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What is the Value of Your Network?

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***Abstract*— Knowledge management systems help organizations to track organizational knowledge such as human, structural or relational capital. The relational capital of organizations tends to include intangible factors and, consequently, it is not always possible to determine this value from traditional business oriented accounting systems. The problem addressed in this research is: how to analyze this capital to achieve a network evaluation metric. Thus, answer the question: "What is the value of your network?". This research has been developed in the SNARE ("Social Network Analysis and Reengineering Environment") project that involves engineering artifacts to extract, analyze and monitor the value of social networks. The SNARE-RCO (short for "Relational Capital of Organizations") model allows us to define and evaluate the relational capital of organizations. it combines techniques derived from social network analysis with aspects of organizational assessment, including also human and structural capital. This paper reviews SNARE-RCO's main elements, which are applied to compute the relational capital value of three social networks, namely: (1) Telecommunications operator; (2) School; and (3) Collaborative social platform.**

Keywords – organizational social networks; social media platforms, content management systems; relational capital; measurement

I. INTRODUCTION

Knowledge may be tacit or explicit and 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 [1].

Knowledge management (KM) refers to a set of processes used to identify and leverage the collective knowledge of an organization to help it compete better [2]. Knowledge management systems (KMS) are a class of information systems for managing organizational knowledge, and for supporting and enhancing the organizational processes of knowledge creation, storage/retrieval, transfer, and application [1]. KM and KMS are a way to keep track of the tacit knowledge of organizations.

Human, structural and relational capitals are knowledge assets of organizations [3]. *Human capital* is the knowledge, skills and experience of individuals (e.g. competencies, experience, longevity, and attitude). *Structural capital* is the set of procedures, processes and internal structures that contribute to the implementation of organization's objectives (e.g. culture, organizational knowledge, and intellectual property). 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 (e.g. with customers, partners, brands, and reputation). Many of these intangibles (e.g. relations) are not owned by the organization itself and it is usually hard to separate them from the human and structural capital. The combination of human, structural and relational capital is called *intangible* or *intellectual capital* [4].

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 [5], which tend to be invisible in the organization's accounting systems. To date, there is no dominant model for intellectual capital assessment [4], because every company has specific intellectual capital evaluation purposes. To identify these intangibles can contribute to the operational effectiveness of an organization. In fact, they are not intangibles if they can be: detectable as an amount, observable and measured, i.e. *measurement* can be seen as a result of observations that quantitatively reduce uncertainty, thus an improvement on prior knowledge [6]. A good overview of intangible measuring theories can be found in [7]. Researches of measuring the intellectual capital of organizations have produced several methods and theories over the last years, and all measurement systems have to rely on proxies, such as euros, and other indicators, because the common reason for measuring and reporting is to improve internal performance [7].

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) [8] is the foundation for other related approaches such as: *Organizational Network Analysis* (ONA) [9], *Value Network Analysis* (VNA) [10] and *Dynamic Network Analysis* (DNA)

[11]. These approaches provide methodologies for studying communication flows in organizations with quantitative and descriptive techniques for creating statistical and graphical models of the individuals, tasks, groups, knowledge and resources of organizational systems.

Combining distinct approaches, the key challenge of our research is to answer the following question: *"What is the value of your network?"*.

In section II, we present SNARE Framework which includes an overview of SNARE-RCO (a model to compute the relational capital of organizations) and SNARE-Explorer (the prototype tool used in our research). In section III, three validation case studies are overviewed as well, namely: (A) a telecommunications operator; (B) a school; and (C) a collaborative social platform. In section IV we show how to compare the relational capital value of distinct networks. Finally, in section V, we present the conclusion regarding our research's key challenge.

II. SNARE FRAMEWORK

SNARE ("Social Network Analysis and Reengineering Environment") is a project that has several engineering artifacts to: (1) describe social network structures; (2) define relations, social entities and properties; (3) store, manage and visualize the information required for social network analysis; and (4) monitor the relational capital of a given social network. In the next sections we overview two SNARE-Framework core components: SNARE-RCO and SNARE-Explorer.

A. 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 entities' intellectual capital [12].

The Relational Capital Value (RCV) results from computed parameters OVF (Organizational Valuable Factors), NVF (Network Valuable Factors), SEVF (Social Entity Valuable Factors) and RV (Relational Values), which may change depending on the target organization. Fig. 1 depicts the SNARE-RCO model, with its parameters and dependencies to compute the RCV [12].

Organizational Valuable Factors (OVF) are attributes of the organization, for example: annual sales turnover, client satisfaction, customer count, efficient energy use, investment in R&D, investment in IT, new processes implemented, number of brands, number of employees, number of new services implemented, number of partners, number of

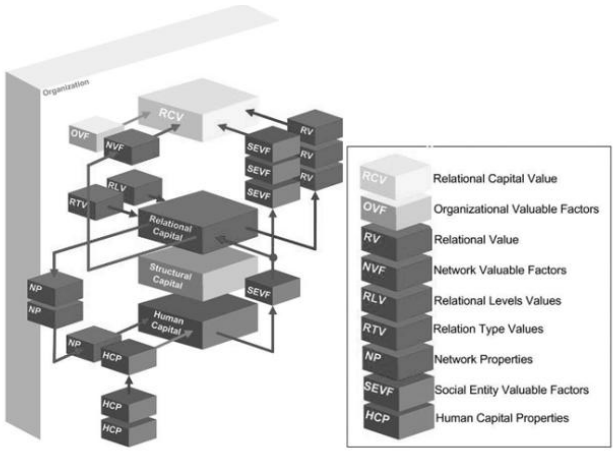

Figure 1. The SNARE-RCO Model

projects, operating expenses, production cost, profit per employee, profitability per customer, project execution average time, revenues, sales to new customers, satisfied customers index, seniority average, and shared capital. Network Valuable Factors (NVF) are properties of the organization's social network. These properties can be derived from the social network analysis of, for example, the network's size and density. Relational Values (*RV Sum*) is computed for all network individuals and uses a combination of RTV, RLV and SEVF computed factors. These factors are described next. Relational Level Values (RLV) expresses the *proximity* between two social entities in a dyad. Examples of relational values include: very near, near, regular, far, and very far. Relation Type Values (RTV) expresses the type of organizational relation. Examples: collaboration, information share, and problem solving. Network Properties (NP) are individual network measures. E.g. centrality *indegree* or centrality *outdegree*. Social Entity Valuable Factors (*SEVF Sum*) is a combined NP/HCP metric for organization individuals. I.e. a metric for the network's real role of the individual (NP), combined with typical human resources evaluation metrics (HCP). Human Capital Properties (HCP) are role dependent individual properties such as skills and may result from human resources management analysis like questionnaires or other evaluation techniques. Examples of HCP properties include: analytical problem solving, business ethics, communication, creativity and innovation, credibility, discretion, education level, fairness, honesty, integrity, leadership, multitasking, problem diagnosis and solution, productivity, self-confidence, sense of humor, technical expertise, time management, and trust.

The Relational Capital Value (*Network RCV*) of an organization is computed according the following formula [12].

(1)

(= organizational calibration weight, = organizational valuable factors product, = network calibration weight, = network valuable factors product, =social entities calibration weight, =social entities valuable factors sum, =relational calibration weight and = relational value from all network connections)

B. *SNARE-Explorer*

SNARE-Explorer is a desktop-based interface for data analysis and rich visualization developed with Java technology [13-14]. This system is able to store, manage and visualize the information required to dynamically analyze organizational scenarios (See Fig. 2). Each node represents a social network platform user. Grey arrows represent friendship connections. Black arrows depict users who have downloaded a file provided by the network administrator.

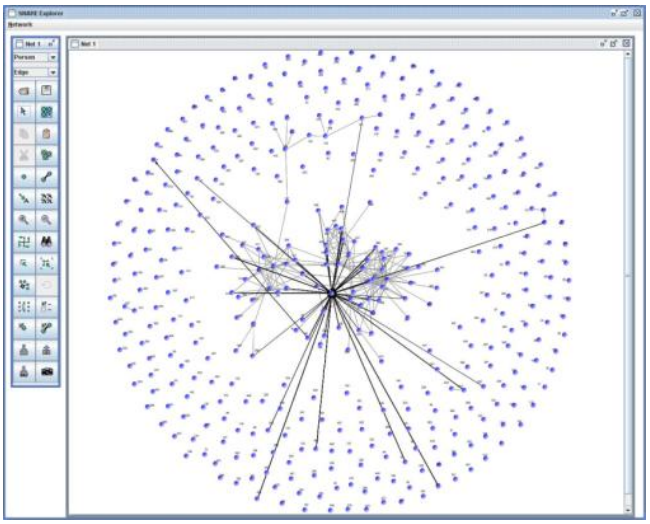

Figure 2. The SNARE-Explorer Network Window

As an engineering tool, SNARE-Explorer is able to show and simulate scenarios in real-time (e.g. for web-based systems [14]) and uses SNARE-RCO model to compute and graphically visualize the value of the organizational relational capital.

III. RESEARCH VALIDATION

In this section we overview three distinct research validation case studies, namely: (A) Vodafone; (B) School, and (C) Learning Objects Pool (LOP).

A. *Case Study: Vodafone*

Vodafone case study was focused on the analysis of the relational capital of six teams from a Vodafone Portugal Unit: GSS [15].

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 three main business processes in which the Unit under study participated on: *Incident*; *Change*; and *Problem.* 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.

To perform the Relational Analysis, Relation Type Values (RTV) and Relational Levels Values (RLV) were firstly determined by the Unit Manager. Next, *RV Sums* for each relational action were computed. As depicted in Fig. 3, we found that predominant relational capital value refers to the *Information Share* relational action, and relational action *Problem* has the lowest RCV [15].

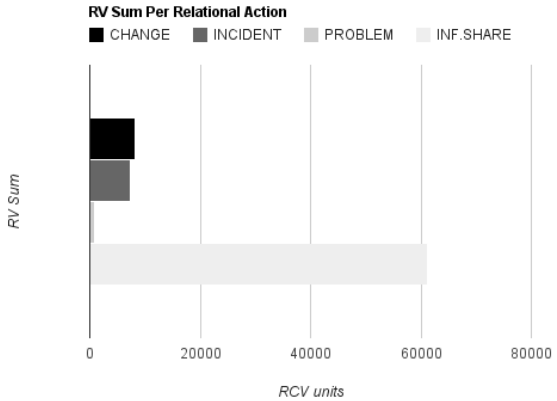

Figure 3. Relational Analysis – Case A

B. *Case Study: A School*

This case was focused on the analysis of *mechanisms of communication and information* in a given school in Lisbon, aiming at answering the question: *"Is the organization optimized to produce and transmit knowledge?"* [15].

The study was conducted with the School Quality Observatory throughout April 2011. We developed a questionnaire with several questions to the local community. Data about employees was collected from the school's human resources management system. The target universe contained 229 employees. 207 questionnaires were delivered and collected (162 Teachers, 11 Technical Assistants and 34 Operational Assistants) [15]. 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 know-ledge?"; and, "Who communicates with you using information technology?". These questions were inspired in Rob Cross' work *Questions to Uncover Important Network Relationships* [9]. These four questions were analyzed, and for each relational action, a name was correspondingly assigned: *TransmitInformation*; *AskForHelp*; *WhoRecognizes*; and *CommunicateWithIT*. The main responsible relational action for RCV increase is *TransmitInformation*. *AskForHelp* and *CommunicateWithIT* are the lowest RCV contributors (See Fig. 4).

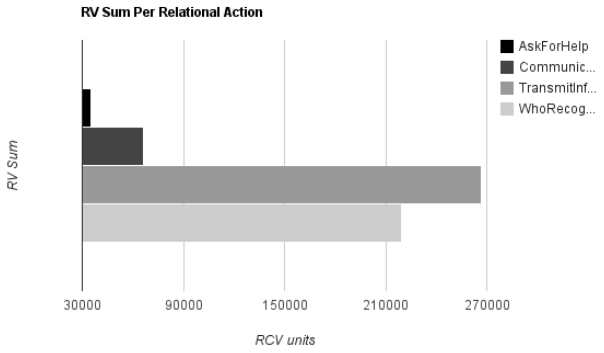

Figure 4. Relational Analysis – Case B

C. Case Study: Learning Objects Pool

We chose to apply SNARE-RCO model to evaluate a Web-based collaborative social platform. In particular, the Learning Objects Pool (LOP) platform which has hundreds of users [17]. LOP 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 users were analyzed, as well as associated relational actions: *download* and *comment* learning objects [15]. Fig. 5 shows the *RV Sum* for each type of LOP analyzed relational action. The predominant relational action to produce RCV capital is *downloads*.

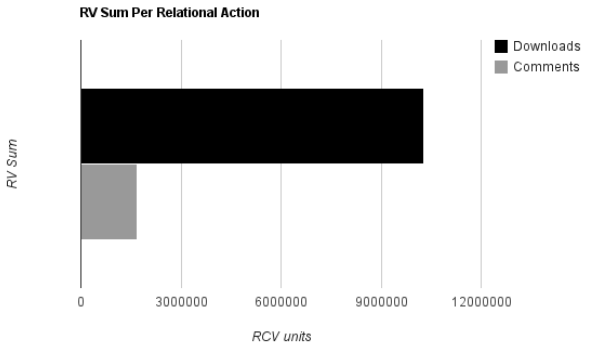

Figure 5. Relational Analysis – Case C

IV. Comparing The RCV of Distinct Networks

After applying the SNARE-RCO model, another challenge emerged: *how to compare and monitor the RCV of distinct networks?* This is a problem because the parameters settings criteria of the SNARE-RCO model change according to specific organizational contexts. Thus, as the validation results showed, computed relational capital values may range significantly. E.g. the LOP Network *RV Sum* has an expressive higher value when compared to Vodafone and the analyzed school. *Are such differences possible?*

When comparing the same *Network RCV* evolution throughout the time (or other SNARE-RCO parameters such as *RV Sum*), settings criteria are not a problem, however, when comparing distinct networks to different parameters settings criteria, the solution is to normalize the RCV computed data. E.g., we have computed the *Network RCV* for each network and values were as follows: Case A, 89017 RCVs; Case B, 733013 RCVs; and, Case C, 15261836 RCVs. As stated, these values refer to distinct networks with significant differences regarding human capital valuing, and relational capital parameter weights. The solution to monitor and compare the relational capital of distinct networks is to normalize RCV computed values. Thus, Fig. 6 depicts normalized values for cases A, B, and C, namely for: (1) *Network RCV* (from each RCV absolute value); and (2) *RV Sum* (connected to each absolute *Network RCV*).

As Fig. 6 shows, the *Network RCV* of case C has the highest value. Thus, the *Network RCV* reflects reality, i.e., when abstracting the target organization type, to evaluate a concrete network the analyst may be confronted with specific contexts which may also imply the use of local specific evaluation systems and metrics. Then, regarding SNARE-RCO model, since there are no standards to compute the RCV of an organizational network, such differences can occur. However, *RV Sum* values, also depicted in Fig. 6, were normalized using the absolute *Network RCV* value of each case. Thus, as the *RV Sum* analysis shows, the produced relational capital of the analyzed digital platform (*RV Sum*) is the lowest when compared to Case A and B. *RV Sum* normalized values enable, as depicted, a comparative relational analysis regarding each *RV Sum* contribution to local *Network RCV*, showing that Vodafone has produced the highest relational capital when compared to the school and digital platform cases. In fact, regarding real scenarios collected data, this interpretation is reality adherent. E.g. Vodafone *RV Sum* contributes more than 80% for its *Network RCV*. Using this comparative analysis technique, the analyst has an effective way of understanding, comparing and monitoring the value of the relational capital of distinct networks.

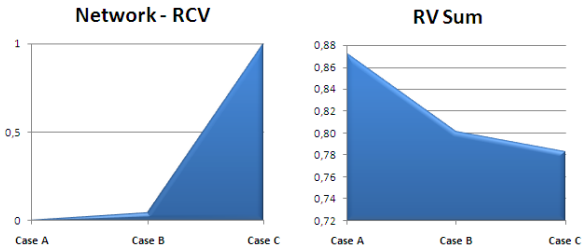

Figure 6. RCV Comparative Analysis

V. CONCLUSION

The key challenge of our research is to answer the following question: *"What is the value of your network?"* using social network analysis techniques and combining several metrics derived from the human, structural, and relational capital assessment.

The SNARE-RCO is centered in organizational networks and helps to compute a relational capital network metric which can be applied to evaluate and compare networks of distinct organizations/organizational units and web-based systems.

We used SNARE-Explorer as a prototype system to compute and monitor the relational capital of organizational networks and we validated it using controlled case studies [15-16]. The RCV of validation cases was computed through a bottom-up approach. To analyze the relational capital value of a given organization, SNARE-RCO model uses several assessment inputs. These inputs depend on the target organization which has business processes designed to accomplish specific and measurable business goals. A business process is an activity or set of activities that will accomplish a specific organizational goal. Typically, a business process has specific inputs and outputs, uses resources, and has a number of activities that are performed in some order. Also, a business process may affect more than one organizational unit. Starting from this knowledge, it is possible to extract and combine appropriate data to build and use a bottom-up social network evaluation system based on SNARE-RCO model. From an information systems perspective, it is possible to automatically extract knowledge about who does what in the organizational network. Since every business process is started by events which are triggered by organizational actors, it is possible to track this knowledge and use it to feed SNARE-RCO relational parameters such as RV, RLV and RTV. Each relation is analyzed as a dyad, and for each business process, all dyads are computed using SNARE-RCO formulas. In this way, the RCV of a given organization is computed in a bottom-up perspective, i.e. from individuals to organizational units such as teams or departments. This is possible because SNARE-RCO measures were designed to accomplish three analysis levels: (1) Organizational unit/Organization; (2) Dyad; and (3) Individual. More specifically, these analyses levels correspond respectively to the following SNARE-RCO measures: (1) Relational Capital Value (*Network RCV*), Organizational Valuable Factors, and Network Valuable Factors; (2) Relational Values (*Rv Sum*), Relational Levels Values, and Relation Type Values; and (3) Network Properties, Social Entity Valuable Factors, and Human Capital Properties.

Through the development of SNARE-RCO model, to achieve a new network metric, our research extends previous approaches in the area and it is distinguished by its focus on organizations, combining techniques derived from social network analysis, organizational aspects and its deep relation with intellectual capital evaluation.

SNARE Framework has proved its applicability to compute RCV in real scenarios and compare distinct networks.

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