A Mapping of Intra Research Park Networking
Toward Efficient Utilization of Social Capital in Science Driven Innovation

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...yanks out from the realms of rehearsed responses.

Force you into the present.

Here in the fleeing moment,
your are left improvise

to come to terms with your raw
true Self.

Vagabonding
Rolf Potts
Abstract

This thesis contributes to the advancement on the network view of social capital and entrepreneurship, focusing on science-based innovation by observatory social network research. The study has conducted a survey to construct a network map of and network attitudes in Zulu science park (alias name) located in Sweden. The analysis showed that there were relatively positive expectations to utilize network more effectively and efficiently in their business activity with respect to sharing of research skills and resources, as well as social exchange in particular. Currently, the science park seems not yet to take advantage of the potential momentum of the respondents or bottom-up initiatives where tenants maintain the environment mutually under trust. I discuss the merits and challenges in such resource and knowledge sharing in the business development support and governance as a new way of unique business incubator and science-park management, focusing on networking.

Keywords

Network, Social Network Analysis, SNA, Social Capital, Science-based innovation, science park, Bottom-up approach, Business incubator,
Acknowledgement

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1. Introduction

1.1. Background

There seems science based innovation is in a trouble as science and technology become more complex to make market-viable results. Such innovation requires large resources and knowledge capital in order to set-up a sustainable business (Brindly, 2008; O’Riordan and Davis, 2015; Osborne et al., 2014). Entrepreneurs and her/his teams alone can neither create all resources nor knowledge themselves and often face resource constrains.

Science agencies keeps renewing their innovation systems (Gabriel, 2013). Still, to create new business opportunities in such field, the situation of capital scarce leads to require entrepreneurial teams to exchange resources and knowledge, that is the share of social capital to gain venture’s favorable conditions. An interest emerges to observe their team’s network and networking trait not only from the pure academic interest but also to propose suggestions to groups of science-tech based ventures. For instance knowledge about such networks is important in a science park where resource and knowledge is presumed to be mutually accessible among tenants.

This thesis has conducted an inter-firm network research by mapping the network and networking attitude in two time frames: status-quo and future. The unit of analysis was set to a science park “Zulu” (Alias name) which is located in the Stockholm capital region. The aim is to find possibilities for resource and knowledge sharing and beyond by the concept of networked and bottom-up business development environment using social capital as study lens. Such capital is the set of assets maintained by mutual trust among actors, exploiting for a socioeconomic advancement (Burt, 2000; Granovetter, 2002; Lin, 1999; Putnam, 2001; Woolcock and Narayan, 2000). A story by Leo Leonni, titled “Swimmy” says that a small fish can defend together with many other smalls to the threat by a large one. – telling us that the unfair disadvantage, such as scarce resources can be changed by sharing and combining the ability and learning in mutual trust (Lionni, 1973).

Science and engineering research have been a source of not only invention of know-hows but also innovation that continuously creates new socioeconomic outcome. Bush who contributed the establishment of National Science Foundation in the United States wrote
"products, new industries, and more jobs require continuous additions to knowledge of the laws of nature ... This essential new knowledge can be obtained only through basic scientific research.” (Bush, 1945, p. 5). Forty years later and towards the 1980s, it was argued that science and technology led, linear model of innovation does not apply to the reality well and a new system that has more focus on the market was proposed (Kline, 1985). In recent years, customer focused and (business) architectural innovation seems more successful in rapidly changing market dynamics than pursuing technological newness (Blank, 2013; Osterwalder and Pigneur, 2010). Despite these facts, science and technology-based company still constitute the source of innovation for instance, electric self-driving cars, new recyclable materials as well as yet-to-come space traveling and personalized medicine. Powers and McDougall (2005) find that in science-tech based business, focusing on the university startup, it is important to have work partnerships among the university facility and the entrepreneurial teams. Slack resources from university department gives the vestures further advantages. Still, it is a difficult task to acquire all necessary resource in excess for capital-intensive startups. The communication between business developer's (entrepreneurs' and her/his team's) network and surrounding environment can lead the firms to excel in the market adjustment and learning ability (Newbert, 2005), The network view of social capital calls for continuous acquisition and renewal of corporation's capability by “learning” assets and the combination of their given resources through co-specialization that is in similar context to Teece's dynamic capability. (Teece, 2002 and Pisano, 1994).

1.2. The Zulu research park

In this study, I used and analyzed the obtained data from Zulu science park under the lens of theories of, “social capital and its network view”. The science park of study interest has a feature safety regulated laboratories and office space where new ventures can set-up their research and development as well as pilot plant environment. The institution is embedded in the part of university innovation system around the academia together with a modern business incubator and technology transfer office. The place has been playing an instrumental role for science and technology driven ventures to increase the business viability therefore bridging the academia and scale-up production and services. Zulu (2015 March) hosts approximately laboratory and office for 10 companies and 30 active workers. The selected seven entities for this study are listed on Table 1 with information about the floor story, venture's business phase in terms of business operation
and relative size respectively to other firms in this study. Zulu science park enforce tight security to the building maintaining 24/7 security and the science park only grant access to individuals with an access card and those who are invited for a short time visit. Laboratory and office rooms are allowed to have dedicated key lock and log-insecurity system – as recent thief incident at the vicinity of the science park, the security concern was felt high.

I have chosen social capital as a lens to my study because it emphasizes on the exchange the capitals, resources and knowledge than considering them static. Social capital is often considered as the source of firm's performance and can co-exist with other views in the corporate management for instance, resource-based view to my topic of interests. The network-view of social capital focuses on the exchange of such capital than the assets at their disposable which is often in static (Wernerfelt, 1984). This study made a network mapping of tenants in Zulu science park using the approach used by Johannisson and Mønsted (1997). The work sets a reference point for future network study at Zulu science park by constructing a network map within the organization, and capture the emotional attribute against exploiting network (networking) at the science park. Previously, the network view of social capital is applied to study the interaction between actors within IT oriented incubators in Denmark (Bøllingtoft and Ulhøi, 2005; Hansen et al., 2000). Still, however, little exploratory study, especially focus on “the sharing of resource and knowledge” is conducted under the setting at science park using the social capital approach. In addition to contribution to research in this area, I hope the outcome of this a study is to facilitate the utilization of social capital through their network and improve the performance of tenants pursuing science and technology-based innovation at the science park in general.

<table>
<thead>
<tr>
<th>Firm</th>
<th>Floor</th>
<th>Estimated Phase*</th>
<th>Size</th>
<th>Year Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpa</td>
<td>B</td>
<td>M</td>
<td>Large</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Bravo</td>
<td>A</td>
<td>M/Bd</td>
<td>Large</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Charlie</td>
<td>A</td>
<td>Bd</td>
<td>Middle</td>
<td>&lt;3</td>
</tr>
<tr>
<td>Delta</td>
<td>B</td>
<td>Su/Bd</td>
<td>Middle</td>
<td>&lt;2</td>
</tr>
<tr>
<td>Echo</td>
<td>B</td>
<td>M/Bd</td>
<td>Small</td>
<td>&lt;3</td>
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<td>Foxtrot</td>
<td>B</td>
<td>Su/Bd</td>
<td>Small</td>
<td>&lt;3</td>
</tr>
<tr>
<td>Golf</td>
<td>B</td>
<td>Su/Bd</td>
<td>Middle</td>
<td>&lt;2</td>
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</tbody>
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Table 1: Summary of companies at Zulu science park M = maturing, Bd* = business development Su = Startup-phase. Size of these companies are assigned in relative scale
1.3. Research question

Observing the current status of inter-firm networking at Zulu science park, this work tries to associate the observation to literatures of social capital with focus on “network”. Therefore, ultimately this thesis is to answer the following research question,

“What is the current attitude of social capital networking at Zulu Science Park?”

1.4. Scope and Delimitations

This thesis aimed to reveal the social networking between the individuals at Zulu science park (unit of analysis) by observation of the environment. Particular focus is set on the resource, skill and knowledge sharing within the science park but beyond firm's boundary. Therefore, the task sets eyes on the interaction among randomly selected seven tenants at the Zulu and the management of science park in social capital point of view. The result of this study is considered to be generalizable for a similar environment for instance, university incubators with an interest on science-driven innovation, science parks in Scandinavia and innovation management firms. Another potential use of this work would be for inter-project networking and programmification (Maylor et al., 2006) at a science/ttech-based network-centric organization where their product and service portfolio are broad but maintained as bundle of projects. Overall it is hoped to improve the environment of science-driven innovation in the science park so that resource requiring but limited entities can leverage and take advantage of surrounding network in order for good future prospect.

1.5. Sustainability Aspects

I consider sustainability as maintain and endure in the long term survival from the environment that extend meaning from the ecosystem of biosphere, resource, knowledge in the rapidly changing market. This thesis contributes in direct to the firm's longevity for science-based innovation. This may extend as indirectly to the other environmental sustainability such as to support firms which aims to solve the problem of global warming by science knowledge and surrounding resources as this thesis is to help their business operation with good-will.
1.6. Limitations

This thesis aims to reveal the inter-firm relationship within Zulu science park and to make an implication that such relationship may be useful for the sustainable growth of the science-based entrepreneurship. As the investigation only map the network within the science park, this study cannot resolute the potential opportunities through external actors and organizations for instance, university faculty, open innovation platform, investors and industrial incumbents. I expect that such relationship plays as important role as intra-science park network because of absolute resource and knowledge abundance. In addition, social capital is omni-existent and typically not bounded. University resources are often shared. Without any doubt, combined dynamic capability of such system can be large when properly utilized. Furthermore, my questionnaire based study made toward positive bias as I am negligent to the group of non-respondent. Respondent may be a cluster of network proponent who may seek resource and knowledge sharing opportunity. Still, the questionnaire was collected from approximately 70% of all personnel who have office in the Zulu science park. Therefore, I believe the presenting result reflects the attribute of majority than skewed distribution that may cause biased result. Comparing to the study of matured small and medium enterprises, the nature of startup venture organization is dynamic and expected to be difficult to categorize. As the nature of entrepreneurship can differ by industry, for instance B2C IT firms can embrace “Lean Startup” (Lemminger et al., 2014) but B2B science-driven enterprise may require different development path because of dependency relationship. Therefore, the generalizability of this study can be limited only to similar startup, business development environment and its proximity.

1.7. Outline of the thesis

In the following sections, the academic development about social capital, in the network view is discussed. It puts emphasis on entrepreneurship and networking for such activities. The section develops the network evolution of firms and networking habits and such practice in business incubators. The nature of science park is contrasted to previous studies of the business incubators. After the choice of methodology, research results are extended to an analysis on the network map and networking attitude. With an argument from the analysis, the discussion section tries to establish a connection between the preceding knowledge as well the methodology concerning the network view of social capital. Future work is suggested by further extending implications from the results and
discussion for science and technology based innovation and its vicinity.
2. Networks and Social Capital

2.1. The Network View of Social Capital

Woolcock and Narayan (2000) define social capital as the combination of both tangible and intangible assets held by the individual and close personnel, for example friends and family who can be exploited for the profit or material gain. In other words, social capital is a comprehensive set of resources and knowledge that can be taken advantage of, in order for not only financial capital advancement but social goods such as well-being. Exploitation of social capital must be carefully executed because it does not guarantee positive creation (Putnam, 2001). The exchange of social capital is to be the one important factor to characterize the bond in the society – “The norm and networks that enable people to act collectively” (Woolcock and Narayan, 2000, p. 226). Granovetter (2002) introduce social structure and embeddedness problem by saying that “economic behavior...was embedded in social relations in premarket societies” (p. 69). Social capital is a built upon trusting and trusted others to form a weak network than creating contract based. (Putnam, 2001).

Woolcock and Narayan (2000) continue, among other scholars to build the network view of social capital that emphasized on the bonding between actors in the business activities. Network view champions the activity of omni-directional relationship with surrounding organization and private enterprises for long term co-existence. They phrase “Network can be leveraged...(to) find a potentially more diverse network where...economic opportunities (is) more promising” (p. 223). Therefore, the network and networking are seen as important catalysts in the economic activity in general. Such catalyst is presumed to be most welcome for creating new business startups because entrepreneurs often have to face unfair advantage to build up their business capacity. It is vital to establish a network channel to allocate the resources for materializing/monetizing the “entrepreneurial profit” (Schumpeter, 1934). Knight (2006) mentions that entrepreneurship is a risky operation in ambiguity and uncertainty. Utilization of social capital may ameliorate cognitive barriers, bias and/or to support the entrepreneur team's decision making in the path to shape the teams' stakes into a promising opportunity, hence it results in a sustainable business entity. Furthermore, Birley, (1985) says network(ing) is
the first entry point for startup process because that creates a channel for resources and information.

Granovetter (2002) claimed that “Social relations between firms are more important and authority within firms is less or so, in bringing order to economic life than is supposed in the markets and hierarchies line of thought” (p. 85). Social capital is argued to be inevitable to demonstrate the dynamic capabilities which constitute the firm's adaptability to the market change (Eisenhardt and Martin, 2000). Blyler and Coff (2003) proposed that social capital strengthens the dynamic capability in all phases of firms' activity such as resource acquisition, integration, recombination and releasing. Their view suggests open (informal) social network increases firm's innovation capability by controlling “structural holes” and “network centrality”. The utilization of social network indicates the firm's performance and future survival. The discovery of new network connection as well as gate-keeping the in- and out-flow of social capital improves firm's accessibility to the both tangible and intangible resources because such activity increases the opportunities for instance, referencing and nomination by trusting and trusted others.

Florin et al. (2003) have conducted a quantitative study to measure the performance of startup ventures under the network view of the social capital. They have measure the performance against the credentials embedded in the team's social contacts. Their analysis suggests the use of social contacts increases the performance in the financial gain in pre-IPO entrepreneurship. Embedded social capital has long lasting effect regardless of changing firm's environment such as organizational structure and the world economy - social network and credential is a facilitator to construct startup's dynamic capability in the resource limited environment. The implication matches to the finding by Winborg and Landström (2001) who say that small and medium firms which maintains good network are to grow at faster rate. For example, good relationship with others leads an opportunity for mutual discounts to the knowledge and resources in contrast to ones who pursues asset management through delay payment and rigorous cost savings.

Social capital is influenced by the cultural embodiment (Burt, 2000; Lin, 1999). Johannisson and Mønsted (1997) have greatly contributed to establish the network view of social capital relating to entrepreneurship context for Scandinavian countries. They have established “Scandinavian” way of studying networking attitude and map of thereof. According to their studies, initiating and managing an own enterprise are considered to be “socioeconomic endeavor”, characterized as an organization and the degree of network
embeddedness. They continue “(Authors) perceive entrepreneurship and venturing as an organizing process of weaving actions into new patterns by way of personal networking...helps us understand...how venture enact when resource and legitimacy are scarce” (p. 116). Furthermore, they tell Scandinavian entrepreneurship is integrated within the economy and social sphere which are dependent on sectional and informal social capital. For instance in Science parks in the Scandinavian region, it tend to have weak contextual personal network and the tenants are more interested in their field of profession than “commercialization products”. These high-tech enterprises are prone to build a network with his/her science and engineering backgrounds.

Westlund et al. (2014) find from the regional study inference prosperity of regional economy to social capital. Fogelberg and Lundqvist (2012) suggest that reconfiguration of resources and networking activities among research groups are important for the entrepreneurship in Sweden. Åsheim and Hårsmar (2014) find that there are numbers of gap between science and technology venture (university spin-off context) and surrounding actors for instance investors. Social capital is a catalyst to exercise firms good performance (Winborg and Landström, 2001). The importance of social capital, or simply the entrepreneur team can benefit on the venture's performance to assure the firm's long term survival and their future.

2.2. Network Evolution of the Firms

Preceding research shows further the importance of network that can be spurred from social capital in the entrepreneurship activities. It is known that the founder's pre-startup network influences in the early stages (Hite and Hesterly, 2001). They have studied the evolution of inter-firm network and discussed that start-up companies adapt the networking strategy to be more robust in uncertain economic environment. Starting from “identity-based” networks in the entry phase, the network evolves to “calculative” as firm becomes an established entity. Identity-based network is ego-centric and often a group of friends and family who are embedded in per-venture relationship. It is more path-dependent from the personal history of startup teams. On the other hand, calculative network is a network actively managed by the startup teams which the contact is selected by the opportunity cost and proactive management so that the firm will fit their needs. Hite and Hesterly (2001) mention that co-evolution with multiple firms guides healthy venture growth. In other words, firms can play different variables to test and improve their business network for the pursuit of their future successes together with others. Pirolo and
Presutti (2010) find that balancing the use of weak tie and distant-time among organization such as beyond-the-industry alliance and casual conversation affect the startups' performance and growth. They have drawn the same conclusion as Hite and Herterly that co-evolution of firm with extensive networking is important during the organization's life-cycle. The study has shown that entrepreneurs' team, whose network is rather lose and unbounded may have better business development opportunity through spontaneous knowledge-spillover as suggested to for a source of high-impact innovation (Acs et al., 2009; Karlsson and Wigren, 2010; Valente, 1996).

Hughes et al. (2007) report that networking within the business incubator raises competitive advantage to the business ventures. They phrase “Firms destiny lies in the hand of their combination of strategic networking activities” (p. 154). In their view, excess pursuit of competitive edge by stand-alone firm is no longer practical in the complex economy and call for economizing resources and knowledge with partners for sustainable business. The construction of trust network creates social value therefore, supports their capability of not only the one entity but the firms within the network as combined force by resource and knowledge pooling. Hughes et al. (2007) recommend the management of business incubation to support and balance the venture's back-up proactive actions - the rigidity-networks may create negative consequence. Business incubator/science park is a conglomerate of firms aims success in the market business. As tenants are physically located close, such institutional setting can be used as a platform for ventures to increase network density and radius without large burden. Especially when the incubator users share origin in their social capital for instance, regional culture, university education and previous professional experience, the barrier to create mutual network is expected to be low. Therefore, the use of social capital through networking is expected to be well-observable (Woolcock and Narayan, 2000).

2.3. “Science Park” and Networked Business Incubators

According to Campbell and Allen (1987), the origin of the modern business incubator and science park is rooted in United Kingdom that art designers have created experimental “working community” similar to shared office in 1972. Through 40 years time, such community was utilized in various forms, for instance “community workshop” at which in the beginning, was founded to assist creating new business therefore jobs to support human resource redundancy as well as a part of city re-development. The origin of
science park seems to have a root in initiatives by National Science Foundation (U.S.) and Standford University. They introduced an institutional instrument to assist technology transfer of university experts' knowledge to commercialize the technology. Bruneel et al. (2012) find such business development instrument has kept evolving as a mere office sharing site (0/1st generation) to a place proving a coaching and training (2nd generation) towards the 3rd generation that is swiss-army knife like business supports including a support to legitimacy and financial networks. Bergek and Norrman (2008) contributed to classify the business incubating environment in Sweden.

Bergek and Norrman, (2008) distinguished science parks from business incubator that science park typically tend to have portfolio with more matured companies which has product and service offering based on new but reproducible technology. On the other hand, Johannisson and Mønsted, (1997) said “...science park as a collective...bridge between university and business community” (p. 125) for academic entrepreneurship which require an assistance to develop a business model. Lindelöf and Lōfsten (2003) as well as Lōfsten and Lindelöf (2001) made little distinction between business incubator and science park. This study is to follow the idea of Lindelöf and Lōfsten as business support can be benefit to firms of any phases (start-up, business development and maturity). – I apply the same terminology indistinguishably to the science park to business incubators unless stated.

There was a movement to improve the business incubating environment by theorizing from empirical studies. However, Campbell et al., (2013), Sherman and Chappell (1998) phrase that business incubator should not have generalized management styles as if “operation” because systemic management will discourage the motivation of entrepreneurs and is to be a disturbance to creative innovation. Lindelöf and Lōfsten (2003) wrote that science parks should avoid deducing general management practice based on “successful” cases which is difficult to set the criteria for (Grayson and Culshaw, 1993). Every startup has different purposes, vision, departure resources and surrounding networks. These embedded values are otherwise influenced by entrepreneur team’s intangible asset and obtained through their networking. Both business incubators and science park physically put firms in close distance to each other in order to facilitate the ease of social capital interaction.

Hansen et al (2000) has proposed a framework of “networked business incubators”. In their view, such an incubator can integrated the “scale and scope” of industry incumbents and well-spirited startup ventures. Extensive networking and supporting
institution can create mutual benefit by weakly constructed “virtual” firms in other word an organization as if “Swimmy” which fended off large predator fish by mocking larger ones with many small fishes (Lionni, 1973).

Bøllingtoft and Ulhøi (2005) published an empirical study of networked business incubator in Denmark. In their six month research, they found social network was utilized for business, “daily problem” and personal and this activity is argued to raise more opportunity for synagetic activities. It has led to realize bottom-up governance such that tenants are inherited to make decision making about incubator programs along which their business development therefore the management decision is made as a case basis than following a manual. Top-down style networking activity such as “organizing event” was less effective compared to network started from small conversation. In bottom-up governance, tenant candidates are to be evaluated by current tenants than evaluation criteria attributed to investment scale, business scalability and candidate’s previous track records. “Trust” facilitates the formation of network and network incubator therefore to enrich the social capital which extends from barrier by business focus area and/or individual competencies. Neergaard (2005) lists such practice may help the process of start-up recruitment, fund raising and joint marketing. Further study by Bøllingtoft (2012) phrases that “bottom-up (networked) incubator is based up on...positive attitude towards sharing knowledge and experience with others....(and) cooperation instead of competition” (p. 309). Extending the argument, good amount social capital: trust can voluntary help to form a bottom-up and networked business development environment (and such environment can be only maintained by social capital itself. - “(In)...difficult relationships characterized by mistrust and mistrust ad malfeasance, they can simply move on to the legion of other traders” (Granovetter, 2002, p. 71)

2.4. Intra-Firm Mapping by Social Network Analysis

Social network analysis (SNA) is a tool frequently used to capture the snapshot of social structure for instance, relational tie among individuals in a group and interaction between organizations. Social networking analysis is a method to reveal and understand the interaction between actors in the organization of interest (Nicolaou and Birley, 2003; Scott, 1988). The tool is rooted from social network studies but modern graph theory by Barnes in the 1950s. In the social network representation each actor are plotted as a node (a place where networking starts from and terminates.). These nodes are connected when
network criteria is met for instance, friendship, knowledge sharing as well as transfer/exchange of tangible resources. Such “point to point” representation allows social scientist to conduct the strength of relational ties and estimate the power in the bounded network, for instance identifying and/or discovering hidden gate-keeper who may not be revealed otherwise in the rank structured organization. The social network analysis is characterized by an idea that individual actors is to form a group instead of defining people in prior to the analysis. In addition, the analysis focuses on the strength and the exchanged items between the nodes connected by edges. SNA aligns the methodology in the network view of social capitals. Mathematical formalism on SNA is avoided for this study; basic properties frequently used for SNA are summarized in Table 2.

An example of SNA is constructed on Figure 1 by using open source data about the story networking about Les Miserables. The graph representation can reveal the connection between actors and find a lead to the actors who play a central role in the bounded network for instance, not only novels but also inter-organization. As SNA put a point of view to individuals, the methodology reveals social connections. And it often finds difference to the organizational hierarchy which may be a useful tool to see the insight of firm dynamics and hidden corporate strength and weakness.

<table>
<thead>
<tr>
<th>Terminology</th>
<th>Brief Explanation</th>
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<tbody>
<tr>
<td>Node</td>
<td>Node is a point representing, individual or organization who leverage the network through interaction with others. Node can help exchange of others between as a broker, for instance.</td>
</tr>
<tr>
<td>Edge</td>
<td>Edge represents the connection and pipeline between the nodes. Edges can have different property by node's ego, resource and knowledge. Degree is a number of connections to and from the node. When the edge is toward the node of interest, it is called in-degree and out-degree for out-bound connections. Larger number of in-degree can present the node is being reliable, gate-keeping roles on the network. On the other hand, large-out degree may indicate an active networker.</td>
</tr>
<tr>
<td>Degree</td>
<td></td>
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<tr>
<td>Eigenvector</td>
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<td>Centrality</td>
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<tr>
<td>Betweenness</td>
<td>Betweenness is the property to present the role of a node of interest that how many other nodes relies on to connect each other. Large value may indicate the node has gate-keeper like property.</td>
</tr>
<tr>
<td>Cetrality</td>
<td>Structural hole is a region of network that yet-to-be connected otherwise (two) nodes need to go around the large edge distance path to reach or may not even connected yet.</td>
</tr>
<tr>
<td>Structural Hole</td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td>Density presents the actual degree of nodes per possible pairs surrounding to the nodes. High density indicates the node is well-know and connected, to be a part of dense network.</td>
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</table>

Table 2: Terminologies often used in social network analysis
Figure 1: Example of SNA. The graph was constructed according to the character’s relationship appears in the Victor Hugo’s novel: Les Miserables. The data was sourced from open source found at Gephi (http://gephi.github.io/users/quick-start/). As Veljean as the main character, it can be seen that multiple actors are connected through him to other important actors, leading him to have high eigenvalue centrality,
3. Method

The study was planned and conducted to observe overall inter-firm network within a science incubator in Nordic states in order to set up a reference point for future studies. The methodology was structured mainly from a social capital framework by Burt (2000), Lin (1999) and Johannisson’s Scandinavian research in entrepreneurial networking through social capital perspective (Johannisson et al., 2002; Johannisson and Mønsted, 1997).

Burt (2000) suggests that the key to revealing social capital is hidden in the network of individuals. Observing the strength of network stems from each individuals and the strategic location, one can observe “structural holes” and bridges where one can take advantage to reach desired skill, knowledge and resources. In contrast, Lin proposes social capital measurement that replies on resource embedded in the ego by each individual against her/his social status. Lin (1999) recommends combining the both views of social capital (network) measurement: embedded resource and network location. A questionnaire was therefore constructed to capture some degree of ego (not presented for privacy concern) and strength of bridges between the individuals presented to affiliated/employed companies. Johannisson and Mønsted (1997), who greatly contributed to structure the entrepreneur networking, comments accordingly from direct quote:

“Dynamic network is ...giving rise to a bias toward stable structures in empirical network research...since networks are based on tacit knowledge, they are not easily uncovered in interviews...Personal connection represent a secret strength that should be protected from inquiring researchers.” (p. 118)

This study respected this guideline therefore; research data was collected through questionnaire from individuals who voluntarily participated. In order to maintain the privacy of the individuals, this work masked participates with their affiliation entity but untraceable ID numbers by accepting several disadvantages. For instance, the survey can only generate a map of network in low-resolution. Therefore, information such as gate keepers, structural hole and inter-firm network bridges are not revealed but the peers (nodes) were set as “firm” but superimposed by individuals participated the survey. In addition, presenting study decided to use dummy names for the result and discussion.
section. This process was necessary in order to the thesis to be presented neutral perspective so that the study does not infer any performance evaluation of firms at Zulu science park.

Questions in the survey were constructed in order to create a network map within the Zulu science park in the current state (T = 0) and attitude towards the future development (T = + 1) (Appendix: questionnaire). For instance, I have asked questions if the respondent utilized others research resources to establish the current state T = 0 and nearly identical question was given to see if the respondent’s expectation toward extended inter-firm network and networking practice in T = +1. The data for social network analysis was constructed from reply from Question #4. The question asked to chose 3 companies in familiarity order. Multiple sub-questions were given such as how many people the respondents know currently (T = -1/0) from the selected company in four scale, 1. None, 2. A few, 3. More or Less and 4. About All. Familiarness of product and service portfolio was questioned in similar manner (3 categorical levels: 1.No/Little, 2. More or Less and 3. Very Much). The sub question continued to see the degree of resource and knowledge share currently, otherwise the past (T = -1/0) in two categorical scale (Yes and No). Similarly, future expectation for the sharing scheme was asked to reveal the attitude of respondents in the future (T = +1).

In addition, the questionnaire extended from the mapping survey to see the “static” such as individuals' emotions: happiness, care, fear and adequateness (Question 5). The question asked the participates to chose unlimitedly from 12 adjective randomly placed words which has one of four emotion attributes but in different strength (Appendix: Emotions adjective list). The question also accepted any other words to discover other emotions. Further, questions extended to survey T = +1 perspective whether the participants are interested to hold joint events, for instance, product and service ideas, market and product bundling, research skill and resource sharing and at last, Friday bar and Wednesday breakfast (Question 7). This question asked their interest in four categorical scale, setting 1 as “not interested” and 4 as “very interested”, and intentionally avoided to use “middle” value thus assigning 2 and 3 as unassigned intermediate value. The consideration of Zulu as research and development hub was also asked for the status quo and the future perspective (T = -1/0 and T = +1, Question 3A/3B). Overall, the questionnaire was distributed through face to face, one by one introduction to explain about the surveyor's identity, ensuring this is voluntary participation and have freedom to skip any questions when they are uncomfortable to response. Collection was done through

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a poll box placed in a shared space at Zulu for two and half weeks.

In recent study about entrepreneurial network(ing), Bøllingtoft (2012) and Bøllingtoft and Ulhøi (2005) utilized various source and methodology to characterize the network and networking practice with an empirical immersion surveying, for instance participating in the company meeting and troubleshooting such as bank payment and an Internet server setups for a web-shops. Product and service offer or competitive advantage (Porter and Heppelmann, 2014) by high-tech and science-based entrepreneurship may be created on a secrecy and data requires high security protection. To eliminate any potential risk stems from the information spill, empirical data was corrected only outside the firms, such as during their lunch and coffee break when possible.

In Scandinavian study of the Network, “comparative-static” method was proposed to understand the entrepreneur team's network through the maturity of the study interest. Therefore, qualitative approach was adapted to present the result to lead the discussion in the majority of questions in the questionnaire. I understand that there is an opportunity to use the method to conduct a quantitative analysis. However, acquired data was only used to present “relative” respect than attributing the definitive value to individual entity or personnel. Only analysis was carried out using “categorical variables” as quantitative analysis may cause un-fair bias in the discussion. This work eliminated the use of “weight bias” related to “ego” although this may be valuable information in the social network analysis (Burt, 2000; Lin, 1999; Scott, 1988).
4. Result

4.1. Summary of Zulu science park

The investigated science park (alias “Zulu”) holds the status of 1st generation business incubator because it has relatively weak business support. Administration of Zulu science park is exercised by an innovation officer (part-time) and the place is largely governed under the top-down management from the university administration as well as stakeholder departments – the direction of Zulu has been decided through the discussion between the Zulu representative (mainly only by the officer). Board members who, the latter was assigned from the interest group at the university. At current moment, Zulu does not practice extensive either network or business incubating service as the organization jointly coordinates with other business incubators and university's technology transfer office. The former is 3rd generation type business incubation and provides business support to an initial funding and investment opportunity. The technology transfer office runs a program to assist very early phase of spin-off such as patent and initial marketing research.

Therefore, Zulu stands on a place for science and technology ventures towards the post-incubator phase and even to established entities that look for laboratory platform and/or knowledge access to the university. Zulu is taking a responsibility in more “hardware” and core-resource to science-driven innovation to ensure the safe and controlled R&D environment. In fact, one company has already made IPO and several others look for scaling up their activities. For instance three companies are setting up a production at a pilot factory. Furthermore, other three companies out of eight have formed outside the university in the Stockholm region but either by entrepreneurs' own stakes or spin-off from other knowledge intensive firms within Sweden. This fact indicates that Zulu science park is embodied with a potential for diverse network when utilized the opportunity.

As the company data presented in the introduction (Table1), the size and age of the companies vary remarkably. Company Alpha and Bravo have (had) several office spaces outside the Zulu science park and their technology and business development was started approximately 5 years ago. Many others have still a strong tie to the university. For instance, the entrepreneur holds a part-time research position where he and she seeks an
independence. The tenants' residence at the science park is between 2 - 3 years and similar but smaller figure (22 months) was found to employee as I expect it by new and replacement employment for their business growth. It is reported that the inter-firm network may form from the companies nearby on the same floor (Bøllingtoft, 2012). Zulu in fact has a building with multiple building stories. Companies Bravo and Charlie shares the same floor and the rest of others are on the other floor on which kitchen is located.

The phase of startup(ness) was estimated from company's technology offering at external website and the degree of specialization. Alpha was found to fully satisfy to be categorized as a matured firm as it is a public entity and listed in stock exchange market. They have divisional roles within the company for instance, different roles in R&D, accounting and financing. Corporate vision, strategy and their product and service offerings are well-visible. Bravo, Delta and Echo stands in between matured and business development. The employee's work role shows an indication of work division by tasks. Also, these firms have unique product and service which can be purchased. Others, Foxtrot and Golf have a focused business area to explore industrial application with their verified technology.

4.2. Network Mapping

Due to sensitivity of data, privacy concern and risk of mis-interpretation of result by readers, this section is written without companies name and identifiable data over Table 1.

The survey data from question #4 was drawn as a network map (Figure 2). On the figure, larger yellow circles represent companies and small but light colored circles are the participants (heterogeneous actors). The question asked to chose tenants of others in familiarity order – therefore one response creates one out-degree connection from the individual to one in-degree connection to the selected. Ego, created by the ranking was discarded from the analysis. The depth of colors in the background indicates the (absolute) density of network based up on two-level (Yes/No) questions about previous resource sharing experience (T = -1/0). Similar question was given to know for T = 1 regarding competence match as well as interest to the other's technology that respondent may be capable to offer. Company spheres are allocated to indicate the closeness among the firms, that means circles nearby are likely to have close tie and vice versa.

From the graphical representation, the density of network has one high density center (purple area in Figure 1: Area “A”) and decreases as outwards. No correlation was
found among the companies at the center, for example by the floor level or company maturity. It was found that many of respondent makes the same or similar answer therefore it can be the mere presentation of absolute size by the tenants - the value of “closeness” and Eigenvector centrality cannot indicate the networking performance from this data. Still, however, there has to be noted that company of relatively smaller scale (less than 3 employees) appears within the one the triangle “A” because of large in-degree connection.

Companies appearing in the surrounding of the region “A“ tend to be ones in the phase of startup and business development. Despite the small size of firm (1 – 4 employees, some of them are operated as part-time), these companies receives several in-degree connection from others to be a part of the network in Zulu science park. However, it is interesting to note that small companies are rather divided by the high density center. Considering that 70% in reply rate (n = 20 in which 28 people identified as the office user), young start-up firms in the science park may tend to seek network toward larger network density as they are supposedly to hold larger amount of knowledge and resrouces. Firm’s co-evolution would happen more often with entity of different size with potential preference in one in different phase of business startup at least in Zulu science park.

Figure 2: The social network (heterogeneous) map in the Zulu Science park, generated by data at question #4. Large circles in yellow represents the company and small dots are the questionnaire respondents. Purple color indicates high network density and it gradually fades at its outskirt (green). Three company enclosed a triangle “A” seems enjoying networking activities as the network density and degree is both high. The author holds the image rights
4.3. Inter-Firm Networking - Emotional Attitude (T = 0)

Generally, a positive outcome was found in the attitude against the use of network regarding to their work, especially about know-how to the R&D activities. In order to focus the response regarding to the context of innovation and social capital, the question was given with example of “advantage” and “disadvantage” by the share of work-related information. The response (question #5) found emotions attributing to “Happiness” and “Care” at moderate degree. Respondents explicitly have chosen “happy” and “trusting” in 30% of the time to suggest that personnel in Zulu already utilize network and share social capital with each other whether they noticed it or not (Table 3). Still, there was significant concern to “usefulness” of sharing information within the science park. For instance by 35% of time, the study observed “uncertain” (unfortunately it is difficult to say “information sharing is uncertain to be useful” or “uncertain to judge their emotion”). Interesting to note, few participants marked emotion value related to “fear” thus, personnel in Zulu science park possess rather proactive and open attitude for new dialog about their work, know-how and technology, indicating there is “trust” and “joy”.

4.4. Inter-Firm Networking Attitude (T = -1/0 towards T = +1)

In the Questionnaire, it asked about an opinion if Zulu science park is a platform for research and development activities beyond the entity’s boundary (question #3A/B). The response for T = -1/0 was found neutral that similar amount of people answers that whether scale 2 or 3 that is value in between “Not at all” and “Very much so”. This indicate questionnaire participants consider the science park as space sharing space or the first generation business incubator. They have taken little advantage of economies of scope or scale in terms of resource and knowledge capital utilization. In contrast, the response for T = 1 moves the direction positive toward value “Very much so” and “3” indicating a potential for economizing their resources by forming a research hub (Table 4).

The same trend was seen from other company specific questions (Question #4) that asked respondent to rank the familiarity of other firms and indicate the previous experience in sharing work-related resource and knowledge as well as interest to contribute such in the future (Figure 3). It was found that the survey participants are willing to interact with a company of less familiar in T= 1 in relative to the most familiar company. According to the data, 45% of respondents have experience in such sharing with the company in the 3rd rank (T = -1/0). But the value increases to 85% for question
regarding to $T = +1$. This fact indicates that expansion of network in the science park is weak but has potential to extend by spontaneous information spill-over (Figure 4). I have seen the same positive perceptions that towards $T = +1$ in another question that the majority of respondents is interested in resource sharing initiatives and social events such as “Friday bar” and Wednesday breakfast shows potential to the success perhaps by bottom-up approach driven by tenant's interests (Figure 5).

<table>
<thead>
<tr>
<th>Emotional Attribute</th>
<th>Strong</th>
<th>Frequency n=20</th>
<th>Middle</th>
<th>Frequency n=20</th>
<th>Weak</th>
<th>Frequency n=20</th>
<th>Sum Frequency (value &lt; 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happiness (+)</td>
<td>Delighting 0.05</td>
<td>Happy 0.3</td>
<td>Fine 0.4</td>
<td>0.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Care (+)</td>
<td>Compassionate 0.05</td>
<td>Trusting 0.3</td>
<td>Appreciative 0.3</td>
<td>0.65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fear (-)</td>
<td>Horrifying 0</td>
<td>Afraid 0</td>
<td>Anxious 0.05</td>
<td>0.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inadequate (-)</td>
<td>Useless 0</td>
<td>Ineffective 0</td>
<td>Uncertain 0.35</td>
<td>0.35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>Helpful 0.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 3**: Emotion attributes. Number of positive words appears from the selection for example trusting and appreciative. In contrast, negative words, presents fear and confusion. The list was constructed from question #5.

<table>
<thead>
<tr>
<th>Asked items</th>
<th>Not at all Value 1 (Freq.)</th>
<th>Value 2 (Freq.)</th>
<th>Value 3 so (Freq.)</th>
<th>Very Much so Value 4 (Freq.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D Hub $t = -1/0$</td>
<td>0.1</td>
<td>0.5</td>
<td>0.4</td>
<td>0.0</td>
</tr>
<tr>
<td>R&amp;D Hub $t = +1$</td>
<td>0.0</td>
<td>0.2</td>
<td>0.6</td>
<td>0.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Asked items</th>
<th>Not interested Value 1 (Freq.)</th>
<th>Value 2 (Freq.)</th>
<th>Value 3 (Freq.)</th>
<th>Very Interested Value 4 (Freq.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product and Service Research</td>
<td>0.4</td>
<td>0.4</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Marketing Study</td>
<td>0.2</td>
<td>0.4</td>
<td>0.3</td>
<td>0.1</td>
</tr>
<tr>
<td>Research Resource Share</td>
<td>0.1</td>
<td>0.1</td>
<td>0.6</td>
<td>0.2</td>
</tr>
<tr>
<td>Friday Bar / Wednesday Breakfast</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.3</td>
</tr>
</tbody>
</table>

**Table 4**: The frequency table made by question response about current status and future status about Zulu science park as “R&D hub (Question 3A/B). In addition, in question #7, the attractiveness of different types of events is asked (Product and Service Research, Marking study, Research Resource Share and Social Events). Scoring was made by setting the value close to close to very interested as the threshold to consider proposed event is attractive to respondents.
Figure 3: Respondents’ consideration and future expectation in Zulu science park as a R&D hub. The data was retrieved from the data by question 3A ($T = -1/0$) and 3B ($T = +1$). How would you consider Zulu research park as R&D hub…? (Question #3A/B), four categorical questions with choices, very much so, toward very much so, Toward not at all, and not at all.

Figure 4: Response to the question #4, if respondents are interested in the future resource and knowledge sharing. This plot was constructed from the response at the part of question #3. The question asked, have you share and/or knowledge with selected others? ($T = -1/0$) and are you interested in to do so ($T = +1$)? in yes and no basis.
Figure 5: Response to the question #7 about the interest to future gatherings at Zulu science park. The respondents are asked if interested in the networking events with specific agenda such as product and service by ideation (most right), marketing studies (2nd right), skill, resource and knowledge share (3rd right) as well as social events (Friday bar and Wednesday bar), (left). Value was assigned, 1 as not interested, 2 and 3 as intermediated value and 4, very interested.
4.5. Comment from the conversation and informal interviews.

I have often heard from the respondents saying that “I know some people but I was a bit surprised that I cannot tell which company she/he is working for”. Questionnaires were only distributed within the same building and the majority of the respondents have work experience in Zulu science park for more than a year. This implies that network growth in Zulu is both or either slow and/or happens in informal occasions, for example, over the lunch or coffee table without association to the company. The specialization of work roles and focused technology portfolio may be hindering them to talk about their work. The field of science and engineer are institutionalized. Therefore, constructing collaborative networks may not be easy without own personal networking which fills outskirt of the core resource and knowledge sharing. However, the study have heard some additional positive perspectives about the network itself and networking.

“Companies tend keep to themselves….mingling activities are good. Never know they (personally) cannot help your company, they may know someone who would”.

“It would be fun to have a company presentation day where each company could present one or two challenges to go forward”

Anonymous

“I believe that networking is crucial for new ideas!”

Anonymous

“The university...has the most technical equipment one can need, if you make the right contacts, possibility is probably very big.”

Company Delta

For more concrete opinion and request,

“Friday bar!”

“More conference room!”

Anonymous

“Sending and receiving parcels should be easier. I cannot receive items sometimes and that delays a project delay.”

Company Delta
5. Discussion

This thesis aimed to map the inter-firm network and their network(ing) attitude. In general, a positive spectrum was found that tenants at Zulu science park seem to have a will to adapt more dense network in the future. From the questionnaire replies, the most interest was towards activities such as research skills and resource sharing when compared to commercialization activities such as new product ideas and marketing studies. The result matches to the fact mentioned in a previous study (Johannisson and Mønsted, 1997) that science park tenants tend to show more involvement in their work activity that is research and development. The network view of social capital should support the idea as increased the fluidity of social capital to lead the firms to gain access to new knowledge. Furthermore, the response implies tenants of the science-park seek to utilize their research resources more efficiently as firms have chance to economize their research equipment. It potentially creates co-benefit within the part of network not only for the exchange of social capital resource but also an opportunity to create new capital in a form of tacit skill and knowledge. The idea seems to be supported by the financial bootstrapping study by Ebben and Johnson (2006) as well as Winborg and Landström, (2001). Especially in the setting of research-based firms, (tangible) resource acquisition is a large financial burden. Intangible resources is difficult to find outside the university and knowledge intensive industries. As relation-based boot-strapping has been known as a good indication of the growth in small and medium size firms, the slack resource and skill share is presumed to increase the overall sustainability of science-based innovation companies.

Through social network analysis, I found that the ratio between in and out-degree connection are significantly different company by company. Information exchange and flow is typically asymmetric (Krishnaswami and Subramaniam, 1999). Hite and Hesterly (2001) mention firms’ network cohesion weakens to fill the structural holes and practice calculative network to reach necessary resources and the market. There seems an indication that the firm maturity and mere tenants’ attitude is connected to the degree of imbalance at first look. Perhaps, as firms become more established, the value of in-degree connection decreases due to the work specialization. Therefore, their network becomes locked-in. On the other hand, matured firms are attractive to startup ventures to gain resources and knowledge thus, the value of in-degree should increase. In order to
investigate such in-balance, future studies requires details of social capital embedded in the nodes (individuals) such as skill, knowledge and personal attributes and credential emobedded in their network (Florin et al., 2003)

Reflecting my results to the networked incubator studies (Bøllingtoft, 2012; Bøllingtoft and Ulhøi, 2005; Hansen et al., 2000), I did not find a systematic practice of bottom-up way of science-park governance. But, there seems some indication that the tenants communicate with each other during the daily work to maintain their network capital which is more personal approach than calculative. As the tenants are more interested to take an advantage of group events, it is certain there is a potential to build a momentum with collective bottom-up actions so that they can decide a way to make more efficient, interactive and fun to work. This fact agree with the view by Johannisson et al. (2002) and Johannisson and Mønsted (1997) that is weak tie is more important to the networking and entrepreneurship. I expect this approach will not interfere with top-down science-park and business incubation management as the expected outcome will positively add up to the organizational performance: sustainability of science and technology-based knowledge firms.

Granovetter (2002) says, “(the) web of (social) interaction is mainly what explains the level of efficiency...of new organizational form” (p. 85). Still, however, it has to be noted there will be potential insecurity in bottom up governance. For example, Bøllingtoft (2012) found there was an incident that one tenant has impended other's business within the studied incubator (tenants have already reached the settlement). Thus, the science-park/incubator management should pay attention to embed trust and set a defense for potential mishaps. In addition, heavy reliance on the bottom-up approach may create rather disparity in the shared office. One can argue that partitioning happens as the part of path-dependency in the closed system. On the other hand, such partitioned cluster may increase a chance of unnecessary political conflict as “one” institution/organization – top management should intervene the bottom-up governance to undo “network” to maintain the tie is loose but enough strong to function as a system for group deision making. A number of scholars claim there is no general way of managing science park or incubators. Considering their proposition, further analysis may need a help from organization and behavior scientists, perhaps studies beyond social capital but practical researches such as organic (project) organization (Aiken and Hage, 1971; Tichy et al., 1979), distributed leadership (Gronn, 2002; Horner, 1997; Pastor and Mayo, 2002) and design thinking (Brown, 2008; Brown and Wyatt, 2010) are useful to make the site specific rules and
governance styles. The organic organization seems to match with resource pooling activities proposed by Hite and Hesterly (2001). Distributed leadership raises confidence and satisfaction in governance of bottom-up business incubator/science park. Design thinking could facilitate for creating new ideas and improve the cognitive capacity (trust) of entrepreneur's team and surrounding colleagues.

Moving the focus to the case in Zulu science park, there is a number of risk to share R&D resources. For instance, cross-contamination caused by the resource sharing needs to be avoided with maximum caution as slight impurity can adversely influence in the whole value- (research-) chain. Shared knowledge needs to be validated its reproducibility. Furthermore, addressing to the missing interest towards business and commercialization, university technology transfer office can play a significant role in both hardware (finance instrument) and software setting (awareness to the marketing importance). In entrepreneurship and business world, it is often heard phrases like “think outside the box” (Hendricks, 2014) and “Do not fall love in own product and service ideas” (Merch, 2014). Impacting on innovation is typically created from an idea with association to the outside of comfortable zone (Zwilling, 2014). I think it is important to avoid the situation of lock-in network at any cost because innovation looks for newness from yet-to-configured resource and knowledge and constant renewal to be accepted from the market.

In terms of the measurement, this study refrained from unleashing the full potential of the social capital tools such as social network analysis. Often, I hear from concerns on social network service such as Facebook that personal privacy is a concern for in-depth measurement of the social network (Jones and Soltren, 2005; Steel and Fowler, 2010). In the Internet practice, the use of for instance, cookie and page count can give insight of user's ego without largely noticed. I sense it is more difficult to conduct experiment to ask questionnaire respondents to judge significant others and close but influential stakeholders. I advocate the approach by Johannisson and Mønsted (1997) to study further but calls for building up a support to raise the importance of network utilization for new social capital opportunity. Creating an agreeable environment allows researchers in the simultaneous measurement of embedded resource and network to contribute the advancement of social capital study along improving the firm's sustainable business with surrounding others like “Swimmy” who scared off a large fish with many smalls (Lionni, 1973).
6. Conclusions & Suggestion for Further Research

In this thesis, I have presented a work on the social network map in the Zulu science park and discussed the potential future opportunity in bottom-up networked business incubating environment. The study has obtained primary data from questionnaire of tenants approximately 70 % and informal chatting to carry out to hope the result to minimize bias. Over all result indicated that there is a positive attitude to utilize their surrounding network for future research and development work. Also, the data revealed asymmetric information and resource flow therefore it would may be an interesting contribution to understand its independent variable through logistic regression within the quantitative approach.

I have used the theory regarding to the network-view of capital with a use of social network analysis. The view encourages entrepreneur team to utilize the surrounding network for sustainable resource. Also, the view expanded to see the evolution of firm's network from the business starting phase to matured established entity that is less reliable to the path-dependent network and firm actively modify their network connection to their needs. Networked business environment is to help firms to take advantage of knowledge and resources, those which are otherwise difficult to obtain by the startup their own. Together with bottom-up governance of business development, there seems new opportunity and way to help to relieve the headache of entrepreneurship, resource-scarce environment and lack of business operation know-hows. Distributed “Swimmy” – like governance is to increase the “trust” in the business community. This scheme will take positive feedback to be self sustainable as more social capital shared, network becomes more resilient from unexpected business threats.

6.1. Suggestions for future research

In this thesis, I discussed the importance of social capital and network for resource and knowledge sharing, which can facilitate the firm's sustainable growth. A focus was set on science-based innovation at science park where typically university spin-off otherwise entrepreneurs’ team with the research experience set off their business. In recent years,
there seems emerging popularity in the maker's community where private groups form a bottom-up DIY (Do-It-Yourself) shared workplace. For instance in Stockholm region, “Makersplace” defines themselves very similar line to 1st generation business incubator but aims science and technology innovation in interests basis than business ambitions from the disciplines.

“A Makerspace (also called hackspace / fab lab) is a location where people with common interests, often in computers, technology, science, digital or electronic art (but also in many other realms) can meet, socialise and/or collaborate.”

http://www.makerspace.se/om-oss

The facility shares the number of science and engineering tools for instance, 3D printer to reduce the financial and resource burden, improving the machine utilization rate. Also, the place lowers the barrier to access the knowledge to the innovators in order to (re)configure ideas and resources for science and technology innovation – their philosophy has commonality to “Swimmy” governance. The community is run on trust network founded on the social capital as they seem to build up the facility by volunteers. I sense that there will be an open area to conduct inter-sectional study and take the advantage of movement for further development of science park as well as bottom-up, networked business incubating environment. I feel the majority of study over-emphasizes the sectoral policy, organizational management and regional intellectual capital than the interaction of actors who exchange resource and knowledge. As entrepreneurship is unique set of actions for exploiting an opportunity for socio-economic benefits, future study of science park and it proximity should be more atomic actor-based while balancing to the study bias and other empirical studies without over-theorizing the nature of research park governance.
References


Questionnaire

I would like to have your help for a Network Survey!

Hej, this is Noriyuki, my master thesis in Entrepreneurship and Innovation Management at KTH. In the thesis, I would like to map an inter-firm networking within the Zulu science park and I greatly appreciate your 10 - 15 mins to answer as many questions as below. The data will be handled anonymously and will be open to entire but limited within Zulu science park to create a network mapping. Once finished, please toss this form to a collecting box next to the exit.

Q1. How long do you work here at Zulu Science Park? ( ________ Years and about ________ months)

Q2. How often would you have a coffee, fika and/or lunch with people from other companies at Zulu?

□ Rarely: □ Usually by chance: □ A few days a week: □ Actively, Everyday

Q3A. How would you consider currently Zulu as a hub to the R&D network in “four scale”

□ 1 (Not at all): □ 2 : □ 3 : □ 4 (Very much so)

Q3B. How would you consider in the future, Zulu as a hub to the R&D network in “four scale”

□ 1 (Not at all): □ 2 : □ 3 : □ 4 (Very much so)

Q4. Select your affiliated company and 3 entities that you are familiar with, in order. Please, complete the table too.

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<tr>
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<td>Foxtrot</td>
<td>Golf</td>
<td>Items are randomly placed</td>
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Sub questions | Your Affiliation | Most Familiar | 2nd Familiar | 3rd Familiar |
--- | --- | --- | --- | --- |
Name of the Company | | | | |
Know their “Product and Services” | □ No/Little | □ No/Little | □ No/Little | □ No/Little |
| □ More or Less | □ More or Less | □ More or Less | □ More or Less |
| □ Very much | □ Very much | □ Very much | □ Very much |
How many workers do you know there? | □ None | □ None | □ None | □ None |
| □ A few | □ A few | □ A few | □ A few |
| □ Half | □ Half | □ Half | □ Half |
| □ About All! | □ About All! | □ About All! | □ About All! |
Did/Do you share Technical Experience? | ... | □ Yes / □ No | □ Yes / □ No | □ Yes / □ No |
Did/Do you borrow their Research Equipment | ... | □ Yes / □ No | □ Yes / □ No | □ Yes / □ No |
My competence could help them | ... | □ Yes / □ No | □ Yes / □ No | □ Yes / □ No |
I am interested in their technology | ... | □ Yes / □ No | □ Yes / □ No | □ Yes / □ No |

The questionnaire continues on the other side of this page.
Q5. Often, social network between companies is reported to help increasing the performance of the organizations for example, quality of the innovation output. Still, misuse of shared information can lead undesired consequences. How would you feel exchanging information of your work within Zulu Science Park? (Pick many as applies)

- Uncertain: □ Anxious: □ Appreciative: □ Fine
- Horrifying: □ Delighting: □ Compassionate: □ Useless:
- Trusting: □ Afraid: □ Ineffective: □ Happy: □ Cheerful: □ Other feelings? ( _____________ )

Q6A. Which is your field, you feel the most associated with? Choose one

- Construction : □ Mechanical Eng.: □ Electrical Eng.: □ Chemical Eng.: □ Factory operation:
- Biotech.: □ Health & Medical: □ Programming & ICT: □ Design & (New) Product Management:
- (IP) Law & Negotiation: □ Accounting, Marketing & Finance: □ Other field? ( _____________ )

Q6B. What are the fields, you feel like/missing to work with? Choose as many as you wish

- Construction : □ Mechanical Eng.: □ Electrical Eng.: □ Chemical Eng.: □ Factory operation:
- Biotech.: □ Health & Medical: □ Programming & ICT: □ Design & (New) Product Management:
- (IP) Law & Negotiation: □ Accounting, Marketing & Finance: □ Other field? ( _____________ )

Q7. How would you feel Zulu Science Park to organize inter-firm brain-storming meetings for example, new product ideas, marketing research, skill/resource sharing and social events?

- Product and Service Ideas : □ 1 (Not interested): □ 2 : □ 3 : □ 4 (Very Interested)
- Friday Bar / Wednesday Breakfast : □ 1 (Not interested): □ 2 : □ 3 : □ 4 (Very Interested)

At last, I appreciate your opinion and thoughts on this question as well as networking within Zulu Science Park.

Thank you for the participation! / Tack för hjälpen! :)  
Noriyuki Masuda  
noriyuki@kth.se / nnmasuda@gmail.com  
Rev3.A
### Raw data

| Floor | Max Weight | IQA | IQB | IQC | IQD | IQE | IQF | IQG | IQH | IQI | IQJ | IQK | IQL | IQM | IQN | IQO | IQP | IQQ | IQR | IQS | IQT | IQU | IQV | IQW | IQX | IQY | IQZ | ISA | ISB | ISC | ISD | ISE | IST | ITA | ITB | ICT | ITD |
|-------|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
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|       | 2          | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  | 24  | 25  | 26  | 27  | 28  | 29  | 30  | 31  | 32  | 33  | 34  | 35  |
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|       | 4          | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  | 24  | 25  | 26  | 27  | 28  | 29  | 30  | 31  | 32  | 33  | 34  | 35  |
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|       | 20         | 21  | 22  | 23  | 24  | 25  | 26  | 27  | 28  | 29  | 30  | 31  | 32  | 33  | 34  | 35  |
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Notes:
### Emotion Adjective list by Tom Drummond


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Tom Drummond, North Seattle Community College