Network of networks: Uncovering the secrets of entrepreneurs' networks

Song, Y.

Citation for published version (APA):
CHAPTER 6

Implications and Discussion
In this dissertation, we studied an entrepreneurial NoN from different perspectives. In brief, the dissertation included a methodology chapter and three chapters discussing empirical studies. Chapter 2 presented a novel methodology for collecting online social network data. Chapter 3 analysed the relationship of entrepreneurs' online social network diversity to their survival. Chapter 4 analysed the distribution of entrepreneurs' online social networks, while Chapter 5 used a simulation model to explore the potential influences of an NoN on the entrepreneurial process. The strengths of this dissertation lie in the methodology for collecting NoN network data and the simulation of the entrepreneurial process in a given network structure. In this chapter, we will summarize the contributions and limitations of this dissertation and suggest directions for future research.

6.1 Summary of methodology

In Chapter 2 we developed a methodology to explore entrepreneurs' social networks, which we found to be an NoN and on this basis used NoN theory to study the online social networks of entrepreneurs. The method of collecting NoN data was made possible due to the dramatic increase in the use of online social networking sites. Entrepreneurs in particular are interested in using multiple online social network sites. Rather than analysing entrepreneurs' online social networks individually, we examined their networks as a whole to determine the influence on entrepreneurship.

The central idea is that entrepreneurs are embedded in a network of networks (NoN). It is the NoN rather than the individual networks that contributes to the entrepreneurial process. We developed a method of collecting NoN data through online social networks and concluded that sufficient NoN data is available through online social networking sites. Our research project involved 384 participants. We suggest that this methodology can be applied in other fields to explain phenomena caused by social networks.

6.2 Summary of network diversity

We studied the size and structure of entrepreneurial social networks by analysing the online network industry and location diversity. Our findings suggest that entrepreneurs use multiple online social networks that form their network of networks (NoN). We examined the entrepreneurs' network size and diversity to gauge their impact on performance in terms of survival. Our findings suggest that the entrepreneurs' LinkedIn network size has a positive relationship with entrepreneurial survival, the size of the entrepreneurs' Facebook
network is not related to their survival, while the size of their Twitter network had a negative relationship with survival. We visualized the entrepreneurs’ LinkedIn network in terms of industry diversity. Finally, we reflected on the implications for future research on the structure of entrepreneurial online social networks.

6.3 Data secrets

In view of the importance of networks for entrepreneurs, the study presented here is intended to fill a gap in the literature pertaining to the structure and entrepreneurial use of online social networks such as LinkedIn, Facebook and Twitter. Drawing on the literature on social network analysis, we found that entrepreneurs use multiple online social networks as a network of networks (NoN). We merged the data from these three online social networks to study the structure of the entrepreneurs’ NoN. We explored the communities within the NoN by removing the edges with the highest betweenness values. Our analysis suggested that the entrepreneurs’ NoN follows an exponential degree distribution, which implies that weak ties between individual networks play an important role in forming an entrepreneurial NoN. Furthermore, we found overlaps between entrepreneurs’ neighbours across the NoN, which suggests that entrepreneurs develop and use NoNs to support the entrepreneurial process.

6.4 The simulation of the entrepreneurial process in a given network

In our simulation model, we found that entrepreneurial growth is not only related to wealth but also to the network degree. The entrepreneurs’ start-up wealth can guarantee they will survive when they do not have a collaborator. Although we were not able to find the threshold for entrepreneurs to survive at a given time, we could still infer the survival probability from the start-up time frame.

We expected that entrepreneurs with a higher network degree would collaborate more with others. However, our simulation model only allowed entrepreneurs to collaborate with one entrepreneur at a time. In other words, the probability that an entrepreneur could collaborate with someone in the network became lower when entrepreneurs’ network degree was higher. In fact, entrepreneurs with fewer connections may collaborate more and survive longer than those with a higher network degree.

The initial network was part of the online social network, thus the whole analysis may be biased. However, we are intending to develop an approach to further explore the
entrepreneurial process in a given network. Due to the limitations of our simulation model, it seems that entrepreneurs with a higher network degree had lower collaboration rates. We will solve this problem in the next simulation model. In addition, the empirical research was limited by a lack of longitudinal and process-oriented data. Therefore, it neither addressed the emergence and dynamics of networks over time nor the link to venture performance. Thus, future research should address entrepreneurial network dynamics from both the NoN and simulation perspectives. In order to understand network dynamics and evolution and their effect on entrepreneurial performance we must move beyond mere descriptive accounts of network structures in future research and develop in-depth explanations of the structural dynamics of entrepreneurial networks.

6.5 An additional note on methodology – future perspectives

In addition to the findings presented here, we also believe that mobile phones, especially smart phones which carry large amounts of information, could be used as an alternative for collecting information on entrepreneurs’ NoNs. The information found on smart phones can help us further understand the nature of the interaction and communication between human beings. For example, mobile phones allow us to observe the geographical position of their carriers, to analyse the call logs or text messages to determine the frequency of communications between two carriers and to study the use of the internet through mobile phones. Jointly, this kind of information can provide us with large amounts of data that sheds light on human behaviour in real-life situations and can help us predict interactions among individuals constituting a particular group, such as entrepreneurs.

The recent literature on mobile phone networks has mainly adopted one of two perspectives: either the physical patterns of mobile phone networks have been analysed or a social perspective has been used to understand mobile phone networks. The physical perspective focuses on complex networks and analyses the network structure (graph) by looking at those non-trivial topological features that do not occur in simple networks, such as lattices or random graphs. The social perspective primarily reflects on how people communicate and interact with each other through mobile phones.

As we know, mobile phone data itself can provide interesting insights, for instance, the way mobile phone viruses spread (Wang, Gonzalez, Hidalgo, & Barabasi, 2009), and human mobility patterns that can be traced from a mobile phone user’s position (Gonzalez, Hidalgo, & Barabasi, 2008). Moreover, this data reflects the interaction and communication between human beings, such as heterogeneous calling activities (Candia et al., 2008) and mobile
communication networks (Onnela et al., 2007). In short, these studies make it clear that mobile phone data can provide relevant insights for research.

In addition to making phone calls and sending text messages, recent developments in mobile phone technology allow people to use the internet on the mobile phone, as well as small applications which allow them to communicate with each other in new ways. Adopting a qualitative view on mobile phone networks, Chen and Katz (2009) observed the pattern of mobile phone usage between college students and their families in order to analyse how mobile phones affect university students’ lives. The research was conducted through focus-group interviews and focused on how college students use mobile phones to communicate with their parents. Furthermore, text messages can be used to collect and provide feedback when experiments are conducted in larger classes (Cheung & Lee, 2010).

Despite the relevant qualitative insights into mobile phone usage, these studies did not quantitatively analyse the structure or the dynamics of mobile phone networks. However, it is particularly these aspects of mobile phone networks that can provide us with novel insights into the dynamics and patterns of social networks – NoNs – over time, given the overwhelming number of mobile phone users. For example, inferring real networks from mobile phone network data (Palla, Barabasi, & Vicsek, 2007), researchers have studied scientists’ collaborative networks and mobile phone network users. Eagle et al. (2009) inferred a friendship network structure by using mobile phone data and compared it with the real friendship network by correlation analysis, in which three types of information were collected to map networks – communication (via call logs), location (via mobile phone towers) and proximity to others (via repeated Bluetooth scans).

As we suggested, smart phones can be used as a tool to collect NoN data. With smart phone data collection, we can observe when a node is added or broken off from an existing network. The findings of such a study will be twofold. On the one hand, we will explore the different purposes for which entrepreneurial start-ups make use of SNSs. Equally important is exploring why they do not use certain SNSs (Boyd and Ellison, 2007). We will use these insights to understand why particular SNSs are more important for entrepreneurial start-ups than others. In addition, these insights will be used to assess the relationship between the use of SNSs and entrepreneurial performance.

Depending on the results, such a study could make several contributions. First, mapping and visualizing the closed network of entrepreneurial start-ups shows how SNSs support the building and maintaining of the social networks of entrepreneurs involved in starting up ventures. Second, exploring the different purposes for which such entrepreneurs use SNSs
can help us understand how SNSs are used in organizational contexts and why certain SNSs are considered less significant from a business perspective. Third, analysing the relationship between the use of SNSs and entrepreneurial performance provides insights into the benefits of SNSs for venture start-ups. Therefore, such a study would contribute an understanding of how SNSs are used in organizational contexts and more specifically in the context of entrepreneurial start-ups, and provide insights into the benefits of online social networks for entrepreneurial start-ups.

Based on existing research on mobile phone networks, we can draw two conclusions. First, most of these studies focus on the physical patterns of the mobile phone networks using a complex network approach. Second, very little work emphasizes the social elements of the mobile phone network or has analysed human interaction and communication in detail. In other words, the majority of mobile phone network studies neglect the social aspect of mobile phone networks, given their focus on physical characteristics. This is due to practical problems associated with telecommunication companies collecting mobile phone data, such as privacy laws.

We believe that analysing entrepreneurs’ mobile phone networks can provide relevant contributions to research on human behaviour such as that related to entrepreneurship and to the study of entrepreneurs’ NoNs. As the mobile phone network is an NoN, it has all the characteristics of social networks, allowing us to use the same measures as we use in relation to social networks. Individual entrepreneurs will be the unit of analysis for this study. We also suggest that the structure and dynamics of entrepreneurs’ social networks can also be studied using smart phone network data. The network data can be extracted from mobile phone call logs and mobile phone internet usage by gaining access to online social networking sites.

### 6.6 Limitations and conclusions

One of the limitations of this dissertation is the lack of data on entrepreneurial performance. Due to the limitations of our data collection method, we need more extensive performance data to support the whole design of this study. Nevertheless, we managed to collect a large amount of network data by sending our survey link randomly to entrepreneurs in the Netherlands. The boundary for this network is very broad, in other words, we do not have a lot of edges in the graph of our network.

Alternatively, we might also adopt methods similar to those we designed for extracting data from online social networks using smart phones which access the internet. We would only
gain access to the entrepreneurs’ online social network if they accessed the survey via smart phones. Applying the survey used here and improving it for use on smart phones would allow us to conduct our future research in another way. In order to collect mobile phone network data, both from the mobile network and the LinkedIn online network, several practical issues need to be given special attention. For example, entrepreneurs are generally reluctant to provide detailed calling records, because this is private or sensitive information. An alternative would be to provide entrepreneurs with smart phones which are already programmed to store and transfer the data. Our future study will provide entrepreneurs with IPhones as this will offer an additional incentive for engaging in the study.

In this thesis, we mainly focused on entrepreneurs’ online social networks. The idea of this research project was to address the influence of online social networks, due to the ubiquitous use of the internet and smart phones. The thesis did not link entrepreneurs’ online social networks to their offline networks; however, our simulation model could be used as an approach to study entrepreneurs’ offline networks. The connection between online social networks and offline networks should be addressed in future research.

During the entrepreneurial process, the network can be used to search for information and resources. In addition, the interaction and communication between entrepreneurs can also influence their business decisions. The complex nature of this interaction remains a question for the future.