A Model to Evaluate the Relational Capital of Organizations (SNARE RCO)

Alexandre Barão, Alberto Rodrigues da Silva

IST – Instituto Superior Técnico/INESC ID

barao.alexandre@gmail.com, alberto.silva@acm.org

Abstract. We consider social networks as artifacts that are part of organizations. The relational capital value of a social network represents a contribution that should satisfy demands which are conducted by social entities. It is not always possible to capture this value in accounting systems of organizations because it is almost invisible in conventional forms of information systems. There are several evaluation models, but there is a lack of models for evaluation of relational capital that combine techniques derived from social network analysis of organizations. The SNARE, short for "Social Network Analysis and Reengineering Environment", is a project that has been developed in recent years with engineering artifacts to represent social networks, and allows researchers to design and build real scenarios for social networks relational knowledge discovery. We propose SNARE RCO as a model to evaluate the relational capital of organizations.

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

1 Introduction

In the field of organizations, human capital, relational capital and structural capital are essential knowledge of organizations. By *human capital* it is denoted the knowledge, skills and experience of individuals [1]. It is understood by *structural capital* the procedures, processes and internal structures that contribute to the implementation of the objectives of an organization [1]. Finally, the *relational capital* is the value of social relationships in a given organization that contributes to achieve its objectives. I.e. the value of internal and external relationships of an organization [1].

The intangible value of the organization is generated from informal, noncontractual activities that help build business relationships and contribute to operational effectiveness [2]. From these noncontratual activities can result intangible deliverables. *Intangible deliverables* can be seen as knowledge and benefits extended or delivered by an individual or group, that are noncontractual but still have value for the organization. The combination of all intangibles of an organization, i.e. *human*, *structural* and *relational capital*, is called *intangible capital* or *intellectual capital* [3]. The value of intangibles can be difficult to identify through financial transactions and the use of nonfinancial indicators is a way to provide intellectual capital measurement

[3]. It is not always possible to capture intellectual capital in accounting systems of organizations because they are almost invisible in conventional forms of information systems [3]. Also, there is a lack of standard metrics for relational capital evaluation of organizations [4].

Social network systems identify existing relations between social entities and provide a set of automatic inferences on these relations, promoting better interactions and collaborations between these entities. The SNARE, short for "Social Network Analysis and Reengineering Environment", is a project that has been developed in recent years. It has engineering artifacts to represent social networks [11] and allows researchers to design and build real scenarios for social networks relational knowledge discovery [10, 12]. In this paper we propose SNARE RCO as a model for evaluation of the relational capital of organizations.

This paper is organized in five sections. Section 2 overviews intellectual capital evaluation challenges. Section 3 proposes the SNARE RCO model as a way to compute the relational capital value of a given organization. Section 4 shows a sample of computed interaction relational scenarios using SNARE RCO. Finally, Section 5 presents our preliminary conclusions.

2 Intellectual Capital Evaluation Challenges

There are still three basics challenges associated with intellectual capital (IC) [7], in essence how can we: value (measure) intangibles in a better way; 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 [3] 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 [3]. Also, Zadjabbari argues that "*there is a lack of standard metric method to measure this kind of knowledge and assets*" [4].

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 of prior knowledge [5]. Even when some amount of error is unavoidable, it can be an improvement on prior knowledge of a system [5]. There are strong mathematical foundations for considering measuring this way. A measurement doesn't have to eliminate uncertainty [5], for that we consider the measurement definition from Hubbard: *"A quantitatively expressed reduction of uncertainty based on one or more observations"* [5].

An overview of intangible measuring theories can be found in [8] and also in [9]. 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 [8]. All measurement systems have to rely on proxies, such as dollars, euros, and other indicators [8]. 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 [8] and there is no standard intellectual capital measures/metrics

because every company needs a unique understanding of which intangible assets are really valuable for the organization [3]. Some of the indicators are financial but it is possible to use nonfinancial indicators to provide the most basic parameters for intangible capital. Depending on the nature of the business there are hundreds of indicators, the most important question for the manager is how to choose the appropriate ones to build a unique performance measurement system [3]. In the current business performance methods, e.g. European Foundation for Quality Management model [6], or Skandia model [13], measuring indicators are not standard and are not widely used in organizations, although, in some models, the real asset values of different types of intellectual assets are not clearly defined [4].

There are several intellectual capital evaluation models. However, there is a lack of models to evaluate relational capital that combines techniques derived from social network analysis with organizations. One reason for this may be the division of organizational knowledge assets in three areas: human capital, structural capital and relational capital. That is, the separation of these factors assumes that the relational capital is independent of human capital and structural capital. But in fact, it is not. The challenge is to find a unique metric to evaluate the relational capital of an organization starting from the analysis of its social network and including assessments of human and structural capital.

3 A Model to Evaluate the Relational Capital of Organizations

We consider social networks as artifacts that are part of organizations, then, the value of a social network represents a contribution to satisfy a given *demand*. This demand is conducted by its social entities. In this sense, the value of a relation reflects the link between a thing (a good or service) and the two social entities that are connected in a given context. Then there is an offer made by a *Social Entity producer* and a demand from a *Social Entity consumer*. Consider Figure 1 a). In a given context *x*, the social entity A has a *consumer* role (Rc) and social entity B plays the role of *producer* (Rp) of a given good or service. In this case, the good or service can be tangible (t) and/or intangible (i). The value *v* of the good or service provided by the social entity B is formed from the *demand*. I.e. from the satisfaction that the good or service represents to the social entity A *consumer*. In a given context, there is a function to compute the connection relation value between social entity A and social entity B.

Naturally, the social entity B can assume a consumer role and the social entity A can play a producer role. In a dyad, the roles may be commutative and Figure 1 b) depicts this fact. V*ab* represents the value of connection *Social Entity A – Social Entity B*, and V*ba* represents the value of connection *Social Entity B – Social Entity A*. So, to identify and assess the relational capital of an organization it is necessary to identify the value of relations among its social entities which are social network members. Even when a social entity is an isolate node in the organization network, it holds tangible (e.g. goods or services) and/or intangible (e.g. competences or skills) value which can stimulate future connections (*demands*), thus contributing to the whole relational capital value of the organization.

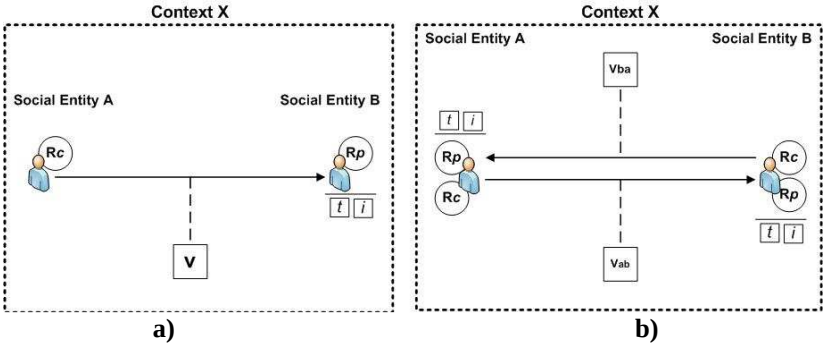


Figure 1: RCO Supply and demand relation logic

The aim of measuring and evaluating is to reduce the uncertainty of the **Relational Capital Value (RCV)** of a given social network based on one or more observations. To observe and evaluate the RCV of a given organization, our model proposes three kinds of assessment inputs: organizational, network and social entity. These inputs are dynamic, i.e. defined by the observer. In subsection 3.1 we describe the process of classifying these inputs, and in subsection 3.2 we describe the method to evaluate the relational capital of an organization, i.e. how to compute the organization RCV.

3.1 Classifying parameters

It is necessary to define a set of parameters, namely: Organizational Valuable Factors (OVF), Network Valuable Factors (NVF) and Social Entity Valuable Factors (SEVF). These are factors that depend on the target organization. For each factor, a weight can be defined according to its importance. These weights are multiplied by the values of the parameters. OVF, NVF and SEVF weights ranges are defined by the observer. To illustrate the following examples we considered weights ranging from 1 to 5.

Organizational Valuable Factors (OVF) are attributes of the organization that may contribute to the evaluation system. The definition of those attributes in accordance with the objectives of analysis should be performed by the observer (e.g. a management expert). However, to illustrate the concept, we include three intellectual capital properties: number of active customers; number of partners; and number of brands. Table 1 exemplifies the applied system of weights and the calculation of its total (OVF).

Table 1 Organizational Valuable Factors

Organizational Valuable Item	Value	Weight	
Number of active customers	275	1	
Number of partners	15	5	
Number of brands	4	5	
		OVF =412500	(275*1)*(15*5)*(4*5)

Network Valuable Factors (NVF) are properties of the organization network. These properties can be derived from classical analysis of social networks. Two key characteristics of a network are size and density, so, to illustrate this example, we chose different combinations of these values (See Table 2). *Size* is measured by number of nodes: if there are *n* nodes, then the maximum possible number of undirected links is *n* (*n*-1)/2. We considered *n* = 200. *Density* is the proportion of ties in a network relative to the total number possible.

Table 2 Network Valuable Factors

Network Valuable Item	Value	Weight	
Size	19900	1	
Density	0.32	5	
		NVF = 31840	(19900*1)*(0.32*5)

Social Entity Valuable Factors (SEVF) are properties that are assigned to each social entity. The observer can use properties from classical analysis of social networks such as *centrality indegree*, *centrality outdegree*. Also, must be considered human capital properties. These properties are role dependent and they result from other previous organization analysis such as questionnaires or other evaluation techniques. The definition of those properties should be performed by the observer in accordance with the objectives of analysis. However, to illustrate this application, we considered 5 human capital properties: analytical problem solving, creativity and innovation, problem diagnosis and solution, technical expertise and time management. Table 3 shows the filling properties process and calculation of SEVF for a given social entity. At this stage the organizational valuable factors, network valuable factors, and the social entity valuable factors were computed. Now we have to define a weighting system to compute the relations value. For this it is necessary to define **Relation Type Values (RLV)** and **Relational Levels Values (RLV)**. These relations must be actionable for observers after the results are disclosed. To illustrate this, we choose two types of collaborative relations as described in Table 4. These questions were extracted from Cross [14] and for each relation type between two social entities, we defined values to be used to compute the dyadic relational capital, and, finally, relational levels classification. A relational level is a classification to characterize the proximity between two social entities. The average value (*Regular*) can be assumed by default. However, the link level between two entities can enhance the relational capital of the organization.

Table 5 describes relational level values from our framework to be used in order to compute the dyadic relational capital.

Table 3 Social Entity Valuable Factors

Social Entity Valuable Item	Value	Weight	
Network properties (np)			
Centrality indegree (Absolute)	23	5	
Centrality outdegree (Absolute)	16	2	
		np=147	(23*5)+(16*2)
Human capital properties (hcp)			
Analytical Problem Solving	8	1	
Creativity and Innovation	7	2	
Problem Diagnosis and Solution	8	2	
Technical Expertise	10	3	
Time management	2	2	
		h**cp**=72	(8*1)+(7*2)+(8*2)+(10*3)+(2*2)
		SEVF=10584	(np*hcp)

Table 4 Relation Type Values

Relation Type	Value
Collaboration/Information relation type *E.g. "From whom do you typically seek work-related information?"*	2
Collaboration/Problem solving relation type *E.g. "Who do you typically turn to for help in thinking through a new challenging problem at work?"*	1

Table 5 Relational Level Values

Relational Levels	Value
Very near	5
Near	4
Regular	3
Far	2
Very far	1

Finally, to allow calibration processes, our system defines four weights: **Organizational weight (Ow)**; **Network weight (Nw)**; **Social entity weight (SEw)**; and **Relational weight (Rw).** These weights are used in the RCV formula. See (1) in the next section.

3.2 Evaluating relational capital

The **Relational Capital Value (RCV)** of an organization is computed according the formula:

$$\boldsymbol{RCV} = Ow * \boldsymbol{OVF} + Nw * \boldsymbol{NVF} + SEw * \boldsymbol{SEVFsum} + Rw * \boldsymbol{RVsum} \quad (1)$$

(Ow= organizational calibration weight, OVF= organizational valuable factors product, Nw= network calibration weight, NVF= network valuable factors product, SEw=social entities calibration weight, $SEVFsum$=social entities valuable factors sum, Rw=relational calibration weight and $RVsum$ = relational value from all network connections)

Where:

$$\boldsymbol{OVF} = \prod_{\boldsymbol{i=1}}^{\boldsymbol{totalOVF}} \boldsymbol{vOVI_i} * \boldsymbol{wOVI_i} \quad (2)$$

(totalOVF = total of organizational valuable factors, vOVI = value of organizational valuable item and wOVI = weight of organizational valuable item)

$$\boldsymbol{NVF} = \prod_{\boldsymbol{j=1}}^{\boldsymbol{totalNVF}} \boldsymbol{vNVI_j} * \boldsymbol{wNVI_j} \quad (3)$$

(totalNVF = total of network valuable factors, vNVI = value of network valuable item, and wNVI = weight of network valuable item)

$$\boldsymbol{SEVF_{(X)}} = \left(\sum_{\boldsymbol{n=1}}^{\boldsymbol{totalNP_x}} \boldsymbol{vNP_n} * \boldsymbol{wNP_n} \right) * \left(\sum_{\boldsymbol{h=1}}^{\boldsymbol{totalHCP_x}} \boldsymbol{vHCP_h} * \boldsymbol{wHCP_h} \right) \quad (4)$$

($totalNP_x$= *total of network properties of social entity X,* $totalHCP_x$= *total of human capital properties of social entity X, vNP = value of social entity network property item , wNP = weight of social entity network property item , vHCP = value of social entity human capital item* and *wHCP = weight of social entity human capital item)*

$$\boldsymbol{SEVFsum} = \sum_{s=1}^{totalSE} \left(\boldsymbol{SEVF}_{(s)}\right) \quad (5)$$

(totalSE = total of social entities from the network and $SEVF_{(s)}$ = network and human capital valuable factors from social entity s)

$$\boldsymbol{RVsum} = \sum_{c=1}^{totalC} \left(\boldsymbol{RTV}_{\boldsymbol{c}} * \left(\boldsymbol{RLV}_{\boldsymbol{c}} * \boldsymbol{SEVF}_{\boldsymbol{SocialEntity}_{\boldsymbol{Producer}}}\right)\right) \quad (6)$$

∀ *connection* $\boldsymbol{C}$ ($\boldsymbol{SocialEntity}_{\boldsymbol{Consumer}}$, $\boldsymbol{SocialEntity}_{\boldsymbol{Producer}}$)

(totalC = total of network dyadic connections, RTV_c = relation type value of connection c, RLV_c = relation level value of the connection c, $SEVF_{Social\ Entity\ Producer}$ = network and human capital valuable factors from connection social entity with role producer)

4. SNARE RCO simulated scenarios

To demonstrate the calculation of the relational capital using SNARE RCO model, we have defined 7 relational scenarios based on the existence of three social entities. These scenarios are depicted in Figure 2. We used SNARE Explorer [10-12] as a simulation tool which implements our model in real-time. For each scenario, SNARE Explorer computes the network RCV. The calculations history and the monitoring graphic produced by SNARE Explorer are depicted in Figure 3. In the 7 scenarios, during the observation, we keep OVF (arrow #2), NVF (arrow #3) and SEVF Sum (arrow #4) constant. As we can see in Figure 3, the network RCV (arrow #1) evolution is strongly correlated with RV Sum increase (arrow #5). We also defined a ratio between network relational value sums and social entities valuable factors sums. In Figure 3, depending on the scenario this ratio is observable and ranges from 0 to 6.

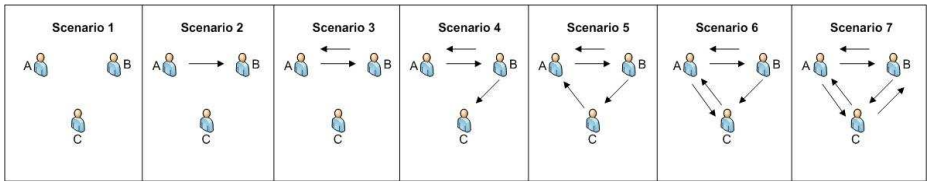
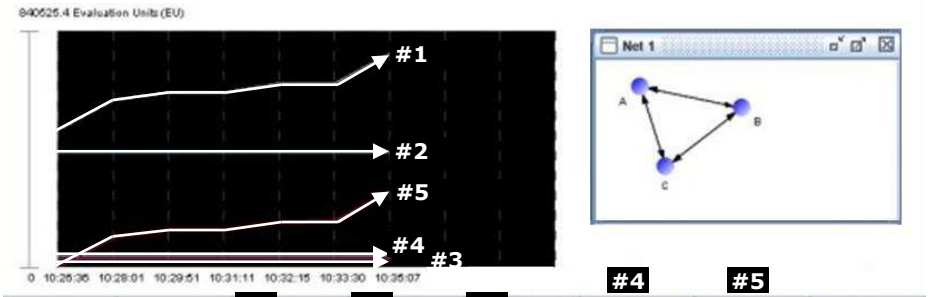


Figure 2 Seven possible interaction scenarios of a triad



Date	Time	#1 RCV	#2 OVF	#3 NVF	#4 SEVF Sum	#5 RV Sum	Racio
30/Mai/2011	10:35:07	764.114	412.500	31.840	45.682	274.092	6
30/Mai/2011	10:33:30	657.314	412.500	31.840	45.682	167.292	3,662
30/Mai/2011	10:32:15	655.292	412.500	31.840	45.682	165.270	3,618
30/Mai/2011	10:31:11	627.068	412.500	31.840	45.682	137.046	3
30/Mai/2011	10:29:51	625.046	412.500	31.840	45.682	135.024	2,956
30/Mai/2011	10:28:01	586.822	412.500	31.840	45.682	106.800	2,338
30/Mai/2011	10:26:36	490.022	412.500	31.840	45.682	0	0

Figure 3 Graphical evolution of RCV

5 Conclusions

To propose this organization's relational capital assessment framework it was necessary to research various methods of assessment. There are several evaluation methodologies for studying aspects such as economic impact or operational impact. However, there is a lack of assessment methodologies that combines techniques derived from social network analysis with organizational aspects and its relation with intellectual capital. One reason for this may be the division of organizational knowledge assets in three areas: human capital, structural capital and relational capital. That is, the separation of these factors assumes that the relational capital is independent of human capital and structural capital. But in fact, it is not. So, from our point of view, to evaluate the relational capital of an organization it is necessary to combine metrics that derive from assessments of human capital and structural capital. On the other hand, evaluating "intangibles" is a subjective process of reflection and depends on the focus of analysis. For this reason, most evaluation systems in organizations focus on skills evaluation, e.g. evaluating skills tends to be easier than evaluating relations.

The key challenge remains: the need for a relational capital evaluation system to answer questions like: *What is the value of this network?* This is not an easy answer. Our research lead us to conclude that any metric for assessing the relational capital of an organization should also include aspects of human capital and structural capital. From the various organizational evaluation models we found, they do not consider the analysis of the organization from this integrated network perspective.

From our point of view, to define the relational capital of an organization a system should combine techniques derived from social network analysis, with aspects of organizational assessment, and must consider dynamic properties from the social entities intellectual capital.

References

1. P. Anklam, *Net Work - A Practical Guide to Creating and Sustaining Networks at Work and in the World*. Oxford: Elsevier (2007)
2. ValueNetworks, *What is Value Network Analysis (VNA)?* Online. Retrieved from www.valuenetworks.com (2010)
3. M. Adams and M. Oleksak, *Intangible Capital - Putting Knowledge to Work in The 21ST-Century Organization*. Santa Barbara, California: Praeger (2010)
4. Zadjabbari, B., Wongthongtham, P., & Hussain, F. K., Towards an Ontological Intellectual Capital based Model in Sustainable Business Performance. CIMCA 2008, IAWTIC 2008, and ISE 2008: IEEE. (2008)
5. Hubbard, D. W, How to Measure Anything - Finding the Value of "Intangibles" in Business, 2nd Edition. Hoboken, New Jersey: John Wiley & Sons, Inc. (2010)
6. European Foundation for Quality Management (2011) [Online] http://www.efqm.org/en/
7. Greene, D., Measuring what matters: The Paths Of Intangible Value. Paper presented at the Institute for International Research, July, San Diego, C.A. (1999)
8. Sveiby, K.-E. Methods for Measuring Intangible Assets. Online. Retrieved from www.sveiby.com/articles/IntangibleMethods.htm (2010)
9. Bontis, N., Assessing knowledge assets: a review of the models used to measure intellectual capital. International Journal of Management Reviews , 3 (1) (2001)
10. Hernâni Borges de Freitas, Alexandre Barão, Alberto Rodrigues da Silva, "Social Networks in Information Systems: Tools and Services", book chapter, Handbook of Research on Social Dimensions of Semantic Technologies and Web Services, Idea Group Inc (IGI), May, 2009. ISBN-13**:** 978-1605666501 (2009)
11. The Snare Language Overview. Barão, Alexandre; Silva Alberto. 12th ICEIS - International Conference on Enterprise Systems (2010)
12. Barão, Alexandre; Silva, Alberto, SNARE - Social Network Analysis and Reengineering Environment: Architecture Overview. WEBIST 2008, Funchal, Madeira (2008)
13. Intellectual Capital at Skandia, Maylun Bucklew, Ernst & Young Center for Information Technology and Strategy, Leif Edvinsson, Skandia AFS (1999) [Online] http://www.fpm.com/cases/el3.html
14. R. Cross and A. Parker, *The Hidden Power of Social Networks: Understand How Work Really Gets Done In Organizations*. Harvard Business School Press (2004).