Tacit knowledge in action: basic notions of knowledge sharing in computer supported work environments

Prof. John Mackenzie Owen
University of Amsterdam
(owen@hum.uva.nl)

Introduction

An important characteristic of most computer supported work environments is the distribution of work over individuals or teams in different locations. This leads to what we nowadays call 'virtual' environments. In these environments communication between actors is to a large degree mediated, i.e. established through communications media (telephone, fax, computer networks) rather in a face-to-face way. Unfortunately, mediated communication limits the effectiveness of knowledge exchange in virtual environments because the communications media employed are less suited for tacit knowledge than for explicit, codified knowledge.

It is the objective of this workshop to explore the area of tacit knowledge in virtual environments, to identify problems and develop ideas for solutions. This paper will provide a basic conceptual overview, pointing to various issues that will be covered in more detail by other speakers. I hope this will provide some common ground for our discussions.

The typology of knowledge

The concept of 'knowledge' can be confusing. There is no accepted definition, and it is even not intuitively clear what 'knowledge' actually is. An important starting point for thinking about knowledge in an organisational context (nowadays usually referred to as 'knowledge management') was given by Nonaka and Takeuchi in 1995 in their book 'The knowledge-creating company'. However, and more specifically for our subject area, the concept of tacit knowledge was already developed by Michael Polanyi in 1966 in his book 'The tacit dimension'.

According to these authors, there are two different kinds of knowledge: tacit knowledge and explicit knowledge.
Tacit knowledge is an individual's personal knowledge that allows a person to act in the way he or she does. Explicit knowledge is knowledge that is encoded (or even recorded in documents or information systems or embodied in values, methods and procedures) and shared within the organisation. One way to explain this is to regard it as the difference between 'what *only I* (as an individual) know' and 'what *we all* know (as a group or organisation) know'.

At this point it is important to understand that in the context of knowledge management 'knowledge' is more than what we 'know' in a traditional sense. Knowledge consists not only of factual knowledge, but also of values, attitudes, beliefs, intuition, emotions, experience, skills, expectations and ambitions – of all those things that make an individual an intelligent being and that form the foundation of his or her thought processes and actions, that allow somebody to make sense of the world around him, and that define the way she interacts and communicates.

Some authors make a further distinction between tacit knowledge (implicit, individual), explicit knowledge (capable of formal expression and encoding) and cultural knowledge: the 'cognitive and affective structures that are used to perceive, explain, evaluate and construct reality' (Choo 1998, Choo et al., 2000). If we regard tacit knowledge to be an individual's knowledge, cultural knowledge could be seen as the 'tacit' knowledge of a group or organisation.

To these types of knowledge we can add a further type: external knowledge ('what *they* know'). This is the knowledge that is available in the outside world (external to the organisation or individual) and that can be obtained from outside sources. This is a useful addition, because tacit, explicit and cultural knowledge are usually defined as knowledge that is already available within the organisation or group. However, relevant knowledge can in most cases be found outside of one's own organisational context. Including external knowledge as an issue for knowledge management can prevent the organisation from becoming too inward looking, and ensures that fresh knowledge keeps entering into the work process. It also helps to manage knowledge resources efficiently by allowing knowledge to be obtained from outside where and when it is required.

Knowledge and context

To this typology of knowledge a further remark has to be added. Explicitation and codification of knowledge in the form of information tends to isolate knowledge from the context in which it acquires its specific meaning and that provides the common ground for understanding between individuals (cf. Devlin 1991, 1999). It is quite possible to have knowledge that makes sense and is useful in one context, and makes no sense at all and is utterly useless in another. Knowledge sharing is a communication act where one person must interpret a message containing the representation of another person's knowledge (fig. 1).
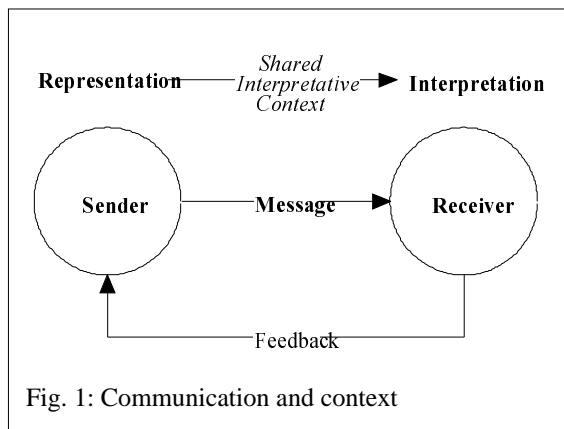
Fig. 1: Communication and context

Both representation and interpretation are based on a whole array of background knowledge, assumptions, values etc. Creating a collaborative work environment requires not just making knowledge available across the environment, but also creating a common interpretative context. This is no easy task, since in any group it is the context or background that tends to be 'tacit' rather than 'explicit' in nature. It is not quite clear how this can be done in an effective way, although situation analysis and feedback mechanisms are at least useful.

From knowledge to information

Tacit knowledge can be loosely defined as being in the minds of individuals or embedded in the culture of an organisation, In what way can such tacit knowledge be made explicit and shared with other people? This happens through a number of related processes (cf. Choo et al., 2000):

1. *Codification*: the construction of categories and rules that hold for the application of knowledge to a specific case. Riding a bicycle draws mainly on uncodified knowledge. Knowing how to use Microsoft Word draws on codified knowledge of categories (the various things the word processor can do, e.g. functions such as opening or printing a file) and rules (i.e. how to perform these functions).
2. *Abstraction*: the creation of structure and causal logic, leading to generalised knowledge that can be applied in many different but related situations. For instance, the knowledge how to use the Microsoft word processor can be abstracted to knowledge that allows us to use any word processor based on the windows operating system.
3. *Recording*: the creation of a symbolic representation of codified or abstracted knowledge.
4. *Diffusion*: the communication of recorded knowledge to others.

Codification is perhaps the most fundamental process in transforming tacit knowledge into information, since it involves the act of (consciously) *knowing* what one

(unconsciously) knows. The applicability of knowledge is however greatly enhanced though abstraction which always must involve a certain level of *understanding.*

An important objective of many approaches to knowledge management is to make relevant knowledge available to the organisation in an explicit way by transforming tacit knowledge (that is only available in the minds of individuals) into explicit knowledge. This is done by asking people who possess or obtain useful knowledge to encode and record it in a way (including the relevant context) that allows it to be accessed and understood by other people. Another way of describing this is by saying that individual, tacit knowledge has to be codified and abstracted into explicit knowledge, and then to be recorded an distributed in a way that will make it available to and owned by the organisation.

But it becomes clear in practice that much - and perhaps the most important - tacit knowledge cannot easily be transformed into explicit knowledge, if at all. In fact, the strictest definition of tacit knowledge would be: knowledge that cannot be made explicit and transferred to others in the form of codified information. In any case, although codification and abstraction are essential conditions for transforming tacit knowledge into information that can be recorded and distributed, they cannot be performed easily at will.

Instead of trying to encode and record tacit knowledge, it often makes more sense to make an individual's knowledge available through more direct interaction and knowledge exchange between people. In other words: an important issue for knowledge management and knowledge work support systems is facilitating the way people can learn from each other, and facilitating knowledge transfer through learning processes.

Knowledge and learning

Where does knowledge come from? We can obtain knowledge from information and information systems, but that is only one of the ways in which people acquire knowledge. We can demonstrate this by looking at four distinct types of learning processes:

1. *Socialisation*: the empirical process whereby people learn from other people (such as parents, peers or more experienced colleagues) through observation and imitation. This is a very common type of learning that already exists at a very early age. It is a mostly unconscious process leading in general to tacit, implicit knowledge. Whenever people know something without being able to tell how they became to know it, they are likely to have obtained that knowledge through socialisation.

2. *Externalisation*: a rational process whereby people express knowledge (often obtained through

socialisation) in terms of explicit concepts such as theories, analogies, models or concrete examples. Externalisation is usually involved when people express themselves explicitly in language or symbols (e.g. in writing, drawing diagrams or verbally). The significance of this process is that people 'become to know (explicitly) what they know (implicitly)'. That is a very useful process, as it makes knowledge available in a form in which it can be applied, adapted and communicated. However, as indicated above, it is unlikely that all implicit knowledge can be externalised in this way.

3. *Combination*: a mostly rational process whereby people acquire knowledge (e.g. through reading) ad process that knowledge through analysis, structuring, comparison, association, generalisation, etc. This results in new knowledge configurations and combinations, i.e. existing knowledge is transformed into new knowledge and enhanced understanding that can be applied to new problems. This type of learning is applicable to both individuals and groups.

4. *Internalisation*: explicit, rational knowledge always has a tendency to develop into more internalised, implicit knowledge. This is often a case of 'learning by doing': explicit knowledge (e.g. about how to drive a car) becomes 'second nature' through practice, knowledge that is available 'without giving it second thoughts'. Although we are perfectly able to use internalised knowledge, we may find it very difficult to externalise it again and to explain and communicate that type of knowledge to somebody else. But of course, somebody else can also acquire that knowledge from us through socialisation, i.e. by observing the knowledge as we apply it in practice.

Information – knowledge recorded in a codified form – is an important intermediary between externalisation and combination. Externalisation makes knowledge available in the form of information. Combination uses such information to create new knowledge configurations that themselves can be externalised as information. In this way information acts as an intermediary between available knowledge and individuals or groups who which to make relevant use of it.

This analysis demonstrates that there are many areas of learning and knowledge acquisition where recorded, documented knowledge does not play a significant role. Socialisation and internalisation are empirical and psychological learning processes based on social behaviour, person to person relationships and individual human behaviour. The knowledge shared and acquired is usually not codified and recorded in the form of information. Yet these are extremely important and common modes of knowledge transfer. It is important to understand this, because it makes it clear that creating an effective collaborative work environment requires more than just codifying knowledge, storing it in information systems and developing access and distribution systems. It also requires creating learning environments that facilitate socialisation and internalisation.

A 3-stage model of knowledge work

Most work carried out in modern organisations – certainly including that in virtual work environments – can be characterised as 'knowledge work', incorporating the gathering, processing, creating, sharing and disseminating of knowledge. The objective of this kind of work is to utilise available knowledge in the best way, and/or to create new knowledge to support the future goals of the organisation. Such knowledge work basically consists of three distinct stages:

1. the input stage where relevant existing knowledge and data are gathered;
2. the throughput stage where knowledge and data are analysed and processed in activities such as design, experimentation, construction etc.;
3. the output stage where the results of the previous stage are recorded and disseminated.

These three stages characterise knowledge work at different levels. For instance, a large-scale research project could consist of a review of the literature (input), experimentation (throughput) and publication of results (output). Communication between research groups happens at the output stage through pre-prints and formal publications, i.e. in the form of codified knowledge. At a smaller scale, consider the communication within a collaborative R&D-project where the work is split up into work packages carried out by different teams. Each team will go through its own input, throughput and output stages fairly independently of the others. Communication between teams is based on output information from one team serving as input information for another. At an even smaller scale, communication within a virtual team using CSCW-techniques operates according to the same principle: based on some form of initial knowledge (input), individual team members will do a piece of work (throughput) and put the results onto a whiteboard (output), to be taken up as input by other team members.

What is characteristic of this 3-stage model in the examples given is that there is little or no communication at the input and throughput stages, and that knowledge sharing with the outside world (including partners in a distributed team) is based on the codification of results, while the work process itself remains a 'black box'. An explanation for this might be that it is mainly in the throughput stage that tacit knowledge comes into play. Much of what happens at this stage cannot, by its very nature, be codified and expressed in the form of

information. This explains why output information tends to focus on results rather than on the underlying process of work performed at the throughput stage.

The communications process is therefore a discrete process rather than a continuous one: it happens at specific moments in time, whenever a team member has finished a throughput stage and communicates the results in the form of information, i.e. codified knowledge. In other words: there is in this type of activity a continuous switching between communication (explicit knowledge) and non-communication (tacit knowledge). In the non-communicative stage, knowledge is applied rather than shared, and is only available to other actors through socialisation mechanisms such as observation or participation.

In cases where this model applies, communication and knowledge sharing are therefore often based almost exclusively on explicit knowledge rather than on tacit knowledge. This is not only the case in virtual environments using computer supported collaborative mechanisms. It also applies to many 'normal' types of collaborative R&D-activities and even to scientific research as a whole. What is surprising is that, in spite of the lack of tacit knowledge exchange, communication in these cases seems to be highly efficient.

One explanation for this is the high degree of specialisation in many types of knowledge work, especially at the throughput stage. Understanding and knowledge sharing between actors at this stage could be unnecessary and even impossible (due to a lack of shared intellectual contexts). The codification of knowledge at the output stage is then done in such a way that a more general context is created in which all relevant actors van understand the results of the work carried out. An additional explanation is that within (mono-) disciplinary research there is a high level of shared context (including not only research methods, standards, accepted theory etc., but also specific scientific values). What does not belong to this 'common domain of knowledge' within the scientific field – and would therefore belong more to the domain of tacit knowledge - is considered to be less important or even irrelevant.

In terms of communication efficiency and division of labour this focus on codified output knowledge is fine. In terms of knowledge management it is less satisfactory. A lack of openness in the throughput stage (in fact a deliberate creation of tacit knowledge) prevents other people from learning the special skills employed. It also shields the worker from critical comments and suggestions from others (perhaps as knowledgeable or more knowledgeable) that might improve his or her work methods. And it limits the development of 'best practices', and as a consequence reduces the learning potential of the organisation.

CSCW-systems alignment

The type of knowledge sharing described here, based on codified output information, is characteristic for disciplinary-based knowledge work or at least knowledge work that is based on a disciplinary task division. It is also characteristic for what Gibbons et al. (1994) describe as knowledge production in 'mode 1' (the traditional academic, institutional, mono-disciplinary type of research and development).

Gibbons et al. contrast this with what they call 'mode 2' knowledge production. Basically, this can be described as knowledge production 'in action' (e.g. though solving actual, real-life problems on a specific and localised context) within interdisciplinary (or 'transdisciplinary') teams, aimed at innovation rather than discovery. What is interesting in 'mode 2' is that communication and knowledge sharing take place at the throughput stage rather than at the output stage – in fact there often is little or no formal output since the objective of the team is to solve a problem rather than to disseminate findings. Here the handling of tacit or implicit knowledge is of fundamental importance: work is carried out in close interaction by people from different disciplinary and organisational backgrounds who may share little common ground. Even when codified knowledge is exchanged, the relative lack of shared context (as compared with 'mode 1') due to the specificity of the problem domain and the various disciplinary backgrounds of the actors can create problems of understanding and interpretation. In 'mode 2' types of work activities, therefore, socialisation mechanisms tend to be more important than formal communication and information exchange mechanisms.

What I would now like to suggest is that many if not most CSCW-applications are more in the domain of 'mode 2' than 'mode 1', whereas the CSCW-systems themselves, by focussing on the use of explicit knowledge communication through and codified information, seem to be based on a 'mode 1' approach.

Therefore there is a need to ensure proper alignment between the type of collaborative work and the support system. Most current computer supported techniques for collaborative work may be more suited for some types of work than others. In particular, I would argue that they are often more supportive for disciplinary-based, mode-1 type of work than for the transdisciplinary, mode-2 type. In order to support the latter type of work a different approach is required.

Because tacit knowledge is of fundamental importance here, there is less need for mechanisms for the exchange of codified knowledge and more need for an environment where the application of (tacit and explicit) knowledge 'in action' is supported as a collaborative process. This approach would have to put less emphasis on (formal) communication processes, and more emphasis on (informal) interaction, contextualisation, consensus building and the support of socialisation processes.

Literature

Choo, Ch.W. - The knowing organization. - New York: Oxford University Press, 1998.

Choo, Ch.W.; Detlor, B.; Turnbull, D. - Web work: information seeking and knowledge work on the World Wide Web. - Dordrecht: Kluwer Academic Publishers, 2000.

Devlin, K. – Logic and information. – Cambridge University Press, 1991.

Devlin, K. – Infosense: turning information into knowledge. – New York; W.H. Freeman, 1999.

Gibbons, M. et al. – The new production of knowledge: the dynamics of science and research in contemporary societies. – London: Sage, 1994.

Nonaka, I.; Takeuchi, H. - The knowledge-creating company: how Japanese companies create the dynamics of innovation. - Oxford University Press, 1995.

Polanyi, Michael. – The tacit dimension. – New York: Doubleday, 1966.