Draft version of: "Alexandre Barão, Alberto Rodrigues da Silva, "Applying SNARE-RCO to Evaluate the Relational Capital of an Organization: The SH Case Study". Book chapter in *"Sociotechnical Enterprise Information Systems Design and Integration."* IGI Global, 2013".

Applying SNARE-RCO to Evaluate the Relational Capital of an Organization: The SH Case Study

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Abstract. We consider that social networks are important artifacts of organizations. The relational capital of an organization tends to include intangible factors, and consequently it is not always possible to have this value from accounting systems because it is almost invisible in conventional forms of information systems. There are several evaluation network models, but there is still a need for models to evaluate relational capital tangibles and intangibles. The SNARE (short for "Social Network Analysis and Reengineering Environment") is now used to evaluate the relational capital of a knowledge-intensive organization. In this case, we use the SNARE-RCO model (short for "Relational Capital of Organizations") as a basis to evaluate the relational capital of an international software-house: the SH company. Analyzing *partner-developer* SH product improvement requests, the model is used to uncover the relational capital value. This work presents the network layout under study and shows how to define *Human*, *Structural* and *Relational Capital* SNARE-RCO properties, aiming at evaluating six months of *partner-developer* relationships.

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

1 Introduction

Human capital, relational capital and structural capital are essential knowledge of organizations. *Human capital* denotes the knowledge, skills and experience of individuals (Anklam, 2007). *Structural capital* denotes the procedures, processes and internal structures that contribute to the implementation of the objectives of an organization (Anklam, 2007). Finally, *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 (Anklam, 2007).

The intangible value of an organization is generated from informal, non-contractual activities that help build business relationships and contribute to operational effectiveness (ValueNetworks, 2010). From these non-contractual activities can result intangible deliverables, which can be seen as knowledge and benefits extended or delivered by an individual or group, that are non-contractual 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* (Adams & Oleksak, 2010).
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 (Adams & Oleksak, 2010). It is not always possible to find out the intellectual capital in their accounting systems because they are almost invisible in conventional forms of information systems (Adams & Oleksak, 2010). Also, there is a lack of standard metrics for evaluating the relational capital of organizations (Zadjabbari, Wongthongtham, & Hussain, 2008).

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. SNARE involves engineering artifacts to represent social networks (Barão & Silva, 2010) and allows researchers to design and build real scenarios for social networks relational knowledge discovery (Freitas, Barão, & Silva, 2009) (Barão & Silva, 2008).

In this chapter we introduce the SNARE-RCO (Barão & Silva, 2011) as a model to evaluate the relational capital of a software-house: the SH company. This company has an international network of partners. SH partners keep a special relation with company developers. They ask for product improvements and in this process there are intangible factors to include in the evaluation, such as the *partner-developer* proximity. The main motivation is to evaluate the SH *partner-developer* relation and the produced relational capital between them during a period of six months.

This chapter is organized into five sections. Section 2 overviews intellectual capital evaluation challenges. Section 3 describes the SNARE-RCO model as a way to compute the relational capital value of organizations. Section 4 shows the application of SNARE-RCO model in the SH company. Finally, Section 5 presents the preliminary conclusions.

2 Intellectual Capital Evaluation Challenges

There are still three basic challenges associated with intellectual capital (IC) (Greene, 1999), 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 (Adams & Oleksak, 2010) 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).

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 (Hubbard, 2010). Even when some amount of error is unavoidable, it can be an improvement on prior knowledge of a system (Hubbard, 2010). There are strong mathematical foundations for considering measuring this way. A measurement does not have to eliminate uncertainty (Hubbard, 2010), for that we consider the measurement definition from Hubbard: "*A quantitatively expressed reduction of uncertainty based on one or more observations"*.

An 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 (Sveiby, 2010). All measurement systems have to rely on 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) 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 (Adams & Oleksak, 2010). 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 (Adams & Oleksak, 2010). In the current business performance methods, e.g. European Foundation for Quality Management model (EFQM, 2011), or Skandia model (Skandia, 2011), measuring indicators are neither standard nor widely used in organizations. In addition, in some models, the real asset values of different types of intellectual assets are not clearly defined (Zadjabbari, Wongthongtham, & Hussain, 2008).

There are several intellectual capital evaluation models. However, there is a lack of models to evaluate relational capital that combine techniques derived from social network analysis with organizations. One reason for this may be the division of organizational knowledge assets into 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. However, 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

If 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. Afterwards, 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, social entity B can assume a consumer role and 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*. Therefore, 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 that can stimulate future connections (*demands*), thus contributing to the whole relational capital value of the organization.

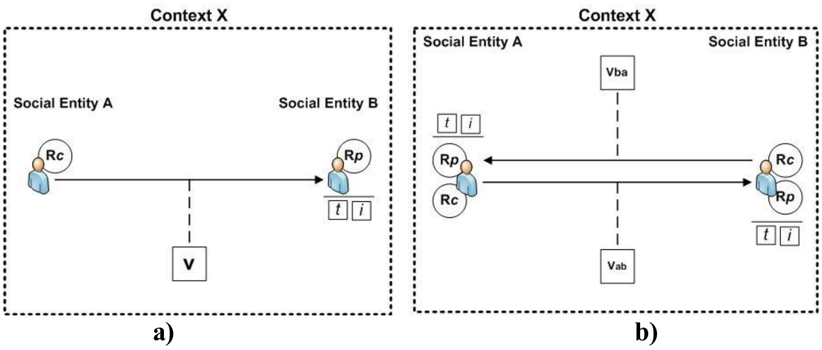


Figure 1: RCO Supply and demand relation logic

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. In subsection 3.1 we describe the process of classifying SNARE-RCO inputs and, in subsection 3.2, the method to evaluate the relational capital of an organization, i.e. how to compute the RCV of an organization.

3.1 SNARE-RCO parameters

As stated in Section 1, an organization has *Human*, *Structural* and *Relational* capital. The problem is: *how to combine human, structural and relational parameters in order to achieve a network evaluation metric*? Figure 2, shows parameter flows to compute RCV.

Firstly, it is necessary to define a set of four RCV input parameters, namely (Barão & Silva, 2011): Organizational Valuable Factors (OVF), Network Valuable Factors (NVF), Social Entity Valuable Factors (SEVF) and Relational Values (RV). These factors depend on the target organization and, for each one of them, a weight can be defined according to its importance. OVF, NVF, SEVF and RV weights ranges are defined by the observer.

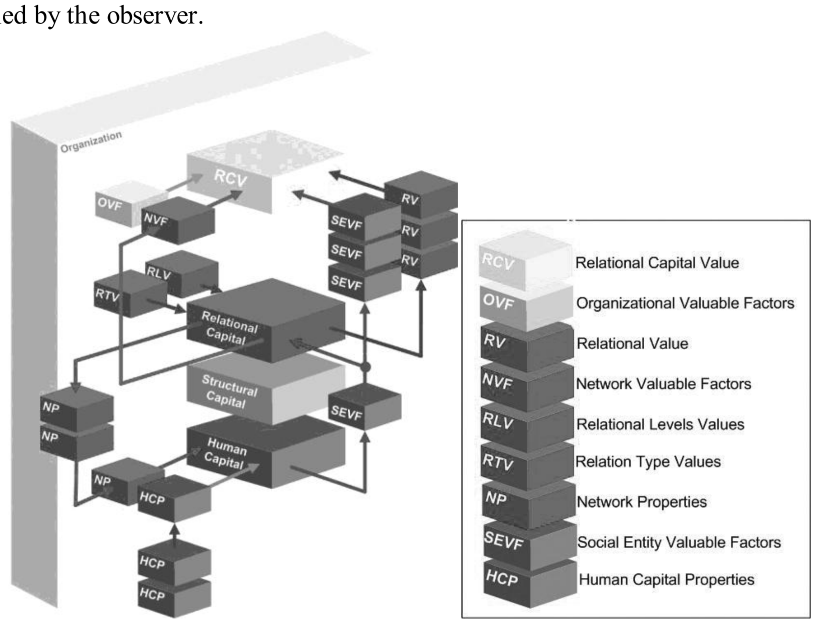


Figure 2: SNARE-RCO Flows to Compute RCV

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 analysis' objectives should be performed by the observer who must be a management expert. E.g. number of active customers, number of partners, and number of brands.

Network Valuable Factors (NVF) are properties inherent to organization network. These properties can be derived from classical analysis of social networks. Two key characteristics of a network are *size* and *density*. *Size* is measured by the number of nodes: if there are *n* nodes, then the maximum possible number of undirected links is *n* (*n*-1)/2. *Density* is the proportion of ties in a network relative to the total number possible.

Social Entity Valuable Factors (SEVF) are properties assigned to each social entity. The observer can use network properties **(NP)** from classical analysis of social networks such as *centrality indegree*, and *centrality outdegree*. Also, human capital properties **(HCP)** must be considered. 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 analysis' goals. E.g. analytical problem solving, creativity and innovation, problem diagnosis and solution, technical expertise and time management.

Relation Type Values (RTV) and **Relational Levels Values (RLV)** must be actionable for observers after the results are disclosed. A relation type is a kind of relation to be analyzed, e.g. s*haring information*. A relational level is a classification to characterize the proximity between two social entities. E.g. *Very Near, Near, Regular, Far, Very Far*. A **Relational Value (RV)** is computed with these inputs as described in Section 3.2.

Finally, to allow the calibration processes, the SNARE-RCO model 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 Formula (1) in the next section.

3.2 Evaluating the relational capital value

The **Relational Capital Value (RCV)** of an organization is computed according the following formula. For further details please consult (Barão & Silva, 2011).

(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)

Where:

(2)

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

(3)

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

(4)

= total of network properties of social entity 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)

(5)

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

(6)

$\forall$ *connection* ***C*** (,)

(totalC = total of network dyadic connections, = relation type value of connection c, = relation level value of the connection c, = network and human capital valuable factors from connection social entity with role producer)

4 The SH Case Study

This section presents a case study that demonstrates the applicability of the SNARE-RCO model.

4.1 The SH Company

The SH company considered in this case study is an international software-house. The network of this company has more than one hundred partners. Each partner maintains regular contact with the company developers through requests for enhancements and suggestions to improve the software products.

The aim in this research is not to evaluate the SH software development process. The objective is to analyze *how* the relational capital of its social network evolves during a six-month period. This is achieved through a *relational analysis* to understand the RCV contribution of each partner in the network, each developer and each relation, including intangible factors to achieve a metric.

The analyzed network data was obtained from the *problem-solving* management information system. This network is a *customized response network.* According to Rob Cross (Cross & Parker, 2004), *customized response networks* develop in order to quickly define a problem and coordinate relevant expertise in response. In this process there are intangible factors that determine who does what, e.g. the proximity (See Section 4.2) between partners and the software-house. Using the RCV is a way to value *partner-developer* relationships and analyze the performance of development teams, i.e. the *response* team.

Each *partner-developer* request is recorded in the task information system of the company and assigned to a specific developer. As stated before, there are intangible factors in this process, namely the partner-developer *proximity* (See RLV in section 4.2). From the management tasks information system, we extracted requests from partners and identified 40 different types of requests, such as: *suggestions*, *technical assistance*, *support*, *meetings*, *training*, *tests*, and *specific development*. The considered requests of this research occurred between January 2011 and June 2011.

Figure 3 depicts a SNARE-Language diagram (Barão & Silva, 2010) for the SH company, namely the diagram of analyzed *partner-to-developer* relationships. In the SH company, partners and developers are connected through the *IsConnectedWith* relationship. Partners are employees who trigger requests. In the *IsConnectedWith* relation, for each requested service, at least one developer can be found.

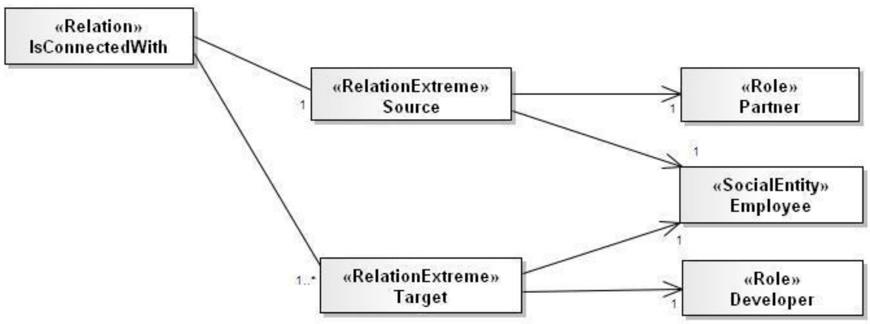


Figure 3: The SH Case Study's Relations View (SNARE-Language)

Figure 4 depicts the network layout corresponding to the referred *partner-to-developer* relationships. Each node in the figure has an identifier. Identifiers between

1 and 29 correspond to developers while Identifiers between 100 and 229 correspond to partners. The network layout was produced using the SNARE-Explorer tool (Barão & Silva, 2008) (Freitas, Barão, & Silva, 2009) and depicts distinct centralities for developers and partners as well.

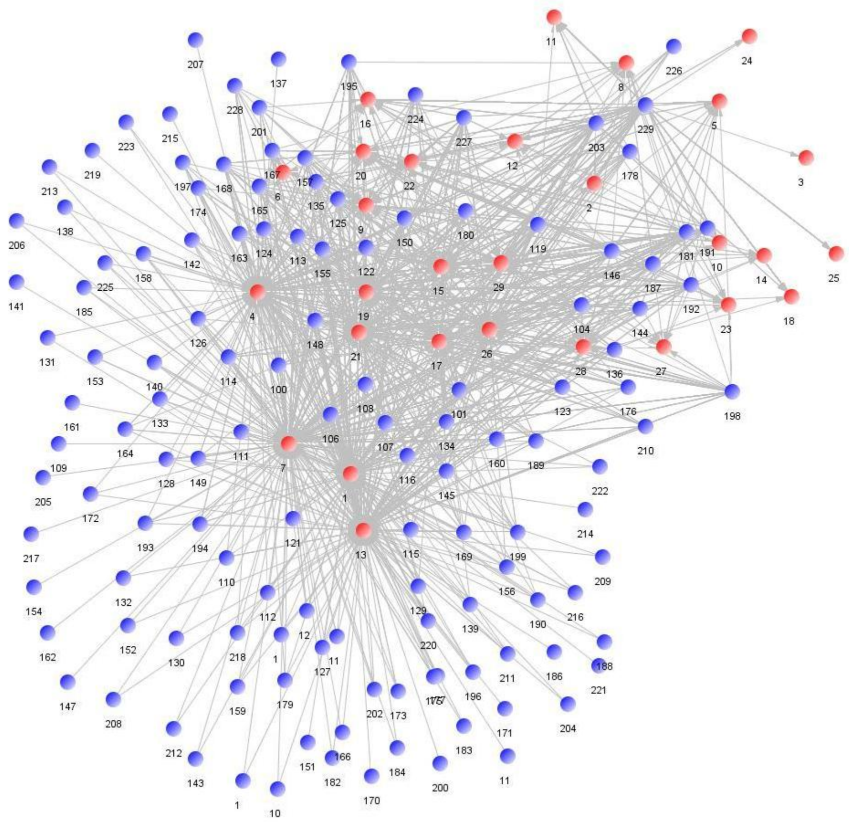


Figure 4: Network Layout based on partner-developer requests

For a given node, the number of head endpoints adjacent to a node is called the *indegree* of the node and the number of tail endpoints is its *outdegree*. Figure 5 depicts an *indegree*/*outdegree* analysis of this network. *Outdegree* corresponds to requests triggered by partners and *indegree* corresponds to requests received by developers, which are thus executed. In this study the sum of *outdegrees* is equal to the sum of *indegrees*. Figure 5 clearly shows the *outdegree* of network partners and the *indegree* of high performance developers.

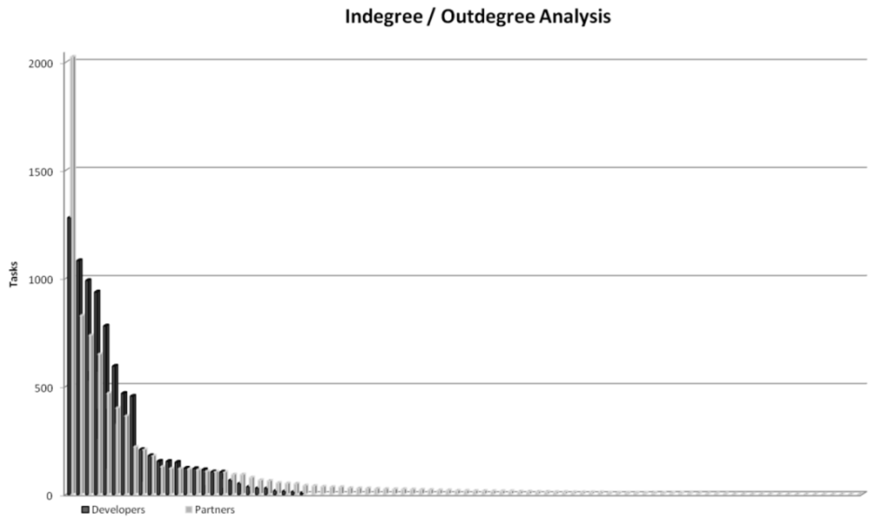


Figure 5: Indegree / Outdegree Analysis

4.2 SNARE-RCO parameters

In this section we explain how we defined SNARE-RCO parameters (Barão & Silva, 2011).

The OVF parameter is particularly useful when comparing the RCV of different organizations. In this case, the objective is to analyze the RCV of a single organization: the software-house, SH. For this reason, the parameter OVF could have been calibrated to zero. However, we decided to use the number of partners that the company has to compute the OVF in order to support comparative studies in the future. The number of partners considered was 130 and the weight given to this parameter was 100. The assignment of weights depends on the type of analysis to perform and the organizational variables that are intended to highlight. The computed OVF of this study is 13000 RCV units. This value is constant over the six months of analysis since the company neither increased nor decreased its partner's network.

To compute NVF we chose the network density property. The *density* is the proportion of ties in a network relative to the total number possible. This network property was chosen because it allows us to evaluate organizational levels of communication. Thus, if the network density increases, this means that the network communication level increases as well. The computed density values for the six months in analysis are given in Table 1 (See NVF). March was the month with the highest level of *partners-developers* communication, and January, the lowest. Despite this, the study shows that the month with higher relational capital value was May.

SEVF are properties assigned to each social entity. To compute the SEVF for each developer or partner, network (NP) and human capital properties (HCP) were used.

The network under study is *problem/solving* type. Thus, for partners, the network property considered was the *outdegree,* because it corresponds to the number of requests that they send to developers. For developers, the network property considered was the *indegree,* because it corresponds to the number of requests they receive from partners. Moreover, factors from human capital were considered. For each developer, a *technical expertise* factor was used. This factor was provided by the Sponsor as a result of previous internal evaluation procedures. Also, a *competence* factor for each partner was provided by the Sponsor. The range of the HCP factors varies between 5 (very high) and 1 (very low).

After organizational valuable factors, network valuable factors, and the social entity valuable factors were computed, a weighting system to compute the relations value was defined for relation type values (RTV) and relational levels values (RLV). The purpose of RTV is to differentiate relational actions value. Relations can be of numerous types and for each one several relation type values can be assigned. These values are weights to compute RCV. In this study, each kind of partner request has a unique type code. We have detected 40 RTV types. Examples of RTV types are: *technical assistance, suggestions, external service, specific development, planned development, web development, plug-in development, training request and software bug report*. According to the importance of requests and priorities of the development team, each RTV was defined with a five range weight. High importance request was weighted with 0,5 and low importance request was weighted with 0,1. These weights were defined by the Sponsor.

In the next step, relational level values (RLV) were defined. A relational level is a classification used to characterize the proximity between two social entities. In this case, the proximity between partners and the software-house, more specifically the partners-developers proximity. Not all partners have the same proximity to developers. In this study, *proximity* reflects the informal knowledge about a partner-developer relation. This knowledge is based on factors such as trust and informal communication. For this reason, in this study, *proximity* is an intangible asset with direct influence on the network relational capital value. Proximity weights were defined by the Sponsor (5 corresponds to *very near*, and 1 to *very far*).

Finally, global calibration weights Organizational weight (Ow)**,** Network weight (Nw), Social entity weight (SEw)**,** and Relational weight (Rw) were set to 1 (neutral calibration weight).

4.3 Evaluating the relational capital value

To analyze the relational capital value of the SH organization, a summary of RCV computations is given in Table 1. *OVF*, *NVF*, SEVF Sum, *RV Sum* and global *RCV* were computed as introduced in Section 3. Figure 6 depicts the RCV evolution during the six-month analysis period. During the first quarter of 2011 the RCV had increased meaning, in this period there was an equivalent increase of partner requests. In April, the relational capital value lowered. In May, RCV reached the highest value of the six months analysis, and in the last month (June), this value declined again.

The SNARE-RCO model allows us to analyze how *RV Sum* is produced, as showed in Table 1. In this case study the *RV Sum* is the main RCV parameter that most contributes for the relational capital evolution.

Table 1 RCV Summary (6 Month Analysis)

	J	F	M	A	M	J
OVF	13000	13000	13000	13000	13000	13000
NVF	241,77	272,78	308,86	273,41	299,99	252,53
SEVF Sum	1529,8	2484,7	2733,9	2307,7	2920,7	2539,8
RV Sum	813916,21	1599630,15	1886936,39	1500598,93	2232657,91	1651917,16
RCV	**830249,98**	**1617977,63**	**1905961,15**	**1518794,94**	**2251930,61**	**1670551,99**

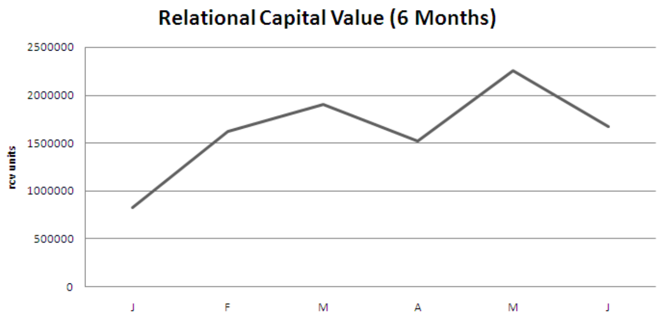


Figure 6: Global RCV Evolution (6 Months Analysis)

After this, three questions emerged: *How is RV Sum distributed by network relations?; How is RV Sum distributed by developers?;* and *How is RV Sum distributed by partners?*

To answer the first question, Table 2 provides a detailed analysis of *RV sum* RTV distribution. I.e. in this table it is possible to analyze what relations triggered relational capital value for *partners-developers* relations. Figure 7 a) depicts *RV Sums* for six months and it is possible to observe that RTV with code 12 has the highest RCV value. Secondly, Table 3 provides a detailed analysis of *RV sum* distribution per developers. Figure 7 b) depicts *RV Sums* for a period of six months of developers work and it can be observed that the developer with identification code 4 has the highest RCV value. Finally, Figure 7 c) depicts the respective partners *RV Sum* distribution, and it is possible to observe that the partner with the identification code 229 has the highest RCV value.

Table 2 RV Sum distribution per Relation Types (6 Months)

	Months						
RTV types	J	F	M	A	M	J	RV SUM
1	2025,08	6282,36	12046,84	11564,12	26234,18	17962,72	76115,3
2	5658,6	15569,88	111470,55	72808,59	185633,49	83582,85	474723,96
3	139999	246590,88	292822,12	243262,44	223870,24	193701,64	1340246,32
4	0	0	10949,2	950,3	3148,8	93549,5	108597,8
5	0	1974,6	0	0	0	0	1974,6
6	0	0	1339,65	6021,75	13746,24	4824,09	25931,73
7	31076,92	56199,24	70358,28	39712,52	72253	19684,96	289284,92
8	0	0	0	0	0	8216,1	8216,1
9	17671,64	41280,08	45192,64	44445,04	35010,44	34422,32	218022,16
10	1390,48	10968,88	26876,84	16679,84	24029,32	32998,52	112943,88
11	5782,18	11111,8	14319,32	11448,04	24630,6	17225,28	84517,22
12	529479,7	772347,32	471554,8	240133,32	646510,64	385596,54	3045622,32
13	0	0	205,92	1414,64	13600,38	1747,8	16968,74
14	1868,96	23549,18	9038,48	23122,3	15524,58	32853,8	105957,3
15	9955,05	22756,02	34238,22	73744,5	96060,6	174066,75	410821,14
16	16906,8	55066,44	72346,52	76770,48	100831,72	186814,4	508736,36
17	3307,25	16243,8	18225,8	30315,5	27775,5	44424,45	140292,3
18	9199,16	45629,56	35593,48	77589,36	159463,88	0	327475,44
19	1520,58	17262,84	7377,6	8833,85	1660	0	36654,87
20	4900	71634,68	14458,24	28915	2253,28	0	122161,2
21	0	0	18277,2	20879,55	5409,45	0	44566,2
22	0	0	2332,8	6294,8	2199	0	10826,6
23	0	0	132433	64070	19974	0	216477
24	0	0	0	2137,2	0	0	2137,2
25	1764,25	0	0	0	0	0	1764,25
26	1669,6	5011,8	14897,6	23855,6	16226,24	4067,8	65728,64
27	1464,06	4835,22	12373,8	20783,4	30241,32	14535	84232,8
28	0	0	39794,4	45999,2	52193,4	23390,2	161377,2
29	0	0	0	0	5495	27640	33135
30	0	0	0	3103,2	0	0	3103,2
31	17222,8	12221,4	75363,2	40155,8	127291,2	69892,2	342146,6
32	8751,3	44668,83	44728,32	7637,55	36022,83	23600,7	165409,53
33	0	0	0	1531,2	1738,8	0	3270
34	0	0	32399,25	0	0	0	32399,25
35	0	0	0	0	0	20848,32	20848,32
36	0	7087,1	55998,8	5172	10056,2	50714,9	129029
37	0	8265	0	0	180,4	0	8445,4
38	1592,2	200,8	715,4	0	17,34	163	2688,74
39	710,6	3704,8	0	0	950,2	0	5365,6
40	0	99167,64	209208,12	251247,84	252425,64	85393,32	897442,56
	813916,21	1599630,15	1886936,39	1500598,93	2232657,91	1651917,16	

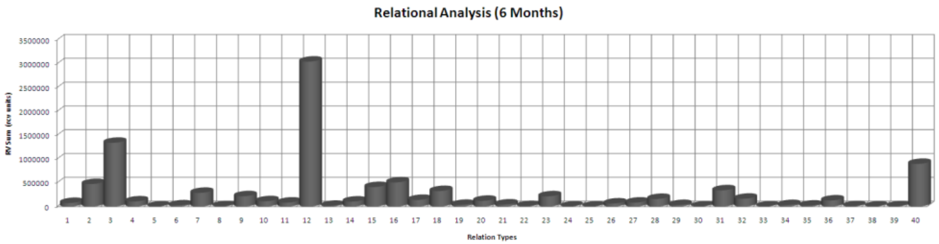
Table 3 RV Sum distribution per Developers (6 Months)

			Months				
Developers	J	F	M	A	M	J	RV SUM
1	33051,42	26050,5	31557,24	52353,12	75325,14	72696,3	291033,72
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0,45	0,45
4	467945,05	807932	350723,8	46462,35	652925,7	437084,7	2763073,6
5	8791,2	4401,76	1763,28	1816	11186,56	412,16	28370,96
6	0	3,6	1,44	9	23,52	11,85	49,41
7	53053,4	69625,6	102120,48	40957,28	87003,62	69864,8	422625,18
8	4,32	5,88	22,36	13,6	342,72	78	466,88
9	756,16	8477,8	3294,2	5360,4	7814,4	2989,6	28692,56
10	3594,8	47178,5	80265	33612,3	7554,75	24653,75	196859,1
11	358,2	2111,67	3052,92	995,28	6525,78	2026,35	15070,2
12	294	2692,32	8770	1508,8	6389,76	1884,96	21539,84
13	161960,94	130930,8	155550	232154,91	134175,6	51198,84	865971,09
14	15,84	665,28	31,2	3891,6	609,12	904,8	6117,84
15	2254,2	2164,4	15738,84	19007,6	20933,12	203736,68	263834,84
16	1751,04	504,6	1213,2	125,8	2254,56	11503,68	17352,88
17	6265,92	97305,56	149495,28	215817,28	415053,52	225867,44	1109805
18	9,6	3993,96	3074,4	7413,12	491,84	4947	19929,92
19	4364,64	39831,84	121488,88	101201,36	114510,24	32823,6	414220,56
20	127,4	2701,8	20806,95	21958,8	25560	23095,5	94250,45
21	56137,4	227565,88	499129,76	411553,28	515671,2	252656,04	1962713,6
22	1412,88	6555	2482,92	9095,58	10120,95	7935,18	37602,51
23	0	230,4	42961,8	1892,4	381,6	978,56	46444,76
24	0	0	0	0	17,34	20848,32	20865,66
25	288	5561,4	2315,4	5880,6	13320,6	0	27366
26	10103,4	98720,16	286648,32	282086,88	120029	187942,08	985529,84
27	21,12	343,2	50,4	84,6	61,92	329,28	890,52
28	1236,24	4809,84	1829,52	776,16	100,8	319,68	9072,24
29	119,04	9266,4	2548,8	4570,83	4274,55	15127,56	35907,18
	813916,21	1599630,15	1886936,39	1500598,93	2232657,91	1651917,16	

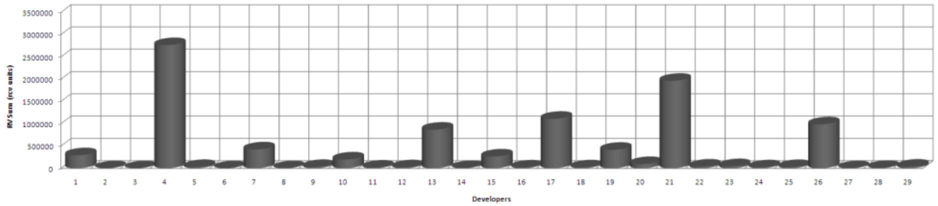
Analyzing May, the most critical month, a deeper study on network relations was made. As previously stated, the relation with code 12 is the main responsible for the network *RV Sum* increase. Figure 8 shows two radar diagrams. In Figure 8 a) partners that trigger relation type 12 requests are represented. In Figure 8 b) target developers involved in relation type 12 are represented. On the one hand, it is possible to see that only three partners have a major role in requesting analyzed tasks. On the other hand, few developers are involved in solving relation type 12 requests. More specifically, developers with identification codes 1, 4, 7, 13, 17, 19, and 21. Furthermore, the developer with identification code 4 is clearly the most overloaded. This unbalance was primarily responsible for the rise of RCV in May. We found a high dependency on developer 4. To lower the RCV value, partner requests shall be distributed by other network developers. Developers 7 and 13 should keep their performance levels, and more tasks ought to be delegated to developers 1, 17, 19, and 21.

Draft version of: “Alexandre Barão, Alberto Rodrigues da Silva, “Applying SNARE-RCO to Evaluate the Relational Capital of an Organization: The SH Case Study”. Book chapter in *"Sociotechnical Enterprise Information Systems Design and Integration*." IGI Global, 2013”.

a)



b)



c)

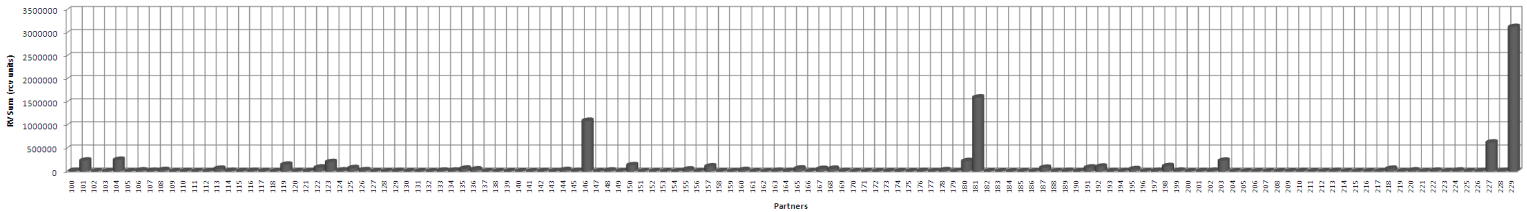
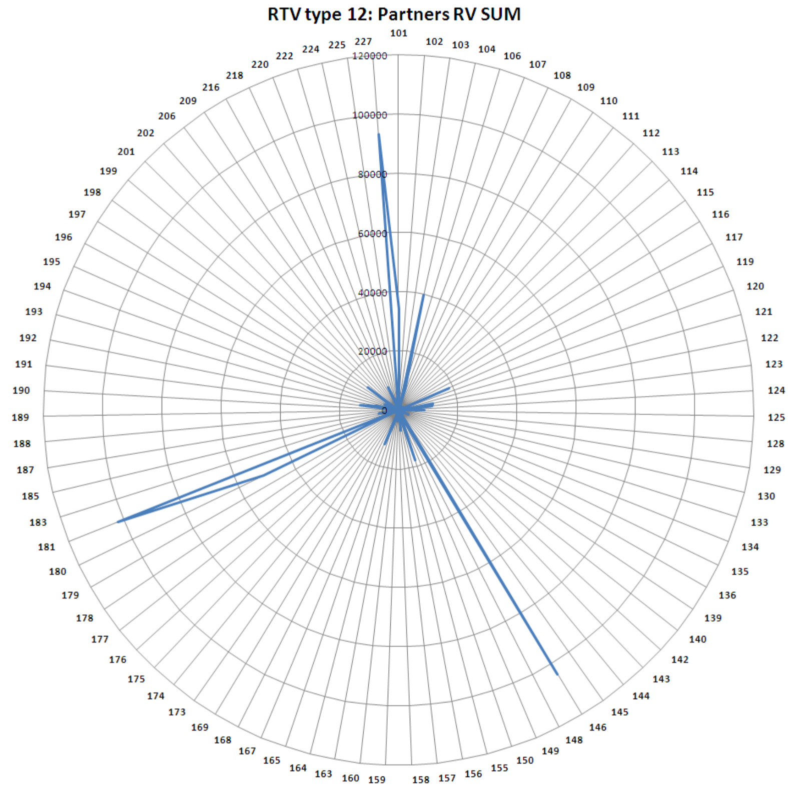


Figure 7: Relational Analysis (6 Months)

a)



b)

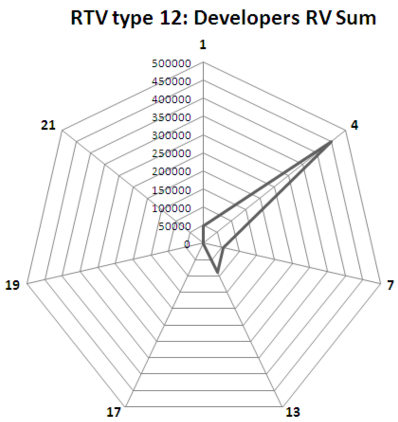
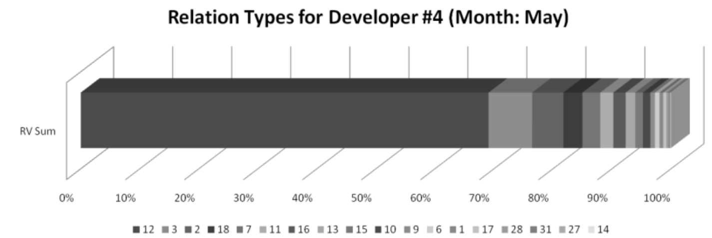


Figure 8: Relation Type 12, Partners-Developers Distribution (Month: May)

When analyzing the relations in which the developer with identification 4 is involved, the RV Sum shows that over 60% is related with relation type 12 (Figure 9 a). However, only four partners are responsible for more than 50% of the requests (Figure 9 b). This reinforces that the unbalanced network task distribution can be avoided if partner requests are better assigned to different developers.

a)



b)

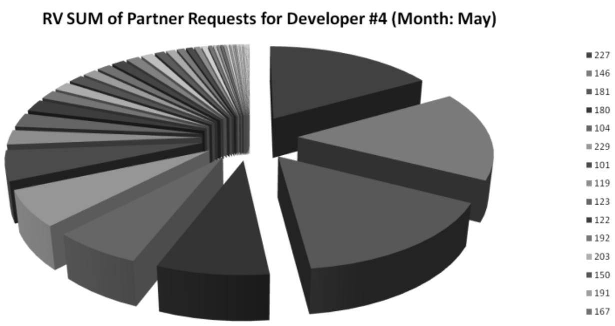


Figure 9: Relational Analysis for Developer 4 (Month: May)

4.4 Discussion

After analyzing several intangible measuring theories, we found hundreds of indicators, and the most important question for the manager is how to choose the appropriate ones to build a unique performance measurement system. Even in the current business performance methods such as European Foundation for Quality Management model (EFQM, 2011) or Skandia model (Skandia, 2011), measuring indicators are neither standard nor widely used in organizations. Besides, as previously stated, the real asset values of different types of intellectual assets are not clearly defined (Zadjabbari, Wongthongtham, & Hussain, 2008).

There are several intellectual capital evaluation models. They are validated in organizations and meet their objectives. However, there is a lack of models to evaluate the intellectual capital, including intangible factors, which combines techniques derived from social network analysis. SNARE-RCO model (Barão & Silva, 2011) supports the use of metrics from different approaches, e.g. using OVF and SEVF parameters but the main difference between SNARE-RCO and other models is that SNARE-RCO considers the additional use of NVF and RV parameters. This is an advantage because SNARE-RCO combines the power of social network analysis techniques (e.g. through the use of NVF parameters) with the strength of relational analysis (e.g. through the use of RV).

The combination of RTV and RLV parameters to achieve a metric is a distinctive aspect to assess relations with inherent relational tangible and intangible factors (See Figure 1). For example, in the SH case study, RLV parameter was used to differentiate *partners-developers* proximity. Proximity is a factor that enhances professional relationships. As mentioned before, through SNARE-RCO model it is possible to define parameters from *Relational*, *Structural* and *Human Capital*. Table 4 summarizes the semantics applied to the SNARE-RCO parameters.

Table 4 *The SH company: SNARE-RCO Parameter Semantics*

Capital Type	**Parameter**	**Semantics**
Relational	NP	To detect partners and developers network *centrality degrees*
Relational	NVF	Based on network *density*
Structural/Human/Relational	OVF	Based on *number of active partners*
Human	HCP	Based on *technical expertise*
Relational and Human	SEVF	Combined NP and HCP parameter to analyze the RCV strength of each social entity
Relational	RTV	Used to differentiate 40 distinct relation types
Relational	RLV	Based on partner-developer *proximity*
Relational	RV	Combined SEVF, RTV and RLV factors to understand each relational action RCV contribution

After applying the SNARE-RCO model to the SH organization, we met with its Sponsor and recommended precise strategic decisions to enhance the analyzed situation by reducing the RCV. The network is designed to allow external requests and we found an unbalance regarding the *partner-to-developer* request distribution. To minimize this, the organization must redirect some requests to other developers and increase specific training plans for low-performance developers. On the one hand, high performance developers should be involved in this knowledge transfer process by adopting better collaborative environment practices. On the other hand, the tasks regarding the assignment should be redesigned. Why is a high-performance developer solving “easy” problems? The partners-developers *proximity* is one of the possible answers to this question. We also found coordination based on formal structures in which the work is predefined by inappropriate process flows. Finally, the culture and leadership of the SH company also reveals centralized decision making, focused on standardization and task accountability instead of promoting collaboration across organizational lines.

5 Conclusion

To propose the SNARE-RCO model it was necessary to research various methods and techniques of organizational assessment. There are several assessment methodologies for studying aspects such as economic or operational impact. However, there is still a lack of assessment methodologies that combine techniques derived from social network analysis with organizational aspects and its relation with intangibles from intellectual capital. One reason for this may be the division of organizational knowledge assets into three areas: human capital, structural capital and relational capital. That is, the separation of these factors assumes that the relational capital is independent of the human and structural capital. But, in fact, it is not. Therefore, from our point of view, to properly evaluate the relational capital of an organization it is necessary to combine metrics that derive from the assessment of human capital and structural capital. On the other hand, evaluating "intangibles" is a subjective process of reflection and depends consequently on the focus and purpose of the analysis. For this reason, most of the evaluation of organizations tends to be based on HR skills and performance.

The key challenge remains - the need for a relational capital evaluation system to answer questions like: *What is the value of this network?* There is not an easy answer. Our research leads us to conclude that any metric for assessing the relational capital of an organization should include aspects of human capital and structural capital. The SNARE-RCO model can be applied to distinct kinds of organizations by adapting and/or extending parameter semantics.

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