emancipation. The notion of crystallisation of organisational learning into artefacts is suitable because it focuses on technical artefacts while taking praxis as the basis of analysis. Thus, avoiding to understand organisational learning as mere system optimisation or gathering of information, but rather as the active acquisition and construction of ability to act.

In reflecting a materialist understanding of organisational learning into design of CSCW applications we should maintain the procedural memory of the organisation by transforming existing artefacts crystallising this memory into new artefacts. Further we should support continual crystallisation of organisational procedures and knowledge into the CSCW application by facilitating tailoring and easy redesign. Finally we should support continued organisational learning by formalising and making explicit the current modus operandi by the CSCW applications. Thus making the CSCW application a Marxo-Freudian tool for building consciousness about the existing limitations in order to transcend these and build a new emancipated praxis

References


CSCW as Form of Organizational Memory: Implications for Organizational Learning
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Organizational memory is a topic currently receiving attention from a variety of disciplines including organizational studies, communication, and information systems. As a concept, it focuses attention on the organizational processes through which organizational knowledge is stored and retrieved, and the material bases in which this occurs. Consequently, it offers a useful approach to understanding how organizational learning works, particularly with respect to the form(s) it takes.

Much of the recent work on organizational memory is focused on one or another form of organizational memory. For example, economists Nelson and Winter (1982) identify organizational memory as the performance of routines. Yates (1990) discusses documents, while Ackerman and Malone (1990) concentrate on a variety of information technology. Walsh and Ungson (1991), in their oft-cited review of organizational memory literature, develop five different types of “retention facilities”, but do
not include information systems. Stein (1995) makes an effort to integrate information systems with other forms of organizational memory from a content and process perspective, but does not systematically address differences in form.

One theoretical approach which offers a comprehensive framework for different forms of organizational memory was developed by Klaus Krippendorff. Writing from a general systems perspective before the proliferation of personal computing, Krippendorff (1975) focused on the information processes and the material basis of social memory. He also noted how the development of computers would be relevant to this framework. Now that computers are common, his work can be extended to include the role of CSCW technology in organizational memory. This paper will develop that focus and then discuss its implications for organizational learning.

THREE KINDS OF ORGANIZATIONAL MEMORY
In determining how the concept of organismic memory might be extended to social organizations, Klaus Krippendorff (1975) focused on the information processes associated with the material basis of social memory. Krippendorff defined memory as:

a form of explanation in which the material basis or particular information processes within machines or organisms, or within social forms of organizations are taken to account for the observation that information about past events participates in structuring the present and future behavior of a system. In a sense, this is a structural-behavioral form of explanation. (1975: 32)

Krippendorff (1975) proposes that social memory can be conceptualized as manifesting in three different modes of information storage and retrieval: temporal memory, memory involving records, and structural memory. Looking at the use of CSCW technologies, we can see how different aspects serve as different kinds of memory, and consequently play different roles in organizational learning.

Temporal Memory
Temporal memory stores information incrementally as it circulates continuously; the transmission process involves small delays at each point, and the complete series of steps required for transmission is an identity relation with the basic information. Retrieval of information from this form of memory is accomplished through interception of transmission at a particular point in time and space. (Krippendorff 1975: 19-22) Non-technological examples of this type of organizational memory are the organizational processes and narratives that are transmitted from member to member throughout time. Temporal memory describes a general infrastructure for learning in communities of practice (Lave and Wenger 1991).

CSCW applications which support synchronous communication serve as a form of temporal memory; examples are awareness and videoconferencing tools. These technologies act as conduits for the transmission of information; together with the human users, they transmit continually changing information with relatively small time delays. Their role in organizational learning supports the transmission of organizational knowledge through interactions among organizational members.

Memory Involving Records
Memory involving records is constituted by semipermanent changes in a medium that persists in time; the information is stored spatially. Storage and retrieval are complementary and invertible time-distinct transformations (encoding and decoding respectively). These processes are dependent on cognitive capacities for classification and labeling. (Krippendorff 1975:22-25) A standard example of this kind of memory involves the writing and reading of books. Learning is often thought of as decoding and assimilating this kind of knowledge. Asynchronous communication and knowledge base technologies such as email and communication databases are a form of social memory with records. These technologies involve the storage of encoded information in separate records which can be individually manipulated. As such, they support the aspect of organizational learning that involves shared representation(s). Argyris and Schon refer to this as the organizational or public maps that are "the media of organizational learning" (1978:17).

Structural Memory
Structural memory is created through adaptation, it may be considered synonymous with organizational learning. Writing about this form of memory, Krippendorff states: "Information is manifest in the organizational structure or in the mode of operation relative to a particular environment." (1975:32) Retrieval of the information is accomplished by triggering the behavior. This kind of memory improves an organization's ability to cope with the environment by incorporating information about coping behavior directly into the organizational structure; the learned behavior is performed when triggered by environmental conditions. Examples of structural memory are family and legal structures which have adapted over time to changes in their environments.

Together, the implementation and adoption of CSCW technologies constitute a form of structural memory in
organizations. Once adopted, CSCW enables and enforces particular patterns of behavior among organizational members. These patterns emerge out of design decisions that occur during implementation. Orlikowski’s (1992) example of software design heuristics which were implemented into software tools that then functioned to constrain the designs available is a good illustration.

**ENHANCING ORGANIZATIONAL LEARNING**

The popularity of CSCW technologies can be explained in terms of their ability to increase organizational memory capacities. CSCW technologies affect the time, space and structural capabilities of organizational memory in a desirable manner. A major organizational function of these technologies is to minimize the time- and space-related distances between organizational members. This is the underlying message of the familiar matrix about same time, different time, same space, different space.

Through extending organizations’ memory capacities, CSCW enhances organizational learning in several ways. As temporal memory, CSCW technologies such as videoconference and awareness applications compress geographical space, thus increasing the amount and extent of communication that can occur in a given situation. This expedites organizational learning over larger geographic areas. Through increasing organizational capacity for memory involving records, CSCW technologies such as electronic mail and shared databases extend the amount of knowledge that can be shared among organizational members. Additionally, retrieval time for accessing spatially stored information is decreased through the use of computers (considerably more than for temporal memory).

The implementation and adoption of CSCW constitute a direct manifestation of organizational learning as structural memory. The changes in organizational structure and routines that accompany the adoption of CSCW technologies manifest this adaptive process (Barley 1990). Recent interest in business process reengineering designed around information technology is an indication of this. Unplanned structural adaptation may be less obvious given the time lag involved; the anticipated trend toward networked or flattened organization is one common image that conveys some of this change.

**Tradeoffs in Time/Space/Structure**

A note about tradeoffs is in order here. The tradeoff between time and space has long been an accepted tenet of computer science. This is as true for the relation between CSCW technology and users as it is within computers. Videoconference and awareness technologies transform behavior patterns involving the exchange of recorded messages into concurrent interaction -- a dependence on spatial records over time is replaced by temporal memory requiring less physical storage space. Repeated instances of temporal memory involving a question and answer session with an expert can be transformed into an exchange with a knowledge base such as Answer Garden (Ackerman and Malone, 1990) that substitutes computer storage for the expert’s time.

The tradeoffs between structural memory and the other two forms are also interesting. Structural memory requires less storage space than records and can therefore be more economical. Technology, at base, is structure. The compression of time and space provided by CSCW technology come at the expense of increased structure; changes in structure include the intrusion of the technology itself into the social realm, along with changes in organizational roles. Increasing reliance on resources such as electrical power, technical knowledge and financial capital, all associated with high technology, may result in increased rigidity or inflexibility -- vulnerability of institutional information systems to crackers and terrorists is an example of this.

**References**


Cooperative processes

From the point of view of its work practice, a group of persons engaged in a common performance is not an organizational structure but it is a social aggregate cooperating in a work process, participating to a cooperative process (De Michelis, 1996). A clear understanding of cooperative processes, of their participants, of the relations binding them together in a group, of the factors affecting, both in positive and negative terms, their performance, is on the other side the basis for designing and enacting effective cooperative processes, and for providing them with adequate tools.

A cooperative process can be characterized by the communicative relations binding its participants to each other and with the actions they are performing (Winograd and Flores, 1986; Medina Mora et al., 1992; De Michelis and Grasso, 1994; De Michelis, 1995, 1995b, 1996). The basic communicative relations within a cooperative process are therefore the conversations giving raise to the cooperative process itself where the customers and the performers reach an agreement on the actions to be performed and share the evaluation of their execution. The actions performed within a cooperative process are, in fact, embedded into the conversations between its customers and its performers. Both customers and performers are participants of the cooperative process, they cooperate in it consuming their resources and creating together a value.

The value of a cooperative process, in very general and abstract terms, can be characterized by the increase of the potential of action it generates. The knowledge it generates (Nonaka and Takeuchi, 1995) is a principal component of it. Having this in mind, it is possible to say something more about the value of a cooperative process.

First, the value is not created by the performers for the customers. The customers themselves contribute, in fact, to the process specifying their condition of satisfaction in terms of a clear request for actions and later publicly claiming how much the performers satisfied them. Second, the created value is such not only for the customers but also for the performers. Not only the customers, but also the performers, take advantage of the value created within a cooperative process. Finally, within a cooperative process, both customers and performers consume resources, both have costs, since any performed action and/or interaction consumes irreversibly an existing potential for action.

As it has been said above, the knowledge created within a cooperative process is a principal component of its value: there is therefore a direct link connecting value creation and communication in a cooperative process. Through their conversations the participants in a cooperative process share an experience constituting them into a whole, into a group, despite they occupy different positions in it: they, in fact, share a space, a set of artifacts, a language, the knowledge of the world they live in and of the possibilities it opens, the history of the cooperative process to which they participate and the value they create within it.

As a social phenomenon a cooperative process is complex: the group involved in it is a network of social relationships that cannot be reduced to any functional and/or hierarchical model. Despite any attempt to plan its evolution with respect to its expected outcome, its history is unpredictable. The group members during a cooperative process, in fact, change their understanding, their image of the requested actions, their ways of performing them, their mutual agreements in a history of successes and failures, in a common experience of learning and knowledge creation, in the building of their community bounds.

The complexity of a cooperative process has a social character: it derives from the way in which the 'biological' autonomy of its actors conflict each other impacting the complication of its performance. It is possible to give an account of it in terms of a combination of two factors: its