

Guiding the Process of Requirements Elicitation with a Semiotic-based Approach – A Case Study

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Abstract

Requirements Engineering (RE) is the process of discovering the purpose of a prospective software system, by identifying stakeholders and their needs, and documenting these in a form that is suitable to analysis, communication, and subsequent implementation. Requirements elicitation is closely related and even interleaved to other RE activities such as: modeling, analysis & negotiation, and communication of requirements. RE is a multi-disciplinary and human-centered activity. This paper presents a participatory approach to requirements elicitation that deals with functional and non-functional requirements considering social, political, cultural and ethical issues involved in understanding the problem in the process of RE. The proposed approach is theoretically grounded in methods and models from Organizational Semiotics. The proposed approach is illustrated with a case study related to the development of an application of Geographical Information Systems in the Web (Web GIS). Results of the case study allowed us to observe the contribution of OS in the proposed approach, including elements to inform the user interface design of the system.

1 Introduction

Software requirements have been recognized in the past 25 years to be a real problem in software systems development. Literature has pointed out that inadequate, inconsistent, incomplete, or ambiguous requirements are numerous and have a critical impact on the quality of the resulting software (Lamsweerde, 2000). The primary measure of success of a software system is the degree to which it meets the purpose for which it was intended. Broadly speaking, requirements engineering (RE) is the process of discovering that purpose, by identifying stakeholders and their needs, and documenting these in a form that is suitable to analysis, communication, and subsequent implementation (Nuseibeh and Easterbrook, 2000). There are a number of inherent difficulties in this process. Stakeholders (including paying customers, users and developers) may be numerous and distributed. Their goals may vary and conflict, depending on their perspectives of the environment in which they work and the tasks they wish to accomplish. Their goals may not be explicit or may be difficult to articulate, and, inevitably, satisfaction of these goals may be constrained by a variety of factors outside their control. Moreover, non-functional requirements have been presented as a second or even third class type of requirement, frequently hidden inside notes and therefore, frequently neglected or forgotten (Cysneiros and Leite, 2002). This paper presents a semiotic-based method for requirements elicitation that deals with functional and non-functional requirements considering social, political, cultural and ethical issues involved in understanding the problem in the process of RE. Our approach is based on the Organizational Semiotics (OS), a branch of Semiotics that studies organizations using concepts and methods from Semiotics (OSW, 1995).

The rationale behind for OS is based on the assumption that any organized behavior is affected by the communication and interpretation of signs by people. OS understands the internal activities of an organization, including its information systems and its interactions with the environment, as a semiotic system (Liu, 2000). Our approach is based on MEASUR, a set of Methods for Eliciting, Analyzing and Specifying User Requirements. The case study reported in this work is based on PAM (Problem Articulation Methods) and SAM (Semantic Analysis Method). PAM comprises a set of techniques that can be applied in the initial stages of a project, to support the definition of system units that are validated by the interested parts.

The proposed approach is illustrated with a case study related to the development of an application of Geographical Information Systems in the Web (Web GIS). In the context of this work, we define a Web GIS as a system that allows visualizing and consulting geographic data through the Web. The process of instantiation of the methods included three workshops of three hours each, with the participation of professionals from the fields of networks, image processing, databases, geo-processing, agro-environmental studies, human-computer interaction experts, administrators of agricultural federal agencies (EMBRAPA – Empresa Brasileira de Pesquisa Agropecuária) and Web GIS application developers. The discussion was recorded in video and notes were taken from observations. The workshops used artifacts of OS (Stakeholders Analysis, Evaluation Frame, Semiotic Diagnosis and Collateral Analysis) in a collaborative and participatory way. The main outcome of the workshops was the agreement on requirements including considerations on ethical issues, and social and business model implications of the prospective system.

Results of the case study allowed us to observe the contribution of OS in the proposed approach, in relation to other techniques. The activities carried out deal with information not captured by other techniques, involving cultural, behavioral, ethical and political aspects. A list of agreed requirements was derived from the artifacts used in the workshops. The elicited requirements was represented with the use of an ontology model, an outcome of the Semantic Analysis, with agents, affordances, ontology relation and determiners concepts, providing elements to inform the user interface design of the system. The result of the Semantic Analysis is complemented with the dynamic aspects (constrains, rules, etc.), obtained with the Norm Analysis

The paper is organized as follows: Section 2 presents the Organizational Semiotics view for understanding requirements, and our approach constructed from that theoretical basis. Section 3 presents and discusses the proposed approach to Requirements Elicitation instantiated in a case study with WebMaps: a Project in the field of GIS application that involves an interdisciplinary team and served as an object of investigation in this work. Section 4 discusses the main findings of this case study and in Section 5 we conclude.

2 Understanding User Requirements: a Semiotic-based View

Starting with the pioneer work of Floyd (1988), several authors have acknowledged the social nature of information systems design. As Erickson (1995, p.37) points out “(...) the design of technology-based products is inextricably entwined with social and organizational dynamics.” The same author argues that we could make the design process more effective by developing a better understanding of how concrete artifacts support communication in design. Kuutti (1995, p.27) observes that because the organizational context where a computer system is embedded is a social system, some of the questions that might be discussed in the context of system design are: “To what extent should this social character be taken into account in design? How could that be methodologically done? What is the relationship between the social system and the technical one?” The same author also suggests that “(...) hardly any system design method still recognizes the need to model the organization or work beyond the immediate use actions of a system” (Kuutti, 1995, p. 30). In this paper we draw upon concepts from the Organizational Semiotics (OS) to address these questions and to set appropriate foundation for designing information systems, reflecting the proposed approach in the design of user interfaces.

Organizational Semiotics is a discipline that explores the use of signs and their effects on social practices. We situate our work on Stamper’s school of OS (Stamper, 1973, 1993), which proposes a set of methods to the design of information systems, based on the socio-technical paradigm. Organizational Semiotics situates the technical information system (software) development within the formal and informal levels of an organization. As so, it favors/supports a semiotic view of information system design. Although a sound theory for developing IS within this paradigm, literature on OS and IS hardly addresses user interface design issues. Organizational Semiotics comprehends the internal tasks of an organization, including its information systems and their interaction with the environment, aiming at finding new and significant ways of analyzing, describing and explaining the structure and behavior of the organization. The study is not limited to the information expressed in speech, writing or charts, but it also considers the semiological aspects of the organizational products and productive resources. From this semiotic perspective several layers of meaning should be considered in a system design. To Morris’ classification of syntax, semantic and pragmatics (Morris, 1938), that deals respectively with the structures, meanings and uses of signs, Stamper (1973) added another three layers: physics, empirics and social world. Stamper’s Semiotic Framework is composed by six layers, as briefly described:

- *Social World*: deals with the social consequences of using signs (beliefs, expectations, commitments, etc.)
- *Pragmatics*: deals with the purposeful use of signs and the behavior of agents.
- *Semantics*: deals with the relationships between a sign and what it refers to; in all modes of signification.
- *Syntactic*: deals with the combination of signs without considering their specific signification.
- *Empirics*: deals with static properties of signs when different physical media and devices are used.
- *Physics*: deals with the physical aspects of signs and marks.

Within this framework, an organization is seen as an information system in which interdependent links between the organization, the business process and the Information Technology (IT) occur (Liu, 2000). At an Informal level there is a sub-culture in which meanings are established, intentions are understood, beliefs are formed and commitments with responsibilities are made, altered and discharged. At a Formal level form and rule replace meaning and intention. At a Technical level part of the formal system is automated by a computer-based system. The Informal level embeds the Formal that, by its turn, embeds the Technical. Modifications that occur in one of the levels can lead to modifications in the other levels. Thus, for example, changes in the informal or formal levels have implications in the technical information system, and the introduction of a computer-based system in the organization (technical level) can generate modifications in the formal or informal levels of the organization. The information system is impacted by and reacts to the environment, as Figure 1 illustrates. The informal level embodies the formal that, by its turn, embodies the technical level, meaning that changes in some level have impact in the other levels. In a semiotic perspective, different layers of meaning must be considered in the information system analysis and software design (Stamper, 1973). One of the purposes of the OS approach is to provide a methodological basis to reflect in the system the articulation of these organizational levels.

Organizational Semiotics (OS) provide us with methods to construct a meaningful understanding of the organizational context, which will embed the Information System. In this paper we argue that OS methods can provide the interested parts of a focal problem with a better understanding of their requirements and intentions, as well as the restrictions not only regarding the information system, but the software system as well.

2.1 The MEASUR Methods

MEASUR is an acronym for Methods (Means, Models) for Eliciting (Exploring, Evaluating), Analyzing (Articulating, Assessing) and Specifying (Structuring) User's Requirements. The MEASUR research program (Stamper, 1993) proposes a set of methods to deal with the three upper layers of the Semiotic Framework, which are concerned with the use of signs, their function in communicating meanings (semantic layer) and intentions (pragmatic layer), and their social consequences (social layer). The MEASUR methods related to the analysis and specification of users' requirements, our focus in this study, involve the problem articulation, semantic and norm analysis, briefly described in the next sub-sections.

2.1.1 PAM – Problem Articulation Methods

PAM consists of a set of methods to be applied in the initial phases of a project, when the problem definition is still vague and complex. The analyst is helped in defining system units that will be validated by stakeholders using Stamper's Semiotics Framework (Liu, 2000). PAM is composed by the following methods:

- *Stakeholder Analysis*: allows to investigate the interested parts that directly or indirectly have influences or interests in the information system in analysis.
- *Evaluation Framing*: allows to identify, for each stakeholder, their interests, questions and problems, in order to discuss possible solutions.
- *Semiotic Diagnosis*: allows us to examine the organization as a social system that is constructed through the use of information, emphasizing not only technical issues (physical world, empirics and syntactic) but other levels of relationship (semantic, pragmatic and social), which affect aspects of the system design.
- *Collateral Analysis*: allows the analysis of relationships between unitary systems that compose the complex system, and the its effective limits in the environment, the focal system and its infrastructure.

2.1.2 SAM – Semantic Analysis Method

SAM assists analysts and users or problem owners in eliciting and representing their requirements in a formal and precise model. With the analyst in the role of a facilitator, the required system functions are specified in the Ontology Model, which describes a view of responsible agents in the focal business domain and their actions or patterns of behavior called “affordances”. It is a process of conceptualization of a business organization, in which the organizational behavior is analyzed and captured in the Ontology Model. In Semantic Analysis the ontological relationship is considered as the most fundamental relationship to be modeled. The purpose of the Semantic Analysis is to help system analysts and problem owners to articulate the requirements focusing on the language used to express the problem. It is a process of conceptualization of a business organization, in which the organizational behavior is analyzed and captured in the Ontology Model. The primary focus of system analysis is on the agents in action. The agents and their patterns of behavior (affordances) have a graphical representation in the Ontology Model, which includes:

- *Agent* (graphically represented as an ellipse): Actors who build and interact with the reality.
- *Affordance* (rectangle): Semantic primitive representing possible patterns of agent actions or behaviors.
- *Ontology Relation* (line): Define the limit or period of existence of an affordance related to the agent that holds it. The “antecedent” in the relation is represented on the left and the “dependent” on the right.
- *Determiner* (preceded by #): Invariant property that distinguish one instance from others.
- *Role* (half circle): An agent can have a particular role when he or she is involved in relations and actions.
- *Whole-part Relationship* (line with a dot): Defines a possible subdivision of an agent, represented from the left (whole) to the right (part), according to the ontological dependence.
- *Generic-specific Relationship* (box): specifies whether agents or affordances possess shared properties.

The Ontology Model shapes a context that involves concepts and words used in the domain of a specific problem. This allows a contextual semantics as each word or expression is linked to its antecedents. In Semantic Analysis (SA) the ontological relationship is considered as the most fundamental relationship to be modeled. The result of the SA is complemented with the dynamic aspects (constrains, rules, etc.), obtained with the Norm Analysis.

2.1.3 NAM – Norm Analysis Method

Societies use several systems of normative control: religious, ideological, educational, scientific, cultural, social, political and economic. Some situated examples are the business organization strategies, codes for employees, laws, regulations etc. Complex agents can be formed for certain purposes, as for example, cultural clubs, political parties, corporations, governments, nations, multinational alliances, etc. The norms exist to determine the behavior that are legal and acceptable inside a social context and also have directive and prescriptive functions, sometimes called normative functions. When an agent is in the eminence of acting, norms serve as a guide for his action. In each particular case, the agent will evaluate the situation to find norms that seem relevant for his case.

NAM focuses on social, cultural and organizational norms that govern the actions of agents in the business domain. A norm, in a formal or informal sense, defines a responsibility of an agent engaged in a task, or condition under which certain actions may (must, must not, etc.) be performed by the agent. Each specified norm is associated with an action pattern described in the Ontology Model. In Norm Analysis, norms related to the social and pragmatic layers of Stamper’s framework are identified and associated to specific parts of the Ontology Model.

2.2 A Framework based on MEASUR for Engineering User Requirements

Jacobson et al (1999, p. 342-343) consider that the “major challenge is that the customer, who we assume to be primarily a non computer specialist, must be able to read and understand the results of requirements capture”. We argue that this initial work on the problem clarification should be part of the information system development, considering information system in a broader sense. We propose the use of MEASUR methods, PAM, SAM and NAM to explore the problem and its context. Previous studies conducted with business organizations (Simoni and Baranauskas, 2004) showed that these methods were valuable to capture the core problem and its context, and provide a common language between non-technical and technical people involved in the process.

Figure 1 presents the rationale underlying our approach. PAM is used to understand the forces involved (needs, intentions, existing conflicts, etc) among the stakeholders, allowing a big picture of the problem context and the main requirements. SAM and NAM are both used to model this context, capturing informal and formal aspects

related to it. Both the static (SAM – terms, concepts, etc) and dynamic aspects (NAM - constrains, rules, etc.) are modeled, and the outcomes are inputs for the software development. Figure 1 illustrates a case in which the software development process chosen was the Unified Process (Simoni et al., 2005).

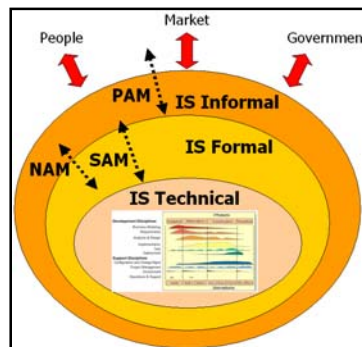


Figure 1: OS integrated in a development process

3 Eliciting Requirements for the WebMaps Project: A Case Study

Current research in Requirements Engineering (RE) presents it in terms of the core activities that constitute the field: eliciting, modeling and analyzing, communicating, agreeing and evolving requirements. Despite the fact of usually being described independently and in a particular order, in practice these activities are interleaved, iterative, and may span the entire software system development life cycle (Nuseibeh and Easterbrook, 2000). Information gathered during requirements elicitation has to be interpreted, analyzed, modeled and validated. Therefore, requirements elicitation is closely related to other RE activities. In many cases, as pointed out by Nuseibeh and Easterbrook (2000), the elicitation technique used is driven by the choice of the modeling scheme or vice-versa: many modeling approaches are used as elicitation tools, where the modeling notation and partial models produced are used as drivers to prompt further information gathering.

RE is not only a process of discovering and specifying requirements; it is also a process of facilitating effective communication of these requirements among the different stakeholders. This stresses the importance of a shared representation for the information gathered and a way of discussing and negotiating meaning for the represented elements. Requirements validation is a difficult activity as it concerns the question of truth and of what is knowable; nevertheless, the participation of the involved people (problem owners, users, designers, developers and other stakeholders) in activities where they have an active role and voice in requirements gathering may facilitate the group in reaching agreement. Moreover, knowledge of the stakeholders and designers about the problem and its context evolves during the RE process, which implies the need of iteration. In the next sub-section we detail the proposed process model and context of this case study.

3.1 Method and Scenario

A process suggested to manage and integrate the different RE activities based on OS principles, artifacts and models is illustrated by Figure 2. The process is centered in the activity of Communication, which involves the use of Organizational Semiotics artifacts as shared representation for information gathering in the first place, and for common ground knowledge and memory for the group in subsequent stages. Three workshops were conducted, the first one during the Elicitation stage, the second and third during Analysis and Negotiation after Elicitation and after Modeling respectively.

We drew upon MEASUR methods to compose the Requirement Process, which started with the Elicitation Phase followed by Analysis & Negotiation, Modeling and Analysis & Negotiation (validation) again. Three Workshops, each one 3 hours long, were conducted by facilitators with the stakeholders in a participatory format. 17 participants from different backgrounds and fields, including image processing, databases, geo-processing, agro-environmental studies, human-computer interaction experts, users representatives, software systems developers, to name a few, took place in the workshops. The artifacts of OS were used as communication tools during the Workshops. Figure

3 illustrates snapshots of the scenario in which the workshops took place. The next sub-section describes the participatory format of the Workshops.



Figure 2: The Requirement Process Model Illustrated



Figure 3(a) The Scenario Preparation for the First Workshop - **(b):** Participants during the Second Workshop - **(c):** A snapshot of the SO artifacts during the Second Workshop

3.1.1 The Participatory Workshops

We describe the workshops in terms of six attributes adapted from Müller (1998) for Participatory Design techniques:

- *Communication Artifacts:* For Workshop 1, the artifacts of PAM: Stakeholder Frame, Valuation Frame and the Semiotic Ladder. For Workshop 2, the same artifacts of the Workshop 1 populated with the written pos-its; the Collateral Analysis Frame filled and a poster with first draft of Requirements collected from results of Workshop 1. For Workshop 3, the artifact of SAM: ontology chart (outcome of Semantic Analysis); the Use Case Model and a synthesis of Content Organization for the user interface of the Web GIS application. Pos-its, and pens are the material used for running the participatory practice for the Workshops 1 and 2; computer and projector for the third Workshop.
- *Process Model:* In the format of a Workshop, the participants take a sit around a table and the facilitators stay close to the wall, where the posters with the communication artifacts are hung on. Starting with the Stakeholders Analysis, and proceeding with the other artifacts, the facilitators conduct discussion and the participants write their ideas in post-its that are put in the artifacts hanging in the wall (Workshops 1 and 2). During Workshop 3 the designers show concepts of the problem domain modeled in a ontology chart (projected in the room) that includes the affordances available or/and that would be available by the system use in a new organizational context. This model contains the concepts compiled by the designers from data of previous workshops (the diagram must contain only the terms used by the users). If necessary, the designer clarifies the notations and concepts in the diagram. After that the designer read the ontology chart for the group. During the reading, for each concept quoted in the model that any person of the group judges important, the practitioners discuss the semantic dependencies with other

concepts and the formal and informal norms associated. Members of the group, as a result of discussions, may propose changes to the semiotic models. A Use Case Model is also presented and discussed suggesting scenarios of using the prospective system. A first draft of Contents Organization for the User Interface is presented and mapped to parts of the Ontology Chart.

- *Participation Model*: participants from different backgrounds and fields, including image processing, databases, geo-processing, agro-environmental studies, human-computer interaction experts, users representatives, software systems developers, to name a few, together with the design team participate in the Workshops. Two facilitators mediate the interaction among the group.
- *Final Results*: Agreed Requirements among the group; Ontology Chart as a common ground representation of knowledge elicited and reviewed during the workshops which included people from the organizational context. Use Case Model produced and detailed. Preliminary User Interface Contents Organization.
- *Position in the RE life cycle*: The Workshops are applied during the Elicitation Phase, and during the Analysis & Negotiation Phase that take place after Elicitation and after Modeling respectively. If applied in a traditional development process it can contribute for the following phases: Problem Identification & Clarification, Requirements & Analysis, High-Level Design, Evaluation and Re-Design.
- *Group Size*: 17 Participants in this case study (5-15 is the recommended; the number of designers should not be higher than the number of users and stakeholders).

During Workshop 3 the ontology chart and the other artefacts resulted from Modelling and/or from previous practices were discussed, assuming that there is a conceptual and design dependency between the user interface and the work practices considering the prospective application; changes in the OS models may have impact in the user interface and vice-versa. The next section presents results of applying this semiotic-based approach to RE in the context of WebMaps system design.

3.2 Preliminary Findings

The First Workshop started with the Stakeholder Analysis, as previously described, and the shared representation used as a communication tool between the participants was the stakeholder frame. This analysis investigated the interested parts, distributed into four categories: Contribution, Source, Market and Community.

- *Contribution*: the analysis is done starting with the identification of the interested parts that have more direct influences or interests in the information system. The participants identified two major groups: Content Processing Team (agricultural technicians, people responsible for data maintenance, data quality assurance people, etc) and the System Development Team (analysts, programmers, etc).
- *Source*: in this layer the prospective clients (National and International Governmental Agencies, Researchers and National Private Companies related to agriculture) and information providers (National Agencies - Inpe-Cptec, Embrapa, Cepagri, and International Agencies – USDA, NASA) of the future system were identified.
- *Market*: in this layer prospective partners and competitors for the project were evaluated, involving national and international government and private companies, in terms of software solution.,
- *Community*: in the last layer, interested parts which are indirectly involved in the process were identified; e.g. schools, financial market, banks, several medias etc.

Activities of filling the frame were followed by the Valuation Analysis and Semiotic Framework Analysis. The identification of the stakeholders allowed the discussion of the interests, expectancies, problems and questions for each one, provided by the Valuation Analysis, and the alignment of the main commitments and intentions with the technical infrastructure that should be constructed, provided by the Semiotic Framework Analysis. Some examples of outcomes from the analysis were:

- *Valuation Analysis*: the participants explored the questions related to technical and non technical issues, which should be addressed during the development; e.g.: Who should host the site? Who would be in charge of providing financial support for the system maintenance? Who should take the responsibility for the data? What kind of information should be accessible to the clients? What are the security needs? Other problems were also discussed regarding the quantity of information processed daily and how quickly the data should be processed.

- *Semiotic Framework Analysis*: the analysis began with the definition of the main commitments and agreements in the Social World layer; that the participants discussed the “rights of the citizen for information” and the “need of enabling access to information for the agriculture sector”. Starting with these two points, the participants discussed the needs, questions and problems relative to each layer of the Stamper’s Semiotic ladder, which served as an infra-structure to keep the social issues.

Outcomes of the First Workshop were then compiled generating a documentation; data from the tape recorder and from the poster materials were also used as input for the Second Workshop.

The Second Workshop had as input the stakeholder frame with the data organized by classes (e.g. the prospective clients: National and International Governmental Agencies, Researchers and National Private Companies related to agriculture), and the Collateral Frame previously prepared by the facilitators with data extracted from the First Workshop. The Collateral Analysis (CA) allowed the participants to discuss issues beyond the software development, involving also non technical questions about the business model to sustain the project, resource needs, etc. Table 1 shows part of the outcomes of the Collateral Analysis.

Table 1. Part of the Collateral Analysis: some examples of discussed issues

	Cycle	Description
Life	Predecessor	Former semi-automated process at CEPAGRI
	Focal System	Web-based; discussion about the business model (Should It starting with free access?); infra-structure and architecture
	Successor	To combine weather information with images; workflow
Environment	Environment	Agriculture area; decision makers
	Input	Data and images from satellite; use of hand-held and GPS; process of data collecting
	Output	Tutorials; visualization and search tools; data and images processed

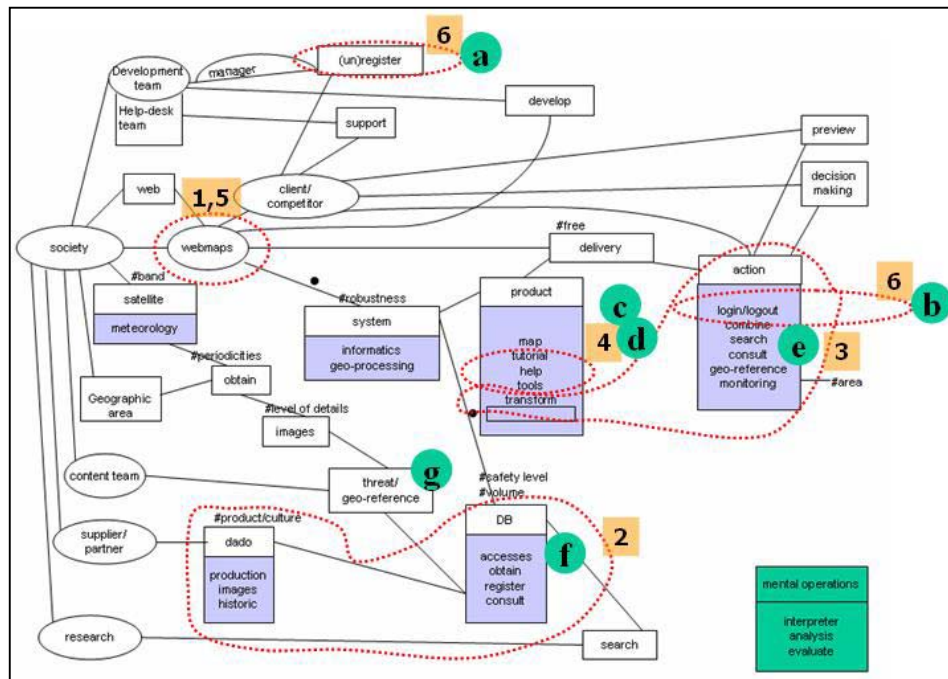


Figure 4 Outcomes of the Modeling Phase

During this Workshop, the Stakeholder and the Collateral Frames were reviewed and a First Draft of Functional and Non-Functional Requirements were validated. Figure 3(c) shows a snapshot of the wall in the Second Workshop, showing from the left to the right the Stakeholder Frame, CA Frame and a poster with the requirements listed by category: functional, non-functional (related to the product, the organization and the external).

Following Elicitation, Analysis & Negotiation the Modeling Phase took place, having the outcomes of the previous Workshops as input data. During this phase, Semantic Analysis was the core activity, producing the Ontology Chart. The Use Case Model was also constructed from scenarios elicited from the input data. A first organization for the contents to be presented in the user interface of the application (the WebMaps) was also prepared. As outcomes from the Modeling Phase we had the Ontology Chart, the Use Case Model and the UI Contents organized, which were used to inform the Third Workshop. Figure 4 illustrates part of the outcomes of the Modeling Phase: an Ontology Chart with indication of the elements associated with the UI Content Organizer, and relation between agents in the OC and actors in the UC.

In Figure 4 the numbers (1 to 6) indicate the mapping between the elements of the Ontology Chart and the UI Content Organizer: (1) WebMaps; (2) Data; (3) Search tools; (4) Help; (5) Credits and Rights; (6) Login. The letters (“a” to “g”) represents the mapping between the elements of the Ontology Chart and the Use Cases: (a) To (Un)Register users; (b) To make Login/Logout; (c) To consult tutorial; (d) To consult help; (e) To delivery data; (f) To search for data; (g) To generate visualization forms.

The mapping among these three artifacts: Ontology Chart, Use Cases and the UI Contents Organization, were presented and discussed in the Third Workshop.

3.3 Discussion

It is already agreed that a software cannot function in isolation from the organizational and social context in which it is embedded; thus, instead of emphasizing the behavior of the software system as usually proposed by traditional methodologies, the Organizational Semiotics methods allowed us to encompass a system level view, involving the team into considerations about the formal and informal levels of a prospective use of the application. Considering the multi-disciplinary profile of the participants in the WebMaps Project, results from the proposed approach allowed us to have a better elicitation, modeling and analysis of the problem domain - a Web GIS application.

Requirement Engineering usually takes place in a context of systems development to support human activities and the stakeholders are people with different backgrounds. As a multi-disciplinary and human-centered process, the participatory approach adopted, which merged activities from the workshops with activities carried by the designers, facilitated discussion among the stakeholders (including customers, users and developers), leading to a better understanding of the context and social implications of the system. Central to the proposed process for RE was the communication between the stakeholders; this communication was provided by the Organizational Semiotics artifacts, which allowed meaning negotiation by a shared representation of the data being captured, analyzed, and discussed. The OS methods showed sensitive to how people perceive, understand and interact in the world around them.

RE is concerned with interpreting and understanding stakeholder terminology, concepts, viewpoints and goals. Thanks to the dynamic of the participatory workshops, the terminology was originated from the stakeholders themselves, who expressed their ideas in the post-its, hanging them in the frames, and discussed their viewpoints and goals with the group. Hence, in our approach, the RE involved the understanding of beliefs of the stakeholders (the informal layer of the OS onion), the question of what is observable in the problem domain (agents, pattern of behavior, etc.), and what is agreed as true (its ontology).

4 Conclusion

RE has been recognized as a critically important stage in any systems engineering process; ineffective RE has been one of the causes of delivered systems that do not meet their customers’ requirements. Moreover RE is often regarded as a time-consuming and bureaucratic process. In this paper we presented a participatory approach that covers multiple intertwined activities of RE. OS provided theoretical grounding and practical techniques for the

proposed approach to guide incremental elaboration and assessment of requirements. The proposed approach seek to find best compromises between model expressiveness, precision and simplicity for better analysis and better usability of the artifacts.

Other approaches from the Human-Computer Interaction field, such as contextual approaches and ethnographic techniques provide a rich understanding of the organizational context for a prospective system; however these approaches do not map well onto existing techniques for formally modeling the desired properties of problem domains. Results achieved so far in this case study, as well as in other application of the theoretical framework of Organizational Semiotics to the information system design (Bonacin, 2004; Bonacin et al., 2004; Simoni and Baranauskas, 2004) have encouraged us to use it for bridging the gap between requirements elicitation and more formal specification and analysis techniques.

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