Towards a Social Interaction-based Cognition Model: An Analysis of Spatial Data Infrastructure

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Abstract

Distributed cognition is a psychological theory which assumes that knowledge lies not only within the individual but also in the individual's social and physical environment. Today, we tend to achieve cognitive results by means of a sequence of complex and subtly interwoven interactions, using technological devices, and with the help of other, more knowledgeable people. As dwellers of a new century, we are agents of a novel technological assembly where knowledge is socially produced, and nurtured by the various sources of many communities of practice (CoP). In this paper we propose a social interaction-based cognition model which applies distributed cognition and interoperability between different actors of CoP in web environment. The core components of the model are: Authenticity and Cohesion, Assemblage and Shared Meanings. We also present the main findings of qualitative research in a case of study to Spatial Data Infraestructure (SDI) and CoP around this technological assemblies.

Keywords: Social Interaction. Distributed Cognition. Communities of Practice. Interoperability.

1. INTRODUCTION

[SURROUND vs ENVIRONMENT PERSON vs INDIVIDUAL]

Studies have traditionally considered cognitive processes [1] and development as something possessed by individuals and residing in their heads. Accordingly, cognitive models have been reduced to the process being carried out by an individual. However, thinking and learning often involve giving up some higher-order knowledge and executive functions to the environment in worthwhile ways. From a distributed-cognition-based perspective, the person and its surround are taken into account as a single system in order to analyze thinking and learning contexts and processes. As for the person's surround, both social and technological factors need to be considered. Both undoubtedly contribute to cognitive development; they are more than external sources of stimulation.

The social development theory by Vygotsky [2] constitutes an important framework dealing with the social surround of the learning process. Vygotsky's theory involves an individual, with the help of *more knowledgeable others* (*MKO* in Vygotsky's theory), in a *zone of proximal development (ZDP)* environment. Our reasoning can be expressed in this way: without help from others, many of our ablest learning experiences, such as those resulting from interaction between the individual and *MKO*, could not be performed. Distributed cognition describes the cognitive aspects which are triggered between these individuals involved in the process, with the consideration of technological resources and environment.

The theory of distributed cognition [3] does not oppose to existing cognitive theories of the isolated individual. It rather encompasses those theories within a wider model where cognitive aspects are not just produced by an individual but also by the interaction among subjects, and between subjects and their envi-

ronment.

We believe that the topic of interaction is what remains to be studied in existing cognitive models. The study of social interaction and cognitive interaction will contribute to understand social cognition and [knowledge of humanity [4] that endures and keeps on growing beyond the life of an individual.]

In such a study, the application of distributed cognition could be [complemented with theories of] communities of practice (*CoP*) [5] and social networks (*SN*) [6][7][8]. When we work in a social network, as well as in CoP, we need to think of ourselves as an interwoven chain of nodes that interacts between each other. A social network is a social structure made up of social actors (nodes), such as individuals, groups or organizations [9][10]. CoP are present in organizations as much as in our ordinary life, as they are a facet of social networks.

We focus on interoperability of actors within social and technological environmental interactions, as well as on analyzing which roles are performed by actors in these contexts. We show the findings of a qualitative research we perform [with] inside? communities of practice [around] about? Spatial Data Infrastructure (*SDI*). SDI emerged as one technological solution of this century to manage and analyze physical space (land and water). The [technological assemblies] of organizations within a SDI have evolved and improved in several countries, at different scales (local, national, regional). SDI requires that each organization participating in building the [data?] infrastructure contributes providing its own [space information (or spatial ability)] within a common [information?] framework. [Space information which is interchanged share a common technology to allow the space to be visualized, analyzed and managed accordingly. To get such an infrastructure (SDI), social, cultural [11] and cognitive changes should take place within intertwined communities.] Space information is shared by means of common technology to allow the space to be visualized, analyzed and managed accordingly. To get such an infrastructure (SDI), social, cultural [11] and cognitive changes should take place within intertwined communities.

The paper is organised as follows. Section 2 introduces the theory of Distributed Cognition. Section 3 provides an overview of Communities of Practice. Section 4 describes Interoperability [ability] aptness. Section 5 presents a Y-model of the Social Interaction-based Cognition. Section 6 details a case study of Communities of Practice and interoperability of SDI. Section 7 goes on to describe conclusions and future work.

2. DISTRIBUTED COGNITION

This theory was originally developed in the mid-1980s by Edwin Hutchins. Using insights from sociology, cognitive science, and Vygotsky's psychology (cf. cultural-historical psychology), it emphasizes the social aspects of cognition. The theory provides a [more] balanced theoretical treatment of problem solving in real work situations, and supplies a new framework for cognitive science in general. Distributed cognition has been proposed as a new foundation for human-computer interaction [12].

[The unit of analysis is not the same as in previous cognition studies.] Distributed Cognition parts ways from previous cognition theories in that it employs a variable unit of analysis. Traditional cognitive theory takes the individual person as the proper unit of analysis. In this traditional view, cognitive processes are internal processes. Social, technological and cultural context is thus often left out of the analysis. In contrast, the theory of distributed cognition makes a larger cognitive system out of the individual and its socio-cultural context, one that is to be analyzed in a broadly traditional way, [such] as a computational system. Enlarging the unit of analysis in this way has the advantage that representations internal to the system are now external representations with respect to the individual agents that use and make use of them. So, distributed cognition is conceived as a system that entails both person and surround [3].

Distributed cognition can be considered as aligned with: (1) Vygotsky, whose cultural-historical theory [2] locates individual cognitions within, rather than just interacting with, social and cultural contexts of interaction and activities [3]; and (2) Cole, who had pointed out [13] that the proper unit of psychological analysis should be the joint socially mediated activity in a cultural context.

Within distributed cognition, Perkins [14][15] introduces a learning model in which he proposes not to take as unit of analysis the learner without resources in his or her surround –the *person-solo*, but the *person-plus surround*, or person-plus for short. People employ the surround to support, share and undertake outright aspects of cognitive processing. That is the perspective taken by the person-plus on thinking and learning contexts, to treat the person plus surround as one system. He also introduces the concept of *equivalent access hypothesis*, which distinguishes four factors: the kind of knowledge, the way it is represented, how readily it is retrieved, and how it is constructed [3].

Existing literature includes many examples of distributed cognition. They are diverse with varying com-

plexity. Simple examples involve problem-solving using pencil and paper or computers, to more complex metaphors in the context of navigating a navy vessel, or crewing a plane [16].

We think that the study of distributed cognition may alleviate cognitive drawbacks of learning designs based on traditional cognitive models:

- People often fail to apply knowledge and skills learned in one context to other situations [14] (cognitive transfer). Distributed cognition emphasizes collaborative learning, learning by practice and learning within communities of practice.

- People often fail to decontextualize[1]: Cognitive decontextualization is a required cognitive activity prior to applying cognitive transfer.

- People often fail to solve problems applying mediator instruments (such as technological resources). Cognitive distribution considers that thinking and learning often involve relinquishing some higher and executive function to the surround in worthwhile ways. Usually, this relinquishing includes the use of technological devices and resources which should be taken into account. Distributed cognition analyzes the interaction between subject and objects.

3. COMMUNITIES OF PRACTICE

Learning is not an activity that can be carried out in isolation. We learn from other people, either from the culturally produced artifacts that provide mediator elements [17]. Wells [17] argues that to understand learning we need to understand how an individual, as a member of a community, applies and produces representations in the collaborative effort to transform their shared world.

Wenger [5] argues that the primary unit of analysis (in sociological studies) is neither the individual nor social institutions but rather the informal communities of practice that people form as they pursue shared endeavors over time [5]. The author emphasizes that engagement in social practice is the fundamental process by which we learn and so become who we are. Three processes for individual and group identity formation

are identified in communities of practice, as the key elements for individual membership identity as well as for developing community identity: (1) mutual engagement, (2) joint enterprise, and (3) shared repertoire.

Learning takes place during active participation in a social group, which not only allows the individual to become a member, but also provides the elements for that individual to construct an identity through these communities. Individual identity, as well as social identity, affects the perception of the group and its common repertoire. Perception in consequence affects cognition and influences [in their?] tasks.

4. INTEROPERABILITY

When analyzing distributed cognition in web environment, access to resources and [relationships?] between actors is key. Distributed cognition is not conceived without communication, or without ability of its members to communicate.

Interoperability is the ability of making systems and organizations to work together (inter-operate). People (or organizations) working within an interoperability environment should develop a capacity or ability to exchange (and retrieve) knowledge, as well as to use the exchanged knowledge and to build new one upon them. While the term *interoperability* was initially defined for information technology or systems engineering services allowing for information exchange, a broader definition takes into account social, political, and organizational factors that impact system-to-system performance.

The three dimensions of interoperability include:

- Technical interoperability: refers to those technical issues to ensure that the technological components of information systems of participating actors are prepared to work together. Therefore it lets provide common mechanisms for transferring data and invocation of functions, transparent to networks substratum and information systems (applicable to multi-platform, multi-language systems). Among other questions, it refers to interfaces, interconnection services, data integration, middleware, data presentation and exchange, accessibility, open systems and secure systems. It comprises the use of technology to manage information structure, the structure of services, semantics of information, and semantics of web services [18]. The technical dimension of interoperability allows us to analyze an economic perspective of interoperation between actors. When considering the different roles that the actors can take in terms of consumer / producer, or supply / demand information (even other roles of the model RM-ODP)

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[1]Decontextualizing [2] is the handling of information in a way that either disconnects other information or backgrounds it [4], it is produced when the meaning of the signs is becoming less dependent on the spatial and temporal context in which they are used. For example, when we obtain (to induce) a general rule for a set of observed facts we abstract/produce a common structure behind the observed cases, so changing of propositional levels is applied.

we can have a clear view of flow and traffic information .

- Semantic interoperability: It deals with the meaning in the use of data and information and, in particular, ensures that the precise meaning of exchanged information can be understood by any application. The information must be interpreted in an univocal manner. Actors usually handle own definitions of information, which often introduces a disadvantage for the exchange of information. The information that is unequivocally performed is easier to be exchanged and interpreted, ensuring an adequate flow of information [18]. In this matter it is necessary to comply with a formal mechanism to define common elements. This mechanism should ensure quality, must be accepted and respected. Formal documentation that defines the data must be formally managed, allowing the actors to maintain reliability in them. On the other hand,they should be disseminated by the mass media, being available to every actor. Additionally, if the definitions are adapted to new requirements, the compatibility backwards must be guaranteed with previous definitions. Some of the tools available are classification systems, thesaurus, metadata, and ontologies.

- Organisational interoperability: This deals with the definition: (1) business goals, (2) modeling business processes, and (3) facilitate the collaboration of administrations that wish to exchange information by maintaining different structures and internal business processes of government [18].

  Organisational interoperability ensures alignment of administrative procedures involved in the provision of e-government services. In practice this means defining, collaboratively, the why and when of the trading of information, rules and regulations that ensure safety in such trade or plans that will guide the implementation of the initiatives. It is also responsible for analyzing the gaps in provision of information and even overlaps of responsibilities in information and processes [18]. In other words it attends the analysis of boundaries, scope and information links and processes between actors.

The semantic dimension of information exchanged and its own interpretation is in relation to the perspective of the symbolic space of society. For example, an ontology is the conceptualization of collective concepts and semantic relationships established between them in a particular domain. This collective conceptualization is itself a symbolic construction which in turn is based on cognitive and individual representations of the domain. Finally, it is important to note that in the field of symbolic space also resides the public sphere and field of action of civil society, and it is from these that modifications to the new social space are made. It is through the symbolic space that individuals and institutions can demonstrate their agency capacity [19]. Many times this is an individual agency capacity, but in an interoperable space it can be developed as a whole (and affects) their immediate environment (proxy agency in the theory of Bandura [19]).

The organizational dimension of interoperability is related to Castells's administrative perspective in [20]. The determination of business processes and competencies of the authenticity of the social partners that interoperate must be analyzed using a formal, legal framework, which allows to formalize what is exchanged, when information is exchanged and what means of security are implemented. These formal frameworks are part of the rules of the institutions. In terms of social capital, a concept that refers to the networks and norms that facilitate collective action [21] [22] [23] [24] [25] administrative interoperability relates more to the rules associated with the social capital of a society, and networks to its technical dimension. The determination of gaps or overlapping information, will affect new legislation, which facilitates the adoption of new regulations on the subject.

4.1 Technical Interoperability

In this section technical interoperability is described in more detail. Technical interoperability describes the system in terms of economic aspects of the relations of production / consumption, supply / demand and the technology used. The regency ISO model for open distributed process (Reference Model for Open Distributed Processing RM-ODP) can be applied and used in the study of these forces of production considered in this aspect of interoperability. Using a distributed model is useful to describe a system regarding to data and services in terms of a number of those involved, whose functions are producers and consumers of data-services, thus contributing to a richer view of the system.

Stakeholders can be categorized according to the roles, which will be briefly described below: Producer (Identified as PRD in Fig. 2): An actor who produces data or services. Provider (Identified as PRV in Fig. 2): An actor who provides data or services to users.

The provider differs from the producer, because an actor can serve as support in providing service without having produced the original data. Political deci-

sion maker (Policy Maker, Identified as PM in Fig. 2): An actor that sets economic policies implemented (or needed) by a group of those involved. Broker (Identified as in Fig. 2): An actor who provides assistance to users and providers and assists in negotiating contracts between them and can maintain metadata records on behalf of an owner of a product. Their functions include metadata gathering of producers and suppliers, creating catalogs and providing services based on these catalogs. Value Added Reseller, Identified as VAR in Fig. 2): An actor that adds some feature to an existing product or group of products, and then makes it available as a new product. End User Identified as EU in Fig. 2): An actor who uses the information for a specific purpose, an actor with legitimate interest in the use and consumption of data or services provided by other actors.

5. SOCIAL INTERACTION-BASED COGNITON

The computer science has never been alien to the human component in which it is developed, for example by addressing the study of human-computer interfaces, the elicitation of system requirements, etc. In particular, software engineering itself is an inherently human discipline and its measurement makes it closer to the social sciences than the physical sciences [26], because the phenomena addressing rely on human behavior and these are not easily controlled. During the last decades, many human factors and learning characteristics of those who interact with the software have been taken into account (for example the study of human-computer interface, the study of the correlation between learning styles of users and specific software, etc.) and transcultural and global factors in their development (eg. global software engineering). Likewise when the task of the government proposes reaching out to citizens through transparent and accessible mechanisms in e-government, the efforts in the study of government policies have been moving closer to the social sciences, particularly to the society [27]. For example when implementing e-government applications aimed at citizens having at their disposal the functionality they need [28], beyond the internal division of the government into distinct units, for example with a unique access in a single window [29]. However, the advent of the Internet and the adoption of social networks, have resignified the study on the formation of opinion and communication in society as an important object of study that serves as input for decision-making by governments and market policies. In this type of study should be highlighted the growing importance

areas that are no longer in the individual or institutional spectrum but in the social approach, eg. Studies on Collective Intelligence [30], Social Web Applications [31], Social Network Analysis [32] and Computational Sociology. These technologies applied to the design and analysis of social networks may allow a better approach to civil society and the public sphere (eg. this strategy has been used in political campaigns with a strong presence in social networks).Thus, we can argue that the social field is of increasing significance.

5.1 THE PROPOSED Y-MODEL

Three dimensions compose the Social Interaction-based Cognition (SIbC): CP, CD and Interoperability. Each of them presents three components as Fig. 1 shown through a Y-model. The model is named the Y-model simply because the dimensions of IbSC are presented in the form of the letter Y. The dimensions's components complement between each other, they are semantically connected.

The outside circle of the Y-model shows the cohesion of Social interaction which is primarily based of technical interoperability' habilities, in establishing ties between actors (dyadic, triadic, etc.) through social nets, in maintaining strong and weak interactions. The actors (individual or organizations) of that social interactions reveal specific roles (authenticity).
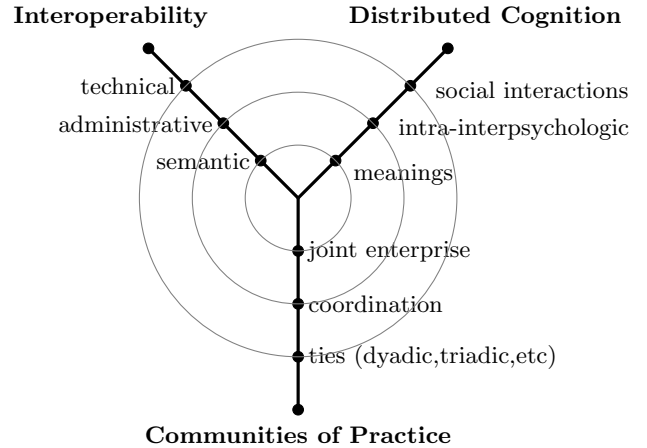

Figure 1. Y-Model of Int-based Social Cognition

The middle circle of the Y-model describes that social interactions is based in confidence and assemblage's links. Assemblage is the product of dialectic process that reside within the intra and interpsychological plane [2] producing internalization and externalization of actions. Assemblage in social interactions manifests as summary communication between actors

when they are conscious in collaboration tasks avoiding overlaping, or when the 'shared experience' shrinks communication or action. This property is materialized between actors through abstract informal links like confidence, or through objective formal relationships of social contracts (or social procedures).

The inside circle of the Y-model displays the inner core of the model: a joint enterprise is a social construction based in shared meanings between actors, implying a semantic interoperation around a joint repertoire.

6. A CASE STUDY: SDI

In this century, land management's organizations have tended to use Spatial Data Infraestructure (SDI) technologies to interoperate with the society. SDI allows a shared infraestructure which integrates each data source to coproduce the same space. Spatial information with the help of SDI is the result of the integration of different geographical objects which are produced and mantained by each land manager.

Spatial Data Infraestructure had been adopted by many land management communities around the world such as INDE in Brasil, IDEE in Spain, European SDI INSPIRE, etc., their associated technologies are widespread. However, land management organizations have had to traverse a profound shift from the original use of GIS (in isolation) towards the participation within SDI. This change was cultural, cognitive and organizational.

We adopt a qualitative and inductive methodology running several unstructured interviews in Neuquén province and others communities of Argentina implementing SDI. We study the interactions of several actors within SDI, we focus on their roles, their interoperabilities, cognitive changes and demands, and the benefits of working in communities of practice. Interviews help us to identify and characterize role' categories of SDI actors.

Noucher [33] also applies qualitative research in the study of appropiation stages of spatial dataset, however she takes a Piagetian approximation (identifiying assimilation and accomodation stages). Our vygotskian appraoch, is not separated from the social context, we do not study stages but roles of SDI actors which are inherent to its organization goals and we also study their interaction through interoperability and CP.

We describe in this section the main findings of our case study. The section is divided as follow. The first section describe SDI and communities of practice. The following details the interoperability around SDI. In the last section cognitive aspects around SDI is included.

6.1 CP AROUND SDI

SDI communities of practice are not only a way of sharing knowledge and know-how of stakeholders around land management. They are important mediators instrument to hold the agreement of the collective negotiation which allowed that the SDI be defined. However, these SDI actors need to work with spatial data which is the result of collective negotiation as well as the object of individual representation [33]. Technologies to manage internal geographical data (of the organization) are not exactly the same as those applied to interoperate in SDI. Neither their cognitive representation, nor the interpretation applied. However, in geographical management and its analisis a set of patterns can be identified, common experience in dealing with its problem-resolution can be interchanged, giving a suitable context to articulate communities of practice.

In the last two years a regional broker (OPTIC) of the province of Neuquén (Argentina), is trying to encourage the sense of belonging to communities of practice around SDI, of different organizations. OPTIC asked for the designation of organization's referents to participate in land management communities. The SDI' communities of practice are: Legal, Data Fair, and Geographical Data. The SDI of this province is being built from the work of these referents working in communities of practice.

- Data Fair's Community allows the SDI stakeholders to analize their data in terms of a data system of offer and demands. Each organization should provide a particular set of data and to be accesible to a set of data provided by others with which interacts. In this communities the referents are motivated to verbalize related problems and to applying a reasoning of their organization from interaction point of view. This community is the origin of defining and maintaining web services of geographical data.

- Legal Community allows the SDI stakeholders to concentrate in legal aspects. SDI requires administrative ' interoperability: to avoid overlaping of functions; to ensure the provision and consumption of data, to change the isolated methodologies of an standalone organization to one which emphasizes source of information; etc.

- Geographical Data' community is intended to support the organizational internal work of each stakeholder in producing and managing its data. The community promotes the interchange of know-how in using GIS technology according to

their internal goals within the framework of SDI polices.

Noucher et al. [34] reported other SDI communities of practice in France, Canada and Switzerland. The authors [33] argue that a community of practice as a learning network, offer one of the most important component of territorial intelligence.

6.2 INTEROPERABILITY IN SDI

The SDI represents infrastructures that allow the exchange and interoperability of geographic information among multiple stakeholders (public sector, private, academic, non-governmental and civil society). During the last decades the exchange of geographic information was digitally systematized by multiple organizations in different contexts in order to serve different purposes [35] [36]. Initially the exchange of geographic information from different Geographic Information Systems (GIS) was performed by replicating data and converting data from one encoding mechanism to another, but this is cumbersome practice whereby exchanges of information were scarce. The specification and adoption of international standards has allowed systems to interoperate with geographic information through SDI. Web services applied to SDI allows to build the infraestructure consuming and providing data and services from different sources.

6.2.1 TECHNICAL INTEROP.

There are about 100 standards that can be considered as part of a software architecture of an SDI, and implementation of an interoperable geospatial solution [37]. The community of the Association for Global Spatial Data Infrastructure recommends adopting the definition of a relatively small set of standards (eg. WMS, WFS, etc.) as well as maintaining suitable metadata.

To illustrate the different roles of actors in a SDI we will mention one of each type for a SDI provincial scale in the province of Neuquén in Argentina (see Fig. 2). Examples of information producers are the Registry of Property (RPI), the Provincial Directorate of Cadastre and Land Information (DPCeIT) and the Provincial Directorate of Revenue (DPR). These three mentioned actors interoperate between them; the RPI sends updates of the legal ownership of land to the DPCeIT; DPCeIT in turn sends economic information (tax valuations) and holders of formal and informal domain to the DPR. An example of a VAR actor in the province is the Provincial Bureau of Statistics which from the information coming from other providers, as

well as own sources, provides aggregate statistical information. The Secretariat for Public Management is considered a PM as it sets the underlying policy of provincial SDI guidelines. The Provincial Office of Information Technologies (OPTIC) plays the role of broker, setting the negotiation between suppliers, producers, etc. Besides, OPTIC is also shown in Fig. 2 as a provider due to the fact it provides internet access to a producer. Currently the OPTIC Fair is coordinating meetings regarding data and services in order to orchestrate interoperation. The end users are taxpayers, citizens, property owners, etc. from civil society.
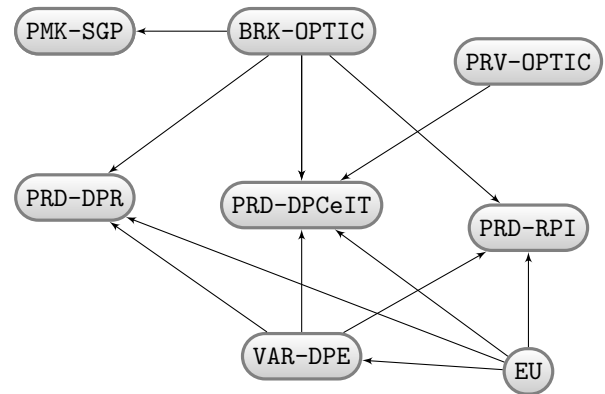

Figure 2. Interactions between SDI Stakeholders

6.2.2 ADMINISTRATIVE INTEROP.

Perhaps the administrative interoperability, and even semantics, are the two areas in which progress has been less in terms of definition of SDI. The update of geographic data is a costly task. The SDIs facilitate the information to be provided and administered by the authentic sources of information, and the geographic dataset from each source to be used and analyzed collaboratively. In this respect the SDIs have facilitated the avoidance of costs duplication in time and effort, since it is not necessary to duplicate the information. However most SDI require more detailed analysis regarding the quality of the generated data, the overlapping information when the competences of the sources are not clear, and the use and interpretation of information. This topology of interoperability requires an exhaustive work, a macro and collaborative analysis, as well as an agreement of the data flow and structure from larger scales.

6.2.3   SEMANTIC INTEROP.

While an SDI requires agreement on which technologies are applied in communication and collaborative work in relation to the management of one space, and an analysis of the associated business processes, also needs to agree on which data and metadata are exchanged. Delgado Fernández et al. in [35] describe how the SDIs benefit from the common use of ontologies.

6.3   DC IN SDI

Spatial data sharing and analysis requires a change on how SDI' stakeholders think about themselves and a change of how they think the space. With SDI, spatial knowledge is a consecuence of a shared coproduction of the space by many actors (land management sectors such as planners, geologists, forester, etc.) so the stakeholders should not be working in isolation but in social networks. SDI introduces a change in the identity of the organization. It does not change its organizational goals but in the way to obtain them through the collaborative work with the help of more knowledgeable others.

Besides, SDI introduces epistemological, hermeneutical, cognitive and sociological issues. The fact that the space knowledge is structured differently as organization would do if it works in isolation, introduce epistemological changes. The fact that SDI stakeholders should use a shared representation of the space knowledge implies to apply a shared interpretation (we need to study hermeneutic issues). Distributed cognition behind SDI involves also interpretation of spatial data which is the product of collective negotiation.

What encourage the sense of belonging to spatial communities [34], as well as what facilitate and hinder the attribution of common meaning to data [33] are cognitive and sociological issues. SDI unveils shared meaning [33], materializing the geographical interactions needed to work in colaboration, and which are inherent of a common representation of the space. These new technological objects, are product of reification of the social interaction (according to Durkheim [38] we should consider social facts as things), but need to be appropiately defined, due to the fact they are product of the knowledge engeneering and sostained cognitive activities from several organizations.

During data appropiation process Noucher et al. [33] identify two different dialectic process performed by stakeholders of land management: Individual projection and collective negotiation. The former is based on expectation and experience of the stakeholder. The latter is based on participation and reification process.

7. CONCLUSIONS

Technologies are usually mediators instruments of society helping to its members to interact and interchange in performing their goals. With the introduction of web technologies 2.0 and 3.0, applications are built of a network of cooperating data services, users are important value added of their own data to those provided by the application, the emphasis of the application is focused on the coordination and interactions. When technology is used as an instrument by communities of practice, or even by a more wider set of organizations, harmonization and orquestation of services are required, members' roles and interoperability should be analized. These technological changes, demands profound cultural investments in members and organizations due to the fact that data is a shared resource and object of interchange, relationships and interactions are materialized vehicles in social networks with specific roles. This flow and interaction should be analized from cognitive theories. The investment of efforts (in time and cost) are profitable, the analysis of aspects of cognition in distributed communities of practice allow substantial improvements in how knowledge is perceived, retrieved, transfered and applied (cognitive improvements).

We believe that societies facing such crucial changes of its process traverse important cognitive changes: knowledge is organized in a different way (introducing epistemological changes), and by consequence, this impacts in the way the society interpret the information it should deal (hermeneutic aspects that should also be considered). Our razoning is that: distributed cognition (which enhances the understanding of interactions between humans, machines and environments) within communities of practice around web applications provides a suitable context to analyze the aforementioned problematic. Based on a set of interviews and the experience related to our case of study, spatial data infraestructure, we understand cognitive issues inside these communities. Data armonization and services orquestations requered by these changes, also contributes to their sense of identity and improve its capacity of agency proxy. Community interoperability (ability of making systems and organizations to work together) plays a central role in the process of 'making meaning', being perception of process information (issue of cognition) influenced by sense and meaning.

As a future work we intend to continue to deepen the qualitative analysis of cognitive aspects that occur in these types of technological assemblies in society, applying methodologies of grounded theory which can guide us in a theoretical samply of data. We also plan

to apply focus group techniques within communities of practice.

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