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CSCW: The development of a taxonomy

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Abstract

Computer supported cooperative work (CSCW) is a research field that studies the use of computer technology for group work. A review of the CSCW literature found that the use of terminology and definitions were inconsistent. This paper reports on the process of development of an holistic taxonomy of terminology and related definitions used in the CSCW literature from 1996 to 2003. The taxonomic structure will provide a framework for classifying the terminology and defining each concept to improve communication in this field. The completed structure will be presented to other researchers to determine implications for research practice.

Keywords

CSCW, GSS, Classification Systems, Taxonomy

INTRODUCTION

CSCW is a relatively new research field and includes areas such as: groupware research, group support systems (GSS) research, group decision support systems (GDSS) research and computer supported cooperative learning (CSCL) research. Computer supported systems for group work have been developed to allow groups of workers to collaborate and communicate on common tasks. These systems are usually referred to as 'groupware'. Over the years researchers have attempted to categorize these computer systems as a way of describing the differences between the systems.

During the investigation of prior research in this field it was found that the terminology and definitions used by researchers were inconsistent. These inconsistencies make it difficult to determine what technology has been used in the research and where each research study fits into the research field. As CSCW is a multidisciplinary field it is important that researchers have a clear holistic view of the research field.

An interpretive/descriptive study has been undertaken for this research. An unobtrusive data collection of prior literature and content analysis has been used to extract data about terminology, definitions, and other groupwork issues. A list of terms and concepts using open coding has been compiled that will be used to develop a dictionary to support the taxonomy of CSCW terms. The dictionary has not been presented in this paper. A preliminary taxonomic structure has been developed from the concepts identified during the analysis of the research articles in the CSCW field and presented in Appendices 1 and 2. An overview of the methodology and methods used in this research has been described in the methodology section of this report.

This study has undertaken an examination of literature from 1996 to 2003. The 200 articles used in the research were retrieved mainly from electronic databases and include: book sections (8 articles), electronic sources (10 articles), 9 conferences (84 articles), 49 journals (91 articles), and reports (7 papers). This paper presents a portion of the taxonomy that is under development, for classifying the terminology and defining each concept and type of system used in the CSCW research field.

This paper provides an overview of the study that includes a literature review, an overview of linguistics and taxonomy, and CSCW classification systems. The paper then describes the research problem and justification for the research. The methodology and analysis approach are then introduced and a portion of the taxonomy presented.

BACKGROUND TO THE STUDY

This report presents preliminary results from research being undertaken for a PhD study into the classification of terms and definitions of the CSCW research field. This study will develop a taxonomy of terms and a dictionary of definitions for the CSCW research field and determine implications of these structures for practice. This paper presents the methodology and analysis for development of the preliminary taxonomic structures.

Literature review

During a review of the literature in this field it became apparent that there was a proliferation of terms, software and systems and that the definition of a term such as group support systems (GSS) used by one author was different to the definition used by another author. These inconsistencies have been commented on by a number of authors who say there are no agreed standards, no agreed definitions, and no agreed terminology (Greenlaw 1999, Turner & Turner 2002, Ward & Whymark 2003). This inconsistency makes it very difficult to determine what technology had been used in particular research and where each research study fits into the research field. It also makes it difficult to find relevant articles in electronic databases because of the lack of consistency of keywords and search terms.

CSCW classifications

The term CSCW was first used by Paul Cashman and Irene Greif in 1984 (Grudin 1991), and was publicly' launched in 1986 as the title of a conference. The CSCW research field is multidisciplinary and is concerned with group work practices and computer systems that support groups. CSCW is described by Greenberg (1991) as the nature of work practices on which groupware builds.

During the literature review for this study a number of classifications in the CSCW field were identified. One of the prolific areas of research in the CSCW field is GSS. Zigurs & Buckland (1998) presented examples of GSS technology classifications and commented that classification schemes for group support systems are as abundant as definitions of the technology.

The most often cited classification scheme used by researchers in the field of CSCW is the time/space (place) matrix developed by Johansen (1988) that provided a 2 x 2 grid showing modes of interaction along synchrony and proximity dimensions. Group interaction can occur at the same time (synchronously), or at different times (asynchronously). Members can be located in the same place (proximate) or in different places (dispersed). This matrix has been used and further developed by many researchers (Mallach 2000) to include other dimensions or characteristics such as level of group output, type and usage. This matrix has also been used to describe, the type of computer systems (Johansen 1988), the workgroup environment (DeSanctis & Gallupe 1987; Lewis 1994) and the hardware communication requirements (Mallach 2000).

Some studies have conducted reflective studies of the literature in the subfields of CSCW (Pervan 1998; Turner & Turner 2002). The value of these studies is in providing an opportunity to consider what has been researched and achieved in these subfields. This provides a way to see the whole picture and to identify gaps in the research which need to be addressed, and to set directions for future research. However none of these classification systems have been used to clearly define all the groupware systems or considered a holistic view of the CSCW research field.

The issues of classificatory systems is also a problem in other areas of research. Behling (1978), for example, explained that one of the major issues affecting the study of organizations was the failure to develop an adequate classifactory system for midrange theories in Organizational Studies. While, Hasselbring (1999) described the problem of inconsistency in computer science terminology and suggested the development of a taxonomy to resolve the confusion.

CSCW terminology

Many researchers who have studied systems that support group work, do not agree on a definition for terms such as groupware. Some researchers consider groupware only in terms of application software (Greenlaw 1999), some as hardware and software (Dennis et al 1998), and others as a system which includes group processes (Genuchten et al 2001). Gutwin and Greenberg (2000) only include real-time systems (synchronous), while Roseman (1996) includes both synchronous and asynchronous systems in their definition of groupware.

Disagreement also occurs for applications that are used for group work. Email is considered to be a groupware product (Mallach 2000) while others do not (Greenlaw 1999). Some rank workflow systems among groupware applications (Hinssen 1998) while others do not (Gutwin & Greenberg 2000). GroupSystems is also discussed in terms of an electronic meeting system (EMS) (Hein et al 1998), a GSS (Genuchten et al 2001), and GDSS

(Gopal & Prasad 2000), distributed group support system (DGSS) (Briggs et al 1998), and groupware (Boutellier et al 1998).

The issue of consistency of terminology and definitions is also discussed by researchers in other fields. People must share the terms for concepts and their definitions if they are to be of value (Neuman 1994). Cooper and Emory (1995) discussed definitions and stated that "if words have different meanings to the parties involved, then they are not communicating on the same wavelength. Definitions are one way to reduce this danger" (p.35). Bruce and Levin (1997) agreed by stating "Experts often disagree about what constitutes the objects of their study but avoid addressing their disagreements directly. It is no surprise that discourse in the field appears disjointed and inconclusive" (p.1).

Authors discuss the CSCW field of research in both the business and educational environments and state that the scope of the field is not clear (Bannon 1992). When writing about any area of research it is important to understand the scope of the field and the terminology used. Many authors adopt definitions as used in prior research without perhaps considering how the definition of these terms overlap with the definitions of other terms. As CSCW is a multidisciplinary field it is important that researchers have a clear holistic view of the research field and use the same terminology and definitions to describe their research. A taxonomy of CSCW terms would provide a framework to address this problem.

RESEARCH PROBLEM

The literature review highlighted the inadequacies of the definitions and categorizations in CSCW, which negatively impacts both research and practice. It is apparent that terms used in the CSCW research field and their definitions change over time as the systems and research develop. This study has been undertaken to examine the categorization models, terminology and the prior research to develop a comprehensive taxonomy of terms and definitions in CSCW, to provide a structured flexible foundation on which future research can be built.

The objective of this research was to develop a holistic taxonomy of terms in the CSCW research field, which included CSCW technologies. This objective was used to frame the general research question.

> RQ: What are the themes and topics of the CSCW literature that can be used to develop an holistic taxonomy of CSCW terms that will provide a foundation for research and practice in this research field.

The issue of standardization of terminology and meanings provided three reasons to justify conducting this research:

- The need for a holistic review due to the inconsistency in terminology and definitions in this research field.

- Improve information exchange and understanding among diverse interdisciplinary, geographically scattered researchers and practitioners; and

- Add hierarchical relationships (broader terms, narrower terms) and relate terms to controlled vocabularies for improved information retrieval (preferred terms, synonyms and near synonyms) which should help to achieve consensus between researchers and practitioners of the meaning of terms.

In summary, this section introduced the research question and provided a justification for undertaking this research.

Limitation of this research

The articles have been collected mainly at random from full text databases available to the authors. However some articles were retrieved from web pages, conference proceedings and hard copy journals. This means that there may be a number of relevant documents that have not been included.

The articles analysed are from 1996 – 2003 only and do not cover the 20 year history of the field. However the authors have assumed that if terminology has not been used in the last 8 years it is probably not relevant for the current CSCW research field.

This research has used large quantities of data and it is possible that some relevant material from these articles has been missed.

METHODOLOGY

This study was divided into two parts. The first part of this study provided a quantitative analysis of research articles found in the CSCW literature, mainly from journals and conference proceedings, during the last 8 years. The papers have been analysed to identify the 'demographics' of journal or conference name, year, authors, and affiliations, and CSCW factors (such as technology type, time and place dimensions, CSCW software and tools used, and research focus).

The second part of this study analysed the terms and definitions used by authors in the literature of this field of research. The analysis of documents is accomplished in a number of stages. The number of stages proposed by other authors vary for this type of research.

Sarantakos (1993) described four stages of documentary research: Stage 1: Identification of relevant documents, Stage 2: Organisation and analysis of the documents, Stage 3: Evaluation of the information, Stage 4: Interpretation of the data (p.207-8). When discussing qualitative analysis Miles & Huberman (1994) describe three activities: Data reduction – includes selection and condensation, Data display – in diagrammatic, pictorial and visual forms, Conclusion drawing and verification – displayed data are interpreted and meanings drawn.

This study has modified the above processes and has used six stages to analyse the documents to provide more clarity in describing the processes for this research. As this research is iterative, these stages are not mutually exclusive and not consecutive. Each stage is explained in the next section.

ANALYSIS

Stage 1: Identification and retrieval of the relevant documents

In this study a sample of articles from the CSCW research field was chosen. The choice of articles depends on availability, accessibility, relevance, and personal interest of the researcher. As articles were found they were subjected to stage 2 of the process.

Judgement sampling (Cavana et al 2001) was used for this study as it relies on the researcher to try to obtain a wide a representation of material as possible, taking account of likely sources of difference in author views and experiences. Sampling was commenced with finding a few articles by using general search, using keywords. A snowball effect was then used to identify other articles from reference lists from the original documents found.

Stage 2: Condensation of the documents

The content of this stage depends on several factors, primarily related to the method of analysis and the purpose of the study. When methods such as content analysis are employed, organization of the data as well as their analysis become more sophisticated (Sarantakos 1993). The general analytic approach is not to simplify the data but to open them up in order to interrogate them to try to identify and speculate about the features (Coffey & Atkinson 1996).

Stage 2 included reading, highlighting, grouping articles, relevant paragraph extracting, creating electronic files of extracted data (using MSWord™), recording articles using EndNotes™ database, and filing articles. This stage was very time consuming, but very necessary to reduce the quantity of text down to relevant data and to keep an audit trail of the process. Berg (1995) quoted Becker, Gordon & LeBailley (1984) when describing this phase "Organizing large quantities of notes is very time consuming and both physically and mentally exhausting. It is desirable, then, to amass these notes in some systematic fashion and perhaps even to reduce their bulk for analytic purposes" (p.112).

Stage 3: Coding of the documents

Paper versions of coding forms and a codebook were developed and used to collect the data from the articles. A random sample of the completed coding forms, were checked by an independent researcher to determine the validity of the data collection procedure. These coding forms included the author, date, research type, theory or research framework, and variables discussed in the research such as, time/place, team environment and technology used. The coding forms and codebook were used as a means of checking for reliability of the data to ensure stability, reproducibility and accuracy. These coding forms were also used to transfer details of research type, time/place dimensions, and system type into the EndNotes™ database.

The documents were then searched using open coding to identify all the terms and definitions used in the CSCW research field. This was achieved by developing hermeneutic units in Atlas-TI™ which provided computer assisted coding. Auto-coding was used for some of the terms and definitions where the words 'define', 'defined', and 'definition' were specified in the document, and manual coding by reading the documents and attaching codes where other descriptions of terms were used.

Stage 4: Data reduction of the documents into themes, clusters and categories

After the data was summarized and coded, it was organized into themes, clusters and categories (Miles & Huberman 1994). In this research the documents were coded to identify terms that described the structure of terminology use. Spradley (1979 in LeCompte 2000) used semantic relationships to assist with this process as shown in table 1.

1. X is a kind of Y	7. X is a place for doing Y
2. X is a place in Y	8. X is used for Y
3. X is a part of Y	9. X is a way to do Y
4. X is a result of Y	10. X is a stage or step in Y
5. X is a cause of Y	11. X is a characteristic of Y
6. X is a reason for Y	12. X is a place for doing Y

Table 1: Spradley's semantic relationships

An example of a simple hierarchy developed from the data in this research, using Spradley's semantic relationships, is shown in table 2. This table uses four quotations from the data:

"TeamRooms is a [kind of] groupware system" (Roseman & Greenberg 1996).

"Notification Collage (NC) is a [kind of] groupware system" (Greenberg & Rounding 2001)

"Lotus Notes is a [kind of] groupware application" (Hein, Keenan & Reincke 1998)

"DOLPHIN [30] is a [kind of] groupware system" (Prante et al 2002).

Taxonomic Name (Y)	Individual item (X's)
Groupware system	TeamRooms
	Notification Collage
	Lotus Notes
	DOLPHIN

Table 2: An example of items using "X is a kind of Y"

Table 3 shows another example. This example shows the hierarchical structure of the following data: "Awareness deficits suffered by the virtual teams: Lack of awareness about other's activities (what are they doing). Lack of awareness availability (when can I reach them). Lack of process awareness (Where are we in the project). Lack of perspective awareness (what are they thinking and why)" (Jang et al 2000).

Awareness deficits	Activity awareness
	Availability awareness
	Process awareness
	Perspective awareness

Table 3: Hierarchy showing 'awareness deficits'

Stage 5: Evaluation and display of the data

Data is then displayed in diagrammatic, pictorial and visual form in order to show what those data imply. These can be viewed as an organized compressed assembly of information that permits conclusion drawing and/or action taking (Miles & Huberman 1994).

The simple hierarchies from stage 4 were drawn together into themes that were used as the starting point for the development of the CSCW taxonomy.

During stage 5 it became clear that the issue of inconsistency in the system terminology made it inappropriate to structure the systems at this time in the hierarchy. An alternative approach to group the systems will be tried. A matrix structure will be developed, using the system characteristics mentioned by other authors and cluster

analysis will be undertaken to determine the most appropriate characteristics to group the systems. It is anticipated that this process will identify clusters of systems that more clearly belong to the different groupings. This cluster analysis has not been included in this article.

RESULTS

Stage 6: Summarization and interpretation of the results

The first part of the literature analysis was undertaken during stage 3 and the article categories were counted to determine the number of articles per year and whether the articles were qualitative, or quantitative studies, reviews or conceptual papers. Table 4 shows the final results of this analysis.

Articles by year	Total	Qual	Quant	Both Qual & Quant	Review	Conceptual paper	Review and Conceptual
2003	17	5	7	2	1	3	1
2002	34	8	10	6	8	1	3
2001	23	6	5	2	6	2	0
2000	28	11	6	3	2	5	1
1999	32	14	2	0	6	6	4
1998	36	13	4	3	11	4	1
1997	11	2	3	0	4	2	0
1996	18	0	3	0	6	7	1
Total	200	58	39	16	45	35	12

Table 4 Articles by year

It was found that the articles that discussed CSCW or groups using computer systems for groupwork were located in many different journals. This is probably due to the multidisciplinary approach of CSCW research. The main journals identified and the article types are shown in table 5. The main conferences that were identified were: CSCW conferences, ECSCW conferences, and ACM conference on Human Factors in Computer Systems.

Journal	Articles	empirical		Review	Concept
		Qual	Quant		
Decision Support Systems, 1998	2	0	0	1	1
Communications of the ACM, 2000, 2001, 2002	5	1	2	2	0
Decision Sciences, 1997	2	1	1		
Group Decision and Negotiation, 2001, 2002, 2003	6	2	3		1
IEEE Transactions on Professional Communication, 2000	2	1	1		
Information and Management, 1996, 1998, 1999	3		3		
Information Resource Management, 2002, 2003	5		4		1
International Journal of Human Computer Studies	2	1		1	
Journal of Management Information Systems, 1996, 1997, 1998, 1999, 2001	9	3	4	2	
R & D Management	3	2		1	

Table 5: Articles in Journals

The qualitative study also commenced during stage 3 when the articles were searched for terminology used in the CSCW research field, 844 CSCW related terms were found using open coding. Of these 591 terms were found to have definitions or descriptions in the literature. 250 terms were identified but were not defined or described. Of the 844 terms, 78 were names of systems or applications, 20 were integrated tools, 21 were theories used in the research, and 5 were toolkits

As shown in table 6 the first level of the hierarchy shows CSCW and the second level shows six main themes that were identified in the data during stage 5. The extension of the 'groupware functionality' theme at level 2 is extended in the hierarchy to level 3, to include 'groupware features', 'groupware usability', 'groupware products', 'groupware system types' and 'groupware application types'. An extension of table 6 has been included in Appendices 1 and 2 that show concepts linked to 'groupware features' and 'groupware usability'

from level 3. The numbers in brackets included in appendices 1 and 2 are for audit trail purposes and identify the quote from which the terms were extracted.

Field of research (Level 1)	Themes (Level 2)	Level 3
CSCW	Groupware functionality	Groupware features
		Groupware usability
		Groupware products
		Groupware system types
		Groupware application types
	Tasks	
	Group work	
	People (groups, facilitators)	
	Processes	
	Environment	

Table 6: First three levels of taxonomic structure

This taxonomic structure is beginning to show the scope of the field of CSCW. It gives an overview of the relationship between terminology and provides a framework for definition comparison and development.

CONCLUSION

This paper has presented an iterative qualitative methodology that can be used to extract terminology and definitions from documents in any field of study. It has presented an introduction to the structures that are being developed to identify the terminology and definitions of the CSCW field and provide a taxonomic structure for these terms. These structures will be used to provide an holistic view of the CSCW research field and a classification of the systems that support group work. Definitions for all concepts used in the taxonomic structure will be included in a dictionary of terminology which will complement the hierarchy. The purpose of this paper is to present a preliminary version of the CSCW terminology in a hierarchical structure to research professionals in this field, in order to obtain feedback regarding the implications of these structures for research practice.

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APPENDIX 1: GROUPWARE FEATURES CONCEPTS OF CSCW

Level 2	Level 3	Level 4	Level 5	Level 6
Groupware functionality	groupware features (139, 142, 140, 160, 161)	groupware technology (60, 123, 124, 125, 126,)	hardware (60, 123, 139, 160)	computing (124, 126)
				peripherals
			services (160, 123)	networks (60)
				decision support technologies (124, 126)
				communication (124, 126)
				procedures (123, 139)
				methods (125)
		group process support (160)	technical measures (2, 251)	access control (2, 251)
				concurrency control (2, 251)
				undo (2, 251)
				version control (2, 251)
				turn-taking (2, 251)
			system architecture (GDSS) (346)	a database (346)
				a model base (346)
				group functioning procedure (346)
				easy to use flexible interface (346)
		software (60, 123,139, 142, 160)	groupware integrated tools (160)	workflow (160)
				database sharing (160)
				contact management (160)
				group scheduling (160)
				variety of environments (160)
			bird's eye view (33)	visibility of embodiments (33)
				actions (33)
				feedthrough (33)
			Software features (GSS structures 164)	anonymity
				simultaneity (164)
				electronic recording (164)
				display (164)
				structured interaction process (164)
				enhanced information processing (164)

APPENDIX 2: GROUPWARE FEATURES CONCEPTS OF CSCW

Level 2	Level 3	Level 4	Level 5	Level 6
Groupware functionality	groupware usability (162, 163)	process measure (214) (teamwork (163, 288))	effectiveness (88, 162, 214, 288)	accuracy (88)
				completeness (88)
			effectiveness measures (89)	number of ideas (89)
				decision quality (89)
			efficiency (91,162, 214, 288)	resources expended (91)
			participant satisfaction (288)	
		taskwork(163)		
		satisfaction (162, 235, 236) satisfaction measures (234)	subjective experience (234)	
			system satisfaction (234)	
			comfort (235) freedom of discomfort (236)	
			acceptability of use (235) positive attitude of use (236)	
		system usage (268, 269)	exposure (to new technology) (106)	testimony (106)
				observation (106)
				experience (106)
			acceptability of use (235) positive attitude of use (236)	
			perceived daily use (268)	
			frequency of use (268, 269)	
			number of applications used (268, 269)	
			number of tasks supported (268)	
			duration of use (269)	
			variety of tasks performed (269)	
			product performance measure (57)	completion time (57)

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