Electronic communication and knowledge transfer

Ettore Bolisani
University of Padova, Dipartimento di Tecnica e Gestione dei Sistemi Industriali, Stradella Sau Nicola, 3 – 36100 Vicenza, Italy
Fax: (+39) 0444 998888 E-mail: bolisani@ux1.unipd.it

Enrico Scarso
University of Modena, Dipartimento di Scienze dell’Ingegneria, via G. Campi, 213/B – 41100 Modena, Italy
Fax: (+39) 059 270477 E-mail: scarso@unimo.it

Abstract: The paper focuses on the process of inter-organizational knowledge transfer and on the potential of Electronic Communication systems (ElCom). First, the different forms of knowledge exchanged by firms are classified. Then, different models are proposed of inter-organizational communication, in order to describe each particular kind of knowledge transfer process. As a result, it is argued that, although today various ElCom applications are available, a universal communication tool is far from being available, so that different applications may be necessary for any specific communication need of the users. In particular, since the most critical challenge is represented by tacit communication, it is discussed that the development of ElCom systems for such kind of communication depends on the availability of a wide range of tools for carrying a large variety of contents. At the same time, any effective solution requires customizing in accordance with the specific needs.

Keywords: Inter-organizational knowledge transfer; knowledge management; communication models; electronic communication.


Biographical notes: Ettore Bolisani took a degree in Electronic Engineering and a PhD in innovation studies at the University of Padova. After working as post-doctoral researcher, he is now Assistant Professor at the Faculty of Engineering of the University of Padova. In 1997 he was visiting research fellow at PREST (University of Manchester), where he carried out a research project funded by the European Commission on the developments of Electronic Commerce. His research centres on technology assessment and technology management, with an emphasis on Information and Communication Technologies. He has participated in various research projects funded by the European Union, by Italian Institutions, and private organizations.

Enrico Scarso took a degree in Electronic Engineering and a PhD in industrial innovation at the University of Padova. He was Assistant Professor at the University of Padova, and he is now Associate Professor of Engineering Management at the Faculty of Engineering of the University of Modena. His current research interests are in the area of technology and organizational strategy, with particular reference to traditional sectors and SMEs. He is author of various papers on those topics.
1 Introduction

The general opinion is that these are times of radical changes in the structure and organization of the modern economy. We are quickly moving into the so-called knowledge-based economy, more strongly and more directly rooted in the production, distribution and use of knowledge than ever before [1]. Signs of the transformation being under way are: the acceleration in the rate of learning and change, the emerging of new organizational structures, the growing knowledge intensity of goods and services, the strengthening of intellectual capital, the technology fusion, and the information technology revolution [2–4]. All these changes highlight the role of knowledge as the driving variable of economic progress and firms’ competitiveness [5].

In this context, knowledge management (KM) is emerging as a new managerial discipline [6], whose aim is to improve the processes by which knowledge is generated, communicated and used by firms [7]. This discipline substantially focuses on intra-organizational issues, i.e. the processes, actions, and projects that can support the management (in a broad sense) of knowledge assets inside the firm. By contrast, there are still few studies concerning the management of inter-organizational knowledge flows, even though it is recognized that one of the main KM activities should concern the acquisition of knowledge from external sources, and its assimilation and use [8].

In fact, it is practically impossible for a single firm to internally create all the knowledge required [9]. Hence, a continuous exchange of knowledge is needed with external sources, and it is only by means of collaborative arrangements with other companies that internal and external complementary competencies can be combined [2,8,10]. The increased importance of external knowledge sources is stimulating the development of network organizations, designed to generate and use knowledge more effectively and to learn rapidly from outside [11,12]. Empirical evidence confirms that companies tend to form knowledge networks [13], and it is for this reason that the emergence of knowledge-based inter-firms relations, generally supported by electronic interconnections, can be regarded as one of the salient features of the knowledge-based economy [1].

Actually, this economy heavily stands on an increasing use of Electronic Communication systems (ElCom), whose development is directly associated to new potential for the process of generation, distribution and exploitation of knowledge. These technologies, in fact, can connect people who need to share information across the globe, and are considered to be able to carry the richness of individual knowledge [14]. However, the actual way such systems can effectively support the transfer of knowledge between organizations is still the subject of extensive debate.

This paper deals with the issues of inter-organizational knowledge transfer and the ways ElCom can underpin such a process. In particular, after examining the different forms of knowledge involved in firms’ activity, as well as the main managerial implications deriving from such distinction, the role that ElCom can play in the sharing of network knowledge is discussed.
2 Forms of knowledge

A clear consensus has yet to emerge on a precise definition of knowledge [15]. This paper does not seek to enter fully into this discussion, but rather to present a summary of the key features of knowledge and their relevance to management practices.

First of all, it is worth mentioning the basic distinction between data, information and knowledge, as often underlined in the literature [14,16,17]. Data may be seen as a set of discrete, objective facts about events, that may or may not be pertinent or useful for a particular task. Information is data whose form, content, and time of transmission/reception are appropriate for a particular use. Information can be described as the ‘contents’ of a message that can influence the judgement and behaviour of the receiver. Knowledge is the combination of information with the individual’s ideas, procedures, and perceptions, that guide action and decision. From a managerial perspective, knowledge can be considered as linked to meaningful behaviour, since it may induce to modify behaviours and undertake actions [18,19]. A key implication of the above classification is that information itself is not sufficient to generate new knowledge. Thus, knowledge can’t be equated to information, and KM should not be reduced to the problem of choosing a communication infrastructure for exchanging information [20]. Nevertheless, even though the amount of information transmitted is different from the amount of knowledge generated [21], the new technologies have an enormous potential for KM, since they mark a significant advance in the quantity and quality of the information that can be processed.

Another point to stress is that knowledge can take different forms. The most important classification highlights the basic contrast between explicit and tacit knowledge. This distinction, that builds on Polanyi’s works [22], has been the subject of extensive discussion, and is the foundation of many other studies [23,24]. In short, explicit knowledge represents the knowing about (the objective knowledge), while tacit knowledge the knowing how (or the subjective knowledge). This distinction emphasizes issues of the transferability of knowledge and the mechanisms employed for this. Explicit knowledge comes from a rationalization of the information about facts, and can be codified in the form of formulas, designs, reports and so on; it is therefore relatively easy to obtain, transfer, and store. On the contrary, tacit knowledge is directly connected with ideas, perceptions and experience, and therefore is quite impossible to codify. Generally, it can only be observed through application and acquired through practice and experience, and is consequently difficult to transfer. It should be remarked that knowledge of individuals can be described as a combination of those two ‘ideal’ forms (explicit and tacit) [18,25].

It is worth noting that other classifications, despite based on different criteria, still recall the contrast between the explicit/codified form and the tacit/uncodified form of knowledge [26]. Even more detailed taxonomies [2,4,27,28] always stress both the radical difference between explicit and tacit knowledge [4,18,29] and the different degrees of transferability of those two forms. Furthermore, almost all the authors argue that the different forms require different organizational and supporting infrastructures to be managed [2,28], and emphasize the role played by tacit knowledge, as one of the firm’s strategic assets, in achieving a sustainable competitive advantage [4,18,27].
3 Knowledge management as a new discipline

As mentioned, the issue of knowledge management (KM) is the focus of much attention in recent literature [30]. In addition, empirical surveys [31] also testify that several firms are carrying on specific projects with the purpose to improve their knowledge assets [32]. Nevertheless, a rapid glance at the literature shows that the definition, purpose, and methods for KM are still the subject of extensive investigation: attempts to identify and classify the possible activities of KM have been made by numerous researchers. For example, according to Demarest [19], KM should involve activities such as constructing knowledge, embodying it (namely, embedding it in a suitable 'container'), disseminating it through the value chain, and using it to generate value. Millar et al. argue that KM includes four interdependent activities: knowledge identification, codification, interchange and production; in particular, the interchange activity involves both knowledge transfer and its assimilation by the receiver [2]. Davenport et al. affirm that KM is oriented to different goals: finding and storing existing knowledge, creating fresh knowledge, or assembling externally created knowledge [33]. These different orientations are associated with different objectives, methods, and technical and organizational structures [34,35]. Lastly, Davenport and Prusak [14] affirm that KM substantially consists of three sub-processes: knowledge generation, knowledge codification (and coordination), and knowledge transfer. In particular, knowledge codification aims to make knowledge accessible to those who need it, and should be regarded as the preparatory process to knowledge transfer. Concerning this process, the crucial issue is whether and how it is possible to codify knowledge, since the tacit one [36] can’t be codified without losing relevant parts of its meaning.

KM can also associated with the conversion between the different kinds of knowledge, which is the basis of Nonaka’s model. According to this author [37] the process of knowledge generation is described as a sort of never-ending spiral, involving tacit and explicit knowledge exchange among individuals and organizations. This process is represented by a continuous conversion between the two forms of knowledge, and four different modes of knowledge conversion may be identified:

1 from tacit to tacit knowledge: the process of sharing experience and thereby creating and exchanging tacit knowledge such as mental models and technical skills (e.g., to teach somebody how to use a machine);

2 from tacit to explicit knowledge: the process of rationalizing tacit knowledge and articulating it into explicit concepts and formal models (e.g., to write an instruction manual);

3 from explicit to tacit knowledge: the process by which explicit knowledge is converted into specific know-how (e.g., to use a piece of equipment for specific needs);

4 from explicit to explicit knowledge: the process of systemizing and converting a system of formalized concepts into another one (e.g., to obtain a new formula, procedure, or software from existing ones).

From this perspective, KM implies to provide a ‘space’ (physical, virtual, mental or a combination of them) where to share and create knowledge [25]. Of course, the different conversion processes are underpinned by different kinds of space, so that, for example,
the factors, methods or even technological infrastructures that can favour the *socialization* process may hinder the *combination* process, and conversely.

To sum up, there are different views of KM and of the activities it should include. In any case, it can be said that KM involves a wide set of processes varying from the disclosure and exploitation of the existing knowledge assets, to the search and the creation of new ones. It is also notable, however, that the attention of researchers and practitioners has been prevalingly directed to the management of knowledge within a firm. This confirms the fact that, despite the increasing importance assumed by inter-firm relations, the issues related to the management of *inter-organizational knowledge flows* have not yet been investigated thoroughly.

### 4 Managing inter-organizational knowledge transfer

In the light of the previous remarks, this section focuses on the management of network knowledge, and specifically on the issue of knowledge transfer between organizations. This raises different problems from the intra-organizational KM, since the actors involved belong to distinct organizations. In particular, they may be far from one another not only in spatial but also in cultural terms: they may work in different environments, speak different languages, have different mental models, different beliefs, and so on. Moreover, exchanging knowledge involves not only its transmission, but also its active absorption and use at the destination point [38,2,14].

Clearly, the relative difficulty of transferring knowledge depends on the kind of knowledge which is exchanged, and this is especially challenging in case of tacit knowledge, since this resides within people and may be embedded in organizational and social processes. Explicit knowledge, instead, can be expressed in documents and hence transferred with reasonable accuracy. Thus, a crucial issue of network KM is how to provide an effective tacit knowledge exchange when actors do not interact ‘face-to-face’ and are not co-located [39]: this is associated with the problem of ‘codification’.

As mentioned, in principle codification [40] implies that knowledge is transformed into ‘clear and unambiguous messages’ that can be easily transmitted [2,41]. This would require ‘to take information that human agents carry in their head and find hard to articulate, and then structure it in such a way that its complexity is reduced so enabling it to be incorporated into physical objects or described on paper’ [42]. Thus, codified knowledge is typically expressed in a compact and standardized format, and in this way it can be transferred over long distance and across organizational boundaries at low costs [1]. In substance, codifying means to convert knowledge into a code to make it as explicit, portable, and easy to understand as possible [14]. But the question is that the ‘real’ knowledge is a combination of two forms of knowledge, and the tacit one is substantially *impossible* to codify [43]. Thus the codification process can never be complete [41], so that the tacit dimension continues to play an important role for taking full advantage of what has been codified [44].

Hence, the transfer of any kind of knowledge (with the exception of that completely explicitable) requires that the involved actors are able to interpret all the (implicit and explicit) contents and meanings of the exchanged information. It is for this reason that the solutions used to support knowledge transfer inside a single organization [45] are substantially based on the fact that the interacting people belong to the same community.
and hence share a common interpretative context. Naturally, all these means are not applicable when physical and cultural distance exists.

Furthermore, to be of actual use, the exchanged knowledge has to actually enrich and renew the knowledge base of the receiver. It follows that the value of the received knowledge depends on the contents of the transmitted information, and without doubt the more extensive and articulated these contents the bigger the potential value of what is exchanged [46]. In fact, as widely underlined in the literature, the variety of knowledge the firms can have access to may increase the flexibility in their interpretations of new problems, as well as their responsiveness and thus their innovative potential [30].

In short, on the one hand codification (and hence an effective transfer) is easier when the two parties (sender and receiver) share the same interpretative context [47]; on the other, the more complementary the transmitted knowledge is to what the receiver knows, the harder may be the codification process. Consequently, there could be a sort of antithesis between the transmission efficiency and the richness of the exchanged knowledge, in the sense that while codification may enhance the former by improving the communication process and increasing the number of possible contacts, it may also substantially reduce the latter [14].

Since this question is directly associated with ElCom systems, which differ in scope, functions and technical components, in the following sections we will discuss the actual role that different ElCom solutions can play in supporting inter-organizational knowledge transfer.

5 Knowledge transfer and communication processes

With this aim, we first need a model of communication system, and of the communication process in general; thus, we need to associate such models with the issues highlighted in the previous sections.

The conduit model is the most familiar reference in organization studies, and is also dominant in management literature and Information Systems disciplines. The model, that develops from early studies of Shannon and Weaver [48], portrays communication as an outgoing message/incoming message process, through a channel having particular characteristics and limitations. A communication system is therefore represented by a source and a receiver, connected by a channel which carries messages (Figure 1).

Figure 1  The conduit model

From this perspective, the solution to communication problems (and consequently the technical requirements) simply consists of enhancing the performance of the channel, i.e. by reducing noise, refining the encoding/decoding procedures, providing more reliable
data storage and retrieval systems, etc. This point of view derives from an information processing view of cognition [49], where some rationalist assumptions are made as follows:

- there is underlying objective knowledge in the world that has universal applicability;
- language can be a medium for representing objective knowledge, and words have fixed meanings;
- actors can achieve universality of understanding since fixed meanings can be communicated objectively;
- realization of objective knowledge is a rational process;
- knowledge evolves through the systematic application of scientific methods.

In short, the conduit model refers to a communication channel that can reliably transfer elements of a given vocabulary of meanings. This implies that the symbolic or interpretative character of messages is not considered. Since coding/decoding activities are treated as discrete selections of messages from a predefined set, the model does not allow for the variations, ambiguity, richness of meanings that can characterize human communication. Other forms of knowledge exchange (in particular, tacit knowledge) are not considered: the implicit assumption is that any kind of knowledge can be converted (reduced) to explicit forms, and then transmitted.

In order to consider tacit knowledge, new views are required; a possible example is the language games model [50], developing from Wittgenstein’s theories [51] and further studies. Wittgenstein’s image of communication appreciates language as fundamentally and inexorably embedded in the situated action of our community or our forms of life. In this viewpoint, language cannot be understood without life experience. It is through action within a particular ‘community of knowing’ that we can make and remake both our language and our knowledge. Unlike the conduit model, in a language game there is no fixed set of messages or meanings from which to choose in communicating. The language games model can be associated with the ‘narrative’ view of cognition [50]. Humans also have a narration capability, where the term ‘narration’ can be seen here in a broad sense, i.e. referring to various modes: verbal or written narration, pictorial representation, exemplary action, etc. This is a fundamental cognitive process through which the human cultural world and sense of self are constructed and maintained over time. In short, from this perspective:

- knowledge, as well as methods for realizing knowledge, depend on the interpretative conventions of the members of a particular social community;
- words can have consensus of meaning only within that community;
- however, even within the same community the meanings change and are never fixed in time or space;
- language is not a medium for representing thoughts and objective knowledge. Language is thought and knowledge. The limits of language are also the limits of the present knowledge since we can explain the world only through some kind of knowledge and narrative forms;
- knowledge can evolve by inventing new language and narrative forms.
According to the language games model the communication process is both based on and favours the development of specialized languages shared by the communicating subjects, and of meanings localized in the same community. In other words, the communication process necessarily becomes established within the community, whereas gaps with other communities may enlarge.

It is for this reason that a further perspective should be considered to enable the representation of a third kind of communicational situation, characterized by the exchange of perspectives or interpretative contexts between subjects of different communities that have different languages, values, viewpoints, ways of life, ways of working, etc. In this kind of communication the use of either formal languages or narrative forms is insufficient. Two communities willing to communicate their own perspectives have first to make visible their feelings, values, opinions, to teach their languages to the other communities, to show their mental words, and so on. In fact, there is the necessity to exchange not only ‘contents and meanings’, but also ‘the way to interpret them’. Nothing or only a few elements of communication can be taken for granted. Clearly, this kind of communication is a long term process, requiring special efforts to fill the gap between the communicating communities.

In short, the three perspectives described above represent three different ways or models of communication (Table 1). In the next section we attempt to apply those conceptual categories to the interpretation of the constraints, requirements, and opportunities characterizing different ElCom systems.

Table 1 Perspectives on inter-organizational communication

| Conduit model | - outgoing message/incoming message process  |
|               | - fixed language                             |
|               | - universal knowledge communicated objectively|
|               | - variety of meanings and ambiguity of languages not allowed |
| Language games model | - narrative action within the same ‘community of knowing’ |
|                   | - knowledge depends on a community’s interpretative conventions |
|                   | - meanings can change and are never fixed in time or space |
|                   | - language itself is part of knowledge |
|                   | - knowledge evolves together with languages and narrative forms |
| Perspective taking model | - exchange of meanings, languages, and also interpretative context |
|                       | - actors make visible their interpretative context |
|                       | - few elements of the communication process can be ‘taken for granted’ |
|                       | - communication as a long term interactive learning process |
6 Implications for electronic communication

By combining the three perspectives previously described, we could represent the whole spectrum of inter-organizational communication as a *continuum*, where we can place three different *communication domains* corresponding to the three models described above. The different focus that characterizes ElCom implementation within each domain is discussed below (Figure 2).

Figure 2  Focus of ElCom implementation in different communication domains

<table>
<thead>
<tr>
<th>Explicit communication (conduit model)</th>
<th>Tacit communication (language games model)</th>
<th>Context communication (perspective taking model)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focus on:</strong></td>
<td><strong>Focus on:</strong></td>
<td><strong>Focus on:</strong></td>
</tr>
<tr>
<td>standardization,</td>
<td>flexibility, variability,</td>
<td>innovative potential,</td>
</tr>
<tr>
<td>replicability, reliability,</td>
<td>management of ambiguity within the same</td>
<td>context exploration,</td>
</tr>
<tr>
<td>communication speed,</td>
<td>context</td>
<td>richness of communication</td>
</tr>
<tr>
<td>efficiency, automatic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>processing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.1 Explicit communication

This kind of communication, well represented by the *conduit* model, is based on the main assumption that communication can regard only explicit knowledge, represented through a fixed vocabulary and finite set of symbols [52].

Accordingly, not only the *language* used, but also the *vocabulary of meanings* (i.e. the *semantics*) are set in advance [53]. In those ways, new knowledge is simply deduced by the receiver from the information carried through the communication channel, by means of rational and formalized methods. Due to its intrinsic nature, this kind of communication can be automated. In relation to ElCom implementation, the focus of systems design is necessarily on standardization, error-free communication, process replicability, reliability, communication speed, reduction in processing time, and in general efficiency. In short: how to perform the communication in the *optimal* way, by automating it whenever possible.

The examples of communication systems for inter-organizational explicit communication include technologies, such as Electronic Data Interchange (EDI) and Workflow Management Systems [54], developed in the stream of *automation* based on rational models, and stemming from the same perspective as the ideas of ‘computer integrated manufacturing’ and ‘unmanned factory’ in the 1980s. Probably, EDI is the best example to understand the features of inter-organizational *explicit communication* systems, as well as the limitations of such approach. EDI is the technology that enables the interchange of structured commercial messages (orders, invoices, etc.) between the computers of two (or more) organizations, and is thus the basis of highly reliable and efficient communication, as well as a higher integration along the value chain. EDI makes possible the automatic acquisition and handling of data on the external environment (for instance, demand trends). It reduces the need for human processing, thus resulting in the efficient information handling within a context of completely pre-
defined communication, where language, meanings, and use of information have been completely preset. For this reason, in some industries EDI has been a key component of just-in-time or quick response implementations by large companies, but also requires a rigid set of organizational relations [55]. Any effort to extend the use of highly automated EDI systems necessarily faces a key question: the development of universal formal languages of business communication; in other words, the formalization of communication [56]. However, the realization of a universal EDI language, comprising all the possible messages and meanings used in commercial documents, is quite impossible, even conceptually [57]. Empirical evidence also shows that the attempts to make the use of EDI communication more flexible requires to abandon the goal of complete automation [58].

6.2 Tacit communication

This form, represented well by the language games model, is the communication between subjects which share a common ‘perspective’ or interpretative context (see also [53]). It is a situation where the communication regards contents that can’t be made explicit or formalized, and can thus require a variety of narrative ways to be communicated. But in any case the subjects have to share the ‘basis’ for interpreting the ‘narration’, i.e. they have in common a set values, viewpoints, and aims that do not need to be explained [59]. The focus of EICom implementation is on the flexibility of contents and language, the reproduction of (partial) ambiguity, the capability of managing exceptions and variations, however within the same interpretative context.

In short, it may be argued that the use of EICom for tacit communication depends on the meeting of two conditions:

1. a common interpretative context, which the interconnecting subjects have to share in any case, and independently from the use of EICom;
2. a higher flexibility and transparency of the EICom application, with regard to languages, meanings, and narration forms.

It is generally believed that the developments of the Internet and multimedia have made major progress towards tacit communication systems. As a matter of fact, such advancements bring about new opportunities, but also new challenges at the same time. In fact, the new applications have an extremely high potential, and it is now clear that their role is not simply ‘to replace or simulate human communication’, but rather ‘to enhance human communication’ [60]. This means that on the one hand such technologies add new ways of communicating, and on the other hand that the users have also to learn how to exploit such opportunities and to change their narration forms accordingly [61]; in other words, to learn how to create and use new forms of narration with such equipment.

Theoretically speaking, there are different perspectives from which the development of EICom for tacit communication can be seen. A first perspective is that of task automation whenever possible. This means to formalize those parts of knowledge that can be formalized, so that to extend the application of the same methods used for explicit communication. This possibility is directly associated with the design of network intelligent agents, that develop from studies of artificial intelligence and expert systems. Interface intelligent agents [62] are based on formal models of the human mind, of which they simulate the behaviour on the basis of given parameters or learning rules. The aim of
those agents is to act as the interface between the communication channel and the terminals (receiver, sender), in order to reduce the work and help to reach efficiency in the incoming/outgoing flows of data [63]. In principle, the functions of such systems can range from simple tasks (e.g. e-mail filtering) to more complex functions (e.g. electronic shop assistants helping consumers in Electronic Commerce applications).

However, even though a great amount of work has gone into the modelling and construction of agents, currently available techniques are still far from being able to produce the high-level human-like interactions. The main technical problems to be faced are as follows [62]:

- the problem of validity: is the mind-model embedded in the software adequate? How to embed tacit mental models into explicit representations and into software?
- the problem of learning: how does an agent acquire the knowledge it needs to decide when to help the user, what to help the user with, and how to help the user?
- the problem of trust: how can we guarantee that the user feels comfortable when delegating tasks to an agent?

At present, the difficulty of solving those problems reduces the applicability of such agents to semi-structured problems. Furthermore, studies of agents stress the necessity of combining different software designed for highly specific functions, in a sort of multi-agent environment [64].

A second perspective that can be considered is that based on the concept of media richness (or information richness) theory [65]. According to this theory, media choices are linked to the information richness required by the specific communication objective. In this view, the key question is how to carry the richest information contents as possible, in order to favour the process of tacit knowledge transfer. This implies the development of a range of ElCom tools, and the aim of each of them is to support different forms of data transmission (sounds, pictures, movies, structured data, etc.). Groupware applications allow cooperative work by supporting the exchange of a variety of contents. Interactive tools also facilitate the real-time exchange of information, just like the way human communication occurs. The last generations of software and Internet protocols also have the advantage that applications can be designed independently from the platform used for data carrying.

Such systems can enhance the opportunities for interconnecting operators, not only by reproducing human communication, but also by providing tools that facilitate the work. Furthermore, the problems stemming from the formalization of languages and meanings are less critical, since the degree of formalization can be easily adjusted to the particular communication process to be performed and to the specific interpretative context shared by the communicating actors. However, it is also worth noting that the media richness perspective leads to the flourishing of a variety of applications, depending on the specific characteristics of the communication flows. In other words, the choice and design of a suitable ElCom application is tightly associated with the characteristics of such flows: the language used, the vocabulary, the contents exchanged, the narration forms, the aims of communication, and (when possible) the data format. For example, two mechanical designers may wish to exchange CAD files, while two stylists would prefer high-resolution pictures, two financial advisors would require graphs and written reports, and so on. Today’s challenge for systems designers is the development of integrated platforms for tacit communication, generally consisting of a common infrastructure for a
set of different applications [66]. Clearly, this raises problems such as redundancy and integration between applications designed for different purposes. This may result in low efficiency and may require large investments. Furthermore, at the moment it is not possible (or, at least, difficult and ineffective) to integrate all the possible functions in a universal application supporting all the range of tacit communication flows with the same effectiveness and reliability. For example, although videoconference is maybe the most powerful means for reproducing face-to-face communication, and is apparently the most versatile communication tool, it is not sensible or effective to use videoconferencing for implementing groupware, or for exchanging plain text. In such cases, specific applications (e.g. Lotus notes, or just e-mail) are more appropriate.

6.3 Context communication

The third kind of communication regards the case of subjects in different ‘communities’ that do not share the interpretative framework: they use different languages, vocabulary, values, procedures, have different feelings, world views, etc. [67]. In this case, a subject willing to communicate necessarily requires communication tools allowing to make visible the interpretative context, and helping the receiver to ‘understand’ it. The focus is on the innovative potential, i.e. suggesting new perspectives to others. The implementation of ElCom systems for context communication raises particular problems, such as:

- the need for continuous real-time interaction;
- the transparency of channels, that should carry a broad range of information without forcing it into pre-defined languages or semantics;
- redundancy of communication means and variety of communication channels, in order to facilitate the subjects to choose the best tool for ‘explaining themselves’ in the different conditions and depending on the receiver. The problem is particularly difficult since any kind of communication tool (including narrative communication, explanatory action, display of texts, pictures, etc.) may be necessary.

In the development of such ElCom systems, two main challenges can be therefore identified. First, it should be noted that any tool, even the more general and transparent systems, necessarily has peculiar functional characteristics and technical limitations. As Dustar and Hofstede argue [68], in order to learn how to interact through computers it is necessary to see the cultural issues as dependent variables even in tools such as videoconference, the use of which requires a sort of shared social protocol.

A second aspect to consider is associated with a sort of dilemma that arises in context communication. The nature of such communication is that its purpose and its expected results can’t be made clear in advance. It can be said that, just like travellers in an unknown country, nobody can exactly know what to communicate, to whom, and how. In short, context communication has the purpose of ‘opening minds’ and stimulating innovative perspectives. This is clearly a long term objective, and is a completely different situation than other kinds of communication; (for example, in tacit communication, subjects should at least ‘know’ what they are seeking). This implies that individuals and organizations interested in context communication should invest in the implementation of a ElCom system without knowing clearly the aims and the possible
returns. This makes more difficult the design of the system, and raises questions on who should pay for the costs.

7 Conclusions

In this paper we attempted to model the different kinds of communication that may occur between organizations. The classification proposed here is based on the assumption that inter-firm relations are based on the transfer of different forms of knowledge. Accordingly, the potential role of different ElCom applications strictly depends on the particular communication process occurring. In other words, since ElCom applications differ from one another with regard to scope, functions, and technical components, a universal communication tool, capable of resolving all the possible problems of communication with the same efficiency and effectiveness, is impossible or, at least, far from being available.

For instance, the tools for explicit communication (i.e. EDI systems) improve the efficiency of communication and allow a high degree of automation. But such applications require that interpretative context, languages, and contents should be completely pre-defined, which is clearly a major limit of those systems. At the opposite extreme, context communication refers to the situation where the interconnecting actors have also to exchange the interpretative framework for interpreting the knowledge transferred. As a consequence, ElCom tools should be able to transfer extremely rich contents, more flexible, and ‘transparent’ with regard to languages and interpretative context. But at the same time, a suitable ElCom technology for supporting context communication (for instance, videoconference) may be inapplicable or inefficient if used for the communication of formalized contents.

We also argued that tacit communication is today the most critical challenge for ElCom implementation. In fact, on the one hand evidence shows that ElCom systems for explicit communication are highly efficient but very restricted in scope. On the other hand context communication, although it can underpin major changes in the long run, has limited importance in the short run, and only under particular circumstances.

The implementation of ElCom systems for tacit communication is associated with two major aspects. On the one hand, since tacit knowledge can’t be made explicit or reduced to codified information (without the loss of ‘valuable meanings’), highly automated communication systems can’t be used. On the other hand, in tacit communication individuals or organizations share the same interpretative context; furthermore, the purpose of communication is generally well defined and clear. In short, it may be argued that the development and use of ElCom systems for tacit communication depends on the elements summarized below:

- the availability of a range of tools, applications, and technologies for carrying a large variety of different contents (i.e. the concept of media richness), so that it is possible for different individuals or firms to choose the most suitable and effective system depending on the specific circumstances;

- since the complete automation of communication is not a realistic purpose, the development of tools for facilitating a few specific tasks or sub-tasks, despite restricted in scope, can be much more useful: for example, flexible databases,
‘intelligent’ search engines, automated facilities for specific repetitive operations, effective interfaces, etc.;

- it is necessary to customize the specific application in accordance to the particular needs of the interconnecting subjects; in other words, groups of individuals or firms operating in different contexts may require completely different systems. As a result, even when based on the use of some standard components (e.g. standard software, Internet protocols, open networks, etc.), the final implementation of each specific application is necessarily a localized process.

Acknowledgements

This work has been financially supported by MURST (Italian Ministry of University and Research) program, “New Information and Communication Technologies and the Development of the Information Society: Implications for Firms’ Strategies and Public Policies”.

References and Notes


6 This is confirmed by numerous volumes, conferences and special issues. Although knowledge is not a new topic, what is new is to recognize it as a corporate asset that has to be managed.


25 Each kind of knowledge can also be described as characterized by different dimensions. In particular, tacit knowledge has a technical dimension, which encompasses the kind of informal personal skills or crafts often referred to as know-how, and a cognitive dimension, which consists of beliefs, ideals, values, schemata and mental models which are deeply ingrained in the individual minds. Nonaka, I and Konno, N. (1998) ‘The concept of ‘Ba’: building a foundation for knowledge creation’, California Management Review, Vol. 40, No. 3, pp.40–54.
26 For example, Lundvall and Johnson distinguish among four different kinds of knowledge: know-what (knowledge about ‘facts’); know-why (scientific knowledge of principles and laws); know-how (practical capability to execute specific activities); know-who (information about who knows what, and who knows how). Again, while the first two kinds of knowledge are easy to codify, and can be assimilated to explicit knowledge, the last two are inherently individual and difficult to translate into codes, and consequently can be seen as tacit knowledge. See: Lundvall, B-Å and Johnson, B. (1994) ‘The Learning Economy’, Journal of Industry Studies, Vol. 1, No. 2, pp.23–42.
Ruggles (1998) [30]. It is worth noting that many projects are directed to improve the management of internal knowledge, thus confirming that KM activities are already considered as limited to the single organization.

Some projects are directly related to the implementation of adequate ElCom supports.


We agree with the Authors when they argue that tacit knowledge is almost impossible to codify, i.e. to make it explicit; in any case the explicitation process is necessarily limited to few elements.


The absorption presumes the fully understanding of the meaning of what is transmitted and its actual exploitation in the business process. We do not consider here the other important problem of knowledge interwork, that arises from the need to synthesize knowledge coming from disparate sources.


The literature does not ascribe to the term codification a univocal meaning. Very often the location indicates the transformation of a particular kind of tacit knowledge (e.g. embedded into a person) into an easier one to understand (e.g. expressed through a language) which still remains to a large extent tacit. Indeed, a strict definition implies that codified knowledge is reduced to a code that is ‘universally’ transmittable and understandable. This is also the definition we adopt in this paper.


Reducing knowledge into codes may make it lose some distinctive properties. For instance, when human skills are translated into books, reading those books does not imply to acquire such skills.

An interesting discussion about the ways the different kinds of knowledge can be codified is in Foray and Lundvall (1996) [1]. In particular, it is illustrated that tacit knowledge may be necessary also for exploiting codified knowledge.

Cowan and Foray, [41] argue that knowledge is easier to codify (and to transfer) within a community of agents who can read and understand a common code. In those cases there has been a former codification process (both intentional and unintentional) which has brought to generate a shared interpretative context.

E. Bolisani and E. Scarso


52 That is, in a sort of ‘decontextualized’ environment, where communicating subjects can simply ‘deduct’ everything they need by means of rational and logical procedures.

53 Since ElCom systems carry messages in the form of coded data (i.e. sequences of ‘bits’ or elementary symbols) and data itself has no meaning nor value, the process of knowledge transfer necessarily involves a sort of conversion mechanism between data, information, and knowledge. The elements of those mechanisms can be described as follows: syntax (i.e. the rules of the language used); semantics (the interpretation of data, namely their meaning); and pragmatics (the valuable use of information). For a discussion, see: Kamel, N., Narasipuram, M.M. and Toraksar, K. (1997) ‘An approach to value-based modelling of information flows’, *The Information Society*, Vol. 13, No. 1, Special Issue on Electronic Commerce, pp.93–96; Hyvarinen, (1970) *Information Theory for Systems Engineers*, Springer-Verlag, Berlin. Also see the application of the concept of ‘Semiotics’ to specific examples of ElCom systems in Bas, H.P.J., Vermeer, T. and Tom Veth, F.L. (1998) ‘Interorganizational data integration: theory and practice’, in Gricar, J., Novak, J. and Doukidis, G. (Eds.) *11th International Bled Electronic Commerce Conference* ‘Electronic commerce in the information society’, Bled, Slovenia, June 8–10.

54 A workflow can be defined as ‘the automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules’. A workflow management system is ‘the software components used to interpret process definitions, create and manage workflow instances as they are executed, and control their interaction with workflow participants and applications’: Lawrence, P. (1997) *The Workflow Handbook*, The Workflow Management Coalition, Wiley, Chichester. According to recent surveys in the UK, an ‘elective’ application field of WMS is financial services, where for example banks and insurance companies can support automatic procedures involving both internal staff and external agencies. See: Doherty, N.F. and Perry, I. (1998) ‘The uptake and application of workflow management systems in the UK financial services sector’, in Baets, W.R.J. (Ed.) *6th European Conference on Information Systems*, Aix-en-Provence, June 4–6.


58 An example is represented by the so-called Web-EDI systems. Such systems use Internet protocols and technologies to make EDI communication more accessible to the users, but the complete automation is impossible, since one of the terminals of the communication channel necessarily requires a human operator.
An example is the communication process occurring when someone ‘teaches’ to somebody else how to use a piece of equipment, by means of practical example or verbal (interactive) instructions.


For example, in order to maintain a virtual community through email, users have started to add new notational systems to convey surrogate emotion (see the studies of ‘emoticons’ and ‘smiley’ symbols). Reid, E.M. (1991) ‘Electropolis: communication and community on Internet relay chat’, University of Melbourne.


This is an increasingly critical problem in presence of ‘information overloads’, for example due to new Web applications (Maes 1994, [62]). Research in consumer decision making suggests that decision effectiveness degrades in the presence of too much information.


Boland and Tenkasi (1995) [5] make the example of scientists working in different fields (e.g. physicians, biologists researchers, and chemists) aiming to share knowledge for new pharmaceutical research.