Knowledge Transfer: Short-circuiting the learning cycle?

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Abstract
Knowledge is considered to be a key organizational resource in the 21st century and the knowledge management 'movement' has alerted organizations to the fact that they should more strategically exploit their knowledge assets. Companies are thus lured by the suggestion that they can gain competitive advantage by the more astute management of their knowledge base and in particular, by the transfer of knowledge across individuals, groups and organizational units, using IT to accomplish this. In this paper, we reflect on this common view of knowledge transfer. More specifically, we question an implication of this view - essentially the possibility of short-circuiting the learning cycle, so that individuals do not have to rely on their personal or shared experiences to identify better practices, but can learn from the codified lessons of others through IT systems. More importantly, we consider the characteristics of knowledge – that knowledge is distributed, ambiguous and disruptive – that makes its transfer highly problematic. We conclude by considering ways of overcoming these barriers by emphasizing the importance of social systems alongside technical systems.

1. Introduction

Knowledge is considered to be a key organizational resource in the 21st century and the knowledge management 'movement' has alerted organizations to the fact that they could more strategically exploit this knowledge [15, 19]. In particular, individual experts could be encouraged to write down what they know and pass this on to more novice employees in 'how to' type manuals; project teams could review what they have learnt during the project and capture this in a 'lessons learned' document to pass on to other project teams [31]; and at the organizational level, 'best practices' could be identified that can be transferred across business units, either within a larger corporate enterprise or across firms in the form of best practice templates, for example embedded in software designs [11]. Companies are thus lured by the suggestion that they can gain competitive advantage by the more astute management of their knowledge base and in particular, by the transfer of knowledge across individuals, groups and organizational units. So how-to documents, lessons learned, and best practices should be written down and stored on databases so that they are made available for others to apply.

From this perspective, the focus is on the exploitation of knowledge, as opposed to the exploration of knowledge [23]. The exploration of knowledge refers to activities that are directed at creating new knowledge, for example new knowledge that can facilitate the development of new products, services of organizational arrangements. Exploitation, on the other hand, refers to activities that are directed at using and reusing knowledge that already exists, for example in terms of sharing established best practices. The exploration of knowledge is important since this creates the new ideas, practices and lessons that need to be shared. However, the focus in much of the knowledge management literature, especially in the IS domain, is the exploitation of existing knowledge and more specifically the transfer of this knowledge across people, times and places [17, 33, 34], utilizing IT. Nevertheless, knowledge transfer is often problematic and the purpose of this paper is to explore the characteristics of knowledge that make its transfer difficult and to identify the technical and social mechanisms that are needed to support knowledge transfer in different contexts. In exploring these issues, we draw on learning theory and relate this to knowledge transfer.

2. Knowledge Transfer and Learning

Knowledge and learning are intimately connected in the sense that knowledge is the product of learning. We can learn about something and so acquire explicit knowledge or we can learn to do something and so accumulate tacit knowledge. Explicit knowledge, thus, refers to knowledge that has been codified in some form, as opposed to tacit knowledge that is established through

practice and remains situated in the mind and body of the knower [10]. In practice, learning, at least in the applied sense of gaining expertise to be able to do something that one could not do previously, involves both learning about (mental processing or cognitive learning) and learning to do (practice-based or behavioural learning). This can be illustrated by considering Kolb's [20] learning cycle framework, which identifies the set of processes (concrete experiences, observational reflection, abstract conceptualization, active experimentation) that have to be gone through in order for learning to be established.

Any one of these processes can be the starting point for the learning cycle according to Kolb [20], but to illustrate we can begin with concrete experiences, taking as an example a project team learning through working together for a period of time. The team engages in some activities together (concrete experiences) [20]. Then, at a particular milestone, they can observe what has been achieved and reflect upon why certain objectives were not achieved or not achieved to the standards required (observational reflection) [20]. They can then develop hypotheses (abstract conceptualization) [20] to explain poor performance – for example, the team can decide that they did not spend enough time at the start of the project on team-building so that there was a lack of trust between team members, leading to insufficient coordination and a breakdown in communication. Team members can then try to build these trust relationships (active experimentation) [20] through different types of team-building exercises. If this still does not work they will need to develop new hypotheses and test these (i.e., iterate through the learning cycle). However, if the team-building appears to have facilitated improved communication and coordination the learning cycle is complete, since they have learnt how to improve team coordination.

The learning cycle, thus, emphasizes that there is both behavioural/practice-based and mental processing/cognitive work involved in learning [18]. Thus, from a behavioural perspective we can learn from our actual experiences (concrete experience) and experiment and practice to find out what works best (active experimentation) [20]. This kind of trial-and-error learning was emphasized traditionally by the behavioural school of learning, for example with Skinner's [34] operant conditioning theory. More recently the situated learning theory of Lave and Wenger [21] also emphasizes situated practice and feedback from that practice. At the same time, we can learn in a more cognitive way than simply trial-and-error so that we make sense of our experiences without having to try out each variant until we find the solution that works best. Thus, we can engage in observational reflection of our experiences and come up with abstract conceptualizations that help to make sense of these experiences. The cognitive school has emphasized this aspect of learning [29]. The learning cycle suggests that learning requires both situated practice and mental processing to be effective [20]. In a managerial sense, literature on the 'reflective practitioner', for example by Watson [43] or on reflective team practices, by Ayas and Zeniuk [3], attests to the importance of both situated practice and mental processing.

Once a person, group or organization has iterated through the four processes of the learning cycle, they will have acquired new knowledge. The point of interest in this paper is to consider what the concept of knowledge transfer implies in relation to this learning cycle. Taking our team learning example, knowledge transfer suggests that the team can make their knowledge about the importance of team building at project onset explicit as a set of recommendations (essentially the codification of their abstract conceptualization that they have found to be effective through active experimentation [20]) and transfer this to other teams who will then be able to learn about the importance of team building without having to go through the learning cycle. Other teams could, therefore, learn from the set of recommendations and so not have to go through the actual experience of working in teams where there was a lack of trust because of ineffective team-building. In other words, from the knowledge transfer perspective that we are questioning in this paper, abstract conceptualizations can be codified and transferred to others so that these others need neither to engage in situated practice or mental processing, but can simply follow instructions – the manual, advice on lessons learned, or the best practice template. Knowledge transfer or knowledge exploitation thus suggests that each individual/group/organizational unit need not learn from scratch but rather can learn from the experiences of others. In other words, knowledge transfer implies that it is possible to short-circuit the learning cycle.

While this idea of knowledge transfer is prevalent in both the academic and the practitioner literature, here, we emphasize the limitations of this view by identifying the characteristics of knowledge that make its transfer more problematic than is often assumed. Literature does exist that recognizes the problem of knowledge transfer. For example, Szulanski [36] talks about knowledge being 'sticky'. This is often ignored in the more prescriptive literature, however. Moreover, the reasons why knowledge is 'sticky' have not been fully explored. In this paper we suggest that by recognizing the characteristics of knowledge that make its transfer problematic, we will be in a better position to design socio-technical systems that can support the effective sharing of, and learning from, others' experience. To build the case for this, we use some examples from a

study of cross-project learning (sponsored by a UK research council), supplemented with other examples from previous studies.

3. Methodology

The main empirical study from which the examples are drawn was an exploratory, qualitative investigation of 13 unrelated projects across 6 UK organizations, operating in different sectors (health care, public services, utilities, automotive, construction, and bioseciences). It was aimed at understanding the processes by which project-based knowledge and learning is created and transferred in organizations in different industrial sectors. Each organization selected for the study had been operating for at least 30 years and on average employed over 50,000 people. The unit of analysis was the project. The study used interviewing techniques better to understand the ways in which projects transfer knowledge and lessons learnt to other like groups within the firm. Interviewing was chosen because of a need to be sensitive to the context in which knowledge and knowledge transfer is based [2, 36]. The limits to generalizability of research involving a small set of cases are well documented. However, the value of the methodology lies in its ability to provide rich insights and to provide directions for future inquiries. Given limitations of space, we do not provide detailed accounts of each case but instead select one of the cases and then use 'vignettes' that provide us with the clearest example of the particular issue or the most contrast. This approach has been used by others to good effect [27, 42].

In each organization, two specific projects were chosen as the focus of our investigation (in one company data were collected from three). Projects were chosen by the organization, based on guidelines set by the research team. Since we were interested in generic project-based learning issues, we asked each organization to provide us with a 'typical' project. We also recognized the difficulties in comparing projects at different phases of their life cycle [22], and so we requested a mature project. Individual interviews were held with the various project managers and project team members for focal projects. Team members had different roles and responsibilities, thereby providing a broad perspective on project-based learning and cross-project knowledge transfer for that team. In total, 137 interviews were carried out over a two-year period. Interviews averaged one hour and fifteen minutes. Where available, archival project documentation – e.g. project process charts and minutes from previous project meetings – were collected.

At each interview, the researcher gave a brief example of knowledge transfer to help the respondent understand the phenomenon of interest. Interviews followed a pre-designed interview protocol that included questions about the facilitators and barriers to knowledge transfer among project teams. Questions in the interview protocol were developed based on a detailed review of the knowledge transfer and learning literature and on issues raised at a workshop in which senior managers from each company discussed cross-project knowledge transfer. As is typical in inductive studies, analysis was an iterative process in which the data were constantly revisited [13]. In this paper we use Kolb's learning cycle framework [20] as an organizing framework for this analysis. To aid in data consistency, the interview data was initially coded based on a coding scheme developed by the research team using NVivo. Data coding involved the research team searching the data for regularities and patterns and then recording these key words and phrases to represent topics or themes which became the categories for further study [5]. Within each category, if inconsistencies occurred among the collected data , third party sources were consulted for clarification. Triangulation across the different sources of primary and archival data revealed a high level of data consistency. On completion, each case study was re-analyzed to develop the conceptual insights presented here. While there were no hypotheses a-priori, patterns emerged from the data reflecting the barriers and facilitators to the transfer of project-based knowledge using ICT.

4. A Case Illustrating the Problem of Knowledge Transfer

4.1 Case Description

A project was set up in a UK NHS Trust Hospital to improve the process of diagnosing and treating cataracts [25]. In most NHS trusts, including the Trust Hospital prior to the implementation of the process improvement project described below, cataract diagnosis and treatment involves a patient in a number of visits to various specialists. Typically, patients begin with an optician because they believe that deteriorating eye-sight suggests they need new glasses/contact lenses. However, let us assume that the optician diagnoses that the problem is actually cataracts (a dirty film that forms over the lens of the eye that impairs vision, requiring the replacement of the lens with an artificial one in a relatively simple operation), the optician will then refer the patient to his or her general practitioner (GP). After a visit to the GP who, not being an eye specialist, generally relies on the diagnosis of the optician, the patient is referred to the hospital consultant for further examination. The patient then goes on a waiting list and is eventually called for a brief meeting with the consultant, who usually confirms the optician's diagnosis, and, in a separate appointment, the patient meets with the hospital nurse for a physical examination. Only when all of these visits are complete

will the patient get in the queue for a date for surgery. In many UK hospitals, the lead-time for cataract surgery is over 12 months. Post-surgery, another visit to the consultant is scheduled to check on the patient and then the patient is referred back to the optician for a new pair of glasses or contact lenses. Therefore, it takes patients at least six visits and often well over a year to have a routine, 20-minute, outpatient, surgical procedure.

Given the complexity and long-drawn out nature of this existing process, a new reengineered cataract diagnostic and treatment practice was seen in Trust Hospital as potentially beneficial. To facilitate that change, a member of the hospital's transformation team was assigned to explore opportunities for process reengineering. The transformation team member gathered a team of eye experts from both the hospital and the community to discuss ways in which to cut surgery lead times and improve patient satisfaction. Members of the cataract project team included the head nurse in the eye unit, a hospital administrator, GPs, a number of opticians from the local community, and a surgical consultant who was instrumental in championing the need for change and in leading the change process. Team meetings were held in the evening to facilitate attendance, and were led by the transformation team member. Minutes, flow charts and other necessary documentation for the process, were produced by the transformation team member, and distributed to all team members after each meeting. In total, approximately five team meetings were held over a six-month period.

A number of changes to the existing practice were made. Non-essential visits to the GP; the consultant and the nurse were eliminated. Instead, opticians were empowered to decide whether a patient needed cataract surgery. In doing so, they are required to fill out a detailed form that provides the consultant with specific information about the nature and severity of the cataract, and to call the hospital and book a time for the patient's surgery. For their additional responsibility, the opticians are given some extra training and receive a small amount of compensation from Trust Hospital. The preliminary pre-operation physical was replaced with a self-diagnostic questionnaire that each patient is required to complete and return to the hospital before surgery. Nurses telephone each patient before surgery to check the patient's details and answer any questions. Post-operation consultant appointments were also replaced with follow-up telephone calls.

The new cataract procedure has resulted in a number of efficiency gains. Lead times have been radically reduced from over 12 months down to six to eight weeks. In addition, theatre utilization rates have improved due to the addition of an administrator whose sole responsibility is scheduling. Finally, and most importantly, according to follow-up phone conversations with cataract patients, patient satisfaction has improved dramatically. The new cataract procedure can, therefore, clearly be seen as at least 'better practice'. The new 'best practice' has been written-up and presented to other NHS hospitals but knowledge transfer has not been successful, with those in other hospitals dismissing it as "unworkable".

4.2 Case Analysis

From a learning cycle perspective [20], the cataract project team went through each phase of the cycle: they recognized that patients were dissatisfied with the existing process (concrete experience), reflected on why this was the case (observational reflection), came up with a new process that would reduce these problems (abstract conceptualization), and successfully implemented the new process (active experimentation) to the satisfaction of patients and everyone else involved. However, they were not able to transfer their new practice, as a set of recommendations to improve the service – to allow opticians to diagnose and patients to self-examine – to other hospital groups.

How do we explain this? The process of reengineering the cataract diagnostic and treatment procedure entailed members of the project team developing a holistic understanding of the procedure so that each professional group was aware of and understood the knowledge and capabilities of others involved with different aspects of the procedure. For example, one of the opticians who had been involved in the project from the outset explained how his changed role allowed him to diagnose and directly refer patients. However, he also explained that this process was not entirely straightforward, and had been particularly difficult at the beginning of the pilot phase. He stated that at times he had needed to clarify issues with the consultant in order to ensure that a particular patient was actually suitable for the cataract operation. With many consultants, this would be very difficult because they undervalued the knowledge of opticians:

> "When patients eventually find their way to hospital any comment that the optician has made that is relayed to the hospital staff is usually treated with contempt – 'what do they know about it', that sort of attitude" (project team member).

Prior to setting up the project team, each professional had known only about their small part in the procedure and had known little about the knowledge and expertise of others. Creating this holistic knowledge was only possible through bringing together a number of individuals with different knowledge and understanding who were willing to share their largely tacit knowledge in order to generate new knowledge. Bringing together

individuals from different professional backgrounds was necessary in order that each group member could understand and appreciate the skills and capabilities of other groups. Without this collective activity, the knowledge and understanding of the different groups would have remained unconnected and isolated, and preconceived notions of the limits of the professional competence of others would not have been challenged.

Through working together on the project and sharing professional knowledge, the consultants involved had learnt to respect and trust the competencies of opticians, and the GPs and nurses had learnt to respect and trust that patients could self-diagnose. Moreover, the building of relationships, facilitated by membership in the project, meant that now an optician could telephone a consultant working at the hospital and directly ask his/her advice. The consultants were providing regular feedback to the opticians, so that the opticians could continue to learn how to make diagnoses that were acceptable to the consultants. Thus, an important outcome from involvement in the cataract project team had been the creation of a community of practice [7], in which shared meaning was being continuously constructed through a process of narration and joint work. Essentially, through interactions that occurred during the process of redesigning the cataract practice, the landscape of social relations had been changed. In the absence of this holistic generation of knowledge and of these changed relationships, the templates and the new practice are likely to make little sense. This explains why it was not possible to transfer the templates and knowledge of the new diagnostic and treatment process to other contexts, where this knowledge generation process had not taken place; barriers between the professional groups involved still exist elsewhere.

5. Characteristics of Knowledge that make its Transfer Problematic

What does this case tell us about the characteristics of knowledge that makes knowledge transfer problematic? There are three key characteristics that appear to be important – that knowledge is distributed, that knowledge is ambiguous, and that knowledge is potentially disruptive. Each of these is discussed next.

5.1 Knowledge is Distributed

In terms of the distribution of knowledge, the point here is that any given business process will usually involve multiple actors, each engaged in an aspect of the process [14]. These different actors are likely to have knowledge about aspects of the process with which they are involved, and possibly with adjacent processes, but not other parts. As Cook and Brown [10] observe, groups not individuals, possess the 'body of knowledge', and not everybody within a group possesses everything that is in this body of knowledge. Where there is no attempt to bring people together to create this more holistic understanding, each individual will know only about their part of the process and will remain unaware of the knowledge of others. One crucial outcome of this is simply that people are not aware that there are ideas available that could improve their practice, whether at the level of the individual, the team or the organizational unit. So in our case, nurses do not know that patients have knowledge that could allow them to self-diagnose, and consultant optometrists do not know that opticians have knowledge that could allow them to diagnose.

More generally, our research has identified that teams only seek out knowledge when they know they have a problem (this is likely to be the same for individuals or business units). They do not seek out knowledge if they feel they can use the experience that already exists within the team (or with the individual or organizational unit). Thus, they are not aware that there is knowledge available that could possibly be useful to them. An example was provided in a Biosciences company where we interviewed the team involved in an IT implementation project. The team had failed to test the system adequately with some disastrous results when the system actually went live. But as one of the interviewees commented, given the inexperience of the project team, members had simply been unaware that they needed to do more testing. They had not been given adequate training. So, while they did very little testing, they assumed this was normal because nobody had told them how much testing was necessary, even though this knowledge was available in other parts of the organization. Thus, individuals, groups and organizational units can be said to wear 'blinkers' – even if potentially useful knowledge is available to them, it often remains unused simply because no one looks for it.

As a result, the distribution of knowledge creates a supply and demand problem for the transfer of knowledge. Very often in organizations there is no shortage of supply of knowledge – lessons learned documents, manuals, best practice templates, etc. – but much of this, especially that stored in large corporate databases, goes unused very often because the potential recipient does not look for it, being unaware there is knowledge available that could improve practice. In the cataract project example, it was certainly the case that not all cataract hospital teams across the country were aware of the new practice.

5.2 Knowledge is Ambiguous

The second characteristic of knowledge that makes its transfer difficult is that knowledge is ambiguous [38]. An easy illustration of this is provided by the concept of football. Anyone not from the USA 'knows' that football involves kicking the ball with your feet, hence FOOTball. However, those from the US 'know' that football involves handling or throwing the ball to team mates – an illegal action in 'real' football. Carlile [8] talks about the syntactic and semantic barriers to knowledge sharing, emphasizing that it is important to create some knowledge redundancy or common understanding [26] to enable knowledge transfer. Without this common understanding those receiving the transferred knowledge will not be able to understand it. Thus, in the cataract project, the project team had to spend considerable time learning about each others' knowledge so that they could reorganize the process around this shared understanding. Elsewhere, where this shared understanding had not been achieved, the new practice was rejected as "unworkable". We each of us exist in what might be described as a cognitive cage – our thought worlds in Dougherty's [12] terms – that restrict how we view the world and therefore what we consider to be valid knowledge. Transferring knowledge across different thought worlds is difficult, as exemplified in the cataract case. Similarly, Boland and Tenkasi [6] talk about the importance of perspective taking – the need to get into the head/world of the other in order to be able to understand and use knowledge that they can provide. However, this is no trivial matter, and accepting the perspective of others can be very difficult, especially when it involves fundamentally-held beliefs.

This was illustrated in another project where we were observing the knowledge sharing of a large team of UK academics who had won a major research grant [24]. The team of nine was composed of people from different disciplinary backgrounds, based at different universities. The initial goal was to work jointly on the project. However, after they started, it became very clear that they were unable to come to a common agreement on how to approach the research because some believed in a more positivistic perspective while others came from a more interpretivist tradition. The outcome was that they worked in a federated way – divided along the disciplinary lines that separated them intellectually. They did come together when they needed to make a presentation to the funding authority, but the rest of the time they worked almost completely independently.

The point here is that our tacit and explicit knowledge are mutually constituted [38]. Thus, we can only understand and accept the explicit knowledge transferred from another if we share at least some mutual tacit understanding. Thus, a book written in Portuguese might provide knowledge to a Portuguese speaker but not to a non-Portuguese speaker. Similarly, a book written in English but about nuclear physics, would mean little or nothing to a person untrained in this field, even if they spoke English. So, our existing knowledge creates a 'cognitive cage' that can facilitate the transfer of knowledge, but only if we share common knowledge and, in particular, share a tacit understanding of the world [30]. Yet, knowledge transfer is often attempted across cultures or across functions where this necessary common base is absent. In such cases, knowledge transfer is likely to be ineffective, even if those using the knowledge are aware that it exists and may be of help to them. In the cataract case, for example, many of the cataract teams who did find out about the new practice at Trust Hospital dismissed the knowledge as 'unworkable', not understanding how it could be operationalized in practice as they did not have a shared understanding of each others skills and competencies.

5.3 Knowledge is Disruptive

Knowledge can also be disruptive [9, 39]. As Carlile [8] reminds us, we are invested in our knowledge – knowledge is a source of power and so changes in practice that undermine one's knowledge will be resisted. Another project we were researching involved a pharmaceutical company trying to market a new treatment for prostate cancer. The new treatment meant that prostate cancer would no longer be treated by surgeons removing the tumors but by radiologists burning the tumor from within using radioactive iodine capsules [35]. The change was very difficult to introduce because surgeons resisted the new technology as it undermined their own knowledge and, more particularly their power base. Our practice, thus, creates a knowing 'straight-jacket' – we resist change that undermines our knowledge. Knowledge that is being transferred that potentially undermines the knowledge base of one group or another, will be blocked by that group in an attempt to maintain their power/knowledge base. For example, in the cataract case, consultants in other areas resisted the new diagnosis and treatment practice, at least in part, because it undermined their own knowledge – they would have to give some of their knowledge away to the opticians and were not prepared to do this.

6. Characteristics of Knowledge and the Learning Cycle

We can therefore identify characteristics of knowledge that makes its transfer difficult if not impossible:

Knowledge is distributed and this creates problems for getting knowledge from a source to the recipient for whom it would be useful: We wear

knowledge blinkers so that we do not know that knowledge is available that may be potentially useful, or we do not know that we have knowledge that others would find useful

Knowledge is ambiguous and this creates problems for accepting knowledge that does not fit with one's current view of the world: We exist in a *cognitive cage* that means we do not trust knowledge that is transferred that does not fit with out pre-existing mental view of the world

Knowledge is disruptive and this creates problems for getting accepted knowledge that changes practice, especially when it threatens the recipient's knowledge base: We wear a *straight-jacket* that makes us resistant to knowledge that would change practice, especially if this undermines our knowledge – our powerbase.

Linking this back to the learning cycle [20], we can see that there are different barriers to the transfer of abstract conceptualizations – the codified knowledge found in how-to manuals, lessons learned databases, and best practice templates.

1. If a person/group/organizational unit has not had certain concrete experiences [20] they may not be aware that they need knowledge, as in the example of the project team that did insufficient testing of the new software – in this case the knowledge was available (on the supply side) but knowledge blinkers meant that the knowledge was not sought (on the demand side).
2. If the person/group/organizational unit comes from a different mindset or thought world compared to the person/group/organizational unit supplying the knowledge then the observational reflections [20] that are provided will not be understood by the recipient as they fall outside the cognitive cage of what is currently acceptable, as in the example of the university research team who dismissed the knowledge of those with a different epistemological base.
3. If the knowledge transferred indicates a change in practice is required – active experimentation [20] with something new – it will be resisted, especially by those whose existing knowledge and powerbase will be undermined, as in the example of the prostate cancer surgeons.

7. Technical and Social Systems that can support Knowledge Transfer

By understanding those characteristics of knowledge that make its transfer difficult we can begin to design information systems that facilitate this process. Such systems would comprise not only the IT that can potentially make explicit knowledge available to others to learn from, but also the social systems necessary for the transfer to be effective. The limitations of purely technical systems have been noted by others [e.g., 1, 32, 33, 41]. However, identifying the characteristics of knowledge that make its transfer difficult helps to explain why this is the case and also alerts us to the required properties of social (and technical) systems. More specifically, such social systems would need to:

- facilitate awareness of potentially useful knowledge to overcome the knowledge blinkers caused by a lack of concrete experience,
- support the interpretation of knowledge to open the cognitive cage that allows the observational reflections to make sense, and
- encourage acceptance of knowledge and the change in practice that this new knowledge implies when the straight-jacket of existing knowledge prohibits active experimentation.

This suggests a typology of knowledge transfer, supported by different technical and social systems, as indicated in Table 1. The important point of the table is that different kinds of technical and social systems will be needed depending upon the context of transfer, i.e., whether knowledge transfer problems are going to stem from the distributed, ambiguous and/or disruptive characteristics of knowledge. Table 1 identifies the barriers to knowledge transfer, the challenges that need to be confronted, and the systems – both technical and social – that might facilitate such transfer, depending on whether the key feature of the transferred knowledge is that it is distributed, ambiguous and/or disruptive. Each of these contexts is discussed in turn.

Taking the distributed nature of knowledge first, we note the need to increase awareness of knowledge by removing 'knowledge blinkers' for transfer to take place. This indicates that even knowledge transfer within a function or profession, where the source and recipient share tacit knowledge, can be problematic. In this situation, the absence of concrete experience [20] means that the potential recipient can be oblivious to the fact that there is knowledge available that may improve practice. Thus, while knowledge can be placed on a database from which others can learn, the database will only be used if the potential recipient actively seeks out this knowledge. Given our predisposition to rely on what we already know, some means needs to be found to shake us out of our complacency – perhaps in the form of knowledge brokers [28] who act as a kind of bridge between our knowledge and new knowledge sources that we might find useful. While technical solutions – such as sophisticated search engines – might be introduced, they fail to address the core issue here. The key is that we do not look for knowledge if we feel confident in our own,

existing knowledge base (however limited this is). Knowledge brokers or intermediaries of some kind might help us in drawing the links that otherwise would be missed.

Second, the ambiguous nature of knowledge means that it is particularly problematic to attempt to transfer knowledge across professional, functional or cultural boundaries, where there is a lack of common knowledge and understanding. Indeed, knowledge transfer within a discipline or culture can be problematic where there are different 'factions', with different underlying world-views. In these cases, even if someone is aware that knowledge is available, for example, on a database, it will be dismissed because it does not fit existing assumptions. Here, reflective observations [20] of the knowledge source make no sense to the potential recipient. In such cases, this common understanding needs first to be built for knowledge transfer to take place. This common understanding requires each taking the perspective of the other [6] and depends on building relationships so that individuals will begin to understand and trust the knowledge of others. Such boundary-spanning can take a long time [40], especially as in the research team example, when fundamental beliefs, world views and approaches are different. We see this also in cross-cultural relationships and undertakings [cf., 42]. While communication tools such as video conferencing, email and groupware can help here, it is likely they will require augmenting by team-building exercises and social interactions that can help create trust, mutual respect and understanding.

Before we turn our attention to the final column in Table 1, the point should be made that, while the ambiguous nature of knowledge necessarily incorporates its distributed nature, the reverse is not the case. Similarly, however, the disruptive nature of knowledge incorporates both its distributed and ambiguous characteristics. Thus, knowledge transfer that can lead to changes in practice, is particularly complex and difficult to achieve. Here, given professional rivalries and jealousies, negotiation will undoubtedly be necessary for any active experimentation [20] with a change in practice to have a chance of being accepted. This negotiation is always going to be a political process that is likely to depend considerably on norms of reciprocity [16] rather than one group imposing power on another. The latter is just as likely to increase resistance. Negotiation can be facilitated by IT through online discussion forums and other communication tools, but the total reliance on virtual communication is likely to be ineffective since the necessary social and professional relationships that need to be developed can only occur through face-to-face interactions and the building of close working relationships over time. In other words, knowledge transfer in this context depends on the creation of a new community of practice [7], as in the cataract example. While virtual interactions can work, they are – at least for the foreseeable future – a compliment to, and build on face-to-face meetings and team working.

Table 1: The Characteristics of Knowledge that make its Transfer Problematic

Knowledge characteristic	**Distributed**	**Ambiguous**	**Disruptive**
Barrier related to learning cycle	No concrete experience, so is lack of awareness that knowledge exists that may be useful	Close-mindedness, so that reflective observations of others do not make sense	Resistance to power-knowledge shifts, so refusal to engage in active experimentation
Challenge	Remove knowledge blinkers	Open knowledge cage	Unlock knowing straight-jacket
Technical systems	Databases; search engines	Communication tools	Online discussion forums
Social systems	Knowledge brokers; intermediaries	Perspective-taking and trust building activities	Reciprocity and the creation of new Communities of Practice
Purpose/use	Knowledge transfer within function/ profession	Knowledge transfer across functions/ professions	Knowledge transfer to change practice

It could be argued that what is being advocated here is little more than a socio-technical systems approach and that there is nothing new in that. We would counter this argument by claiming the importance of this perspective in the new era of knowledge transfer. By unpacking some of the problematic characteristics of knowledge in the context of knowledge transfer, we have been able to confront some of the more simplistic and superficial treatments of the role of IT in knowledge management. Further, in so doing, we have been able to identify social systems that may facilitate knowledge transfer, working in conjunction with the IT, within and across different functions, professions and cultures. Indeed, these social systems foster *knowing* [4] and knowledge creation [406] in and between individuals, groups or organizations. This is important because it indicates that in some contexts of knowledge transfer, especially those where there are problems of ambiguous or disruptive knowledge, the exploitation of knowledge cannot occur independently from the exploration of knowledge [23]. In other words, there is a need for *both* the exploration of knowledge and exploitation of what already exists, in order for the exploited knowledge to be understood or accepted by the recipients of the transferred knowledge.

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