

# **Explaining intra-organizational Knowledge transfer at the individual level**

**Dana B. Minbaeva  
Kristiina Mäkelä  
Larissa Rabbiosi**

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**Center for Strategic Management and Globalization  
Copenhagen Business School  
Porcelænshaven 24  
2000 Frederiksberg  
Denmark  
[www.cbs.dk/smg](http://www.cbs.dk/smg)**

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Dana B. Minbaeva

Center for Strategic Management and Globalization

Copenhagen Business School

Porcelaenshaven 24, DK2000 Copenhagen Frederiksberg, Denmark

[dm.smg@cbs.dk](mailto:dm.smg@cbs.dk)

Kristiina Mäkelä

Department of Management and Organization

Swedish School of Economics and Business Administration

P.B. 479 FIN-00101 Helsinki, Finland

[kristiina.makela@hanken.fi](mailto:kristiina.makela@hanken.fi)

Larissa Rabbiosi

Center for Strategic Management and Globalization

Copenhagen Business School

Porcelaenshaven 24, DK2000 Copenhagen Frederiksberg, Denmark

[lr.smg@cbs.dk](mailto:lr.smg@cbs.dk)

# **EXPLAINING INTRA-ORGANIZATIONAL KNOWLEDGE TRANSFER AT THE INDIVIDUAL LEVEL**

## **Abstract**

The knowledge-based view has recently been criticized for overlooking individual-level action and interaction in favor of an over-emphasis on the firm-level capabilities. This paper seeks to respond to that criticism by providing some individual-level explanations for a collective-level phenomenon – intra-organizational knowledge transfer. We suggest that variations in individual ability, motivation and the use of interaction opportunities provided by the organization explain part of the variation found in individual-level knowledge acquisition and use, and that this has an influence on organizational level knowledge transfer within a firm. More specifically, we find that ability and intrinsic motivation are important drivers of individual level knowledge acquisition and use, while extrinsic motivation has no impact. Furthermore, the extent to which an individual uses interaction opportunities provided by the organization influences knowledge transfer both directly and through a moderator effect with ability and person-to-person interaction.

Keywords: knowledge transfer, individual level, ability, motivation, opportunity, MNC

## **Introduction**

In the recent years, knowledge-based explanations have emerged as powerful determinants of value creation in organizations, with firm-specific knowledge ultimately becoming a critical source of competitive advantage (Grant 1996; Kogut and Zander 1992, 1993; Spender 1996). Consequently, issues such as how to transfer and integrate knowledge existing in the various parts of the organization have risen in importance on both research and corporate agendas (Argote and Ingram 2000; Argote, McEvily and Reagans 2003). Indeed, we have learned a great deal about what influences the effectiveness knowledge transfer, including factors such as the characteristics of the knowledge, the properties of the sending and receiving units and the transmission channel, and various facilitators and barriers of transfer between two organizational units (Argote, McEvily and Reagans 2003; Gupta and Govinradajan 1991, 2000; Minbaeva 2007; Szulanski 1996, 2000; Zander and Kogut 1995).

However, the knowledge-based view (KBV) has recently been criticized for focusing too much on collectives as the locus of knowledge (Felin and Hesterly 2007; Foss 2007), and thereby underestimating the role of individuals in knowledge processes (Argote and Ingram 2000). Extant literature has tended to

overlook individual level variation by implicitly assuming that individuals a priori are homogenous, compliant, and randomly distributed in organizations (Felin and Hesterly 2007). For example, KBV research has typically failed to collect multi-source individual level data accounting for the heterogeneity that exists at the individual level. Even studies that have considered determinants related to individual behavior (e.g., Gupta and Govindarajan 2000; Minbaeva et al 2003; Szulanski 1996) have generally used organizational-level data and a single respondent to represent the whole organization, in the majority of cases a CEO or a general manager. Yet, a full understanding of intra-organizational knowledge transfer involves implying attention to individuals (Grant 1996), individual heterogeneity (Felin and Hesterly 2007), and interpersonal interaction (Felin and Foss 2005).

This paper seeks to address these theoretical and empirical limitations of extant research and, by doing so, further the understanding of the micro-foundations of organizational knowledge transfer (Foss 2007). We suggest that differences in individual ability, motivation and use of interaction opportunities provided by the organization explain part of the variation found in individual-level knowledge acquisition and use. In the following, we first develop several hypotheses on the effect of individual ability, motivation and use of opportunities on knowledge acquisition and use by that individual. The hypotheses are then tested on a sample of 656 individuals working in different sub-units of three multinational corporations (MNCs). We find that ability and intrinsic motivation are important drivers of individual level knowledge acquisition and use, while extrinsic motivation has no impact. Furthermore, the extent to which an individual uses interaction opportunities provided by the organization influences knowledge transfer both directly and through a moderator effect. We end by discussing the theoretical and practical implications of these findings.

### **Intra-organizational knowledge transfer: the role of individuals**

We build our individual focus on the argument that a deeper understanding of intra-organizational knowledge processes “cannot be reached *in lieu* of a starting point in individuals” (Foss 2007: 43). Accordingly, explanations of organizational-level phenomena should be grounded in explanatory

mechanisms that are located on the individual level (Felin and Hesterly 2007; Foss 2007). As far as our paper is concerned this means that if intra-organizational knowledge transfer is to be explained, we need to consider not only the organizational level antecedents (such as the employment of human resource management (HRM) practices), but also, crucially, its individual level micro-foundations. To illustrate this argument, we consider a diagram by Coleman (1990), which depicts two levels of analysis: the macro and the micro (see Figure 1). This diagram explains a macro-level phenomenon (arrow 4) through the micro-level as denoted by arrows 1, 2 and 3. In the figure, arrows represent causal mechanisms - the “cogs and wheels” (Elster, 1989: 3) - that produce the observed associations between phenomena (referred to as Type-1, Type-2 and Type-3 relations). In the beginning of each arrow is the *explanans* (the class of those sentences which are adduced to account for the phenomenon), and in the end the *explanandum* (the sentence describing the phenomenon to be explained). So, a macro-level phenomenon, located in the upper-right-hand corner of Figure 1, is explained through an aggregation (allowing for emergence) of the actions of the individual actors (Type-3 relations). These actions, in turn, are taken under the impact of specific individual level circumstances or ‘conditions of individual action’ (Type-2 relations), while the individual level circumstances are influenced by macro-level factors (Type-1 relations).

- INSERT FIGURE 1 AROUND HERE -

For the purposes of our paper we consider the macro-level as organizational whilst the micro-level is that of individuals.<sup>1</sup> There are various organizational-level antecedents that can be deployed to foster knowledge transfer and direct it in desired directions at desired levels. The link between organizational antecedents and knowledge transfer represents the Type-4 relations shown in Figure 1 (macro-to-macro), which according to Abell et al. (2008: 6) “may be taken as no more than a representation of a correlation between macro variables”. Instead, by adjusting the nature and application of the organizational antecedents, organizations can influence the ‘conditions of individual actions’ (macro-to-micro), thereby

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<sup>1</sup> There could also be an added group level in the diagram depicted in Figure 1. Since we are exploring individual level *explanans* of an organizational level phenomenon we have deliberately simplified the model, but emphasize its possible extension as an avenue for future research.

affecting the corresponding ‘individual actions’ (micro-to-micro). When these are aggregated they are expected to produce firm-level outcomes, which in our case concern the degree of intra-organizational knowledge transfer (micro-to-macro).<sup>2</sup>

We use Coleman’s diagram as a starting point, and having pointed to the interrelationship between the organizational and the individual levels (to which we will return to in ‘Discussion and Implications’), we concentrate our attention on the individual level, namely on the micro-to-micro relationship (Type-2 relations). We focus on the ‘conditions of individual actions’ and examine whether these explain variation in ‘individual actions’. Specifically, the ‘individual actions’ in the context of intra-organizational knowledge transfer refer to the extent to which individuals acquire and use new knowledge (Bresman et al. 1999; Minbaeva et al. 2003). We consider knowledge acquisition and use at the individual-level as a behavioral concept, i.e. “an overt act of the person that can be observed and measured” (Tosi, Mero and Rizzo 2003: 32). Like any behavior, knowledge acquisition and use by an individual could be further deconstructed into internal processes and “explained by opportunities and desires – by what people can do and by what they want to do” (Elster 1989: 14). We see these internal processes as consisting of individual abilities and motivation on the one hand, and their use of interaction opportunities provided by the organization on the other. Individuals are heterogeneous and hence differ in their degree of knowledge acquisition and use due to the individual differences manifested in their abilities, motivation and use of interaction opportunities provided by the organization.

Our conceptualization of the ‘conditions of individual actions’ is rooted in the literature on information processing. In particular, we are inspired by the Motivation-Opportunity-Ability (MOA) framework developed by MacInnis, Jaworski and Moorman (MacInnis and Jaworski 1989; MacInnis et al. 1991), which has been widely used in marketing and advertising research. The MOA framework was originally

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<sup>2</sup> This is not to say that macro-level explanations do not exist for macro-level phenomena. On the contrary, several macro-level factors (such as those related to organizational structure) may exist and influence intra-organizational knowledge transfer directly. We contend, however, that with explanatory factors involving human action (such as those related to exchanging knowledge) it is vital to go down in the level of analysis in order to ensure a deeper understanding of the causal mechanisms that are in effect.

used to explain how consumers process external information, linking individual behavior with that processing. This approach seems particularly appropriate for examining the individual-level antecedents of knowledge transfer as it moves away from the structure/content assumption characterizing previous research and adopts a more process-driven view (Lane et al 2006).

Literature in the field of psychology has also hosted a significant debate between the behaviorist and cognitive approaches to learning, differentiating between ‘can do’ (ability) and ‘will do’ (motivation) factors (Dunette 1976). Indeed, this distinction has been a subject of research among industrial and educational psychologists for over a half century. The ability/‘can do’ factor denotes “a potential for performing some task which may or may not be utilized” (Vroom 1995: 198), while the motivation/‘will do’ factor refers to a willingness to perform a particular task. In KBV-inspired research, the distinction between ability and motivation was explored by Minbaeva et al. (2003), who discussed the ability and motivation of employees to acquire knowledge as key components of the absorptive capacity. Moreover, Argote et al. (2003) were among the first to bring together individual motivation, ability *and* opportunity in relation to knowledge transfer, arguing that the consideration of these three individual level variables is vital in explaining organizational-level knowledge processes. Building on these studies, we will now consider how ability, motivation and opportunity may affect knowledge acquisition and use by individuals.

### **Ability**

The dictionary definition of *ability* refers to human attributes such as initial skills, aptitudes, experience and prior achievement, which are relevant for the skillful accomplishment of tasks, and may include both generic and more task-specific aspects. Indeed, as Vroom (1995: 232) argues, “[a] person’s ability to perform a task refers to the degree to which he possesses all of the psychological attributes necessary for a high level of performance excluding those of a motivational nature”. MacInnis and Jaworski (1989) confirm that deficiencies in ability limit the capacity of an individual to process information, and factors

such as limited intelligence and lack of experience, for example, have been observed to reduce it (Anderson and Jolson 1980).

The ability of an individual may well represent the ‘prior related knowledge’ (Kim 2001) that is required for knowledge acquisition. Experience in one learning task may influence and improve performance in a subsequent one. Indeed, as Cohen and Levinthal (1990) point out, prior possession of relevant knowledge and skills is vital for knowledge absorption, as it increases creativity and facilitates association between previously unconnected information. Furthermore, a belief in one’s ability, referred to as self-efficacy, has been shown by several researchers to increase commitment for learning (e.g., Bandura 1997; Cabrera et al 2006; McGill et al. 1992). Argote et al. (2003) agree, stressing that individual ability, including both innate skills and experience, plays an important part in knowledge processes. Hence, we propose a relationship between individual ability (this may include both generic and task-specific aspects) and knowledge acquisition and use as follows:

*Hypothesis 1. Individual ability is positively associated with the degree of knowledge acquisition and use by that individual.*

## **Motivation**

Motivation - referring to as a willingness to engage in a particular action - is another key factor in addition to ability that has been considered to influence individual knowledge acquisition and use. In fact, the argument that both ability *and* motivation are important influencers of individual behavior is well rooted in the behavioral science literature (e.g., Baldwin 1959; Porter and Lawler 1968). There is a considerable amount of research associated with cognitive process theories, such as the expectancy-valence theory of work motivation (Vroom 1964), which focuses on the intensity of effort amongst employees. This longstanding empirical work suggests that both ability and motivation are needed in order to increase performance (e.g., French 1957; Fleishman 1958; Heider 1958; O’Reilly and Chatman 1994). Furthermore, a key argument in this literature is that individuals with a high ability to learn will fail to absorb knowledge if their motivation for doing so is low or absent (Baldwin et al. 1991).

The critical role of motivation has also been observed in the literature on knowledge processes, in which it has been maintained that individual motivation influences knowledge-related outcomes positively (Argote and Ingram 2000; Argote et al. 2003; Quigley et al. 2007; Szulanski 1996, 2000). Two types of motivation are typically considered in this context, namely extrinsic and intrinsic (Osterloh et al. 2002). Individuals are said to be extrinsically motivated when they satisfy their needs indirectly, primarily through financial compensation (Osterloh et al. 2002). Indeed, this form of motivation has typically been associated with knowledge management initiatives, such as the well-known example of Siemens ShareNet, for which a reward system was designed to create a critical mass of content by making users aware of it and encouraging contributions (Nielsen and Ciabuschi 2003). In fact, the use of reward systems to enhance (extrinsic) motivation seems widespread: Bock et al. (2005: 91) assert that every organization they interviewed for their study “had implemented monetary incentives, points towards promotion, or both as extrinsic motivators for knowledge sharing”. Therefore, along with Cabrera et al. (2006: 251), who argue that “when individuals perceive a link between knowledge sharing behaviors ... and organizational rewards ... they will be more inclined to participate in knowledge sharing activities”, we propose that:

*Hypothesis 2a. Individual extrinsic motivation is positively associated with the degree of knowledge acquisition and use by that individual.*

On the other hand, an individual is said to be intrinsically motivated when he/she undertakes an activity because it satisfies his/her internal needs.<sup>3</sup> Intrinsic motivation is fostered by a commitment to a self-defined goal or to an obligation to comply with personal and social norms for their own sake (Osterloh et al. 2002), rather than by external rewards: “there is no apparent reward except the activity itself” (Deci 1975: 23). In the field of organizational behavior, intrinsic motivation has been found potentially to lower transaction costs, and to enhance trust and social capital (Osterloh and Frey 2000). Furthermore, its

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<sup>3</sup> It is worth emphasizing that motivation, whether extrinsic or intrinsic, always refers to a particular task or activity (in the case of this paper, to knowledge acquisition and use), and is not a general characteristic of a person. In other words, people can be extrinsically motivated to pursue a particular thing, and intrinsically motivated to do another, etc. Furthermore, various degrees of extrinsic and intrinsic motivation may exist, also simultaneously. As motivation as such is not the focus of this paper, we will deliberately refrain from further engagement in the debate around the dynamism of these concepts, and simply refer to extrinsic and intrinsic motivation for the sake of analytical clarity.

presence may be able to make up for a deficiency in relevant skills and expertise, especially in tasks requiring explorative work: “a highly intrinsically motivated person is likely to draw skills from other domains, or apply great effort to acquiring necessary skills in the target domain” (Amabile 1997: 44). Therefore, intrinsic motivation to share and reuse knowledge is critical for employees, and particularly so for organizations that depend on their employees’ capabilities to create new knowledge or to share tacit knowledge with others (Osterloh and Frey 2000; Cabrera et al. 2006). Hence, we put forward the following hypothesis:

*Hypothesis 2b. Individual intrinsic motivation is positively associated with the degree of knowledge acquisition and use by that individual.*

There is evidence in the literature that extrinsic motivation may not be quite as effective a determinant of knowledge transfer as intrinsic motivation. For example, intrinsically motivated employees may exhibit higher levels of learning than the extrinsically motivated (Deci and Flaste 1995), because people are typically at their most creative when their motivation stems from within (Amabile 1997). Furthermore, rewards are generally contingent on behaviors or performance on the level not only of individuals but also of groups or the whole organization. Therefore - as the theory of incomplete contracts (Simon 1951; Williamson 1975) suggests - outcomes cannot be completely specified as the observation of the individual behavior and the assessment of its value are not always directly linked, and the effectiveness of monetary compensation might be compromised (Austin 1996; Osterloh and Frey 2000). Finally, as Osterloh and Frey (2000) suggest, when tacit knowledge is involved and multiple-task problems are combined with the problem of ‘free riding’ in teams, intrinsic motivation enables knowledge transfer under conditions in which extrinsic motivation fails. Given these argumentations, we expect that:

*Hypothesis 2c. The positive effect of individual intrinsic motivation on the degree of knowledge acquisition and use by that individual is greater than the positive effect of individual extrinsic motivation.*

## **Opportunity**

The effect of ability and motivation may be complemented by the existence of an opportunity to share and receive knowledge in interaction: “ability and extra effort are even more valuable when coupled with

opportunity ... to create, retain and transfer knowledge” (Argote et al. 2003: 575). Indeed, knowledge transfer takes place only when at least some form of interaction exists between a sender and a receiver (Makela et al. 2007). Hence, organizations try to “reduce the amount of distance” (Argote et al. 2003: 575) by building communication bridges, offering possibilities for dialogue across the organizational hierarchy, improving conditions for team learning, and creating various systems for capturing and sharing knowledge within the organization (Argyris and Schon 1996; Levitt and March 1988; Senge 1990;). These interaction strategies include those that rely on personalized interaction through frequent interpersonal contact, and those that rely on codification through electronic networks (Hansen 1999; McKenney et al. 1992). Yet, it is not just the pure existence of various opportunities to interact, but rather the individuals’ *use* of these opportunities that matters as far as knowledge acquisition and use is concerned.

Indeed, the level of interaction between the members of different groups or units has been observed to have a significant positive effect on the level of knowledge exchange within the dyad (Hansen 1999; Reagans and McEvily 2003; Tsai and Ghoshal 1998; Tsai 2002). On the interpersonal level, Uzzi (1997) and Uzzi and Lancaster (2003) observed that embedded ties characterized by close interaction were associated with a higher level of knowledge sharing than more arms-length ties. Moreover, as Hansen (2002) contend, the low use of various interaction opportunities may result in organizational knowledge remaining undiscovered, under-leveraged, or trapped in individual minds and knowledge management systems. Accordingly, we expect that:

*Hypothesis 3. The use of opportunities by an individual is positively associated with the degree of knowledge acquisition and use by that individual.*

### **Opportunity: a Moderator of Ability and Motivation**

In line with studies on information processing, we argue that ability, motivation and opportunity affect knowledge acquisition and use at different points (MacInnis and Jaworski 1989). Ability and motivation reside internally within the individual, while his/her use of interaction opportunities is conditioned by the extent to which these opportunities are provided by his/her respective organization. Furthermore, we would expect that the extent to which individual employees use the interaction opportunities provided by

the organization may interact with ability and motivation. For example, a higher use of interaction opportunities allows people with a higher level of ability to access more knowledge as compared to individuals with a lower level of ability - simply by the virtue of their capacity to recognize distinctive and rare knowledge, combined with the fact that they may be able to better recognize the direct positive impact interaction has on the level of knowledge transferred (Bresman et al. 1999). Additionally, individuals with a higher level of ability may also be more likely to realize the capacity of interaction to promote cooperation (Wagner 1995), leading to more effective knowledge processes (Gladstein 1984). Furthermore, a higher use of interaction opportunities may allow the relatively more skilled individuals who feel more 'secure' about their capabilities (referred to as self-efficacy) to better exploit available opportunities. For example, Cabrera et al. (2006) found that an individual's sense of personal competence and confidence could be used as an indicator of his/her inclination to proactively engage in interpersonal and integrative tasks. We therefore argue that an individual's use of interaction opportunities moderates the relationships between his/her ability and knowledge acquisition and use:

*Hypothesis 4. The use of opportunities by an individual positively moderates the impact of individual ability on the degree of his or her knowledge acquisition and use.*

Moreover, we argue that an individual's use of interaction opportunities may also moderate the relationship between his/her extrinsic and intrinsic motivation, and knowledge acquisition and use. As Hoskins and van Hooff (2005: 189) contend, learning is a fundamentally social act in which "exposing yourself to others' thinking processes promotes cognitive [self-]growth". The higher is the use of interaction opportunities, the more possibilities there are for intrinsically motivated people to exploit the chance for interaction for the pleasure of the interface itself (e.g., Osterloh et al. 2002), in the belief that such behavior promotes interpersonal trust (Handy 1995) and the sharing of meanings and understandings (Boutellier et al. 1998). On the other hand, an individual's use of opportunities may also moderate the relationship between his/her extrinsic motivation and knowledge acquisition and use. A greater use of the available opportunities can be exploited by extrinsically motivated employees to achieve other results that

are rewarded. Even if that interaction is not rewarded or assessed directly, the use of opportunities could be seen more as ‘a means to an end’ than a valuable activity in its own right. Accordingly, we expect that:

*Hypothesis 5a. The use of opportunities by an individual positively moderates the impact of individual extrinsic motivation on the degree of his or her knowledge acquisition and use.*

*Hypothesis 5b. The use of opportunities by an individual positively moderates the impact of individual intrinsic motivation on the degree of his or her knowledge acquisition and use.*

However, given that social-exchange theory posits that people behave in ways that maximize their benefit and minimize their costs (Molm 1997), the effect of the use of opportunities is likely to be more pronounced for people who are intrinsically motivated to transfer knowledge, than for the extrinsically motivated. Extrinsically motivated individuals are likely to exploit the various opportunities at minimum cost, not being willing to spend extra time in interaction as it is not typically rewarded directly. They would also be expected to engage in interaction selectively, and may therefore not be able to reap its full benefits. We therefore contend that the effect of the use of interaction opportunities is greater for individuals who are intrinsically motivated (i.e., who would find joy in the process of knowledge transfer regardless of its outcomes) than for the extrinsically motivated:

*Hypothesis 5c. The effect of the use of opportunities by an intrinsically motivated individual on the degree of his or her knowledge acquisition and use is greater than the effect of the use of opportunities by an extrinsically motivated individual.*

The hypotheses presented above are summarized in the conceptual model presented in Figure 2 below.

We will now turn to the data and the methods through which the hypotheses are tested.

- INSERT FIGURE 2 AROUND HERE -

## **Methods**

### ***Survey***

The data used in this paper were collected as a part of a larger research project focusing on individual level knowledge sharing within organizations. Based on the focused literature review and cross-case analysis of the in-depth case studies conducted in cooperation with project’s corporate partners – CSC

Denmark A/S, Rovsing Management A/S, DIOS A/S, ITK and Cell Network AB – the project group developed a structured questionnaire consisting of questions pertaining to the nature of knowledge management and individual perceptions of the enablers of and barriers to knowledge transfer. The questionnaire was available in a number of different languages, and in both Internet- and paper-based versions. The questions were translated and back-translated, thereby reducing the risk of comprehension problems.

The questionnaire was administered globally in three Danish-based MNCs – NovoNordisk Engineering (NNE), Danisco and Chr. Hansen.<sup>4</sup> Selecting these particular MNCs was a conscious choice for a number of reasons. First, the possibilities of testing our hypotheses in the context of the MNC allowed us to study a wide array of individual employees located in various geographical, cultural and institutional contexts. Until recently, intra-MNC knowledge transfer has been studied predominantly on the organizational level, focusing on vertical (headquarters - subsidiaries) and horizontal (subsidiary-subsidiary) knowledge flows. With our dataset we are able to capture high individual-level heterogeneity that is expected to affect the process of knowledge transfer (including cultural, demographical, and other individual characteristics). Second, an effective flow of knowledge is a key priority in all three companies. For example, NNE's strong client focus requires a flexible and integrated organization in which engineers, architects, and pharmacists work closely together, and they rely heavily on collaborative projects following an 'Engineering around the clock' principle. Stressing its commitment to internal knowledge sharing, Danisco has adopted the corporate slogan 'First we add knowledge...', signaling both internally and externally the importance it puts on knowledge processes. Chr.Hansen's, in turn, has an ongoing strive for innovation and development which has resulted in its adoption of the corporate slogan '130 years of innovation'. Finally, all three companies encourage face-to-face interaction in order to share knowledge, and rely on various IT-based solutions to overcome geographical distance. Yet, the degrees to which the

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<sup>4</sup> More information about NNE, Danisco and Chr. Hansen could be found at [www.nne.dk](http://www.nne.dk), [www.danisco.com](http://www.danisco.com), and [www.chr-hansen.com](http://www.chr-hansen.com) respectively.

interaction opportunities are used by individuals within the companies differ, providing us with the necessary variation.

The data collection took place during 2004-05. Prior to launching the survey, we pre-tested the questionnaire in each company in order to ensure question clarity and to avoid interpretation errors. Some questions (such as department/function names) were adjusted to specific company contexts. In NNE, of the 897 employees invited to participate in the survey, 341 responded (38% response rate). In Danisco, 281 invitations were sent out. Of these, 221 completed questionnaires were returned and 219 of them were usable for the analysis (78%). In Chr. Hansen, the invitations were distributed to 350 employees. We received 251 responses (72%). As a grand total, 811 questionnaires were returned. Table 1 provides a detailed description of the respondents. Following consultation with company representatives, the distribution of the survey responses was regarded as representative. After the list-wise deletion of all observations with missing data, the final number of usable observations for our econometric exercise was 656.

- INSERT TABLE 1 AROUND HERE -

In order to reduce possible social desirability bias we followed the example of Tsai and Ghoshal (1998) and explained in the opening paragraph that the software we were using prevented any identification of individuals, that the data would be collected through a company-external server, and that our analysis would be restricted to an aggregated level. With respect to possible common method bias, the performance variables were placed after the independent variables in the survey in order to diminish, if not avoid, the effects of consistency artifacts (Podsakoff and Organ 1986; Salancik and Pfeffer 1977). We also developed multiple items constructs, as response bias has been shown to be more problematic at the item level than at the construct level (Harrisson et al. 1996). Finally, we performed Harman's (1976) single-factor test: if common-method bias exists in the data, a single factor or one general factor accounting for most of the variance will emerge from the factor analysis. Our unrotated factor analysis criteria revealed

13 factors with the first factor explaining 14% of the variance in the data, indicating that the findings cannot be attributed to common method bias.

## **Measures**

### ***Dependent Variable***

We follow Minbaeva et al. (2003) in defining knowledge transfer as the extent to which the recipient acquires and uses the new knowledge (Bresman et al. 1999), and in recognizing that the key element in knowledge transfer is not the underlying (original) knowledge, but rather “the extent to which the receiver acquires potentially useful knowledge and utilizes this knowledge in its own operations” (Minbaeva et al., 2003: 587). The measure thus adopted was modified for the individual level. More specifically, the respondents were asked to indicate on a five-point Likert-type scale (ranging from 1=‘Little or no extent’ to 5=‘Very large extent’) ‘to what extent (1) have you *gained* knowledge from colleagues *in your own department?* (2) have you *used* knowledge from colleagues *in your own department?* (3) have you *gained* knowledge from colleagues *in other departments?* (4) have you *used* knowledge from colleagues *in other departments?*’ We ran a principal factor analysis on the four items (see Table 2 below), which produced one factor with an eigenvalue greater than one and explaining approximately 80% of the variance, thus confirming the unidimensionality of the measure. The final measure of the variable *knowledge acquisition and use* was a weighted average of the items, with the factor loadings used as weights (Alpha =0.84).

- INSERT TABLE 2 AROUND HERE -

### ***Independent Variables***

We used the following independent variables to test our hypotheses. In accordance with prior literature, we measured individual ability in terms of prior achievement and skills (Kim 1998; Minbaeva et al. 2003) complemented with a measure of self-efficacy, which has been demonstrated in previous research to have a significant effect on individual knowledge-related processes (e.g., Bandura 1997; Cabrera et al 2006; McGill et al. 1992). We asked the respondents to evaluate on a five-point Likert-type scale (ranging from 1=‘Strongly disagree’ to 5=‘Strongly agree’) their individual performance compared to their colleagues’

performance on the following six dimensions: (1) 'Individual productivity'; (2) 'Level of salary'; (3) 'Career enhancement'; (4) 'Ability to share knowledge' (self-efficacy); (5) 'Job satisfaction'; and (6) 'Expert status'. The variable *individual ability* is the average of the scores on the six items (Alpha=0.67<sup>5</sup>).

As recommended by Vroom (1995: 7), we operationalized motivation as "governing choices made by a person". Extrinsic motivation constitutes the individual's *responsiveness to incentives* for behaving in a certain way. In order to capture this concept, we asked the respondents to assess the extent to which they would prefer to be rewarded in the future for transferring knowledge in their company (1) 'by increments/bonuses', and (2) 'by promotion', and to what extent they would prefer to be rewarded for reusing knowledge in their company (1) 'by increments/bonuses', and (2) 'by promotion' (five-point Likert-type scales ranging from 1='Little or no extent' to 5='Very large extent'). We operationalized the variable *individual extrinsic motivation* as the average of responses to these four items (Alpha=0.87).

Intrinsic motivation, in turn, is fostered by commitment to the task itself, the reward being in the activity or the compliance with personal goals or social norms (Deci 1975; Osterloh et al. 2002). Accordingly, we defined the variable *individual intrinsic motivation* by averaging the scores on five-point Likert-type scales (ranging from 1='Strongly disagree' to 5='Strongly agree') for the following three items: (1) 'Increased value for me is enough to motivate knowledge sharing'; (2) 'Increased value for my department is enough to motivate knowledge sharing'; (3) 'Increased value for my company is enough to motivate knowledge sharing' (Alpha=0.85).

Previous research has indicated that socialization mechanisms that develop trust and cooperation among individuals and facilitate formal and informal face-to-face relationships positively affect knowledge transfer (Bjorkman et al. 2004; Gupta and Govindarajan 2000; Schulz 2001). Likewise, knowledge – explicit knowledge in particular – can also be transferred through electronic media (Almeida et al. 2002;

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<sup>5</sup> Although the value of 0.7 is commonly used as a guide for Cronbach's Alpha, Nunnally (1967) recommends a value equal to or greater than 0.60 as the minimum for research purposes. While our results concerning ability have to be taken with the necessary caution, we contend that this does not undermine them since similar values have been used in previous knowledge-transfer-related research (see Minbaeva (2007) for a review). For example, Szulanski's (1996) study on knowledge stickiness in the *Strategic Management Journal* reported two scales with a Cronbach's Alpha of below 0.70: "unproven knowledge" - 0.67 and "source is not perceived as reliable" - 0.64.

Andersen and Foss 2005; McKenney et al. 1992; Pedersen et al. 2003). As knowledge acquired and utilized by an individual may be explicit as well as tacit, we need to cover a broad array of interaction opportunities that individuals can use when they are involved in knowledge processes. Thus, we defined the variable *use of opportunities* based on the scores (ranging from 1='Never' to 5='Very often') attributed by the respondents to the following ten items: (1) 'To what extent do you use meetings when you transfer knowledge to other people in your company?' (2) 'To what extent do you use informal communication (coffee breaks, social events, etc.) when you transfer knowledge to other people in your company?' (3) 'To what extent do you use meetings when you search for knowledge?' (4) 'To what extent do you use informal communication (coffee breaks, social events, etc.) when you search for knowledge?' (5) 'To what extent do you use e-mail when you transfer knowledge to other people in your company?' (6) 'To what extent do you use electronic discussion forums on the intranet when you transfer knowledge to other people in your company?' (7) 'To what extent do you use teleconferences when you transfer knowledge to other people in your company?' (8) 'To what extent do you use e-mail when you search for knowledge?' (9) 'To what extent do you use electronic discussion forums on the intranet when you search for knowledge?' (10) 'To what extent do you use teleconferences when you search for knowledge?' (Alpha=0.73).

### ***Control variables***

We included a number of control variables in order to capture potential exogenous effects stemming from heterogeneity in the sample. First, the function or department to which the employee belongs to may influence the extent to which he/she acquires and uses knowledge from other colleagues. Since the functions/departments varied across the three firms included in our sample, we clustered them according to their position in the value chain, adding the two dummy variables '*product related*' and '*customer related*'. The former equaled one if the individual operated in a product-related department (e.g., production, R&D), and the latter if he or she operated in a customer-related department (e.g., marketing, sales, logistics). Corporate functions (e.g., finance, human resources, information technology) were used

as a benchmark. Secondly, previous studies have found that females may be more intrinsically motivated than males (Valerand and Bissonnette 1992), and more sensitive to factors such as the social interaction culture (Connelly and Kelloway 2003). In order to capture potential gender differences we added the dummy variable '*female*'. Third, although one of our dependent variables - *individual ability* - captures the current skills and capabilities of the individual, it does not cover educational level, which has been used by educational psychologists to predict learning ability. We therefore added the variable '*education*' in order to capture the schooling level, the values ranging from 1 (high school or below) to 4 (Ph.D. degree). Fourth, another source of heterogeneity pertains to the correlations existing between the individual and his/her role in the firm. Accordingly, we added the dummy variables '*top management*' and '*middle management*'. The former was set at one if the employee's current position had been classified by the companies' representatives as a top-management position, and the latter if it had been classified as a middle-management position. Non-management levels were used as a benchmark. In an effort to control for the importance of individual heterogeneity (Felin and Hesterly 2007), we also added the variable '*experience in position*', indicating how many years the employee had held his/her current position. Fifth, as individual propensity for transferring and searching for knowledge may be positively affected by a favorable environment or, conversely, negatively affected by an adverse setting, we controlled for how valuable knowledge sharing was considered in the work context. The respondents were asked to indicate on a five-point Likert-type scale (ranging from 1='Strongly disagree' to 5='Strongly agree') to what extent they agreed with the following two statements: (1) 'Knowledge sharing is valued in my company', and (2) 'Knowledge sharing is valued in my department'. The variable '*importance of knowledge sharing*' was derived from the average of the responses to the two items (Alpha=0.69). As the respondents belonged to three different MNCs, i.e. Danisco, Chr.Hansen, and NNE, we also controlled for firm-specific effects, adding the dummy variables '*Danisco*' and '*Chr.Hansen*' (NNE being the benchmark). Finally, co-location is increasingly being recognized as an important determinant of effective knowledge transfer (Song et al. 2007). As knowledge is expected to be perceived, valued and transferred differently by individuals in the organization across different functions, departments, locations, and countries, we

clustered the observations (individuals) into different groups comprising those belonging to the same department and located in the same place. The variable '*establishment*' assumed a different integer value (from 1 to 73) for each identified group of individuals.

## Results

Descriptive statistics of the variables are reported in Table 3. We standardized the independent variables by subtracting the mean and dividing by the standard deviation, in order to avoid high correlation between these variables and their interaction terms (Neter et al. 1990).

- INSERT TABLE 3 AROUND HERE -

The results of the OLS estimations are reported in Table 4. We obtained a robust variance estimate that adjusted for within-cluster correlation (Froot 1989; Williams 2000). Specifically, we performed the statistical analysis using the variable '*establishment*' in Stata's linear estimation command as the cluster option (for details, see Rogers 1993). We were thus able to control for the fact that the observations (i.e., individuals) belonging to the same department and location (i.e., the same '*establishment*') were potentially not independent.

Model 1 in Table 4 includes the control variables and the independent variables. Model 2 adds the interaction term of ability with opportunity, and Model 3 includes the interaction term of motivation with opportunity. All of the models turned out to be significant at  $p < 0.001$ , with adjusted R-square increasing from 0.263 in Model 1 to 0.279 in Model 3. In order to test for the possibility of multicollinearity among individual ability, extrinsic and intrinsic motivation, and the use of opportunities, we calculated variance inflation factors (VIFs) for Model 3. High VIFs (above 10) in the variables of concern would indicate evidence of multicollinearity (Neter et al. 1990). The VIFs for the models were less than two, indicating that multicollinearity was not a problem.

Of the control variables, the coefficient of '*product related*' turned out positive and statistically significant at  $p < 0.01$ , suggesting that knowledge acquisition and use was greater for individuals operating in departments such as R&D and production. The dummy variable '*female*' was also positive, and

statistically significant at  $p < 0.001$ , supporting previous research results (Connelly and Kelloway 2003; Valerand and Bissonnette 1992). Not surprisingly, the '*importance of knowledge sharing*' variable showed a strong positive effect ( $p < 0.001$ ) on the amount of knowledge acquisition and use by its employees.

The findings reported in Table 4 support Hypothesis 1. The coefficient of the variable '*individual ability*' turned out to be positive and statistically significant ( $p < 0.001$ ). We cannot, however, confirm Hypothesis 2a because the coefficient of the variable '*individual extrinsic motivation*' was not statistically significant at any conventional level. Hypothesis 2b is supported, with the variable '*individual intrinsic motivation*' having a positive and significant ( $p < 0.001$ ) impact on the dependent variable, suggesting that intrinsic motivation is another key determinant of individual knowledge acquisition and use. The tests reported in Table 4 show that the coefficient of the variable '*individual intrinsic motivation*' was statistically ( $p < 0.01$ ) higher than that of the variable '*individual extrinsic motivation*', lending support to Hypothesis 2c. The coefficient for '*use of opportunities*' was positive and significant ( $p < 0.001$ ), supporting Hypothesis 3.

- INSERT TABLE 4 AROUND HERE -

Model 3 reveals a significant interaction term coefficient between individual ability and the use of opportunities at  $p < 0.05$ . As the level of the employee's ability increases, an increase in the use of opportunities increases his/her chance of acquiring and using knowledge from other colleagues. Therefore, Hypothesis 4 is corroborated.

An increase in the use of opportunities was found to negatively moderate the impact of extrinsic motivation on knowledge acquisition and use ( $p < 0.01$ ). This contradicts Hypothesis 5a. Furthermore, we did not find any significant effect for the interaction term '*individual intrinsic motivation*'  $\times$  '*use of opportunities*', and accordingly, Hypothesis 5b is not supported. Finally, the difference between the interaction terms '*individual intrinsic motivation*'  $\times$  '*use of opportunities*' and '*individual extrinsic motivation*'  $\times$  '*use of opportunities*' turned out to be positive and significant at  $p < 0.01$  (see the tests reported in Table 4), thereby supporting Hypothesis 5c.

## **Discussion and Implications**

In this paper we provide a micro approach that is complementary to the macro emphasis that has dominated the intra-organizational knowledge transfer literature (see Felin and Hesterly 2007). A micro approach is warranted because knowledge transfer takes place between individual employees in the organization and because much knowledge in an organization resides with individual employees (Argote et al 2003; Felin and Foss 2006; Foss 2007). In this paper we sought to provide some individual-level explanations for a collective-level phenomenon – intra-organizational knowledge transfer. We suggest that variations in individual ability, motivation and the use of interaction opportunities provided by the organization explain part of the variation found in individual-level knowledge acquisition and use, which are conditions *sine qua non* for the degree of organizational knowledge transfer.

More specifically, we developed hypotheses predicting that more capable and motivated individuals would show a higher degree of knowledge acquisition and use, and expected that the use of opportunity would both have a direct effect on the dependent variable and moderate the effect of ability and motivation. Furthermore, we sought to offer a more nuanced perspective on motivation by distinguishing between the extrinsic and the intrinsic types. We were able to confirm previous research by finding that ability is an important driver of individual level knowledge acquisition and use. Our results concerning motivation were more surprising, however, as we found that intrinsic motivation had a significant positive impact on knowledge acquisition and use while extrinsic motivation had no impact at any conventional significance level. Although our distinction between extrinsic and intrinsic motivation and the related findings are novel in relation to knowledge transfer, they do support Amabile's (1997) Intrinsic Motivation Principle of Creativity, which states that intrinsic motivation is more conducive to creative tasks than extrinsic motivation. In the context of knowledge acquisition and use we also found empirical support for Deci and Flaste's (1995) more generic argument that intrinsically motivated individuals have higher learning levels than extrinsically motivated employees.<sup>6</sup>

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<sup>6</sup> Evidence in the behavioral-science literature would lead us to expect an interaction effect between ability and motivation (Vroom 1964). Although it is not the purpose of this paper to provide a thorough review and

Our results indicate that the use of interaction opportunities provided by the organization affects knowledge acquisition and use directly. We also suggested that ability, motivation and (the use of) opportunity affect individual knowledge acquisition and use at different points. Indeed, while ability and motivation are a priori (internal to the individual), opportunity is a moderator of their relations to knowledge acquisition and use. Our results show that as the level of the employee's ability increases, an increase in the use of opportunities increases his/her chance of acquiring and using knowledge from other colleagues. In other words, we find that the individual ability is even more valuable for knowledge acquisition and use when coupled with an increased use of interaction opportunities provided by the organization.

In terms of motivation, we found that with an increase in the employees' extrinsic motivation, an increase in the use of opportunities reduces the degree of knowledge acquisition and use. This result is unexpected. Yet, potential explanations can be found in theories of motivation (Deci 1975). Externally motivated individuals are more likely to engage in knowledge transfer if they believe that the returns are positive, proximate and predictable, and they are also likely to repeat actions that will bring rewards at minimum cost. This may lead to a higher degree of knowledge exploitation at the expense of explorative searching for new knowledge - for which the use of various opportunities offered by the organization is a must.

Moreover, although we found a positive coefficient for the interaction between individual intrinsic motivation and the use of opportunities, this effect was not significant. In order to better understand this unexpected result, we conducted a post-hoc analysis and distinguished between the use of opportunities embedded in person-to-person interactions and opportunities offered via IT interfaces, following Hansen's (1999) distinction between personalization and codification strategies for knowledge sharing. Accordingly, we formed two new variables – '*socialization mechanisms*' and '*electronic networks*' – that we interacted with individual intrinsic motivation (for further details, see the Appendix). We then

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argumentation around this relationship, it should be noted that we did not find any statistically significant evidence of the synergic effect of ability and motivation on knowledge acquisition and use.

estimated a new model including the new variables and their interaction terms with intrinsic motivation (see Model A1 in the Appendix). Interestingly, we found that the use of socialization mechanisms enhanced knowledge acquisition and use by intrinsically motivated individuals, while an increase in the use of electronic networks did not moderate the process of knowledge acquisition and use. It seems that intrinsically motivated people will get more value out of personalized (face-to-face) interaction because they find more personal and social satisfaction in the process (cf. Daft and Lengel 1986). They may also be more likely to perceive uncooperative behavior as harmful to their reputation or the prevailing social norms. The non-significant finding concerning the interaction term '*intrinsic motivation*'  $\times$  '*electronic networks*' supports this argument, as interaction through electronic media is not likely to create such satisfaction.

In sum, our key empirical contributions pertain to the counter-intuitive findings around motivation, the use of opportunities, and their different interactions. These findings may have several noteworthy theoretical and practical implications. First, the slicing up of the determinants of individual-level knowledge acquisition and use makes it easier to identify organizational practices, the employment of which should facilitate knowledge processes within organizations (Type-1 relations in Figure 1). Such logic is advocated in the emerging knowledge governance approach (Grandori 2001; Foss 2007), which focuses on the interplay between governance mechanisms such as coordination mechanisms, reward systems and standard operating procedures, and knowledge-based contingency factors. A similar logic is expressed in some of the literature concerning HRM and performance, which recommends deriving the grouping of HRM practices from theoretical rationales (MacDuffie 1995; Youndt et al. 1996). Furthermore, introducing ability, motivation, and the use of opportunities as 'conditions of individual action' could also correspond to Guest's (1997) suggestion to identify the individual level variables that mediate the relations between HRM practices and performance variables. We subscribe to the above arguments and, based on our findings, propose at least three groups of governance mechanisms conducive to individual knowledge acquisition and use. In short, these include HRM practices aimed at increasing (1) individual ability (e.g., talent-based-staffing, training, competence-based performance appraisal), (2) intrinsic

motivation (e.g., job design, career planning, acknowledgement schemes), and (3) the use of opportunities offered by the organization (e.g., networking initiatives, team building exercises, orientation programs, and initiatives supporting a knowledge-friendly corporate culture).

Secondly, our model suggests that firms should differentiate their investments in governance mechanisms depending on which type of motivation is important for their specific situation, taking into account the moderation effect of opportunities on motivation. The combination of high intrinsic motivation and an extensive use of personalized interaction seems particularly beneficial in situations in which knowledge exploration or the sharing of tacit knowledge is crucial (such as R&D or other complex tasks). Extrinsic rewards, on the other hand, may be beneficial for promoting the use of systems for sharing explicit knowledge, but the creation of various interaction mechanisms may not be necessary – or it may even be harmful as it creates an opportunity cost. However, as both extrinsic rewards and intrinsic motivation are often found together (Deci 1975), their interaction is not straightforward and should be subjected to more fine-grained evaluation of the advantages and disadvantages of different governance mechanisms. The question also remains how effectively firm-level governance mechanisms can influence intrinsic motivation, which is by definition internal to an individual: further research should dig more deeply into this issue.

### **Limitations and Future Research Directions**

We acknowledge that our findings also have certain limitations. First, we based our empirical analyses on cross-sectional data. Further longitudinal research should verify our model as it is certainly true that knowledge acquisition and use will enhance the ability of an individual at least, and will possibly also influence his/her intrinsic motivation for future knowledge acquisition and use, thereby creating a feedback loop at the individual level (Type-2 relations). Secondly, we also acknowledge the shortcomings of using perceptual instruments to measure our major variables. However, despite their obvious limitations, perceptual and self-reported measures have been argued to be most suitable for the study of individual human behavior and, when employed as part of a rigorous research design, may even be

superior to other approaches (Howard 1994; Schmitt 1994; Spector 1994). Nevertheless, it would be useful in the future to combine perceptual data with more objective indicators in order to develop more elaborate measures.

Thirdly, our empirical focus was limited in that we only examined three MNCs, all of which originated from Denmark. We recognize that individual processes, which we consider in the paper, are sensitive to a number of firm-specific characteristics and home-country factors. We collected data from a number of countries and controlled for the company, the establishment, and the functional area to which the employees belonged. However, there is a need for further empirical studies based on individual data gathered from a wider variety of firms from different country origins in order to further generalize the findings. Future studies should also take the impact of the external environment (formal and informal institutions) into account in relation to the formation of the individual processes we considered. Among the external environment variables that must be considered is national culture. For example, national culture may have an influence on how employees respond to extrinsic rewards and how they would like to be rewarded for transferring knowledge. In order to test these potential exogenous effects, we re-run our model with an additional dummy variable for individuals working in Denmark (home-country effect); however, the results did not change. Similarly, we formed three additional dummy variables pertaining to the geographical area in which the respondent was employed - *Europe*, *U.S.*, and *developing countries*. We did not observe significant changes in this model, either. However, notwithstanding the robustness of our model pertaining to the above variables, there may be further country-level effects outside the home country, which we were not able to control for given our per-country sample size.

We also recognize the need to pay more attention to individual heterogeneity and its effect on knowledge processes (Felin and Hesterly 2007). Our individual level analysis in itself sought to deal with heterogeneity, and we also introduced a number of individual-level control variables such as gender, education, position and experience. Indeed, in line with previous research (e.g., Connelly and Kelloway 2003; Valerand and Bissonnette 1992), we found gender to have a strong impact on knowledge acquisition

and use in that the female respondents were more likely to gain and utilize knowledge than the males. Future studies should consider elaborating further on individual differences, particularly as they may become pronounced in the aggregation of 'individual actions' into the organizational level outcomes (Type-3 relations in Figure 1).

The logic behind such aggregation from the micro to the macro level is that individual actions when combined are expected to produce social outcomes. This involves potentially strong interdependence between the actions of an individual and of others in the same context. Each individual's actions influence other individuals, and each individual is expected to be influenced by the actions of others, either positively or negatively. In addition to producing complex and unpredictable aggregation patterns, this may also lead to free-riding: "It may often be to the individual's interest to withhold activity and to enjoy the benefits of others' activity without contributing" (Coleman 1966: 50).

Explaining micro-macro interdependence has proved to be the main intellectual hurdle both for empirical research and for theory that treats macro-level relation via methodological individualism (Coleman 1990). Our work and the literature we are building on being no exception. There are however some recent potentially interesting empirical contributions. For example, Makela et al. (2007) observed that national-cultural, linguistic and functional similarity on the interpersonal level produced a powerful organizational-level informal clustering effect when individual-level actions were aggregated. In other words, when large numbers of managers all had a tendency to interact and share knowledge with similar others, these individual level actions produced an aggregated clustering effect, the consequence of which was that knowledge flowed significantly better within similarity-based clusters than between them.

Still, empirical research on knowledge transfer on the individual level is, to some degree, at an exploratory stage, and certainly so with regard to multilevel micro-macro relationships. We have contributed to this emerging research agenda by examining ability, motivation, and the use of opportunity as possible individual level explanations of intra-organizational knowledge transfer, but much more remains to be

done. Future studies should continue exploring individual and interpersonal level determinants of knowledge transfer, and link them back to the organizational level through multilevel research. Such a focus is important both theoretically and practically, as the “implications for how a firm creates new value are radically different, depending on the underlying assumption about the locus of knowledge” (Felin and Hesterly 2007: 196).

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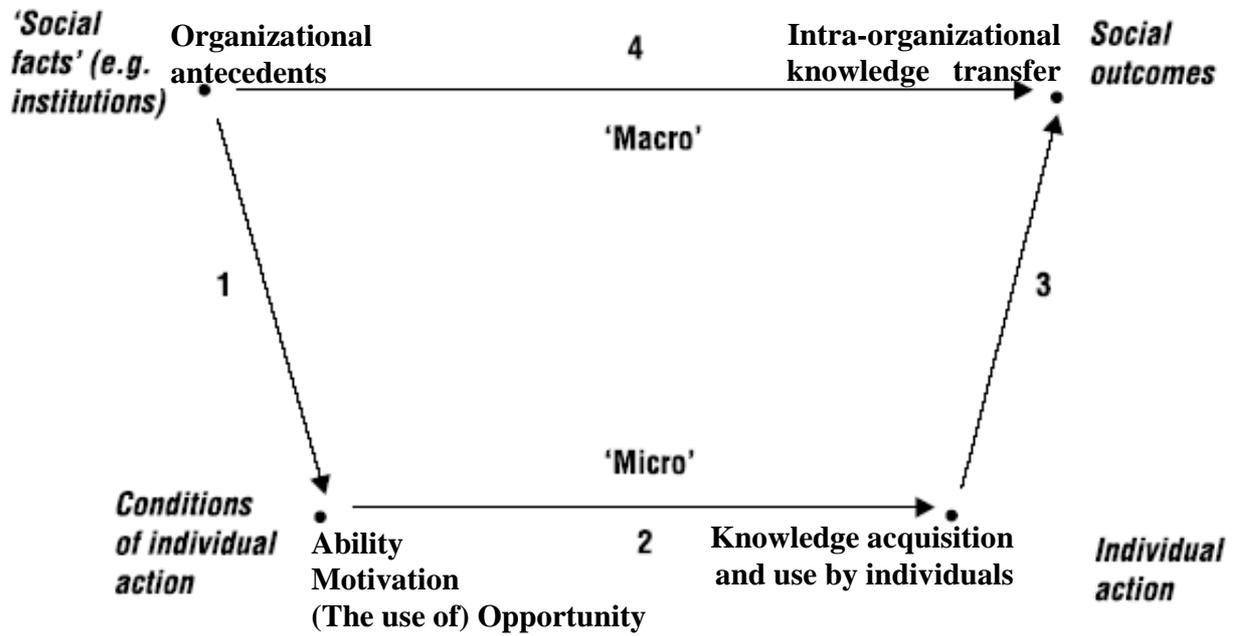
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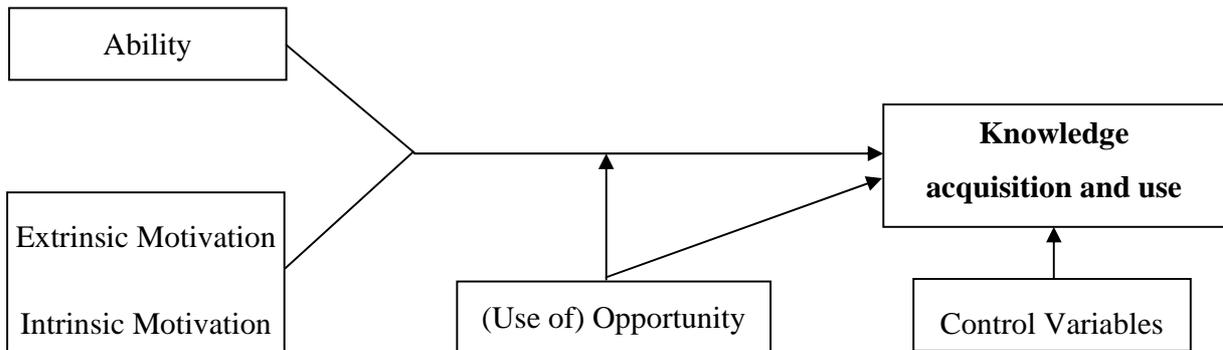
Figure 1. Intra-organizational Knowledge Transfer: Organizational vs. Individual Levels



*In Italics* – the original model

**In Bold** – the interpretation for the purpose of this paper

Figure 2. The Conceptual Model



**Table 1. Details of the Respondents**

		<b>Danisco</b>	<b>NNE</b>	<b>Chr.Hansen</b>
<b>Gender:</b>	Male	125	230	139
	Female	91	107	112
	Non-response	3	4	0
<b>Position:</b>	Low	118	191	80
	Middle	69	100	84
	Top	30	35	81
	Non-response	2	15	6
<b>Experience:</b>	Average	9.48	6.73	8.34
<b>Age:</b>	Average	39.52	40.2	40.91
<b>Education:</b>	High school or below	43	48	27
	Bachelor's degree	99	167	99
	Master's degree	70	115	88
	Ph.D.	5	8	37
	Non-response	2	3	0
<b>Country:</b>	Australia	6		
	Belgium	17		
	China	13	3	
	Denmark	48	310	153
	Finland	15		
	France		13	26
	Malaysia	19		
	Mexico	20		
	New Zealand	9		
	Sweden		5	
	UK	20		
	USA	48	10	59
	Other	4		13
<b>Total</b>		219	341	251

**Table 2. Definition of Knowledge Acquisition and Use: Principal Factor Analysis**

	Factor Loadings
You gained knowledge from colleagues in your own department	0.76
You used knowledge from colleagues in your own department	0.76
You gained knowledge from colleagues in other departments	0.82
You used knowledge from colleagues in other departments	0.80
Eigenvalue	2.46
Cumulative variance	0.79
Cronbach's alpha	0.84

**Table 3. Descriptive Statistics**

	Mean	S.d.	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Knowledge acquisition and use	0.00	1.00	-3.21	1.87														
(2) Product related	0.61	0.49	0.00	1.00	0.11													
(3) Customer related	0.16	0.36	0.00	1.00	-0.02	-0.53												
(4) Education	2.34	0.80	1.00	4.00	0.09	0.17	-0.06											
(5) Female	0.37	0.48	0.00	1.00	0.08	-0.04	0.04	-0.10										
(6) Top management	0.19	0.39	0.00	1.00	0.12	-0.12	0.03	0.20	-0.09									
(7) Middle management	0.28	0.45	0.00	1.00	0.00	0.08	-0.03	0.12	-0.07	-0.30								
(8) Experience in position	4.14	4.07	0.00	29.0	-0.10	0.03	-0.09	-0.17	-0.05	-0.11	0.10							
(9) Importance of knowledge sharing	3.87	0.72	1.50	5.00	0.33	0.09	-0.02	0.08	-0.01	0.03	-0.01	0.01						
(10) Danisco	0.28	0.45	0.00	1.00	-0.05	-0.21	0.11	-0.11	0.05	-0.05	0.05	0.17	0.09					
(11) Chr.Hansen	0.31	0.46	0.00	1.00	0.08	0.03	-0.10	0.21	0.06	0.26	0.08	0.00	-0.04	-0.42				
(12) Individual ability <sup>a</sup>	3.49	0.45	1.00	5.00	0.28	0.06	-0.11	0.16	-0.04	0.14	0.08	0.03	0.26	-0.09	0.09			
(13) Individual extrinsic motivation <sup>a</sup>	2.73	1.00	1.00	5.00	0.00	-0.01	-0.01	0.04	-0.06	0.03	0.00	-0.07	-0.06	0.08	0.00	0.07		
(14) Individual intrinsic motivation <sup>a</sup>	3.69	0.66	1.00	5.00	0.32	-0.01	0.00	0.09	0.06	0.12	-0.01	-0.09	0.30	0.03	0.07	0.23	-0.02	
(15) Use of opportunities <sup>a</sup>	2.81	0.51	1.30	5.00	0.31	-0.08	0.02	0.23	0.01	0.20	0.12	-0.08	0.19	-0.01	0.19	0.24	0.13	0.18

<sup>a</sup> The variable is standardized. The table lists the means, standard deviations, minima, and maxima of these variables prior to this standardization.

**Table 4 – Determinants of Knowledge Acquisition and use by Individuals: OLS Regressions**

	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>
a <sub>0</sub> Intercept	-1.10 (0.23)***	-1.11(0.23)***	-1.12(0.23)
a <sub>1</sub> Product related	0.32 (0.10)**	0.32(0.10)**	0.33(0.10)**
a <sub>2</sub> Customer related	0.20 (0.13)	0.21(0.14)	0.20(0.14)
a <sub>3</sub> Education	-0.06 (0.04)	-0.07(0.04)	-0.07(0.04)
a <sub>4</sub> Female	0.14 (0.04)***	0.15(0.04)***	0.15(0.04)***
a <sub>5</sub> Top management	0.14 (0.10)	0.14(0.10)	0.14(0.09)
a <sub>6</sub> Middle management	-0.01 (0.06)	-0.01(0.06)	0.00(0.06)
a <sub>7</sub> Experience in position	-0.01 (0.01)	-0.01(0.01)	-0.01(0.01)
a <sub>8</sub> Importance of knowledge sharing	0.26 (0.06)***	0.26(0.06)***	0.27(0.06)***
a <sub>9</sub> Danisco	-0.05 (0.09)	-0.05(0.09)	-0.06(0.09)
a <sub>10</sub> Chr.Hansen	0.02 (0.08)	0.02(0.08)	0.02(0.08)
a <sub>11</sub> Individual ability	0.14 (0.03)***	0.15(0.03)***	0.14(0.03)***
a <sub>12</sub> Individual extrinsic motivation	-0.02 (0.04)	-0.02(0.04)	-0.02(0.03)
a <sub>13</sub> Individual intrinsic motivation	0.17 (0.04)***	0.17(0.04)***	0.17(0.04)***
a <sub>14</sub> Use of opportunities	0.21 (0.04)***	0.20(0.04)***	0.21(0.04)***
a <sub>15</sub> Individual ability × Use of opportunities		0.06(0.03)*	0.05(0.03)*
a <sub>16</sub> Individual extrinsic motivation × Use of opportunities			-0.08(0.03)**
a <sub>17</sub> Individual intrinsic motivation × Use of opportunities			0.05(0.04)
Test H <sub>0</sub> : a <sub>12</sub> = a <sub>13</sub>	7.96**	8.11**	10.00**
Test H <sub>0</sub> : a <sub>16</sub> = a <sub>17</sub>			7.24**
N. Observations	656	656	656
N. Establishments	73	73	73
Adjusted R <sup>2</sup>	0.263	0.268	0.279
F-test	20.08***	28.16***	36.32***

In brackets - robust standard errors corrected for heteroschedasticity and cluster-correlated data using the variable *establishment*.

\* p< .05; \*\* p< .01; \*\*\* p< .001 (two-tailed tests applied)

## Appendix

We distinguished between the use of opportunities embedded in person-to-person interactions (*socialization mechanisms*) and those offered via IT interfaces (*electronic networks*). We then estimated a new model including the new variables and their interaction terms with intrinsic motivation.

We defined the independent variable *socialization mechanisms* by averaging the responses (ranging from 1='Never' to 5='Very often') to the following four items: (1) 'To what extent do you use meetings when you transfer knowledge to other people in your company?' (2) 'To what extent do you use informal communication (coffee breaks, social events, etc.) when you transfer knowledge to other people in your company?' (3) 'To what extent do you use meetings when you search for knowledge?' (4) 'To what extent do you use informal communication (coffee breaks, social events, etc.) when you search for knowledge?' (Alpha=0.74).

We defined *Electronic networks* by averaging the responses (ranging from 1='Never' to 5='Very often') to the following six items: (1) 'To what extent do you use e-mail when you transfer knowledge to other people in your company?' (2) 'To what extent do you use electronic discussion forums on the intranet when you transfer knowledge to other people in your company?' (3) 'To what extent do you use videoconferences when you transfer knowledge to other people in your company?' (4) 'To what extent do you use e-mail when you search for knowledge?' (5) 'To what extent do you use electronic discussion forums on the intranet when you search for knowledge?' (6) 'To what extent do you use videoconferences when you search for knowledge?' (Alpha=0.70).

**Table A1 - Individual knowledge acquisition and use, intrinsic motivation, and different types of opportunities**

	<i>Model A1</i>
Intercept	-1.07(0.23)***
Product related	0.28(0.10)**
Customer related	0.20(0.13)
Education	-0.07(0.04)
Female	0.14(0.04)***
Top management	0.01(0.06)
Middle management	0.14(0.09)
Experience in position	-0.02(0.01)*
Importance of knowledge sharing	0.25(0.06)***
Danisco	0.04(0.10)
Chr.Hansen	0.11(0.08)
Individual ability	0.12(0.03)***
Individual extrinsic motivation	-0.01(0.04)
Individual intrinsic motivation	0.17(0.03)***
Socialization mechanisms	0.21(0.04)***
Electronic networks	0.06(0.03)*
Individual intrinsic motivation × Socialization mechanisms	0.10(0.04)**
Individual intrinsic motivation × Electronic networks	-0.01(0.04)
Observations	656
Establishment	73
Adjusted R <sup>2</sup>	0.285
F-test	30.47***

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