Towards a consistent analytical framework for studying knowledge integration:
Communities of practice, interaction, and recurrent interaction patterns

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Abstract

The objective of this paper is to contribute to understanding knowledge integration. The guiding question is 'What are the mechanisms underlying knowledge integration?' By knowledge integration we mean solving the problem raised by specialization: Specialization leads to a dispersion of specialized bodies of knowledge that are held by different specialists. Knowledge integration refers to how this drawing on different bodies of specialized knowledge is organized. The paper is organized in three main parts. First, we analyze what the problem of knowledge integration consists in, how it can be approached, and what mechanisms are underlying the approaches. Subsequently, we supply an empirical and a conceptual anchoring to our understanding. Finally, we propose to answer the question how to use such an understanding in analysing knowledge integration by focussing the analysis on communities of practice as the most adapted level of analysis for analysing knowledge integration, and on 'recurrent interaction patterns' within and between such communities. Such a focus would centure on one of the most important mechanisms for providing knowledge integration, it would be on a solid conceptual grounding, and it also is a practical approach that can be implemented.

Keywords: knowledge flows, knowledge integration, communities of practice, recurrent interaction patterns, routines

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As the themes of this conference reflect, one of the most pertinent open research questions with regard to organizational knowledge, learning and capabilities is: How do knowledge retrieval, utilization, integration, and transfer in organizations work?

The objective of this paper[1] is to contribute to understanding knowledge integration. The guiding question is 'What are the mechanisms underlying knowledge integration?' By knowledge integration we mean solving the problem raised by specialization: Specialization leads to a dispersion of specialized bodies of knowledge that are held by different specialists. For solving a task such as for instance producing a complex product, a number of different bodies of specialized knowledge have to be drawn on. Knowledge integration refers to how this drawing on different bodies of specialized knowledge is organized.

While the focus of the paper is on knowledge integration, knowledge integration is one type of knowledge flow. Let us therefore briefly situate knowledge integration amongst the other knowledge flows. A large number of different terms is used to denote knowledge flows: knowledge retrieval, utilization, integration, transfer, creation, application, retention etc. In order to see clearly, it is helpful to have a schematic representation of how knowledge flows through organizations. Having been (i) created (innovation, invention – which might also take place in the process of knowledge utilization or application), knowledge then can (ii) be transferred (or from the point of view of the user: retrieved), and then (iii) be utilized or applied. Where knowledge is specialized, step (ii) – the transfer – might involve not just the transfer itself, but also the integration of specialist knowledge. In our view, knowledge integration therefore 'includes' knowledge transfer (or retrieval), but is more than that: it is transfer plus coordination. The difference can be illustrated at the example of a production plant. Setting up production involves a problem of knowledge integration – coordinating the suppliers, hiring specialists etc. Once production is set up, i.e. a production plant, the organization and management structures to run it and so on are in place and the decision is

taken to open another production facility, maybe on a foreign market, the 'duplication' of the plant is a knowledge transfer task – the solution to the knowledge integration problem that is already implemented is transferred.

The paper is structured as follows. Section one briefly introduces the problem of knowledge integration, section two possible approaches to deal with knowledge integration, and section three the mechanisms underlying these approaches, and thus how it is they achieve knowledge integration. Section four introduces empirical material from a study of knowledge flows in customer service centers, which helps to enrich and empirically ground the understanding of knowledge integration. The understanding gained so far is then put on a firm sociological basis in section five. The remaining sections turn towards drawing implications. Section six presents the notion of communities of practice as the most adapted level of analysis for analysing knowledge integration, section seven proposes to make 'recurrent interaction pattern' within and between communities of practice the focus of analysing knowledge integration. Section eight concludes.

Knowledge integration

As Adam Smith has established, specialization and the division of labour are important sources of productivity improvements. Ever since Smith's time, the quest for increasing productivity has been uninterrupted, and the most important means to yield productivity improvements were and still are specialization and the division of labour. Even in the so-called 'New Economy', neither the quest nor the means have changed much. Outsourcing is just another form of division of labour and specialization. The benefits of specialization and the division of labour come at a price, however: they create distinct bodies of specialized knowledge (which in the case of outsourcing are held by distinct firms) that subsequently have to be integrated. While in craft production, all the knowledge for producing horseshoes was integrated by the master, or rather, in the master's head (and hands), in industrial production management has to find a solution for integrating the knowledge held by the engineers with that of the marketing department, for instance. Historically, these problems often did not arise in early times when the craft system was dominant, mainly because the customer demands were more homogenous and changing more slowly. Specialization and division of labour raise the problem that different bodies of specialized knowledge have to be drawn on. Knowledge integration refers to how this drawing on specialized bodies of

knowledge is organized.

Knowledge integration is thus a task managers have to solve.[2] The same task also arises on the level of a national economy, as the famous 'socialist calculation' debates from the 1930s and 1940s attest. In these debates the question was what would be an appropriate way to integrate the dispersed specialist knowledge (and information) in an economy. While some held that a central organization structure could do so efficiently, Hayek (1937; 1945) and others held that 'dispersed knowledge is *essentially* dispersed, and cannot possibly be gathered together and conveyed to an authority charged with the task of deliberately creating order' (Hayek, 1988, p. 77). A centralized organization structure thus could never be able to integrate all the dispersed specialist knowledge.

On the firm level, the debate is still much more open. For solving the knowledge integration task, managers have a number of possible options. The next sections reviews them.

Possible approaches to integrate knowledge

Decomposition. The problem of integrating dispersed knowledge can be handled by containing the size of the problem, thus side-stepping its implications. This can be done by decomposing the organisational units that are to provide knowledge integration into smaller units. In this way, the problems caused by large numbers, and the lack of overview, are alleviated. Decomposition is implemented by delegating tasks. One form of delegation is delegation to an external unit – outsourcing. The need to integrate and co-ordinate the decomposed elements is often fulfilled by what Mintzberg (1979) has called 'co-ordination by standardisation of work outputs': Outputs are standardised when the results of the work, for example the dimensions of the product or the performance, are specified. The notion of modularity is a contemporary expression of co-ordination by output standardisation. Modularity has been defined as an approach for organising complex products and processes efficiently by decomposing complex tasks into simpler portions so they can be managed independently (Baldwin and Clark 1997). It consists in a scheme by which interfaces shared among components in a given product architecture are standardised and specified, thereby

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[2] For more detail on the problems raised by dispersed knowledge and managerial approaches to solving it see Becker (2001).

allowing for greater reusability and commonality sharing of components among product families (Sanchez and Mahoney 1996).

Substitute knowledge by access to knowledge. A second way to provide the integration of specialist knowledge that is dispersed, is to create and foster communication structures through which knowledge can be acquired (Cohen and Levinthal, 1990; Nahapiet and Ghoshal, 1998). Know-what or know-how is substituted by 'know-whom'. Knowledge is substituted by 'knowledge surrogates' (Scheuble, 1998). Maybe the most common manifestation of this strategy are 'company yellow pages' or databases that allow searching for who holds what specialist knowledge in the organisation. It has been pointed out that the key to achieving co-ordinated action in the face of dispersed knowledge is to develop ways of interrelating and connecting the knowledge each individual has (Tsoukas, 1996). A communication channel itself, however, only provides the necessary, not the sufficient requirement for integrating knowledge. In addition to the availability of a channel, there also need to be the willingness and motivation, as well as the competencies to use it. In particular, 'absorptive capacity' (Cohen and Levinthal, 1990), i.e. being able to receive, interpret, and apply knowledge is pertinent here, but also other complementary skills and capacities like the background knowledge to interpret the information and knowledge exchanged, to judge the (degree of) truthfulness of the information given, and so on.

The competency to fill in knowledge gaps. Knowledge gaps created by the dispersedness of knowledge can also be dealt with by filling them in, rather than attempting to transfer the 'missing' knowledge. Egidi suggests that 'in reality, individuals ... have 'incomplete' knowledge, and they are able to complete it by *recreating its missing components'* (Egidi, 1996, p. 307; see also Nonaka and Takeuchi, 1995; Argyris, 1996; Collins and Kusch, 1998). Collins and Kusch (1998) argue that this strategy is – at least to a certain extent – applied by almost everyone in everyday life. Think about your own capacity to 'repair' spelling errors and still understand the meaning despite the misspelling. In a similar way, users of software can be counted on to systematically have certain capacities, so that the features that a software has do not have to be provided just be the software alone. The problem of integrating specialist knowledge can thus also be solved by substituting, rather than integrating, the knowledge in question. In order to be able to do that, a competence in completing incomplete knowledge is required. The higher this competence, the less knowledge is required in order for the task to be fulfilled.

Firms as integration mechanisms. In the literature known as the 'knowledge-based approach' to the theory of the firm[3], *firms* are seen as providing the integration of specialist knowledge (Grant 1996a). Firms hire specialists, they put them under the authority of a manager, and thereby integrate the knowledge these specialists hold. This literature sees firms doing so by creating the *conditions* for knowledge integration, for instance providing incentives designed to foster co-ordination between individual specialists (Grant 1996a). Providing knowledge integration is indeed taken to be the reason why firms exist. To provide the *conditions* for knowledge integration does not mean to provide knowledge integration, however. We have to ask: What are the mechanisms underlying the integration of knowledge in firms? Grant (1996) specifies the following mechanisms for integrating specialised knowledge: rules and directives, sequencing, routines, and group problem solving and decision making.

What are the mechanisms underlying these approaches to integration knowledge?

As mentioned in the introduction, our objective is understanding knowledge integration. To do so, it is helpful to understand the underlying mechanisms that do the 'work' of integration. Let us therefore scrutinize the four approaches identified above and ask how precisely they address the problem raised by the dispersedness of specialist knowledge and how they achieve knowledge integration.

Decomposition. Is decomposition a viable response to dealing with the integration of knowledge? In a decomposition or modularization approach, what is integrated is the *outcome,* the *product* of processes in which the knowledge in question has been applied. For example, a certain component of a brake system is integrated with other components to form the whole brake system. Knowledge is integrated by integrating the 'products' or 'outcomes' of the processes it was used in – but the underlying knowledge itself (for instance, the expertise and competencies of the engineers, the blueprints) is not integrated. This can easily be seen when considering who holds the knowledge underlying the competence to construct the components in question: in the case of outsourcing, the supplier holds them, while the car-maker integrates the products produced with this knowledge, but not the knowledge itself. This leads to a self-reinforcing effect: the fact that specialist knowledge is dispersed triggers a

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[3] See for instance Barney 1991, Dosi and Marengo 1994, Grant 1996a, Grant 1996b, Kogut and Zander 1992, Kogut and Zander 1993, Madhok 1996, Penrose 1959, Peteraf 1993, Spender 1996; Foss and Foss 1999 provide a good overview.

further specialisation and division of labour (possibly again including outsourcing) and thereby fuels the necessity of integrating knowledge (now specialised even more). Once a non-myopic view on the problem is taken, the secondary (i.e., indirect and long-term) effects appear to outweigh the primary (i.e., direct and short-term) effects. In other words: decomposition can only be a short-term remedy, and comes at the cost of increasing the very problem it is supposed to solve in the long term.

Substitute knowledge by access to knowledge. This approach amounts to creating communication channels for retrieving specialist knowledge. It is about facilitating the transfer or retrieval of knowledge, and thereby knowledge integration. More widely interpreted, one could subsume all measures that improve the capacity to transfer or retrieve knowledge under this approach, such as the communication capabilities in the channel (minimize all kinds of 'distortions', provide time for organization members to communicate etc.), or their 'absorptive capacity' (Cohen and Levinthal, 1990). While this in principle is beneficial for knowledge integration, it stops short of knowledge integration itself. This is because this approach creates and improves the conditions of knowledge integration, but is not about *effecting* knowledge integration itself. A communication channel still needs to be used, and in order for that to happen organization members might need to be motivated and so on. Still, putting the conditions in place is important.

The competency to fill in knowledge gaps. In this approach, the 'integrative power' is located in individuals. It is their skills that are able to deal with the fact that some parts of the specialist knowledge that would be required for fulfilling the task (such as producing a complex product, an airplane for example) are not available. Maybe the best example is the competence to 'invent around' a patent. This strategy is therefore not really about integrating knowledge, but is an alternative to it that makes it – at least apparently – unnecessary.

Firms as integration mechanisms. What are the mechanisms underlying the integration of knowledge through firms? For Kogut and Zander (1992), firms apply a set of higher-order organizing principles (i.e., organizing principles not reducable to individuals). According to Grant (1996), the organizing principles that integrate specialized knowledge are the following four:
- rules and directives,
- sequencing,

- routines,
- group problem solving and decision making.[4] Let us look at them in turn.

Rules and directives. Rules and directives work because of authority. A firm is a hierarchy based on authority. The question which employee will perform a certain task is decided not by a system of demand and supply (in which prices convey all the necessary information) to take the decisions, but by superiors who have authority over their subordinates to tell them what task to perform. The problem is that a hierarchy and its underlying mechanism, authority, in principle is not a good way to integrate specialist *knowledge* – even although it might be a good way to co-ordinate and integrate labour inputs. In the case of knowledge it is not possible to know *about* the knowledge that has to be integrated and co-ordinated for its utilisation. As Arrow has pointed out, the reason is that knowing *about* knowledge means having the knowledge – knowing about it without possessing it is impossible. Under the assumption of limited cognitive capacity (Simon 1955, 1956), the possibility of integrating knowledge in this way will therefore be subject to limits – it is not possible to at the same time have the expert knowledge of an engineer, accountant, strategist, marketer, salesman etc. In order to effectuate knowledge integration by authority, however, possessing the knowledge would be necessary, as knowing about something without possessing that knowledge is impossible. Therefore, the knowledge of an organisational unit is neither integrated in the unit manager's head nor through the unit manager's directives. This is Hayek's point (Hayek 1937; 1945; 1988). In conclusion, rules and directives do not seem to be where the 'integrative power' of firms lies, at least as regards knowledge.

Group[5] problem solving and decision making. The literature known as the 'knowledge-based approach' (KBA) identifies various mechanisms by which groups are supposed to have an influence on knowledge integration. Groups are seen to be a mechanism for integrating specialized knowledge (Grant 1996a). Furthermore, to the extent that teams are composed partly of outsiders, they are thought to offer the benefits of exposure to outside capabilities,

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[4] In another article published in the same year, Grant only identifies two mechanisms for integrating knowledge: direction and organizational routines (Grant 1996b). We stick to the more extensive list here.

[5] At this point a word is in order on the term 'group' and 'team' and their relationship. What is the difference between 'groups' and 'teams'? Is there a difference? Different authors use these terms in different meanings. For some, 'team' connotes more than 'group' (for instance Katzenbach and Smith, 1993), while for others the terms are interchangeable (for instance Guzzo and Dickson, 1996). For Katzenbach and Smith (1993), groups become teams when they develop a sense of shared commitment and strive for synergy among members. We will have more to say on a distinguishing criterion later on in the text. Until then, we will follow Guzzo and Dickson's (1996) suggestion and use the terms interchangeably.

but also to involve the costs of resources that are less specific and harder to redeploy within the firm. This points to another aspect of knowledge integration, the introduction of outside knowledge into the organization. As to the mechanisms that underlie the fulfilment of the role of groups in knowledge integration, the KBA indicates that *interaction* in groups plays an important role in knowledge integration. For instance, the accumulation of small group interactions is said to facilitate the creation of shared coding schemes within functions (Kogut and Zander 1992). Teams thus provide a shared context and shared codes. Furthermore, the internal institutional context 'team' not only acts as a coordinating device, but more fundamentally influences the values and amibitions of employees (Foss and Foss 1999).

Summing up, in our search for the mechanisms underlying the 'integrative powers' of firms with regard to knowledge, groups (teams) and the interaction within those seems to be important. This conclusion is also supported by the literature that connects teams and knowledge. A cursory literature review[6] reveals a remarkable overlap with regard to the role of teams in knowledge integration. In the integration of the various (individual) knowledge domains, shared models develop by learning from each other, and this takes time and requires speaking the same language (Walz, Elam and Curtis 1993; Paulus and Yang 2000). Such ideas are also consistent with ideas found in psychological research, a stream of research that typically focuses on individual aspects of what takes place in groups. In this literature, teams are seen as enabling a cognitive division of labor for sampling information during discussion (Stasser, Stewart and Wittenbaum 1995), and as pooling unshared (that is, dispersed) information (Steward and Stasser 1995). Teams are also seens as the 'location' where cooperative learning takes place (Janz 1999).

The literature thus supports the idea that shared (cognitive) overlap between team members plays a particularly important role for the roles of teams in knowledge integration in organizations. *Teams are an important mechanism underlying the role that firms have in knowledge integration.* The KBA states that firms have the role to integrate the specialist knowledge of its members; that one mechanism for integrating specialized knowledge are groups; and that what gets knowledge integrated within groups is *interaction*; groups provide a shared context and support the development of shared codes (which, amongst others, are

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[6] The literature review was carried out using the ProQuest database. The search terms were 'subject (knowledge) AND subject (group)' (59 entries) and 'subject (knowledge) AND subject (team)' (9 entries). The time frame was from the earliest available entries in ProQuest (before 1986) up to March 2001.

required in transfering and sharing knowledge).

Sequencing. Sequencing is a means to integrate knowledge by assigning a fixed sequence in which the 'inputs' into the common process are delivered. The sequence is what provides coordination. For example, in the case of a production line, the semi-assembled module that a part has to be integrated to already provides much information about where and how it has to be fitted. Would the sequence be different every time and the semi-assembled module not be in the same state every time when the part in question has to be assembled, coordination of the knowledge-inputs would be much more difficult. This mechanism is elegant in the sense that by arranging the steps in which the (knowledge-related) inputs to the process have to be delivered, some degree of coordination and integration is provided that comes at very low cost. On the other hand, this mechanism also stops short of entering the level of the knowledge itself – one could say that it coordinates the 'assembly' of knowledge inputs into some larger whole, but without integrating the knowledge itself (as would be the case for instance when teaching both the specialist knowledge of A and B to person C).

Routines. To the extent that certain sequences of steps are carried out recurrently, they blend into routines. In the present context, routines can therefore be seen as a more stable, more institutionalized form of sequencing. Accordingly, the mechanism by which they are able to integrate knowledge is the coordination of inputs into a process. As has been remarked, they have the ability to support complex patterns of interactions between individuals in the abssence of rules, directives, or even significant verbal communication (Grant 1996a). Importantly, routines also encompass flexibility. The sequences coordinated by routines do not always have to be exactly the same. Rather, routines can encompass a varied repertoire of responses in which individuals' moves are patterned as 'grammars of action' (Pentland and Rueter 1994).

Concluding this section, the impression gained regarding the approaches to knowledge integration and their underlying mechanisms is the following. The approaches fall into two groups: such that tackle the cause itself, and such that could be said to only tackle the symptoms. In the latter group are decomposition, substituting knowledge by access to knowledge, and the competency to fill in knowledge gaps. They all alleviate the problem of dispersed knowledge by evading it, which becomes most clear in the substitution approach. They do not tackle the problem in a way that would lead to *integration* of the dispersed

specialist knowledge itself. On the other hand, integration by firms as integration mechanisms tackles the problems raised by dispersed knowledge directly, integrating the dispersed knowledge itself. Out of the four approaches, the firm as integration mechanism is therefore the most interesting one.

Following this lead, a similar conclusion arises as to the mechanisms that underlie knowledge integration in this approach. Rules and directives seem to 'evade' the problem itself, as the principle is precisely not to convey the specialist knowledge itself (because of the costs attached to that), but to set up rules that allow a coordination of the work outputs even without the specialist knowledge. Safety rules how to handle chemicals are a case in point. Also 'evading' knowledge integration itself are sequencing and routines, to the extent that they do not effect a 'fusion' of different bodies of specialist knowledge, but only a coordination of outputs produced with that knowledge. This leaves us with *interaction* as the most interesting and promising of the mechanisms responsible for knowledge integration in firms. Note here the intermediate position of sequencing and routines. To the extent that they refer purely to coordinating the 'assembly' of inputs to a process, they are stopping short of being promising for understanding knowledge integration. Sequencing and routines can also, however, be interpreted as more precise ways to specify interaction, as mentioned above. The question is therefore what is the nature of the interaction coordinated by sequencing and routines.

Knowledge integration in practice - Some indications from case studies

The question what mechanisms are underlying knowledge integration is an empirical question. It has to be resolved – at least partly – by empirical research. What indications from practice are there?

This section reports on ten exploratory case studies of knowledge flows in customer service centers. They were carried out in customer service centers (also: 'call centers') in the Republic of Ireland in November 2000. These case studies cut across different industries, including the airline, car rental, hardware, and software industries. A total of 38 interviews were carried out across the different hierarchical levels as well as with suppliers, industry associations, and trade unions. Customer service centers are a good empirical setting to study knowledge flows. Such centers are the firm's interface with the customer. Where the customer service center is centralized and there is only one phone number for customers to dial, it might even be the

only interface between customer and firm. It is at this interface that knowledge flows between firm and customer: customers ring (or email) asking for information either directly (for example when their order will be delivered), or by requiring some problems to be solved (for instance complaining about delivery of the wrong merchandise). But they also – consciously or unconsciously – give information to their conversation partner at the other end of the phone line: this opportunity is pursued to different degrees by firms, somewhere between not at all and actively collecting as much information about the customer as possible. Likewise, the information collected is then retained and processed to different degrees and in different ways. However, the interface is crucial for the exchange of knowledge: if it is the only interface, it means that if knowledge is not exchanged here, it will not be exchanged at all. Their reputation to the contrary notwithstanding, customer service centers are a knowledge-intensive 'place'. In particular, customer service center representatives have to solve a problem of knowledge integration. Often, representatives are not experts. To the contrary, because of high labour turnover, representatives typically have a generic qualification (education) and then receive some basic training. It is them, however, where (sometimes complicated) questions from customers arrive. The customer is on hold, and the question has to be dealt with. Where the institutionalized solution is not to take the call away from the representative at this point and to route it to a specialist for answer (immediately or later, off-line), the representative has the challenge to integrate the specialist knowledge required to answer the question[7].

In the case studies, the aspect of knowledge integration that becomes visible most clearly is knowledge retrieval. This is because of the nature of customer service centers: the customers call, and a representative has to retrieve the 'missing' knowledge in order to answer. In doing so, the impression from the case studies was that interaction played an important role in this process. For instance, when asked whether teams were important for their work, a telephone representant gave the following answer.

> Oh, completely. That is so important. It's just important that, I mean ... it's quite busy, it's quite demanding, I mean people need to be able to turn over [to their colleagues] – it's a lot of products, a lot of information, and people need to be able to feel free to

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[7] Note that even in the case of an internal division of labour, i.e., of routing questions to specialists, the problem of knowledge integration is attenuated, but not solved completely. This is because the 'border' of what constitutes a problem that requires specialist knowledge is fuzzy, a situation will in tendency always arise in which the generic, standard knowledge of the representative is exhausted and she will have to draw on the (somewhat) specialized knowledge.

turn over and say 'do you know ...?', and you get that a lot, people turning over and asking people ....so it's very important from that point of view that it's a good atmosphere here and that people do not feel alone on their own dealing with customers, otherwise it would be quite difficult. (Phone representative, company A).

What seems to be going on here is that teams provide a way of retrieving knowledge, and therefore provide an important contribution to integrating knowledge. As comes through in other interviews, too, this role of teams is particularly important for newcomers. Until they have got 'up and running', newcomers can have potentially harmful effects on customers because of the little specific (e.g. product- or company-related) knowledge they have. Turnover in customer service centers is very high. Having to build up this specific knowledge is not just an exception but rather the norm. If colleagues are always willing to 'turn around' and help a new colleague, this makes a big difference – not just for the atmosphere in the team, but more importantly for shortening the time required for new team members to get 'up to speed', for decreasing the risk of negative customer experience because of a lack of knowledge on part of new hires, for the level of 'knowledgeability' of phone representatives and for the speed of access to knowledge.

One could object that transferring, or retrieving, knowledge could be sped up by means of appropriate database infrastructures. Somewhat surprisingly maybe, the case studies indicate that this does not seem to be as effective as direct inter-personal contact. Consider the following quote of a phone representative:

> ... we also help each other, in particular those that have been around longer. For example, when there are questions about customs, I mean, there are countries where questions are quite infrequent, and then – I mean, of course we have the systems to look it up – but if it has to be really quick ... (Phone representative, company B).

Although all the systems and databases are in place, *if it has to be really quick staff do not use them!* And mind you, in a customer service center environment, it always has to be quick: the customer is on the phone, you might put her on hold, and you might have 10 seconds to find something, but not even one minute. Time literally is counting by the second, rather than the minute. On top of that, in many customer service centers a fixed number of calls have to be made every day. This target is controlled and enforced, for example by being linked to

rewards and remuneration. Speed is therefore crucial. Why is using the system too slow, even despite the high computing speed available today? It seems that asking your colleagues simply is simply *faster* than looking something up in a database. To inquite into the reasons for that seems an interesting research topic in itself.

The case studies therefore indicate that teams and the interaction in teams play important roles in knowledge transfer and retrieval, and therefore in core processes of knowledge integration, confirming the impression emerging from the literature review. Regarding the level of mechanisms underlying this role, the case studies further indicate that interaction is indeed involved and crucial. The selected interview quotes illustrate what is underlying the capacity to get knowledge to someone who has to answer a question of a customer who is on hold – by 'turning around' to her colleagues, that is, by interaction within the team. The case studies thus support the idea emerging from the literature review that interaction is underlying knowledge transfer and retrieval – and thereby knowledge integration – in teams.

This point is not always perceived, however. Consider the following quote by a call center manager:

> People always talk about teamwork, but there is not a huge amount of interdependency. ... When you're in this job, you're one on one on the call, you're really your own boss. Your supervisor can help you, but you're not gonna really deal with three or four people in a chain to deal with one customer. You deal with the customer. It's a one-stop shop. (Customer service center manager, company C).

Contrast this with the following quote by a team leader:

> No person here can work as an island. (Team leader, company D).

For some managers, however, teams are just an administrative solution for a large-number problem.

> Because there are so many people we break it down into teams, and we have team leaders, to make it more manageable, to motivate the staff, to get performance out of them, and give the phone representative a point of reference, a contact ... they build up

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a relationship with these people, instead of a relationship with more people (Customer service center manager, company E).

Moreover, in company C, that is, the one of the customer service center manager quoted above, we actually spent some time sitting with a telephone representative, listening to phone conversations. Almost every single call during that time involved interaction with team members, either using a chat system, email, or 'turning over'. This is an impressive example of how management can come to neglect knowledge flows in firms. One gets the impression that managers mainly perceive the 'external' aspects of teams; for example, teams are used for measuring performance because in some cases it is difficult to account for individual efforts. When that is done, managers perceive just the one team instead of the 12 persons that constitute it; they will take a perspective on the outside of the team (what it produces) – not the inside (how it does so). This is the team leader's responsibility. Each team becomes 'visible' only as team, the persons constituting it retreating into the background. Of course, this is a basic phenomenon of hierarchies. By definition, hierarchical levels are also aggregations of underlying levels, and the working principle is precisely that a higher hierarchical level does not have to engage with all the details of the lower level. It is important to note, however, that in the customer service center cases, this aggregation also involves a further difference: when managers take a perspective on the outside of teams, they focus on results, on performance. They abstract from what goes on *inside* the team. They abstract from the *processes* that lead to the results. As it turns out, this is what matters from a knowledge-management perspective. Therefore, the managers of company C in fact overlooks the knowledge-related aspects of teams.

In conclusion, the case studies leave us with support for the idea *interaction holds a central key* to understanding knowledge integration.

A sociological perspective on knowledge integration

Section two, scrutinizing the different approaches to knowledge integration, identified teams and interaction as the most interesting mechanisms underlying knowledge integration. Most of the other approaches were addressing knowledge integration not directly, but rather indirectly, by its symptoms. In section four, this impression received (at least illustrative)

support from case studies. At least in a customer service center setting, this idea appears plausible. We therefore focus the analysis of the mechanisms underlying knowledge integration on teams and the interaction within (and possibly across) teams.

It turns out that basing the analysis of knowledge integration in teams and the interaction within teams also can be put on a solid fundament: a sociological fundament. In sociology, groups are defined by interaction between its members. The implication is crucially important for understanding knowledge integration: if interaction is, as we have argued above, indeed important for knowledge integration, then with a definition of teams that is not based on social interaction, much of what is important for knowledge integration slips through the fingers of the analyst.

The importance of interaction in sociology goes back at least to Émile Durkheim and Max Weber, the founding fathers of sociology[8]. It finds a very clear expression in the works of Charles H. Cooley and George C. Homans, which we draw on in this section. In one of his later works, Cooley established a link between the development of knowledge and communication (interaction[9]). He there distinguished two types of knowledge, 'personal' or 'social' knowledge and 'spatial' or 'material' knowledge. The latter kind of knowledge is knowledge of things, and is developed out of 'sense contacts' (Cooley 1926). For example, sight gives knowledge about the shape of a cup, tactile perception gives knowledge about its surface, and so on. 'Personal' or 'social' knowledge, on the other hand, is knowledge that enables us to understand other people. The way in which this is achieved is by sharing states of mind (Cooley 1926). What is crucially important for 'personal' or 'social' knowledge is that it is developed from contact with the minds of other people. Such contact with the minds of other people takes place in communication, or more generally, in interaction. Therefore, interaction can be seen as a prerequisite for the development of 'personal' or 'social' knowledge. Cooley also provides us with a more specific understanding of interaction. Two characteristics of interaction shall be pointed out here. First, interaction (or 'communication') does not have to be 'actual' interaction in the sense that it takes place in the same point of time, as for example when two persons have a conversation at a table. For Cooley, interaction

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[8] The importance that Weber gave to taking into account others in one's actions – including, but not being limited to interaction – is explained well in Swedberg (1998), ch. 2.

[9] Developing Cooley further, Homans later expressed the relationship between interaction and communication as follows: 'interaction' includes both verbal and nonverbal communication, that is, it is wider than the term 'communication' (Homans 1950). Important about interaction is that it also means that stimuli are involved: Interaction means that 'some unit of activity of one man follows, or, if we like the word better, is stimulated by some unit of activity of another' (Homans 1950, 36).

leading to 'social' knowledge could also include reading a historical text. If I read Aristotle, I am in interaction with Aristotle's ideas (Cooley 1897). In fact, *all* influences reaching a person from another person qualify as interaction capable of leading to 'social' knowledge. Second, interaction does not have to be physical interaction but could also be imaginative interaction: 'It is not to be inferred that we must go through the same visible and tangible experiences as other people before we can sympathize with them. ... Social experience is a matter of imaginative, not of material contacts' (Cooley 1902, 95).

For Cooley, interaction was therefore central for the definition of groups. Later, the idea was carried on and expressed in even stronger form by Homans. For him, groups are defined by interaction (Homans 1947, 17):

> The only essential criterion is the interaction of members with one another (Homans 1974, 95).

Homans also developed more precise criteria: that the team members interact with each other often, and that they do so face-to-face (or at least they have the possibility to do so). These two conditions translate into a small team size:

> ... a number of persons who communicate with one another often over a span of time, and who are few enough so that each person is able to communicate with all the others, not at secondhand, through other people, but face-to-face (Homans 1950, 1).

Later, Homans added further precision to this condition. In a group, members are to be in contact with each other more often than with outsiders.

> ... a small group ... a number of persons, defined as its members, participate in a closed network, when during a given period of time ... each of its members is in contact with each of the others more often than he is with outsiders, or at least is able to be thus in contact (Homans 1974, 4).

This very strong emphasis of interaction as the defining characteristic of groups in sociology supports the idea to base an analysis of knowledge integration on analyzing interaction.

Cooley's and Homans's notion of interaction is also consistent with what we know from empirical findings. It is not only possible to get an idea – to learn something – from a book, to be inspired by it and to connect it with other knowledge held already. Learning from books and other written documents is also a very important and common mechanism for transferring knowledge and for learning. The qualification of the notion of interaction as made above therefore is important. By including interaction between not temporally co-located interaction partners, as well as mental, not physical, interaction, we are provided with an analytical perspective that is consistent with what we know from empirical studies, and that seems to allow us to capture the gist of the phenomenon in question here, the use, transfer, retention, creation of knowledge. Note that if the notion of interaction includes solely physical interaction at the same point of time (as for example in the transaction cost economics definition of a transaction as occuring 'when a good or service is transferred across a technologically separable interface', Williamson 1985, p. 1) many phenomena – and in particular many phenomena related to knowledge – will be outside the theoretical reach of the theory built on this notion. It is therefore crucial to adopt a wider, more encompassing notion of interaction, like the one presented above. The advantage of such a move is that it builds on a solid sociological fundament.

Communities of practice

Having first analysed what the problem of knowledge integration consists in, how it can be approached, and what mechanisms are underlying the approaches, and second, having supplied an empirical and a conceptual anchoring to our understanding, we now turn towards the question how to use this in analysing knowledge integration. This section proposes the level of analysis most helpful for analysing knowledge integration. What is a good level of analysis for capturing interaction within groups? In this section, we argue that the notion of 'community of practice' provides an appropriate level of analysis for purposes of analyzing knowledge integration, because a community of practice is defined based on the interaction of its members – much more clearly than are many definitions of teams or definitions of groups that are not firmly grounded in sociology.

The originators of the notion 'community of practice', Lave and Wenger, define a community of practice as 'an activity system about which participants share understanding concerning what they are doing and what that means in their lives and for their community. Thus, they are

united in both action and in the meaning that that action has, both for themselves and for the larger collective' (Lave and Wenger 1991, 98). Since the original formulation, communities of practices have been varyingly defined based on the following criteria, of which different authors choose different combinations[10].

- *Regularity* of interaction between members of the community of practice, for example sharing and learning (Lesser and Storck 2001).

- *Goals* are set by members. In contrast, the goals of teams are often established by people not on the team. (Lesser and Storck 2001).

- *Members have common overlaps both in action and in cognitive frameworks* (Lave and Wenger 1991; Wenger and Snyder 2000).

- *Communities are only responsible to their members*, while teams are often responsible and reporting to someone not on the team. (cf. Lesser and Storck 2001).

- *Membership is voluntary.* Membership in teams, on the other hand, often is assigned by authority (cf. Lesser and Storck 2001).

- *Authority relationships are emergent.* Authority relationships within teams, however, are organizationally determined. Authority relationships in a community of practice emerge through interaction around expertise (Lesser and Storck 2001).

- *Legitimization through interaction, not formal roles.* In a team, legitimizing occurs principally through the assignment of formal roles and relationships (i.e., team membership and structure are defined external to the team). Members of a community of practice establish their legitimacy through interaction about their practice (Lesser and Storck 2001).

- *Processes defined from the inside.* Teams rely on work and reporting processes that are organizationally defined. Communities develop their own processes (Lesser and Storck 2001).

- *Relationships are emergent, not formal.* Team relationships are established when the organization assigns people to be team members. Community relationships are formed around practice. (Brown and Duguid 1991)

- *Communities of practice evolve, they are not created.* They are not a form of formal structure, like a team or a department (Brown and Duguid 1991; Liedtka 1999).

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[10] ProQuest database, 'community of practice' and 'communities of practice' in the body of the abstract. The search was carried out in February 2002.

- *They are often not bounded and not recognized by the organization*, as opposed to groups as bounded entities that lie within an organization and that are organized or at least sanctioned by that organization and its view of tasks (Brown and Duguid 1991).

In the literature on communities of practice, communities of practice are primarily linked to knowledge creation, knowledge transfer, knowledge retention, and knowledge acquisition/learning. Brown and Duguid, for instance, hold that 'a great deal of knowledge is both produced and held collectively (Brown and Duguid 1998, 91). Such knowledge is readily generated when people work together in 'communities of practice' (cf. also Lesser and Storck 2001). At the same time, 'community of practice' also denotes a group across which such know-how and sensemaking are shared (Brown and Duguid 1998). They are also able to decrease the learning curve of new employees (Lesser and Storck 2001). Finally, communities of practice also appear to be a means of developing and maintaining long-term organizational memory (Lesser and Storck 2001).

Communities of practice therefore are credited with playing a role in processes that feed into knowledge integration. At the same time, as opposed to teams, communities of practice are thus characterized by being more informal, emerging, and based on shared elements (context, activity, objectives, mindset) between its members. Considering the importance of tacit knowledge in organizations, their informal and emerging character strongly suggests that they might well be more adequate for understanding knowledge integration because they are able to capture a richer picture of knowledge flows, and because they trace the interaction more closely than other constructs do.

'Recurrent interaction patterns' as the focus of analysing knowledge integration

So far, the paper has argued for basing the analysis of knowledge integration on the social interaction-based level of analysis. Communities of practice have been advanced as the notion closest to such a level of analysis. Can we focus even more on interaction? The challenge is to attempt to empirically capture interaction in the most comprehensive way, and to analytically penetrate it as deeply as possible.

The argument for how to empirically capture interaction in the most comprehensive way is a simple one. That interaction that is *repeated most often* is the one that characterizes the

organization to the highest degree. It is what is typical, what is usually taking place. It is what represents the bulk of organizational activity. If one captures that interaction, which is repeated most frequently, one captures what characterizes the organization *as an actor*. For instance, one captures a large multinational with a strong brand *as constantly reinforcing its brand image through the activities of its marketing department*, or captures the fact that a car manufacturer has a high reputation for quality *as the constant (i.e., frequently repeated) interaction in quality circles and other forms of interaction focused on upholding and improving quality*. The advantage of such a perspective is that one has a dynamic analytical perspective on phenomena like brands and reputation (or corporate culture or 'knowledge management'). It allows us to understand the organization as a bundle of processes. Such a dynamic perspective then allows to draw on analytical frameworks that have a good chance of covering angles not covered in the frameworks used so far. More on this below when we approach the second question, that of analytical penetration. The proposal is therefore simply to concentrate on analyzing those interactions that are recurring frequently. Frequently recurring interaction typically forms patterns. Some aspect of the interaction stays invariant over the recurrences. The same participants or the holders of the same formal positions participate in meetings, or the interaction follows the same sequences (cf. the notion of 'scripts'), to give just two illustrations. The recurrent interactions are recognizable as patterns. We can therefore usefully term them '*recurrent interaction patterns*'.

At this point, we would like to come back to section three. There, we noted that Grant (1996) identified four organizational mechanisms for integrating specialized knowledge: rules and directives, sequencing, routines, and group problem solving and decision making. In our understanding of communities of practice defined by interaction – which in turn can be captured as recurrent interaction patterns – the connection between Grant's sequencing, routines, and group problem solving and decision making comes out nicely now. 'Group problem solving and decision making' refers to interaction in a community of practice, in our terms. This is best captured focusing on recurrent interaction patterns, a term that captures (and also specifies more closely) what is often connoted with the term 'routines' (see below). Recurrent interaction patterns being patterns of interaction over time, they involve sequences. In our interpretation, the four mechanisms listed by Grant therefore fall into two groups of constructs that can be used to empirically capture them: rules and directives, and recurrent interaction patterns. While the former has been dealt with extensively in the context of

knowledge integration, the latter one seems to bear some as yet not completely exhausted potential.

We now turn to the second question, 'How to analytically penetrate interaction as deeply as possible, in order to understand knowledge integration?' In the previous paragraph, we just mentioned that recurrent interaction patterns capture what is often connoted with the term 'routines'. In a systematic way, this term has appeared in the social sciences in the 1920s, partly driven by the Scientific Management movement (see Becker 2002 forthcoming). Broad attention has been drawn to it by Sidney G. Winter and Richard R. Nelson in their 1982 book 'An Evolutionary Theory of Economic Change' (Nelson and Winter 1982). Since then, the notion of organizational routines has inspired several streams of literature, amongst which evolutionary economics and organizational theory. Now, one of the problems with the term 'routines' is that different authors use it in different ways, namely to refer to the level of action (routines as recurrent interaction patterns or recurrent activity patterns), or to the cognitive level (routines as rules). This conflation of levels is a problem that plagues the term 'routine' and is the source of some confusion. It is therefore preferable to distinguish the two levels and use more precise labels for them. Obviously, the term 'recurrent interaction patterns' refers to the level of action. However, this weakness of the concept as such also bears some attraction in the present context. Namely, if recurrent interaction patterns are *one part* of what has been called 'routines', then there might well be some kind of systematic connection between that part and the other part – the action level and the cognitive level – a connection that the literature employing the term 'routines' might have something to say about. By specifying that we talk of recurrent interaction patterns (the 'action level' aspects of routines), we can then draw on the body of 'routines' literature and use what it has to say on the link between the action level and the cognitive level. It can serve as a framework for conceptualizing and understanding the link between interaction and cognitive processes. This is work yet to be done, however.

Conclusion and implications for further research

This paper has attempted to anchor the problem raised by the dispersedness of specialist knowledge – the task of knowledge integration – more firmly in the agenda of managers and management researchers. Assuming that specialization and division of labour still are major

driving forces for efficiency improvements, the problem of the dispersedness of specialist knowledge and the task of knowledge integration supposedly should be of paramount importance. Often, however, both managers as well as management researchers seem to have awarded this problem not as much attention as it would command.

In scrutinizing possible approaches to the problem raised by dispersed knowledge, and then the mechanisms underlying these approaches, i.e. what leads to the integration of knowledge, a pattern can be detected. In both cases, one group of approaches, resp. mechanisms, tackles the causes, while the other group tackles the symptoms. As for the approaches, decomposition, substituting knowledge by access to knowledge, and the competency to fill in knowledge gaps all alleviate the problem of dispersed knowledge by evading it, by getting 'around' it. They do not tackle the problem in a way that would lead to *integration* of the dispersed specialist knowledge in the sense of a fusion of different bodies of specialist knowledge. Only firms as integration mechanisms, i.e. mainly by providing the conditions for knowledge integration, tackle the problems raised by dispersed knowledge directly by knowledge integration. It is therefore this latter approach that seems most interesting for analysing knowledge integration.

As for the mechanisms underlying firms as knowledge integration mechanisms, the same pattern shows up again: of the mechanisms underlying knowledge integration by firms, rules and directives seem to 'evade' the problem – in fact, the decomposition approach is applied here, and the problem gets 'solved' by decreasing the span of control (and thus another hierarchical layer), but has the implication of further increasing specialisation and the division of labour. To the extent that they do not effect a 'fusion' of different bodies of specialist knowledge, but only a coordination of outputs produced with that knowledge, sequencing and routines are also stopping short of knowledge integration.

On the other hand, interaction seems to be the underlying mechanism responsible for knowledge integration. In particular, interaction within communities of practice seems to be relevant here, but also interaction between communities of practice should not be left out of consideration. It is thus this trail to interaction and interaction-based groups or communities that holds most promise for the analysis of knowledge integration. This is a non-trivial result, as it is not obvious that the most 'powerful' way to integrate knowledge should be by

interaction.[11] It is also a call for anchoring the analysis of knowledge integration in a sociological fundament, that is, in focussing the analys on interaction. The notion of 'community of practice' has been proposed as the one that lends itself as the easiest entry point for this purpose.

Focussing even more firmly on interaction, the notion of 'recurrent interaction patterns' has been proposed. The notions of sequencing and routines already pointed in that direction. Sequencing and routines can be interpreted as more precise ways to specify interaction (interaction sequences, recurrent interaction). The notion of 'recurrent interaction patterns' is specifying them more precisely. Note how this notion at the same time is practical and potentially fruitful. It is practical because it is an easy way to get access to the processes that characterise an organization[12]. All that is needed is to document those interactions that recur most often. It is potentially fruitful because by starting the analysis there, one starts scrutinizing that approach and that underlying mechanism to knowledge integration, which tackles the problem itself, and one does not analyse an approach and an underlying mechanism that is evading the problem. Furthermore, it is fruitful because it is anchored in sociology and it can draw on the literature on and employing the concept of 'routines' – with the additional benefit that 'recurrent interaction patterns' clearly refer to the action-level of routines (as opposed to the cognitive level), so that, rather than conflating recurrent interaction patterns and routines, the notion of recurrent interaction patterns gives guidance of what to take over from the routines literature.

This work is still to be done. Very first attempts to apply the line of thinking presented in this paper to empirical contexts have been started (Becker and Zirpoli 2002), and much refinement and enlarging still needs to be done. The contribution of this paper is in focussing efforts in understanding knowledge integration on interaction, and in particular guiding them to communities of practice and recurrent interaction patterns. The next steps along this road are spelling out what analytical power can be drawn from the routines literature, and applying the approach presented here to empirical contexts, thus sharpening it.

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[11] Note that interaction *obviously* is of central importance for other knowledge flows, in particular knowledge transfer and retrieval. This makes the case for focussing on interaction not only in analysing knowledge integration, but also other knowledge flows.

[12] It is much easier to operationalize 'recurrent interaction patterns' than 'routines', a notion that is plagued in particular by problems in operationalization.

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