

Analyzing Success of Startup Entrepreneurs by Measuring their Social Network Distance to a Business Networking Hub

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Abstract. In this project we compare the success of startup entrepreneurs and innovators with their social networking behavior. In particular, we analyze the LinkedIn, Facebook, and e-Mail network of swissnex, Switzerland's science and technology outpost in Boston connecting Swiss and American entrepreneurs and academics for collaborative work. We invited 500 members of the swissnex community to share their networking data, leading to 72 LinkedIn and 31 Facebook ego networks. We also included one month of all e-mail traffic of swissnex. We find that centrality in the network predicts entrepreneurial and academic success: the more central actors are in the different types of networks, the more successful they are. We also include the metric of "proximity" to key people, including the swissnex director as well as a longtime Boston entrepreneur and academic. We again find that proximity in the LinkedIn network to these two people correlates with business and academic success of the members of the swissnex community.

Keywords: entrepreneurship, social network analysis, social networking, LinkedIn, Facebook, social networking hub.

Introduction

Established business wisdom tells that networking is key for founders of startups and others that push new ideas and innovation, especially in high tech circles. A wide body of research has been looking at what type of network might be indicative of and even supportive for successful entrepreneurs. Most of this analysis so far has been based on "real" "face-to-face" networks. These face-to-face networks were constructed by different means. One way to model ties was the so-called interlocking directorates of board members, where two different companies have a tie if the same director sits on the boards of both companies. Benefits of this construct were seen as far back as to Imperial Germany (Fohlin 1999). A second type of network is the supplier-manufacturer relationship, where Uzzi (1997), studying a sample of apparel manufacturers in New York, discovered the "paradox of embeddedness", meaning that being embedded into a close-knit group of entrepreneurs is good for business performance – up to a point, after which the entrepreneur loses flexibility in the case of external shocks such as an economic crisis. On the other hand, alumni networks seem to provide a powerful knowledge advantage for mutual fund managers. (Cohen et al 2008) found that fund managers preferably bought stock of companies whose board members were alumni of the same university, and they also achieved higher returns on those investment compared to their average portfolio. Another way to construct networks is through the strategic alliances between firms. Schilling and Phelps (2007) found that firms with high clustering and high reach to other companies were more innovative than others. Raz and Gloor (2007), looking at Israeli software startups, found that startups whose founders had more formal and informal ties had a higher chance to survive the burst of the e-business bubble.

While all of these links are collected in the "brick and mortar" world, online social networking is becoming increasingly important also for business. Networks such as LinkedIn and its German sibling, Xing, are seen as essential business tools for executive recruiters, HR administrators, sales and marketing

managers, and startup entrepreneurs. In earlier work, (Nann et. al. 2010) found a correlation between central network position of entrepreneurs in Xing, and their business success. In later work, however, a more differentiated picture emerged, where having too many online friends was detrimental to longtime startup success.

In this project we compare the professional success of scientists and startup entrepreneurs with their social networking behavior. In particular, we analyze the social network of the swissnex Boston community. swissnex Boston is the consulate of Switzerland in the Boston area, dedicated primarily to education, research, and innovation. swissnex Boston is part of a network of five Science and Technology outposts in the United States (Boston and San Francisco) and Asia (Singapore, Shanghai and Bangalore) run by the Swiss State Secretariat for Education and Research. One of its key objectives is to support the activities of Swiss scientists, researchers and startup entrepreneurs in the Boston area by assisting them to build their networks and exchange knowledge with their local counterparts

Our business project goal was to make the contributions of swissnex Boston more measurable in order to assess the efficiency of their community-building efforts and to see the impact of their programs on the professional success of each segment of their community. As the mission of swissnex Boston consists of nurturing connections among Swiss and American innovators, our approach was to analyze the networks brokered by the efforts of swissnex staff. Collecting the LinkedIn and Facebook network of entrepreneurs, academics and researchers allows us to compare their centrality in the social network and their proximity in the network to key swissnex Boston staff members with their professional success. Furthermore, by mapping the interactions within the swissnex Boston community, this analysis will allow swissnex Boston to evaluate which sub-categories of their transatlantic network need to better connected. The study will also be a useful management tool for such a novel organization by giving tangible measure of its relationship-building activities, which it can then communicate to its stakeholders.

Method

We conducted a survey sent out by e-mail to 500 close contacts of swissnex, asking about the satisfaction of swissnex customers. Some members of the community only participate in selected events whereas others actively engage in networking activities seeking or offering more connections in their industry. We also asked for the general and monetary value participants attached to their interaction with swissnex as well as for new services they might want to obtain in the future from swissnex. The survey was answered by 39 Swiss entrepreneurs, 23 US entrepreneurs, 36 Swiss academics, and 41 US academics, leading to a response rate of 28%. We also asked the participants to share their LinkedIn and Facebook networks, obtaining LinkedIn networks from 72 respondents with a total of 15913 actors, and Facebook networks from 31 respondents with a total of 6928 actors. In addition we also collected the e-mail headers of 50 days worth of full e-mail traffic in spring 2011 at swissnex.

In addition to obtaining direct answers to our questions in the survey, we compared the success of the entrepreneurs and academics with their social network position in the Facebook and LinkedIn networks. Success was measured by manually evaluating entrepreneurs and academics on the Web, looking at their Facebook page, LinkedIn page, Google Scholar listings, company Web sites, and any other online sources we could find. Table1 shows our definition of the professional success of entrepreneurs and academics.

Table 1. Evaluation of professional success of entrepreneurs and academics

Success Level	Description Entrepreneurs	Description Researcher
1	Company bankrupt / web site not existing / side business < 1 year	0 papers in Google Scholar
2	Company in business < 5 years / side business	1 paper in Google Scholar
3	Small or medium size business > 5 years / main income / successful	2-5 papers in Google Scholar
4	Medium size / family business/ stable / very successful	5-10 papers in Google Scholar
5	Large company / highly successful projects / external funding / rewards	>10 papers in Google Scholar

We also did an evaluation of the individual job level that each person reported (table 2).

Table 2. Evaluation of individual success of entrepreneurs and academics

Success Level	Description Entrepreneur	Description Academic
1	Specialist, Manager	Grad student
2	Senior Executive, Management Team	Post-Doc
3	CEO	Prof/ Senior Researcher

Figure 1 show the distribution of success of the 226 people who were manually rated, selected by snowball-sampling by betweenness centrality in the LinkedIn-Network. Combined success was calculated as the product of professional success and individual success. An interrater reliability analysis using the Kappa statistic (Landis & Koch 1977) was performed to determine consistency among raters with Kappa = 0.52*** (N=77).

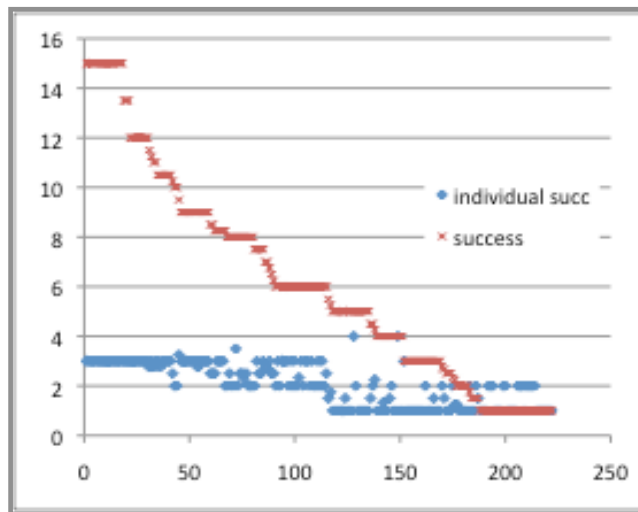


Figure 1. Distribution of combined success among participants (N=226)

As figure 1 shows, combined success is exponentially distributed among the swissnex-affiliated entrepreneurs, with very few entrepreneurs and academics being considerably more successful than the rest. In the results section we will investigate whether the position in the social network bears any relation with the success of the individual academic or entrepreneur.

Analyzing the LinkedIn Network

We found that the LinkedIn and Facebook networks exhibit substantial differences. The LinkedIn network is clearly focused on business use. Figure 2 shows the LinkedIn network of all respondents. Pink dots are the people who are either swissnex staff or relations from the swissnex staff. Purple dots are people who are either Swiss entrepreneurs or their relations. Brown dots are people who are either US entrepreneurs or their relations. Green dots are Swiss researchers or their relations. Blue dots are US researchers or their relations. Looking at the picture of the LinkedIn network shows that there is a noticeable split between Swiss and US entrepreneurs, with the Swiss academics (green) “bridging structural holes” between Swiss entrepreneurs (purple) and US entrepreneurs (brown), while the US academics (blue) are fairly isolated. The fact that Swiss entrepreneurs’ networks tend to cluster can be explained by their participation in the diverse entrepreneurship programs launched by swissnex over the past 10 years. The Swissnex staff members (pink dots) clearly act as connectors, bringing together the members of the four diverse groups.

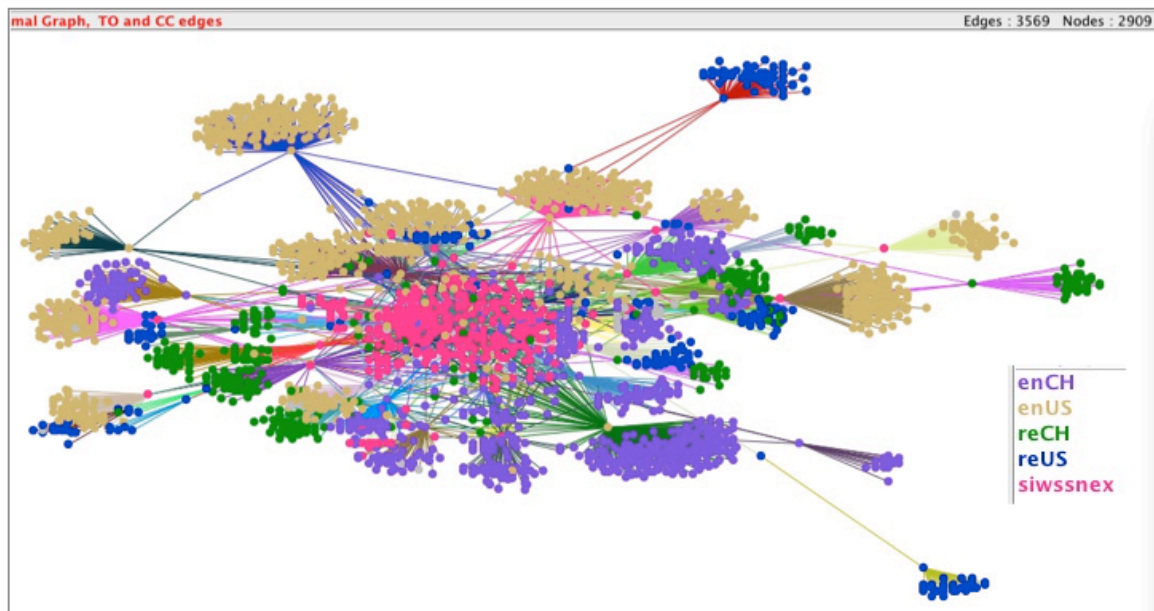


Fig. 2. Social Network of LinkendIn respondents (N=72)

The social network position in the LinkedIn network nicely predicts the success of an academic or entrepreneur. Being more central in the LinkedIn network (table 3) is an indicator of success both for degree ($R=0.238^{**}$) and betweenness ($R=0.199^{*}$) centrality (Wassermann & Faust 1994), this means that the more central a person is in the network, the more successful s/he is. This means that swissnex succeeded in building up a network of successful people. However we still have to answer the question of causality: are people more successful because they are central in the network, and thus close to the swissnex staff, or are they more central because they are successful. We speculate that both assumptions are partly true: more successful people are more sought out as networking partners, and are thus more central in the business network. The central presence of successful people will also facilitate and improve – through mentoring and networking activities – the professional development of young talented researchers and entrepreneurs and thus increase their centrality over time.

Table 3. Correlations between success and social network position in Facebook and LinkedIn networks

		Individual success	Combined success
Degree centrality in Facebook	Pearson Correlation	.108	-.010
	Sig. (2-tailed)	.339	.928
	N	81	81
Betweenness centrality in Facebook	Pearson Correlation	.115	.126
	Sig. (2-tailed)	.307	.264
	N	81	81
Degree centrality in LinkedIn	Pearson Correlation	.238**	.225**
	Sig. (2-tailed)	.006	.010
	N	131	131
Betweenness centrality in LinkedIn	Pearson Correlation	.199*	.165
	Sig. (2-tailed)	.023	.060
	N	131	131

Analyzing the Facebook Network

In contrast to the LinkedIn network, the Facebook network is more scattered and spread out. There is no clustering among the four categories (US and Swiss entrepreneurs, US and Swiss academics). The center around members of the Swissnex staff is also less dense compared to the LinkedIn network, nevertheless the blue cluster in the center around the Swissnex director is somewhat more crowded than the rest (figure 3). It seems that most people use Facebook differently from LinkedIn, making a distinction between managing their business contacts in LinkedIn and their private friends in Facebooks. This also shows in the larger number of entrepreneurs we were able to identify and evaluate in the LinkedIn network (131 out of the 226 we looked up) as compared to the Facebook network, where through snowball sampling of the network created by the 31 respondents who had donated their Facebook network, we were only able to identify and evaluate 81 entrepreneurs and academics.

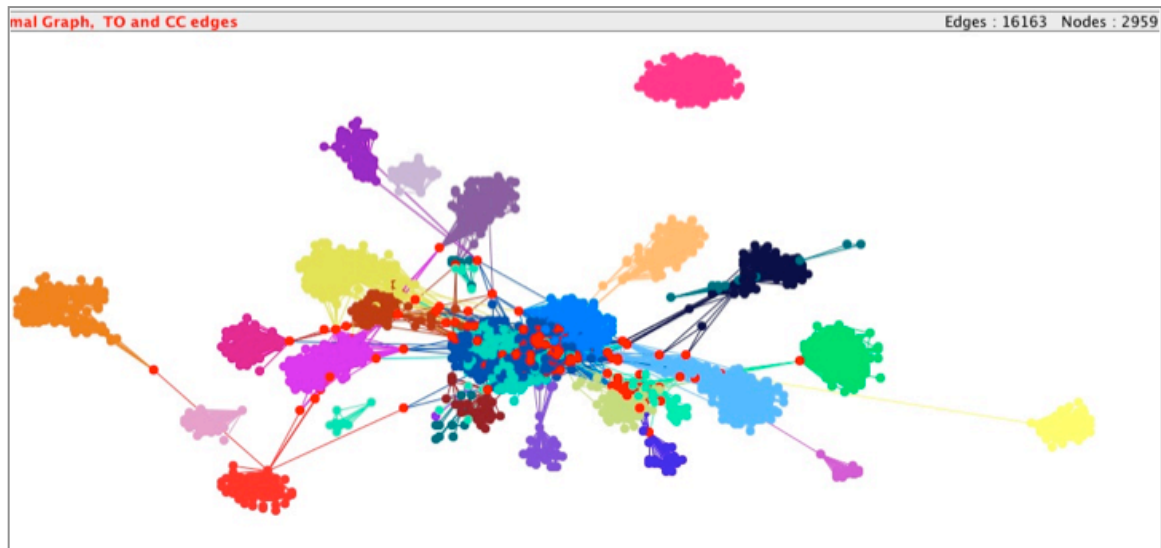


Fig. 3 Social Network of Facebook respondents (N=31)

More central people in the Facebook network are also more somewhat successful, but the correlations are rather weak and non-significant (top two rows in table 3). Degree centrality in the Facebook network has no predictive power at all, this means that the number of Facebook friends does not predict the business or

academic success. Betweenness centrality position in the Facebook-Network is a better predictor of individual success, although it is not significant ($R=0.126$, $p=0.264$). This might suggest that at least a few people are indeed using Facebook to manage their professional contacts, just like in LinkedIn.

Analyzing the Combined LinkedIn and Facebook Network

We therefore speculate that the combined LinkedIn and Facebook network, created through combining the 72 LinkedIn networks with the 31 Facebook networks, might have the best predictive power to measure individual success. Figure 4 shows the combined network, thanks to the strong clustering effect of their LinkedIn network, the swissnex staff members show up in the center of the combined network (figure 4). The social networks of the Swiss entrepreneurs (lighter blue) and the US entrepreneurs (pink) are the most dominant, although they again have little overlap, US entrepreneurs are in the top half of the graph, Swiss entrepreneurs in the bottom half. Swiss researchers (dark blue) and US researchers (green) are scattered throughout the network, their absolute number is relatively small. Visually, the US entrepreneurs and their networking friends seem to be the strongest group. As the number of uploading US entrepreneurs was relatively small, this tells us that the average LinkedIn network of an US entrepreneur is larger than the one of their Swiss counterparts. Entrepreneurs also seem to have larger networks than academics or at least use online social networking more intensively.

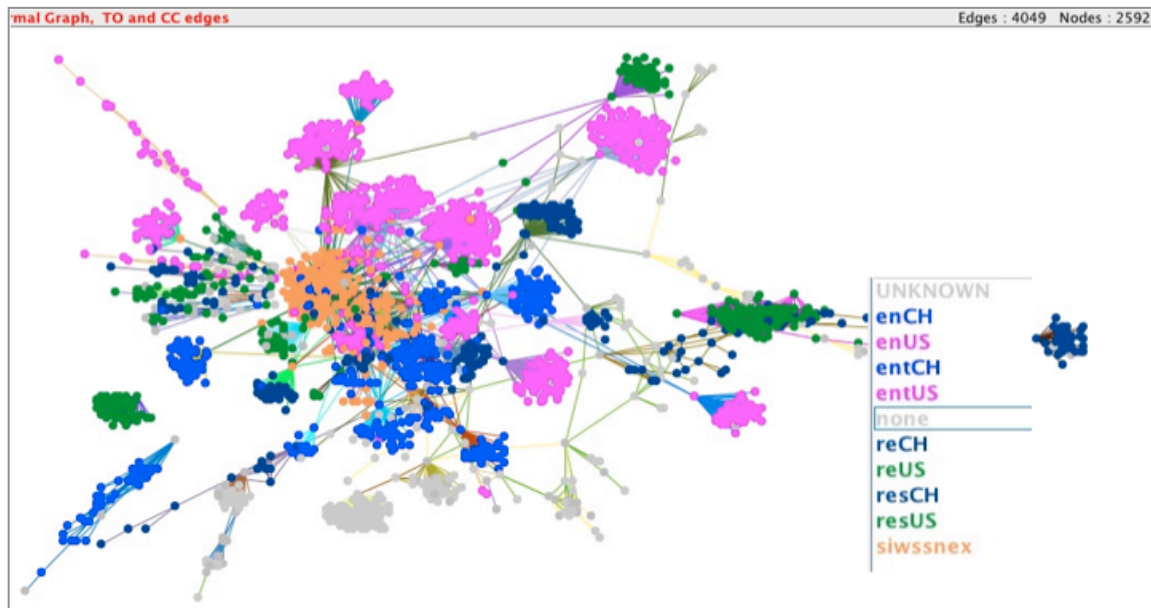


Fig. 4. Social Network combined by Facebook and LinkedIn profiles ($N=103$), 24,176 actors, 70,924 edges, colored by role (top 3000 actors shown)

It turns out that the combined LinkedIn and Facebook network is indeed the best indicator of success: the more friends an actor has in this network, the more individual success s/he has ($R=0.409^{**}$), see table 4. We also calculated the correlations for the separated samples of academics and entrepreneurs, respectively. Both samples show the same behavior, although the effect is stronger for academics ($R=0.371^{*}$) than for entrepreneurs ($R=0.166$, $p=0.382$). This does not answer the question of causality, however: are people more central because they have been successful in the past, or will they become even more successful because they are central in the swissnex network. Based on prior work doing an longitudinal analysis in a German entrepreneurship network (Nann et. al. 2010) we suspect a combined effect: more successful people know about the value of business networking, and will therefore spend more time connecting to potential academic collaborators and business partners, while also being actively contacted by other participants at swissnex events. Therefore they will be more central in the swissnex

network. On the other hand, through their more active networking, they will also become more successful in their entrepreneurial and academic ventures.

Table 4. Correlations between social network position and success in combined Facebook and LinkedIn network

		Individual success
Degree centrality combined network, all people	Pearson	.409**
	Sig. (2-tailed)	.000
	N	131
Degree centrality combined network, academics	Pearson	.371*
	Sig. (2-tailed)	.013
	N	44
Degree centrality combined network, entrepreneurs	Pearson	.166
	Sig. (2-tailed)	.382
	N	30

Measuring Entrepreneurship and Academic Success by Proximity to the Stars

To better understand the role of key networkers at swissnex, we define the new metric of “proximity” to the “stars”. In particular, we measure the social distance between a person whose friendship we consider beneficial to business success and all the other people in the LinkedIn and Facebook network. We are looking to find a negative correlation between proximity and business success: the smaller proximity is, i.e. the closer a person is to the “star”, the more successful the other people in the network are. In other words, proximity is the number of networking steps it takes a person to reach a “star”.

Table 5 lists the results. Proximity to the swissnex director is beneficial for people both in the LinkedIn and Facebook networks, although the effect is stronger for the LinkedIn network ($R=-0.200^*$). On the other hand, people close in the LinkedIn network to the academic counselor and the startup counselor are less successful. The opposite is true for the Facebook network, where people with smaller proximity, i.e. who are closer to the academic counselor and the startup counselor, are more successful. This might suggest that many people who are searching LinkedIn-friendship with the academic counselor and the startup counselor are not particularly successful.

Table 5. Correlations between proximity to stars and entrepreneurial or academic success

		Combined success	Individual success
Director-fb	Pearson Correlation	-.140	-.078
	Sig. (2-tailed)	.316	.580
	N	53	53
Startup-counselor-fb	Pearson Correlation	-.144	-.103
	Sig. (2-tailed)	.304	.461
	N	53	53
Academic-counselor-fb	Pearson Correlation	-.204	-.158
	Sig. (2-tailed)	.143	.258
	N	53	53
Customer1-fb	Pearson Correlation	.142	.198
	Sig. (2-tailed)	.311	.156
	N	53	53
Customer2-fb	Pearson Correlation	-.030	-.046
	Sig. (2-tailed)	.832	.745
	N	53	53
Customer1-ln	Pearson Correlation	-.187*	-.218*
	Sig. (2-tailed)	.031	.012
	N	133	133
Director-ln	Pearson Correlation	-.141	-.200*
	Sig. (2-tailed)	.104	.021
	N	133	133
Startup-counselor-ln	Pearson Correlation	.156	.042
	Sig. (2-tailed)	.072	.629
	N	133	133
Academic-counselor-ln	Pearson Correlation	.121	.112
	Sig. (2-tailed)	.166	.199
	N	133	133
Deputy-director-ln	Pearson Correlation	.037	-.044
	Sig. (2-tailed)	.674	.616
	N	133	133
Entrepreneurship-counselor-ln	Pearson Correlation	-.012	-.109
	Sig. (2-tailed)	.893	.211
	N	133	133

There is the interesting case of an active swissnex participant – both academic and researcher – who is not a staff member of swissnex. People in his proximity in the LinkedIn network are significantly more successful ($R=-0.218^*$) than people less close to him. The opposite is true, however, for his Facebook network. People close to him are less successful than people further away in the network. It therefore seems that he uses LinkedIn (for managing business contacts) and Facebook (for his private friends) in very different ways, not choosing his friends for their business success.

This suggests that there is quite a difference in the way the LinkedIn and Facebook networks are used and structured. It seems that some swissnex staff members, such as the director, use Facebook similarly to LinkedIn, managing their professional relationships, although individual correlations are lower than for the LinkedIn proximities. But for instance the swissnex participant, whose LinkedIn proximity is a strong predictor of success for the people close to him, showed the opposite effect in the Facebook network, in that Facebook proximity to him predicts less business success.

Evaluation the E-Mail Network of swissnex Staff

To better understand the dynamics of collaboration at swissnex, we also collected one month of full e-mail communication. To respect privacy, we only collected the e-mail headers and timestamps. Figure 5 shows the results. The top picture displays the full network of all people at swissnex including those who at least

exchanged 50 e-mail messages. The blue dots are people from the .ch domains, i.e. with Swiss e-mail addresses. As can be seen, they appear quite prominently in the network, mostly with admin.ch addresses, i.e. the functional supervisors of swissnex at the Swiss Secretariat of State for Education and Research and the Swiss department of Foreign Affairs. By using the “core/periphery” function of the social network analysis tool Condor (Gloor & Zhao 2004) we identify the core people in the network. In figure 5 these are the big black dots. It turns out this is the core swissnex staff, as we would have hoped. Overall the social networking structure indicates a healthy swissnex staff team network, where team members are collaborating very well.

One surprising result was that the overlap between people in the e-mail archive, and people in the Facebook and LinkedIn networks was rather small: out of the 1958 names in the e-mail archive, only 450 were also in the swissnex Facebook or LinkedIn network. Out of the top 257 Facebook and LinkedIn people (ranked by degree centrality) only 27 were in the e-mail archive. This shows that the work network, indicated by e-mail exchange, and the social network of swissnex customers in LinkedIn and Facebook are two separate worlds. It might be worth exploring how they could be connected.

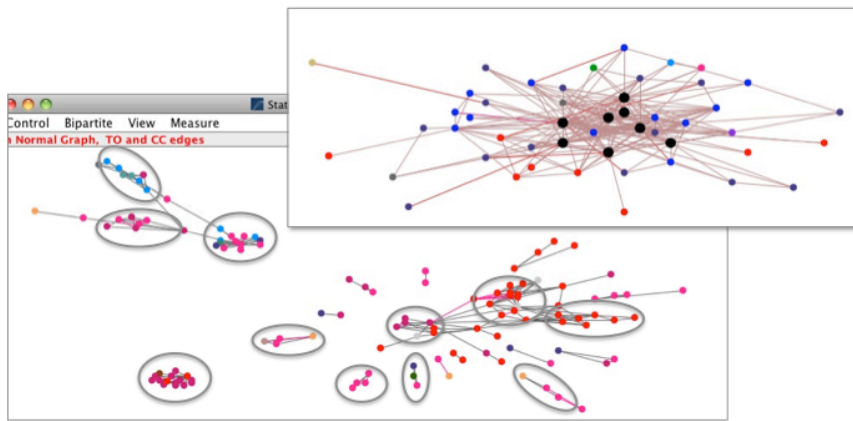


Figure 5. Top: Full e-mail network, only people who have at least exchanged 50 e-mails, colored by domain. Big black dots in the core are the key Swissnex staff members. Bottom: All swissnex staff removed, only people shown who have exchanged at least 5 e-mails

To look for new and emerging Collaborative Innovation Networks (COINs) (Gloor, 2006) in the e-mail network, we removed all swissnex staff members. As the network at the bottom of figure 5 illustrates, even without swissnex staff there are a dozen small groups, fully connected subgraphs where every team member is communicating with every other team member. This type of network is a good indicator of a healthy innovation network. The small groups are all prime candidates for COINs. To check if these cliques are indeed COINs, i.e. engaged in collaborative innovation, or if they were just organizing barbecue parties, we would now have to read the content – which we could not do because of privacy concerns, or do interviews with the team members. As organizing social events and parties is one of the key innovative activities of Swissnex, we speculate that most of the cliques in the bottom window of figure 5 are indeed COINs engaged into creative projects on behalf of swissnex customers in research and entrepreneurship. Even if some private communication is included into the network, it will still give an accurate picture of social relationships between swissnex employees (top picture in figure 5) and between members of the swissnex community (bottom picture in figure 5).

Facebook Demographics of Swissnex Customers

To better understand the key interests of the swissnex constituency, we also collected the Facebook profiles of the people who “like” the swissnex fan page. Aggregating Facebook profiles this way offers easy access to accumulated demographic information which would have to be laboriously collected otherwise through surveys, polls, or focus groups. Analyzing the “likes” of the 879 people who “like” the swissnex Facebook page identifies the most popular topics.



Fig. 6. Most liked Facebook pages of people who clicked the “like” button on the Swissnex Facebook page

Figure 6 illustrates the fan network of the swissnex community, with the fan pages shown as actors, and a link between two fan pages drawn if it is liked by the same person. This way we can easily measure the popularity of fan pages through network position and metrics such as degree or betweenness centrality. In decreasing order of popularity, we find that “Roger Federer”, “Barack Obama” are most popular among the swissnex community, followed by technology and political topics such as “TED” the “The Economist”, and “NPR”. Further popular topics are the “ThinkSwiss” program that promotes Swiss science and research in the US and “swissnex San Francisco”. Finally also topics such as MOMA (the museum of modern art in NYC) are popular. We obtain indeed an excellent and highly relevant demographic profile of the constituency of swissnex Boston, illustrating that the swissnex community likes Roger Federer (not really surprising), might be more liberal or international (liking Barack Obama), and high-tech oriented (TED), while cultural aspects, although present, are less high on the priority list.

Conclusions

In this study we have shown through the lens of social network analysis that swissnex is doing an efficient job supporting aspiring Swiss entrepreneurs and academics in the greater Boston area. Swiss scientists and innovators are prominently represented within the community, however there is also a vibrant community of US entrepreneurs and academics who connect to their Swiss counterparts. We have been able to show that the better the innovators are connected to the swissnex core team, the more successful they are. But we still have not conclusively answered the question of causality between networking position and business success. We speculate, however, that the link of causality goes both ways. Innovators become more successful, if they actively network with the swissnex community. On the other hand, with increasing success they also become ever more attractive as networking partners for the other members of the community, leading to a positively reinforced feedback loop: success begets success, the better connected members are, the more successful they become, and the more successful they are, the better they get connected.

These findings also motivate some recommendations for swissnex to further increase business networking efficiency: one goal would be to increase the density of the community network by identifying central hubs, and have special networking events connecting these community leaders, leading to increased connectivity and proximity of the entire network. Another idea might be to connect members of the unconnected groups in the e-mail network in figure 5, picking a topic of shared interest to create newly combined COINs. Another idea would be to set up a LinkedIn or Facebook-based matchmaking application, which would allow Swissnex members to search for potential networking partners at swissnex events prior to the event.

While our results are still preliminary, they nevertheless illustrate that studying online social networks is an excellent way to analyze the efficiency of business networking organizations.

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