

Communication and narrative in the construction of a transdisciplinary knowledge base

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ABSTRACT

Transdisciplinary communication is an essential requirement for the successful implementation of projects that approach the complexity of socio-environmental problems we face in research and practice. Transdisciplinary knowledge integration can be achieved when conversations are built not only over common principles, but also on how our spatial knowledge and experience is communicated over an issue in a specific territory.

Among the themes undertaken by interdisciplinary teams are those related to territorial and land management, ecosystem services, environmental risks and vulnerabilities, competitiveness, health, education, public safety, migration, water, energy, among other.

This paper refers and expands the lessons learned through our line of research called Geomatics and Society and the transdisciplinary methodologies proposed for a *Meta-Design for Geomatics applications* (Paras-Lopez, 2017). Specifically, we emphasize the role of the territory as a connecting agent through the narratives of the interacting stakeholders and experts, geared towards social needs or problems and their possible solutions.

Our purpose is to approach the questions:

- ¿How to bring about the organization of disciplines, their specialized models and contributions to the solutions?
- ¿What principles and communication rules we follow when an inter-disciplinary team works together?
- ¿Where to? Understand the dynamics of socio-environmental organization in a specific time and place (the territory).

Through interweaving the diverse knowledge and territorial maps of experts with those of social claimants, a transdisciplinary knowledge network emerges.

Keywords: Trans-disciplinary communication; territory; territorial narratives; rules of the game; emergent knowledge network

1. INTRODUCTION

The purpose of the paper is to contribute to foster *inter-disciplinary communication*, "facilitating contacts among the different academic areas through the trans-disciplinary systems approach and in its application to concrete problems"¹. To approach these tasks we follow our research (Paras, Lopez, 2017) and expand the notion of "territory" as an interlocutor and communication agent among the participants in an interdisciplinary conversation.

Through problems posed by society it has been possible to advance transdisciplinary methodologies, establishing bridges and creating relationships between researchers, students and social claimants through a scientific management model for Geomatics and society. (Reyes, Paras. 2010, 2012). Its main axes of development are: society's demands; contextualized science; knowledge management; Geomatics (GISc) innovation.

2. COMMUNICATIONS AND INTERDISCIPLINARY KNOWLEDGE MANAGEMENT

To **know how**; to **know what**; to **know where to** (space and time). These are guidelines to progress to transdisciplinary methodologies **establishing bridges** between research and social claimants.

Due to their complexity, social systems are inherently very difficult to model, control or predict. For it requires trans-disciplinary teams looking for models that can lead to the solution of these problems. Holland (1998, 242) suggest that looking at the same phenomenon from different contexts or points of view, in which different

¹ Program by International Institute of Informatics and Systemics (IIIS) at: <http://iiis.org/purpose.asp>, <http://www.iiis.org/MainPurpose/> and Callaos, N. [http://www.iiisci.org/journal/CV\\$/sci/pdfs/iGA927PM.pdf](http://www.iiisci.org/journal/CV$/sci/pdfs/iGA927PM.pdf)

specialists have developed an experience, it is possible to identify subtle characteristics that are not explicit for them but are present and tied to the context.

On the other hand, Heylighen (1999) identified a classical issue in multidisciplinary or interdisciplinary research regarding specialists: “in order to collectively tackle a problem they **need to communicate**. Furthermore, if the specialists’ mental maps are too different, they will have great difficulty understanding each other. One way to bridge the gap is to make sure that there is always some overlap between different mental maps, so that two specialists from very different disciplines (say, a chemist and a biologist) will be able to communicate via one or more “interpreters” who belong to an intermediary discipline (say, molecular biology) that overlaps with both.” (Heylighen, 1999)

However, this idea of the specialist intermediary only solves the problem between two specialists and not the general case of a variety of specialists and the social plaintiff. What is interesting about this proposal is the search for superimposition between the different mental maps of the specialists.

Lets us introduce the concept of territory in our narrative:

A. Knowing the territory and its properties

Geographers, physicists, biologists, sociologists, economists, anthropologists, have posed questions and notions approaching space-time. This is a crucial knowledge and experience for Geomatics applications, given their objective is the modeling of geographic space or territory. (Paras, Lopez, 2017).

The territory as a living organism: It is the product of an **emergent process** of social construction where its agents interact, adapt and learn from experience.

There is also innovation and self-organization, as manifested in living organisms. (Kauffman, 2000, 105) For example, cities take successful innovations that occur in others as in transportation, housing, water management and urban services.

Emergency is above all, the product of a self-constructive and cumulative organization that propagates, but is also a product of novel collective properties derived from contextually dependent interactions.

These properties lead us to consider the territory as a living organism. When trying to model its dynamics we are modeling the evolutionary, creative and innovative dynamics of living organisms in space-time. (Holland, 1998, 121) Social coupled interactions are contextualized in relation to a specific territory.

The emergence of the territory is not limited to its self-organization as a whole, but over time, it can present new emergent processes when interacting with its environment.

“Persistent emergent phenomena can serve the components of more complex emergent phenomena”. (Holland, 1998, 142) For example, stock exchanges, industrial clusters, and cultural spaces.

3. THE TERRITORY AS A CONNECTING AGENT IN THE CONSTRUCTION OF A KNOWLEDGE BASE

After some years of research, we came to the understanding of the formal processes that brings about the development of a meta-design an organizing knowledge-model, and what has been defined as an **emergent knowledge network**. (Lopez, 2011, 20; Lopez et al, 2014, 21)

As one of our lines of research, **Cybercartography** explicitly incorporates cybernetic concepts according to three main axes (Fig. 1): modeling, communications and knowledge-based processes (Reyes et al. 2006, 7-20).

Through the development of Cyber cartographic Atlases we establish a communication with the society through diverse cartographic, linguistic, mathematical, statistical and even visual resources. (Taylor et al, 2005). For example, virtual maps, geo-text, videos, photographs, space maps, satellite images, computer simulations, graphics, sound and diagrams were used to communicate organized messages that convey relevant information and knowledge to social claimants and users.

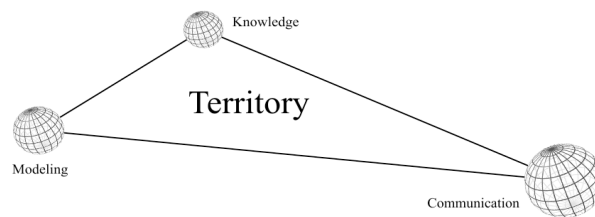


Fig. 1. Organizing principles in Geocybernetics. Adapted from Reyes, 2005,78.

To deal with complex problems a territorial systemic, analytical and transdisciplinary approach has been put forward in a meta-design for Geomatics applications (Paras, Lopez, 2017) in which not only scientific knowledge (explicit and formal) is considered valuable but also the profound experience of the society is recognized as a product of creativity and tacit knowledge, acquired and progressively adapted to changes in its environment.

Applying this framework we observe intra, inter and trans- disciplinary communication levels:

- a) The social claimant proposes a problem and social needs, establishing the approach to the solution in analogical thinking derived from planning, design, management and politics. The organizational languages are those of specialists, acting as bridges concerning the pertaining knowledge and their territorial experience. We identify this as a normative level that guides the research.
- b) The next is called a pragmatic or management level. It comprises knowledge about socio-environmental systems with their multiple territorial interactions, including relations with the systems of nature and technology. The coordination between disciplines suggests a correspondence with the development of scientific-technological capacities required to construct and model the physical and social spaces. The language of organization at this level is that of cybernetics, incorporating the processes of control, feedback, modeling and communication.
- c) An operational/empirical level corresponds to the disciplines that study the physic/biological systems in which life develops, allowing us to know what exists using spatiotemporal analysis and quantitative models. The knowledge, information and data required are defined from top down approach (from the normative and design level to the knowledge management and from it to the operational levels). Look for the figure 2 in Parás and Lopez, 2017.

4. CONVERSATIONS AND NARATIVE: GAME RULES.

To address the territory and its complexity we require territorial cognitive agents; the question is ¿who these agents are?

After years of investigation, it has been observed that a territorial cognitive agent is that person who has the knowledge of the territory. It is not necessarily a scientist or an academician whose knowledge is explicit and formal, but also a person whose territorial knowledge has been acquired through experience, product of tacit knowledge.

In this regard, the Reyes Method is a conceptual guide that consists of taking to a workspace the conceptual models of all the participating agents, from which a common knowledge base is constructed, synthesizing the knowledge and the geographical vision of the social network. (López et al, 2014, 20-21).

Social claimant needs (main stakeholders identification):

A solution is successful when it meets the needs of the social claimant in a comprehensive and consistent way and the requirements have been well defined.

These type of analysis should be conducted by a team of specialists who will be responsible of establishing the links with key stakeholders and identify the needs, the spatial/temporal characteristics and the context (organizational, administrative, social and cultural) that have to be taken into account at this stage of the project design.

How can social structural coupling be established? Some of the typical human mechanisms for solving collective problems are by conversation or by discussion (Helmer, 1967).

It is through the recursive dynamic of the conversation that people interact expressing and sharing their preferences, it is here where territorial arguments are given, such as why they believe that one particular option is better than another. These arguments supported by “territorial” evidence can convince others that the option presented is better, or incite them to counter-argument. At best, the arguments presented and the counter-arguments will highlight the most important implications of the different territorial options, or suggest a new option that combines the best of the previous options (Heylighen, 1999). This argumentation bears much resemblance to the metaphor of genetics. Holland (1995, p65) says that in a rule-based system this arrangement is important, because strong rules represent knowledge won. Under competition, strong rules usually determine the agent's actions, so they are the core of the agent's internal model.”

The conversations between the actors of society take place through a heterarquical group. Some individuals play a key role in the modeling at different stages of the interaction process; we identify them as “knowledge managers” whose function is to interconnect knowledge frameworks for Geomatics solutions. In some cases they are researchers and in others well qualified professionals with an understanding of the impact of geo-spatial knowledge on specific and societal problems. (Reyes, Parás, 2010)

Reyes establishes the following **rules** to achieve convergence in the construction of models and possible solutions to the stated problem:

- *Each of the specialists and societal actors/claimants has a knowledge model.*
- *The dialogue or conversation among them should be focused on the territory, on a conceptual level as opposed to a technical one.*
- *The specialists and the actors must cooperate and have empathy.*

Heuristics of the Reyes method:

- *Tacit knowledge models of the actors and the specialists should be made explicit based on the territory.*
- *Communication between all specialists and stakeholders should be established based on a conceptual level as opposed to a technical one* (Lopez, 2014, 23-24).

Something that characterizes the methodology that uses these rules is that transdisciplinary bridges are constructed between the different knowledge models, to establish a social structural coupling that integrates a common knowledge base that conceptually synthesizes the comprehension of all the participant agents. It is important to point out that these basic and concise concepts are the result of a process of selection and self-organization, product of the conversation between social and scientific actors (López et al, 2014).

The challenge for the social agents involved is to be able to negotiate and build consensus regarding group goals and methods of achieving them, going beyond individual interests.

5. EMERGENT KNOWLEDGE NETWORK (EKN)

A knowledge network emerges (EKN) from the communication and conversations of scientists and non-scientists building a common language in the process. (López et al, 2014, 22-25). A conceptual language is required in order to achieve structural coupling between the different concepts (backbone ideas) of the participants' tacit or explicit models of the territory.

Now, structural concepts can be seen as seeds triggering the construction of a network of narratives that describe the complex relationships involved in natural and social processes, interacting in territories.

This process of emerging concepts continues successively until reaching a level in which quantitative representations are appropriate to model the systems: mathematical, physical, statistical and heuristic models. This semantic network, as a whole, is called the Emerging Knowledge Network, and must reflect the holistic vision of the territory, product of the social structural connection of all the participating agents (López et al, 2014, 22-25).

6. CONCLUSIONS

The design of models/applications that addresses complex problems such as those mentioned above requires transdisciplinary teams. When you look at a phenomenon from different perspectives, in which each specialist has developed an experience, you can identify subtle features that are not explicit in the eyes of all of them, but are present and tied to a context. In this sense, transdisciplinary comparisons allow us to differentiate the incidental from the essential. In addition, what is hidden for a specialist may be obvious and easy to examine for someone else. This makes the collective overcome individual cognitive limitations, accumulating a greater amount of knowledge than a single specialist. Therefore, from this perspective, some social organization is required in which the agents help each other in order to maximize the collective benefit. (Heylighen et al, 2003).

If the territory is observed as the crossword puzzle, it should contain the concepts that solve it in all its forms (Einstein, 1954, 294-295). The question would be, what these concepts are? The experience tells us that it is possible to establish a set of coherent territorial concepts and communication rules that give a broad and organizing vision, with a greater perspective and orientation to tackle this complex problem.

Transdisciplinarity offers a worldview and a methodology, recognizing the legitimacy and the need for complementary perspectives and territorial outlooks. It therefore requires as a necessary condition, communication among agents for the generation of an emergent knowledge base. (Parás, Lopez, 2017).

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