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KNOWLEDGE INTEGRATION IN ROUTINE WORK: WHY IT WORKS OR FAILS

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Abstract

Organisations spend a great deal of efforts on information management, but if they are not successful in information mediation and use, it can be a waste of resources. In this paper we have applied a knowledge perspective on mediation and use. The purpose is to describe and explain why knowledge integration processes in knowledge-intensive routine work may work or fail. As an example of such work we have used a case study from the Swedish healthcare sector, more specifically a microbiology laboratory and some of its customers. Empirical data were collected by interviews and observations, and analysed with the help of theories about knowledge boundaries, knowledge integration and knowledge mediators (boundary objects and brokers). The case analysis shows that the boundaries between these groups are more complicated than they may appear to be at first sight, but also that there are methods to create a common understanding and overcome the complications. The main conclusion is that in this type of work, there are in fact several different boundaries between groups, depending on differences in work tasks, interest and motivation and that various ways to attain knowledge integration, directed both to groups and to individuals, can be required.

Keywords: Knowledge management, Knowledge integration, Knowledge-intensive routine work, Case Study.

1 INTRODUCTION

Organisations spend a great deal of resources on managing information repositories and information flows, whether manual or computerised. However, information management can be a waste of time, energy and money if organisations are not successful in information mediation and use. We address mediation and use of information with a focus on what happens when mediated information needs to be interpreted and converted to knowledge. Hence we study how different groups that must integrate knowledge actually do so. A focus is on the boundaries between the groups where information is transferred.

There are several studies and theories about knowledge integration and mediation between groups (e.g. Carlile 2004), but those studies and theories primarily focus on new product development or innovation contexts, i.e. the integration of knowledge shall result in new ideas, products or services. In this paper we use some of those theories but apply them to what we call knowledge-intensive routine work. With knowledge-intensive routine work we mean daily work situations where the aim is not to develop or innovate, but where the work situation requires extensive knowledge of the participants involved.

We have used a case study from the Swedish healthcare sector as an example of such knowledge-intensive routine work that also has a great need of knowledge integration. To provide good medical treatment, a number of specialists and occupational groups must exchange information and knowledge. When a patient sees a physician, a process of gradual collection of information starts and behind the information is a considerable amount of knowledge which must be communicated and shared between different wards and service units.

The purpose of our research is to study and analyse knowledge integration in knowledge-intensive routine work and to describe and explain why knowledge integration processes may work or fail. We are influenced by contemporary thinking in organisation studies, which are problem-driven and oriented toward events unfolding in the world (Davis & Marquis 2005). The focus is on social mechanisms which are “sometimes-true theories” providing “an intermediary level of analysis in-between pure description and storytelling on the one hand, and universal social laws, on the other” (Hedström & Swedberg 1998). In the words of Davis and Marquis: “If a regression tells us about a relation between two variables—for instance, if you wind a watch it will keep running—mechanisms pry the back off the watch and show *how*. Mechanisms describe ‘a set of interacting parts—an assembly of elements producing an effect not inherent in any one of them. A mechanism is not so much about ‘nuts and bolts’ as about ‘cogs and wheels’—the wheelwork or agency by which an effect is produced’ (Hernes 1998, p. 74).” (Davis & Marquis 2005). Problem-driven research “...is distinguished by its orientation toward explaining events in the world, beginning with the question, ‘Why is it that ...?’” (Schoonhoven et al. 2005). In our case: why is it that knowledge integration works or fails?

The remainder of the paper is organised as follows: In the next section (Section 2) we start with some clarifying definitions and then we present research and theories that we have used in our case study. In Section 3, we present the case and the analysis, and Section 4 contains a discussion about the results. The last section, Section 5, is a summary of our conclusions and has some suggestions for further research.

2 DEFINITIONS AND THEORETICAL UNDERPINNINGS

2.1 Some clarifying definitions

In this paper we use the terms *knowledge* and *information* as they are defined by, for example, Alavi and Leidner (2001): “...information is converted to knowledge once it is processed in the mind of

individuals and knowledge becomes information once it is articulated and presented in the form of text, graphics, words, or other symbolic forms” (Alavi & Leidner 2001, p. 109).

Knowledge may be seen on both an individual level and a group level. Tsoukas and Vladimirou (2001) define individual knowledge as "...the individual ability to draw distinctions within a collective domain of action, based on appreciation of context or theory, or both" (p. 979); knowledge becomes organisational when "...as well as drawing distinctions in the course of their work by taking into account the contextuality of their actions, *individuals draw and act upon a corpus of generalizations in the form of generic rules produced by the organization*" (italics in the original) (p. 979). The definition illustrates why we can say that different workgroups have knowledge as a result of established ways of working.

There are different concepts which are used to describe how knowledge flows between individuals and between groups (e.g. Bechky 2003). Following Grant (1996), we use the concept of *integration*. The essence of integration is well illustrated by the quotation: "If Grant and Spender wish to write a joint paper together, efficiency is maximized not by Grant learning everything that Spender knows (and vice versa), but by establishing a mode of interaction such that Grant's knowledge of economics is integrated with Spender's knowledge of philosophy, psychology and technology, while minimizing the time spent transferring knowledge between them." (Grant 1996, p. 114). This quotation highlights collaboration and effective transferring. If different workgroups shall be successful in collaboration they must find ways to get knowledge across the boundary between them.

2.2 Boundaries

Carlile (2004) discusses knowledge integration between groups and identifies three types of boundaries: *syntactic*, *semantic* and *pragmatic*. The distinctions between these types can be discussed in terms of *difference*, *dependence* and *novelty*. *Difference* can be seen in the amount of knowledge (e.g. novice vs. expert) or in domain-specific knowledge (e.g. different specialities). *Dependency* refers to the relations that are created between different parts when they collaborate for a common goal (e.g. different stations in an assembly line), and *novelty* signifies new needs that create new requirements on different actors (e.g. changes in customer needs).

A *syntactic* boundary can be found between groups that have a common and well-defined lexicon; differences and dependencies between the groups are known and the conditions are stable. In this case a "traditional" information processing approach can be used where knowledge (in the shape of information) is fairly easily *transferred* between the groups and where the receivers have no problems in integrating the information to create knowledge.

Many boundaries are not as simple as syntactic boundaries, and sometimes novelties arise making the differences and dependencies unclear. This makes the common lexicon insufficient, and knowledge transfer may fail. When boundaries have these properties, Carlile labels them *semantic* boundaries and argues that knowledge must be *translated* between groups. In the translation process, a common lexicon is not enough; the actors must also identify differences and dependencies and understand the consequences of them. In some cases this understanding is enough, the groups involved can develop a common meaning and knowledge may be integrated without changes in the domain-specific knowledge.

The third boundary type, *pragmatic* boundaries, is even more complicated and will appear when novelties arise and a common meaning cannot be developed without changes in the groups' domain-specific knowledge. A knowledge *transformation* must take place and because knowledge can not be separated from practice, this transformation will be strenuous. Different groups have different interests and to reach a common knowledge that is required for knowledge integration, some sort of negotiating is necessary.

From this discussion we conclude that boundaries may be classified in terms of complexity. A fundamental aspect in knowledge integration between workgroups is the capability to create a

common understanding. Furthermore, for knowledge integration across boundaries to take place there must be a boundary mediator, or carrier, of knowledge. Next we discuss more about common understanding and two types of possible mediators (boundary objects and brokers).

2.3 A common understanding

The discussion about boundaries suggests that there must be an understanding of similarities and differences between knowledge sender and receiver. Boland and Tenkasi (1995) write that if a group is unaware of differences between their own and other groups' knowledge perspectives, perspective taking, i.e. knowledge integration, can be unsuccessful. Another reason for unsuccessful integration can be that the groups are aware of the differences, but not the complexity in each other's work. Such an understanding can be attained through a common ground. Scholars discuss how this common ground can be created and how groups negotiate and change their previous knowledge (e.g. Bechky 2003). On the one hand, a common ground consists of basic knowledge such as capacities to read, write and work in teams, and on the other hand a common working language and knowledge about each other's specialist knowledge (Dixon 2000, Grant 1996, Szulanski & Cappetta 2003). If the common ground is missing, the receiver cannot absorb knowledge from the sender (Szulanski & Cappetta 2003).

For successful integration, the receiver must understand how the sender's knowledge fits into their own work (Bechky 2003). Szulanski and Cappetta (2003) discuss how the nature of one's own work affects knowledge integration and they point out that there may be differences in how a work process is described and how it is really carried out. If the process is not well defined, it is difficult in advance to know what and how external knowledge can be used. This may be compared with discussions about tacit and explicit knowledge (e.g. Nonaka 1994). Some knowledge is tacit and difficult to describe, but even if a work task is described, there are many things that fall outside the description. To illustrate this, we can use an example from Tsoukas (1996) where he compares a work task manual with a map as a description of a drive. In a map it is impossible to describe all situations that can arise when you go for a drive and in the same way it is impossible to write down all variations in a work task. We cannot in advance know what we need to know.

Knowledge integration is also affected by the frequency of a work task (Dixon 2000). Some tasks are frequent tasks while others are performed only a few times. In the same way, some jobs consist of activities which are the same every time, while others differ between occasions. From experiences of previous work tasks relevant knowledge will be sorted out by the receiver. If there is too little experience of how knowledge will function in a new situation, the receiver may be more or less resistant to new knowledge (Szulanski & Cappetta 2003). Individuals work in different ways, but after all not completely differently. Tsoukas (1996) argues that similarities depend on socialisation, on explicit rules and on expectations, while differences originate from individual backgrounds. When we integrate experiences with an actual situation and rules and expectations in that situation, we create ways of working that are individual but yet similar.

Dixon (2000) also calls attention to reflection. If experiences shall be developed into knowledge we must reflect on our actions and results. If an organisation is too focused on actions there may be a lack of time for reflecting. In workgroups this will be even more complicated since all group participants must reflect.

There are also characteristics of the sender's knowledge that are important for the integration process; it may, for example, be more or less easy to make the knowledge visible (Dixon 2000). If the sender's knowledge is mainly explicit it can be defined in formal rules and instructions. If the sender's knowledge is mainly tacit, words can be insufficient and the knowledge integration may need personal meetings and joint work (Dixon 2000). Bechky (2003) also calls attention to what she calls tangible definitions, i.e. concrete demonstrations of physical objects which can be complemented with discussions that result in understanding and increased knowledge.

Both the sender and the receiver must be motivated if knowledge integration shall be successful (Szulanski & Cappetta 2003). The sender must see advantages in sharing knowledge because it will imply some efforts. In the same way, the receiver must see that they have use for the knowledge and accept it. Pride and status may affect the knowledge integration because they may create a feeling of trespassing on one's own knowledge domain.

The literature suggests that a common understanding is a necessary, but not sufficient, condition for knowledge integration. The literature also suggests that the required common understanding is contingency dependent (context dependent) and boundary objects and brokers are two different means of increasing the likelihood of successful integration.

2.4 Boundary objects and brokers

To describe carriers of knowledge between groups, we have used the concepts boundary objects¹ and brokers². A boundary object, e.g. an information system (IS), is a reification that can be viewed from different group perspectives (Wenger 1998). When Fischer (2001) discusses learning between different Communities of Practice he points out that the boundary objects must mediate a shared frame of reference to all parties involved. A single individual or a group of individuals has just one part of the interpretation control for the boundary object and just one part of the knowledge that is needed for solving a common problem (Fischer 2001).

The other type of connection, brokers, refers to human beings that are members of different groups and have working roles comprising integration of knowledge between these groups (Wenger 1998). A good broker opens up new possibilities for sense making. Managers at varying levels often have such brokering as a work task.

3 CASE STUDY

3.1 Background and method

The purpose of our research is to study and analyse knowledge integration in knowledge-intensive routine work and to describe and explain why knowledge integration processes. As an example of knowledge-intensive routine work that has a great need for knowledge integration, we have used a case study from the Swedish healthcare sector.

The clinical laboratories are one type of service units in hospitals and primary care and they play important roles in the medical service. Physicians and nurses request a large quantity of analyses from the laboratories and consequently there are a number of answers going back from the laboratories to the ordering persons, the customers. Both the customers and the laboratory staff must have knowledge about the analyses and what information they should integrate.

There are different clinical laboratory specialities and in this study we focus on knowledge integration between a microbiology laboratory and four of its customer units. The communication between laboratories and customers has traditionally been done using paper-based orders (referrals) and paper-based answers (laboratory reports), but information transfer in the Swedish medical service is now changing rapidly, and the ordering/reporting process in the actual county council is to be digitalised in 2005-2006. This study, which is one part of a large longitudinal study focusing on changing working practices and routines as a result of computerisation, examines the use of the current paper-based

¹ The boundary object concept originates from Star & Griesemer (1989), and is then used in, among others, theories about Communities of Practice (Wenger 1998).

² We have borrowed the concept of broker from the theory about Communities of Practice (Wenger 1998).

ordering/reporting IS. (The first author has extensive microbiology education and microbiology laboratory work experience.)

The microbiology laboratory is a countywide speciality that diagnoses diseases caused by bacteria, viruses, fungi, parasites and immunological reactions. Two of the customers are primary care centers and the other two are hospital wards. In the laboratory, two observations and two interviews (with a laboratory instructor and a laboratory physician) were carried out. The observations consisted of participating in ongoing analysis work of laboratory technicians. The customer interviews were semi-structured and done with two to five individuals (physicians, nurses, local laboratory technicians and assistant an assistant nurse from each centre. All materials from the observations and the interviews were written down and analysed using our research question and chosen theories. This implies that boundaries, groups, boundary objects and brokers were identified and analysed.

3.2 The work process

The customer writes a referral, takes a specimen and sends the referral together with the specimen to the laboratory. The referral must be supplied with a great deal of information such as patient data, choice of analysis, specimen material and details about where the specimen was taken. Furthermore, in most cases, there must be some information about diagnosis and other facts about suspected findings. From this information, the laboratory staff select relevant methods for analysing the specimen. The laboratory tries to elicit all the necessary information through predefined fields and checkboxes, but the study showed many examples where the customers gave insufficient or wrong information. For example, if the referral does not include information about how deep an ulcer is, some important bacteria may be overlooked.

The specimens that are sent to the laboratory can be all types of body fluids or secretions. To perform an analysis, the laboratory must get specimens that are taken correctly, but our study showed several examples where the specimens were taken incorrectly or were unsuitable. When the analysis is finalised, the laboratory sends the laboratory report to the customer. This answer may consist of preprinted text that tells the customer what the analysis has shown, or numbers (measurements) together with a short interpretation guideline. If the preprinted alternatives do not cover the result of an analysis, laboratory staff may write a modified answer or explanation. The customer receives the laboratory report and makes an interpretation of its information.

If customers have questions about specimen taking or specimen handling they can search information in specimen handling instructions. These instructions are published since summer 2001 on the county council's intranet and are constantly updated. If there are more extensive changes, the laboratory also publishes news on a specific intranet site. Furthermore, there are persons at the laboratory, a laboratory instructor and some physicians, that shall inform customers continuously about microbiology analyses.

4 CASE ANALYSIS

Even if, for a majority of the customers, microbiological analyses are just a small part of their total work activities, results from the analyses may be very important for diagnosis and patient treatment. In our empirical study of the ordering/answering process we can identify a number of factors that need to be taken into account for it to be successful, but there are also several examples of activities that can fail or cause unnecessary problems. For example, specimens can be taken in the wrong kind of test tubes or be handled in the wrong way and referrals can be without relevant information, which affects the analysis and, in turn, the laboratory reports. One way to understand the process and to explain the problems in the knowledge integration is to focus on and discuss the boundaries between the laboratory and its customers.

4.1 Boundaries

As discussed in Section 2.2, boundaries within which knowledge integration between groups takes place can be categorised into three types: syntactic, semantic and pragmatic (Carlile 2004). There is a clear variation in domain-specific knowledge between the microbiology laboratory and the customers. The dependence between the laboratory and its customers can be seen as considerable since the laboratory's existence is based on the analyses they perform and since the customers need the laboratory's help in diagnosis and treatment work. The wider the difference and the greater the dependence, the more difficult it is to integrate knowledge (Carlile 2004).

In Carlile's categorisation the syntactic boundary is the most uncomplicated boundary type. In this boundary type knowledge can be transferred if the groups have a lexicon that is common and stable. If the boundary between the laboratory and its customers is syntactic, knowledge integration can be accomplished by access to each other's databases, i.e. the laboratory can have access to case records and the customers to the laboratory's production system. Apart from the secrecy rules that regulate this type of connections in the healthcare sector, this study shows that the integration will be even more problematic with such a procedure. Case records as well as the laboratory's production system contain detailed and internal information that has no relevance for other groups. With the receiving group's needs in mind, irrespective of whether we take a laboratory or a customer perspective, an evaluation and a synthesis must be accomplished before integration can take place. The groups have a common medical language, but well-defined syntaxes for the evaluation are missing and it can be difficult for the customers to determine what information is relevant for the laboratory and vice versa. According to Carlile's theory, this means that the boundary is more complicated than a syntactic boundary and the simplest form of integration, i.e. transferring, will not be successful unless some actions are taken.

If the referral is provided with information that is relevant and that the staff in the laboratory can interpret, if the sample is taken and handled in a proper way, and if the laboratory report is formulated in a way that customers can assimilate, then the boundary can be seen as semantic. Knowledge integration in a semantic boundary is called translation according to Carlile's categorisation (Carlile 2004). In this case, it is not only a simple transferring of information but also an interpretation that requires awareness of differences between the groups' contexts, and if this translation shall succeed, the knowledge must be stable for both groups even when novelties arise. At the laboratory there are continuous changes in analysis offers and methods which they must inform the customers about. This might lead to a need for a change in the customers' domain knowledge, depending on their previous knowledge. The customers, who vary both in speciality and occupational groups, are also changing in a way that may affect the laboratory's work; they may, for example, need new types of analysis. Hence, the laboratory might also need to change its domain knowledge. These changes indicate that the boundaries are often more pragmatic than semantic and that the translation of knowledge will not be successful. When a boundary is pragmatic, it is not enough to understand the differences between groups; the groups must also be prepared to change their own knowledge (Carlile 2004). For the laboratory and its customers, this will mean that they must be successful in informing each other about what is going on in different specialities and they must be open for negotiations about how to adjust their practices.

4.2 Common understanding

Through education and experience a common medical language has been developed which can be seen in manuals and work descriptions. However, in the laboratory also an internal working language could be identified which is quite different from that of the customers. Even if this study does not examine the language in different customer units, it is very likely that such an internal language can also be found in the different specialities. In the empirical material there were several examples of situations when laboratory staff were unable to assimilate information on the referral without consulting colleagues, physicians or medical dictionaries. In the same way, some nurses said that the laboratory

reports can be difficult to interpret. Accordingly, even if there is a common language, this language is not enough to cover all knowledge integration needs.

The importance of understanding each other's perspectives is emphasised by several authors (e.g. Boland & Tenkasi 1995, Grant 1996). To a certain degree this understanding exists in the different healthcare units, because all staff have medical education and they all work in the same organisation. However, some individuals or occupational groups seem to have a better understanding of microbiology analysis than others, and these people also seem to have a better capacity both as sender and as receiver of knowledge in this specific area. To obtain a deeper understanding, other integration methods than referrals, laboratory reports, information about news, and specimen handling instructions may be required. One method that was highlighted in the empirical material was study visits at the laboratory. The respondents emphasised such visits as really valuable, because when they saw the practical work they could relate their own experiences to instructions and other information provided by the laboratory. This is what Bechky (2003) calls "attention to" in her discussion about knowledge integration through concrete objects. In the same way the laboratory instructor wished that other laboratory staff could accompany her when she visits customers. More insight into customer work followed by reflections on one's own work tasks increases understanding. The positive reactions from study visits and the instructor's wish can also indicate the importance of understanding the knowledge that is attached to place, environment and people, i.e. tacit knowledge and culture. Even if there are descriptions of work activities, certain standpoints will never be explicitly described (Tsoukas 1996).

If the knowledge from the sender is mainly explicit, it can more easily be expressed in rules and manuals (Dixon 2000). The manuals and formal rules that were found in the empirical material were mainly different types of routine descriptions and descriptions concerning occupational groups or positions. The manuals that describe specimen and referral handling were mainly written by laboratory staff, but there were only two respondents who used the new updated version on the intranet; all the others used an old printed version. Several of the respondents stated that information about news and changes was supplied through paper documents from the laboratory, but the laboratory instructor claimed that all such information is presented on the intranet and that paper documents are normally not sent out. If news and changes do not reach the customers, changes in domain-specific knowledge and creation of a common ground will be obstructed.

The empirical material demonstrates quite large differences in the work tasks. The staff in the microbiology laboratory do not meet the patients in person, and the primary focus is on the analysis work whereas the customers' work is focused on patient care and the medical judgments that are relevant. But different customers have different work tasks and even in units where the tasks seem to be the same, they have created different routines. This, in turn, implies that the laboratory has boundaries that differ from customer to customer and they have to handle a great deal of different customer perspectives.

Another aspect that affects knowledge integration is frequency and variation in work tasks (Dixon 2000, Szulanski & Capetta 2003). There are large variations between different customers in how many microbiology analyses they need to have done. Some customers have specialities, like the isolation ward, which implies that they take many microbiology specimens of various kinds and they have also in their special education developed reliable knowledge about microbiology. Other customers take only a small number of specimens and/or specimens of only a few types. In the laboratory most types of analysis are performed, if not daily, at least weekly. Accordingly the staff are well updated about the different analysis procedures. However, every specimen is to some degree unique since the information on a referral is unique. An analysis procedure can be more or less easy to learn, but often the most arduous part in the analysis work is to make a detailed judgment of the information on the referral and then evaluate the analysis result in relation to that.

If experiences shall affect knowledge, the groups must have time for reflection (Dixon 2000). Especially in the hospital wards, lack of time for reflection was emphasised. Searching for and

assimilating knowledge is not prioritised until the need is urgent. Also in the laboratory the physician expressed that specimen handling may be wrong because they work under high time pressure.

Motivation is another important factor in the integration process (Szulanski & Capetta 2003). Naturally, the laboratory staff want to get adequate and legible information from the customers, and the customers want laboratory reports that are as good as possible. Accordingly, the motivations for the receiving part in the integration process are high and clear.

The motivation for sending knowledge is vaguer. The respondent who showed most motivation to provide the laboratory with information was a physician who in addition to his speciality in medicine is also specialised in infectious diseases and accordingly has extensive knowledge about clinical microbiology work. This is something that further strengthens the importance of understanding the receivers' knowledge and work processes. There were also several respondents who did not have more knowledge than their colleagues but still expressed that they had enough knowledge about microbiology and they showed no interest in learning more. On the contrary, they argued that other issues had a higher priority and that they had no possibility to keep themselves updated on every subject. This can be related to the issue of many and different boundaries. The customers collaborate with many different specialities and the boundary between themselves and the microbiology laboratory is just one of many boundaries. Time is not sufficient to create deep understanding for all specialities' perspectives. Customers must prioritise based on needs, interest and time available and the study suggests that they do not handle their boundaries strategically, in the sense that they do not have a longer perspective and a clear vision of how to develop their boundaries. Instead they act quite opportunistically.

When groups face pragmatic boundaries they must negotiate and change their domain-specific knowledge. This may be compared to Szulanski and Cappetta's (2003) claim that motivation may be attained if sender and receiver agree on what knowledge to integrate. Agreements in turn demand relations between parties, and Tsoukas (1996) argues that knowledge integration is facilitated by social relations. Some formal communication ways were found in the empirical material. For example, there were groups that consisted of laboratory physicians and representatives from customer units. However, if they agree on something but information about the agreement fails to reach other units, more profound changes in knowledge will not be attained. There were also some informal communication ways between certain customers and certain individuals at the laboratory, but they were few and there was almost no communication at all between some customers and the laboratory.

4.3 Boundary objects and brokers

In this study we view boundary objects and brokers as mediators of knowledge. They carry knowledge within the boundary and thus they have an important role in the knowledge integration process.

Three main boundary objects were identified. Referrals may be seen as a boundary object since they are a kind of communication document between the customers and the laboratory. Some fields in the referral are easy for the customer to interpret, e.g. where to specify concrete facts about the patient, while others are more demanding, e.g. fields for clinical data, diagnosis and expected laboratory findings. The formal rules say that all ordering shall be done by a physician, but physicians often leave the active writing of the referral to nurses or other staff. In one of the units some referrals were written by the local laboratory technicians, and they had no access to the patient record system, which means that they could not include all the relevant information in the referral.

Another type of boundary object is the laboratory reports that are sent back to the customers. Physicians shall interpret the reports, but in all the units studied, nurses make the first interpretation and alert the physicians if urgent actions must be taken. The laboratory draws up the reports with physicians' medical knowledge and responsibility in mind, and when nurses handle the reports they must obtain this knowledge, but in some cases, the nurses have difficulties with the interpretation.

The third type of boundary object is instructions for specimen taking and specimen handling. Only two of the customers interviewed (employees at the same unit) said that they use the intranet for this purpose. The other respondents use an old version of the instructions, which was published in book form and has not been updated since 1994. This means that there is a considerable risk that changes in the instructions will be missed.

Individuals who work as brokers can be identified both in the laboratory and at the customers' units. In the laboratory, the physicians and a laboratory technician who is employed as an instructor have these roles since their work tasks comprise informing customers and answering their queries. The instructor is known by the customers' local laboratory technicians, but not by other occupational groups. The laboratory physicians are more widely known, but several of the customers say that they hardly ever speak to them. The most frequently mentioned name is instead that of one of the secretaries at the laboratory, because she is the first person they speak to when they call the laboratory. She is often able to answer customer queries.

Among customers, some individuals with more knowledge about microbiological analyses than others have been identified. Their extra knowledge comes from special education, special interest or special work tasks. These customer brokers spread their knowledge in their workgroups, but they are not known or used as resources by the laboratory.

5 DISCUSSION

The purpose of our research is to study and analyse knowledge integration in knowledge-intensive routine work and to describe and explain why knowledge integration processes. We start our discussion by focusing on what makes integration work and why and then move on to what makes integration fail and why.

5.1 When knowledge integration works

The case analysis shows that the boundaries between laboratory and customers are handled as semantic even if in most cases they are pragmatic. This means that for knowledge integration to be successful, laboratory and customer must have a common understanding, and they must allow their own knowledge to change in relation to the other party's changes. There is a basic common language and a fundamental understanding of each other's work which is a foundation of common understanding. However, the study indicated that there are tacit dimensions and culture in the work tasks that play important roles if understanding shall increase and knowledge domains shall be changed. Some individuals have attained this increased understanding and they showed a good ability to integrate knowledge. In addition to basic education and training these people had learned more about laboratory analysis from previous work tasks or interest. Furthermore, meetings in real work situations and study visits seem to be valuable because in these situations the tacit dimensions are included. There were also individuals who acted as unofficial knowledge brokers and accordingly helped knowledge integration to work.

5.2 When knowledge integration fails

We can also identify some clear difficulties in the knowledge integration process. Interest and motivation differ between customers, not only between different units but also between individuals in the same unit. Through collaboration within groups, knowledge may be transferred, but the groups vary with regard to competence and forms of collaboration and the study indicates that individual experiences and knowledge dominate in the knowledge process.

In some parts of the knowledge process, feedback is missing. Customers are not always notified if the information they have written on the referrals is inaccurate. Furthermore, if there is lack of both

interest and time for reflection, they may not evaluate given information in relation to the laboratory reports they receive, and accordingly changes in knowledge will be difficult to achieve. For example, customers who handle many specimens but a small number of different analysis types would be expected to be more knowledgeable and make fewer mistakes than others. However, this is not seen in this study. If they do not get feedback, they assume that everything has been done correctly. In the same way, because laboratory staff normally get no feedback on reports, they cannot evaluate their contributions to the subsequent care process, and consequently their knowledge will not change.

The three types of boundary objects that we identified, referrals, laboratory reports and specimen handling instructions did not work well in all situations because the first two are created with physicians in mind but other occupational groups use them, and because updated versions of the third type do not reach the customers. For changes in knowledge to be possible, boundary objects must be understandable by all persons involved and news as well as feedback on activities must be disseminated between the different units. In this study the laboratory had certain channels for this (especially the intranet), but at the customer units very few of the respondents actively used them. Accordingly, it is quite possible that they miss important information.

6 CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

The main conclusion we can draw from this study is that in the type of work we call knowledge-intensive routine work, knowledge boundaries between groups are in fact a great number of different boundaries. These boundaries, in turn, can be more or less complicated, but the groups have to find ways to handle them all. The reason why the boundaries vary is differences in experiences, work tasks, interests and motivation.

Even if we have focused on groups in this study, some individuals have clearly come into view. In this type of knowledge-intensive routine work, there seems to be a great deal of individual knowledge that is not naturally disseminated within one's own workgroup. This can be compared with Blackler's categorisation of knowledge types in organisations (Blackler 1995). As an example of an expert-dependent organisation he mentions hospitals, where "performance of specialist experts is crucial" (p. 1030).

With this discussion in mind, we can also conclude that handling a large number of boundaries in this type of work may require varying knowledge integration ways, directed both to groups and to individuals.

One of these methods is a computerised information system. In the organisation studied such a system, aiming at partly replacing the manual ordering/answering process, is currently being implemented. This raises some interesting questions for further research. Can a computerised information system comprise functions for disseminating news and changes in a way that is suitable for all users? Can feedback be built into the system? Boudreau and Robey (2005) showed in their study of an ERP system that users first avoided the new system and tried to keep their old working routines, but if a system that requires mandatory use is implemented, can the system be used as an efficient knowledge integration mediator?

Apart from motivation as benefit, we may associate motivation with pride and status (Szulanski & Cappetta 2003). In healthcare many occupational groups and many specialities are involved and there may be an unwillingness to share knowledge. There are also informal working routines in healthcare that bypass formal rules; physicians, for example, are responsible for the ordering of laboratory tests and the interpretation of the results, but often other workgroups do the practical work and just alert physicians if problems appear. Could a computerised information system affect potential unwillingness to share knowledge and how would this change formal and informal working routines?

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