Networks of Growth: Case Young Innovative Companies in Finland

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Abstract: In this paper, we explore a vital part of the Finnish innovation ecosystem: young, innovative companies that are supported for fast international growth. Highlighting the importance of networks, we proceed to analyze the perceived existing relationships these companies have with other companies, financing organizations as well as with individuals taking part in their co-creation. We propose that these existing relationships, or connections, may be used to explain the firm as a resource integrator within a network, contributing to its growth and success. Overall, we propose that network analysis and resulting network visualizations can provide novel insights into the understanding of possibilities for global growth and success.

Key words: innovation, growth, networks, network analysis, young companies

1 Introduction

Networks (whether you call them innovation networks or business networks) address the notion that value creation, and especially innovation activities, are rarely carried out within a single organization in the flat-world economy (Friedman, 2005). Rather, resources are extracted from multiple sources; see e.g. Triple Helix Model highlighting the university-business-government interactions (Etzkowitz and Leydesdorff 2000); open innovation referring to the idea that ideas could come from both inside or outside of the company (Chesbrough 2003), and co-creation emphasizing collaboration with customers, suppliers and other stakeholders (Ramaswamy and Gouillart 2010). Service-dominant logic takes this even further as it states that all economic and social actors are resource integrators, implying that the context of value creation is in networks (Vargo and Lusch 2004, Vargo 2009). These networks rely on the infrastructure of relationships of people and organizations, and relationships are recognized as channels through which resources flow (Wind and Fung 2008), in forms such as linkages between executives (Ibarra and Hansen 2011). Therefore, in the background of this study is the understanding that innovation takes place in the context of relationships that form a network via the linkages between firms and their human and financial resources (Russell et al. 2011), manifesting between people, in teams, organizations as well as between organisations.

In this study, we explore approaches for understanding the participation of a company in the networked world. We propose that looking at existing relationships of firms as resource integrators according to Vargo provides glimpses of the participation of the company, and can show the channels, or access, to needed resources, or other resource integrators in the network. Flows of knowledge are also recognized as important resources in networks: sharing, acquiring and deploying knowledge is integral in networks (Dhanaraj and Parkhe 2006). On individual level good communication and social skills, and interactions are seen important; on organizational level formal and informal communication channels and knowledge exchange forums are highlighted for creating a strong reputation that enhances operating in networked environments (Ritala et al. 2009).

As network actors are clearly social actors, we propose using social network analysis (SNA, which has been used for several decades to study the sociological relationships of people and organization) to gain insights into the social configurations of the network (Wellman and Berkowitz 1988; Wasserman and Faust 1994). For example, network analysis has been used to study the interdependence of industries and nations (Yim and Kang 2008) as well as the dependence of innovation networks on knowledge flows (Owen-Smith and Powell 2004) and to explore the investment flows into an innovation ecosystem (Huhtamäki et al. 2011). One of the benefits of network analysis is in enabling investigators of networks to gain insight in the social configurations of the networks and in supporting them in communicating their findings to others (Freeman 2009).

2 Research methodology: Case young innovative companies in Finland

We will be using a case-study methodology into exploring the possibilities of growth and success of SME companies, and the role of networks in it. The explanatory nature of a case study approach, and its applicability to social studies (Yin 1994) guided our selection. In addition, case-study methodology is seen to provide detailed and analysed information about real world environments which can be seen as examples of phenomena under research, allowing the researcher to answer "how" and "why" questions (Benbasat 1987), which are seen relevant for this study.

We will be using an integral part of the Finnish innovation ecosystem called "Program for funding young innovative companies" as our case environment. The case environment is presented as an example of an approach to take in order to gain insight on the people- and investor-based networks surrounding and possibly interconnecting companies.

2.1 Program for young innovative companies in Finland

According to Statistics Finland, "Of all enterprises, 99.1 per cent were small enterprises, that is, employing under 50 persons. They employed 48 per cent of all personnel and accounted for 35 per cent of total turnover (http://www.stat.fi/til/syr/2010/syr_2010_2011-11-25_tie_001_en.html). Overall, the contribution of small companies to Finnish society and its wealth creation as well as employment creation is enormous. Consequently, the Finnish innovation ecosystem and its guiding policies have recently been emphasizing the role of these SMEs, start-ups and growth companies, also due to the changes attributed to restructuring of Nokia Corporation.

The Finnish Funding Agency for technology and development Tekes has a major role in building and sustaining the Finnish innovation ecosystem, through funding and other services that it provides for individual companies as well as clusters of organizations. In 2011 Tekes made funding decisions regarding 1,928 projects, which resulted in total investment of €610 million, of which 58 per cent was targeted at SMEs (Tekes annual review 2011, http://www.tekes.fi/u/Annual_Review_2011.pdf). Tekes new strategy reflects the new emphasis in Finland: it states that it gives priority to growth-seeking, innovative SMEs (http://www.tekes.fi/en/community/Structure/557/Structure/1428).

One example of the Tekes strategy is program for "funding for young innovative companies", supporting young companies for international growth. Through it, Tekes not only provides funding resources, but also other resources, such as expertise and experience of its personnel, access to accelerator environments, and as well as its connections, for the selected companies so that they can grow and succeed in global markets. This program was initiated in 2011. It is intended for a company that (1) has a capacity and willingness to strive for fast international growth, (2) has products or services that can generate considerable business, (3) has a credible growth plan, and a committed and skilled management team, (4) has been in operation for less than 6 years and is small, and (5) invests strongly in innovation activities (http://www.tekes.fi/en/community/Young_innovative_growth_enterprises/1155/Young_innovative_growth_enterprises/2528).

2.2 Using social media data

Our approach to explaining the possibilities for growth and success for young innovative companies is to show how the companies participate in the world, seen through the lense of social media. Towards this goal, we will be using data-driven, network centric methods and two sets of data.

First, this study takes and extends the approach of Ecosystem Network Analysis that has been applied e.g. when looking into the co-creator configuration of Finnish Innovation Ecosystem (Huhtamäki et al. 2011). Accordingly, as data source, the IEN dataset (Rubens et al. 2010) will be used: a socially constructed dataset, which is built by crawling the Internet for socially curated information on press-worthy technology-based companies, their executives and board level personnel, and investment organizations as well as transaction flows. It is socially constructed, like Wikipedia, referring to the fact that individuals can add data to it when they want (they can also verify and correct its data), therefore contributing to its availability and timeliness, but also to its potentially erroneous data and public bias. Therefore, it basically has the power to combine the interesting activities happening in technology-based companies, and can show how different actors are

connected. The dataset is a rather large one: in April 2012 it includes over 100,000 people, 80,000 companies and 7,000 financial organizations, and is based on sources in English.

We see that when something interesting and newsworthy happens in the company, it wants to share its news and communicates through its web site, press releases, or through its social media activities which also allows for engagement with the surrounding ecosystem resulting in impacting the perception of the company. This interesting information can prompt individuals within the company or outside the company to add its information that then ends to IEN dataset and eventually to network analysis.

> *Our assumption is that at least some of the Young Innovative Companies are included in the IEN dataset. The resulting visualizations of their relationships to other individuals, organizations and investors may provide insights into understanding ways to act as resource integrators for growth.*

The second method of analysis looks at social media presence of Young Innovative Companies from a different perspective. Therefore, it is proposed to provide findings for bringing forth at least some of their activities in attracting resources and using their resources for engaging the innovation ecosystem around them, impacting the perception of the company. This provides an alternative and, at the same time, broader view of social networks surrounding the companies. For example, it allows for bringing forth the activities of users and customers in relation to the individual company. Hence, we reached for Twitter as a social media allowing relatively straightforward data-collection in real-time.

> *Our assumption is that especially using social media the companies want to interact with their environment. By looking at their Twitter activities, we can see the networks of their resource integration interactions, including those with users and customers, within this social media platform.*

3 Findings

Our findings present the two separate, yet interrelated sets of analysis and resulting visualizations that explain how young innovative companies that are part of the Tekes program are seen to participate in the world. For visualization, we used Gephi, an open interactive visualization and exploration platform for networks (Bastian, Heymann and Jacomy, 2009) for graph metrics, visualization and layout. Traversing and other network-creation procedures are implemented as Python-based batch processes. MongoDB, an open source document-oriented NoSQL database system, was used for managing the data.

3.1 Networks based on IEN dataset

In their public website, Tekes provides a list of companies that were included in its Young Innovative companies program by 31.12.2011. In all, 94 companies are listed. As only the name of the company is mentioned, we applied a fuzzy text-matching algorithm Levenshtein to bring up the potential company instances in IEN Dataset. To ensure that we do not include any false positive matches or miss false negatives, we set the match threshold to 0.7 and double-checked the matches manually.

A total of 33 (contributing to 35 percent) of the Young Innovative Companies were found in IEN dataset. For these companies, we could proceed with the network analysis.

To present the individuals and investors co-creating companies within the Finnish innovation ecosystem, we processed the network layout in two stages: (1) cluster-based stage, (2) relation-based compacting stage. In the cluster-based stage we use OpenOrd layout algorithm (Martin, Brown, Klavans and Boyack 2011) since it produces a layout that allows us to better distinguishing clusters based on the interconnections between the nodes. We then apply the Force Atlas (Bastian, Heymann and Jacomy 2009) to compact the graph (nodes that are connected to each other are pulled closer together) and to make the representation more easy to read and aesthetically pleasing. The network visualizations are embedded in the document by using vector graphics so it is possible to look at network details by zooming in.

Modeling of the network is an important part of the visualization process. Here, the resulting network is a directed one with connections pointing from individuals and investors towards companies. Instead of using node outdegree for sizing the nodes (cf. Huhtamäki et al. 2011), we chose to size the nodes

proportional to their betweenness centrality, i.e. the amount of times a node is included in the shortest path between any two nodes in the network. Betweenness was select to highlight the individuals, companies and investors that have an important connecting role in the network as a whole instead of solely having a large amount of direct connections. For easier viewing, we used different colors to characterize the three kinds of nodes in the network: light blue nodes represent Young Innovative Companies, green nodes represent venture capital investors – individual people, companies and financial organizations that have invested to at least one Young Innovative Company, and blue nodes represent people that have a press worthy relationship to a company. The positions of individuals vary from CEO and board membership to positions on research and development activities. However, for this visualization we have removed the names of individuals, as we recognize the limitations of the dataset as well as want to emphasize the patterns instead of particular individuals. Then, for easier storytelling purposes, we split the visualization process into two steps. Both present the networks and relationships of Young Innovative Companies.

The first visualization (Figure 1) presents the direct network of Young Innovative Companies, showing the people that are working or have been working in the companies, and the investors (both individuals as well as organizations) that have invested in these companies. Tekes Young Innovative Companies (YIC) program is in the center, as it is the connecting entity through its financing activities (all of the Young Innovative Companies are connected to it). The network visualization also shows the connections between these actors: (a) some individuals are connected with more than one company, and (b) some investors are connected with more than one company. It hence introduces a network of 119 actors and 130 connections. We can see that several companies have clusters of actors around them, indicating the number of their direct connections. The participation of investors in this network, marked by green nodes, is also clear.

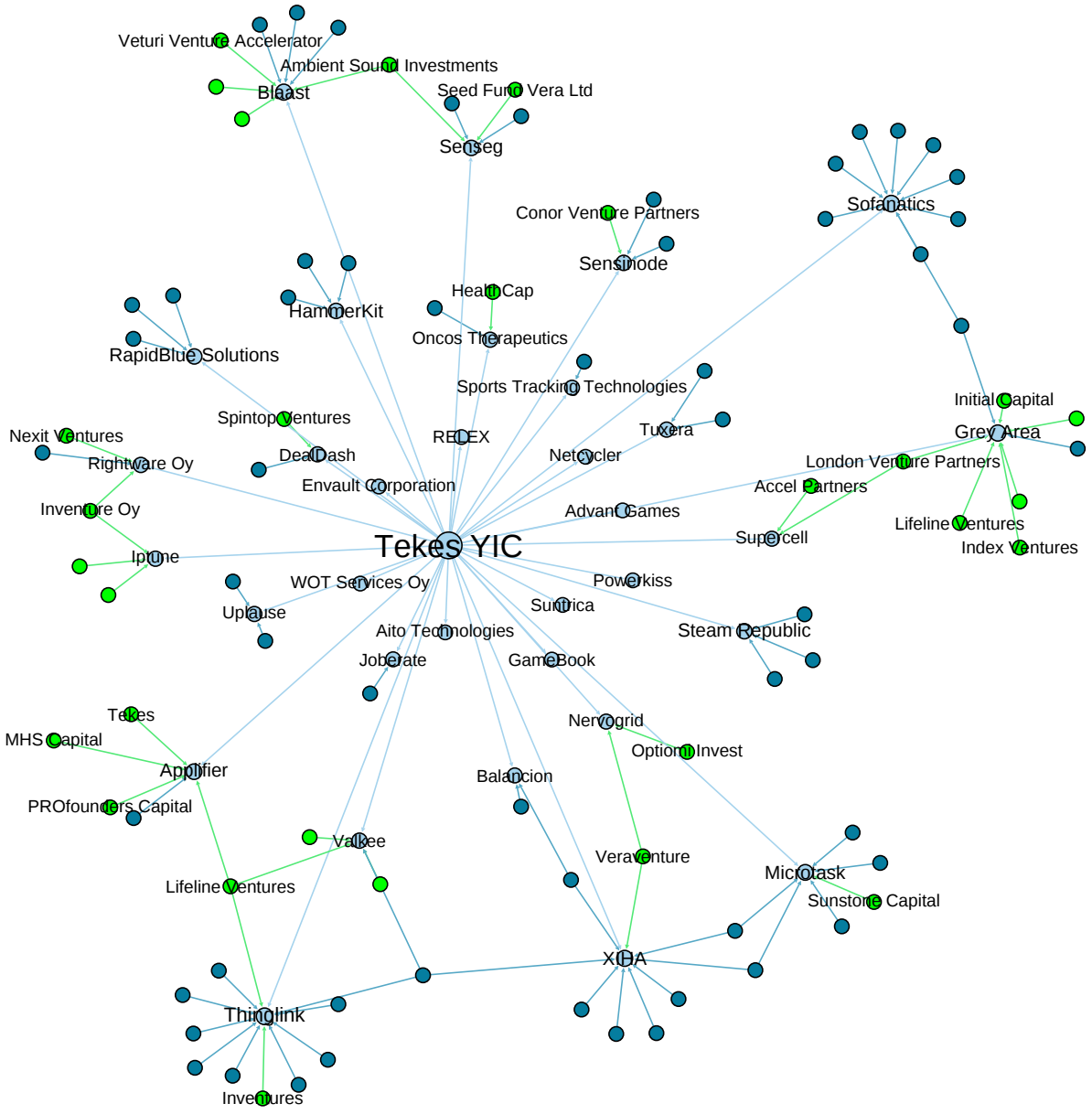

Figure 1. 1-step network visualization of the Tekes Young Innovative Companies and their direct connections

The second visualization (Figure 2) provides a view toward the horizon behind the immediate connections. We traverse through each individual in the first level network to include all companies, represented in red, that the people are connected into but not included in Tekes Young Innovative Companies program. Moreover, people and investors related to the newly added companies are included. The visualization hence adds new actors and connections beyond the direct connections, introducing a network total of 786 actors and 815 connections—a network that could be within reach for Young Innovative Companies in their resource integrating activities. The clusters of individuals and investors around Young Innovative Companies as well as their related companies become evident in the visualization. Due to the visualization technique (node size indicating the betweenness of the actor), one node representing an individual stands out: according to the data, this person is the only individual directly connecting Nokia with Google (the latter with a large number of individuals connected with it), which of course is a significant role. In all, this individual is connected to 12 companies, out of which 3 are included in Tekes Young Innovate Companies program. Further, the presence of Google becomes dominant due to the number of individuals connected. While this may not be truly representative of the Finnish innovation ecosystem, it reflects the global nature of networks as well as Google's key role in the global innovation ecosystem.

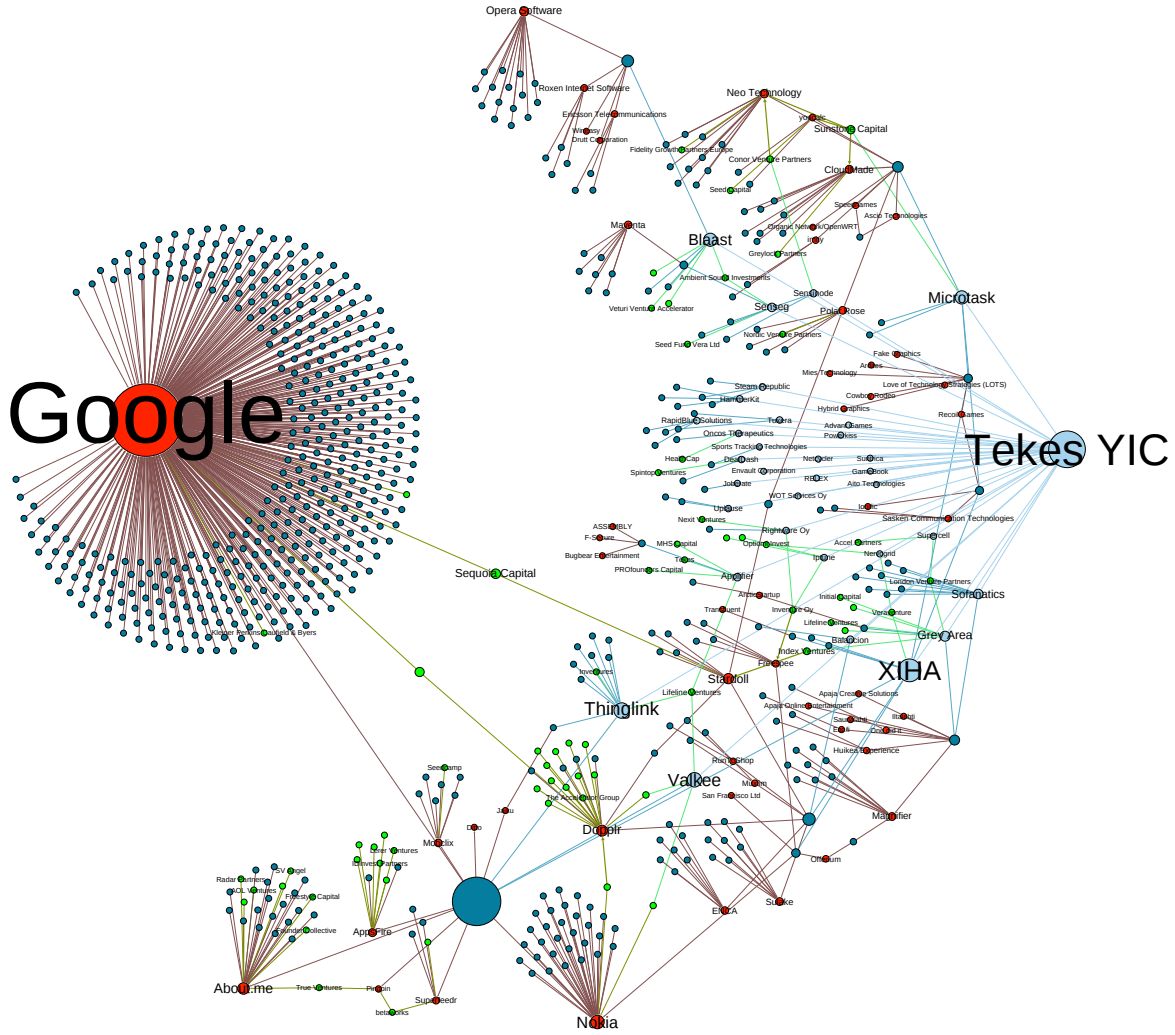

Figure 2. 3-step network visualization of Tekes Young Innovative Companies, their direct connections and the companies, investors and individuals that can be reached through the direct connections

3.2. Networks based on Twitter

For a list of Twitter accounts of Young Innovative companies, we first queried the IEN Dataset and complemented the list by manually adding the missing account information. In all, 46 Twitter accounts were found for the 94 Tekes Young Innovative Companies (49 %). Through a tailor-made batch script, we collected followers for each company through the Twitter API. A total of more than 70 000 followers were found for the companies.

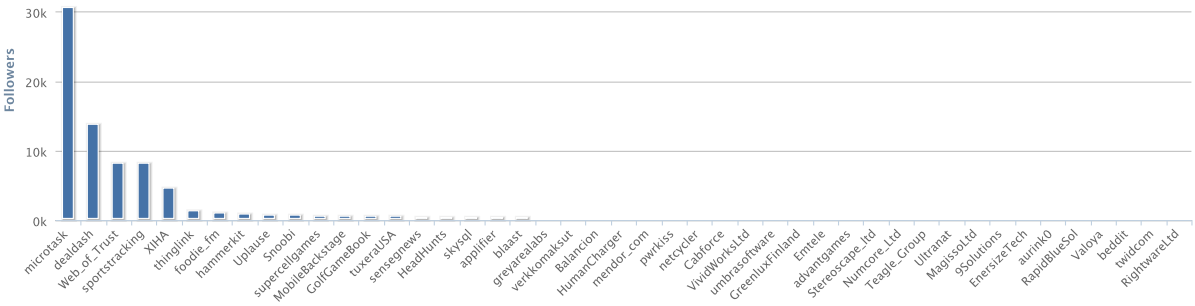

Figure 3. The distribution of Twitter follower count for Tekes Young Innovative Companies

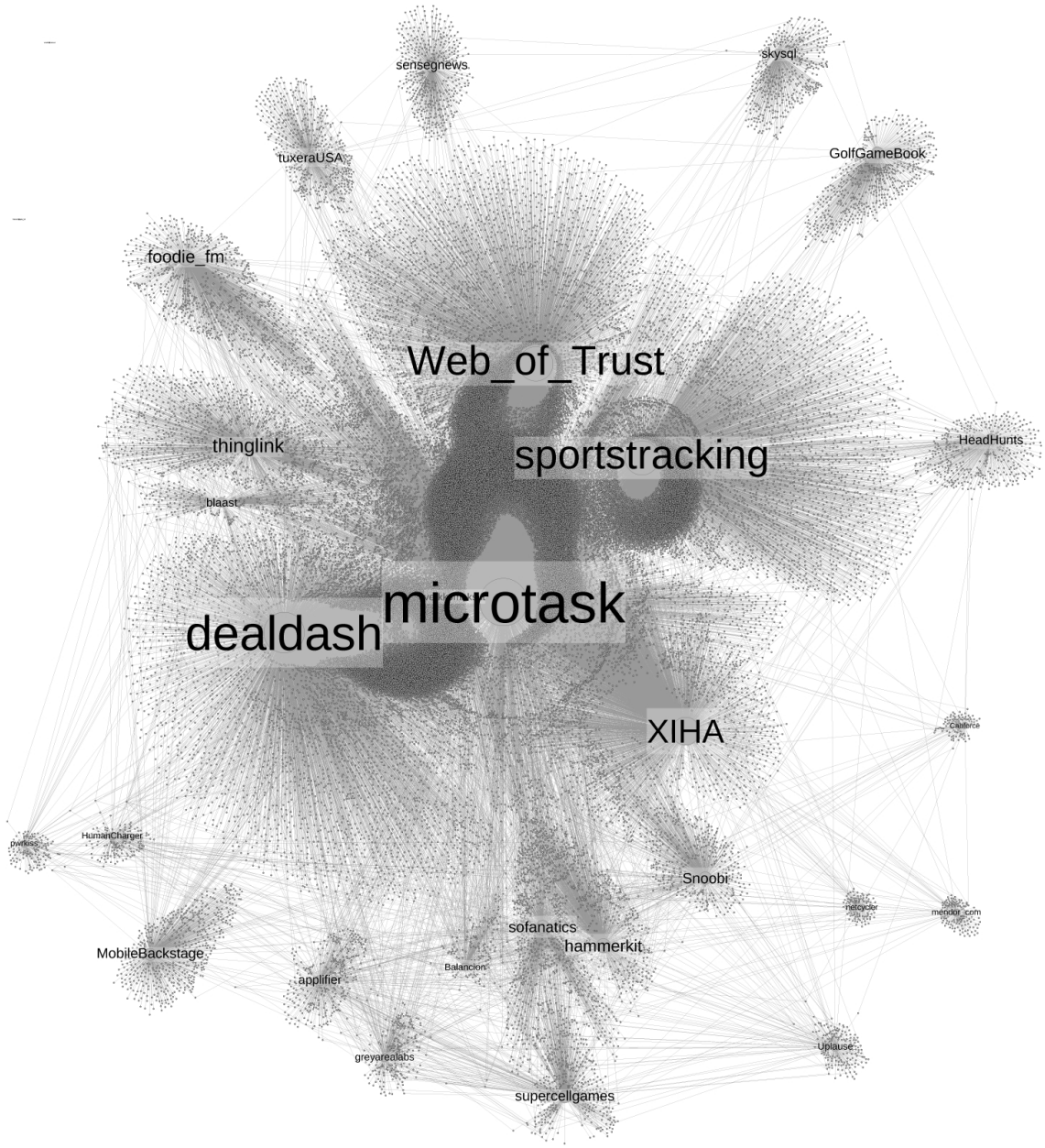

Figure 4. Network of Tekes Young Innovative Companies and their followers

Figure 3 shows the distribution of Twitter follower count for the different companies. As we can see, Microtask (http://www.microtask.com/), a company providing solutions to human powered document processing, has attracted over 30,000 followers and a few other companies have some thousands of followers. However, for most of the companies the follower count is small. This power law like distribution is commonly found in networks that are scale free (Barabási and Bonabeau 2003): this

means that as a result of the process of preferential attachment, one actor dominates the connections in a network. We see that in this context, direct conclusions should not be drawn from the values for individual companies. Rather, a more valuable approach for providing insights on follower data is to create an overall or ecosystemic view to the companies.

For showing the Twitter-mediated interlinkages between the companies, we created a union of 1-step egocentric networks. In other words, the followers of a company were connected to a company with a directed connection but the connections between the followers were not included. Again, a combination of clustering and relation-based compacting stages were used to layout the network. The resulting visualization in Figure 4 shows all the 72,880 nodes and 75,755 connections in the network and can be used to pinpoint e.g. patterns in follower-based connections between the companies. We chose to present a view to the network where node size is representational to its indegree, i.e. the number of Twitter followers of a company. We acknowledge that the modeling and visualization design decisions depend on the questions that one seeks to discuss and answer with the help of the network: if one would be interested in finding the most active followers in the network, node size should be proportional to its outdegree. To find the companies that are most strongly connected to each other through shared followers, a one mode network of companies could be created with connection weight proportional to the number of shared followers. For example, Microtask shares the most amount of followers with other companies: 444 followers with XIHA; 188 with Web of Trust and 155 with Hammerkit.

4. Discussion

Our goal was to explore the networks of growth of Tekes Young Innovative Companies using social network analysis, social media data and network visualizations. We wanted to highlight the role of companies as resource integrators within networks, acting with other resource integrators in order to succeed and grow. Through the process from social media data through analysis we produced concrete visualizations of the networks. Our findings made visible the existing relationships that young Innovative Companies in Finland have: (1) directly with individuals and financing organizations, (2) with individuals, other organizations and financing organizations within their reach, and (3) with people and organizations interacting with them. They show that Young Innovative Companies already have connections (both direct and indirect ones) with a number of individuals and organizations through which they can access resources and interact with resources needed for their growth and success, and due to the nature of data from social media, these visualizations are rather timely snapshots. Hence, we want to highlight that the results are often not generalizable or conclusive. This should not come as a surprise when taking into account the complex, paradoxical and context-sensitive nature of innovation.

First, we evaluated the process and results internally. Initially, we explored the fact that not all Young Innovative Companies were found in the IEN dataset. Through the analysis of their websites, we found out that only a few of the companies did not have their web site in English and that most of them actively issue press releases and news to communicate about them (also in English)—therefore they seem to be actively gearing for international communication and presence, and have the potential for being added into the IEN dataset, furthermore demonstrating the applicability of using the IEN dataset for analysing this sample of the Finnish innovation ecosystem. However, to be included into the IEN dataset requires activities of individuals for recognizing and adding entities to it (either within or outside of the companies), which means that we acknowledge that there are individuals, companies, and financing organizations missing from it, which can be explained with the concept “public bias”. In addition, we addressed the limited connections that are visible in the IEN dataset: for example, we know that certain individuals are married, have gone to school together, and might be neighbors—these connections are not visible in the IEN dataset nor in Twitter data, altogether highlighting the fact that some actions take place in social media or can be traced through social media and some remain outside of it.

As our proposition is that the network visualizations can provide insights for Young Innovative Companies as well as for the ecosystem trying to support them, we then presented the visualizations to experts of the Finnish innovation ecosystem at Tekes for their evaluation, and discussed the value of the process and the results with them. We noted that as network analysis and visualizations are not traditional ways of exploring innovation, the first reaction was “interesting, fascinating”, followed by questions (1) about the methods of producing the visualization: Why is this individual node so big?

What do these different colors of line mean? and (2) about the meaning of the overall results: Is this about gatekeepers in networks? About weak ties? Is this a system? What is the bigger phenomenon that can be explained with these visualizations? Only after arriving in the shared understanding about the visualizations and what they represent, the experts had comments about insights of them: for example, one of them commented that “I would have expected company X to have more connections”. One novelty offered by the visualizations was clearly that it showed the investors within the network— this was something that the experts had not seen before and something that the data they have routinely access to does not show. They then proceeded to provide suggestions for allowing for better and clearer insights: indicating by color the Finnish and international actors of the networks, indicating the specific market segments of companies (for example mobile, gaming, pharma etc.), and bringing in timelines, for example for showing what connections have formed after the company has become participant of the Tekes Young Innovative Companies program.

The kind of modeling used in both parts of this study can be utilized to create network views for further insights on several complementary aspects. First, due to the fact that the networks are directed, node indegree and outdegree values can be used to highlight actors in different roles. In Twitter analysis, for example, the companies that have the most followers have a large indegree and the Twitter users that follow many companies a large outdegree. Second, as the first part of the study shows, betweenness value provides an easy and intuitive way to find actors that have a particularly significant role as connectors in the network. Finally, the network can be filtered or split to smaller pieces e.g. in Twitter case to find individuals following a specific set of companies, for example, operating in the same domain.

We are tempted to suggest the process of navigation as a metaphor or analogy for the kind of cartography we provide here: while being a long way from a modern proactive car navigator, the visualizations shown here make the topology of parts of innovation ecosystem explicit. Indeed, visual network analysis affords investigators insights on the (often latent) (social) configurations of the networks and allows sharing the insights to others (cf. Freeman 2009). The results presented in this article represent the first evolution of the analysis. In order to validate the approach, we plan to engage with different stakeholders to see both what is missing from the networks and, even more interestingly, what are the new insights that the networks afford the stakeholders.

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