Supporting Organizational Learning with CSCW-Applications — The Information Trader Concept

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1 ORGANIZATIONAL LEARNING AND N:M-COMMUNICATIONS

The consensus on the significance of Organizational Learning (OL) still leaves unexplained how OL can be supported with modern information technology — especially CSCW-applications —, and which new functionalities are needed.[8][5]

Starting from the standpoint of organization theory, one might argue that if organizations are to learn, they must focus on a) knowledge acquisition, b) storage of information ("organizational memory"), c) information distribution, and d) information interpretation and assumption sharing.[12][6] Most of these tasks are backed by communication processes between the members of an organization.[6] Quite unexplored are aspects of information distribution that are central to an organization's benefitting from learning, namely how members of an organization who possess information and those members who need specific information and know-how can find each other quickly and share expertise.[12][4] This central challenge of organizational communication can be put into one sentence: Bring the right information in the right time and appropriate quality to the place where it is needed. Thus, idealistically an n:m information distribution or communication among organizational members should be achieved. In this vein, the underlying problem of this imperative can be coined in one question: How can an efficient n:m-communication be supported?

The argumentation in the remainder of this article is organized as follows: In any given organization there are individuals requesting information and individuals offering information at the same time. This situation can be characterized as the organizational information market. Chapter 2 briefly discusses how the organizational information market or n:m-communications can

be supported through CSCW-applications including e-mail, bulletin board systems and news-groups. Due to their limitations it is argued that there is a need for new functionalities aimed at supporting n:m-communication. The Information Trader Concept as an actor-based approach is introduced in chapter 3, which may serve as an adequate concept for improved support of n:m-communications.

2 CSCW AND N:M-COMMUNICATIONS

Four types of relevant interaction relations among members of an organization can be subdivided with different costs arising, 1:1 (known partners), n:1 (individual information request), 1:m (individual information offer) and n:m (organizational information market, see Figure 1). For those who need information the adequate contact is often unknown, for those offering information it is additionally difficult to see who is in need of what kind of information ("lack of informational transparency").

<div style="text-align: center;"> <i>Information offer</i> \ <i>Information request</i> </div>	1	m
1	<i>Well known Partners</i>	<i>Individual Information Offer</i>
n	<i>Individual Information Request</i>	<i>Organizational Information Market</i>

Figure 1 Communication relationship matrix

In order to receive the required information the employee passes a request to several potential partners, or requests information which has been put into the system from a variety of other sources. The conspicuous characteristics of these sequences are that every employee:

- requests information of n potential senders,
- transmits requests or information to m potential receivers and
- may or may not know his communication partners.

The first two points are referred to as n:1 and 1:m-relationship. Thus, each employee faces a n:m-communication situation.

If we understand OL as a n:m communication problem, then the question arises, how, to what extent, and which IT-systems may contribute to supporting the organizational information market?[18][12] For various reasons CSCW-applications including e-mail, bulletin board systems and newsgroups will cover n:m-communication situations.[16] CSCW-applications can generally be defined as computer-based systems that support groups of people engaged in a common task or goal and that provide an interface in a shared environment.[7][9][10][13]

In order to understand specific requirements we shall look at common communication patterns within organizations. The communication partners may be situated in distributed places and

time zones, with the result that the employee has to rely on asynchronous communication. [7] Due to the fact that even in routine work there is a need for ad-hoc problem solving and negotiations with experts [19], and bearing in mind that no workplace has entirely structured tasks [22], we can conclude that there is also a requirement for unstructured communication.

The procedure can be summarized as follows: the employee searches for a communication medium which, at the minimum, will allow him to conduct unstructured communication in an asynchronous manner with an undefined number (n:m-relationship) of known or unknown partners. Given the existing CSCW application types, we can show that these specific requirements, which are not considered unusual in the context of every-day-work, have not yet been satisfyingly matched. It is for this reason that we examine available CSCW applications from this particular point of view: [7][23][24]

Table 1 Functional requirements for CSCW applications

	Support of asynchronous communication	Support of unstructured communication	Support of n:m-communication with unknown partners
Electronic Mail, Message Handling Systems	yes	yes	no
Bulletin Board Systems, Newsgroups, Computer Conferencing	yes	yes	yes
Multi-user editors	yes	yes	no
Group Decision Support Systems, Electronic Meeting Rooms	yes	no	no
Teleconferencing	no	yes	no
Intelligent semi-autonomous Agents	yes	yes	yes
Workflow Systems	yes	no	no

Electronic mail or more general message handling systems (MHS) are mainly used for 1:1 and 1:m communications where the members of a group are usually known. However, if communication partners are unknown the distribution of informations in a "broadcasting" manner to all members of an organization may be considered. Obviously this leads to a high distribution of knowledge, but increases the "information overload" among the receivers who even may "flame" the sender, regarding his mails as junk mails.[9][4][21] The implementation of thematical focused newsgroups, the electronic conservation of frequently raised discussions and questions ("frequently asked questions"), or even the structuring and filtering of incoming informations as in the "Object Lense System"[14] may help to solve these problems. In this context newsgroups and bulletin board systems relatively best support n:m-communications. However,

these applications have limited functionalities for searching, filtering, and qualifying/assessing incoming data and news. Further investigation turned out more detailed performance criteria including "feedback", "intimacy", "information overload" and "flexibility". A more detailed discussion of different kinds of media which we have summarized under "Bulletin Board Systems, Newsgroups, Computer Conferencing" can be found in [20] and a definition for "Intelligent semi-autonomous Agents" can be found in [23].

Table 2 Performance of CSCW applications according to n:m-communications

	Bulletin Board Systems, Newsgroups, Computer Conferencing	Intelligent semi-autono- mous Agents
Feedback	low	medium
Intimacy	low	medium
Information Overload	high	medium
Flexibility	medium	high
Search and Filter Costs	high	medium

The *feedback* criterion [5] is comparable to the termination aspect of computer algorithms. The information request, which is sent to a newsgroup doesn't terminate. Nor does it contain information indicating whether it has been processed or not. The sender can not ascertain whether no information was available, existing answers were lost or the complexity of the question required more time than was allocated. In respect of intelligent agents, feedback between the user and the agent exists, just as it exists between agents, but may need more time. The current status of a request remains unclear to the user until a feedback is received.

Intimacy [5] can be seen as a personal or impersonal approach type to a partner. This contributes to the probability of a qualitatively satisfying response; impersonal (anonymous) requests are less likely to be processed. Furthermore, intimacy may be complemented by privacy. In both respects, intimacy is preferred in communication. Newsgroups do not contribute to intimacy. The search for and supply of information can be read by all members of the newsgroup which may lead to conclusions being drawn about the information patterns of a particular member.

Information overload can be minimized by sticking to narrowly defined topics. [11] In agent technology, this is a task of defining goals and algorithms; the more the user has to define the greater the reduction in useability. In newsgroups the overload is multiplied the more members there are using the medium, also reducing useability. This criterion in whole also contributes to search and filtering costs.

Flexibility [2][20][23] here is understood towards cooperation; it addresses the question of whether it is easily possible to interrupt or terminate a communication sequence and immediately construct another. The more flexible an application is, the more likely it is that it will be used in a communication act or as part of a communication sequence. If the cooperation process can not be structured, the communication sequence used can not be predicted. Nevertheless, communication acts occur and can be subsequently arranged in a sequence. In this case, information technology can still support individual acts, but has to remain open for flexible changes in its use while changing from one (even unsupported) act to another.

Search and filter costs are considered high in respect of newsgroups, since the information content of a contribution can not be determined prior to reading. Agent technology may be able to cut these costs by providing search and filtering mechanisms with several independent agents working on different tasks but the user may instead be faced with the task of filtering the output of the agents, not to mention the costs for primary initialization of each agent.

In both – newsgroups and agents – the user provides either the agent(s) with tasks and goals, or the newsgroup with direct requests matching his subjective information requirement. In contrast to agents, information requests and supply in newsgroups only match randomly and are transitory (thus not permanently and readily *available*).

As a result, they are all unsatisfying attempts to compensate for the absence of an efficient and effective n:m-communication-media including the communications with unknown partners .

A special requirement of media functionality to support this communication has not yet been matched by existing applications. The starting-point for multi-thread, automatic, structured, high qualitative information and knowledge acquisition, distribution and adequate presentation may evolve through the use of intelligent agents.[1][3][15]

3 SUPPORTING N:M-COMMUNICATIONS: THE INFORMATION TRADER CONCEPT

In any given organization there are individuals requesting information and individuals offering information at the same time. This situation was characterized as the organizational information market. A promising approach would be to support the existence of information markets. To be precise, "market" is not the correct metaphor, because there is no real pricing mechanism. There is, however, supply and demand of information which needs to be matched at minimal cost and effort for the individuals affected.[4] A possible concept which might be able to support the n:m communication at low cost could be the Information Trader. Figure 2 illustrates the idea of the Trader. Every user is supposed to have his own personal agent which is, however, not tied to the users session.

- (1) Defined Release of Information through User 1
- (2) Search Request for Information by User 2
- (3) Request from Trader 2 to other Traders
- (4) Trader 1 finds fitting and released Information and passes it on
- (5) Other Traders also pass on Information to Trader 2
- (6) Preselection / Prefiltering of Information through Trader 2
- (7) Proposal of Information through Trader 2 to User 2

Figure 2 The Information Trader Concept

Suppose User 1 releases information to Trader 1 for trading, so that the system can pass on the information to other users autonomously. Normally, a user will not release all his information, thus mechanisms need to be incorporated in the Trader which help to determine what information should be accessible to which person. One way to do this would be a simple access control list. Perhaps more convenient would be an organization model which contains the membership to groups, departments or functions of other individuals in the organization. Information may then be restricted to the specific groups or functions in the organization, e.g. the board of directors or the system administrators.

If User 2 needs information, he can start a search request through Trader 2, his personal agent. Trader 2 sends this request to all the other Traders accessible in the network of the organization. Trader 1, among others, receives the request, searches in the data and may find information which was released for the person who is the owner of Trader 2 (i.e. the person requesting). Trader 1 then autonomously returns all data which fits to the request given by Trader 2. The same happens with other Traders. Trader 2, after receiving all the information, then makes a preselection. Therefore, a valuation component is needed, which can be formed by the user who owns the Trader. The underlying assumption is that individuals in organizations normally have estimates concerning the quality of information received from specific sources in the organization. Information from sources that regularly provide high quality are preferred and in order to filter the information received, an individual then sort the information by quality, normally by using simple heuristics. Consequently, the Trader needs a valuation component to reproduce this action that needs to be flexible for the user's wishes. Having finished the selection and filtering procedure the Trader can forward the information available to User 2.

The advantages of the concept are:

- it avoids information overload due to filtering which occurs at the agent level not at the user level,
- information seeking efforts are accomplished by the agent, only appropriate or — if specified — ambiguous data is forwarded to the user,
- agents may forward requests to other agents or data bases where the likelihood for finding appropriate information is higher. This helps to avoid the inefficient broadcast of requests to all members associated with a group.

The Information Trader Concept focuses on the exchange of information and expertise in terms of communication and data retrieval functionalities. It can also be extended through artificial intelligence.[13] Combined with functionalities for information and expertise capturing the concept may result in computer-resident organizational memories that are superior to the human components or organizational memories and at the same time contributes to OL.[12][17] The discussion of a detailed specification including criteria for secure communication is currently under way. For a prototyp implementation Lotus Notes as a application platform and high level script languages will be considered.

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