude that the *t*-values for all items are highly significant (i.e., all are above 4.74) and that their (standardized) factor loadings are strong (all above 0.60). Secondly, the reliability of each construct is calculated and all of them are above the recommended threshold of 0.70 (Gerbing and Anderson 1988). Also, when we look at the variance extracted the picture is somewhat better: all constructs are above the recommended threshold of 0.50 (between 0.52 and 0.61).

***Discriminant Validity.*** Several measures of discriminant validity were obtained from the data. A test of discriminant validity is to test whether the correlations and causal paths between the latent constructs are significantly different from 1 (e.g. Burnkrant and Page 1982). Constructing 99.9% confidence intervals around the correlations and causal paths confirms that none of them are close to including 1. Fornell and Larcker (1981) suggest a comparison between the variance extracted for each construct and the variance shared between the constructs (the squared correlations between the constructs). Both are given in Table 1, and the variance extracted is clearly higher than the variance shared for all constructs. In combination, these tests indicate that the discriminant validity of the five constructs is very satisfactory.

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Insert Table 1 here  
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The second step in the analytical process is to form the structural model by specifying the causal relations in accordance with the hypotheses. Through repeated iterations a LISREL analysis proceeds with the fine-tuning of the model to obtain a more coherent representation of the empirical data. The purpose of the LISREL analysis is to arrive at and confirm a model consisting of specified causal relations. Thus, in the test, we generate a structural model that contains relationships in accordance with the stipulated hypotheses (cf. Figure 1). We test single causal relations with *t*-values and factor loadings between the constructs in the model. Goodness-of-fit indexes are critical for the evaluation of the entire model. However, given their complexity, there is no consensus regarding the “best” index of overall fit for structural equations. Thus reporting multiple indexes is encouraged (Bollen 1989).

**Goodness-of-Fit.** We assessed the entire model by different goodness-of-fit measures including the chi-square value, the Goodness of Fit Index (GFI), and the Non-Normed Fit Index (NNFI), which are measures of the distance between data and model, i.e., nomological validity (Jöreskog and Sörbom 1993). The model has Chi-square value of 37.14 for 38 degrees of freedom ( $\chi^2[38] = 37.14, p = 0.51$ ), providing strong evidence for rejecting the hypothesis that the estimated model is different from the data. In other words, the model gives a good representation of the data. Thus, there is no significant statistical difference between our theory-based model and the original data, indicating that we explained the original correlations at a level not statistically different from the value of 1. The Goodness of fit index (GFI) that is based on residuals obtained a value of 0.96, which represents a very good fit (suggested GFI > 0.90) of the model to the data (Bollen 1989). Finally, the Bentler-Bonett non-normed fit index (NNFI) represents the proportion of improvement in fit relative to the null model, while controlling for model parsimony. The obtained value (NFI=0.91) represents a good fit of the model to the data. In sum, all three fit indices indicate a good fit of the proposed model to the data.

Furthermore, comparing the estimated path model with the (saturated) measurement model indicates that the estimated path model fits the data better than the measurement model (an increase in the Chi-square value  $\Delta\chi^2 = 3.6$ , but with the use of 4 fewer degrees of freedom). The parsimonious GFI is 0.60 for the measurement model, but increases to 0.66 for the estimated model. This provides further evidence that the estimated model is superior to the measurement model.

## **RESULTS**

### **Findings**

The figures given for the estimated path model or the structural model (cf. Figure 2) are standardized factor loadings of causal relations with *t*-values in parentheses (those in bold relate to the structural model).

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Insert Figure 2 here  
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With respect to Hypothesis 1 (“*The more the focal firm engages in interaction with customers, the better its innovation performance*”) the relevant parameter turns out to be negative, albeit insignificant (*t*-value of -0.84), so the hypothesis is rejected. In other words, interacting with customers is not a sufficient condition for securing innovative performance.

For Hypothesis 2 (“*The more the focal firm interacts with its customers, the more it will delegate responsibility*”) the results are consistent with the hypothesis, since the parameter estimate for the effect of interaction with customers on delegation is positive and significant (*t*-value of 4.87). Moreover, we find evidence supporting both Hypothesis 3 (“*The more the focal firm delegates responsibility, the more it will link salaries to knowledge sharing behavior*”) and Hypothesis 4 (“*The more the focal firm delegates responsibility, the more communication will take place inside it*”): Delegation significantly and positively impacts both salaries linked to knowledge sharing and internal communication (with *t*-values of 6.01 and 5.44, respectively). It may be noted that in terms of the coefficient estimate (0.71), the effect of delegation on salaries linked to knowledge sharing is the strongest relationship in the model. We also find strong support for Hypothesis 5 (“*The more the focal firm engages in internal communication, the higher its innovation performance*”) as the correlation coefficient between these constructs is significant at the one percent level (*t*-value of 2.58). Similarly, there is support for the hypothesis

that states that the more the focal firm link salaries to knowledge sharing, the higher its innovation performance (Hypothesis 6). In sum, for the overall model, we find support for the idea that the link from interacting with customers to innovation performance is an *indirect* one: It is mediated through a set of organizational practices.

In addition, we are able to track the total effect (the sum of direct and indirect effects) of all constructs on the innovation performance. It turns out that internal communication and delegation has considerably larger effect on innovation performance (0.49 and 0.38, respectively) than salaries linked to knowledge sharing and interaction with customers (0.18 and 0.13, respectively). This reinforces the point that the effect of interaction with customers on innovation performance is mediated by organisational practices, and that firms will only gain the full potential of interaction with customers if these organisational practices are in place.

### **Robustness Checks**

In order to test for whether or not our results could be driven by the fact that some firms in our sample are more knowledge intensive than others, a group analysis<sup>7</sup> was conducted for two groups of firms: (i) firms with a high proportion of researchers employed in R&D; and (ii) firms with a low proportion of employees in R&D. Broadly speaking, we find that the model holds for both groups separately (although some significance is inevitably lost in both cases). This suggests that differences in knowledge intensity do not drive the results. Similarly, we conducted a group analysis for the largest and for the smallest firms in our sample. Again, we found that the model, by and large, is confirmed for each of the two groups. As an additional robustness check we experimented with introducing industry-level R&D (for 29 industries—the highest number of

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<sup>7</sup> Group analysis has some resemblance with including control variables in regression analysis as one tests for interaction effects of a group variable on the parameters in the model.

industries for which we could get hold of official R&D statistics). Once more, in conducting the group analysis we found that the results of the model did not differ significantly between firms operating in high-R&D intensity industries as compared to firms operating in low-R&D intensity industries. In addition to the group analysis, we carried out four single-equation regressions, all including a set of control variables to test the seven relations that we have hypothesized on in this paper.<sup>8</sup> Our controls included a variable reflecting whether the level of education within the firm is perceived to be higher than the competitors; the proportion of employees working in R&D; whether the firm has foreign ownership; industry-level R&D intensity (29 industries); and finally, 19 industry dummies. The results correspond to the findings emerging from the LISREL analysis: The relation hypothesized in H1 is insignificant, but all other hypothesized relations are significant at, at least, the two-sided five percent level.

## **CONCLUDING DISCUSSION**

The contribution of this work is to develop a model that highlights the role of organizational practices as mediators between interaction with customers and innovation performance. We have developed an interpretation of the model that highlights the importance of formal organization for successful customer innovation seen from the point of view of established innovating firms. In general, we found empirical support for our model: The effect of interaction with customers on innovation performance is mediated by organisational practices, and firms will only gain the full potential of interaction with customers if these organisational practices are in place.

### **Contribution to Theory**

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<sup>8</sup> These results are available upon request.

A prevalent theme in the strategic management and innovation literatures is that firms increasingly need to rely on external knowledge sources to gain and sustain competitive advantages (e.g., Chesbrough 2003; Dyer and Singh 1998; Teece 2000). The purpose of this work is to enrich the understanding of the role of new organizational practices in the context of absorbing and leveraging customer knowledge that may improve innovation performance. The literature on new organizational or work practices has shown that these practices matter for organizational performance. Our reasoning and results strongly support the notion that such organizational practices also influence how external knowledge that initially resides with customers is leveraged into innovative capacity. The underlying mechanisms are that organizational practices impact individual incentives to absorb knowledge from the outside and share this knowledge inside the firm, as well as make individuals capable of absorbing outside knowledge and sharing it.

From a somewhat different perspective, the paper can be seen as a contribution to the literature on user-innovation (Urban and von Hippel 1988; von Hippel 1986) and the open innovation literature that looks at customers as one of several external sources of innovation (Chesbrough 2003; Fey and Birkinshaw 2005; Laursen and Salter 2006). These literatures tend to take relations between users/customers (and other external sources of innovation) and firms as the unit of analysis, leaving the issue of how organizational factors may leverage user knowledge into innovation on the side. By opening up firms in the context of innovation that involves customers, we have added some of the missing organizational components in the user-innovation literature.

### **Future Work**

The focus of this paper has been on customer knowledge and how it is leveraged by

organizational means into innovative activity. However, customers are not the only source of external knowledge that influences a producer firm's ability to innovate. Indeed, recent work by Chesbrough (2003) asserts that innovative firms increasingly change their sourcing of new knowledge to an "open innovation" model that implies the use of a wide range of external actors and sources to help them achieve and sustain innovation. The earlier notion of "distributed innovation" (von Hippel 1988) also suggests that external knowledge can be obtained from several external sources. Moreover, Baum, Calabrese, and Silverman (2000) show that within biotechnology, innovators rarely innovate alone, while Laursen and Salter (2006) demonstrate that a firm's ability to product innovate is strongly influenced by the openness of the firm's external search strategy in terms of the number of external sources of knowledge applied by the firm. Future research should be expanded to deal with the appropriate organizational response to a much wider range of external knowledge inputs.

Future work may also go beyond the emphasis on formal organization in this paper. The literature on organization as an antecedent to knowledge sharing and creation seems to focus mainly on *either* formal organization (the present paper; Jansen, van den Bosch, and Volberda, 2005) *or* informal organization (see e.g., Hansen 2002; Tsai 2001). However, there are reasons to expect that informal and formal organization interact with respect to their impact on knowledge sharing and creation. For example, it may plausibly be hypothesized that (formal) incentives for knowledge sharing will complement (informal) network ties with respect to the impact on knowledge sharing. Future research should consider such interaction effects in greater detail.

Future research may also treat individual behaviors more explicitly. Individual action and interaction form the micro-foundation for why organizational practices can leverage customer knowledge into innovation. Thus, it is ultimately because organizational practices impact

individual incentives and knowledge that they influence innovation. The research methodology in this paper is, however, too “reduced in form” to explicitly capture these individual level mediating effects. Therefore, we cannot satisfactorily interpret the individual-level mechanisms that mediate between customer knowledge and innovation. Understanding these is crucial because the choice and design of organizational practices that can leverage knowledge into innovation depend on how these practices impact individual motivation and knowledge and therefore individual knowledge-seeking and sharing behaviors (Abell, Felin, and Foss, 2008).

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**TABLE 1**  
**Means, standard deviations and correlations for variables used in the study**

	1	2	3	4	5	6	7	8	9	10	
1) Customers involved in close collaboration	1.00										
2) Intense communication with customers	<b>0.50***</b>	1.00									
3) Strategy of close collaboration with customers	<b>0.38***</b>	<b>0.39***</b>	1.00								
4) Employees engaged in teams with high degree of autonomy	0.17*	0.09	0.04	1.00							
5) Employees influence on own job	0.25**	0.24**	0.25***	<b>0.39***</b>	1.00						
6) Salary associated with the ability and willingness to share knowledge	0.26***	0.32***	0.18**	0.24***	0.34***	1.00					
7) Salary determined by the willingness to improve skills and upgrade knowledge	0.21**	0.26***	0.21***	0.28***	0.28***	<b>0.64***</b>	1.00				
8) Exchange of information between employees across departments	0.07	0.08	0.10	0.15**	0.33***	0.29***	0.20**	1.00			
9) Communication among employees and management	0.10	0.24***	0.15*	0.16**	0.32***	0.26***	0.22***	<b>0.42***</b>	1.00		
10) Innovation capacity performance relative to competitors	0.08	0.14*	0.08	0.16**	0.28***	0.26**	0.24***	0.17**	0.27***	1.00	
11) Profitability relative to competitors	0.09	0.06	-0.02	0.15*	0.23***	0.23**	0.16**	0.17**	0.28***	<b>0.42***</b>	1.00
Mean	4.21	5.32	6.26	3.07	4.97	3.71	4.32	4.71	5.53	5.04	5.15
Std. Dev.	1.84	1.40	0.96	1.41	1.28	1.61	1.44	1.39	0.97	1.55	1.17
Min	1	1	1	1	1	1	1	2	2	1	2
Max	7	7	7	6	7	7	7	7	7	7	7

\*\*\*, \*\*, and \* = significant at 0.1, 1, and 5 per cent, respectively

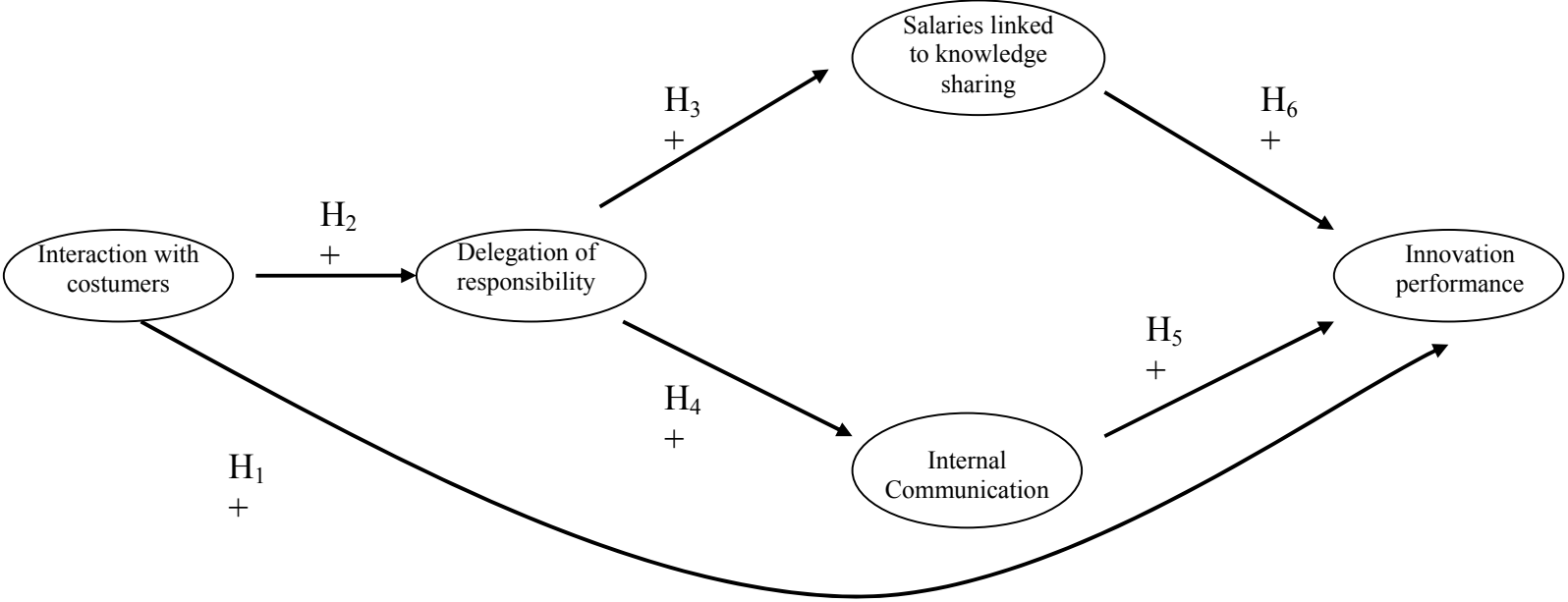
**TABLE 2: Constructs and Items\***

Constructs and items	Factor loading**	t-value	R <sup>2</sup> -value	Construct Reliability	Variance extracted by constructs	Variance shared between constructs
				0.76	0.52	0.34
<i>Interaction with customers</i>						
Customers involved in close collaboration	0.71	6.75	0.50			
Intense communication with customers	0.84	9.31	0.71			
Strategy of close collaboration with customers	0.60	5.64	0.36			
				0.71	0.55	0.34
<i>Delegation</i>						
Employees have influence on their own job	0.77	8.16	0.59			
Employees engaged in teams with high degree of autonomy	0.71	5.26	0.50			
				0.76	0.61	0.28
<i>Salaries linked to knowledge sharing</i>						
Salary associated with the ability and willingness to share knowledge	0.81	10.37	0.66			
Salary determined by the willingness to improve skills and upgrade knowledge	0.75	9.76	0.57			
				0.70	0.54	0.28
<i>Internal communication</i>						
Exchange of information between employees across departments	0.69	5.53	0.48			
Communication among employees and management	0.78	7.33	0.61			
				0.72	0.56	0.14
<i>Innovation performance</i>						
Innovation capacity of focal firm compared to competitors	0.79	4.74	0.62			
Profitability of focal firm compared to competitors	0.71	4.86	0.50			

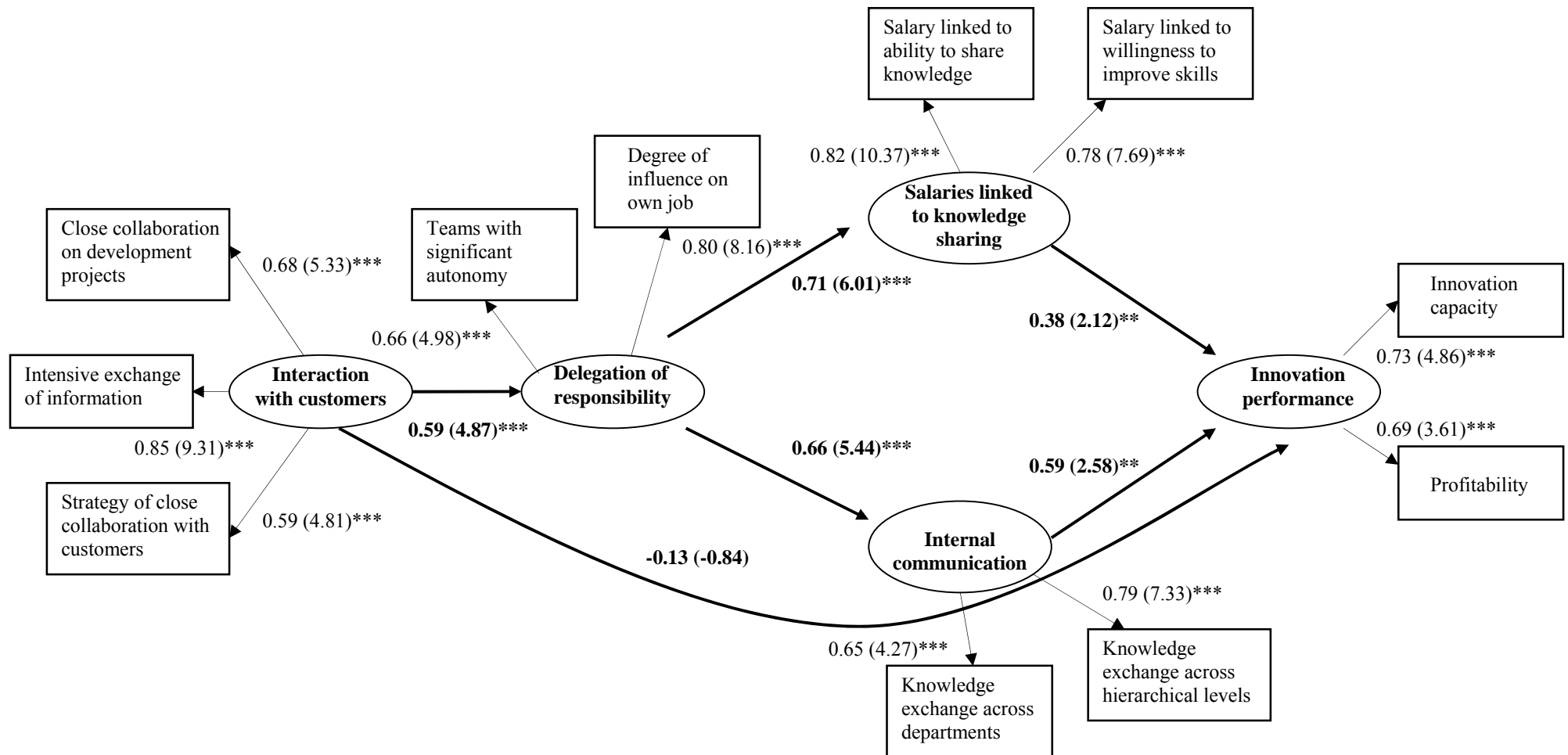
\* factor loadings are provided for the saturated measurement model where all possible interfactor correlations are specified

\*\* all factor loadings are highly significant at  $p < 0.01$  with t-value above 3.30.

**FIGURE 1**  
**Theoretical model**



**FIGURE 2**  
**Estimated Path Model**  
 (with t-values in parentheses)



\*, \*\* and \*\*\* indicate a significance level of 0.1, 1 and 5 per cent, respectively, for the two-tailed t-test