

How the Firm networks affect the foundation and development of NTBF: Empirical evidence on the Propositions of Hite and Hesterly

Anas Al Natsheh¹, Saheed A. Gbadegeshin², Antti Rimpiläinen³, Irna Imamovic-Tokalic⁴
Andrea Zambrano⁵

¹⁻⁵ Centre for Measurement and Information System (CEMIS),
Kajaani University of Applied Sciences, P. O. Box 52 (Kuntokatu 5), FI-87101 Kajaani, Finland.

¹Anas.AlNatsheh@kamk.fi

²Saheed.Gbadegeshin@kamk.fi

³Antti.Rimpilainen@kamk.fi

⁴Irna.Imamovic-Tokalic@kamk.fi

⁵Andrea.Zambrano@kamk.fi

Abstract- Network has drawn attention from different fields and its contributions on the businesses have been discussed; however, Hite and Hesterly (2001) propose that it is significant for companies to change from closed networks to dispersed networks as the firm grows. Similarly, scholars argue that firm network, development and resources are “co-evolved”. These authors further state that changing of networks are affected by (a) individual difference of entrepreneurs, (b) industrial differences for resources, and (c) difference in the compositional quality. Thus, this paper tests their propositions to see “why” it is essential to change networks and to pinpoint “what”, “when” and “how” the necessity is needed in the formation and development of New Technology Based Firms (NTBFs). To achieve the objectives, four case studies are developed and the empirical results show that the origin of firm network determines the necessity for changing networks, the quality of network member affects the changes but individual difference of technology-based entrepreneur may or may not affect the changes.

Keywords- Firm networks; New Technology Based Firms (NTBFs)

1. INTRODUCTION

It is clear that networks contribute immensely to the founding and development of new firms but the extent of positive contribution is not yet researched. In the beginning of new firms, they get support from what is termed as “identity-based” networks; meanwhile, after the company formation, the assistance that come from those identity-based networks are not often sufficient to develop the firm due to increased and dispersed business environment which demands for more resources. In brief, Identity-based networks simply refer to the social networks of the entrepreneur or the entrepreneurial team while the calculative networks are the weak ties which are characterized to be more market oriented than socially oriented. In-between the two, there is a social-business network termed “path-dependent”. Therefore, it is argued that the new firm should move from identity-based to calculative based networks as the company grows (Hite & Hesterly, 2001).

Furthermore, it is important to note that entrepreneur, as an actor in a network, brings his or her connections to the new business; this results to social-business networks. As

company grows, the firm networks move accordingly. In the early stage, the identity-based networks evolve and play their roles. Likewise, during the early growth phase, path-dependent networks emerge and support the entrepreneurs. And, at the growth stage itself, calculative networks enter the trend and assist the entrepreneurs. The main reason for changes of these networks is based on the changes in the needs of company such as resources. Therefore, it is claimed that firm development, network and resources are growing together (Hite & Hesterly, 2001).

Based on their argument, we decided to examine if it is necessary for NTBFs to change their networks according to their life cycle. Although, in our previous paper, Al Natsheh et al (2013), we noticed that networking played crucial roles on the formation of NTBFs, yet we had interest to know further about the extent and variation of the networks on the formation and development of these firms because the outcome of such knowledge would facilitate the growth of NTBFs. Then, we returned to our previous transcriptions to examine the issue. Then, we developed four case studies to test the claims of Hite and Hesterly as well as to pinpoint the necessity of network

changes in the NTBFs because Humphry (2006) argues that the present literature failed to discuss on how the networks contribute to the company formation. The author also stresses that it is worthwhile to know “why”, “what”, and “how” a new firm is formed in relation to its network support; he says “ A valid model is yet to be developed to explain the causes (why), successful criteria (what), and process (how) of organization or new venture formation” (p. 362). Likewise, Stuart & Sorenson (2010) state that it is good to have empirical studies on the roles of firm networks in order to validate the existing theories because most of these theories are not yet confirmed. Hence, this paper contributes to the topic by presenting how the firm networks affect the NTBFs. We present our results after the following literature review and research methodology.

2. LITERATURE REVIEW

In general terms, a network is a structure which comprises of nodes and threads; the nodes are connected together via the threads. The interactions between both nodes and threads create relationships; thus, there is interdependence between the nodes and their relationships (Hakansson & Ford, 2002). However, business network is an interconnection of actors who are responsible for keeping a system running; it can be a market network where the stakeholders like companies, suppliers, competitors and customers are connected and their relationships create, maintain and sustain the market system (Johanson & Vahlne, 2009; Oviatt & McDougall, 2005, and Johanson and Mattsson, 1988). It coordinates the actions of the market and its stakeholders through market measures like prices, strategic moves, and announcements, and non-market measures like agreements. Likewise, it facilitates communications among its participants or members though such communication is “partner-specific, i.e., communication takes place between any two units in the network in a particular fashion” (Arias, 1995; 53).

Therefore, a business network is complex and complicated because it consists of multidimensional nodes (business units) thereby make it difficult to be understandable; it has opportunities as well as threats (Hakansson & Ford, 2002). For example, it has positive impact on the international performance of high-tech SMEs in terms of human capital resource (Kenny & Fahy, 2011) as well as it helps the NTBFs, born-global, to reframe their products, develop new product or services, and improve their customer services (Mort & Weerawardena, 2006).

Network has different types but the common ones are internal - external, stable-dynamic, flexible and speed. It is an important tool for innovation but to enjoy the full potential, it is good to remember that “Networks are not supposed to last forever in their initial form... Changes will be necessary in the nature of the relationships and the components of the network” (Arias, 1995; 55). It can be supported by the social relationships because the people in

the company are also forming the networks of the company (Arias, 1995; Granovetter 1985).

Furthermore, it is obvious that networks are important in the small company development; these small firms need support in which the social networks provide for them and it is important for the researchers to understand more about the ‘social relations’ which include some factors like ‘trust’ and ‘power’ if they want to have a mutual understanding on how the small firms benefit from their networks especially on their formation and development (Pittaway & Rose, 2006; 230). Because, one of the factors affecting the discovery and development of opportunities by the entrepreneurs is firm networks (Ardichvili et al., 2003); even, the networks of the technology-based entrepreneurs and the management of these networks are among the factors responsible for business opportunity identification in the technology-based firms (García-Cabrera & García-Soto, 2009). Opportunity can be identified through an existing and extended networks which includes weak ties, action sets, partnerships and inner circles (Ardichvili et al., 2003) and the international networks are rooted in the different environments such as academia, friendships, business and personal relationships; these ties emerge from a loose end to a much closed connection (Dominginhos & Simões, 2005). These statements were confirmed in the study that firm networks and self-efficacy are important for opportunity recognition in the technology-based companies (Wang, Ellinger & Wu, 2013).

Therefore, firm networks assist the entrepreneurs in technology or knowledge based industries to identify opportunities as well as to mobilize resources to exploit them; it has direct impact on the entrepreneurial stages - formation and development- because it gives needed information about the opportunity and the possible resources to realize the opportunity. Each person holds a certain position and plays certain roles in the networks, thereby such networks help the entrepreneurs to have access to private information and information flows. Specifically, entrepreneurs with better firm networks seem to be able to attract financial capital, recruit skilled labour and have access to tacit knowledge (Stuart & Sorenson, 2010). This is revealed, after reviewing several scholarly articles in which their statistical and case studies proof that firm networks improve international trade by reducing contact problems and providing information on the available opportunity (Rauch, 2001).

The roles of networks are based on the stages of company formation. There are pre-venture, formation and infant stages. These stages require some resources from networks; for instance, at the pre-venture phase, the main networks are “interpersonal” and it is regarded as the first critical point in the company life cycle; if the entrepreneur could get sufficient resources from his or her networks, the proposed business may be formed and if the situation could be otherwise, the venture creation might be failed.

Furthermore, the second stage starts when the firm is formed and the inputs of networks are numerous (Humphry, 2006). Thus, it is concluded that:

“A new entrepreneurial venture can be formed only if the owner-managers’ interpersonal networks are willing to provide valuable resources. Since this will be a forward exchange requiring repayment at some later time, the network can repossess the resources. This is not a unilateral transfer of resources as proposed by most scholars, but rather a deferred possession of resources. In such a way, the network will have nothing to lose eventually. There are incentives for the actors in the interpersonal networks to provide resources” (Humphry, 2006; 371)

Aside the important contributions of networks on the opportunity recognition, it also supports technological resource development, market facilitation and credibility provision which are essential for NTBFs especially born-global firms (Dominginhos & Simões, 2005). Therefore, it is good for the technology-based entrepreneurs to improve, motivate and sustain their networks including their employees so that potential opportunities could be easily identified by their employees (Ardichvili et al., 2003; García-Cabrera & García-Soto, 2009, and Wang et al., 2013).

Furthermore, in a study that examines contribution of network activities on the company formation in four countries (Italy, Norway, Sweden, and the United States) shows that entrepreneurs build their networks systematically and their networks change in relation to the different stages of their entrepreneurial efforts. During the study, it was noticed that entrepreneurs seemed to be discussing more in the planning stage than any other stages and the immediate networks (family members) were present through their company formation stages. Interestingly, these findings are common with the studied countries. Thus, it is concluded that “Social relations play an important role in establishing a firm. Entrepreneurs use social capital to access resources in each phase of the establishment process” (Greve & Salaff, 2003; 16). Likewise, while studying 1,700 new businesses in Germany (Upper Bavaria), it was found out that the entrepreneurs, who could make reference to wide and diversified networks, appeared to get support and such assistance made their company successful (Brüderl & Preisendörfer, 1998).

Despite the positive contributions of firm networks, there is a problem of biased information. As it is explained that the main roles of the networks is information flows, the available information may be distorted; thus, the entrepreneurs might not be able to get accurate information. Once information is wrong; the identified opportunity may be wrong (Stuart & Sorenson, 2010).

From the above, we notice that the networks have different forms, from closed networks to business connections, and these networks provide important support for the company

development. However, Hite and Hesterly (2001) propose that entrepreneurs should pay attention to stage of their company in the life cycle and adopt appropriate type of networks (identity-based, path-dependent, or calculative) in order to manage their resources. Yet, these scholars state that this proposition may be affected by (a) individual difference of entrepreneurs, (b) industrial differences for resources, and (c) difference in the compositional quality; therefore, it is good to test if these propositions could be right. As we have mentioned earlier in this paper that our interest is to pinpoint the necessity of changes in networks in relation to company life cycle, we developed case studies to test the propositions. We use measurement technology NTBFs for our case studies because our organization, Centre for Measurement and Information System (CEMIS), is a research centre which specializes in the measurement technology development, new technology commercialization and NTBFs growth; thus, we do have expertise in the NTBFs from this sector. Therefore, we believe that using these NTBFs will give more insights for related NTBFs.

Based on the propositions of Hite and Hesterly (2001), we outlined the following hypotheses:

H₁: Firm networks, development and resources are “co-evolved”.

H₀: Firm networks, developments and resources are not “co-evolved”.

H₂: Firm networks change according to the company life cycle.

H₀: Firm networks do not change according to the company life cycle.

H_{3a}: Changing of firm networks are affected by the individuality of entrepreneurs.

H_{3b}: Changing of firm networks are affected by the quality of network members.

H₀: Changing of firm networks are not affected by the individuality of entrepreneurs and/or quality of network members.

H₄: It is necessary to change from identity-based to path-dependent to calculative networks in relation to company development cycle.

H₀: It is not necessary to change from identity-based to path-dependent to calculative networks in relation to company development cycle.

These hypotheses were tested via a qualitative research method. Qualitative research was employed because Denzin & Lincoln (2000) state that this method allows the researchers to investigate a phenomenon in their natural environment and this makes such study to be well understood and the researchers can interpret the phenomenon based on the meaning people assign to it. Additionally, a planned and a well-executed empirical study with a purpose of deriving a resourceful meaning can be done successfully with the qualitative method

(Creswell, 2009). The following section presents our research process.

3. METHODOLOGY (CASE STUDY)

Case study, as a research method, is one of the most common and widely-used method but it is challenging in social sciences though it increases knowledge of an individual, group and organization on the certain issues. It also helps people to understand a complex phenomenon. One of the strengths of this method is possibility to deal with a lot of evidence such as, documents, artifacts, interviews and observations. This method can be used in economics where structures of specific industries or a city's economy need to be studied (Yin, 2003). Additionally, it is one of the most common methods of qualitative research in business studies because it is reasonable to use documents which are cheap and easy to solve a phenomenon under investigation. More so, it makes use of many evidences which enables the method to be triangulated and it helps to develop "converging lines of inquiry" (Koskinen et al. 2005; 158).

However, there are five misunderstandings in using of case study as a research method- (1) Theoretical knowledge is more valuable than practical knowledge; (2) One cannot generalize from a single case, therefore the single case study cannot contribute to scientific development; (3) The case study is most useful for generating hypotheses, while other methods are more suitable for hypotheses testing and theory building; (4) The case study contains a bias toward verification; and (5) It is often difficult to summarize specific case study. Meanwhile, based on the given reasons by the prominent scholars and their analyses, case study is an important and a sophisticated method to use for social science researches; thus, it is good to use case study, even to test a theory (Flyvbjerg, 2006; 1 & 26).

Using case study to test a theory or proposition has been discussed by the several scholars especially in the Management Information System literature and it has been agreed that case study can be used as a scientific research methodology; therefore, using it, is accepted within the paradigm of positivist (Iacono, Brown & Holtham, 2011). However, a scientific case study should: answer the research questions of "how" or "why"; investigate certain theoretical propositions (theories) and state the relationship between the phenomena; have a specific unit of analysis; have to link the data and the propositions, and to deduce findings and interpret results (Yin, 1994).

Upon the above arguments, a case study method was employed in this paper. Four transcriptions were examined

due to the sufficient knowledge of the interviewees in the industry and they are still working in the measurement technology industry. Although, there were four people, yet more than ten companies were involved due to the presence of serial entrepreneurs.

3.1 Interview Process

Our interviewees were informed at least a week before the actual interview; the possible interview questions were sent to them. The interviews were semi-structured and they were face-to-face. There were two digital recorders during the interviews and there were at least two researchers (authors of this paper) presented in each case. During the interviews, the main theme of our study was focused and almost the same questions were asked throughout the cases. There were many confirmatory questions and counter-questions, purposely, to determine the consistency of the interviewees and the reliability of their information. The interviews were conducted in the companies' premises and hotels. A friendly atmosphere was created and the researchers firstly clarified the confidential issues before recording. The interviews took an average of an hour. The transcriptions were read and the needed information was extracted. However, the next subsection presents brief information on the participants.

3.2 The Participants

There are two groups of participants; the first group consists of serial entrepreneurs and they are termed as "SE1" and "SE2". SE1 started his first spin-off (Small particle measurement) from a Finnish technical university research and since then, he established another four companies. He holds Ph.D. degree. Meanwhile, SE 2 graduated from a Finnish university's electronics department and his first entrepreneurial career started when he joined an industrial project done by a packaging and industrial manufacturer. The project was to develop instrumentation for quality control of plastic bottles. He was firstly, in the project as a young engineer but finally ended up being the main shareholder. He is founder of four companies and he also holds Ph. D. degree.

The second category is one-time-entrepreneur; they are termed as "E1" and "E2". E1 studied in a Finnish technical university and started doing his diploma work in 2004 for an industrial project on surface topography measurement in paper industry. He also did his Ph.D. thesis on similar topic and when a Finnish company bought the exclusive license to the IPR developed in the university, he moved to the company and he later became a shareholder and managing director. Similarly, E2 was a researcher in a Finnish technical university (Physics department - Optical laboratory). He started his entrepreneurial career when he and his colleagues founded a company; they were researchers then. Later on, he became a shareholder in the

company in 1999 and he worked as a chairman of the board. He also developed one of the inventions in the company. He left the company in 2006 to pursue another career. He holds Ph. D. degree and he is currently a director of a Finnish technology institution.

3.3 The Case Studies

Four case studies were developed based on the first company of the participants. The following table presents the short history of the case study firms:

Table 1: Details of the Case Studies

Interviewee	Case Study Firm	Business Line (s)	Founding Year	Current Situation
SE1	Small Particle Measurement	It specializes in developing, manufacturing and selling of fine particle measurement instruments.	1995	It currently has about 13 products related to particle measurements.
SE 2	Plastic Bottle Quality Control Measurement	It produces quality control measurements for the PT plastic softening bottles.	1981	In year 2000, it was sold to an American company but it still exists.
E1	Online printing process monitoring and optimization	It is a developer, manufacturer and a supplier of measurement and analysis devices for print and paper companies.	2003	It still exists and it has partnership with the big companies in the industry.
E2	Coating Measurement	It specializes in developing spectroscopic measurements and processing methods for industrial companies.	1999	It is still operating but not that active.

3.4 Research Results

After the interview transcriptions, the relevant data were selected and analyzed to produce the research results. The main outcomes are presented in the following paragraphs; we explain how the firm networks of entrepreneurs assisted them to utilize opportunities and develop their companies, how they changed their firm networks and how their changes led to the firm growth.

Case Study 1: Small Particle Measurement Company

The interviewee, SE1, disclosed that he and his team was aware of a conference that would be held in Helsinki from their networks; the conference was highly relevant to their developing product. Then, this conference created a clear timeframe for their invention commercialization and this

compelled them to work hard to develop their product. SE1 explained further that they made a scientific presentation in the conference. With the presentation, they were able to get two distributors from the United Kingdom. It was stressed in the interview that without this conference networking, the commercialization process and the new company would have died. He said:

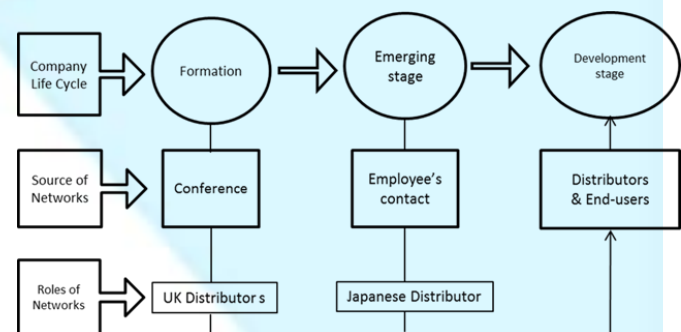
“...it [conference] gave a clear deadline, without that deadline, I think, the company would be dead. Because we didn’t get that drive to finish our product... two weeks to the conference, we really didn’t sleep at all. That was our ultimatum deadline. If we couldn’t make it that time, we’d just pack our things and go.”

The above network was just a turning point but the breakthrough came through a personal link of one of their employees. The breakthrough was that a student from the Finnish university who had been studying in Japan was contacted by the company’s employee and the business connection started from there. SE1 said:

“...it was an easier and trustful connection, and basically the real sales started there.”

This Japanese distributor accounted for their largest sales of the firm. Furthermore, the interviewee stated that the company was able to succeed with support from the university internal networks; he and his team got needed services from the university. The entrepreneur told us further that he keeps using networks to develop companies and to expand the existing firms. To summarize this case, the following diagram shows the details:

Figure 1: Firm networks of Small Particle Measurement Company



From this Figure 1, it can be deduced that the roles of firm networks appear to be crucial to the company development; the network provided resources (distributors) for the company; likewise, it can be agreed that the network changed from interpersonal to business especially at the emerging stage when the employee’s contact turned to business relationship (i.e. from identity-based to calculative); quality of network member appeared to be significant but the individuality difference of entrepreneur seemed to not affect the changes in the network roles.

Therefore, it can be argued that that, H_1 , H_2 and H_{3a} seem to be right; thereby they are not rejected. Meanwhile, the H_{3b} is rejected because the collected data revealed that individual differences did not affect the company progress. Furthermore, H_4 is not rejected because this case shows that a personal network needs to be changed into business when “business” comes into a relation; this is revealed in this case study when the employee’s contact converted into business partner. Nevertheless, this is first case; thus, the next case tells more.

Case Study 2: Plastic Bottle Quality Control Measurement Company

The entrepreneur participated in an industrial project started by a Finnish packaging and industrial manufacturer in 1981 when he was graduating from the university. The project aimed to develop instrumentation for quality control for plastic bottles. Eventually, SE 2 ended up to be a main shareholder of the company. In the beginning of the project, the need for plastic bottle quality measurement did not really exist in the Finnish market due to heavy use of glass bottles, therefore they had to go to international markets quickly.

SE2 narrated that it was a challenge to sell a measurement device worth of 100,000 US dollars when the competing technologies - manual dial gauges - were selling with 500 US dollars. He said that he, his wife and one of his younger brothers had two trips to North America with the help of a local contact; they used a camper van to build the demo-laboratory (with a living area) and drove around in North America and demonstrated the device. He said that the international sales started from a chance meeting with a manager of a large North American multinational beverage company when the camper van was parked in the parking place of the company’s headquarters. The person in charge of the company’s measurement instruments saw the camper van and just went to check what a camper van was doing in the parking place. The manager purchased the instrument then and that resulted to 90% of the sales going to the beverage company’s bottle suppliers.

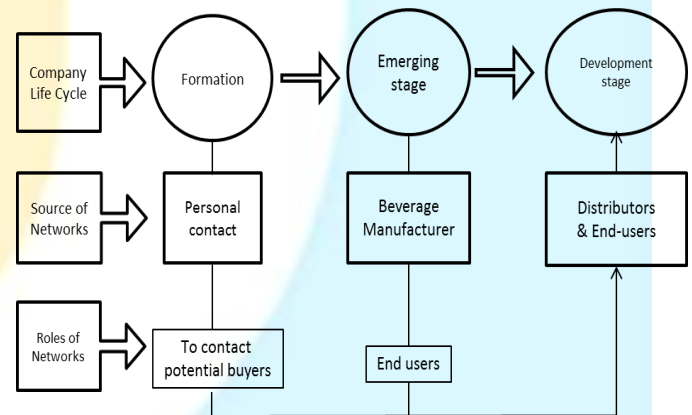
To summarize the story, when the entrepreneur reached North America, he met a retired business angel who provided him with a telephone in his office and with some initial contacts. According to him, he learned from this old business angel that one should build his or her network in the beginning. SE2 commented on the roles of networking that:

“Networking is a key thing and ... finding a good network of suppliers and the research partners or R&D partners, that is the key thing because that enables you to do things simultaneously, in parallel ... it helps a lot..”

He agreed that it is good to change networks but he cautioned that constant changes are not good. He said that since the networks form into a *quid pro quo* relationship which is supported by trust. It was emphasized that changes in the networks would probably lead to change in

the opportunity perception or anticipation and consequently, changes in opportunity perception might lead to business model change for instance. The entrepreneur said that around 1993-1994 they realized that their customers could not effectively utilize the data obtained from their measurements. Then, the company had an opportunity to extend its value chain; so they started to provide contract services and training services for the customers. That resulted in 30% increase of sales. In brief, the next diagram presents more:

Figure 2: Firm networks of Plastic Bottle Quality Control Measurement Company



It is clear, from the above Figure 2 that the networks play important roles in the establishment of NTBFs and these networks change; it is also clear that quality of network members is essential as well as the personality of the entrepreneur. Therefore, our hypotheses are not rejected; thus, our argument from the case study 1 is upheld that the roles of firm networks appear to be crucial for formation and development of NTBFs. Nevertheless, the next case reveals more.

Case Study 3: Online Printing process Monitoring and Optimization Firm

The interviewee, E1, is the managing director and salesperson for the company. E1 explained that there was a project in the university which was based on a survey that was conducted to know the demands and needs for paper industry between 2002 and 2003. Also, Online Printing process Monitoring and Optimization Firm had a parallel project and eventually, E1 joined the company. This company had a close relationship with the key industrial players. In 2009, the industry found out that the actual need was the measurement of the dirt accumulation on paper that comes when the printing blankets transfer the ink to the papers. Then the focus was changed totally to that niche measurement; this was due to network information. The firm went to buy marketing intelligence

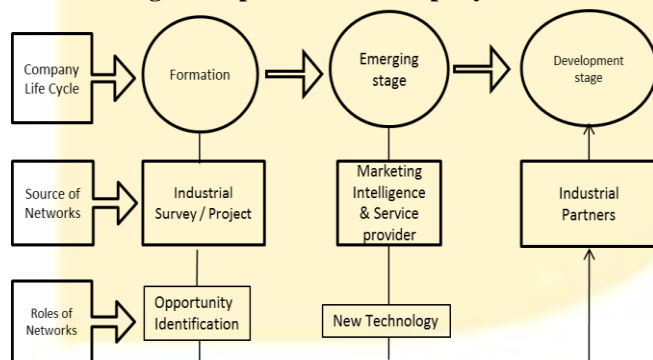
services to verify the existence of the opportunity; based on the outcome of marketing intelligence, the firm developed a new technology for the industry. Fortunately, these industrial partners are still the main end-users for the technology.

This case study 3 reveals that the focus of the company changed as a result of information it got from its network. Likewise, the company is able to exist because of its connection with the industrial key players. E1 firmly agreed that networks played important roles in the firm development and he said:

“And basically... if I need to know something I know people to whom I can call and they will tell me who or which person I will call next so that I can have what I want...networking has been very good support in that way...”

The following figure depicts its networks and their roles.

Figure 3: Firm Networks of Online Printing process Monitoring and Optimization Company



In this case, the sources of network are calculative; though it was noted during the interview that identity-based networks played an important part on the firm development.

Therefore, as we have been arguing since, the firm networks play important roles on the formation and development NTBFs, this company testifies the claims. However, this case shows that identity-based networks are not always needed in the beginning of NTBFs. Based on the propositions of Hite and Hesterly (2001), our hypotheses H_2 , H_{3a} , H_{3b} and H_4 are rejected because the identity-based networks are not visible in this case but H_1 is not rejected because firm networks, development and resources appear to be co-evolved. Nonetheless, the last case study tells further.

Case Study 4: Coating Measurement Company

E2 was the chairman of the board in the company as well as one of the founders. The company formation initiated after the entrepreneurs were aware that there were two potential buyers- a university’s department and a multinational car manufacturer - for their inventions. Then the team decided to develop the real product; they applied for funds and fortunately, they got a seed funding of one million Finnish Marks. The product was successfully

launched in 2001. After the launching, the company got another funds from a Venture Capital funding from the Finnish government program (SITRA) and Finnish bank’s venture capital company to develop the coating measurement technology further and market it; they raised around €1, 3 million and the Venture Capital Company got a 40% stake in the company.

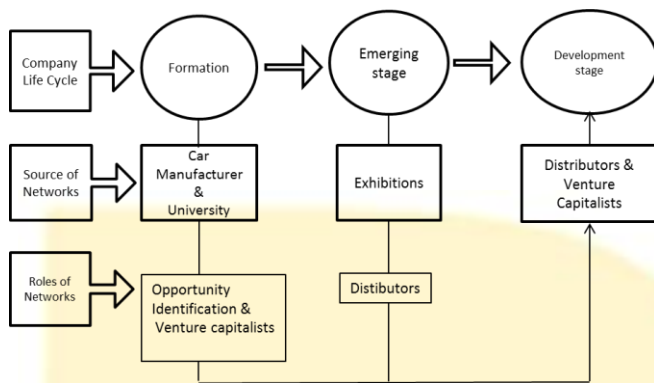
It was further narrated that, initially, the company had three technological applications in which the plan was to start with one, the above mentioned thermal coating measurement and then use the profits gained from that to further develop the other two technologies. The other two technologies were a high-speed camera imaging technology and a heavy-metal content emission measurement technology. However, the company never had a breakthrough; the primary problem was the network and wrong perception of the opportunity. When a question was asked about the wrong perception, the interviewee replied that the problem was that they were all researchers and they did not have sufficient business skills. He further disclosed that the problem in research-based spin-offs is that researchers are more interested about putting all the ideas to their technology than listening to the customer. Indeed, he pointed out that:

“...we didn’t know[our customers] very well and we were not interested about our customer’s needs, because we were researchers...we just like to invent new features...and we did better than our competitors even though customers were not asking to be better...of course they were interested to have cheaper products. We were more expensive, yes and we had more features, but customers were not interested to pay for those features...”

Furthermore, another problem was that they left the supporting network of the university in the earlier stage. They left the university in less than a year after they established their company. Thus leaving reasonably priced office spaces and chance to develop the products and do measurement with rented equipment. Also, they reduced their own possibility to develop the products with the university, because they hired all the people capable of doing that into the spin-off. That decision made the firm to waste its financial resources in a short time. When the company was struggling to survive, the founders went to back to the exhibitions to get their buyers. They succeeded to get few distributors but the company was not that active because it was sold and the money realized was used to pay-off the venture capitalist.

As it can be noted, this case study firm seems to pay no attention to their origin networks as well as customer networks; this almost led to death of the company. It was also disclosed by E2 that change in the networks always affects the perception of opportunity and even, the change may affect to stop the anticipating opportunity and create new ones. The following diagram summarizes the case:

Figure 4: Firm Networks of Coating Measurement Company



From the above figure 4, it can be noticed that the company started from industry and university collaboration; its origin is almost the same to case study 3 but this company failed to continue cooperation with its networks, thereby made it difficult for the firm to succeed like that of case 3. Additionally, it can be noticed that a small success was achieved by the company when it was able to create and maintain its business networks (calculative) via exhibitions and this gave the firm an opportunity to be sold and paid off its debt. From our hypotheses, H_1 , H_2 , H_{3a} and H_{3b} are not rejected; likewise, H_4 is not rejected because there was evidence of changing from path-dependent to calculative networks. Nonetheless, the next section presents the summary of these results and relates them to the testing propositions and other aforementioned scholars' claims.

4. RESULTS AND DISCUSSION

In summary, these cases show that the firm networks, its development and its resources are evolving together; the networks changes according to the company development phases but these changes do not necessarily have to be from interpersonal to dispersed networks, that is, from identity-based to calculative networks because these changes depend on the origin network of the firm; individuality difference of entrepreneur and the quality of network members may or may not affect the changes of the network, and it is essential to change networks if the situation or the company life cycle demands (flexibility is the main argument here). Therefore, our hypotheses H_1 and H_2 are not rejected and we support the argument of Hite and Hesterly (2001). However, H_{3a} and H_{3b} cannot be completely rejected because we found out that firm networks might even start from calculative networks as we presented in the case 3 and 4. Therefore, we argue that the origin networks determine the changes in the networks of NTBFs from identity-based to calculative; our argument is in line with explanations of Arias (1995), Humphry (2006)

and Stuart & Sorenson (2010) on the roles of networks. Although Greve & Salaff (2003) found that interpersonal networks were present in the formation of company, yet we argue that it is not always that origin networks rest on the identity-based network because Brüderl & Preisdörfer (1998) claimed that companies with diversified networks often get outside support; this claim is evident in the Case 3 and 4.

Furthermore, individuality difference of entrepreneur may affect the changes of networks especially if the origin firm networks are identity-based and the firm is initiated by a team. Conversely, this individuality difference may not affect if the origin firm networks are either path-dependent or calculative. The case studies 2, 3, and 4 supported this claim. And, the quality of network members may affect the network changes either the firm's origin networks are identity-based or otherwise. For example, the cases show that they got assistance from their networks and if such networks were composed of non-trustworthy people, this might definitely affect the firms. Even, SEs warned that network member should be carefully selected. For instance, one of them said:

“Network is extremely important but not all networks are friendly, so you must have intuition, which way to go. I think, generally, network in Finland is good. I think, Finnish people are quite nice, so in Finland you can network quite openly but if you go outside Finnish borders you must be careful whether it is industrial surveillance or friendly talk.”

Thus, we support Hite and Hesterly (2001) that quality of network member affects the change of network; this argument also complements the analyses of Johanson & Vahlne (2009), Oviatt & McDougall (2005), Arias (1995), and Johanson and Mattsson (1988) when they are explaining the roles of market networks.

Moreover, it is worth stating that changing networks are supposed to be flexible though it was found in the above cases that the firms need to change their networks as they are growing, yet the companies formed or emerged from the different networks. Therefore, we argue that current situation and strategic goals of the companies determine the necessity for changing their networks; if the NTBFs could focus on this, they might improve their growth. From the studied cases, three firms are still active due to positive changes in networks (there was the need to change and they changed accordingly) while one company (case 4) is not that active as a result of its inability to recognize the situational demand for changes in the networks.

Apart from the above, it was found during our study that the roles of firm networks are significant for the successfulness of company formation as well as the growth of company especially for information acquisition as Arias (1995), Humphry (2006), Rauch (2001) and Stuart and Sorenson (2010) explained, for opportunity recognition and identification as Ardichvili et al (2003), Arias (1995), García-Cabrera and García-Soto (2009), Hakansson and Ford (2002), Humphry (2006) and Wang et al (2013) claimed, for technological resource development, market facilitating and credibility provision as Dominginhos and Simões (2005) stated, for attracting financial and labor resources as Stuart and Sorenson (2010) mentioned, for reframing or re-developing the products or services or improving the customer services as Mort and Weerawardena (2006) presented, and for improving international performance as Kenny and Fahy (2011) concluded.

5. CONCLUSION AND LIMITATIONS

Based on our empirical analysis and evidence, we conclude that firm network, its development and its resources are co-evolved as it is claimed by Hite and Hesterly (2001). Likewise, we conclude that it is reasonable for NTBFs to examine their origin networks and their stage on the company life cycle; if the concerned firm is formed on “identity-based” network, it is important for such company to change to path-dependent and calculative networks as it is growing according to the propositions of Hite and Hesterly (2001). On the other hand, if the firm’s origin networks are path-dependent and calculative networks, such company just needs to maintain its networks as it growing according to Ardichvili et al (2003), García-Cabrera & García-Soto (2009) and Wang et al (2013) so that the company can access and utilize further opportunities. Similarly, we conclude that first-time entrepreneurs may use the identity-based networks to uplift their businesses while serial entrepreneurs may just use calculative networks because they usually have existing networks (identity-based), thereby making it easier to establish new firms. This is noted from our case studies.

We also conclude that the nature or individual difference of concerned entrepreneurs may affect the changes in networks and this depends on the origin of firm networks. In the same view, we ascertain that quality of network members affect the changes of networks; this claim supports the argument of Hite and Hesterly (2001). On the final note, we argue that it is important for NTBFs to change their networks according to their growth but it should be flexible.

Meanwhile, it is important to state that this paper has limitations. Firstly, the case study firms are from Finland and the selected industry is not generic like transportation,

retailing, or other industries; thus, our results cannot be easily generalized without a consideration. Similarly, case study methodology has its weaknesses but these problems do not really affect the quality of our results though it is good to follow our research process so that the same outcome could be attained. More so, the number of case studies is not numerous, therefore it is recommended that any interested researcher should have large case studies to test the propositions; also, it is good if the future researchers can use measurement technology NTBFs in the different countries to see the impacts of nationality on our results. Furthermore, it is good to see another research to test Hite and Hesterly (2001) propositions using the same research methodology.

ACKNOWLEDGEMENTS

We would like to thank Dr. Risto Oikari, the director of CEMIS for his support during our study. Also, we are grateful for our financiers - Centre for Economic Development, Transport and the Environment, Finland; Regional Council of Kainuu, Finland and the European Union Regional Development Fund – for making this study successful.

Also, we thank the members of CEMIS consortium. CEMIS is a consortium that is composed of the University of Oulu, Kajaani University of Applied Sciences, University of Jyväskylä, the Centre for Metrology and Accreditation (MIKES) and Technical Research Centre of Finland (VTT). It was established in 2010 and its primary goals were to improve researches and trainings in the measurement technology and information systems, to facilitate commercialization of research findings, to support measurement technology start-ups and to increase internationalization of Finnish measurement and information system firms. It concentrates on the mining, the renewable chemical, industry, vehicle information systems, sports and well-being, and game and simulation technology industries.

REFERENCES

- [1] J. M. Hite and W. S. Hesterly, Evolution of Firm Networks: From Emergence to Early Growth of the Firm, *Strategic Management Journal*, 22 (3), 2001, 275-286
- [2] A. Al Natsheh, S. A., Gbadegeshin, A. Rimpiläinen and T. Mainela, Technology Based Entrepreneurship: Measurement Technology Perspective, *Interdisciplinary Journal of Research in Business*, 2 (9), 2013, 26 - 42
- [3] H. Humphry, Formation and Survival of New Ventures: A Path from Interpersonal to Inter-organizational Networks, *International Small Business Journal*, 24(4), 2006, 359 –378

- [4] H. Hakansson and D. Ford, How should companies interact in business networks? *Journal of Business Research*, Vol. 55, 2002, 133 - 139
- [5] J. Johanson and J. Vahlne, The Uppsala Internationalization Process Model Revisited: From liability of foreignness to liability of outsidership. *Journal of International Business Studies*, 40(9), 2009, 1411-1431
- [6] B. M. Oviatt and P. P. McDougall, Defining International Entrepreneurship and Modeling the Speed of Internationalization. *Entrepreneurship Theory and Practice* 29(5), 2005, 537 – 554
- [7] J. T. G. Arias, Do networks really foster innovation?, *Management Decision*, 33 (9), 1995, 52 – 56
- [8] B. Kenny and J. Fahy, Network resources and international performance of high-tech SMEs, *Journal of Small Business and Enterprise Development*, 18 (3), 2011, 529 – 555
- [9] G. S. Mort and J. Weerawardena, Networking capability and international entrepreneurship: How networks function in Australian born global firms, *International Marketing Review*, 23(5), 2006, 549 – 572
- [10] M. Granovetter, Economic Action and Social Structure: The Problem of Embeddedness. *American Journal of Sociology* 91(3), 1985, 481 -510
- [11] L. Pittaway and M. Rose, Learning and Relationships in Small Firms, *International Small Business Journal*, 24(3), 2006, 227 – 231
- [12] A. Ardichvili, R. Cardozo and S. Ray, A theory of entrepreneurial opportunity identification and development, *Journal of Business Venturing* 18(1), 2003, 105-123
- [13] A. M. García-Cabrera and M. G. García-Soto, A Dynamic Model of Technology-based Opportunity Recognition, *Journal of Entrepreneurship*, 18 (2), 2009, 167 – 190
- [14] Y. Wang, A. D. Ellinger and Y. J. Wu, Entrepreneurial opportunity recognition: an empirical study of R&D personnel, *Management Decision*, 51 (2), 2013, 248-266
- [15] J. E. Rauch, Business and Social Networks in International Trade, *Journal of Economic Literature*, Vol. XXXIX, 2001, 1177–1203
- [16] A. Greve and J. W. Salaff, Social Networks and Entrepreneurship, *Entrepreneurship Theory and Practice*, Fall, 2003, 1-23
- [17] J. Brüderl and P. Preisendörfer, Network Support and the Success of Newly Founded Businesses, *Small Business Economics*, 10: 1998, 213 – 225
- [18] B. Flyvbjerg, Five Misunderstandings About Case-Study Research, *Qualitative Inquiry*, 12 (2), 2006, 219-245
- [19] J. C. Iacono, A. Brown and C. Holtham, The use of the Case Study Method in Theory Testing: The Example of Steel e-Marketplaces, *The Electronic Journal of Business Research Methods*, 9 (1), 2011, 57-65
- [20] N. Denzin and Y. Lincoln (Ed.), *Handbook of Qualitative Research*, (London: Sage Publication Inc. 2000)
- [21] J. W. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 3rd Eds. (London: Publication Inc., 2009)
- [22] R. K. Yin, *Case Study Research: Design and Methods*, 2nd Edition (USA: Thousand Oaks, California: Sage Publications, 2003)
- [23] R. K. Yin, *Case Study Research: Design and Methods*, 3rd Edition (USA: Thousand Oaks, California: Sage Publications, 1994)
- [24] I. Koskinen, P. Alasuutari and T. Peltonen, *Laadulliset menetelmät kauppatieteissä*. (Finland: Tampere: Vastapaino, 2005)
- [25] T. E. Stuart and O. Sorenson, Social Networks and Entrepreneurship, in Z. J. Acs and D. B. Audretsch (Ed.), *The Handbook of Entrepreneurship*, 2nd Ed, (USA: Spring Sciences + Business Media, LLC, 2010)
- [26] J. Johanson and L. Mattsson, Internationalisation in Industrial Systems – A Network Approach, in N. Hood and J. Vahlne (Eds) *Strategies in Global Competition* (New York: Croom-Helm, 1988, 287-314)
- [27] P. M. Dominginhos and V. C. Simões, Co-Entrepreneurs in High-Tech Born Globals, Research paper presented at the 8th Uddevalla Symposium and 8th McGill International Entrepreneurship Conference, 2005.

Authors' Biography

Anas Al Natsheh (PhD) is a Principal Lecturer and Senior Business Advisor for CEMIS; he also is an expert in empirical researches, research valorisation and technology Commercialization. He studied at the University of Kuopio (currently known as University of Eastern Finland) and his PhD was with an honour on the applications of Nanotechnology in 2006.





Saheed Adebayo Gbadegeshin (MSc) is a Project Staff and Project Researcher at Kajaani University of Applied Sciences and the University of Oulu in Finland respectively. His research interests include technology based entrepreneurship, technology commercialization and family business.



Antti Rimpiläinen (MSc) is a Project Staff and Project Researcher at Kajaani University of Applied Sciences and the University of Oulu in Finland respectively. His research interests include technology based entrepreneurship, technology commercialization, networking and international business.



Irna Imamovic-Tokalic (BSc) is a trainee at Kajaani University of Applied Sciences; her research interests include technology commercialization, digital media and marketing, graphic design and financial management.



Andrea Zambrano (MSc) is a Project Researcher at the University of Applied Sciences; her research areas consist of financial management, research cooperation with Latin-American regions, and Economic impact studies with focuses on: Benefit-Cost analysis, financial analysis, and forecasting.