The purpose of the present study is to describe the process of integrating knowledge created during joint product development projects involving medium sized manufacturing firms, and to find some early factors that can promote success in the integration process. Knowledge integration can be described as spirals within the partners and the alliance network that must interact in order to promote successful integration. On an operational level a technological infrastructure, an organizational infrastructure, and cultural factors can be identified to support the integration. This paper presents a framework for how to analyze the process of knowledge integration when outsourcing new product development (NPD). A case study of six Swedish manufacturing firms, in different industries, was conducted. Results indicate that a culture with high expectations on the potential of the cooperation is the most important part for high integration. Still most firms offer technological and organizational infrastructure without emphasizing the culture of integration.

Keywords: Outsourcing of NPD, Knowledge integration, Cultural factors

Introduction

Higher international competition due to an increasing supply of knowledge workers, refined IT that supports increasing knowledge transfer, and decreased international trade barriers has placed focus on the importance of gaining access to critical resources in order to stay in business (e.g. Quinn & Hilmer, 1994; Davis & Meyer, 1998). To access resources as production capacity or technological knowledge, firms are facing a make-or-buy decision. Some models for the make-or-buy decision have been proposed (e.g. McIvor et al, 1997; Jennings, 2002) mainly treating the outsourcing of production. There is however a difference between outsourcing production and outsourcing activities where knowledge is the main product. When production is the object of outsourcing the measurable result is the goods delivered, but when an intangible product, such as knowledge, is the object of outsourcing the result is more difficult to measure, control and integrate (Bounfour, 1999). Integration of knowledge between the outsourcing firm and the partner firm is wanted in order to create a joint picture of the project and future spin-offs from the created knowledge. The importance of a technological infrastructure (software, intranet) and an organizational infrastructure (arenas, meetings) for the efficiency of knowledge integration within the firm have been indicated by for example Liebowitz and Megbolugbe (2003). But as an alliance is a complex construct where cooperation and competition coexist, other factors may need to be added. In order to achieve an effective knowledge integration factors like motivation, joint language and positive expectations could be of importance. In the construct of a suggested framework the model of Escribá-Esteve & Urra-Urbieta (2002) gave some support, together with inspiration from Sheppard and Ryan (2003).
The purpose of the present study is to suggest a framework, describe practices, and identify some improvement factors for knowledge integration, with a focus on cultural factors. The context of the study is knowledge integration when intangible activities as new product development (NPD) are object for outsourcing.

THEORETICAL FRAMEWORK
In this section the main concepts of the article will be made clear; Outsourcing of new product development, Knowledge integration, and measuring knowledge integration.

Outsourcing of New Product Development
A NPD Process can be defined as the process of bringing a new product idea (generated by for example marketing and/or R&D) to the promotion and sale of the product on the market (McDermott and Handfield, 2000). A product can be either goods or services, or a combination of both. The newness of a product can be distinguished in terms of differences and similarities from already existing products. The term NPD describes results of higher innovativeness than the terms product improvement or reengineering. This could also be referred to as radically new products. When the process of NPD starts, the knowledge about the result is at its lowest. During NPD projects knowledge has to be gathered and developed in order to add new value to the product. This knowledge can be system knowledge and/or technological knowledge (Sanchez and Mahoney, 1996).

Outsourcing can be defined as “the process of transferring the responsibility for a specific business activity from an employee group to a non-employee group” (Zhu et al., 2001 : p 374). Outsourcing could be a way to rationalize or to expand an existing operation. If production costs are lower in another organization, outsourcing of production could be a mean to rationalize an existing operation. If for example, insufficient production capacity would stop expansion, outsourcing of production could be a way to expand an operation. These definitions refer to the process (over time) or to a distinct moment, but both suggest that the responsibility for the activity should be with an employee group before the outsourcing process starts. This definition is supported by Lacity and Hirscheim (1993) who define outsourcing as “purchase of an externally produced goods or service that was previously internally produced” (Lacity and Hirscheim, 1993 : p 74). These definitions imply that to be defined as outsourcing, an activity should have been previously produced internally.

The above discussion implies that outsourcing of NPD refers to the development of new products (goods or service), where all or the innovative part of the NPD process is purchased externally according to a contract with organizational units separate from the outsourcing firm. In this article the term “outsourcing firm” will be used for the firm purchasing the service or activity, and the term “partner firm” for the firm who, by contract, gets the responsibility of the same activity.

Knowledge integration
The consideration of knowledge as a firm’s key resource, in terms of its contribution to the added value and of its strategic significance (i.e. Winter, 1987), means assuming that the firms' ability (competence) to integrate (acquire, synthesize and use) knowledge constitutes a key source of competitive advantages (i.e. Nonaka, 1994).

When the individual’s knowledge is integrated into a collective base of knowledge or organizational memory (i.e. Nelson and Winter, 1982), the stored knowledge can be recovered and translated into action. This transformation of knowledge in action establishes the basis for the creation of new capabilities that could support the competitive advantage. Therefore, as an organization learns, it
will be able to strengthen and/or renew its core competencies, which in turn can be considered the output of organizational learning (Hamel and Prahalad, 1990).

However, in the context of outsourcing, previous research in organizational learning processes is fragmented. The main focus of analysis, both in empirical and theoretical works, has often been the study of the transfer of knowledge from the alliance to the parent organizations (i.e. Frost and Zhou, 2005).

Another issue is that although Grant and Baden-Fuller (1995) already addressed the difference between product and process knowledge a decade ago, the knowledge unit of analysis has often been Product knowledge (technology knowledge and knowledge on the result from a development project). The process knowledge on how to better transfer and integrate knowledge is rarely addressed. An interesting input to the present study came from Sheppard and Ryan (2003), who pinpointed the need of a joint language in order to address both product and process knowledge. This input from a different field (social work) showing the importance of language, triggered the search for cultural factors affecting effective process knowledge integration.

Organizational learning in a co-operative environment is complex because of:
1) Alliances shape a mixed context of both co-operation and competition (coopetition),
2) Organizational learning is itself complex,
3) Alliances are relationships that are instable and difficult to manage,
4) Participating organizations must be able to integrate knowledge to their own organization.

Based on early works indicating a “knowledge-based perspective” such as Winter (1987) and Grant & Baden-Fuller (1995), Escribá-Esteve & Urra-Urbieta (2002) developed a conceptual model to describe the inter-firm co-operation from such a perspective (see figure 1). Their framework focused among other things two specific topics that formed the basis of the present study: [1] the importance of measuring knowledge integration on a micro-level and [2] the importance of developing practices about how to manage knowledge from new alliances.

The creation of knowledge in co-operative agreements can be regarded, following Nonaka (1994) and contemplating Doz's (1996) dynamic model, as a sequential and iterative process that take place both in various levels and in different settings (see Figure 1). Three levels are described by Escribá-Esteve & Urra-Urbieta (2002).

Individual level. Individuals from outsourcing firm A interact with individuals from partner firm B. All individuals interpret new knowledge based on their own values and systems of beliefs where some of the values are individual and some are shared with their respective firms. These processes of exposure and interpretation lead, therefore, to an individual cognitive learning (Inkpen and Crossan, 1995). The knowledge absorbed by these individuals will be used by them in their interactions with colleagues from their own firm, thereby transferring firm B's knowledge to persons from firm A.

Group level. From this individual learning, both the original and the new knowledge are shared among the individuals of the group, who modify their own cognitive maps by means of socialization, combination, externalization and internalization processes (Nonaka, 1994). This diffusion of knowledge forms a process of knowledge integration in groups of individuals. The integration at group level can be viewed as two separate but parallel tracks:
(1) the interaction with other individuals who are involved in the established agreement, and
(2) the interaction with other individuals belonging to their own firm but who are not directly involved in the established alliance.

Organizational level. Learning generated at group level leads to changes in organizational routines, as a consequence of changes in the firm’s systems of beliefs and values. We can say that
organizational knowledge has been institutionalized, culminating the cycle of organizational learning process. When this organizational learning is produced in the setting of the co-operative agreement, it establishes the basis of certain organizational routines, which guide the agreement management and the interrelationship among the partners.

The importance of technological infrastructure and organizational infrastructure was described by Skyrme (1999) and Liebowitz and Megbolugbe (2003). For example technological infrastructure is software, video conferences, or document sharing systems, organizational infrastructure is arenas, scheduled meetings or routines for document handling. However, in order to achieve knowledge integration, the settings of the cooperative agreement must support the settings of the partners. This includes cultural factors such as shared schemas with motivation for individuals, groups and organizations to share and use knowledge generated in the cooperation.

Figure 1. Interaction between the spirals of knowledge creation within the alliance framework and the spirals of knowledge creation within the partner’s framework (Escribá-Esteve & Urra-Urbieta, 2002).

Measuring knowledge integration

For technological learning to yield an advantage, it must be captured, interpreted and deployed effectively (Grant, 1997). Hamel and Prahalad (1990) refer to this process as integration; “the firm recognizes what it has learned and decides how to use it”. Knowledge integration makes the information and skills gained from outsourcing activities as a component of the routines that guide the firm’s future strategic actions (Teece et al., 1997).
The acquisition of technological learning does not automatically translate into strong competitive market positions or high performance (McGrath et al., 1995). Some of this knowledge is tacit, making it difficult to use, unless integrated into the firm's operations. Managers are sometimes unaware of what they have learned from joint product development efforts. Integration helps managers to develop shared learning and to accumulate knowledge over time (i.e. Teece et al., 1997). It enables the firm to internalize the knowledge gained in its outsourcing co-operations network.

Knowledge can be integrated formally or informally (Grant, 1997). Following the literature, this study emphasizes formal integration, defined as the process by which managers’ register, synthesize, and use the knowledge they have gained from their firms' partners. New product development can excel with knowledge integration and establish a competitive advantage relative to their less innovative rivals. New product development usually has organic structures that permit the speedy and effective synthesizing of knowledge and its subsequent use in future product development activities. These structures encourage the exchange of information and experiences, which promotes learning.

Knowledge integration also makes managers consider the skills acquired from their diverse partners and how they can be used to overcome shortages that exist in their firm’s knowledge base. This process of self-examination gives managers insights into the scarcity of their firm’s skill base (Bohn, 1994). As managers explore ways to overcome these deficiencies by cultivating the knowledge that resides in their firm’s partners, the depth of the product development team’s technological learning increases. Managers are likely to share what they have learned with others in the firm, thereby increasing the depth of technological learning (Huber, 1991). Integration also encourages managers to recognize and rapidly internalize the technological knowledge gained from their firm’s partner’s diversity. When knowledge integration promotes communication and discussions among managers (Grant, 1997), it encourages speedy learning.

Consequently we found three areas of investigation where knowledge integration was measured (Holsapple & Singh, 2001, Nonaka & Toyama, 2003):
   a) the firms ability to support acquisition of knowledge,
   b) the firms ability to support synthesizing of the knowledge gained, and
   c) the firms ability to support the use of the knowledge gained

Each of these three areas could be promoted by an emphasis on:
   a) cultural factors (supportive management),
   b) organizational infrastructure (arenas, meeting), and
   c) technological infrastructure (computer support, intranet)

The framework including these two dimensions could be used to analyze knowledge integration when outsourcing NPD. In figure 2 the framework is illustrated with some synthesized findings from the present study.

METHODS USED IN THE PRESENT STUDY
As many authors have suggested, if the limits of a phenomenon to be studied are not apparent at the beginning of investigation, the best option to validate the research will be a case study (Benbasat et al., 1987). The same is valid when control and/or experimental manipulation are not possible to use, due to the complexity of context and/or lack of knowledge about independent and dependent variables (Yin, 2003). Knowledge integration in an alliance is a very complex phenomenon that needs to be studied in its context. In the present project a case study was used in order to describe and analyze the knowledge integration process. Six Swedish manufacturing firms in different
industries were studied. Interviews with the production managers were compared with interviews with R&D managers and product developers at the firms. The specific empirical base contains 22 interviews.

The participating firms were chosen based on a long-term relation to the research group at the university. Two new firms were added and relations of trust built during the one year of study. The long term relation with the firms of the study means that there is also a basic knowledge of the firm’s operations and an informal access to oral and written sources of information that can support or contradict answers given by the respondents. Written material can be contracts, information connected to orders, or the quality handbook of the firm.

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<tbody>
<tr>
<td>A</td>
<td>Food production</td>
<td>280</td>
<td>865</td>
</tr>
<tr>
<td>B</td>
<td>Office appliance material</td>
<td>100</td>
<td>390</td>
</tr>
<tr>
<td>C</td>
<td>Construction material</td>
<td>130</td>
<td>306</td>
</tr>
<tr>
<td>D</td>
<td>Medical equipment</td>
<td>30</td>
<td>227</td>
</tr>
<tr>
<td>E</td>
<td>Medical equipment</td>
<td>65</td>
<td>352</td>
</tr>
<tr>
<td>F</td>
<td>Control and regulation equipment</td>
<td>140</td>
<td>908</td>
</tr>
</tbody>
</table>

Table 1. A summary of the firms in the case study

The above table (table 1) presents a very brief picture of the firms which are all situated in the south of Sweden. All firms have a considerable in-house R&D or NPD activity, which is essential for the discussion in the article.

Semi-structured interviews were used with the matrix shown in figure 2 as a basis for an interview guide. All interviews were also recorded in mp3 format. As a complement to the interviews the firms also gave us unstructured and informal access to walk around, watch equipment, talk to other staff members, and read relevant documents. The material was analyzed per interview, per firm and later the six firms in the full sample was analyzed to try to find generalizing conclusions. The analyze at firm level included triangulation with written material, and general knowledge from a long cooperation with the firms.

Analyze and discussion in this paper is slightly thin due to the limited space in the conference proceeding.

RESULTS AND DISCUSSION

The result of the present study is related to the dimensions presented above. First some practices will be described together with contextualization. Then some improvement factors will be presented based on examples from the cases and a specific successful case. The results and discussion will get a larger space in the developed paper prepared for publication.

Infrastructure and cultural factors

The results presented in the following part include both the visible and invisible manifestations. The invisible manifestations are especially present among the cultural factors and have a higher degree of interpretation from the interviewer (see figure 2).

It was found that all firms had the technological infrastructure. Of course IT maturity varied, but all firms could present both hardware and software to allow knowledge exchange at a distance. Examples of technological infrastructure are databases with access for personnel from all partner firms. This is used as a tool where generated knowledge can be gathered from all partners and
accessed from all firms. Infrastructure for knowledge acquisition was more developed and infrastructure for use less developed. The most commonly existing example was joint mailing lists, which were found in all projects.

Technological infrastructure for knowledge synthesizing existed at almost the same extent as the infrastructure for knowledge acquisition. It could be summarized that all firms in this case study are better prepared for the early phases in knowledge integration, but that technological infrastructure is well developed in all firms.

Organizational infrastructure for knowledge integration is much less developed, at least in formal forms. Again the earlier phases are more developed, and also more accentuated. Infrastructure for knowledge acquisition such as scheduled meetings with partners, gatekeepers, or scheduled appearances on sites for virtual knowledge exchange existed in most firms. The most frequent form is scheduled virtual meetings which lead to a higher use of the technological infrastructure. In the case of organizational infrastructure there is a bigger difference in frequency between acquisition and synthesizing. Fewer forms of organizational infrastructure were found and some firms in the case study had no organizational infrastructure at all for knowledge synthesizing.

Cultural factors were acknowledged by management as important. As one R&D manager said “we always encourage our project workers to have a lot of individual contact with our partners. This is how we can build our future product knowledge”. It can even be stated that most project members felt this support and knew that close cooperation was wanted. However time and stress didn’t allow most project members to fulfill the knowledge exchange wanted by management. Full knowledge about the technology defining the infrastructure and the formal organizational infrastructure is not enough. Not even knowledge about the intentions of management is enough, but also time and space for informal initiatives is needed. Also regarding cultural factors, a major difference could be noted between the three phases. Acquisition is highly represented, while synthesizing and use is much less in focus.

<table>
<thead>
<tr>
<th>CULTURAL FACTOR</th>
<th>ACQUISITION</th>
<th>SYNTHESIZING</th>
<th>USE</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>- Setting up a joint language for the project.</td>
<td>- Implementing joint language internally.</td>
<td>- Acceptance for external ideas in new decisions.</td>
</tr>
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<td></td>
<td>- Motivating for knowledge exchange.</td>
<td>- Motivating for internal knowledge exchange.</td>
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<td></td>
<td>- Funding informal ways of knowledge exchange.</td>
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<tr>
<th>ORGANIZATIONAL INFRASTRUCTURE</th>
<th>ACQUISITION</th>
<th>SYNTHESIZING</th>
<th>USE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Setting up arenas and meetings for partners.</td>
<td>- Setting up arenas and meetings for integration within the firm.</td>
<td>- Informing at physical decision meetings.</td>
</tr>
<tr>
<td></td>
<td>- Planning for physical meetings.</td>
<td>- Planning for physical meetings.</td>
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<tr>
<th>TECHNICAL INFRASTRUCTURE</th>
<th>ACQUISITION</th>
<th>SYNTHESIZING</th>
<th>USE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Databases reachable for all partners.</td>
<td>- Databases reachable for all partners.</td>
<td>- Databases reachable for all partners.</td>
</tr>
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<td></td>
<td>- Project platforms on internet.</td>
<td>- Intranet.</td>
<td>- Direct e-mail lists for staff members in the cooperation.</td>
</tr>
<tr>
<td></td>
<td>- Video conference.</td>
<td>- Direct e-mail lists for staff members in the cooperation.</td>
<td>- Internal tools for communication as real time chatfunction</td>
</tr>
<tr>
<td></td>
<td>- Direct e-mail lists for staff members in the cooperation.</td>
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</table>

Figure 2. A framework with dimensions for promoting knowledge integration, and some examples found in the present study.

Another important cultural factor is language, which in this case does not mean the spoken language but the values of language. One Swedish firm cooperating with US firm found language to be a barrier. English was spoken to a good enough level, but the tradition on how knowledge is
developed was different. The non-hierarchical thinking in the Swedish firm was not familiar among the project members in the US firm. The feeling of free knowledge sharing existing only between staff on the same level made the informal knowledge acquisition less effective. This leads to a language barrier even if English was good on both hands. It indicates no best practice, but it shows only how important shared schemas in all firms in the agreement are.

**Following a successful example**

In one firm who were investing in a travel for three project members visiting a Chinese partner, they achieved knowledge integration in all three phases based on a technological infrastructure, an organizational infrastructure, supported by cultural factors to make use for the knowledge acquired. In this case, the special feature of the technological infrastructure consisted of video conference equipment. This is a rather cheap, but still effective investment combined with internet transmission. Complementary, project communication website and e-mail lists were provided for all involved staff.

In order to make the technological infrastructure deliver, an organizational infrastructure of formal meeting hours and scheduled broadcastings was developed. This offered arenas where the staff could exchange information. “It is important when being on a distance that we have these organized schedules for meeting; we don’t get together at the coffee machine”, one member of the development team stated.

But the key to success was the focus on cultural factors including travel to make the staffs meet in person. In that meeting they did get to know each other, but more importantly they 1) got a mindset with joint goals and visions, and also 2) got to understand each others language (code of conduct), and developed understanding and trust.

The doorway to getting this to happen was a meeting between the management in the two firms. They set up the framework of exchanging culture and decided on the equipment necessary. But as the CEO put it, “It is because I am genuinely interested in culture and cultural differences and because I became personal friends with my Chinese counterpart”. This is a rare example, especially for a medium sized firm with 600 employees, but it can bring up some learning regarding the importance of understanding the mental language of the partner firm. The monetary investments are not tremendous, but still more than most medium sized firms would consider. However, the knowledge developed and integrated has paid back more than it has cost.

The example is also rare because of the geographical distance, but other examples in the study show that the importance of a joint language can be as important even if the setting is within a nation or a region.

**CONCLUSIONS**

The present study had as its goal to develop and test a framework for knowledge integration when outsourcing knowledge intense activities, such as new product development. Considering the theoretical matrix model used in this study, on the vertical side three types of factors were determined; technological infrastructure, organizational infrastructure, and cultural factors. On the horizontal side three phases of knowledge integration was defined; acquisition, synthesizing, and use of knowledge.

Results showed that in the present sample, awareness of all factors were present both among managers and staff, but that most focus existed on technological infrastructure, falling via organizational infrastructure to the least focus on cultural factors. Results also show that acquisition is the easiest phase to handle, followed by synthesizing and use of knowledge. Even if awareness was good, operationally the corner of technological infrastructure for knowledge acquisition was dominant.

If knowledge integration is desired, it can be recommended to firms to give time, space, and resources to embrace the cultural factors. Awareness about this is rather high, but operational
methods are not frequent. Results show however that by activating the cultural factors, a much better use of the technological and organizational infrastructure lead to a higher level of knowledge integration. A joint language (code of conduct) and a joint goal/vision is the most individually important cultural factor for successful knowledge integration.

ACKNOWLEDGMENTS
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