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How to value and monitor the relational capital of knowledge-intensive organizations?

Alexandre Barão – Instituto Superior Técnico
barao.alexandre@gmail.com

Alberto Rodrigues da Silva – Instituto Superior Técnico
alberto.silva@inesc-id.pt

ABSTRACT

Knowledge management systems are a way to help tracking and keeping organizational knowledge. Typically, organizations value is greater than their tangible assets value. Human, structural and relational capital is essential knowledge, but difficult to evaluate because it tends to be tacit, and spread in different organizational elements. The relational capital, as tacit knowledge, is not possible to capture its value as from accounting systems.

There is a lack of models to evaluate the relational capital of organizations in a network perspective and our research question is: *What is the value of this social network?* **SNARE** ("Social Network Analysis and Reengineering Environment") is a framework with engineering artifacts that can answer this question. With the aim of evaluating the relational capital of organizations, we developed three SNARE components : (1) **SNARE-Language** - a descriptive *UML-based* method which provides a representation of an abstract social network structure, able to be extended and applied to organizations; (2) **SNARE-RCO** - a model to determine the relational capital of organizations; and (3) **SNARE-Explorer** – based on SNARE-Language, it is a tool for social networks visualization, able to simulate or use real social network scenarios. It also uses SNARE-RCO model to compute the value of the organizational relational capital.

The chapter presents an approach for the measurement of the value of organizations' networks.

Keywords: social network, organization, relational capital, evaluation.

INTRODUCTION

Knowledge may be tacit or explicit. It can refer to an object, a cognitive state or a capability. Knowledge may reside in individuals, social groups, social systems, documents, processes, policies, physical settings, or computer repositories (Alavi & Leidner, 2001).

Knowledge management (KM) refers to identifying and leveraging the collective knowledge in an organization to help the organization compete (Krogh, 1998). Knowledge management systems (KMS) relate to a class of information systems applied to managing organizational knowledge, and are developed to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer, and application (Alavi & Leidner, 2001).

Typically, the value of organizations tends to be greater than their tangible assets, and so KM and KMS are a way to help tracking and keeping tacit knowledge inside organizations. Human,

relational and structural capitals are essential knowledge assets of organizations (Anklam, 2007). *Human capital* is the knowledge, skills and experience of individuals. *Structural capital* is the set of procedures, processes and internal structures that contribute to the implementation of organization's objectives. Finally, the *relational capital* is the value of social relationships in a given organization which contributes to achieve its objectives; i.e., it is the value of internal and external relationships of an organization.

The intangible value of the organization is mostly generated from informal, non-contractual activities that help build business relationships and contribute to operational effectiveness (ValueNetworks, 2010). Intangible assets can result from these non-contractual activities. *Intangible assets* can be seen as the knowledge and benefits extended or delivered by an individual or group, which are non-contractual, but still have value for the organization. The combination of all intangibles - i.e. *human*, *structural* and *relational capital*- is called *intangible* or *intellectual capital* (Adams & Oleksak, 2010).

Although the value of intangibles can be difficult to identify through financial transactions, the use of nonfinancial indicators is a way to provide intellectual capital measurement (Adams & Oleksak, 2010). However, it is not always possible to capture the intellectual capital in accounting systems of organizations, because the intellectual capital is almost invisible in conventional forms of information systems (Adams & Oleksak, 2010). Also, there is a lack of standard approach to evaluate the relational capital of organizations (Zadjabbari, Wongthongtham, & Hussain, 2008).

We think of social networks as assets that are part of organizations. The value of a social network represents a contribution to satisfy a given *demand*. This demand is fulfilled by its social entities. In this sense, the value of a relation reflects the link between a thing (a good or service) and the social entities that are connected within a given context (Barão & Silva, 2011).

Social network systems identify relations between social entities and provide a set of automatic inferences on these relations, promoting better interactions and collaborations between these entities. Social network analysis (SNA) (Faust & Faust, 1994) is the foundation of several areas such as: Organizational Network Analysis (ONA) (Cross & Parker, 2004), Value Network Analysis (VNA) (Alee, 2008) and Dynamic Network Analysis (DNA) (Carley, Diesner, Reminga, & Tsvetovat, 2007). For example, they provide methodologies for studying communication in organizations with quantitative and descriptive techniques for creating statistical and graphical models of the individuals, tasks, groups, knowledge and resources of organizational systems. In this sense, SNA methodologies are important to discover individual roles in organizations, identify social collaboration patterns, and evaluate the value of intellectual capital.

The question that we want to address and discuss in this research is: *What is the value of this social network?* Starting from this question, we argue that it is possible to define the relational capital of knowledge-intensive organizations.

The state of art analysis led us to conclude that any metric for assessing the relational capital of an organization should include aspects of human and structural capital. To evaluate the relational capital of an organization it is necessary to know various assessment approaches. There are several evaluation approaches for studying aspects such as economic impact or operational impact. However, there is a lack of methodologies for an organizational assessment that combines techniques derived from social network analysis and its relation to intellectual capital. The SNARE-Framework combines techniques from social network analysis and intellectual capital evaluation with the assessment of an organizations' relational capital.

In this chapter we firstly overview organizational evaluation issues and intellectual capital main concepts and measurement challenges. Also, an introductory description of SNA, ONA, VNA and DNA is given. Next, we present the SNARE-Framework components to evaluate organizations' relational capital. A methodology to evaluate the relational capital of organizations is suggested and three validation cases presented. Finally, we will briefly outline future research directions and present our research conclusion.

BACKGROUND

In this section we overview organizational evaluation issues, intellectual capital main concepts, intellectual capital measurement challenges, and current methods used for measuring it. Also, a description of four major areas to uncover network properties, evaluate and analyze social networks is given, namely: Social Network Analysis, Organizational Network Analysis, Value Network Analysis and Dynamic Network Analysis.

Organizational Evaluation

Organizational evaluation can be helpful in identifying (FAO, 2010): (1) whether or not the objectives and goals originally established are being achieved, as well as their expected effects and impact; (2) whether the organization is adapting to new environments, such as changing technology and alterations in other external variables so as to efficiently use the available resources; (3) areas which need to be improved, modified or strengthened; and, (4) different ways to better fulfill the needs of the clients. Also, to evaluate an organization there are several steps and the evaluator must be aware of them (FAO, 2010): Objectives of the assessment exercise; Size and nature of the organization; Areas to be covered during the assessment exercise; Potential users of the assessment results and recommendations; Organizational model on which the assessment methodology is to be based on; Framework for conducting the assessment exercise; Data evaluation; Methods of collecting data; Methodology for conducting the assessment exercise; and Results, analysis and recommendations.

Information measures can be used to evaluate any kind of organization, since an organization is based on interrelations among parts.

Intellectual Capital Concepts

Current economy is supported by information and communication technologies. The processing of information and knowledge creation are the main sources of productivity. An organization has tangible and intangible capital. Tangible capital is what can be measured (e.g. the value of a product or service). Intangible capital is the result of the organization's informal and non-contractual activities, such as interpersonal relationships which tend to be ignored by the organization's accounting systems. These intangibles can help and contribute to the operational effectiveness of an organization. So, in fact, they are not intangibles if they can be: detectable as an amount, thus observable and measured (Hubbard, 2010). The combination of all intangibles of an organization is intangible capital, also called *intellectual capital* (IC) (Adams & Oleksak, 2010).

From the book *The Knowledge Evolution* (Allee, 1997), Anklam summarizes (Anklam, 2007): *Human capital* (HC) is the knowledge, skills, and experience of the individuals required to provide solutions to customers, its core competency; *Structural capital* (SC) can be viewed as the internal procedures, processes, and organizational structures that have evolved to enable the organization to function as it does, for example, standard methods or heuristics passed on from person to person; and *Relational capital* (RC) is the value of an organization's relationships with customers, suppliers, and others it engages with to accomplish its business; for example, its access to specific markets or resources.

We must refer that many intangibles (e.g. relations) are not owned by organizations and it is hard to separate them from the HC and SC. Also, their value can be difficult to identify through a financial transaction, and the use of nonfinancial indicators is a way to provide intangible capital measurement (Adams & Oleksak, 2010).

As previously stated, an organization has tangible and intangible capital. It is difficult to separate HC, SC and RC factors, and KM is starting to become a core process as well as a fundamental competence of all knowledge workers, because they have to develop a better understanding of the information they need at the work. However, knowledge assets are not captured in accounting systems and are almost invisible in other conventional forms of management information (Adams & Oleksak, 2010). We consider intangible capital assets in organizations to be (Adams & Oleksak, 2010): Human Capital (e.g. Competencies, Experience, Longevity, Attitude, and Management); Structural Capital (e.g. Culture, Organizational Knowledge, Intellectual Property, and Processes); and Relational Capital (e.g. Customers, Partners, Brands, Reputation, Shared Knowledge).

Intellectual Capital Measurement Challenges

There are three basic challenges associated to intellectual capital (Buono, 2003) (Greene, 1999). In essence how can we: *Value* (measure) intangibles better; *Create* more value (i.e. invest and manage) from intangible capital; and *Retain* more (conversion) of this capital?

These questions are still a challenge. Mary Adams and Michel Oleksak argue that *"In Europe and Asia, a number of tools have been created by governments as part of competitive initiatives to help training managers in small and medium-sized enterprises (SMEs) so that they can leverage their knowledge capital"*. However, to date, there is no dominant model for intellectual capital assessment (Adams & Oleksak, 2010). Also, Zadjabbari argues that "*There is a lack of standard metric method to measure this kind of knowledge and assets*" (Zadjabbari, Wongthongtham, & Hussain, 2008). So, when trying to solve this problem in order to create an IC assessment system, the main parameters are (Adams & Oleksak, 2010): *Scope*, after defining the scope (e.g. human, relationship or structural capital) it is possible to evaluate and measure intangibles; *Rating System*, this can be extremely valuable for turning data into actionable goals (e.g. using a rating scale from 1 to 10 or letter grades such as A, B, C, etc.); and *Standard of Measurement* in all kinds of assessments within the organization in order to achieve a cohesive picture.

Measurement can be seen as a result of observations that quantitatively reduce uncertainty. A reduction, not necessarily elimination of uncertainty, will suffice for a measurement because it is an improvement on prior knowledge (Hubbard, 2010). Toward a universal approach to measure

intangibles in business, Douglas Hubbard recommends the following five steps framework (Hubbard, 2010): (1) Define a decision problem and the relevant uncertainties; (2) Determine what you know; (3) Compute the value of additional information; (4) Apply the relevant measurement instruments; and (5) Make a decision, act on it, return to step (1) and repeat. Even when some amount of error is unavoidable, it can be an improvement on prior knowledge of a system (Hubbard, 2010).

Methods for Measuring Intellectual Capital

Researches of measuring the intellectual capital of organizations have produced several methods and theories over the last years. A very good overview of intangible measuring theories can be found in (Sveiby, 2010) and also in (Bontis, 2001). According to Sveiby, the main problem with measurement systems is that it is not possible to measure social phenomena with anything close to scientific accuracy. All measurement systems have to rely on their proxies, such as dollars, euros, and other indicators (Sveiby, 2010). The common reason for measuring and reporting is to improve internal performance, i.e. management control. However, the problem is that people do not like to be measured (Sveiby, 2010). To sum up, there are four common approaches for measuring intangibles (Sveiby, 2010): *Direct Intellectual Capital* methods (DIC) estimate the $-value of intangible assets by identifying its various components. Once these components are identified, they can be directly evaluated, either individually or as an aggregated coefficient; *Market Capitalization Methods* (MCM) calculate the difference between a company's market capitalization and its stockholder's equity as the value of its intellectual capital or intangible assets; *Return on Assets methods* (ROA), standard pre-tax earnings of a company for a period of time, are divided by the average tangible assets of the company; and *Scorecard Methods* (SCM), the various components of intangible assets or intellectual capital, are identified and, afterwards, indicators and indices are generated and reported in scorecards or as graphs.

There is no standard IC measures/metrics because every company needs a unique understanding of which intangible assets are really valuable for the organization. Some of the indicators are financial but it is possible to use nonfinancial indicators to provide the most basic parameters for intangible capital. Nevertheless, there is no dominant model because every company has specific IC evaluation purposes. Also, there is a lack of standard metric tools used.

Social Network Analysis

Social Network Analysis (SNA) represents a method for achieving analytical results in about almost any group interaction in which social entities are present. In SNA scope, group dynamics are studied to identify relations and interactions among their members. Starting from these interactions, it is possible to identify social patterns (Haythornthwaite, 2005) and to detect or propose social or organizational changes that reveal how networks grow or should change. Also, it is likely to find potential causes and consequences of a network change, predicting and controlling networks' evolution (Churchill & Halverson, 2005). These features are dependent on metrics which allow group properties' identification or characterize individual influence on a specific group.

To perform SNA it is necessary to define measures that can be compared between actors or networks. Measures in SNA can be distinguished as those that evaluate the entire network and the ones that only assess a specific node (Faust & Faust, 1994). SNA can be used in an organization to better understand the social capital (Borgatti & Foster, 2003); support partnerships and

alliances (Cross & Parker, 2004); measure the degree of embedment of the actors as well as their importance in the network; support knowledge management policies; identify who really knows what happens in the company (Helms & Buijsrogge, 2005); integrate networks across core processes; promote innovation; integrate new members or organizational changes; support the development of informal communities of practice; improve leadership effectiveness; replicate high performance throughout an organization and understand and improve the disconnections between groups in the organization or between groups and the outside world (Cross & Parker, 2004).

Organizational Network Analysis

Organizational network analysis (ONA) is a powerful mean of making invisible patterns of information flow and collaboration in strategically important groups visible (Cross & Parker, 2004). In organizations, ONA methodology can be helpful to uncover network value questions, namely: "Does the network have adequate resources to create value, both tangible and intangible?", "Does the network produce appropriate value for its stage in its development cycle?", "Are there performance metrics for tangible value produced?", "Is the network's value-producing model sustainable?", and "Are all stakeholders receiving the value that they are expecting?" (Anklam, 2007).

Value Network Analysis

Value network analysis (VNA) is focused on: Providing a perspective for understanding value, creating roles and relationships, both internal and external, upon which an organization depends on; Offering dynamic views of how both financial and non-financial assets can be converted into negotiable forms of value that have a positive impact on those relationships; Explaining how to more effectively attain value for each role and how to use tangible and intangible assets for value creation; and Providing a systematic analysis of how one type of value is converted into another (Alee, 2008).

Value networks are sets of roles, interactions and relationships generating economic, social or environmental value, and so any purposeful organization can be understood as a value network (Alee, 2003). VNA fills the analytical and managerial gap between other organizational tools, because it provides a network perspective into how processes and people create value. Also, it shows unique relationships and transactions as well as sequences of value flows (ValueNetworks, 2010). A transaction occurs when a deliverable originated by a role is conveyed to and received by another and two or more reciprocal transactions are an exchange (Alee, 2008). Value conversion is the act of converting or transforming financial to non-financial value; it can also imply changing an intangible input or asset into a financial value or asset (Alee, 2008).

Value interactions are of two types: (1) *tangible deliverables*, which are contractual or mandated interactions between participants; and (2) *intangible deliverables*, that are informal and more personal (e.g. knowledge exchange, favors, and benefits) (ValueNetworks, 2010). The roles and deliverables are made visible through a simple visual mapping technique and the diagrams link a variety of tools, such as cost/benefit analyses, to increase value outputs, leverage knowledge and intangibles for improving financial and organizational performance and find new value opportunities (ValueNetworks, 2010).

Dynamic Network Analysis

Dynamic Network Analysis (DNA) is a scientific field that combines social network analysis, link analysis and multi-agent systems within network science and network theory (Carley, Diesner, Reminga, & Tsvetovat, 2007). There are two aspects to be considered: (1) statistical analysis of data and (2) simulation to address issues of network dynamics. DNA networks vary from traditional social networks in that they are larger, dynamic, multi-mode (multiple types of nodes), multiplex networks (multiple types of links), and may contain varying levels of uncertainty (Carley, Diesner, Reminga, & Tsvetovat, 2007). The difference from DNA to SNA is that the first one takes the domain of time into account, i.e. DNA takes snapshots of the same network from different intervals and observes and analyzes its evolution.

Carley suggests an approach to DNA based upon the combined use of multi-agent modeling, machine learning and a metamatrix approach to network representation (Kathleen, 2003). This metamatrix is a multiplex representation of entities and connections that enriches the traditional one-dimensional representation. Carley combined knowledge management, operations research and social networks techniques to create the notion of metamatrix. The metamatrix approach provides a representational framework and a family of methods for the analysis of organizational data. Under this model, organizations are conceived of as being composed by a set of elements, each of which belongs to one of five classes (Personnel, Knowledge, Resources, Tasks, and Organization) (Carley, Diesner, Reminga, & Tsvetovat, 2007).

SNARE FRAMEWORK

SNARE is acronym for "Social Network Analysis and Reengineering Environment". This framework is able to represent social networks and it allows researchers to design and build real scenarios for social networks extraction and analysis (Barão & Silva, 2008). SNARE framework has engineering artifacts to: (1) Represent social network structures; (2) Define relations, social entities, properties and surveys; (3) Store, manage and visualize the information required for social network analysis; and (4) Monitor the relational capital of a social network in real-time.

SNARE framework provides mechanisms to extract data sets from other systems and it is designed to pull out data from a generic system by mapping data extraction components.

SNARE-Language

The SNARE-Language (Barão & Silva, 2010) provides a representation of a social network structure using UML (OMG, 2010) as a descriptive method. Through the application of SNARE-Language it is possible to graphically design social entities and the multiple relations among them. SNARE-Language main concepts are: *Social Entity*, *Relation*, *Role*, *Action and Event*. Figure 1 depicts the SNARE-Language Meta-Model.

Conceptualizing social structures of a network using SNARE-Language to model social networks is a process which requires the instantiation of social entities, roles, relations, actions and events. To do this, a set of stereotypes can be used. The richness of this language to model social networks comes from the flexibility to combine these stereotypes. Flexibility is expressed by all possible links that may exist on a network without adding redundant instantiations. E.g., a social entity can play several roles in the same relation, and this concept should be achieved through the instantiation of a factorized *Role* stereotype. Regarding the connection patterns we studied, SNARE-Language captures most of the possible social network relations. SNARE-

Language is flexible to fit the needs of modeling social networks. When compared to other social networks representation techniques, SNARE-Language includes a new collection of diagrammatic model elements which are more significant when capturing social network semantic concepts. Also, they are unambiguous and supported by UML tools.

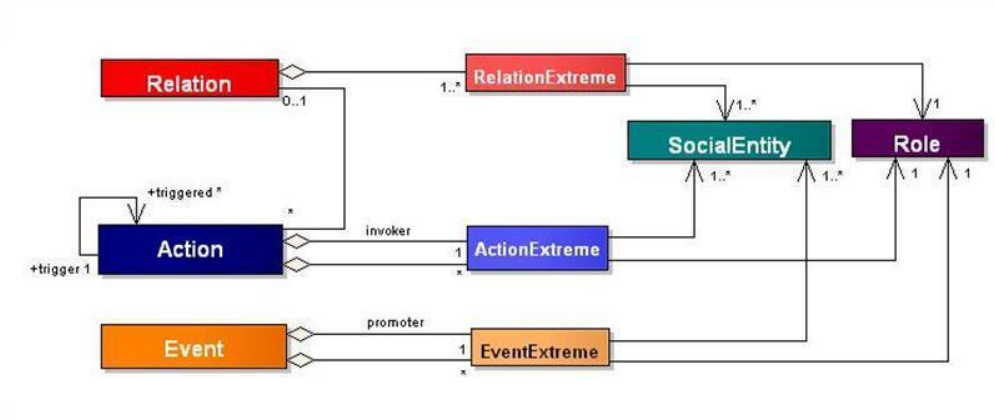

Fig. 1 - SNARE-Language Meta-Model

SNARE-RCO

SNARE-RCO is a model to evaluate the *relational capital of organizations*; it combines techniques derived from social network analysis with aspects of organizational assessment, and considers dynamic properties from the social entities intellectual capital (Barão & Silva, 2011) .

To analyze the relational capital value (RCV) of a given organization, SNARE-RCO model proposes three kinds of assessment inputs: organizational factors, network factors and social entity factors. These inputs are dynamic, i.e. defined by the analyst, because they depend on the target organization. SNARE-RCO model is used to compute the RCV of organizations. Figure 2 depicts the referred assessment inputs to compute RCV.

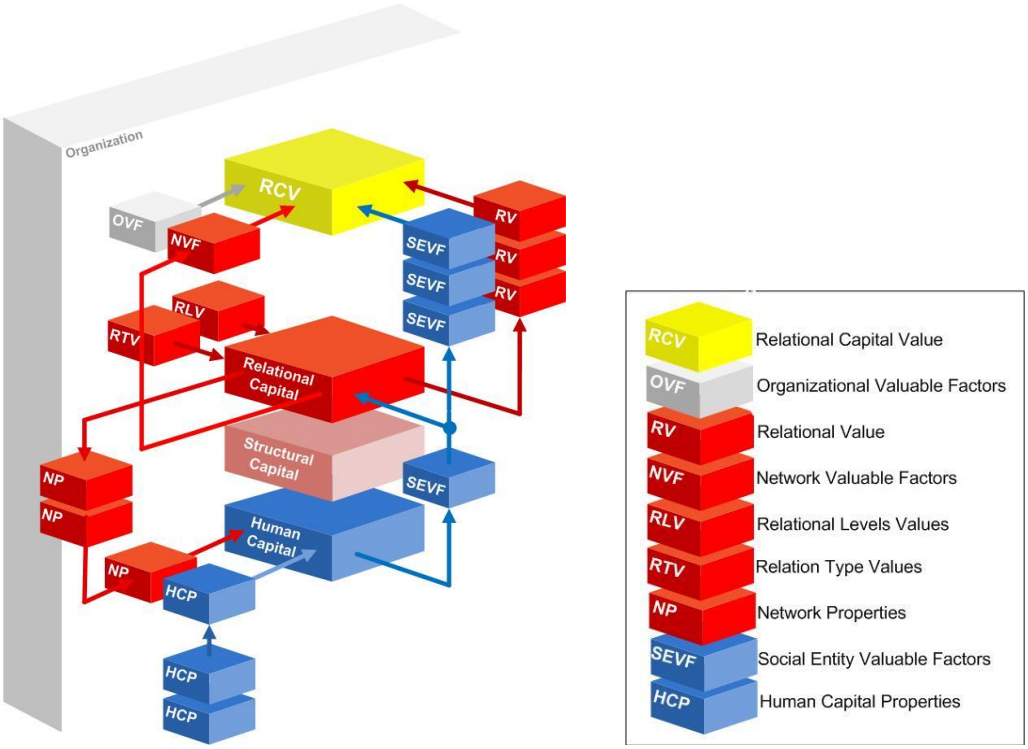

Fig. 2 - SNARE-RCO Flows to Compute RCV

Organizational Valuable Factors (OVF) are attributes of the organization, for example: number of active customers; number of partners; and, number of brands.

Network Valuable Factors (NVF) are properties of the organization's social network. These properties can be derived from the analysis of social networks, for example size and density.

Social Entity Valuable Factors (SEVF) are properties assigned to each social entity. The analyst can use *Network Properties* (NP) from the analysis of social networks, such as *centrality indegree* or *centrality outdegree*. The analyst might also consider *Human Capital Properties* (HCP). These properties are role dependent and may result from previous human resources management analysis like questionnaires or other evaluation techniques. Examples of HCP properties are: Analytical Problem Solving; Creativity and Innovation; Problem Diagnosis and Solution; Technical Expertise; and Time Management.

Relations can be of numerous types (e.g. Collaboration/Information or Collaboration/Problem solving relation type) and for each several *Relation Type Values* (RTV) can be assigned. These values are weights to compute RCV. Also, in a given social network relation, different levels values could be assigned. These values are *Relational Levels Values* (RLV). Examples of relational values include: *Very near; Near; Regular; Far; and Very far*.

Relational Values (RV) are computed for each network and include a combination of RTV, RLV and SEVF factors in *offer-demand* logic.

To compute the RCV, the definition and classification of parameters, such as OVF, NVF, NP, RTV, RLV, and HCP, may change depending on the type of the analyzed network. This way SNARE-RCO is flexible because it allows adapting parameters definitions and classifications. Moreover, any of these parameters can be calibrated or even neutralized according the analyst's

purposes. Besides computing the RCV, this model allows us to identify and compute the value of human capital in a given network.

In general terms, this model enables us to measure the relational capital of social networks from organizational units and organizations, content management systems, or social media platforms. Combining techniques derived from social network analysis with organizational aspects and its relation to intellectual capital, the SNARE-RCO model helps to answer the question "*What is the value of this social network?*". Three key-concepts to compute the organizational network RCV are: (1) the value of a social network is a contribution to satisfy a given *demand; (2)* this *demand* is conducted by its social entities; and (3) the value of relations in a given context reflects *offers* and *demands* from social entities (Barão & Silva, 2011).

SNARE-Explorer

SNARE-Explorer is a desktop-based interface for data analysis and rich visualization developed with Java technology (Barão & Silva, 2008). This system is able to store, manage and visualize the information required to dynamically reconstruct real scenarios for social network analysis extraction and relational knowledge discovery. This tool is based on the SNARE-Language meta-model supporting different types and instances of social entities (e.g. people, organizational-units, and organizations), roles or relations. Also, it supports different integration approaches and it is able to manage and automatically collect social networks data from legacy information systems, through transparent or intrusive approaches. Target systems are accessed by a sophisticated visualization tool which includes specific heuristics to address the different types of data analysis required, and a set of spatial graphics and diagrams able to depict new data views.
As an engineering tool, SNARE-Explorer is able to simulate scenarios in real-time and uses SNARE-RCO model to compute and visualize the value of the organizational relational capital. Figure 3 depicts the SNARE-Explorer *Relational Capital Monitoring System* interface.

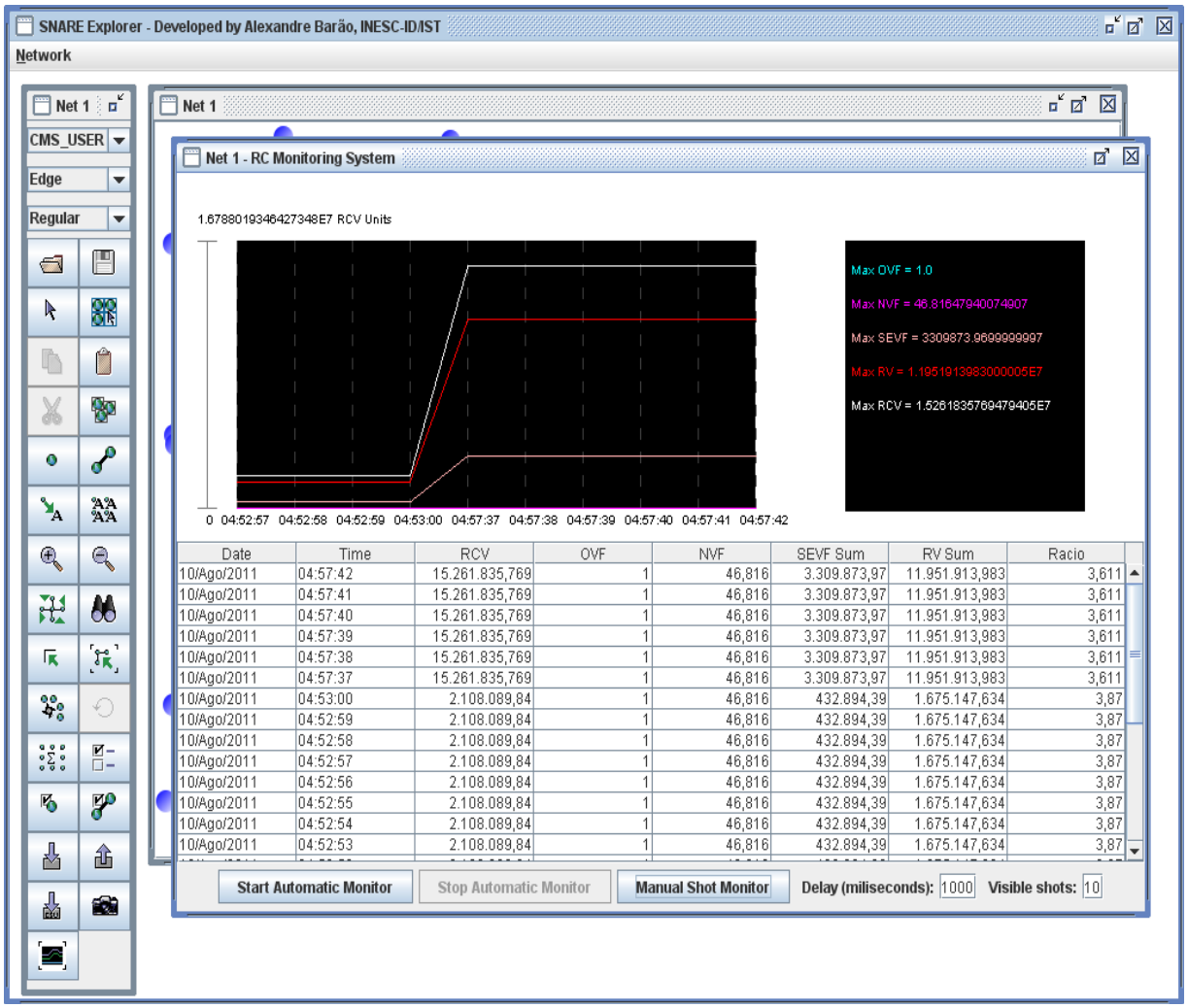

Fig. 3 - SNARE-Explorer Relational Capital Monitoring System

RELATIONAL CAPITAL EVALUATION

For a relational capital evaluation using SNARE-Framework, first we describe a methodology to evaluate the relational capital of organizations and, after, present three distinct evaluation cases.

A Methodology to Evaluate the Relational Capital of Organizations

We present the SNARE-Methodology to be applied to evaluate the relational capital of organizations. This methodology has four main processes: *Diagnosing*, *Designing*, *Executing*, and *Reporting*. Methodology roles and artifacts are also described in this section.

In organizational context *stakeholders* are participants that are normally associated with specific roles such as: sponsors, employees, customers, and suppliers (Anklam, 2007). In social terms, sponsors are *network investors* or *funders*; employees are *network core group members*; customers are *members of the network*; and, suppliers are *partners* (Anklam, 2007). Employee roles are dependent on the target organization which has a specific organizational structure that

expresses allocation of responsibilities for different functions and processes to separate entities like departments, workgroups and individuals.

Aiming at evaluating the relational capital of organizations, the SNARE-Methodology has four roles: *Analyst*, *Sponsor*, *Manager*, and *Team*. The *Analyst* is the SNARE framework expert, and s/he can lead to shifts in management thinking and improvements in the relational capital value of the organization. The *Sponsor*'s primary objective is the preservation of organizational investments. In the organization, the *Sponsor* can be an individual or a group and assumes strategic responsibilities and decisions. The *Manager* serves as an agent to provide access to the organization's private information systems. The *Team* involves all the individuals, typically people who work part-time or full-time under a contract of employment.

SNARE-Methodology considers the use/development of several artifacts namely: *Organizational Context*, *Organizational Structure*, *Project Charter*, *Analysis Pack*, *Evaluation Report* and *Evaluation Presentation*. The *Organizational Context* is a document that results from the organization's elicitation and contains its introductory description. Based on SNARE-Language, the *Organizational Structure* is a document that identifies the social entities of the organization as well as the roles and social relations (*relational actions*) to be analyzed. The *Project Charter* contains four sections: (1) *General Information*; (2) *Overview*; (3) *Project Approach*; and (4) *Project Approval*. The *Analysis Pack* is a set of analysis documents, namely: *Interviews and/or Questionnaires*, *Network Analysis*, *Social Entity Analysis*, *Relational Analysis*, and *Relational Capital Value Report*. *Interviews and/or Questionnaires* contain *Team* answers which help the *Analyst* identify organizational relations. *Network Analysis* is a document which includes: *Network Layouts* (to depict network views with node type differentiation), *Network Properties* (to show social entity centrality degrees or other SNA applied measures), and *Network Valuable Factors* (to identify overall network properties such as density or number of social entities). *Social Entity Analysis* is a file that includes: *Human Capital Properties Analysis* (to compare human capital properties), *Social Entity Valuable Factors Analysis* (to analyze the RCV contribution of each social entity), *Node Type Analysis* (to study social entities' predominant network node types), and *Organizational Valuable Factors* (to spot attributes of the organization that may contribute to the evaluation system). *Relational Analysis* is a document that firstly includes definitions for *Relation Type Values* (to differentiate relational action values) and *Relational Levels Values* (to distinguish proximity relational values). Secondly, it comprises the *Relational Value Analysis*, which is a description to understand each relational action RCV contribution. *Relational Capital Value Report* is a document that describes the global RCV of the network and may include simulated scenarios to analyze RCV changes. *Evaluation Report* is a private file which may include insights and recommendations to improve the relational capital of the organization. Finally, *Evaluation Presentation* is a public domain document with evaluation results.

SNARE-Methodology makes use of a tool and two models. The tool is *SNARE-Explorer* (Barão & Silva, 2008) and the models are *SNARE-Language* (Barão & Silva, 2010) and *SNARE-RCO* (Barão & Silva, 2011). The *SNARE-Language* model is used to produce the *Organizational Structure* document. *SNARE-RCO* model is employed to classify relational input parameters and compute the relational capital of the organization. Finally, *SNARE-Explorer* is the desktop tool application that uses *SNARE-Language* and *SNARE-RCO*. The *Analysis Pack* is produced by *SNARE-Explorer* tool, but other tools can be used, particularly: ETL tools, spread sheets and word processors.

As stated before, SNARE-Methodology is based on four main processes, namely: *Diagnosing*, *Designing*, *Executing*, and *Reporting*. These processes tend to be sequentially performed. In the *Diagnosing* process (See Figure 4), the *Analyst* presents the *SNARE-Methodology* to the *Sponsor* and the *Team*. The *SNARE-Methodology* presentation includes an overview of the *SNARE-Language*, *SNARE-RCO*, and *SNARE-Explorer* tool. After the *SNARE-Methodology* presentation, the *Analyst* produces the *Organizational Context* document in collaboration with the *Sponsor* and the *Team*. Then, using *SNARE-Language*, the *Analyst* writes the *Organizational Structure* document and, finally, produces the *Project Charter*, which must be formally signed by him and the *Sponsor*.

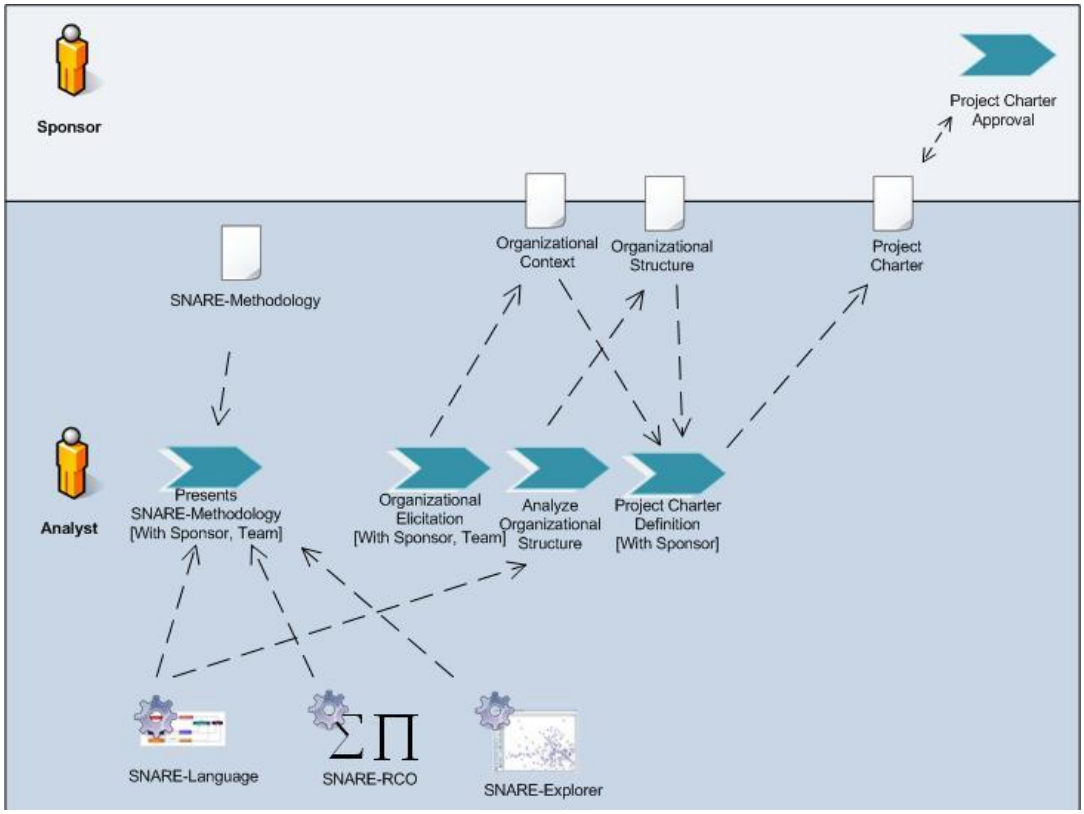

Fig. 4 – Diagnosing Process

In the *Designing* process (See Figure 5) using the identified *Organizational Structure*, the *Analyst* starts to request information access to the *Manager*. After that, the *Analyst* and the *Manager* can determine how organizational data will be gathered from the organization's knowledge base. For the next step, the *Analyst* defines analysis metrics, which are SNARE-RCO metrics. Finally, when appropriate , analysis instruments, such as interviews and/or questionnaires, are defined by the *Analyst*. These instruments must be approved by the *Sponsor*.

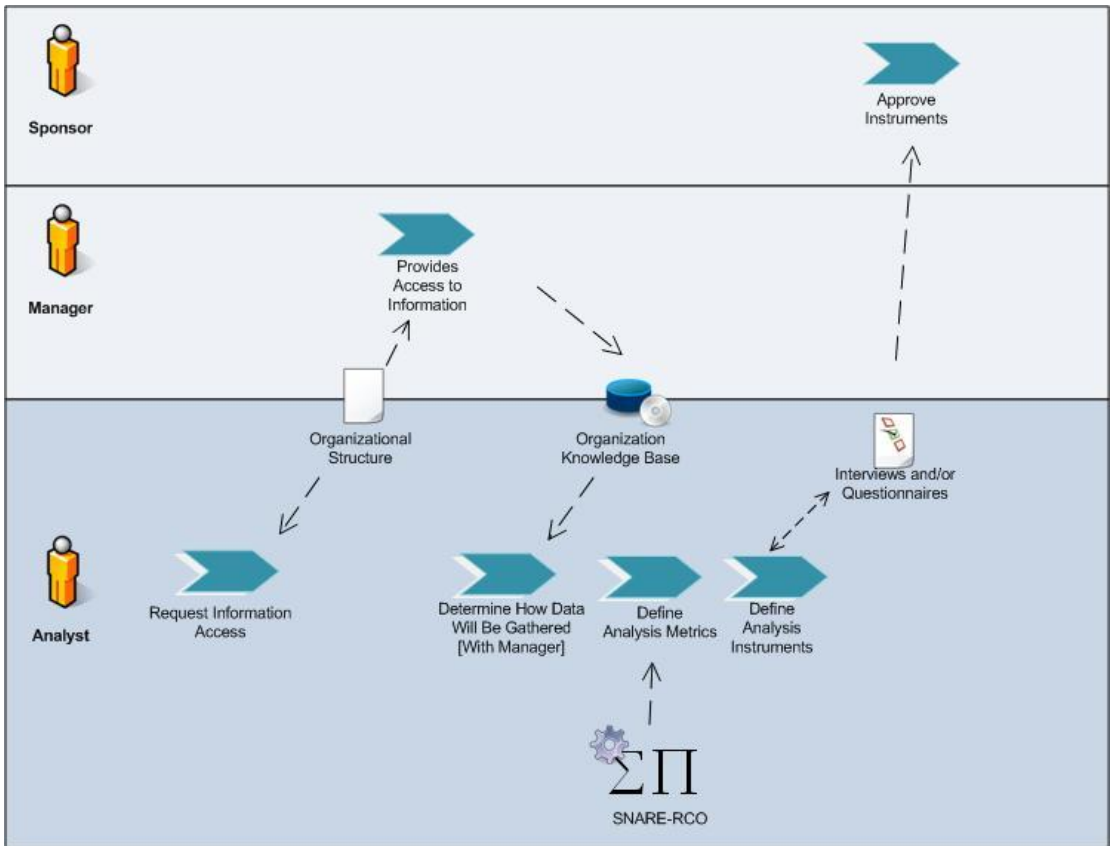

Fig. 5 - Designing Process

In the *Executing* process (See Figure 6), the *Analyst* starts having interviews and/or launching questionnaires to the *Team*. Interviews and questionnaires will be analyzed next by the *Analyst*. The *Manager* grants the *Analyst* access to necessary organizational information systems such as: the relational knowledge base, social networks, or Enterprise Resource Planning (ERP) systems. With this, the *Analyst* is able to start tasks like extract, transform and load data. These will populate SNARE-Databases and, using *SNARE-Explorer*, the *Analyst* can start to examine data, monitor, and evaluate relational capital. As a result, the *Analysis Pack* is produced. This pack includes processed *Interviews and/or Questionnaires*, *Network*, *Social Entity* and *Relational Analysis*, and also *Relational Capital Value Report*.

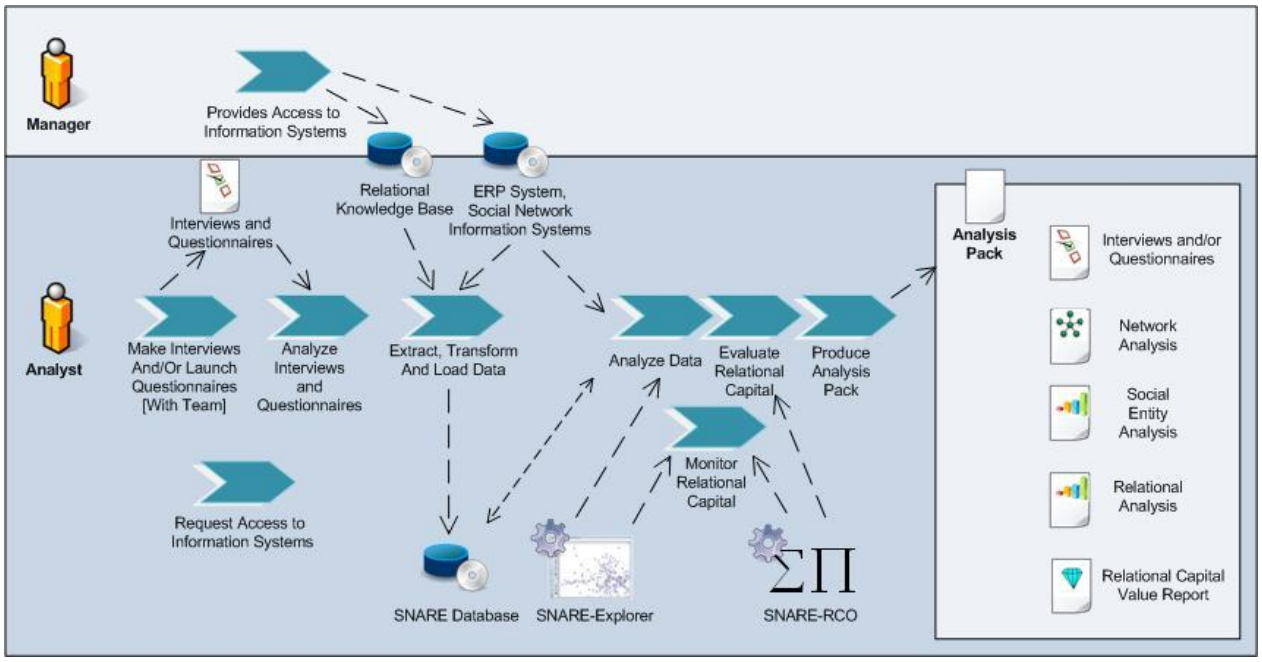

Fig. 6 - Executing Process

In the *Reporting* process (See Figure 8), the *Analyst* starts to review the *Analysis Pack* with the aim of producing the *Evaluation Report.* This report will be delivered to the *Sponsor*. The *Evaluation Report* contains data, some of which may be private, and it is necessary to define the *Evaluation Presentatio*n approach with the *Sponsor*, i.e. define what kind of results can be presented to the *Team*. Finally, the *Analyst* prepares the final presentation which will be performed to the *Sponsor* and the *Team*.

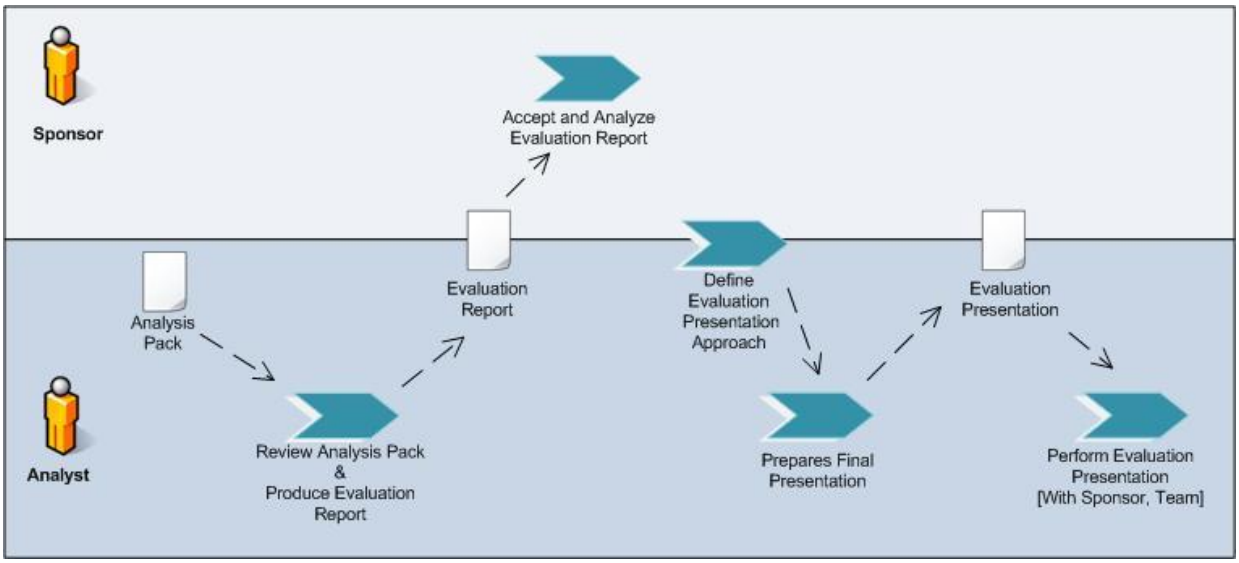

Fig. 7 - Reporting Process

Using this methodology it is possible to define relational capital assumptions and help organizations to identify and solve problems. This methodology can promote ways for organizational characterization and/or change processes. Characterization or change begins with *awareness* and the *Analyst* and *Sponsor* work together for that purpose that is to evaluate the relational capital of the organization for a better characterization, and to find possible organizational changes to improve the organizational knowledge. Increasing the organizational understanding for both *Sponsor* and *Analyst*, regarding the relational capital, is to be aware of possible ways to change the organization. As described, with this methodology, the *Analyst* and the *Sponsor* participate in iterative and reflective processes.

With this methodology, the *Analyst*'s presence can probably affect the situation on the experiment field because it allows direct intervention of analysts into events, e.g. the *Analyst* can be seen as a co-worker. However, intervention improvements can be reflected on an increase of relational capital which is an essential organizational knowledge.

Organizational Evaluation

Using SNARE framework and methodology, we have chosen to apply SNA and RC evaluation in the context of two organizations: (1) Case A - Services Support Group at Vodafone Portugal (GSS), a group responsible for the operation and support in networking services that is composed by more than half-a-hundred collaborators, most of them allocated to the different functional areas; and (2) Case B - A School in Lisbon, which employs over 200 people, namely teachers, technical assistants and operational assistants.

Case A was focused on the analysis of the Relational Capital of six teams from a Vodafone Portugal Unit: GSS. The study analyzed team resilience as a function of its dependency of specific members. Centering the analysis on GSS Unit, the main objectives were to: identify central elements on each team; obtain the RCV of each team; and analyze how RCV varies depending on the type of relational action. Also, in order to verify the GSS network importance, three additional goals were defined: to compute the global RCV of the network; to simulate the absence of central elements and measure the impact on the network RCV; and to replicate the removal of GSS Unit and measure the network RCV impact.

Using SNARE-Methodology, data was collected from Vodafone's workflow tool in the period from June 2011 to July 2011. Logs were gathered from the Vodafone workflow system for two months. This allowed insight into the tree main business processes in which the Unit under study participated on: *Incident* (Processes used to identify and respond to events that fall outside normal operations, including the recording, analysis and categorization of these events, along with measures taken to address the underlying causes and restore normal service operation as quickly as possible to minimize the adverse impact on business operations); *Change* (Processes used to manage any kind of change to existing technology, including definition of procedures; capturing, analysis and formal approval of change requests; , testing authorization, implementation and review of changes); and *Problem* (The process responsible for managing the lifecycle of all problems with the goal of preventing incidents from happening, and for minimizing the impact of incidents that cannot be prevented). The analysis repository was enriched with the log information from the *Information Sharing* used by the Unit under study. Both records belonging to *Business Processes* and *Information Sharing* were processed and analyzed with SNARE-Explorer Tool. These relational actions *Change*, *Incident*, *Problem* and *Information Sharing* were imported by CSV SNARE-Explorer mechanisms.

To perform *Relational Analysis*, Relation Type Values (RTV) and Relational Levels Values (RLV) were firstly determined. In this study, RTV was defined as 0.1 for all relations, and RLV as 1 (regular). Using these definitions, RV Sums for each relational action were computed. The following figure shows RV Sum values for each type of relational action. The predominant relational capital value refers to the *Information Share* relational action, and relational action *Problem* has the lowest RCV (See Figure 8).

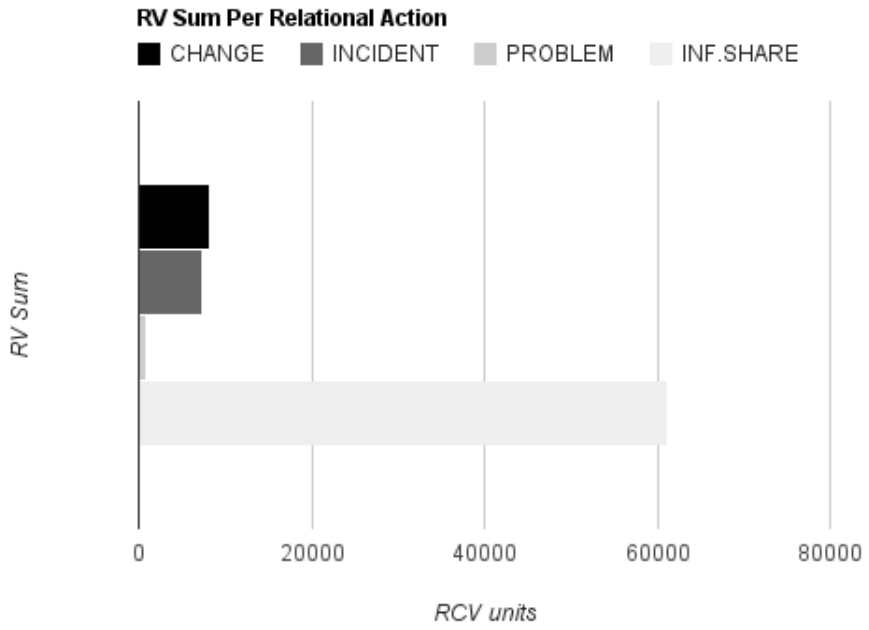

Fig. 8 – Case A, RV Sum per Relational Action

Using the SNARE framework, we successfully identified the central elements of GSS teams. Also, we determined the RCV of each one and analyzed how RCV varies depending on the type of relational actions. Finally, we computed the RCV of the overall network, replicated the absence of central elements and measured the impact on the RCV network. Using SNARE-Explorer tool, we also simulated the removal of GSS Unit and measured the network RCV impact. From this study, we further concluded that network properties and relational value can be a way to translate team resilience in this specific case. The study has validated *Sponsor* expectations, namely: homogeneous groups, in which all members execute similar functions and are expected to equally distribute effort among its members; in addition, if Network Properties (NP) are equally distributed, groups can be more resilient. Notwithstanding, members with NP higher than the average can be a risk of dependency while members with NP lower than the average can represent elements not entirely integrated into their teams.

Repeated over time, this study can help understand: what the impact of improvement measures is; what the consequences of an individual absence are; and how long it takes to fully replace one individual.

Case-B was focused on the analysis of mechanisms of communication and information to transmit knowledge in a given school in Lisbon. This school has over 200 employees and they are divided into three major categories: teachers, technical assistants and operational assistants.

The study's aim was to answer the question: "Is the organization optimized to produce and transmit knowledge?" If sharing knowledge is improved, then scientific articulations can be perfected and this is better for students. To reach an answer to the above question, several main goals were defined, namely to: identify central elements in the organization; spot central groups in the organization; obtain RCV for each relational action; and compute the RCV of the network. Also, two additional goals were outlined: to simulate the absence of central elements and measure the impact on network RCV; and to reproduce the removal of peripheral elements and measure the impact on network RCV.

Using SNARE framework, this study was conducted with the collaboration of the School Quality Observatory throughout April 2011.As a result, several recommendations to improve knowledge sharing emerged. With this study, a network analysis was first performed at the school. With the aim of analyzing organizational mechanisms of communication and information to transmit knowledge, we developed a questionnaire with several questions to the local community. Data about employees was collected from the school's Human Resources (HR) system. The target universe contained 229 employees. 207 questionnaires were delivered and collected (162 *Teachers*, 11 *Technical Assistants* and 34 *Operational Assistants*). The questionnaire contained several questions, and the closed-answer questions were defined as follows: "Who transmits important information to carry out your functions?"; "Who do you ask for help when you have to solve a new problem?"; "Who do you particularly appreciate for professionalism and/or scientific knowledge?"; and, "Who communicates with you using information technology?". These questions were inspired in Rob Cross' work *Questions to Uncover Important Network Relationships* (Cross & Parker, 2004). Using SNARE framework, these four questions were analyzed, and for each relational action, a name was correspondingly assigned: *TransmitInformation*; *AskForHelp;WhoRecognizes;* and *CommunicateWithIT*.

TransmitInformation captured a greater number of responses and *CommunicateWithIT* a lower one. In addition, when answering the questions listed above, people were also asked to rate their peers in terms of five descriptors: *prestige*, *competence*, *experience*, *friendship*, and *proximity*. All questions were initially processed using an online spreadsheet and imported after by CSV SNARE-Explorer mechanisms.

To perform *Relational Analysis*, Relation Type Values (RTV) and Relational Levels Values (RLV) were defined first. In this study, RTV was set to 0.1 for all relations and RLV was defined as 1 (regular). The main responsible relational action for RCV increase is *TransmitInformation*. *AskForHelp* and *CommunicateWithIT* are the lowest RCV contributors. This is a remarkable fact because it proves that communication and transmission of organizational knowledge can be optimized.

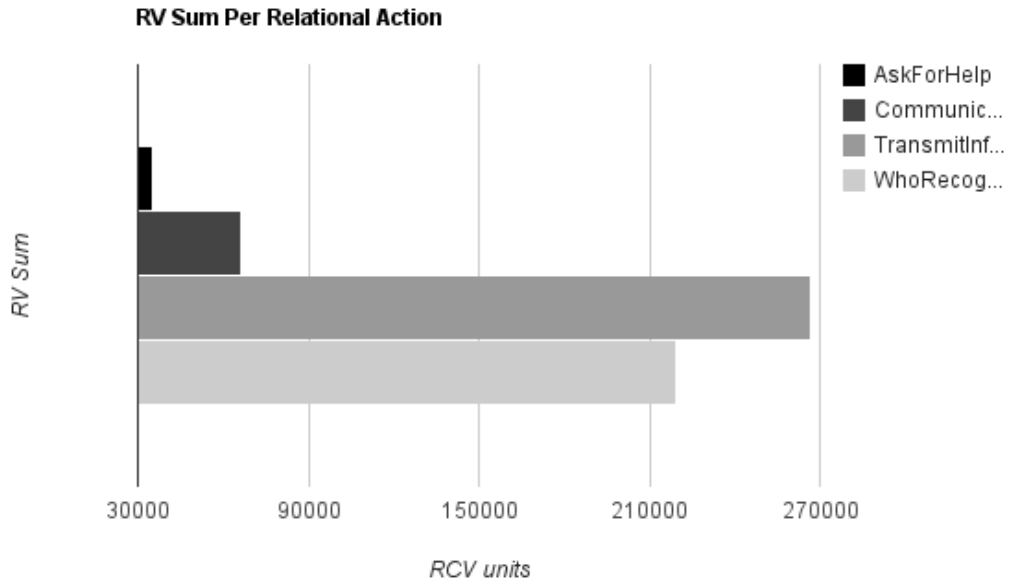

Fig. 9 – Case B, RV Sum per Relational Action

It was also observed that a relatively small number of people play a central position in the organization. Furthermore, a problem was detected: a significant amount of people are dependent on information provided by a restrict group. To increase this problem, *communication with IT* has captured low RCV values. This aspect reveals that to rationalize the information transmission using IT and redistributing workloads can release significant resources for other important tasks. Even when using IT, information senders are typically the network core members. Besides, after analyzing network layouts, we encountered another problem: people receive the same information from several sources.

The SNARE-RCO model evaluation provided very objective information to support decision making. Also, in the future, it can be used to compare several schools. This study has showed that the school is not optimized to produce and transmit knowledge, and a change of plan was recommended by the Observatory of Quality to the School's commission board. The plan was accepted and change actions started in September 2011. Some time from now, it would also be interesting to involve students in order to capture their perception about the school community.

Extending Evaluation to Content Management Systems & Social Media Platforms

We chose to apply SNA and RC evaluation to a Web-based collaborative and social platform (Case C). In particular, the Learning Objects Pool[i] (LOP) platform which has hundreds of users (Silva & Silva, 2009). This system is a repository of learning objects (Carlota, Silva, & Silva, 2009). A learning object (LO) is defined as any digital resource that can be reused to support learning (Wiley, 2000), and LOP is built around the "stock exchange" metaphor, pushing users motivation to produce good learning objects as well as to cooperate with other users, either by submitting suggestions, comments or by rating existing learning objects (Silva & Silva, 2007). To achieve this level of motivation and interest, some kind of competition is promoted, assigning

credits to users and setting a value cost for each learning object. This credit-based system allows us to create users and learning objects rankings, rewarding those that collaborate with the system.

As stated before, LOP is built around the "stock exchange" metaphor, i.e. users are ranked through an *offer-demand* credit system, and the major aim was to compute its network RCV by analyzing two major LOP relational actions: *downloads* and *comments*. Data was collected from LOP database and 268 users were imported by SNARE-Explorer using CSV mechanisms, as well as associated relational actions: *download* and *comment* learning objects.

To perform *Relational Analysis*, Relation Type Values (RTV) and Relational Levels Values (RLV) were defined. In this case, RTV was set to 0,1 for relational action *downloads,* and to 0,2 for relational action *comments*. In this case, *comments* have a higher weight since they trigger interactivity between social entities. RLV was outlined as 1 (regular). Using these definitions, *RV Sums* for each relational action were computed. Figure 10 shows the *RV Sum* for each type of LOP analyzed relational action. The predominant relational action to produce RCV capital is *Downloads*.

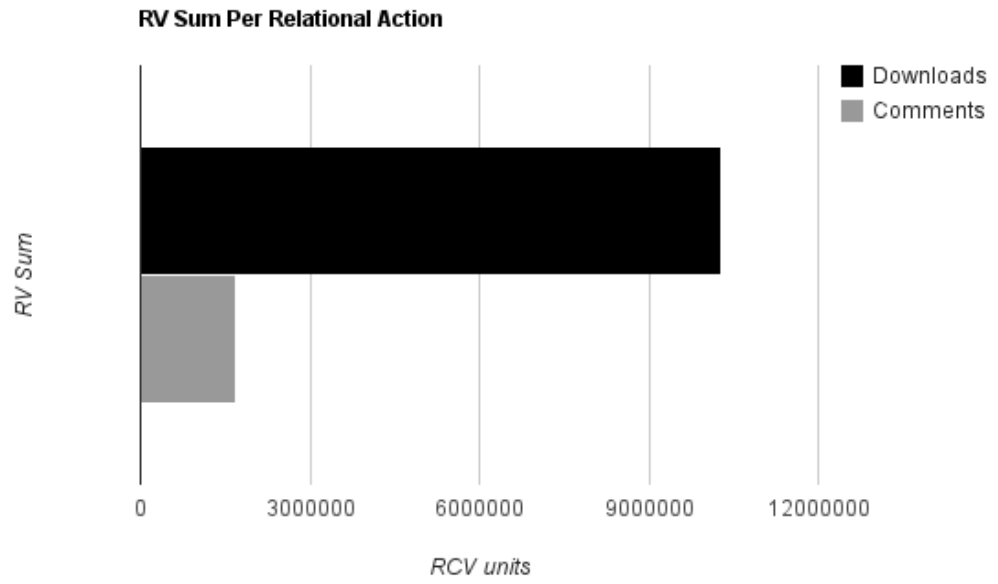

Fig. 10 – Case C, RV Sum per Relational Action

On the one hand, in the LOP system network layout, a significant number of isolated nodes was observable. They are registered users but never make a single LO *download* or *comment*. This means that LOP gave them starting credits to use the system but they are not LOs authors. On the other hand, a small number of users with a high centrality degree were detected. These users are LO authors. In addition, we found an expressive correlation between NP computed properties and user credits imported from LOP system. This fact proves that SNARE-RCO model is able to evaluate registered users with similar computed LOP results. The study has also identified network central members, and proven that SNARE framework can be applied to monitor the relational capital of a CMS system. Relational actions were measured and the RCV was computed for the overall network.

From this study, we believe that it is possible to apply SNARE-RCO model to evaluate the relational capital of systems such as *Moodle*[ii], *LinkedIn*[iii] or *Facebook*[iv]. Consider *Table 1* in which the analyzed platform LOP is compared with possible applications to those systems. In the platforms *Moodle*, *LinkedIn*, and *Facebook*, *demands* are conducted by users, e.g. reading a document (*Moodle*), viewing a job description (*LinkedIn*), or viewing user photos (*Facebook*). These *demands* are relational actions and can be evaluated by the SNARE-RCO model, thus, using SNARE-RCO features, the table below shows several examples of possible scenarios to enforce the SNARE-Framework ability for evaluating the relational capital of these systems.

Table 1. SNARE Framework Platforms Application

Platform	**LOP**	**Moodle**	**LinkedIn**	**Facebook**
Context	CMS	CMS	Social Media	Social Media
Network Analysis				
Network Layouts Depict network views with node type differentiation	authors and readers	teachers and students	colleagues and friends	friends and family
NP Detect social entity centrality degrees	users	teachers and students	colleagues	friends
NVF Compare overall network properties	number of users	number of teachers and students	number of network members	number of friends
Social Entity Analysis				
HCP Analysis Compare human capital properties	user credits	students assessments	professional skills	activities and interests
SEVF Analysis Analyse the RCV contribution of each social entity	recognized authors	best students	skilled workers	friends interests
Node Type Analysis Analyse social entities network predominant roles	users	teachers and students	colleagues	friends
Relational Analysis				
RTV Differentiate relational actions value	downloads comments	forum replies submitted works	status post recommendation	like comment
RLV Differentiate relational levels value	users co-authors	users class mates	friends colleagues	friends family
RV Analysis Understand each relational action RCV contribution	download comments	forum replies submitted works	status posts recommendations e	photo uploads comments
RCV Evaluate the relational capital of the network	LOP value	classes value	colleagues network value	friends network value

FUTURE RESEARCH DIRECTIONS

The evaluation of relational capital of organizations is already a reality, and managers should encourage organizations to adopt it. Towards an evaluation system, the relational capital evaluation research can be useful to increase organizational awareness. In this sense, we believe that new relational capital research efforts will emerge in areas such as Enterprise Architecture, Business Processes Engineering, Organizational Learning, and Knowledge Management.

CONCLUSION

As stated initially, our research was driven by the following question: *What is the value of this social network?* To answer this question we developed a strategy. Our first challenge was to define a way to better design social network structures in order to graphically design social entities and multiple relations among them. To answer this issue we defined SNARE-Language to design social network structures in which organizations are present. The flexibility of this language is expressed by all possible links that may exist on a social network.

Second, to answer the question "How to measure the relational capital of social networks?" we defined a relational capital evaluation model: SNARE-RCO. Using this model, it is possible to define metrics for analyzing the relational capital of a given organization (or corresponding content management system, or social media platform).

Third, to answer to the question "How to visualize the relational capital value of an organization's social network?" we created a prototype system to show how to compute, visualize and monitor the relational capital. This prototype system is SNARE-Explorer, and it enables us to visualize organizational social networks, to evaluate them, and monitor the relational capital.

Fourth, we validated results through controlled case studies using the SNARE-Methodology. With a set of roles, artifacts, and using SNARE-Explorer tool and SNARE models, SNARE-Methodology has four main processes: *Diagnosing*, *Designing*, *Executing*, and *Reporting*. These processes promote iterative ways for organizational analysis. We chose three validation scenarios: (1) A telecommunications company; (2) a school; and (3) a CMS platform. From the validation conclusions we showed that SNARE Framework can be applied to evaluate organizations as well as their KMSs such as those based on content management systems or social media platforms.

Besides the use of SNARE framework in processes of organizational consulting, the following items pose further research that could be pursued in line with our work: (1) Comparing RCV from organizations of the same kind. An interesting study would be applying simultaneously SNARE models in the evaluation of several organizations such as schools. Using the same parameters of analysis, it would be possible to compare the RCV of various schools. Other issues to explore include increasing the analysis period and consider the relational capital of organizations in real-time; (2) Extending SNARE-Explorer with SNA tools integration features. Since there are already popular tools for social network analysis, we consider that the SNARE-Explorer may include new data integration features with those tools. E.g. importing and exporting compatible files with *Pajek*[v] and *UCINET*[vi] tools. Thus, with these new features, in order to evaluate the relational capital of networks, the SNARE-Explorer may be used by the scientific community that already employs these tools; and finally, (3) Extending SNARE-Explorer with

social platforms integration features. Using public application programming interfaces, we also would like to extend SNARE-Explorer data integration features to compute and visualize the relational capital value of platforms such as *Moodle*, *LinkedIn* and *Facebook* in real-time.

To compute the relational capital of an organization, the appraisal system should combine techniques derived from social network analysis, with aspects of organizational assessment. Furthermore, it must consider dynamic properties from the social entities intellectual capital.

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KEY TERMS & DEFINITIONS

Social Network: A social network is generally defined as a set(s) of actors and the relation(s) defined for them. Actors, also defined as social entities, can be individual or collective social units that are connected by links. Links constituting a social network may be directed, undirected, or mixed. Social Networks can be analyzed using defined measures, and their results may be compared with those from similar networks. Each actor's position and connections could also be

individually analyzed and compared with those of other actors in order to understand their relative importance in the network and highlight network bottlenecks and cutpoints as well as isolated and equivalent actors.

Organizational Network Analysis: Organizational Network Analysis (ONA) involves the use of Social Network Analysis in organizational contexts in order to help managers to better understand relationships inside and outside the organization.

Social Network Analysis Measures – Measures in SNA are the metrics through which networks and social actors can be evaluated and compared. SNA measures can be distinguished into those which evaluate the entire network and those that only assess a specific node. At the individual level, the most frequently analyzed measure is *centrality;* this can be measured using *nodal degree*, *betweeness*, and *closeness.* At the network level, it is important to understand how the network is structured; it is, therefore, key to measure network *cohesion*, *centralization*, *and clustering* and to identify important nodes like *cutpoints*.

Social Network Tools – Social Network Tools are software tools that can be used to represent, visualize, and analyze social networks. These tools can usually read and write in common formats and use matrices to compute social networks as well as graphs, called sociograms, to represent them.

Human Capital: Human capital is the knowledge, skills and experience of individuals.

Structural Capital: Structural capital is the set of procedures, processes and internal structures that contribute to the implementation of the objectives of an organization.

Relational Capital: Relational capital is the value of internal and external social relationships of a given organization.

Intangible Capital: Intangible capital is the combination of all intangibles of an organization, *i.e. human, structural and relational capital.*

SNARE Framework: SNARE is an acronym for "Social Network Analysis and Reengineering Environment". SNARE framework has engineering artifacts with the aim of evaluating the relational capital of organizations. SNARE main components are: SNARE-Language; SNARE-RCO; and SNARE-Explorer.

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[i] http://www.vemaprender.net
[ii] http://www.moodle.org
[iii] http://www.linkedin.com
[iv] http://www.facebook.com
[v] http://pajek.imfm.si, Pajek is a Windows program for analysis and visualization of large networks. It is freely available for noncommercial use.
[vi] http://www.analytictech.com/ucinet/, UCINET is a social network analysis program developed by Borgatti, Everett and Freeman. UCINET works in tandem with freeware program NETDRAW for visualizing networks.