

TOWARDS LEARNING COLLABORATIVE NETWORKED ORGANIZATIONS

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The concept of Learning Collaborative Networked Organizations merges both the CNO and the LO paradigms. It aims at augmenting the quality of decision-making and of corporate governance taking inter-organizational knowledge into account. The rationale behind the proposal is that CNOs are still lacking research and work for enhancing their agility where rapid decision-making is crucial for achieving their goals. In this paper knowledge management is proposed as an approach for tackling this problem. The paper presents the first step for a framework for gathering information and for generating new knowledge dynamically according to what users need for given situations. The corporate knowledge is retained, organized, shared and re-used to the benefit of individuals and of CNO as well as of their respective members.

1 INTRODUCTION

Emerging markets and the development of new technologies, such as Internet and web search tools are some of the causes for breaking barriers among people, cities, organizations, and even countries in the whole world (Friedman, 2005). Facilitators include the easy and increasing access to communication channels and information, as well as the production of content by and for everybody in a never-ever-thought rate. Manuel Castells (Castells, 2006) points out that the amount of information provided nowadays is changing life styles and the way of making business. In fact, this reveals that in the global market there is a need to be competitive, to be aware about the changes, to be connected to others, to collaborate, and to share knowledge. It means that organizations should monitor their products, clients, suppliers, competitors, as well as the changes occurring in the market in order to be competitive and, as a consequence, to survive. Therefore, it creates a kind of (dynamic) knowledge chain.

Organizations shall improve their competitiveness when they work collaboratively with each other, in a so called Collaborative Networked Organization (CNO) paradigm. According to Camarinha-Matos (2006), a CNO is a network consisting of a variety of entities that are largely autonomous, geographically distributed, and heterogeneous in terms of their operating environment, culture, social capital and goals, which collaborate to better achieve common or compatible goals, and whose interactions are supported by computer networks.

In order to support the collaboration process, challenges such as how organizations should share common goals, build some level of trust, agree on common practices and values as well as inter-operate based on common technological infrastructures, have risen up (Afsarmanesh, 2005). The supporting

CNO structure for collaboration among organizations has been called Virtual organization Breeding Environments (VBE). A VBE is an association of organizations and their related supporting institutions, adhering to a long term cooperation agreement, and adoption of common operating principles and infrastructures, targeting the growth of their chances and their preparedness towards collaboration in potential Virtual Organizations (VOs) (Afsarmanesh, 2005). According to Rabelo (2004), VO is a dynamic, temporary and logical aggregation of autonomous organizations that cooperate with each other as a strategic answer to attend to a given business opportunity or to cope with a specific need, and whose operation is achieved by a coordinated sharing of skills, resources and information, totally enabled by computer networks.

The essential rationale of this paper is that current approaches for implementing CNOs and their manifestations (VBEs and VOs) have not so far adequately explored an important aspect for enhancing their agility: they have not been incorporating and effectively using the knowledge generated along the CNO life-cycle. Additionally, there is still a lack of adequate support for managers to consider past experiences, as there is no – or almost none – registering and further dissemination for future use of what has been learned individually and collectively during their life cycle. It is argued that both good and bad experiences (CNO organizational memory), which usually comprise precious information, are simply lost during the CNOs' life time.

In this paper the concept of Learning CNOs (L-CNOs) is introduced by making use of the Learning Organizations (LO) paradigm supported by the Knowledge Management (KM) approach. It represents an extension of the LO concept to strategic alliances based on the knowledge spread over the CNO, where members are usually highly heterogeneous, independent and even competitors of one another. Learning CNO aims at augmenting the quality of decision-making and of corporate governance taking inter-organizational knowledge into account. If a certain CNO is able to learn with its success and failures cases, it can reduce risks and better plan strategically its future. The objective of this paper is to introduce a systematic approach on how CNOs can become L-CNOs, making use of KM and LO philosophies.

The content of this paper is divided as follows: section 2 stresses how learning organizations and knowledge management concepts are combined for supporting a Learning CNO environment; section 3 presents the importance of inherited data, information and knowledge in this process. The supporting tools for the Learning CNO are shown in section 4 and, finally, section 5 provides preliminary conclusions and next steps.

2 LEARNING ORGANIZATION AND KNOWLEDGE MANAGEMENT

As time passes by, different categories of organizations have risen up with different working styles. Figure 1 shows the main characteristics of different kinds of organizations, considering their communication scope, life cycle, decisions styles and knowledge usage. The figure is divided in four quadrants. The lower-left quadrant represents how traditional organizations were structured in the past: there was an intra-organizational communication scope, focusing mostly in operational tasks. Decisions used to be taken without considering neither past information nor knowledge, and both knowledge dissemination and human aspects are low.

The upper-left and lower-right quadrants represent some forms of organizations nowadays. Organizations presented in upper-left quadrant (CNOs) have an inter-organizational communication scope, but they are mainly focused in decisions taken to be applied in operational tasks, similar to the traditional organization view, taking into consideration current data and information, even though they require knowledge. In this quadrant it is possible to observe the improvement of knowledge dissemination and human aspects to an intermediate level. The organizations present in the lower-right quadrant (LOs), however, despite they have been working in a “closed world” due to its focus be an intra-organizational communication scope, they focus on operational, tactic and strategic decision, they are intensive knowledge users and human aspects are relevant.

The last quadrant, upper-right (L-CNO), is how the proposed approach sees future organizations. L-CNOs join the inter-organizational communication scope (CNO) – organizations willing to collaborate – with a knowledge oriented view (LO) making highly intensive use of the knowledge in order to take decisions focused not only in the operational level, but also in tactic and strategic decisions. The processes are based on what has been learned and ameliorated along the time horizon. This paper aims to contribute as a starting point towards establishing stronger theoretical foundations of Learning CNOs.

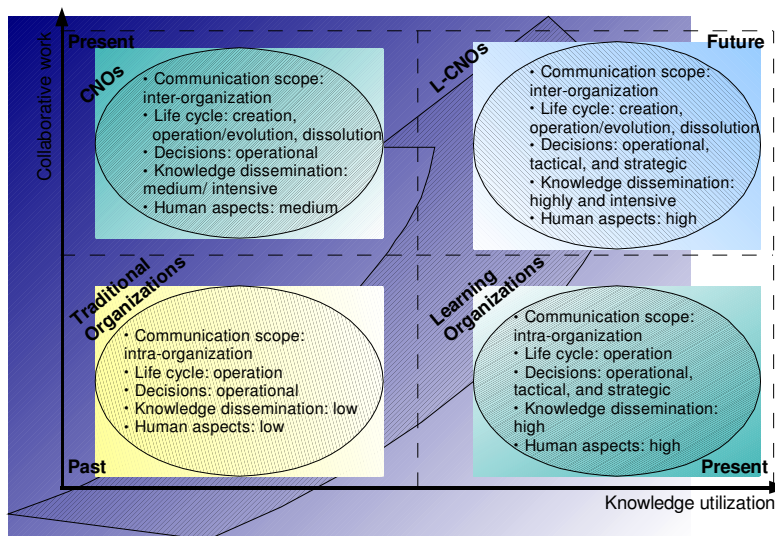


Figure 1- Organizations - past, present, and future views

Peter Senge (2004) explores Learning Organizations concept in a prescriptive view splitting it in five disciplines that he called: systems thinking, personal mastery, mental models, shared vision, and team learning. The first three disciplines have particular application for the individual participant, and the last two disciplines are applied for groups. Senge also argues that the individuals who excel in these areas will be the natural leaders of learning organizations. From another point of view, Nonaka (1995) coined the term of knowledge-creating in companies by the understanding of the dynamic nature of knowledge creation and to manage such a

process effectively. It consists of three main elements: i) SECI, that stands for socialization, externalization, combination and internalization; ii) Ba, that can be defined as context in which knowledge is shared, created and used through interaction; and iii) knowledge assets, constituting the inputs, outputs, and moderating factors, of the knowledge-creating process.

LO and KM can complement each other. On the one hand, as defined by Senge (2004), LOs act as human beings cooperating in dynamical systems that are in a state of continuous adaptation and improvement. As such, they need to be fed with knowledge in order organizations can behave like that. On the other hand, KM emerges as the supporting methodology for creating, disseminating, and promoting knowledge use. However, the existence of KM methods and techniques is not enough: CNO's people must be motivated to use the knowledge. In this sense, LO can provide the support to KM activities.

2.1 Learning CNOs

CNOs, as they are nowadays, are mainly focused on daily events, specially during the VO life-cycle. However, past data is extremely important and may be used as source during the learning process. Data collected, stored and not used are seen as *potential knowledge*. Potential knowledge is related to the knowledge that may be extracted from the analysis of a vast amount of data. Data combination, interrogation, and speculation can lead to precious information and gives advantages for the decision making processes in organizations (Figueiredo, 2005). Some techniques available for this extraction are knowledge discovering in databases, intelligent data analysis, among others.

CNOs may have the capacity to learn from their own experiences as well as to use their data in order to become more competitive. On the one hand, in a learning CNO, people are motivated to externalize their knowledge and the LO is responsible for the process of knowledge generation, on the other hand KM offers support for using such knowledge.

Once knowledge is retained and made available as formal documents, procedures and CNO's culture, it should be used not only to improve the operational phases in CNOs' instances (VBEs and VOs), but also in tactic and strategic planning. For example, when a given VO is not fulfilling its deadlines, some decisions should be taken in order to accomplish with the scheduling previously agreed (operational phase). The reasons "why the 'that' VO was delayed" shall be analyzed and, if suitable, VO members must receive a clearer set of instructions or the VO launching process should be re-studied/re-structured (strategic planning).

Considering the definition of CNO presented in the introductory section, in this work, a Learning Collaborative Organization (L-CNO) is defined as a CNO that is able to learn in a dynamic collaborative environment in order to continuously adapt and improve itself. A L-CNO is able to capture CNO knowledge – stored in people's procedures and actions or in databases – and to further organize, formalize, re-store, and make it accessible to its actors in order to make improvements at operational, tactic and strategic levels. This concept is supported by knowledge management and computer systems. The kick-off process for a L-CNO is to be concerned to what has occurred during the CNO life-cycle, it can be done via the inheritance process that is describe in the next section.

3 INHERITED DATA, INFORMATION AND KNOWLEDGE

The basis for a Learning CNO is the use of data, information and knowledge inherited by the CNO – its organizational memory – as well as the preparedness of CNO actors. In order to have a clear picture about inherited content, it is important to frame the nature related to this issue. VOs have temporary and distributed behavior. They are legally and logically dissolved after the product or service be delivered according to the agreed contractual clauses (Rabelo, 2002).

Although CNOs manifestations¹ have a well defined life-cycle comprising the creation, operation/evolution and dissolution (Camarinha-Matos, 2005), the time-horizon varies from short to long-term collaboration depending on its characteristics. Nevertheless, CNO actors are usually able to identify what happened within their enterprises when a VO is running, however they seldom know what happened and the historical performance of other CNO actors. It makes the process of gathering data, information and knowledge a hard task because they are spread over the CNO.

The task of the VO closing/dissolution, aiming to transfer the VO experience and data, especially VO performance history, to the VBE is known as VO Inheritance (VO-I) (Loss, 2006). This process is extremely important and demanding as such, it is facilitated if it is supported by computer systems.

Despite the differences between VOs, VO-I approach gathers relevant data, information and knowledge throughout the CNO and make it easily accessible, no matter its duration. The main users of the knowledge produced by the process of VO-I are the VBE actors. However, VOs actors can also benefit from the knowledge base made available via VO-I.

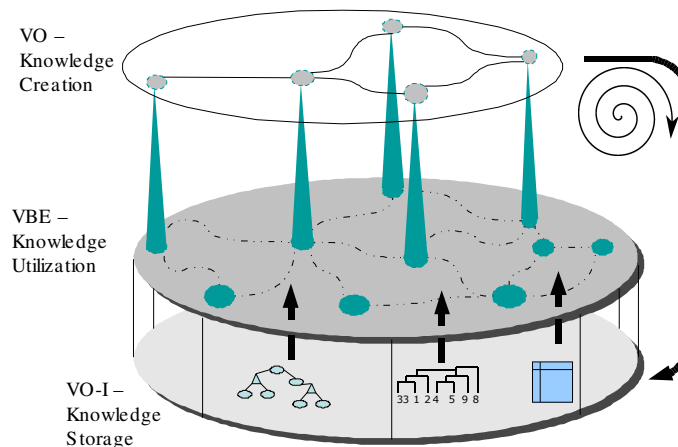


Figure 2 - Global Framework for VO-I

Figure 2 illustrates the overall vision of knowledge flow for VO-I. The top level is seen as an appropriate environment for knowledge creation. VOs are the main producers, because they work dynamically with a diversity of products and services and they are in touch with real and unexpected situations. After the VO dissolution

¹ The ones that have relationship like VBE and VOS where a VBE is the facilitator to create of VOs, or between professional virtual communities and virtual teams.

phase, the knowledge produced by VOs shall be properly stored (bottom layer). The storage process may occur either in an electronic/digital way (automatic follow-up operations), or in a traditional way (like in printed reports and memoranda). The VBE (middle layer) appears as the main client of the knowledge. VBE shall use knowledge in order to create value improving its preparedness as well as advertisement campaigns to increase its reputation to the customers. The overall process occurs as a spiral which enhances knowledge time to time flowing through the three layers.

4 SUPPORTING PROCEDURES AND TOOLS FOR L-CNOS

VO-I is more than a sum of pieces of knowledge. It provides a complete framework with experiences, practices and case studies for CNO actors. KM is the approach adopted in order to support the knowledge retained in the VO-I process and that will be used in the L-CNO framework.

The KM model introduced by Nonaka (1995) was the starting point to KM in the academia. Since then many approaches have risen up. Nissen (2000) presented an amalgamated KM model that is used to support the proposal of this paper. This model includes both individual and collective entities. It is arranged in six phases, which are briefly described below:

1. Knowledge *creation* phase involves the discovery and the development of new knowledge. It also includes the knowledge capture where knowledge shall be new to a particular organization or individual.
2. After knowledge be created or gathered it must be *organized*. In order to perform this task, knowledge representational techniques are used, like keyword extraction, thesaurus, and ontologies to interrelate key terms and concepts.
3. The *formalization* process involves the conversion of existing knowledge from tacit to explicit form. It means to validate the knowledge.
4. Knowledge *distribution* phase is related to the dissemination to people and organizations, according to the access rights previously defined.
5. The *application* phase is related to using knowledge for creating competences.
6. Knowledge *evolution* leads in turn to further knowledge creation.

Despite its importance, KM is more a management philosophy than a mechanism. In this way, the proposed approach for L-CNO is also founded in three main pillars: briefing and debriefing process, knowledge discovering, and knowledge search. These pillars cover the six KM phases presented, linking it with the inheritance process.

4.1 Briefing and Debriefing

When dealing with knowledge intensive tasks, like in CNOs, it is important to map data, information and specially knowledge, by adopting a KM practice. There are some available practices like brainstorming, competence maps, brainwriting, heuristic redefinition, and others. This work applies and adapts the *Briefing* and *Debriefing* practices to the CNO context.

VO briefing consists in sharing with general information regarding VO actors. For example, processes to be executed, management procedures concerning the scope of specific VOs, what is expected at the end of the VO when it is dismantled. In summary, it is a general guideline elaborated *a priori* and that describes to the VOs how to proceed and the estimated outcomes. It comprises the *formalization* and *distribution* (overall Figure 2), two out of the six phases described by Nissen (2000). The former appears when the guidelines are official documents that are made available. The latter takes place when the instructions are disseminated among VO actors in a way all VO actors can have access to that knowledge.

During the process of **VO debriefing** VO actors are required to provide feedback regarding the occurrences during the VO life-cycle which will be cross-checked against the original plans (i.e. what was discussed in the *Briefing* phase). VO debriefing comprises three phases related to the KM approach presented by Nissen (2000). The first one is related to *knowledge creation* (Figure 2 top-level). VO actors are motivated to communicate their mental models and visions about the VO. It is done by sharing ideas and exchanging experiences and formalizing these ideas in working plans, strategies or even rules and, as a consequence, providing the organizational learning in the CNO. Hence, they are *creating* tacit and explicit knowledge. Once knowledge is written down and confirmed by someone else it is *formalized*. If some adjustment is done for the briefing in a further VO, *knowledge evolution* takes place. For example, documents produced by past VOs containing some suggestions about a certain procedure can be used in order to compare and improve processes, like partner search and selection.

Despite VO briefing and VO debriefing do not cover *knowledge application* (Figure 2 middle-top-levels), they provide the source for applying this knowledge. For example, information provided by the debriefing process in, its conclusions as well as the occurrences during the VO life-cycle are refined and, if suitable, used in the briefing process in another VO. This process is repeated for every VO so that VO briefing and VO debriefing are continuously improved. *Knowledge application* (Figure 2 middle-level) is settled when the gained experience (already formalized via documentation) is applied by the CNO.

It is important to emphasize that these processes require the ability to source and integrate information into a suitable format, use effective interpersonal skills to encourage positive contributions, follow up and prepare documentation

4.2 Knowledge Discovering in Databases

Briefing and Debriefing process deal with tacit and explicit knowledge, but not with potential knowledge. A perspective for dealing with it is to apply techniques of knowledge discovering in databases, such as Data Mining (DM) (performed in Figure 2 bottom-level). DM is the process related to the extraction of knowledge from data repositories aiming to identify valid, new, potentially useful and understandable patterns (Fayyad et al., 1996). Data provided from VO actors, products, schedule, performance indicators, trust indicators, and so forth, when collected, become potential knowledge and this kind of knowledge can be extremely important to the CNO.

The results coming from the DM process shall be shown to the managers as transparently as possible so that they do not need to know details about implementation, data cleaning and even databases. It means that with some mouse

clicks and few keywords the manager will have the results of a DM algorithm showing the patterns in data by using an easy-to-use human interface (Google-like). The functionality of knowledge discovering developed to test this concept is called *Mined Knowledge Search* (MKS). It is described in section 5.

If the rules² generated by a DM algorithm seem to be interesting to the manager, (s)he may use them or ask for a more detailed and intensive investigation. It allows managers to have dynamic access, to possible solutions. The evaluation and interpretation of results is up to the manager. It is important to highlight that this process guarantee that the results will be neither good nor accurate enough, however they can provide some insights to the managers allowing them to take smarter and better decisions.

4.3 Knowledge based information retrieval

Five of six steps presented by Nissen (2005) were shown until now: creation, formalization, distribution, application and evolution, but the *organization* (Figure 2 bottom-level) of the knowledge is still missing. Knowledge organization is as important as the other steps because there is no reason to have knowledge stored if it is not intended to be retrieved.

Traditionally, managers have access to information by using reports based on databases. However, they barely have an easy access to unstructured data, typically in documents spread around the CNO, such as plain texts, e-mails, chats, or even the reports produced during the process of VO Briefing and VO Debriefing. It is necessary an instrument for retrieving unstructured data in CNOs. It is done by a tool called *K-Search* that is also described in section 5.

Figure 3 summarizes the proposed approach. CNOs can become L-CNOs when the knowledge generated and used during the VBE/VO life-cycle is stored in non-human repositories, made available and incorporated to the CNO as routines, systems, culture, strategies, and so forth. The main support for L-CNO is found in three main pillars described in this paper - briefing and debriefing, knowledge discovering in databases, and knowledge based information retrieval. The overall approach is based in the six aforementioned KM phases

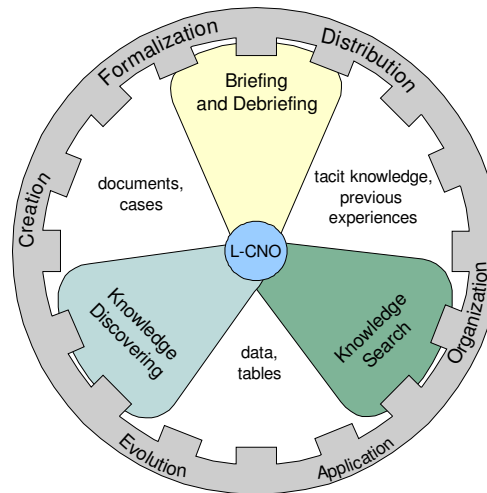


Figure 3 – General model of the proposed approach for L-CNO

² In this approach the results for DM algorithms are presented as rules (if-then), however there are other forms to represent it (Witten, 2005).

5 IMPLEMENTATION ASPECTS

The assessment of the overall approach has been done through prototypes implementation. The tool developed regarding the perspective of knowledge discovering in databases has been called MKS. MKS is internally divided in two phases. The first one comprises the selection of specific tables and the columns that appear to be relevant to be used by a DM algorithm. Data used in the DM process comes from the VBE database that usually follows a CNO reference model. Once the relevant dataset is made available, the second phase can be started, comprising the execution of a DM algorithm that will produce *Association Rules* (Witten, 2005). Association Rules may predict any attribute and also give the freedom to predict combination of attributes. As so many different association rules can be derived from even a tiny dataset, the interest is restricted to those that apply to a reasonably large number of instances and have reasonably high accuracy on the instances to which they apply to (Witten, 2005). Phase 1 occurs only once, when the DM algorithm is configured. Phase 2 is executed off-line, time to time according to a period settled by each CNO. The results (rules) are stored in a database that is accessible via a web service. Rules are not generated on-line because the process may take several minutes, or even hours, and it is not practical.

An attempt to retrieve unstructured data in CNOs has been developed under the scope of the ECOLEAD project with the *K-Search* functionality. It is a search engine that allows users to perform searches with semantic embedded and in a secure way. The *K-Search* functionality wraps KIM platform (Popov, 2003) which provides infrastructure and services for automatic semantic annotation, indexing, and retrieval of documents (knowledge organization). KIM is equipped with an upper-level ontology and a knowledge base providing extensive coverage of entities of general importance, but it does not cover the requirements for CNOs. An ontology related to the CNOs area (Plisson, 2005) was plugged to KIM in order to support documents related to CNOs and to provide shared meaning of CNO terms into documents. Therefore the *K-search* functionality is able to deal with information related to CNOs. Finally, the development of a tool to help the *Briefing* and *Debriefing* is under study.

6 CONCLUSIONS AND NEXT STEPS

This paper has introduced an approach where the concepts of knowledge management and of learning organizations are combined and applied to CNOs. Such approach builds a learning collaborative environment by supporting a more comprehensive decision-making, using data, information and existing knowledge about a CNO.

In order to overcome the necessity of VBE/VO managers in knowing which data, information and knowledge are right and proper, the process is split into three main activities: in the first one there is a transformation from tacit to explicit knowledge and vice-versa as well as the improvement of procedures by applying the processes of VO briefing and VO debriefing. The second one is characterized by the transformation of potential knowledge that is embedded or hidden in CNOs' databases using a data mining tool. The third one allows users to search for unstructured data supported by a tool to retrieve the already stored and semantically

treated knowledge. Most of the prototypes related to the presented approach are already implemented and will be described in details in another opportunity.

The proposed approach is seen as a learning environment where the corporate knowledge is retained, organized, shared, formalized and used to the benefit of CNO's people, CNO's members and CNO as a whole. Next steps include the investigation of the influence of corporate governance in learning, the final implementations as well as examination of how the overall learning process can be used in issues related to logistics in CNOs.

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