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Interactive roles in buyer-supplier knowledge exchange: Towards a research agenda

Nordic Workshop 2010

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1. Introduction

In recent years, several models and frameworks have contributed to an understanding of collaborative new product development projects between the company and its suppliers (Araujo et al. 1999; Handfield et al. 2004; Knudsen, 2007; Wynstra & Pierick, 2000). These frameworks emphasize the importance of buyer-supplier knowledge sharing for achieving a number of advantages in new product development, including reduced costs, higher quality and innovation, and reduced time-to-market (Petersen et al. 2003; Tracey, 2004; Van Echtelt et al. 2008).

The importance of knowledge sharing is thus emphasized in various studies.

It seems, however, that knowledge sharing has become a concept used to describe a wide range of behaviors, without further attention to underlying behavioral differences. A neglect to differentiate between different interaction behaviors has turned knowledge

sharing into a general and comprehensive concept which is used disregarding who is sharing and how much each party share and contribute to the process.

Sharing can be defined as the act of distributing and dividing something, often with the connotation to share or divide something equally¹. When studies apply the term knowledge sharing to describe the interaction in business relationships, they thus seem to rest on an underlying assumption of symmetry in knowledge exchanges where both parties participate and contribute equally.

We wish to broaden this discussion in several respects.

The extant literature on buyer-supplier collaboration in new product development often focus on antecedent factors for effective knowledge sharing (Parker et al., 2008; Sacconi & Perrona, 2007; van Echtelt et al., 2008; Wynstra & Pierick, 2000), but to not explicitly address the process of knowledge sharing thus limiting the discussion to a matter of intensity in knowledge sharing

The processes of knowledge sharing are dealt with in the knowledge sharing literature (Crossan et al., 1999; Nonaka, 1994; Suzlanski 1996, 2000), but transferring these findings to buyer-supplier relationships poses challenges. The literature seems to take as departure point a power-free perspective, where suppliers and buyers are regarded as peers and equal in defining the development task and the validity of inputs to it. Few perspectives, if any, take the dominance of buyers into account and how this may impact knowledge exchange.

In our view, the concept of knowledge sharing must be complemented by other likely modes of knowledge exchange which consider who is contributing knowledge and who is directing the knowledge exchange.

In particular, when linking the symmetry of knowledge exchange to the knowledge domains of the buyer and supplier, we believe that inspiration can be found for furthering the research agenda. Considering the knowledge domains of the parties provides an avenue for addressing the structure of dominance in the interaction.

Secondly, we believe that the impact of the development task has been neglected. While the development task has been used to classify different types of supplier involvement, its impact on behavior at the level of interaction in the dyad is not deeply investigated.

¹ Webster's New World Dictionary

Following the IMP research tradition, we see knowledge exchange in buyer-supplier dyads relating to new product development as an interaction process. In particular, we engage the role theory perspective for understanding interactions among business actors in knowledge exchange. Our research question is: How do task-related knowledge domains and task structure affect interactive roles in buyer-supplier knowledge exchange?

By addressing the structure of the task and the knowledge domains of the parties, it will be possible to discuss the roles the parties assume in the process and hence *who* is contributing knowledge and *how* knowledge is exchanged in different task situations.

Our chief aim with this paper is primarily conceptual. We wish to provide a theoretical framework for addressing different forms of knowledge exchange. However, we elaborate and refine on these through illustrative cases that can help us to further elaborate and ground our theoretical work in empirical realities. With the paper we hope to contribute to both practitioners and to theoretical development. We hope that addressing these differences, we can help managers ask better questions and define better frameworks for involving suppliers - or as a supplier – better decide on how being involved with buyers in knowledge exchange activities best serve their strategic interests. For researchers interested in knowledge exchange and buyer-supplier involvement, we hope to be able to provide a theoretically grounded framework for expanding our research and understanding of this fascinating topic.

2. Knowledge exchange in buyer-supplier relationships: Static versus interactive perspectives

In recent years, knowledge exchange across organizational boundaries has received increased attention and a large number of studies have examined how knowledge exchange can be managed and supported.

Knowledge exchange has been approached from two perspectives, differing in terms of whether knowledge exchange is considered a static or a dynamic process.

One perspective considers the primary role of the organization to merely apply existing knowledge (Grant, 1996; Grant & Baden-Fuller, 2004). The argument in this line of thought is based on a view of knowledge as being static and inhuman. This perspective

underlies the traditional Western epistemology and the theory of knowledge, which defines knowledge as a “justified true belief” and stresses the truthfulness as an essential attribute in an absolute, static and non-human view of knowledge.

Opposed to this view, another perspective considers knowledge as dynamic and human in nature, following a knowledge exchange process that is non-static and active (Nonaka et al. 2000). Contrary to the Cartesian view of knowledge, which emphasises the absolute and context-free nature of knowledge, this perspective emphasizes a dynamic and human nature of knowledge. Knowledge is considered dynamic as it rests on application and use of information (Bohn, 1994; Roberts, 2000). Information thus becomes knowledge as it is interpreted by actors and given a context.

Applying the latter perspective in buyer-supplier dyads considers knowledge exchange as an interactive process unfolding between business actors. This has been the focus in the IMP research tradition (Ford, 2001; Håkansson & Snehota, 1982; 1995). In this line of research the buyer-supplier relationship is analysed by explicating the individual exchange episodes that constitutes the relationship (Ford, 2001). The evolving nature of these episodes draws attention to the dynamic aspect of the buyer-supplier dyad, and makes it possible to conceptualize knowledge exchange as an interactive process.

In the interaction between the actors existing knowledge will be exchanged, and this process will foster a revaluation of existing knowledge and knowledge combinations. This process will therefore cultivate new knowledge as the parties’ existing knowledge is combined and reconfigured into new knowledge combinations (Håkansson & Waluszewski, 2002). In the exchange process, knowledge will thus expand in both quality and quantity.

The IMP perspective provides the avenue for considering knowledge exchange as an interactive process in the buyer-supplier dyad, focusing on how the actors exchange and continually realign their knowledge in an ongoing interaction process.

Approaching knowledge exchange from this perspective draws attention to the actors involved and role theory can therefore be deployed to the analysis of the interactive process. Role theoretic perspectives are often deployed for understanding interaction processes (Anderson et al., 1998; Havila, 1993) and seek to understand the behavior of the interacting parties by addressing the roles the parties assume.

The role perspective assumes that performance results from the social prescriptions of behavior and behavior of others. The behavior of the individual is examined in terms of how it is shaped by the demands and rules of others, by their sanctions for his conforming or non-conforming behavior and by the individuals own understanding and conception of what his behavior should be (Biddle & Thomas, 1966).

In the buyer-supplier dyad, the parties can hence assume different roles in the interaction. We believe that the role perspective provides a promising starting point for a more elaborate discussion of interactive buyer-supplier knowledge exchange.

Instead of regarding all interactive behaviours as “knowledge sharing”, the role perspective provides an avenue to complement the concept by other modes of knowledge exchange, considering who is contributing knowledge and who is directing the knowledge exchange.

By paying attention to the role pattern between the parties (Newcomb, 1950; Sarbin, 1966), leadership roles may be identified when parties have a high interaction rate (Borgatta & Bales, 1953) and directs interaction by giving out directions, information and opinion (Bales et al., 1951). Parties with lower interaction rates may assume a more residual role of supporting and modifying, focusing on giving agreement or disagreement to the information supplied by others as opposed to supplying this information themselves.

To discuss the diversity of roles in knowledge exchange, we suggest two important parameters that influence how and why the actors assume certain roles in the interaction

The first parameter we apply is the structure of the product development task. The task structure provides a procedural orientation, or “the rules of the game” for how members participate. The structure of the task will therefore influence how the parties interact and hence how knowledge is exchanged. Task structure has been applied as a variable in studies of small group interaction (Abdel-Halim, 1983; Mabry & Attridge, 1990; Brown & Miller, 2000) and has been found to significantly influence interaction in groups. The variable seem to lend itself well to studies of buyer-supplier relationships, as the interaction among the parties often will involve several people from the buyer and the supplier, thus constituting a group working together to solve a task.

By paying attention to the task structure, it becomes possible to discuss the roles of the parties as defined by the tasks they assume, rather than merely the position they hold (Havila, 1993). The structure of the task will function as a script and the emergence of roles can be analyzed in situations of different degrees of freedom in the interaction process.

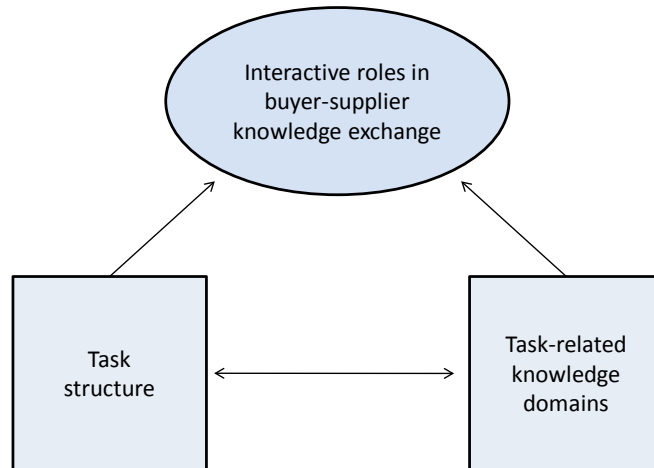
According to Blau & Scott (1963, pp. 195-196) it is possible to extend the role-set approach from the individual level to the organizational level. The relationship can thus be seen as consisting of two parties, the buyer and the supplier, and each in turn consists of a number of individuals (Havila, 1993). In this way, we can analyze the interaction among actors in terms of buyer and supplier roles.

Secondly, the type and amount of knowledge that each partner possesses will determine how the parties can contribute to the process. In a discussion of knowledge exchange, the parties' knowledge domains therefore need to be considered. The symmetry of buyers and suppliers' knowledge domains comprise a second important parameter for understanding how buyer and supplier roles unfold and what form of knowledge exchange correspondingly takes place.

By paying attention to the knowledge domains of the parties it becomes possible to assess the power relation between the parties. Those with power will be able to define the situation by claiming an identity for the self, and by controlling the meanings in the situation by "casting" others into supporting identities (Cast, 2003). The more powerful individuals will thus be more able to control the situation by influencing the behavior of others and to alter the situation so that meanings are consistent with the individual's own definition of the situation. The power relation can emerge as a consequence of position, or as a consequence of asymmetry in knowledge domains.

The conceptual model of our study is shown in figure 1 below and the role of knowledge domains and task structures are further elaborated in the following sections.

Figure 1 – Conceptual framework



3. Task structure

Task structure refers to the overall configuration of the problem space that underlies a decision task (Newell, 1980). It comprises four elements; goal clarity (the degree to which the group is aware of the end states that need to be achieved for successful task completion), goal-path clarity (the degree to which the group is cognizant of the proper means to achieve the desired ends and states), goal-path mechanisms (the number of operations or steps that need to be performed to achieve the desired end state) and goal-path obstacles (the number of barriers that exists to hinder group efforts) (Hirokawa, 1990).

By classifying the new product development task according to its structure it becomes possible to represent tasks on a continuum ranging from *defined tasks*, with high goal clarity and high goal-path clarity and low goal-paths mechanisms and low goal-path

obstacles, to *ambiguous tasks*, with low goal clarity and low goal-path clarity and high goal-paths mechanisms and high goal-path obstacles.

The task structure will affect the need for problem analysis, and procedural orientation and planning, and will therefore influence the interaction needed between the parties.

When the problem space can be defined (Robillard, 1999), the initial state, the goal and a set of operations to reach the goal are available. The structure of the task is therefore given and can be subjected to prior definition of procedures for task completion. This implies that the interaction can be directed towards the end goal as the end goal and the way to reach this goal is known. The knowledge exchange needed between the parties is limited and can be executed according to specifications.

In the defined task, specifications and procedures prescribe behavior and creation of roles becomes an inconsequential part of the interaction process. Interaction between the parties is constituted around the simple conformity behavior demanded by the script, making roles highly standardized and keeping the allowance for improvisation at a minimum. A defined script for the interaction thus restricts the free operation of the process, limiting the repertoire of possible roles and making role boundaries rigid (Turner, 1962).

When the problem space is less definable, the structure of the task is ambiguous. The goal and the way to reach the goal are not known a priori, and the interaction process are thus more iterative fostering a process of negotiation characterized by discussion, elaboration and continual redefinition of individual tasks through interaction (Burns, 1961).

When the task is not well understood it cannot be preplanned and is associated with substantial uncertainty, thus requiring generating and evaluating alternative approaches to solutions. To deal with this kind of task therefore requires intensive interaction, joint decision making and communication.

Ambiguous tasks cannot necessarily be subjected to a clear division of subtask and hence requires mutual intrusion of territories (Lam, 1996, 1997; Nonaka, 1989). This increases the interdependency among tasks and, as taught by organizational theory, this increases the need for knowledge exchange (Argyres, 1995; Thompson, 1967; Willem & Buelens, 2009).

As the ambiguous task cannot be subjected to a priori specifications, the roles of the parties cannot be prescribed, but evolve during interaction. The absence of a priori role definitions implies a higher degree of improvisation as the content of each role are not defined and interaction may thus involve a constant modification of the content of specific roles, occasional rejection of roles and sometimes discovery of new roles (Turner, 1962).

The task thus creates a frame of reference for the group interaction and makes it possible to discuss the need for knowledge exchange during the process. The distinction between defined and ambiguous tasks offers a way to address how the interaction unfolds as a result of different degrees of certainties in how to reach the end goal of the interaction process and hence how much knowledge exchange is needed in the process. It becomes possible to analyze the interaction in the new product development task not only by considering the parties by their position as buyer and supplier, but further by virtue of discussing the roles that emerge in the interaction as the parties act as contributors of knowledge (cf. Linton, 1947; Merton, 1957). Instead of considering the roles of buyer and supplier as distinctly given prior to the analysis of interaction, we can consider the tendency to create and modify conceptions of self and other roles as the orienting process in interactive behavior.

4. Knowledge domains

The structure of the task directs attention to different needs of knowledge exchanges as the degree of specification in the task changes. The ability of the parties to engage in these knowledge exchanges and their disposition to contribute will be determined by the knowledge held by each actor.

The knowledge domains of the actors in relation to the new product development task can be different nature. For the purpose of the present discussion, two types of knowledge can be distinguished; the knowledge can pertain to the use of the final task product, or it can be related to the derived subtasks and the decision making processes towards the final product. This distinction becomes vital when examining the knowledge contributions of the parties and the structure of dominance in the interaction.

Knowledge about the use of the final product will always be held by the buyer. The buying firm is the initiating actor of the new product development process and issues the task to be solved. As such, the buyer will know subjectively what is considered of value and will hold the decision-making competence regarding the end product.

For this reason, the buying firm holds a more dominant position than the supplier. Analysis of buyer-supplier dyads hence needs to appreciate the power balance between the actors as the interaction will unfold on a preordained unequal playing field.

The knowledge of the buyer regarding the end product need not to be complete, but can range from a full specification of a product when the task structure is defined, to a more loose assessment of a problem in the ambiguous task structure.

Knowledge about the task is, however, not restricted to knowing about the use of the end product. The new product development task is a decision-making process comprised by several steps and knowledge can also be related to this process. Knowledge of how to effectuate the new product development task is not reserved one actor, but can be held by both the buyer and supplier.

The parties may not necessarily hold the same knowledge about the task and it becomes of interest to address how this knowledge is distributed (Takeishi, 2002; Tiwana, 2003). It is possible to consider knowledge domains in terms of a symmetric or asymmetric distribution.

When knowledge is distributed symmetrically, both parties know equally much about the tasks to be effectuated in the new product development process. The parties thus prevail as equals as they hold the same amount of knowledge about the tasks.

When knowledge is asymmetric knowledge distributed, one party knows more about the task than the other party. While both parties may have knowledge about the task, the division is skewed towards one of the parties thus creating an asymmetry in the division of knowledge.

The distribution of knowledge about the task will influence knowledge exchange. In the case of symmetry, the actors prevail as equal contributors while in the case of asymmetry, one actor will be able to contribute more due to a more knowledgeable position. Instead of viewing knowledge exchange as comprised by equal contributions by the parties, the consideration of symmetry and asymmetry in knowledge domains

provide the avenue to differentiate between unilateral and bidirectional knowledge exchanges.

The premise of this discussion is that while decision authority resides with the buyer due to knowledge about use of the end task, the knowledge contribution of the parties will be determined by the distribution of knowledge related to the task. The interaction will thus not only reflect a dominant buyer, but will be influenced by who knows most about the task, and this knowledge distribution can be skewed towards both the buyer as well as the supplier.

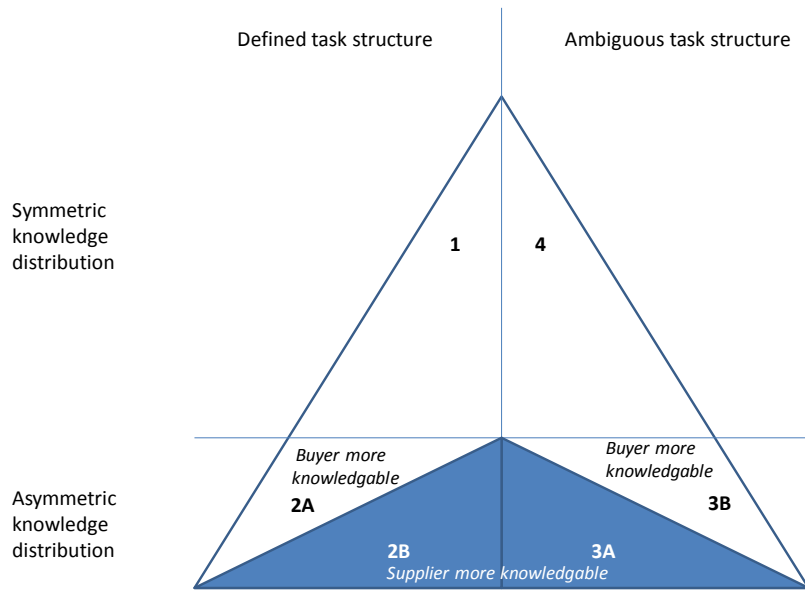
The a priori power relation of the parties must therefore be considered in the interaction analysis, and this power relation is a consequence of the position of the parties as buyer and supplier, where the buyer assumes a more powerful position. The position of the parties is, however, not the only source of power. The process of allocation of roles and negotiation of the content of these roles will also be influenced by the knowledge domains of the parties. It may be expected that the most knowledgeable partner will assume a more directing or dominating role in the interaction, due to expertise concerning the task. Such allocation of roles may not have the same institutional support as the traditional roles of buyer and supplier, but will nevertheless emerge in the interaction and influence knowledge exchange.

We therefore need to distinguish between structural power, as emanating from the status position of the parties (Cast, 2003) and power based on asymmetry in knowledge related to the task.

5. Roles and knowledge exchange in buyer-supplier interaction

By applying the parameters of task structure and knowledge domains, different interaction patterns can be differentiated. These interaction patterns make it possible to discuss the roles assumed by the actors, the form of knowledge exchange and the resulting task solution. This is visualized in figure 2 and will be further discussed below. The figure seeks to capture three dimensions in order to describe interaction in relation to knowledge exchange: (i) Task structure, (ii) Knowledge distribution and (iii) Position of the more knowledgeable actor. The final dimension is only relevant in the case of asymmetric knowledge distribution, which is why the figure has a prism-like shape. The table below the prism outlines the contents of each of the six compartments in the figure.

Figure 2 - A prism of interactive roles in knowledge exchange



	1	2a	2b	3a	3b	4
Knowledge exchange	Limited	Knowledge transfer		Joint search		Knowledge sharing
Supplier role	Solution provider	Knowledge recipient	"Product" Consultant	"Process" Consultant	Assistant	Alliance Partner
Buyer role	Service Customer	Knowledge provider	Client	Client	Explorer	Alliance partner
Task solution	Knowledge distribution and individual appropriation			Knowledge generation and mutual appropriation		
Interaction metaphor	Knowledge spot market	Coaching	Guiding	Parenting	Exploring	
Illustrative Example	Panasonic-RTX	IKEA-supplier	RTX-Microsoft	Lawyer-Client	Vestas-Hydac	Novo-Nissho

5.1 Defined task structure – Symmetric knowledge distribution

In this scenario, the task structure is defined, thus implying that the task goal and the path to the goal are known to the parties.

It may be useful to disregard the extreme case where the task is completely defined, as this case will eliminate the need for knowledge exchange. If the task is completely given, the parties need not interact at all, but can work independently of each other. But as soon as some degree of uncertainty in the task is introduced, the parties need to interact as the path to completion is not precisely known and hence need to be adapted as interaction progresses. In the following, it will therefore be assumed that in the case of the defined task structure, the task is *almost, but not completely defined*.

In the case of a defined task structure, the end goal, the path to reach this goal and possible obstacles in the process are known. This implies that the problem solving process is accompanied with great certainty of the steps needed to be taken for completion and hence the process can be subjected to preplanning and specification. The interaction needed to coordinate the partners' action will therefore be simple as it can be directed towards the a priori known goal. As the structure is known, interaction will unfold according to a defined and specified structure.

The defined structure implies that the knowledge exchange between the actors is limited and will be focused on coordination of the tasks divided among the actors. The end task is known and hence the parties need not interact to discuss this.

The limited need for knowledge exchange is further supported by the fact that knowledge is symmetric distributed. When both parties hold the same knowledge about the task, the need to acquire knowledge from the other actor to execute the task is minimized. Hence the parties can work relatively independent of each other and the need for knowledge exchange is eliminated by procedures and specifications.

The limited interaction will influence the role pattern between the actors. The roles will not be a consequence of interaction, instead the defined structure determines how tasks are allocated and what each partner needs to do and contribute, and roles reflect the

conforming behavior to these specifications. The parties will thus assume roles reflecting their assigned and specified task responsibility.

The role pattern therefore comes to reflect standardized roles, where the buyer assumes the role of a customer needing a service, and the supplier assumes the role of providing the task solution. The defined structure of the task and the symmetric knowledge distribution will imply that the demands of the buyer will be specific and the solution developed by the supplier will be complete, limiting the need for interaction and adaptation between the parties.

The end task solution will mirror the limited interaction between the parties. As both parties hold knowledge about the task and few iterations are needed to coordinate activities, the interaction comes to resemble what Steiner (1972) describes as an additive task structure. Each member of the group has knowledge about the task and contributes a part to the group decision. The performance of the group is determined by the aggregation of individual effort. Thus the completion of the task resembles the assembled knowledge, but no increase in knowledge or creation of new knowledge can be expected due to limited interaction.

The interaction in this case therefore resembles a market transaction as only very little knowledge exchange and adaptation between the parties are needed. This interaction mode can hence metaphorically be described as “knowledge spot market”.

An example of this form of interaction is the relationship between the Danish supplier RTX of DECT-based wireless handsets (used in for instance wireless telephones) and Panasonic. RTX describes themselves as a developer and manufacturer of wireless solutions, which can provide customers with complete OEM solutions to the point that they are produced, engraved with the manufacturers label and shipped directly to the customer’s warehouses (www.rtx.dk). As a wireless phone is based on a modular technology, assembling a cordless phone to a customer calls for minimal interaction in the form of specifications. In the case of Panasonic, the procurement department provides specifications with respect to Panasonics wireless phone product portfolio and asks RTX to come up with ideas to supplement and replace existing models. Based on RTX experience and development efforts in related areas, they can provide Panasonic

with a range of possible solutions, and Panasonic can, based on their own knowledge about this field choose among the suggested variants. The interaction between RTX and Panasonic is short as the task structure is relatively certain and both parties have shared frame of reference, in which knowledge is symmetrically distributed. It is undergirded by mutual knowledge about the existing standards within the field, such as the current range of cordless telephone, memory requirements, the price/quality range of speakers, displays and keypads. Hence, it is akin to a spot market transaction, where choices, benefits and costs are cleared by minimal information (Sturgeon, 2002).

5.2 Defined task structure – Asymmetric knowledge distribution

In this scenario, the task structure is defined and the task is (almost) given as above, but one party knows more than the other party about the end task. This asymmetry in knowledge domain fosters a greater need for interaction as knowledge need to be transferred from the knowledgeable partner to the less knowledgeable partner.

The fact that one party has more knowledge about the task can place this partner in a more powerful position. This implies that the distribution of roles will be influenced by where the expertise resides and the more knowledgeable partner may become dominant. The more knowledgeable partner's position is interpreted as strong by the other partner when interacting about the task, and this interpretation will influence the actions by the latter, who will assume a more residual role.

The interaction will thus not reflect the parties as equal contributors as we saw in the case of symmetric knowledge distribution. Instead the interaction will be dominated by one party who directs the interaction. It is possible to consider two scenarios in this task structure;

A) The asymmetry in knowledge domains can be skewed towards the buyer.

When the buyer holds most knowledge about the task, the buyer will assume a dominant position, acting as a director of the interaction. The buyer informs the supplier what to do, and the supplier effectuates the task accordingly and refers back to the buyer. Setting direction and defining limits will be emphasized over feedback and negotiation (Weick, 1987) and coordination can be effectuated through task specifications

determined by the buyer. Hence, the interaction pattern will be solitary, only needing one, or few, iterations to communicate task specifications.

Knowledge exchange can thus be described as a unilateral transfer governed by formal rules and specifications (Lam, 1997). The interaction will be formalized, where the responsibilities and duties of the members are determined due to the dominance of the buyer, and this can further be written down in rules procedures and instructions due to the certainty in the task.

The defined and buyer directed interaction will influence the role pattern between the parties. In the interaction, the buyer will assume the role of knowledge provider due to the more knowledgeable position and the supplier becomes knowledge recipient. The buyer will provide knowledge and direction, while the supplier will assume a more residual role of responding to this direction.

A metaphor to describe this type of interaction is “coaching” as the knowledgeable buyer coach the supplier to learn about the tasks to be performed.

A case example of this is IKEA, the Swedish designer and retailer and designer of knock-down furniture and its suppliers. IKEA has very little manufacturing of its own and relies heavily on an extended network of suppliers in low-cost countries. IKEA has designed its interface with suppliers to ensure minimal dependence on any single supplier, to be able to swap suppliers as effortlessly as possible (Kinch, 1984, Sanchez, 2001). A critical principle for ensuring its ability to exchange suppliers is an intensive and standardized training program by which it relatively easy can learn new suppliers about the production requirements and quality standards of IKEA. Hence, knowledge transfer takes the form of coaching, with IKEA in the teacher and the supplier in the pupil role.

B) The knowledge asymmetry can be skewed towards the supplier.

In this case, the supplier holds the most knowledge about the task and will therefore be able to assume a dominant position in the interaction. Though the buyer may hold more structural power by virtue of position as buyer, the supplier will assume a dominant position in the interaction as the supplier holds more knowledge about the task.

Decision authority resides with the buyer, but as the buyer hold limited knowledge about the task, knowledge needs to be transferred from the more knowledgeable supplier to the buyer.

The interaction pattern will therefore resemble the supplier as the dominating party, being the one who supplies most information and gives opinion regarding task options. The buyer will assume a more residual role of evaluating these suggestions, thus restricting the buyer's interaction rate to approval or disapproval of supplier directed propositions.

The buyer therefore assumes the role of a client in need of a task solution and the supplier becomes a consultant who provides this solution. Due to the simplicity of the task structure, the solution provided by the supplier can be rather specified, involving only limited modifications in the interaction. The role of the supplier can therefore be described as a product consultant, presenting relatively standardized task solutions to the buyer.

A metaphor describing this interaction pattern is "guiding" as the more knowledgeable supplier guides the buyer in the decision-making process of selecting the final product.

A case example of this is RTX-Microsoft. Microsoft's entry into the platform based market was by many seen as a pre-emptive competitive move to avoid a hardware giant such as Sony to gain control over the computer in the living room and thus provide the distribution center of the future for the coming range of digital applications for the "intelligent home". In order to "get to the future first", Microsoft entered a business area, where they had little knowledge, and they were forced to ally with suppliers much more knowledgeable in this field. To begin with, most of this knowledge was supplied by Flextronics, which acts as a supplier of OEM products for a wide range of brands. However, in their attempt to develop the X-Box 360 as a follow-up product with new and innovative feature, RTX was involved in 2005 to supply technology and solutions for wireless "game pads" (controllers) for the X-Box, based on the DECT technology supplied by RTX (<http://www.rtx.dk/Default.aspx?ID=889&PID=4062&NewsID=114>). A number of problems needed to be solved, for which RTX had their know-how from their production of wireless telephones and similar products. These included: allowing for multiple game play modes, allowing for a large range, allowing for swift responses from the wireless handsets, etc. In all cases, solutions were drawn from existing

knowledge and even routines or blueprints held by RTX. Thus, much like a product consultant, RTX was providing and applying a range of ready-made solutions to Microsoft that they could choose from to solve their problem.

In the cases described above, we consider the asymmetry of knowledge domain as skewed towards one of the parties. Whatever we regard the asymmetry as skewed towards the buyer or the supplier, we get an interaction pattern that is dominated by one party. As such, one party will direct the interaction and supply the most knowledge while the other party will assume a more residual role of responding to these directions. As the task is defined, interaction will be limited comprising only few iterations to transfer knowledge. As in the scenario of symmetric knowledge distribution, new knowledge will therefore not be created as a consequence of interaction, and the task solution comes to reflect appropriation of individual knowledge.

5.3 Ambiguous task structure – Asymmetric knowledge distribution

When the task structure is ambiguous, the task cannot be subjected to specified preplanning as the end goal and the way to reach the goal are not known a priori. Specifications can hence not be applied as coordination mechanism and a greater amount of interaction between the parties is needed to figure out how to approach and accomplish the task. This cannot be effectuated in one interaction wherefore the interaction pattern becomes constituted by multiple iterations where the actors coordinate and adapt their knowledge as task execution progresses. This allows for flexible coordination during task execution and can deal with ad-hoc communication and knowledge needs.

The ambiguous structure therefore entails greater uncertainty and the end task is formulated as a problem assessment rather than a specified solution. The exact configuration of the task is not necessarily known a priori, but will be constructed as the interaction evolves and the parties engage in mutual problem solving activities.

The knowledge exchange in this interaction pattern can be described as a joint search towards a task solution. The interaction process is not “pushed” along by a priori knowledge and design specifications from one part, but is “pulled” along by emergent knowledge generated in the interaction (Lam, 1997). The task is constructed as the

process evolves, and decision making steps are discovered as and the actors continually align their knowledge contributions in the interaction.

The task solution comes to reflect this iterative interaction pattern. No actor is able to solve the task alone and the parties thus need to interact in order to properly interpret task-relevant knowledge. In this interpretation process new knowledge is created and the task solution will comprise an expanded knowledge base, rather than merely a summation of preexisting individual knowledge (Steiner, 1972).

Since the ambiguous task cannot be subjected to preplanning, behavior is not prescribed by specifications and a role pattern will emerge as a consequence of the interaction where the parties continually align their contributions to each other. The manifestation of these roles will be influenced by the distribution of knowledge domains and it is possible to consider two scenarios;

A) The knowledge asymmetry can be skewed towards the supplier.

When the supplier holds most knowledge of the task, the supplier assumes a more dominant role due to this expertise. The buyer holds less knowledge about the task and hence relies on the knowledge of the supplier to solve the task. In the search towards a task solution, the supplier therefore comes to function as a consultant for the buyer.

In the previous case of the defined task, the supplier was described as a product consultant, providing a concrete and comprehensive solution to the buyer. As the knowledge held by the supplier cannot be complete in the ambiguous structure, the role becomes more of a process consultant. The greater uncertainty in the ambiguous structure renders it unfeasible to supply standardized product solutions as the end goal is not known a priori. Instead, the supplier functions as a guide in the search towards a task solution and acts as a facilitator to help the buyer in the process.

The role of the buyer can hence be described as a client, as the buyer has knowledge about the problem to be solved, but does not have knowledge about the concrete configuration of the problem or detailed knowledge of how to solve it. The buyer therefore assumes a more residual role in the interaction, approving or disapproving the steps in the search process suggested by the supplier.

Due to the asymmetry in knowledge domains, the supplier provides the most knowledge and assumes a more leading role in the interaction. This distribution of knowledge will, however, not be static. As outlined above, the ambiguous task demands for multiple iterations and knowledge will be created in the process of interaction. The asymmetry in knowledge domains may therefore diminish as a new area is explored and new knowledge is created.

This interaction can therefore metaphorically be described as “parenting”, where the more knowledgeable supplier starts out by assuming a more prominent role in the interaction, directing the mutual search towards a solution, and the buyer learns and develops expertise as the interaction progresses.

An illustrative example of this interaction mode is the relationship between a client and a lawyer who supplies a legal service. In this case, the client knows of the problem he holds, but knowledge about the process in court, how to handle the case and all other legal circumstances are held by the lawyer.

The case of the specific client will be unique and hence the process of defense will be constructed as knowledge about the case is built up. In the interaction, the lawyer therefore assumes a more prominent role, asks questions to assess the problem and poses solutions for handling the process. The client will evaluate the proposed solutions, but will not be able to arrive at these solutions without the help of the lawyer. By virtue of his legal expertise, the lawyer therefore guides the client in the search process towards a solution.

B) The knowledge asymmetry can be skewed towards the buyer.

When the symmetry is skewed towards the buyer, the buyer holds more knowledge than the supplier and the buyer will therefore be able to direct the interaction.

The knowledge held by the buyer will not be complete due to the ambiguous structure of the task and hence it is not clear how to approach the process of task solution. The buyer has an expectation of the general purpose and sentiment which guides action, but does not have an exact notion of what the specific steps will be, thus fostering a higher degree of improvisation in the interaction.

In the joint search towards a task solution, the role of the buyer can therefore be described as an explorer. The buyer will lead the interaction by suggesting different solution paths, but will not know a priori which path to select.

In this process, the supplier will be casted into the role of an assistant, helping to evaluate the solutions proposed by the buyer. The main role of the supplier will therefore be to support or modify the ideas of the buyer.

The interaction will thus be constituted by mutual trials, lead by knowledge contributions from the buyer. As interaction progress, the parties will build up knowledge, the search process will become more well-versed and asymmetry in knowledge domains will diminish as new knowledge is cultivated. The role of the supplier will therefore evolve in the interaction as the supplier becomes more knowledgeable and hence able to contribute more knowledge. The fact that the buyer initially holds more power both by virtue of position and expertise will, however, influence the interaction in such a way that a complete elimination of the asymmetry in knowledge domains is unlikely.

The role pattern between the parties is therefore expected to evolve in the interaction but maintains the role of the buyer as leading in the search process towards the end solution.

The interaction mode can therefore be described as “exploring” where the buyer and the supplier are on a joint search towards a task solution. The parties are both on a journey, but the buyer will lead the way and guide the exploration.

A case example of this is the collaboration between the wind turbine producer Vestas and its collaboration with Hydac, a systems supplier of solutions of hydraulic equipment. In this particular case, Vestas was developing a new design for the V102 turbine and was looking for suppliers with technological expertise in certain areas who were also willing to help Vestas engineers in designing this particular subsystem so that it would match the overall layout of the wind turbine. As no one had designed gear-box based systems of this magnitude and physical load before, the area was terra incognita for both actors. However, with respect to knowledge concerning how the hydraulic system was supposed to interact with the overall technological architecture of the new wind turbine design, the Vestas engineers had more experience and were more knowledgeable than their counterparts from Hydac (Andersen & Drejer, 2009). Even so, Hydac contributed with knowledge and insights from their compartment of the technology development process and in this process extended both their own knowledge base and that of Vestas.

In the cases above, the knowledge distribution is asymmetric, creating an interaction pattern dominated by one actor. Opposed to the defined task, however, this interaction pattern will not be static, but will evolve due to the ambiguous structure of the task, where the parties engage in mutual search for a solution and new knowledge is created in the process. The roles of the parties are not prescribed by specifications, wherefore these emerge and evolve during the process as the parties interact and learn.

The resulting task solution comes to reflect this mutual search and knowledge generation, and thus comprises an expanded knowledge base.

5.4 Ambiguous task structure – Symmetric knowledge division

In this scenario, the interaction process will still be explorative in nature as the structure of the task is ambiguous.

But as knowledge is symmetric distributed, both parties hold knowledge about the task, and the interaction pattern will be characterized by bilateral and continuous knowledge contributions from the parties. The interaction can therefore be described as knowledge sharing, implying that both parties contribute equally.

Though the buyer defines the new product development task, the parties will prevail as equal partners in defining input to the process due to symmetry in knowledge domains.

In the interaction, roles will emerge as a consequence of the interaction where the parties continually align their contributions to each other.

In the search for a task solution, both parties possess valuable knowledge and this equality can be reflected by describing the roles of the buyer and supplier by the same token as alliance partners. There will not be a clear delineation of task responsibilities and knowledge contributions, and the boundary of the partners' roles is blurred, making it possible to draw on knowledge accumulated by both actors. In the interaction, the parties align their contributions based on interpretation of each other's action in the interaction. The roles of the parties become overlapping, reflecting an undifferentiated demarcation in knowledge contributions.

The interaction is thus not centered around one actor assuming a dominant role, instead responsibilities and authority are continually redefined in the interaction.

The interaction mode can therefore metaphorically be described as “exploring”, as the ambiguity of the task renders a structured and preplanned process unfeasible. In this

exploration, both parties have knowledge and hence contribute as equals in the search towards the end goal.

A case example of this is the Novo-Nissho collaboration regarding the Novo Pen (Andersen & Christensen, 2000). In 1983, Novo was about to launch a revolutionary concept for the treatment of diabetes, that would make the life of a diabetic much tolerable by introducing an multiple injection cartridge system that could be carried around much like a pen. This system was based on multiple injections a day, which meant that a needle had to penetrate the human skin more than 800 times a year. In order to avoid for needle marks, Novo was searching for a knowledgeable supplier in the area of surgery equipment such as needles and scalpels, that could provide them with a needle thin enough to leave no marks, yet sturdy enough to be used under more volatile circumstances than a hospital. After long time of worldwide search, they succeeded in locating a Japanese supplier, Nissho, with extended knowledge regarding high grade steel for surgery (and for Samurai swords). Together with Nissho, Novo issued a collaborative venture for knowledge sharing and further development. This has lead to the launch of even thinner and sharper needles, lubrication forms of needles, new systems for dispensing needles so as to live up to the pharmacology of particular markets, etc. Novo and Nissho have been relying on this complementary knowledge base as an important source for developing their competitive advantage.

6. Conclusion and implications

This paper offers a broader conceptualization of knowledge exchange in buyer-supplier relationships. By addressing the structure of the product development task and the knowledge domains of the actors involved, a model of different interaction patterns are provided, each characterized by different types of knowledge exchange between the actors, different role patterns and different task solutions.

In the model we propose the view that the concept of knowledge sharing needs to be complemented with other modes of knowledge exchange, appreciating who is contributing knowledge and who is directing knowledge exchange. By addressing the different roles assumed by the interacting parties, we wish to contribute to a more elaborate theoretical framework for understanding knowledge exchange in buyer-supplier relationships.

The model provides the avenue for research in collaborative new product development projects by focusing on knowledge exchange at the level of interaction in the buyer-supplier dyad. An appreciation of the contingencies described in this paper in terms of the structure of the task and the knowledge domains of the actors makes it possible to further investigate how different types of knowledge exchange can be nurtured in new product development projects. Distinguishing between different interaction patterns makes it possible to consider the roles the parties assume when exchanging knowledge, and hence better understand the contribution and requirement of each actor in new product development projects.

Instead of considering knowledge exchange as unfolding between equal parties, the paper addresses the power relation between the actors involved. This provides the avenue for further research of knowledge exchange in buyer-supplier relationships where interaction unfolds between unequal parties. Appreciating the structure of dominance in interaction will make it possible to identify how each actor contributes in the interaction and whether knowledge exchange is comprised of bidirectional or unilateral contributions.

By subjecting the model to empirical research, it becomes possible to elaborate on a number of issues, which have not been addressed in this paper.

First of all, the model provides only a snapshot picture and do not sufficiently discuss how roles evolve and change over time in the interaction process. This will impact on the type and structure of knowledge exchange, which may be modified during the interaction. Also, the model assumes that the buyer and supplier each can be described by one role, while in reality interaction involves several people from the two organizations, which may in turn take on different roles.

As such, the interaction in the buyer-supplier dyad needs to be empirically investigated to further understand how roles evolve and what type of roles the parties assume in knowledge exchange.

Secondly, the model only considers the structure of the task and the knowledge domains of the actors when classifying interaction patterns. A number of other factors can be of interest to discuss.

The type of relationship which exists between the parties can be of different nature, for instance with regard to the level of trust, closeness and intimacy, and this configuration

will impact how the parties engage in knowledge exchange. This has been the focus of several studies which examines knowledge exchange in strong and weak relationships (Granovetter, 1973; Hansen, 1999; Uzzi, 1997). Combining insights from these studies with analysis at the level of interaction in the dyad and investigation of the roles the parties assume in knowledge exchange, will provide the avenue to better understand how the type of relationship influences knowledge exchange.

Also, the type of the knowledge being exchanged has not been discussed in this paper, but needs to be considered in future studies, as the different interaction patterns most likely will imply exchange of different types of knowledge with regard to for instance tacitness and complexity.

The model therefore provides a first step towards a broader conceptualization of knowledge exchange in new product development, but further research is needed to elaborate on the different interaction patterns and their contingencies.

Some practical implications can also be provided. For companies involved in collaborative new product development projects, the model offers a more elaborate understanding of different forms of interaction and the requirements placed upon the actors.

From the buyer's point of view the model can assist in defining better frameworks for involving suppliers in tasks of varying structure and internal expertise. The insights into how interaction unfolds in different task situations and the implied need for knowledge exchange, will enable the buyer to better support and manage the interaction process with suppliers in different types of collaborative development projects. The different development projects will comprise different demands on the role of the buyer, extending from an active participant and knowledge contributor, to a more passive and less demanding role of evaluating supplier provided solutions.

From the suppliers' point of view, insights into the requirements of involvement can help the supplier assess how being involved best serve their strategic interest. The time and resource demands of the supplier will increase as a more prominent role is expected, and knowledge of this will enable the supplier to select collaboration projects that merit the effort. As such, the model provides an avenue for suppliers to differentiate strategically between buyers and engage in collaboration projects with different degrees of engagement.

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