New Insights for Relational Capital

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Abstract: In this paper, we concentrate on relational capital, manifestation of the old adage "it is not what you know but who you know". We propose that in this networked world, the importance of relationships between multiple stakeholders created by key personnel and financing becomes fundamental, and hence understanding and measuring those becomes fundamental, too. Accordingly, we highlight a need to go beyond social, individual or personal relationships and organizational context, as well as beyond the limitations of the dyadic (one actor to one actor) view on relationships. Hence, we are introducing the ecosystem as the context for measuring relational capital. This paper builds on a construct of ecosystemic relational capital, created for understanding and measuring the importance of relationships in the context of ecosystems. It looks at the totality of relationships both at organizational level and at individual level, measuring the structures and characteristics related to individuals, organizations as well as the ecosystem as a whole (Still et al. 2014a). We acknowledge that the initial framework emphasizes the "networking capabilities" element of relational capital, with less attention to the element of "customer loyalty and reputation", which is the motivation for building on the construct. The processes of ecosystemic relational capital are built on the possibilities afforded by the volumes of digital data, mostly from social media, providing details on the relationships between various actors related to various regions, sectors, technologies and products. However, we propose enhancing the holistic integration for better understanding and measuring of relational capital with the application of methods of social network analysis (SNA), network visualizations and social media analytics. In this paper, we present concrete examples of the enhanced framework. At the same time, we acknowledge that there are many other avenues for obtaining novel insights for relational capital with these analytics, and we strongly encourage researchers and practitioners to do so.

Keywords: innovation ecosystems, relational capital, social capital, visual ecosystem analytics, social network analysis, social media analytics, innovation indicators

1. Introduction

Despite the fact that ideas and approaches of intellectual capital (Sveiby, 1997; Edvinsson and Malone, 1997) are more than 15 years old, the realities of addressing and measuring it still remain challenging: current company valuations cannot be explained only with conventional economic measures. For example, why was Instagram (with 12 employees) sold for a whopping 1 billion dollars? Why the Facebook valuation turned out to be partly speculative? Why is Google, and no longer Apple, the most valuable company in the world? The concepts of intellectual capital and intangible capital are provide some explanations to questions about the value of relationships in this networked world, in which value is seen to be co-created by multiple actors in interactions with the customer (Vargo and Lusch, 2004). Furthermore, the fundamental proposition of social capital theory is that network ties provide access to resources, contributing to organizational advantage (Nahapiet and Ghoshal, 1998).

The paper is structured as follows: we first explore the theoretical background of relational capital, which is at the core of this paper. The motivation for going beyond the organizational level approach as well as the approaches and indicators for measuring it will be addressed, coupled with the availability of novel data about relationships. We then review the construct for ecosystemic relational capital (Still et al., 2014a) and analyze how it can be enhanced to better capture the various elements related to relational capital, with concrete examples using digital data sources, especially from social media, with methods of social network analysis and social media analytics. Finally, we will conclude by discussing the findings, the insights from them, their applicability and limitations.

In this paper, the emphasis is on the fact that these ecosystemic relational capital indicators provide novel ways of understanding the importance of relationships. We propose that in the ecosystem, there are many types of relationships at many different levels; we already are fairly familiar with some of those—as they describe "business as usual". By using novel data sources, we can get glimpses of the emerging actors and their relationships within the ecosystem.

2. Theoretical background

2.1 Relational capital in an organizational setting

Relational capital is most often seen as an organizational attribute, which has been framed as the totality of relations between a firm and its main stakeholders and is operationalized through image, customer loyalty, customer satisfaction, link with suppliers, commercial power, negotiating capacity with financial entities, environmental activities etc. (Bronzetti et al., 2011). It is generally explained with alliances, exchange, resource, social network processes, relationships, relations, customers, suppliers, employees, and co-operation (Still et al., 2013b). Oftentimes, the emphasis remains on the company's external connections with a wide variety of economic agents, with the elements of networking capabilities, and customer loyalty and reputation (Molodchik et al., 2014).

Relational capital is usually complemented with concepts of human capital (addressing the individuals and "what is in their heads") and structural capital (addressing the organizational, explicit knowledge that "is owned by the organization"), as well as with social capital (Nahapiet and Ghoshal, 1998). These concepts are interrelated and linked (Still et al., 2013b); for example, human capital is not built in isolation, but in interactive relationships. Furthermore, the use of term social capital indicates that it is an asset; while the term social connotes that the particular asset is attained through involvement with a community (Feltman and Zoller, 2012)

There have been attempts to measure relational capital. Commonly used metrics of organizational relational capital have included, for example: (1) measuring contacts with investors, analysts and other stakeholders, as well as opportunities for networking with colleagues in academic and social events; (2) the level of collaboration with individuals and institutions; (3) measuring the exposure to media, notoriety and value perception, and (4) measuring customer satisfaction and loyalty (de Pablos, 2003). Among the indicators of relational capital, advertising expenditures have been described as the most often used (Molodchik et al., 2014), as have factors relating to the existence of satisfied customers (Chang and Tseng, 2005).

Recently, the measurement of relational capital has been defined with two elements: (1) networking capabilities, and (2) customer loyalty and reputation (Molodchik et al., 2014). These elements are appropriated with indicators, such as number of subsidiaries as a measure for networking capabilities, and advertising expenditure as an indicator for customer loyalty and reputation. The constructs, indicators, source of information, and the reasoning of such measurements are presented in Table 1.

At the individual level of relational capital, one recent attempt to measure relational value has been "Klout" (www.klout.com/home). Initially Klout examined at a person's online presence (measuring your reach, how you engage in your network, how well your network is working for you, your influencers, your influences, about content you are influencing) but is now expanding to address the off-line activities of people, too (Stone 2012). The Klout score is a controversial measure, but it embodies the quest and importance of metrics for relational capital—and highlights the rapidly changing nature of this asset, as Klout scores are calculated every day.

For calculating the indicators of relational capital at the organizational level, data frequently comes from corporate financial data. In addition, online sources, web pages, are also mentioned as sources of data about organizational relationships (Table 1).

2.2 Relational capital in ecosystems

Though the emphasis in relational capital literature continues to be at the organizational level, the links to individuals have been noted. For example, the individual level relationships have been described as "personal networks" (Kujansivu and Lönnqvist, 2007) or as social relationships with both business purposes as well as non-business purposes (Agndal and Nilsson, 2006). Furthermore, the concept of "personal relational capital" has been introduced to address the value created by people in a business relationship, with qualities of credibility, integrity and authenticity, and considered by some to be the most important element in business relationship.

Increasingly, it is recognized that sustainable innovation activities—and other business activities—rarely are carried out by a single individual or within a single organization. These interdependencies of multiple actors are addressed with a concept of ecosystem, the business concept of which was introduced by Moore (1996), and which can be defined as networks of relationships for sustained value co-creation (Russell et al., 2011; Russell et al., 2015), including interdependent firms forming symbiotic relationships (Basole and Rouse, 2008) and human networks that generate

extraordinary creativity and output (Hwang and Horowitt, 2012). Hence, companies are not only connected through formal relationships, such as deals and alliances, but also interlocked through key individuals—information flow, norms, mental models (Davis, 1996),

The concept of ecosystemic relational capital is based on the consideration that companies are not isolated systems; on the contrary, they are active and permanently connected to multiple external entities (Dorrego et al., 2013). Talent, information and financial resources are seen to flow through networks of relationships (Russell et al., 2011). Relationships shape the behavior and outcome of all stakeholders as well as the system-level effects (Hwang and Horowitt, 2012), and it is through the relationships of individuals within and across organizations in an ecosystem that knowledge transfer, technology dissemination, and organizational change are accomplished.

Table 1: Constructs and indicators of relational capital elements (Molodchik et al., 2014)

Construct	Indicator	Source of information	Explanation
Networking capabilities	Participation in associations	Company's web site	It is important for a company to participate in professional associations and develop its branches and representatives close to the resources or the markets; reflecting the significant networks of large enterprises
	Number of subsidiaries	Company's annual report, section "Common information"	
	Foreign capital employed	Company's annual report, section "Financial data"	A company which attracts foreign capital is introduced to international markets and is relatively wealthier; the international network is reflected through the foreign capital employed
	Debt to equity ratio	Company's annual report, section financial data	Estimation of the financial resources available to company; reflects the optimum leverage and the autonomy of the company in taking decisions
Customer loyalty and reputation	Ranking brand Finance Global 500	Ranking Brand Finance Global 500 (www.rankingthebrands.com)	A well-known brand together with awards enhance customer commitment and establish corporate image
	Number of awards for innovation	Company's web site	
	Citation in search engines	Search on company's name and its score on the web site: www.prchecker.info/chcheck_page_rank.php	Internet penetration reflects a company's popularity; helps to form its reputation and allows the monitoring of company's current position in the electronic world
	Advertising expenditures	Company's Annual Report, section "Financial data"	Advertising costs are considered as an investment in the promotion in the activities and product of the firms.

Based on elements associated with relational capital and social capital, the framework of ecosystemic relational capital introduces three elements (structural, relational and individual) that are interrelated and have meaning in understanding an ecosystem (Still et al., 2014a). The approach to measure the interrelated elements stems from recommendations to examine the relationships and interactions, so that the processes in innovation ecosystems that are enacted over time in nested network structures can be explored (Halinen et al., 2012).

Calculating the Klout score for an individual introduces the use of social media as data source. Social media is seen to contribute to innovation data, or relational data, as a natural by-product of activities by various actors, oftentimes in unstructured format. Individuals, such as company founders, entrepreneurs, knowledge and financial investors, journalists, policy makers, and customers share information, discuss and communicate about their needs, experiences and opinions using it (Still et al., 2014b). For example, a company writes and shares a press-release when it receives major funding or appoints a new board member; board members reveal their career paths; the same individual could

write a scientific article, which gets cited and could lead to patent filing; companies are written about in Wikipedia, in Twitter and in Facebook.

Social media provides access to volumes of global, multipurpose, real-time digital data related to various actors in a cost-efficient manner (Still et al., 2014b); data describes relationships of many types – individuals-to-individuals, individuals-to-organizations, and organizations-to-organizations, at the same time going beyond single organizations by including universities, research organizations, financing organizations (Table 2). It should be noted that the available data is not dyadic but it can link, for example, multiple financing organizations to one company, a research organization to multiple projects, an individual to multiple companies etc.

2.3 Tapping into network analysis and visualizations

Social network analysis (SNA) is generally used for bringing visibility to the networked aspects of human collaboration and communication, with terminology of networks (referring to the system), nodes (actors, or agents, referring to individual parts of the system), and edges (also called relations or connections between the nodes). The basic mathematical algorithms of SNA provide quantitative approaches for the network as a whole (with metrics such as size, density) and for the individual nodes (with metrics such as degree, betweenness centrality); this differentiation is important because network dynamics at each level, although related, are also distinct (Zaheer et al., 2010).

The inherent emphasis of relationships and their resulting networks provides a list of possible measures based on network metrics. SNA is increasingly used for exploring social media (Welser et al., 2007), as social media is digital, reveals social relationships and is relatively easy to gather and store, making it readily amenable to SNA (Huhtamäki and Parviainen, 2013).

Traditional SNA (Wasserman and Faust, 1994) introduces a set of node and network level metrics that can be used to describe the structural properties of networks and to quantify the various social roles of network actors (Huhtamäki et al., 2015). Existing research on networks shows that network analysis has a good fit for explorative analysis of systems. For example, network structure-density, connectivity, and hierarchy are all features associated with flexibility and ease of information exchange through their impact on the level of contact or the accessibility they pro-vide to network members (Nahapiet and Ghoshal, 1998). Much is already known about structure in networks (Granovetter, 1973; Barabási and Bonabeau, 2003), the roles of individual actors in the network (Hansen et al., 2011), the drivers of network evolution (Giuliani and Bell, 2008) as well as the latent structures and dynamics behind the diffusion of information through networks (Leskovec et al., 2009), network control (Liu et al. 2011) and virality (Shakarian et al. ,2013; Weng et al., 2013).

Already in 2005, visual network analysis was used to analyse how Friendster (a social media service) was used (Heer and boyd, 2005). Also, one of the first and formative papers of studying how and why people use Twitter used social network analysis to understand user intentions and community structure (Java et al., 2007). While network analysis has been available for decades as an analytical method, the realization that networks indeed have a role in the opportunities for value creation and appropriation for a business is only beginning to emerge. Recently, Feltman and Zoller (2012) addressed the role of dealmakers in regional entrepreneurial economies with network metrics, and suggest that strong entrepreneurial and investor networks are associated with successful entrepreneurial economies. Also, Afuah (2013) composed a set of propositions on ways a company's role in network, as well as its conduct, impact its success, and he claims that network effects concern more than the size of company's clientele. Hence, the revelation of relationship-based structures as patterns of connections and interactions within an ecosystem can be captured (Green and Sadedin, 2005), as a sum of organizational level and individual level elements, using SNA metrics and related dynamics (Ahuja et al., 2012).

Showing the relationships with visualizations can be achieved with drawings-by-hand on smaller scale; however, with the advances in computation as well as responding to the larger volumes of data, novel visualization methods can be used. This implementation of the computation, analysis and visualization step is a combination of interactive computing (Goldin et al., 2010), knowledge discovery (Fayyad and Stolorz, 1997), information visualization (Card, Mackinlay and Shneiderman, 1999) and visual analytics (Wong and Thomas, 1994; Heer and Shneiderman, 2012). For example, the ability to visualize one's professional network, using one's network information from LinkedIn, allowed seeing the communities, the friends-of-friends and the influencers in one's own network. This, combined with visualizations provided by other social networking sites, such as Facebook, brought the understanding of network concepts to a new level.

Table 2: Availability of relational data (Still et al., 2014b)

Data source	*Description*	*Type of relational data*
Open data	About public and private financing	financial organizations to companies
	About projects and technology	companies to companies, companies to universities and research organizations, individuals to organizations
Patent data	About patenting activity and their technology	individuals to other indivduals, individuals to companies, individuals to technologies
Scientific publication data	About scientific writing activity and the technology	individuals to other indivduals, individuals to companies, individuals to technologies
Web pages	About company and its connections to products and technologies, people and organizations	companies to companies, individuals to companies, financing to companies, companies to products and technologies
Socially constructed datasets	crowd-sourced datasets (such as TechCrunch Crunchbase, Arctic Startup, AngelList)	individuals to companies, companies to companies, companies to technologies, companies to financing
Wikipedia	About the company, its technology, products, individuals, financing, partners	individuals to companies, companies to companies, companies to technologies and products, companies to financing, companies to research
Twitter	About the company, its technology, products, individuals, financing, partners	individuals to individuals, individuals to companies
Facebook	About the company, its technology, products, individuals, financing, partners	individuals to individuals, individuals to companies

3. Methodology

With the goal of presenting measurements, or indicators, of relational capital in the context of ecosystems, this paper draws heavily on in-depth literature searches. The subsequent understanding, also about the influential and seminal sources related to the research context (especially those of disciplines of knowledge management and intellectual capital), enables a synthesis. Accordingly, an understanding is developed, described and discussed with constructs, which are conceptual frameworks to organize the ideas related to question (Shields et al., 2013).

The constructs for relational capital are approached with a case study research, attempting to understand the nature of the research problem, reflecting, forming and revising meanings and structures of the phenomena being studied. Furthermore, in accordance with the exploratory nature of the study (Yin, 2014), we are relying on ”the inductive multiple case study” (Almpanopoulou and Järvi 2015).

The cases used in this paper are described with boundary specifications of an ecosystem for presenting the composition of an ecosystem and the presence of relational capital in it. In all of the cases, the relationships and interactions are studied using non-traditional relational data:

- Case Finland (Still et al., 2013) looked at the national ecosystem of Finland, with three different country-specific data sources about people and money flows.
- More detail about the Finnish ecosystem was explored with one specific financing instrument used to support startups, and the social media presence of these startups (Huhtamäki et al).
- Furthermore, by tuning the lense to address company specific ecosystems, one case looked at formal as well as informal connections between Nokia—a Finnish giant—and Microsoft (Rahul et al., 2015).

- A case for comparing three ecosystems—namely Austin, TX, Minneapolis-St. Paul, MN; and Paris, France—looked at three metropolitan ecosystems, with data about these cities and their connections Russell et al., 2015).

To highlight the networked and interrelated nature of organizations in the cases, we tap into the potential provided by network approaches. In doing so, we are drawing from the approaches and processes of social network analytics, visual analytics and social media analytics.

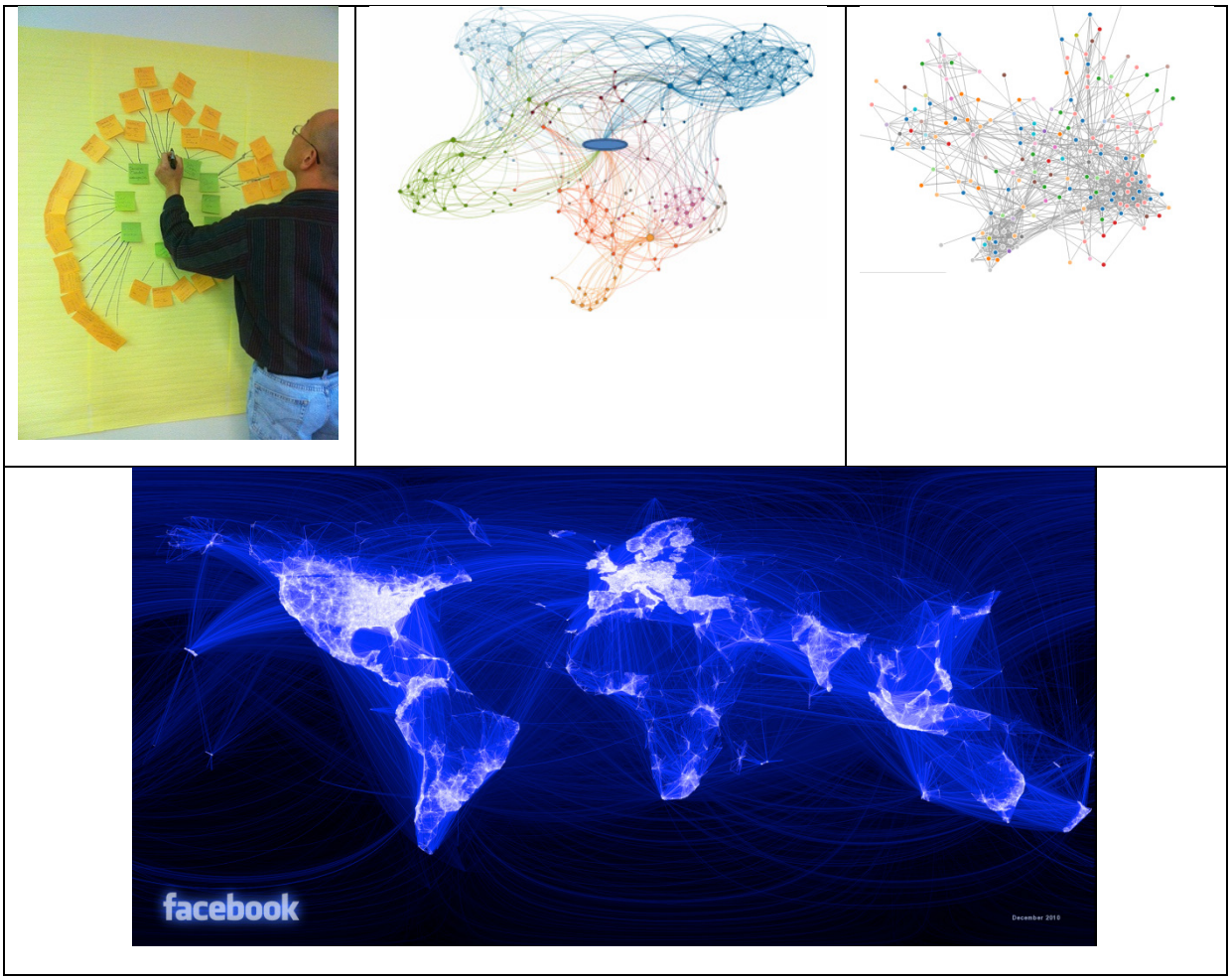

Figure 1. Visualizations of networks: (upper row) left manual network mapping (http://www.bethkanter.org/ network-mapping/); LinkedIn network visualizations, in the middle using Inmaps (2014), in right using socilab.com (2015) ; (lower row) visualization of 500+ million Facebook users and their connections pasted on the world map (https://www.facebook.com/notes/facebook-engineering/visualizing-friendships/469716398919)

4. Findings

As Nahapiet and Ghoshal (1998) so eloquently put it in their groundbreaking paper, this paper also is fundamentally concerned with resources within the structures and processes of social exchange, seeing that the development of social capital is significantly affected by those factors shaping the evolution of social relationships. Due to the ecosystemic rationality of business and innovation activities, the concept of relational capital is seen to evolve from primarily an organizational characteristic into a concept that includes multiple relationships between multiple actors (Still et al., 2014a). The framework (Table 3) for exploring relational capital responds to this by introducing three interrelated entities of the whole ecosystem (structural)—concerning the properties of the social system and of the network of relations as a whole (Nahapiet and Ghoshal, 1998) —as well as its organizational and individual elements as assets created and leveraged through relationships or "actor bonds" (Nahapiet and Ghoshal, 1998: 244).

In the context of ecosystems, the SNA metrics, such as centrality, density, connectivity and clustering within the network, allow for quantitative analysis of the ecosystem and the roles of its individual nodes (organizations and individuals). Those metrics can be seen as a means for describing the structure and character of whole ecosystem as well as those of its elements, as these metrics describe the business context in which new companies are growing. It should be noted that, initially, clustering co-efficiency was considered a characteristic of an individual actor as it describes the "how my friends are connected to each other". However, it can be also been seen to describe the connectivity of the structure, which is why it is now categorized as an indicator of ecosystemic structural capital.

The initial framework, which emphasized SNA metrics as means for describing the structure and character of whole ecosystem as well as those of its elements, can be seen to respond largely to the networking potential of relational capital. This initial framework contributes to understanding "customer loyalty and reputation", for example by revealing the most connected individuals and organizations— and making it possible to add the attribute of connectedness to reputation. Network metrics add an additional perspective into measuring relational capital, essential to understand the network effects of customer loyalty and reputation (Molodchik et al., 2014).

Table 3: Measuring ecosystemic relational capital (Still et al., 2014a; Russell et al., 2015)

		Snapshot	*Ecosystemic relational capital*
STRUCTURAL *Structure and character of the whole ecosystem*	Types of actors present	The similarity of actors present (homophily/heterophily)	The size and composition of the ecosystem
	Quantity of actors and ties	Number of nodes Number of edges	Ratio of edge-to-node: number of connections between nodes in the ecosystem
	Density	Represents how tightly the network is connected	The actual interconnectedness in the ecosystem relative to the potential interconnectedness
	Clustering co-efficient	The level of connectivity between the directly connected partners	Average clustering coefficient: showing: The ecosystem's overall connectivity based on local relationships
	Major component	Size of the main component Percentage of nodes belonging to the main component	% of nodes: showing the cohesion to belonging to the largest group of the ecosystem
ORGANIZAT. AND INDIVIDUAL *Structure and character of ecosystem elements*	Degree	Indegree (the number of incoming connections) Outdegree (the number of outgoing connections)	Average degree: average number of available connections per entity
	Betweenness centrality	High betweenness centrality that a node has a connecting role as bridge between the different parts of the overall network	Average betweenness centrality: showing the availability of bridging relationships across the ecosystem

4.1 Understanding networks of relational capital with the Ostinato Model

A data-driven approach toward understanding and measuring relational capital and its elements described in this paper is largely dependent on the data as well as on the methods of "making the data speak". Although SNA typically visualizes networks in two-dimensions, real world social networks are multi-dimensional and have multiple foreground-background alternatives. The choice of boundary conditions, data, metrics, and sense-making perspectives

depends on the objectives of the analysis – canonized through the Ostinato process which uses an exploration-automation cycle for a user-centric, process-automated data-driven visual network analytics (Huhtamäki et al., 2015).

As much of the data (from web sites, social media sites) is socially constructed, rather than officially curated, its provenance and quality must be understood (Still et al., 2014b). Raw data that is harvested across various sources, online and proprietary, as required by the case context, is refined and curated to create a coherent and consistent dataset about relationships in the ecosystem that provides a solid base for the analysis. Boundary conditions are used to sample from this data, metrics are selected, network representations of the underlying structure of an ecosystem are created, and the sense-making process is inacted (Huhtamäki et al., 2015).

To present the data as a network and its metrics in a visual form, a set of tailored batch-processing tools in Python is used. These tools compile the source data according to the boundary specification, create the network and calculate metrics. To explore and visualize the networks, we used Gephi, an interactive network analysis platform that implements a core set of key functionalities for visual network analytics (Bastian, Heymann and Jacomy, 2009). These network layouts were created using a force-driven algorithm in which nodes repel each other and edges pull the connected nodes together (Noack, 2009), revealing the spatial structure of relationships. Color-coding has been added to differentiate node type: red shows companies; green shows finance organizations; and blue shows key individuals (founders, C-suite, board members.) In a graph theoretical perspective, force-driven layout reveals the macro-level structure of the network including the key clusters, the key brokers in the network as well as possible structural holes (Burt, 1992).

Both actor (node) and network (ecosystem) level metrics can be calculated, and the data is analysed in service to the analytical objective, followed by facilitated sense making and storytelling through visualizations of the networks structure. As fluency with network metrics is just emerging for policy makers and program managers, sensemaking through storytelling is essential to engage the analytical thinking for practical applications. Without context, SNA metrics as stand-alone numbers can be difficult for the lay person to understand. Discussions with stakeholders about the meaning of the metrics has provided the additional benefit of illiciting additional considerations from practitioners, considerations which can refine the analytical boundaries and selection of metrics, catalyzing a user-oriented iteration cycle in the Ostinato process.

4.1.1 SNA metrics

Metrics provide quantitative measures for comparison and analysis. In one use case, showing some SNA metrics for case Finnish ecosystem based on multiple data sources led to engaged discussions with analysis about insights related to the ecosystem. However, when multiple datasets are used (Dataset 1 concentrates on startups, their key individuals and angel investments; dataset 2 on growth companies, their key individuals and investments; and Dataset 3 on deals and alliances), sense-making discussions must include detailed understanding of the source and quality of the data, in order to avoid misleading deductions and guide defensible insights (Table 4).

Table 4: Presenting sna metrics of an ecosystem (Still et al. 2013a).

Network metrics	Dataset 1	Dataset 2	Dataset 3	Aggregate dataset
Density	0.002	0.002	0.007	0.001
Diameter	15	18	4	16

Context can be added to the metrics, for example showing the top ten lists of actors—individuals (such as Ind-PK) and companies (such as Mendor) within the Finnish ecosystem case. The actors who have the highest betweenness centrality can be seen to have key connecting roles within that ecosystem, highlighting the significance of certain specific actors within the various levels of Finnish ecosystem as well as in the aggregate, composite ecosystem (Figure 1). Hence, this example revealed that the same actors play significant roles in the various levels of the ecosystem.

Top 10 actors based on betweenness centrality	Startup Sauna Nokia Ind-PK SunyRide Ind-KB Ind-TT Transfluent Ind-JE Ind-AK Ind-VM	Nokia Ind-PK Ind-TT Ind-JE Applifier Mendor Finnish Industry Investment WOT Services XIHA Tinkercad	Nokia Nokia Siemens Networks Wartsila Metso Kemira Finnair Microsoft Outokumpu Stora Enso Ilmarinen	Nokia Ind-PK Startup Sauna Ind-TT WOT Services SunyRide Ind-JE Mendor Ind-AK Ind-KB

Figure 2: Adding context to SNA metrics: case Finland (Still et al. 2013a)

When the SNA metrics are based on the same dataset and similar analytical procedures are used, comparisons are justified. In the use case comparing three metropolitan ecosystems of Austin, Twin Cities and Paris—concentrating on data about growth companies, their key personnel and their financing, in those areas—the metrics contribute to insights about ecosystemic relational capital (table 5). Furthermore, as the analysis was designed for supporting regional decision making and regional policies, the traditional SNA metrics were explained with terms more familiar and relevant for that specific context. Hence, the measurement of degree was called "relational potential", referring to the number of available connections that could be leveraged (Russell et al., 2015).

Table 5: Allowing for comparisons between cities (Russell et al., 2015)

Relational Indicators	Network Metric	Austin	Twin Cities	Paris
Profile	Number of Nodes Number of Edges	2501 2193	1358 978	1405 1102
Engagement	Ratio of Edge to Node	0.88	0.72	0.78
Relational Potential	Company Avg Degree Finance Org Avg Degree Individual Avg Degree	2.89 1.76 1.03	1.94 1.35 1.05	1.88 3.12 1.07
Vitality	Density	0.0007	0.0011	0.0011
Linking Factor	Average Betweenness Centrality	0.0022	0.0018	0.0002
Embeddedness	Main Component # nodes % nodes	 1132 45	 190 14	 428 30

Furthermore, with the developments of network metrics over time, the ecosystem dynamics related to the metrics can be presented. For example, the evolution of degree and betweenness centrality over time for two companies (Nokia and Microsoft) using two different datasets between the years of 2000 and 2013 makes the dynamics visible (Figure 3). The visual representation highlights that as networks evolve, so do their metrics, providing insight about the relational capital of a single organization in its larger ecosystem.

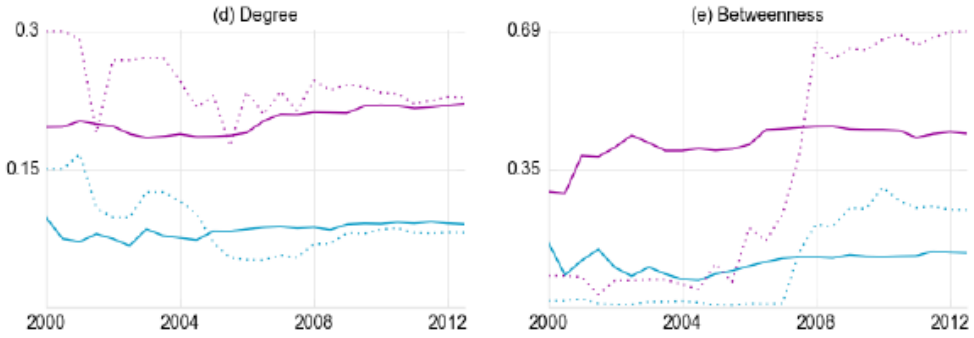

Figure 3: Showing developments of metrics over time (Basole et al., 2015)

4.1.2 SNA visualizations

Visualizations of social network can emphasize the context and draw attention to key metrics for explaining relational capital. Especially for large networks (generally the case for social media networks), the visual presentation of metrics resulting from large datasets becomes crucial. Through visualization techniques, SNA makes relationships visible, revealing the social structures of the relationship phenomena, but also facilitating communicating about it and sharing insights (Freeman, 2009). The visualization of complex data enables decision makers to see patterns, spot trends, identify outliers, and thereby improve comprehension, memory and decision-making (Tufte, 1983). Coupled with the development of tools and computational power, the possibilities of visual network analysis are vast.

For example, an analysis of socially constructed data telling the story about the start-up scene in Finland (figure 3) shows the connections between the actors—companies and press-worthy individuals and financing organizations — of the ecosystem (Still et al., 2013a). It is not surprising that Nokia is a key actor as people previously associated with it are now taking active roles in other companies, either through employment, financing or advising roles. What is notable, however, is the fact that Startup Sauna also has a prominent relational capital role: it is a student-lead initiative for business incubation and acceleration, which connects to a number of start-up companies. Both of these key actors can be found easily from the network visualizations, and their direct relationships can be identified.

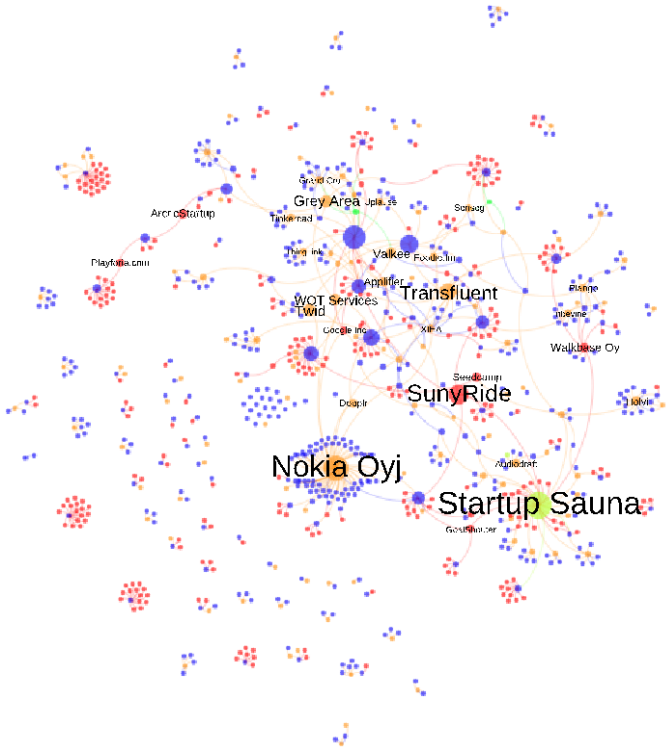

Figure 4: Network visualization insights for relational capital (Still et al. 2013a)

Another example explores the insight potential of comparing alternative visual representations of data drawn from the same datasources, using similar analysis and visualization approaches, but sampling the data at various levels of the ecosystem. In the case of three metropolitan areas, the visualizations highlight the cumulative relationships present in the ecosystem at the growth level (Figure 5). In addition, as the human eye excels in seeing patterns, we can see that the amount of green (presenting the financial organizations and relationships to and from them) is proportionately different in each of the metropolitan areas.

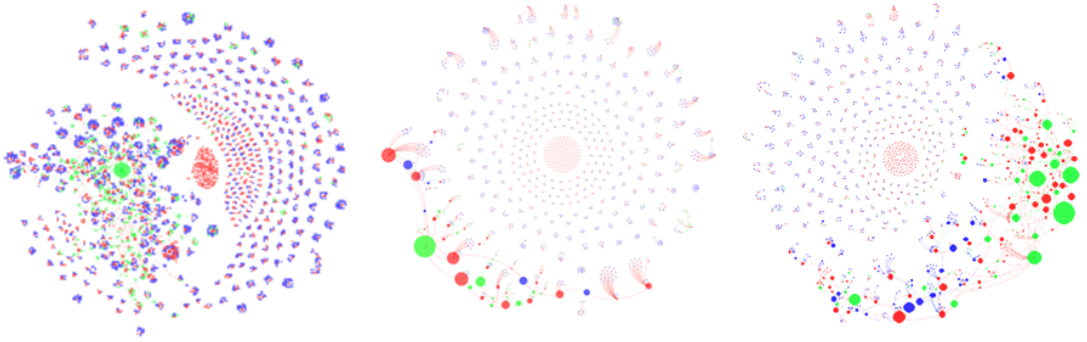

Figure 5: Visualization of comparing three metropolitan ecosystems (Russell et al., 2015)

4.2 Customer loyalty and reputation with social media analytics

With the possibilities awarded by the availability of social media data about relationships, the approaches of social media analytics enhance the inclusion of the "customer loyalty and reputation" component. The example of Klout (Stone, 2012), usually seen as a characteristic of an individual, can be seen as a prominent example of measuring the online reputation.

There is an increasing trend toward using monitoring tools to search, track and analyze conversations and interactions of the large volumes of social media. A well-known understanding of the functionalities of social media is the honeycomb-approach, which lists identity, presence, relationships, reputation, groups, conversations and sharing as the seven building blocks constructed to allow making sense of how different levels of social media functionality can be configured (Kietzmann et al., 2011). Though many of these functionalities contribute toward better understanding of relational capital, one of the most relevant functionalities is reputation, the extent to which users know the social standing of others and content (Kietzmann et al. 2011). Its implication is for monitoring the strength, passion, sentiment, and reach of users and brands.

Toward understanding the reputation of some Finnish companies (all participants in the Finnish program for supporting their growth), the number of their twitter followers was analyzed and presented with the distribution of the twitter follower count (see Figure 6). It showed that some Finnish companies (namely Microtask, dealdash, Web of Trust, and Sportstracking) have significant numbers of twitter followers: Microtask more than 30,000; dealdash more than 10,000 (Huhtamäki et al. 2012), hence highlighting reputation, the attractiveness of these companies from the public perspective.

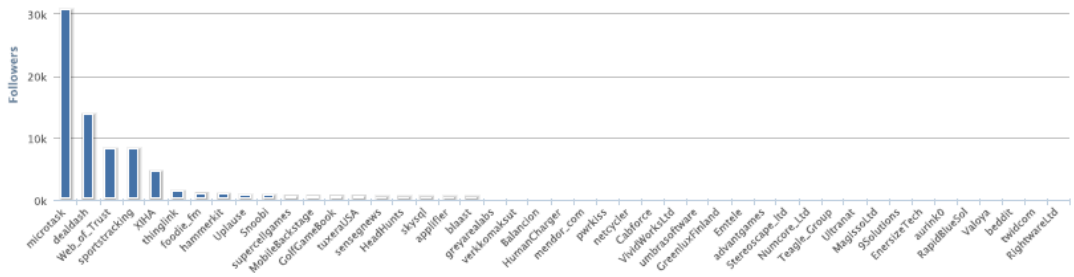

Figure 6: Social network analysis insights for relational capital (Huhtamäki et al 2012)

5. Discussion

We have emphasized that in this networked world relationships are not just within the one organization or from/toward that organization—that many levels of types of relationships do exist in the ecosystem, that they need to be orchestrated upon for knowledge flow and value creation, and that they can be quantified using social capital measurements (Feltham and Zoller, 2012). In addition, we show that there exist volumes of data about these relationships, especially in the realm of social media, including a lot of interactions between individuals, companies, technologies and products, and that data can be used to create novel measurements or indicators for relational capital (Figure 7).

For understanding value in networking capabilities, we support using SNA metrics, according to the initial framework and process of ecosystemic relational capital (Still et al., 2014a), elaborated in this paper to better communicate and explain its applicability. For further improvements in SNA metrics, we propose using and presenting these metrics in their context as well as using network visualizations to make the ecosystem visible and concrete. For enhancing the initial framework to extract elements of customer loyalty and reputation, we propose the use of social media analytics, which have been demonstrated in measuring online activities and content.

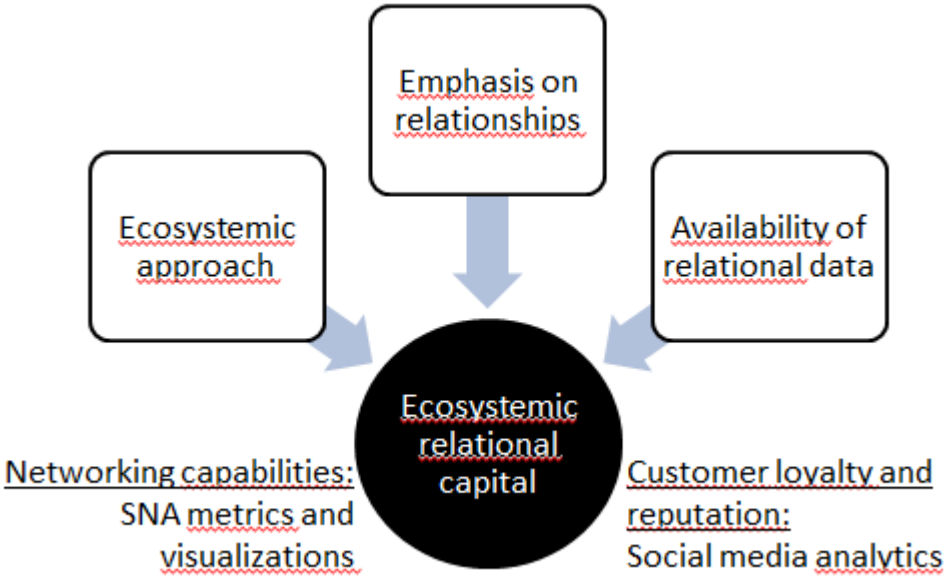

Figure 7: Elements of ecosystemic relational capital

In this paper, we emphasize that these ecosystemic relational capital indicators provide novel ways of understanding and presenting the value of relationships. Hence, though the concrete use cases described in this paper use large volumes of relational data available from social media type data sources, the illustrative metrics and their visualizations can also be applied to more traditional data sources (such as data about deals and alliances, or any other relational data). Our motivation for highlighting these new types of openly available data sources is our expectation that they may provide interesting insights into ecosystems or relational capital.

5.1 Implications

In this paper, we are proposing a new set of tools to be added to the toolbox for exploring value in the networked, ecosystemic world. Our examples of relational capital have focused on networking capabilities and their application to the ecosystem context. The metrics—whether standalone, metrics in context, comparative, or dynamic — and the network visualizations contribute insights to understanding and measuring relational capital in the context of ecosystems. Hence, our paper contributes to the continuum for research designed to identify the processes for capital creation, accumulation, dissipation, and consequence introduced by Nahapiet and Ghoshal (1998).

Increasingly, networks are intentionally "orchestrated" or "engineered" by an organizational actor who recruits network members and shapes their interactions, corresponding to phases of innovation ecosystem building and management (Ritala et al., 2013). Network orchestration, the ability to connect and manage competences across a broad network of relationships, has been recognized as one of the most important meta-capabilities for a networked world (Wind et al., 2008). Previously, some of the stakeholders identified to benefit from network orchestration and its enhanced regional intellectual capital formation include venture capitalists, policy makers and employers' federations and citizens' interest groups (Schebesch et al., 2014).

We see that relational capital insights can contribute to network orchestration by:

- Presenting the "big picture": making visible the complexity of relationships, simultaneously noting that not all actors nor all relationships can be represented. Still, patterns in the big picture can provide a shared mental model (whether with metrics or their visualization), which can then be used for sensemaking, discussions and shared vision within an ecosystem.

- Presenting beyond the "business as usual" ecosystem: showing the emerging actors and their roles. Though data from openly available online sources may not be official, validated or complete, it can be very timely and hence powerful in highlighting emergent patterns in the existing ecosystem - newcomers and their relationships—or the lack of relationships.

- Presenting comparisons between ecosystems: providing new ways for describing, comparing and possibly benchmarking ecosystems. For example, network density has been acknowledged as an institutional variable for innovation (Zoller, 2010).

By making the relationships visible, we see that the relational capital insights support the third dimension of social, labelled "the cognitive dimension" by Nahapiet and Ghoshal (1998), referring to those resources that provide shared representations, interpretations, and systems of meaning among parties. Hence, we propose that like "a minimum viable product" in rapid iterations of product development, business success may be enabled (Ries, 2011) by having a "minimum cognitive dimension" within an ecosystem – to align expectations and drive transformation.

5.2 Limitations

We do not suggest that these novel measurements are stand-alone solutions but rather complimentary approaches for understanding relational capital, which remains a complex concept and therefore should be treated as such. Though we agree with Kohlhammer et al. (2012) that visualization and visual analytics are vital for informed decision-making and policy modeling in a highly complex information environment overloaded with data and information, we do not advocate using network visualizations as the only evidence for decision-making or policy setting. At the same time, we acknowledge the challenges of boundary specification and overall definition for the ecosystem: what is an ecosystem; are ecosystems regional; are they platform, sector or transaction based? This debate is ongoing as the concept of ecosystem keeps getting traction, and we are looking forward of its implications for defining the relational capital and the relationships that need to be accounted for it.

We recognize that data-driven approaches are always limited by the data itself, its quality and quantity. Some of the advantages of social media include availability, large coverage, timeliness, and community verification of data quality. Some of the disadvantages are potentially erroneous data and public bias—and certainly, some of the relevant data might not be included. We encourage the development of improved methods for managing the volume, velocity and variety of data (McAfee and Brynjolfsson, 2012).

We propose experimenting and widening the use of SNA metrics and especially social media analytics, following the promise of big data and its analysis (McAfee and Brynjolfsson, 2012). For example, we highly recommend expanding

the exploration to other social media data, going beyond the Twitter data of our example. Some further experiments about using Wikipedia data have shown us that a very limited number of companies have their own Wikipedia pages. Hence, for policy making—which is traditionally addressing averages when measuring innovation activities—Wikipedia might not be the best data source for getting inclusive data about companies. However, for policy making concentrating on "superstars" the Wikipedia data source shows promise.

6. Conclusions

In today's global and interconnected world, relationships between multiple stakeholders—created by key personnel and financing — are fundamental. Relationships create value through social capital, which is exchanged as talent, information and financial resources pass between people in organizations (Russell et al., 2011). Understanding and measuring social capital becomes fundamental, and relationship networks in ecosystems provide one way of understanding the patterns of relationship. The ecosystem context permits measuring relational capital in a context that extends beyond social, individual or personal relationships and organizational context, as well as beyond the limitations of the dyadic (one actor to one actor) view on relationships. By proposing constructs and methods to examine the totality of relationships - both at the individual and organizational levels, measuring the structures and characteristics related to individuals, organizations as well as the ecosystem as a whole (Still et al., 2014a) – this paper presents a construct of ecosystemic relational capital, which can be used to measure and understand the importance of relationships in the context of ecosystems. This conceptual framework emphasizes the "networking capabilities" element of relational capital, with less attention to "customer loyalty and reputation. It presents a viable avenue for obtaining novel insights about relational capital, which can be used on consort with other methods.

Using data-driven social network analysis, the abstract concepts of relational capital in ecosystem contexts become visible, enabling discussion, the development of shared understanding and vision. In doing so, we believe significant contributions can be made to improving the quality of complex decisions which face leaders. We invite further elaboration of the concepts and analytical methods and look for enhanced judgment and leadership in addressing complex issues.

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