

Constructing Common Information Spaces

Liam Bannon and Susanne Bødker

Computer Science and Information Systems Department, University of Limerick,
IRELAND,

Department of Computer Science, University of Aarhus, DENMARK,

liam.bannon@ul.ie, bodker@daimi.aau.dk

This paper investigates an important, yet under-researched topic in CSCW, namely shared, or common, information spaces. Precisely what is meant by this term, however, is not always obvious. We provide some background to work in the area, and then proceed to examine features of such spaces through examples. The work involved in both putting information in common, and in interpreting it, has often not been sufficiently recognized. We show how, in various ways, it often requires added work to place items in common, and open up the question of how this might affect use of the WWW, often seen as the ultimate common information space. While there is still a need for further elaboration of many dimensions of the concept, and linkage to related ideas, we believe that the issues raised by this exploration are of importance to the CSCW field.

1. Introduction

One of the distinguishing features of the CSCW field over the years has been the continuing effort expended on understanding the nature of cooperative work, the sociality of work, with a view to assisting in the design of genuinely “supportive” computer-based information systems. In its attempts to achieve this goal, the field has embraced a variety of disciplines, conceptual frameworks and methodologies. Whilst not all members of the CSCW community share similar perspectives or approaches, the field as a whole has been shaped by a number of core ideas, e.g the

work of Strauss (1993) on actions/interactions in social worlds, and the importance of “articulation work”, Suchman’s work (1987) on “situated action”, Flores and Winograd (1986) on “language as action”, and the work of Schmidt and Simone (1995) on “coordination mechanisms” have become important frameworks for discussing key CSCW issues, irrespective of the position one takes on the efficacy or utility of these particular viewpoints.

In this paper, we analyse another key concept which we believe to be of central importance in CSCW, namely the construction, use and maintenance of what we call a *common information space* (CIS) among people performing cooperative work. Through the use of several examples, we examine features of this space, and attempt to construct an outline framework within which to discuss issues of collaboration and sharing of information among actors. Our efforts are aimed at pointing to interesting differences in the way in which people, artifacts and settings are brought together in order to accomplish work in different settings. Thus the concept of a CIS is not put forward as another loose abstraction, but rather as a potentially useful construct that may help in elucidating important aspects of cooperative work activity. Key features of our analysis of CISs include: the seemingly dialectical nature of these spaces, the frequent need for additional effort in order to put, or use, information “in common”, the need for both closure and openness in representations, their simultaneous portability and immutability, etc.

The structure of the paper is as follows: In Section 2 we provide an outline of the CIS concept. In Section 3 we relate this conceptualisation to earlier discussions on aspects of this theme in the CSCW literature, and connect these discussions to a number of other important topics that have surfaced amongst researchers studying the boundaries between people, technology and work settings. In Section 4 we return to more extended examples of these information spaces, which align some of the apparently contradictory findings concerning the nature of shared information spaces by demonstrating the dialectical nature of these spaces, before concluding the paper.

2. Putting information in common

Ever since the founding of the CSCW field, there have been debates as to the fundamental nature of cooperative work. e.g., whether all work is not, ultimately, cooperative, or whether the term denotes a specific form of work (Bannon & Schmidt, 1991). While we do not wish to re-visit this debate here, we wish to note that in any cooperative work situation, there is a need for some form of communication or information sharing between actors, implicit or explicit, in order to ascertain what features of the work are of note in that specific situation. Exactly what constitutes this “information space” is not agreed. For some, it simply refers to information, events, or objects that are tangible, external, “out there” in the world, that can be described extensively. For others, the “space” necessarily

involves an interpretative component - the meaning of the terms or objects are not simply “given”, but require an effort of interpretation on the part of the human actors who inhabit this space. It is this latter view which we emphasize here. Thus, to the extent that multiple actors can construct and maintain a common information space, they are able to articulate their work, and thus perform cooperative work.

Common information spaces come in many forms. They are in some cases constituted for people that are co-present in time and space, whereas in other situations they are distributed across time and space boundaries, and the mechanisms used to support “holding in common” the information varies accordingly. The nature of these CISs vary depending on the work context. Thus, in the case of a physically shared workspace, due to the common work setting and exposure to the same work environment, actors are able to cooperate with each other, both in the production and reception of utterances and information, without having to resort to extended descriptions or elaborated codes, due to their understanding of the shared context within which they work. Thus in this setting, there is little additional effort required to construct and use the CIS. On the other hand, in distributed work settings, there is a much greater need for refining and “packaging” information into a meaningful context, in order to maximise the likelihood that the intent of the message is received appropriately, and the recipient is also required to expend some effort in order to “unpack” this information, and hopefully be able to re-create the context of its transmission. Note that we are not arguing for some notion of perfect information transmission here, as we do not believe such a concept makes sense within human activities, rather we wish to draw attention to the myriad of ways in which people struggle to make sense of each other, through drawing on cues from the work setting in order to understand each other. At this juncture, it is also important to point out that, while we are focusing on the need for CISs in this paper, there is also an equally important need to clarify the role of private and bounded spaces in cooperative work situations. In an important paper, Clement and Wagner (1995) provide an insightful overview of exactly this topic, developing “a conceptual framework which allows us to construct rich representations of “sharing and access” within and in between communities of practice”. We will return to their work in several places in this text.

Most discussions of shared spaces in CSCW have tended to confine themselves to situations in ‘real-time’, or near real-time. Our conceptualization of CISs however extends to situations where information is entered into a database at one point in time and subsequently accessed by others, perhaps months or even years later. In what sense can we characterize this situation as a CIS? In our view, the reason is because both the producer and the receiver consciously make an effort to understand each other’s context - of production and use, so that even though the efforts may be distributed over time and space, there is a form of communication, of “putting in common”, going on in such activity. One major difference between such file use activities and those in the shared workspaces example mentioned earlier is that in the file example there is a more explicit attempt to “package” aspects

of the context with the information, in an effort to ensure that in future use situations, the rationale for the original information is apparent. Of course, there is no way in which one can guarantee that this will be the case, but it does mean that the context of the production of information affects its form. Thus in cooperative work situations (defined as such even in the absence of a second actor “in the flesh”, so to speak, but existing through the medium of their packaged information) we find situations where CISs are both open and closed - in a word, they have a dialectical nature. As we examine different settings, we will attempt to illustrate this dialectical nature of CISs, emphasizing on the one hand the open and malleable role of a CIS within a community of practice; as exemplified in the shared workspace concept, and, on the other, the role of CISs as boundary objects, packaged and being turned into immutables to allow for sharing across contexts and communities of practice, and over time, as in the filing system example. While this discussion may seem overly esoteric and, at first glance, of little relevance to ordinary CSCW system design, we hope to show through illustrative examples below how such ideas can assist us in understanding and constructing common information spaces. Let us first assess what aspects of CISs have been noted in the literature to date, before proceeding with our elaborations on the concept.

3. Dimensions of CISs - Links to earlier work

Perhaps one of the most detailed attempts to explicate the nature of this concept appears in Schmidt & Bannon (1992), following on from their earlier discussion of “shared information spaces”¹ in Bannon & Schmidt (1989, 1991), where they discuss common information spaces as an alternative mechanism to procedural or workflow-type arrangements that could support cooperative work:

.. the construction and management of what we term a “common information space” has, in our view, been somewhat neglected, despite its critical importance for the accomplishment of many distributed work activities. Here the focus is on how people in a distributed setting can work cooperatively in a common information space - i.e. by maintaining a central archive of organizational information with some level of ‘shared’ agreement as to the meaning of this information (locally constructed), despite the marked differences concerning the origins and context of these information items. The space is constituted and maintained by different actors employing different conceptualizations and multiple decision making strategies, supported by technology. Schmidt & Bannon (1992)

Schmidt & Bannon note that this space does not simply consist of objects, events, e.g. in a shared database, but also crucially involves the joint interpretation of these objects and events by the actors involved :

Cooperative work is not facilitated simply by the provision of a shared database, but requires the active construction by the participants of a common information space where the meanings

¹ While originally, in Bannon & Schmidt 1991, we referred to “shared information spaces”, we subsequently shifted to talking of “common” spaces as it lessened the connotations associated with the word “sharing” - and indicates the transient and instrumental aspects of people having information “in common”.

of the shared objects are debated and resolved, at least locally and temporarily. Objects must thus be interpreted and assigned meaning, meanings that are achieved by specific actors on specific occasions of use. Schmidt & Bannon (1992)

They discuss in more detail the issues surrounding the interpretation work that is required by the actors in order to construct common meanings. They indicate possible problems that may occur in the subsequent interpretation of information by others where the origins of the information, in terms of the person or system that constructed it, or aspects of the context within which the information was produced, may not be available to other actors in the space. In such situations, the intended meaning of the information may not be apparent to the new user, as the information objects typically do not record the originator of the information, nor the context of its creation. Examples of situations where this lack of contextual information can be important are also given. Crucially, the paper also distinguishes a variety of work settings, and shows how the work involved to make these information spaces cohere for the actors involved can be radically different in different settings. We will return to this point later in the paper.

The problems encountered when different groups of people are involved in the production and maintenance of an information space extending over time and space have surfaced in a number of quite disparate studies concerning the relation between people and technology, many of which have not been conducted by people in the CSCW field. Within the field of social studies of science and technology, the problems of “alignment” of human and technical actors has been noted, and the way artefacts both shape and are shaped by the actor networks within which they participate (Callon, 1991).² The work of Leigh Star and others on the concept of “boundary objects”, and that of Latour and colleagues on the creation of “immutable mobiles”, both can be viewed as being concerned with how communities develop means for sharing items in a common information space. For example, based on a study of a zoological museum, its creation, use and representations, Star & Griesemer (1989) introduce the concept of boundary objects characterising common intellectual tools, which play the role of containers and carriers:

both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual site-use. Like a blackboard, a boundary object ‘sits in the middle’ of a group of actors with divergent viewpoints (Star & Griesemer, 1989, p. 46).

The ordering and registration of the animals in the museum is one example of a boundary object, a map is another. They are both there to be used by all users of the museum, though these users use the boundary objects in very different ways. As we shall see, discussions of boundary objects can be a vehicle for further studies of common information spaces across organizational boundaries. Understanding how

² The validity of the actor-network framework is not our concern here, simply to note that some of the work done under its rubric is of relevance to our current concerns about the development of common information spaces

people work together in networked communities is another area of investigation that has relevance for our discussions here. The concept of “community of practice” developed by Lave & Wenger (1991) to indicate the learning and working environment(s) in which most people work has important implications for the kinds of shared spaces that we might wish to develop for particular purposes. Whether we are moving information within or between communities of practice becomes of central concern. Robinson and Bannon (1991), within the CSCW field, explore some of the difficulties that can occur in sharing representations across different communities. While their paper discusses these issues in the context of systems development methodologies and practices, the problems noted pervade almost any distributed cooperative work setting where there is a requirement for the maintenance of some shared understanding of objects, events, information etc. within an information space peopled by actors from different communities of practice. Bücher et al. (in preparation), propose that whereas Lave and Wenger’s concept of “community of practice” is useful in studying what in Bannon and Robinson’s terms is called a semantic community, it may be helpful to seek inspiration from actor-network theory and Star’s “boundary objects” concept when investigating situations where objects move across semantic boundaries. This is due to the fact that both the active construction by the participants of a common information space - where the meanings of the shared objects are debated and resolved - and boundary crossing of objects between semantic communities, often are very closely interlinked. As Bücher, Gill, Mogensen and Shapiro explain:

We are therefore drawn to some parallels with the application of ‘actor-network theory’ to the study of science (.) There too, there is a concern with the way in which the resources of a process - people, machines, materials are mobilized, and with the way that the outcomes are sometimes simplified as ‘punctuations’ which realise a particular form of summation of a network’s activity (.) This can often be as texts or what Latour () terms ‘immutable mobiles’ - artefacts which hold stable the intractable and heterogenous materials from which they were composed, and which can be conveyed, collated, compared. We consider that the intimate engagement of an ongoing work process is better understood as a community of practice, whereas an actor-network approach can be helpful in understanding the hand-offs and translations which are also a natural feature of the work. Crudely a punctuation can be a point of closure for a situated practice - albeit sometimes a local and temporary one, requiring maintenance and repair.

It is this tension between the need for openness and malleability of information on the one hand, and, on the other, the need for some form of closure, to allow for forms of translation and portability between communities, that we believe characterises the nature of common information spaces, and leads to difficulties in their characterisation. CISs are both open and closed - in a word, they have a dialectical nature. As an example, Bødker (in preparation a) discusses the development of “portable contexts” of representations for systems development (Brown & Duguid, 1994). The context of use is continuously changing, in a dialectical relationship with the practice emerging in the borderland between various communities of practice. These issues of translation, closure, contexts, portability, etc. relate directly to aspects of Latour’s (1987,1990) analyses concerning the construction of

“immutable mobiles”. Again, we are dealing with the problem of maintaining and preserving some shared interpretation or representation, artefact, across divides of space, time and culture. The work of Clement and Wagner (1995) on fragmentation and regionalisation of communication spaces and their implications for the possibilities of shared communication is also quite pertinent, (although the concepts of CISs and communication spaces, while overlapping heavily, are not, in our view, identical). They also pay attention to the issue of boundaries - “greater attention must be paid to questions of boundary management - especially who is within (and outside) the space for particular types of communication.” As a result, they recognize that “..there should be technical facilities for allowing participants to erect, shift, blur, harden, dissolve, and strengthen the boundaries to communication spaces.”

Having now reviewed some of the literature relating to the CIS concept, we plunge ahead with our elaboration of the concept in the next Section.

4. Articulating dimensions of CISs

No representation is either complete or permanent. Rather any description is a snapshot of historical processes in which differing viewpoints, local contingencies and multiple interests have been temporarily reconciled.

Gerson and Star (1986)

In this paper we describe how differing viewpoints, local contingencies and multiple interests are temporarily reconciled in the actual construction of a CIS; how information items may be supplied with some kind of portable context; how local contexts are re-established based on the unpacking of the information from other contexts of use; and how, as a consequence, information items can maintain their open and malleable character in local contexts. We propose that most common information spaces have two aspects: perceived as the working material of a community of practice, the CIS is open, malleable and interpretable, and a number of concerns, as exemplified by studies on centres of coordination, are highly relevant. At the same time, creating closures of various kinds - punctuations - is an equally valid perspective, suggesting a perspective on the common information space as boundary object (Star), border resource (Brown & Duguid), or immutable mobile (Latour). It is the interplay between these two perspectives that can help illuminate the nature of common information spaces.

We find further inspiration from Giddens (1990) who discusses organizations which have been delegated a certain area of societal competence which is not a part of the everyday competence of the rest of us. For such an organization it is extremely important not to reveal the complexity and ambiguity of phenomena/decisions “frontstage” -i.e. their operations and activities are accessible and visible to users. From the viewpoint of the organization, it is important that

procedures are not only carried out correctly, but are clearly seen to be so, from the outside. This frontstage side of organizations in many cases puts an emphasis on closures and immutability whereas “backstage” the perspective of the CIS as open and malleable often makes more sense. In what follows we will use a number of examples to illustrate how common information spaces are constituted rather differently in different organizations, at the same time as there are interestingly similar patterns: In many cases, this is indeed a result of a trade-off between the concerns for openness and malleability on the one hand and for closure on the other. We will specifically look at the work required both to leave an information space malleable and open, and to create these necessary closures so as to transform the information into something that is immutable and ready to “travel” across boundaries of communities of practice.

4.1. Creating a CIS - within a shared workspace

In our first set of cases, work arrangements have evolved to produce complex centres of coordination (e.g. Suchman, 1993, Goodwin & Goodwin, 1996) where several people and artefacts are physically co-located, with shared resources, in real-time, and jointly handle the large number of complex interweaved tasks involved. In the airline operations room described by Goodwin & Goodwin, Suchman and others, the CIS is constituted by the representations of objects and events depicted on screens, charts, etc., spoken out loud in the room, etc. Many of the objects referred to are “out there” as planes, gates and such to be inspected through various more or less structured means. This is combined with complex sheets and other more specialized coordination devices. The common information space is shaped by reading out loud, by shared access to gate monitors etc. Goodwin & Goodwin (1996) emphasize how this common information space allows for different readings based on the purpose of the activity, and that the openness of access is important. In this example the common information space is open and situated, with the participants being able to make interpretations based on their shared physical context. Here, there is a need for as rich a common information space as possible, as the ever changing conditions may require modifications to established procedures, and any such changes require coordination across the set of activities being performed. In such situations, we find numerous examples of complex human coordination patterns, involving “looking over each other’s shoulder”, peripheral awareness, joint monitoring of status screens, broadcast announcements, etc., all intended to ensure that the group as a whole is aware of the current situation and monitoring the unfolding events. In such a situation, members of the team do not have the time to package their information in particular ways, but have to assume that others can interpret events correctly due to the massively shared context that exists in this work setting. This kind of work arrangement is one where the importance remains with an open and malleable CIS, and where parties outside the center of coordination has very limited access to, and interest in this CIS.

4.2 Constructing CISs when cooperating at a distance

In many situations, however, work is organized differently. There is a physical separation between workers, a rigid division of labour, more limited access to shared "material" and regulated procedures to package information and control its movement to selected people in the line. Such a work arrangement is characterized by the assumption that access to an open, malleable and shared information space is unnecessary because of the division of work, etc. Such organizational arrangements characterize, in Weberian terms, a bureaucracy, where the openness and malleability of the information have been minimised, and thus the information can pass to other groups working within the bureaucracy with a minimum of interpretative work (though work is still required, inevitably). In this situation, people are cooperating at "arm's length" (Schmidt & Bannon, 1992) and do not have the ability to clarify interpretations of information, as in situations such as air traffic control rooms or other coordination centres where people are co-located.

As an example, at the local branch of the Danish National Labour Inspection Service (AT), a centralized computer system (VIRK) is applied to record the interaction of AT with companies (see Bødker 1993). Visits to work sites as well as correspondence with companies are recorded, and various materials can be extracted, ranging from lists of specific types of companies within a geographical zone to lists of which recommendations and demands the AT has sent to a specific company. The underlying filing system is intended to support later retrieval of information about particular companies for the organization as such. The files of interaction constitutes the organizational record of past cases and procedures, the retrieval of which is supported by VIRK. At the same time, there are limited possibilities, in the system, for the inspectors to maintain work material for the handling of a particular case, an issue that will be discussed in 4.3. However, whenever an inspector opens a case, he looks at the information that is available about previous encounters with the company: inspections made by himself, perhaps years earlier, or by somebody else. Whenever he closes a case he needs to be concerned with how the material may be used in later encounters with the particular company. At the same time he has no way of knowing what the purpose of this future case or encounter may be, and what information could potentially be vital at this later stage. Thus, a key concern here is with the active nature of the understanding process on the part of the participants. Without an understanding of the different contexts in which information is produced and potentially the different concerns of the originator, the receiver, as in this case a labour inspector, is liable to make incorrect inferences as to the meaning of the "shared" information. But the important point is to realize that one cannot just produce a common information space, that it does not automatically appear as the result of developing a common dictionary of terms and objects, as the meanings of these terms and objects must still be determined locally and temporally. In the labour inspection, what is considered serious offences and work hazards have changed dramatically over even relative short time spans. The

common information space is negotiated and established by the actors involved. There is effort expended on the part of people who put information into the CIS, in terms of how they package the information or event so that it can be successfully be used by others, in some future use situation. There is also effort expended on the part of those people who lookup information in this common information space and attempt to make sense of what they find, when they may lack knowledge of the context in which the information was produced, or when this context has changed.

4.3 CISs - malleability for some yet closure for others

If one goes to the railway station and looks at the time table, one hardly cares who produced the time table. What matters is if the organization as such does not provide what they claim to provide: if there is no train, no announcement of its absence, etc. At the same time somebody, and most likely more than one person, provided the information, and knows about its ambiguities. In the AT case, the VIRK system is also used to provide statistics for the head office in Copenhagen. These figures (numbers of visits, demands, etc.) is the way in which central management has access to the doings of the branch office. The figures are provided by the inspectors though they have little need for them. Due to Danish legislation, citizens have access to all information kept in electronic files by public authorities. This makes VIRK interesting in that it is actually primarily meant to support internal division and delegation of work, i.e. backstage activity. However, because of the potential public access it is only possible to add things to the files that the labour inspectorate are willing to let the "customers" see. In the context of common information spaces, issues of how closures are created become important - what is inscribed in the record and what is left out. This makes internal notes and remarks highly problematic, and filing in VIRK can be seen as an unceasing transformation of material from backstage to frontstage, thus leaving a big hole as regards the maintenance of working material. Internal notes etc. are simply not able to be kept together with the case material. As described in Bødker (1993) the inspectors want to keep such notes and leave traces for later case work, but that is not possible in the current situation. From the perspective of providing as rich a context for interpretation of the information as possible, logic would indicate that working notes, comments etc. should be available on the system so that future users of the information could, if necessary try to re-construct the rationale. But as all of the information in these systems could legally be require to be produced in certain cases, in order to ensure proper procedures and provide a coherent frontstage view, it may be "logical" to refuse to allow these kinds of working notes to be inscribed in the record.

While bureaucracies may value anonymity for certain purposes, there are many situations where the interpretation of information in a CIS requires knowledge of the identity of the originator of the information. Due to the fact that people employ different problem-solving and decision-making strategies, people may need to allow

for the different strategies used by people who are populating the information space. For example, as observed by Cicourel (1990) in medical practice, “the source of a medical opinion remains a powerful determinant of its influence.” That is, “physicians typically assess the adequacy of medical information on the basis of the perceived credibility of the source, whether the source is the patient or another physician.” Thus “advice from physicians who are perceived as ‘good doctors’ is highly valued, whereas advice from sources perceived as less credible may be discounted.” As Schmidt and Bannon (1992) have noted, in cooperative work settings involving discretionary decision making, people may need to be able to mutually critique the decisions of their colleagues, thus requiring access to the identity of the originator of a given unit of information. So while in many situations organizations can efface the identity of the worker involved in specific tasks, there are many occasions of use of information where this anonymity places severe restrictions on the person who perhaps at some later date wishes to understand the meaning of a particular decision or directive.

4.4 Mediating CISs - evolving roles of human mediators

An important mechanism by which common information spaces can be supported is through the use of *human mediators* that help both producers and consumers to package and subsequently interpret information in the CIS. We take as an example a software company that develops computer support for, and planning of, public transportation (see Bødker, 1996). The company supports a number of object-oriented projects, with a technical platform that is based on Windows, C++ and Oracle. One of the major goals of the company has been to increase reuse of code and, the company has established a core library of 50-60 classes that are applied by all projects. This library is maintained by one person, the platform co-ordinator, who offers his service to the projects through active participation, in particular in the design of programs. The platform coordinator knows the platform well enough to be able to produce, for each project, a “parts list” of objects and classes that the project will need from the shared library. It is up to the platform co-ordinator to decide what is put in the shared classes. He does this through his close contacts with the projects, and at times upon direct requests. Bødker (1996) has illustrated how the role of platform coordinator is new and a result of the wish to share pieces of code, one of the much praised advantages of object-oriented technology. Based on this software development case and the experience of another case of shared standards in an office environment (in the AT case, Trigg & Bødker, 1994) we have noted how a variety of structures or mechanisms for sharing or distribution of the platform components are emerging, and how these are partly dependent on the skills of the platform coordinators, and partly on other conditions in the use/development environment. In both cases the efficiency and quality of sharing goes hand in hand with the additional work performed by the platform co-ordinators.

Thus, to assist in the process of developing a CIS, we find evidence of the emergence of a variety of human mediators whose purpose is to assist those producing items for the CIS, and also in packaging relevant information for those who might wish to use the information. What is interesting is that these new roles as mediators emerge because of the introduction of a common technical environment and develop hand in hand with this. Such mediation, thus, is an example of work that is added because of the introduction of the CIS, work that is there exactly because of the wish and need for sharing.

4.5. A Look at CISs on the WWW

The kinds of issues that we have been addressing take on new twists as we observe the ways in which information is produced and consumed on the World Wide Web. As an example, we will refer to a Danish case that we have been investigating. PlanteInfo is a Web site funded by the Danish Farmers' Associations containing a variety of sources of information about farming. The actual PlanteInfo web pages are provided by the Danish Institute of Plant and Soil Science. Through PlanteInfo the farmers and farming advisors are able to get daily updated information on the spreading of diseases, and access to data bases of agricultural providers, soil temperatures, and to various computer programs. Some of the pages are maintained by the Danish Agricultural Advisory Service. Other pages are maintained by the Meteorological office, pesticide manufacturers, and companies buying and selling fertilisers, etc. So here we have a number of different information providers, with different goals and objectives, providing information to a Web site that is used by a large number of people connected with the agricultural trade. Given this heterogeneity of user groups and possible uses, it is not surprising that a number of problems about the nature of the information space created by PlanteInfo have cropped up. The reliability of the information is vital to the farmer, raising a number of problems, the first one being the reliability of semi-automated updates based on figures entered across the country. Secondly, the farmers can make good use of information from the various commercial suppliers. The question is, however, to what extent this information is to be trusted? Both in terms of whether a web page can be guaranteed to be found, and in terms of substance: the companies of course promote their own products as remedies for particular pests. Provided that the farmer can see where the information comes from (that he is now on a web-page belonging to a commercial company) he is likely to understand this phenomenon, but how reliable are the offered calculations of doses etc.?. While the Danish Institute of Plant and Soil Science want to link to such information, they have no way of verifying it.

The situation is somewhat different with such agencies as the Meteorological office in that, in Denmark, they have no immediate commercial interest in the information they are providing. Also it is a State run agency who have their own official Web-pages and services. Independently, there is the problem that if the Danish

Institute of Plant and Soil Science does not want to process and verify all the information to be put on their web pages then they need to trust the information that they link to and the institutions or individuals who provide this information. And an important topic is how to create such trust, as it is obviously the case that there are many unreliable web pages "out there". A variety of potential contracts and rules for the maintenance of the pages that the Institute is connected to could be considered. The role of the Institute is in itself an instance rather similar to the platform coordinator. However, in order to do anything with the problem of validity of the information submitted by other organizations, there seems to be yet another level of articulation work needed, that of networking between platform coordinators in cases where information is not warranted by the organization, or by trusted individuals.

One perspective that has had relatively little relevance for the discussion of this case so far is that of an open and malleable common information space. Given the inherently open "substrate" of the common information space, the WWW, this is indeed a paradox. However, due to the large number of different kinds of users the information that is provided must be already packaged to an extent, thus making it more mobile while at the same time less flexible in its possible interpretations. Thus, in terms of our discussions of CISs, the Web may paradoxically be one of the most open - in the sense of accessible - electronic spaces that exists, while at the same time be one of the most closed - in the sense that due to the heterogeneity of users and possible use situations, the possible interpretations of the information that is presented is impossible to know. Thus, once one moves beyond very factual information it becomes very difficult to have any certainty as to how the information is being evaluated. While it is the case that one is never able to ensure just how information will be interpreted by others, in this situation the possible interpretations seem legion. One may see the WWW as a kind of substrate for common information spaces e.g. for farming counselling, and those developing such common information spaces may wish and need to set up their own rules and deal with them³. How such networking will eventually evolve remains speculation. Hopefully, however, it is possible to learn from the ways in which organizations have managed these problems under more conventional technology regimes, though we are convinced that some of the solutions need to take new forms.

5. Concluding Remarks: The dialectical nature of CISs

It frequently requires added work to place items in common, in order to package the material so that it may be understandable to others. It poses interesting challenges to CSCW research focusing on reducing the complexity of articulation work, when faced with CISs that introduce new kinds of articulation work that would not have

³ On a technical level, progress is being made on suitable kinds of hypermedia/WWW integration to provide the functionality required. See Grønbaek et al (1997).

been there but for the CIS. Common information spaces come in many forms, and this paper has illustrated their dialectical nature, emphasizing on the one hand the open and malleable role of a CIS within a local community of practice, and, on the other, the role of CISs as boundary objects, packaged and being turned into immutables to allow for sharing across contexts and different communities of practice. We have discussed how the tension between “frontstage” and “backstage” needs is an important force in shaping the CIS. Common information spaces are in some cases constituted for collaborators that are co-present in time and space, whereas in other situations they are constituted across time and space boundaries, and the mechanisms used to support holding in common the information vary accordingly. This type of analysis may be elaborated on a variety of levels, emphasizing the variety of functions e.g. with an entry in the file of a public office, the entry is in itself situated in the community of practice of the office. It is often dealt with, and packaged by one person to be sent on to the next etc. At the same time, a similar analysis applies to the file as such - inside the organization, and as we have seen with VIRK, in relation to its surroundings.

As Bowker & Star (1994) note, in their study on the evolution of the international classification of diseases (ICD) framework, fairly large, and in some senses rigidly defined CISs benefit from an ongoing concern over the definition of the rules concerning how information is submitted. A common information space is not just a repository of information constituted once and for all, which raises interesting concerns for design: Designing a common information space entails concern for the possibilities of sharing, looking over shoulders, etc. on the one hand; for the rules of submission of information on the other; and on top of this for the possible roles of human mediators; it requires us to recognize frontstage/backstage concerns, and the potential reworking of rules. With the WWW example we have illustrated that just because the WWW provides a better substrate for a CIS, these problems still exist, and some are accentuated even more because of the vastly heterogeneous user base for Web applications.

In this paper we have discussed a number of dimensions of CISs and illustrated these with examples. While we are aware of the many unresolved issues in this account, we believe that we have managed to highlight a number of important issues concerning the bases for cooperative work, and we expect to revise our account as we deepen our analysis and test our concepts on a larger number of cases. We also hope to provide a more extensive discussion of related work which has not been covered here, such as the work of Weick on collective mind (Weick and Roberts, 1993) and Francophone studies on information spaces (e.g. Rognin, 1996) in the near future.

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