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**Electronic Notes in
Theoretical Computer
Science**

Electronic Notes in Theoretical Computer Science 168 (2007) 237–247

www.elsevier.com/locate/entcs

A Classification Method for CSCW Systems[★]

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Abstract

Computer-Supported Cooperative Work (CSCW) is a research field where the role played by individuals as members of groups is fundamental. The human being is not considered as an individual entity, but it is considered as a being embedded into the society, where he works and interacts. From the beginning, many CSCW systems have arisen. Some taxonomies appeared in order to find a way to classify all these tools, but they have become more and more complicated, therefore nowadays such classifications cannot sort them correctly. In this paper we present a taxonomy according to these changes, so that CSCW systems can be classified in a more flexible way.

Keywords: taxonomy, classification, CSCW, communication, coordination, cooperation

1 Introduction

Paul Cashman and Irene Greif organized a multidisciplinary workshop in the mid-1980s. Many people from different fields but with the same aim: knowing how computer science could help people who work together, computer science as a way to solve their own necessities. In this workshop, Computer-Supported Cooperative Work was coined [5].

The term groupware was used by Peter and Trudy Johnson-Lenz before the CSCW one. Its original definition is "*intentional group processes plus software to support them*", that is, software that supports group processes. It appeared in

[★] We would like to thank the Spanish CICYT project TIN2004-08000-C03-01 for funding this work, which was also supported by the grant PCC-05-005-1 from JCCM.

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1981, in the paper "*Consider the Groupware: Design and Group Process Impacts on Communication in the Electronic Medium*" [9].

We could say that CSCW describes the research and groupware describes the technology [7]. As Greenberg [6] stated, "CSCW can also be considered as a scientific discipline guiding the design and development of groupware in a meticulous and appropriate way".

Due to the interdisciplinary character of CSCW [5], the number of fields where it could be applied is very wide. If we just observe, for example, the number of different fields in the congress CSCW 2004, that took place in November 2004, in Chicago, we can appreciate such a magnitude. There were sessions dedicated to: dynamic architectures, collaboration involving large displays, knowledge sharing in software engineering, evaluation methods, medical applications, systems, social awareness and availability, communities, interactions with shared displays, tabletop design, organizational issues, distilling knowledge, gaming, distributed teams, operational transformation, gesturing, moving and talking together, bridging the physical and the digital, information sharing and access, and synchronous collaboration.

As systems in general tend to be collaborative, to ease human communication and to be a useful tool in the processes and human coordination, it is expected that the number of applications, ideas, forms, etc. will grow in the years to come. Until now, the possibilities to classify tools, functions, etc. related with CSCW are based on a time-space array [8], always looking for an adaptation to the innovations that arise, to new possibilities for communication, collaboration and coordination.

Taxonomies provide a way to classify different groupware tools. However, it is not always easy to do it, and sometimes we do not know where to place a simple tool, and even less where to place a complex system. Nowadays systems are so complicated that they need a new different method to classify them.

If we consider a simple tool which has a concrete functionality to solve a specific problem, such as a chat, the complexity to classify the tool in one of the previous taxonomies is easy. But considering a complex system that implements several functions, such as a document management system that offers tools, functions for the version control, sharing, check-in and check-out, publication, approval, etc. the problem of the system classification becomes more difficult.

How do we classify a document management system? The control version function is not considered to be only used by dispersed users. It could even include a collaboration system to create the documents in real time. Or even, it could have a shared agenda for a group of users, would it imply that they are not working side by side? Therefore, are the classical taxonomies appropriate to classify all the groupware applications? Existing classification methods that have been considered so far are correct, but the complexity of the new tools and the big systems have made the idea obsolete in some way.

In this paper we present a new classification for CSCW systems based on logical principles of this philosophy so as to classify them in a flexible and appropriate way.

In the next section, we present some existing proposals that allow us to classify CSCW systems. We describe the proposed solution in section 3. Section 4 offers

some examples of the application of the classification method proposed. In section 5, we expose the results and sum up the conclusions extracted from the test developed to know the "impact" of the proposed solution in the CSCW context. Lastly, section 6 shows some conclusions about this work.

2 Existing Classifications

Up to now, groupware tools have been classified in many ways [2, 3, 4, 7, 8], but most of them are based on an original matrix created by Johansen in 1988 (see Table 1) [8]. In this section, some of the main taxonomies, as well as the Johansen's one, are introduced as related and previous works.

2.1 Johansen's Time-Space Matrix

In this first classification, tools are categorized according to *time* and *space*. The human-computer interaction can take place on same physical space, as a meeting room, a conference room or a common workspace; but it also can take place in the distance. Some examples of the latter one are videoconference rooms, the use of collaborative editors or shared whiteboards.

Likewise, the temporal dimension of these systems eases a differentiation between those in which the interaction takes place in real time, such as IP telephony or chat rooms; and those in which time is not so relevant, at least, not very much, such as email, version control, agendas, etc.

	Same Time	Different Time
Same place	Face to face interaction	Asynchronous interaction
Different place	Synchronous distributed interaction	Asynchronous distributed interaction

Table 1. Johansen time-space matrix [8]

Hence, tools can be classified in four ways: synchronous / in the same place, synchronous / in different places, asynchronous / in the same place, asynchronous / in different places. E-mail would be an asynchronous tool and, in theory, destined to persons allocated in different places.

But systems have become more and more complicated over time, so much that the matrix could be used to classify the functionality of a single groupware system, considering the system as a set of groupware tools, each one of them offering a functionality that solves one determined problem, and that allows us to classify it.

For example, the BSCW [1] knowledge management system, is a Web-based collaborative tool, developed in Python, that allows different members of a group to cooperate synchronously or asynchronously over the Internet or from an intranet. As a big system, BSCW solves several problems about the document management,

problems that could be solved, each one, by a different tool: control version, check-in and check-out, publication, and so forth. We could consider BSCW as a system composed of several groupware tools and so, as a whole, its classification in the array is not so clear [13], although it is easy to classify in the array all its different tools.

2.2 Other Classifications

Another classification, very similar to the previous one, is presented by Grudin [7,2]. It is based in Johansen’s time-space matrix [8] to create a groupware classification.

Again, the activity can be done in the same place or in different places, and in the same time or in different time. The clue is if the user knows (or not) those places and times which are different. That is, a new characteristic is introduced according to the users knowledge.

By its spatial characteristic, the groupware applications can be applications that take place in the *same physical site*, oriented to be used by all users in the same workplace. It is also possible that they take place in *different but known places* or even they could take place in *different and unknown places*. The same occurs with its temporal particularities.

Erik Andriessen goes beyond and extends even more Johansen’s original classification, with five possible groups of ICT processes [4]:

- Person interchange processes: communication.
- Task oriented processes: cooperation, coordination and information sharing.
- Group oriented processes: social interactions.

3 Proposed Solution

To overcome this situation, it is possible to change some things in the classical classifications. Instead of trying to classify the tools as they can fit in the arrays, we can show the relationship between a function, or an application or a system, with the time-space features and with the typical CSCW characteristics: information sharing, communication and coordination [11,12].

In this way, the possibility that a function, but specially an application or system, can have several characteristics at the same time is not restricted.

Type	CSCW Characteristics		
	Information Sharing No = 0, Yes = 1	Communication No = 0, YES = 1	Coordination No = 0, Yes = 1
X	0	0	0
A	0	0	1
B	0	1	0
C	0	1	1
D	1	0	0
E	1	0	1
F	1	1	0
G	1	1	1

Table 2. Possibilities regarding CSCW Characteristics

3.1 CSCW Characteristics

The common CSCW characteristics are seven possibilities, from *A* to *G*, as shown in Table 2. Of course, the first option is not valid, because a system that has not at least one of the three is not a CSCW system.

Coordination is fundamental in an organization. Harmonizing mediums, efforts, and so forth, to do a common action. Poltrock and Grudin [11] define coordination tools as the groupware which allow users to capture and coordinate the internal processes of an organization. Such coordination might increase quality and reduce costs.

Communication could be understood just like it is defined in the Wikipedia, another collaborative Web phenomenon: "the process of exchanging information usually via a common system of symbols" [14]. Communication has had a big revolution with the arrival of Internet, high quality connections and a big number of well-known programs. "CSCW could bring people into contact through frequent, unplanned, high-quality and real time interactions" [6]. Communication among people, among the members of an organization, is necessary to send and to receive information, solicitudes, instructions, to be in the swim of the state of the enterprise, to be informed about the latest news flashes, and so on. As said in [11], "computers are becoming increasingly powerful communication devices". People talk to one another through the Web instead of using classical communication mediums, such as telephone.

Type	Time		Space	
	Synchronous No = 0 Yes = 1	Asynchronous No = 0 Yes = 1	Same No = 0 Yes = 1	Different No = 0 Yes = 1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

Table 3. Time-space possibilities

Data, information, documents in general are shared, elaborated, modified in a virtual space which provides software to ease all these operations in a coherent manner. "Groupware supports *sharing information* by enabling interaction through a shared document or collection of documents... These environments integrate both communication and workflow features on a core of cooperation support" [11]. Collaborative Web applications such as SharePoint Portal Server [10] or BSCW [1]

provide a way to control the access to the information, allow users to manage different versions of documents, ease publication and protection processes, support advanced searches, provide mechanisms to approve documents, and so on.

3.2 Time-Space Characteristics

On the other hand, we can observe nine *time-space* characteristics. In this sense, an application can be *synchronous*, *asynchronous* or *both* and at the same time, considering the *space*, it can be in the same or in a different one. The states in which the application appears that cannot be synchronous nor asynchronous, or that it does not appear in the same space nor in different spaces, are *forbidden states* because they are not possible. The only possible states, as shown in Table 3, are: 5, 6, 7, 9, 10, 11, 13, 14 and 15.

3.3 Resulting Classification Array

As a result of the previous considerations, an application could be classified in the table shown in Table 4, a non-exclusive classification, which clearly indicates what type of function, tool or system it is.

Type	Tool	CSCW Characteristic			Time / Space			
		Inf. Sharing N=0, Y=1	Communicate N=0, Y=1	Coordinate N=0, Y=1	Synchronous N=0, Y=1	Asynchronous N=0, Y=1	Same N=0, Y=1	Different N=0, Y=1
B-5	Fax	0	1	0	0	1	0	1
B-5	E-mail	0	1	0	0	1	0	1
B-9	IP telephony system	0	1	0	1	0	0	1
B-9	Chat	0	1	0	1	0	0	1
F-7	Document Management	1	1	0	0	1	1	1
F-7	News	1	1	0	0	1	1	1
F-7	Forum	1	1	0	0	1	1	1
F-7	Discussions	1	1	0	0	1	1	1
G-7	Approval mechanisms	1	1	1	0	1	1	1
C-7	Group calendars	0	1	1	0	1	1	1
C-7	Shared planification	0	1	1	0	1	1	1
A-7	Workflow	0	0	1	0	1	1	1
C-7	Event management	0	1	1	0	1	1	1
C-7	Agenda	0	1	1	0	1	1	1
D-11	Co-navigator	1	0	0	1	0	1	1
D-11	Shared whiteboard	1	0	0	1	0	1	1
B-7	Notification systems	0	1	0	0	1	1	1
F-13	Presentation systems	1	1	0	1	1	0	1
G-11	GDSS	1	1	1	1	0	1	1
G-15	BSCW	1	1	1	1	1	1	1
F-7	Sharepoint	1	1	0	0	1	1	1
F-10	Meeting Room	1	1	0	1	0	1	0
F-9	Video-conference	1	1	0	1	0	0	1

Table 4. Non-exclusive classification

B-5	E-mail	0	1	0	0	1	0	1
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Table 5. Classification according to basic and original functionality

G-7	E-mail	1	1	1	0	1	1	1
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Table 6. Classification according to possible additional functionality

Following these same guidelines, instead of using the table, we can utilize an associated code, the general *type*, joining the letter that represents the CSCW characteristics with the number of the *time-space* property.

For example, an application that would only allow chatting would be of type B-9, because it has nothing to do with *collaboration* or with *coordination*, but with *communication*, and as far as *time-space characteristics* are concerned, it has been

completely defined by means of code 9 that it is a *synchronous* tool that can be used on distance. It also could be used in the same place, but this would have no sense at first.

The questions we could ask to determine what each functionality achieves are the following:

- Are the users helped to collaborate to attain a goal? Do they share information? Do they work with it?
- Can it be used as a communication method? Are users informed about anything? Do they inform themselves using this tool?
- Does it coordinate processes and persons?
- Is the tool used in real time?
- Is it suitable to use it pre-recorded?
- Is it suitable to use it in the same physical space?
- Can the tool be used in different spaces?

4 Classification Examples

Table 4 shows some functionality, tools and complex systems examples.

Furthermore, depending on the consideration we do, we can obtain some results or others from the non-exclusive classification table. For example, if anybody needs to classify tools according to the basic and original functionality they have been implemented for, he or she can obtain the results shown in Table 5; however, if he or she wants to obtain a classification of those functions the tools could be used for, then additionally, he or she would obtain a classification as shown in Table 6.

In this example we can appreciate the different classifications of a simple tool: e-mail. If we want to determine the basic and original characteristics of this type of tool, we obtain type B-5, which means that it is a synchronous communication tool for dispersed persons.

If we want to show the possibilities of e-mail, the result would be that of type G-7. A tool that can promote collaboration among users and that can help to coordinate different persons. They are not synchronous programmes in themselves, because the sent message can arrive some time later, and even as they are oriented to send messages from different spaces, they can be used from within an office, as reminders, to inform, coordinate, etcetera.

5 Assessing The Proposed Classification

In section 4, we have offered the proposed solution to solve the current problems identified in the previous section. In this section, we show the opinion of several CSCW experts about the proposed classification.

With this aim, we have opted for carrying out a brief test. This test is independent of the natural validation by acceptance. By means of this kind of validation,

the classification is showed in different forums (congresses, journals, etc.). So, we can verify (after a while) if the classification remains in the state of the art of the CSCW field or if it is forgotten.

The test intends to achieve a first and very general approximation in order to know if the proposed solution is welcome in the scientific context. Subsequently, it would be a very good idea to carry out a more detailed test in order to verify the classification’s main performances.

A correctly selected population for responding to the test is an essential aspect to assure that the results are worthwhile. In this sense, the test’s first question is to determine the experience that the polled person has in CSCW. So, we will be able to isolate groups of answers. In this way, we can give a greater weight to the results provided by the group of experts.

The test proposes two more questions. On the one hand, it intends to know ”How much it is valued the challenge to define a new CSCW classification”. The question purpose is to know if the polled person thinks that new classifications are needed, independently of the proposed solution in this paper. In other words, we wish to know if the polled expert thinks that the current classifications are valid to classify the current CSCW systems. On the other hand, it tries to know ”How much it is valued the contribution of the proposed solution to the CSCW field”.

To carry out the test, we have elaborated a polled list composed by 26 CSCW experts and postdoctoral students. All polled are from different Spanish universities. The test was carried out during August of 2005. Next, we show the analysis results.

CSCW Knowledge								
Expert			Basic			Null		
44%			56%			0%		
How much it is valued the challenge to define a new CSCW classification								
CSCW Experts			CSCW Basic knowledge			Global		
Excellent idea	Indifferent	Bad idea	Excellent idea	Indifferent	Bad idea	Excellent idea	Indifferent	Bad idea
100%	0%	0%	80%	20%	0%	89%	11%	0%
How much it is valued the contribution of the Proposed solution to the CSCW field								
CSCW Experts			CSCW Basic knowledge			Global		
Excellent idea	Indifferent	Bad idea	Excellent idea	Indifferent	Bad idea	Excellent idea	Indifferent	Bad idea
75%	25%	0%	0%	100%	0%	33%	67%	0%

Table 7. Analysis results

5.1 Analysis Results

First of all, the participation percentage is 34.6%. This value is enough to extract a series of valid conclusions.

According to the first question results, the percentage of polled whose level of knowledge in CSCW reaches the degree of expert is 44%, 56% has a basic level, and 0% has null knowledge in this matter. The correct selection of candidates thus permitted to achieve that all the polled have knowledge on CSCW.

According to the second question results, the percentage of polled that values the challenge to define a new CSCW classification as an excellent idea is 89%, 11% values it as indifferent, and 0% thinks that it is a very bad idea. Nevertheless, the percentage of polled that values the challenge to define a new classification as an excellent idea is 100% among the group of experts, and still 80% among the group of basic knowledge on CSCW.

According to the third question results, the percentage of polled that values the contribution of the proposed solution to the CSCW field as very positive is 33%, 67% values it as positive, and 0% thinks that it does not provide anything new. Nevertheless, the value very positive is 75% among the group of experts, and 0% among the group of basic knowledge on CSCW. Table 7 summarizes the analysis results.

In conclusion, we want to emphasize that the main reason to propose a new classification is corroborated. This test concludes that new CSCW classifications are needed to fit the current CSCW systems. Furthermore, the proposed solution has a very good acceptance in the field of CSCW.

Finally, we want to emphasize that the best test values about the proposed solution are more frequently given among the group of experts than the group of basic knowledge on CSCW.

6 Conclusions

From this classification we can obtain some interesting conclusions about the typical configuration of the CSCW systems.

The less frequent applications are the ones that can be classified in an even pattern, that is, the tools of type *-6, *-10, *-14 are not very frequent because it is not usual to create a system to work exclusively in the same place, as could be a meeting room. In general, the CSCW applications can be classified in odd time-space patterns (*-5, *-7, *-9, *-11, *-13, and *-15), because they are intended to be used in dispersed spaces, though many of them can be used in the same space and it is correct to use them (actually, it is so in most cases).

This is a logical conclusion, because the communication method for these systems is Internet (or other communication networks). The time-space patterns in which most of the tools can be classified are *-7, *-9, and *-11; synchronous or asynchronous tools, regardless the place we use them, or synchronous tools oriented to be used in different spaces.

According to the CSCW characteristics, the applications tend to include, at least, communication as one of its functions, directly among members of the organization or information communication, as news, events, etcetera, for the members of the organization. As we can appreciate in Table 4, in this small classification, more than 85% of the tools can be classified in *-B, *-C, *-F or *-G patterns, that are the ones of the communication.

The taxonomy is non-exclusive, meaning that a function could be classified with different attributes at the same time. That is, a tool could be classified considering its possibilities of being used in the same space or in different spaces.

The non-exclusive classification array is consistent, because the tools can only be classified in a single way based on the definition of the author about its origin and objectives. Tools are originally created to do a function, and these functions are used to create the classification.

Another consideration we could take into account is that a tool implemented to do a concrete function can be used to do other ones. Originally, e-mail was used for the communication in dispersed spaces, but we have seen in the previous section, that it could be used in the same space. So, the non-exclusive classification array is flexible according to the needs that arise from time to time, so it can be suited to other possible classification needs maintaining the same structure. Hence, we can state that an e-mail tool is of type B-5 but, in any case, we could consider a flexible approach if we wanted to show the additional possibilities of this tool, so it could correspond to a tool of type G-7.

Lastly, we want to remark that in order to assess the need and validity of the proposed classification method, we have developed a test whose results validate the proposal.

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