Location matters – measuring the efficiency of business social networking

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Abstract: This paper contributes to measuring the efficiency of business social networking events and organisations. In particular, we analysed the communication at Swiss House for Advanced Research and Technology (now Consulate of Switzerland/Swissnex Boston; formerly SHARE), an organisation whose mission is to foster collaboration networks between the scientific and entrepreneurial communities of Switzerland and the greater Boston area. The study consists of two parts. In the first part, SHARE's social network growth over more than a year was measured through an analysis of its e-mail traffic. In the second part, growth of social networks of individuals participating in a set of networking events during a collaboration programme over one week was measured through a web survey. Comparing individual social network growth through attendance and individual follow-up at events organised in Boston and San Francisco demonstrated creation of a much denser network in Boston – with an almost even split between academic and industrial participants in Boston, while the majority of participants in the Silicon Valley came from industry. Boston's academic participants acted as information brokers, building bridges between industrial participants from Boston and Switzerland.

Keywords: business networking; Social Network Analysis; SNA; Collaborative Innovation Networks; COINs; business networking hub; Silicon Valley; Boston area high-tech cluster.

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1   Introduction

There are many professional networking associations such as chambers of commerce, trade associations, and regional economic development agencies. Their common goal is to act as networking hubs, assisting members to build better internal and external networks for mutual learning, collaboration and deal-making. All of these networking organisations have the common problem, however, of proving their added value to their affiliates. This paper uses a Social Network Analysis (SNA) approach (Wasserman and Faust, 1994) to measure the growth and sustainability of new networks of members and partners of professional networking hubs. SNA is a growing field, combining the power of new technologies with techniques from social sciences (Cross et al., 2004). It is a diagnostic tool that organisations use to assess their positions within a network or the virtual communities around them.

This paper measures the added value of SHARE, a networking hub connecting entrepreneurs, researchers and investors from Switzerland and New England through SNA. According to its website, "The Swiss House for Advanced Research and Education (SHARE) is the world's first digital Consulate and serves as a link between the scientific, academic, and high-tech communities of New England and Switzerland. SHARE is a community that is both physical and virtual". Although it is a Swiss institution, it is physically located in Cambridge, MA.

We use a social network approach to understand how SHARE contributes to the development of the second leading technology region in the USA, the greater Boston area, in the past also called 'Route 128' (Castilla et al., 2000).

Our approach consists of collecting SHARE's entire e-mail logs over a period of 450 days to identify and assess communication patterns within SHARE and with its customers (Gloor, 2005). In addition, we also invited participants at a SHARE networking event to respond to a two-part online survey to report with whom they had made new contacts, and if they derived additional value from those new connections. As analysis tool we are using Temporal Communication Flow Analysis (TeCFlow) (Gloor and Zhao, 2004). TeCFlow creates visual maps and temporal movies of a network based on relationships between people by analysing communication archives such as e-mail and phone logs, mailing list or web access.

2   E-mail analysis of SHARE

The first part of our analysis relies on mining e-mail archives from February 2004 to April 2005. TeCFlow allows for various levels of analysis. To address privacy and confidentiality concerns, we only collected the header information about who was sending a message to whom at what time. For privacy reasons, the names of all external e-mail senders and recipients were anonymised. The first step was to create a map showing the communication patterns of each month. To eliminate spam and passive mailings, only two-way e-mail communication, where a receiver responded to a message, was included. Figure 1 displays all e-mail communication of the SHARE staff members during October 2004. Each line represents an e-mail relation. The shorter the distance between two people, the higher their frequency of communication. This graph illustrates – as was to be expected – that SHARE staff members occupy the central positions within the overall communication network, and that from the perspective of SHARE staff members very few communities outside of SHARE develop.

Figure 1   Social network of SHARE over one month (for colours see online version)
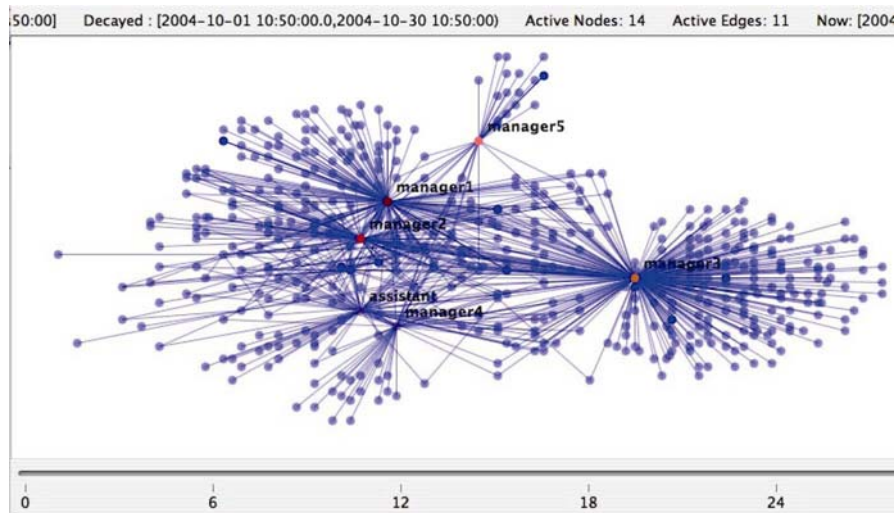
This contrasts with SNA of other organisations done by the authors (Grippa et al., 2006; Zilli et al., 2006), where through the lens of the different mailboxes of group members, the emergence of outside communities could be observed.

2.1   Measure the growth of new customers

To measure the contribution of SHARE, we assessed the acquisition of new members into the growing social network of SHARE. We were mostly interested in 'repeat customers', defined as users who are connected by more than 30 messages over the entire e-mail observation period of 14 months.

Most new users send only a few e-mails. SHARE gets a fair amount of new users every month, both from the people who find out about it online or through direct marketing efforts of SHARE. For example, SHARE ranks high in Google keyword

searches such as 'innovation in Boston'. However, the majority of those contacts don't interact repeatedly with the team. They may sign up on the mailing list, drop in for a visit, share information with other visitors and SHARE staff, but only rarely engage in extended discussions which might lead to a long-time collaboration with SHARE and its sponsor firms in Switzerland. To exclude those occasional visitors, we focused on the high-traffic-volume customers.

Figure 2 illustrates new customers having more than 30 e-mail interactions with SHARE staff over the course of the entire 420-day observation period. There is an initial peak of new customers at the beginning of the observation period. This is because it will be easier for customers showing up for the first time at the beginning of the observation period to get over the 30-message threshold. After normalising the number of new users for their shrinking time window towards the end of the observation period, by multiplying the number of new users per day with a factor inversely proportional to the remaining time window, there is a noticeable growth trend in the number of new customers, indicating growing popularity of SHARE.

Figure 2   Growth of new users over 420 days (normalised over 420 days)
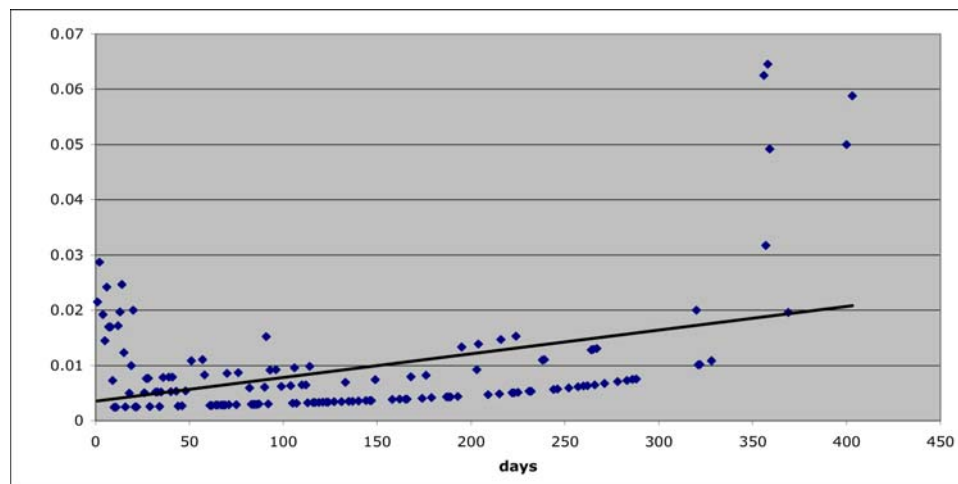

Figure 3 shows the temporal social surface (Gloor, 2005) of the SHARE social network over the observation periods. A temporal social surface plots all actors (*y*-axis) over time (*x*-axis) against their betweenness centrality on the *z*-axis. As Figure 3 shows, the population of low-frequency users (with low betweenness) is growing steadily. There is a very small group of highly active (high-betweenness) users at the very left (with high values on the *z*-axis), who dominate discussion – the SHARE staff itself. In order to increase customer participation, it might be recommendable to somewhat decrease betweenness of the highly central SHARE staff. This would also support SHARE's role of fostering creation of new Collaborative Innovation Networks (COINs) (Gloor, 2006). As will be shown later in Subsection 2.3 in Figure 6, this is indeed what is happening within SHARE.

Figure 3 Social surface of SHARE participants over one year
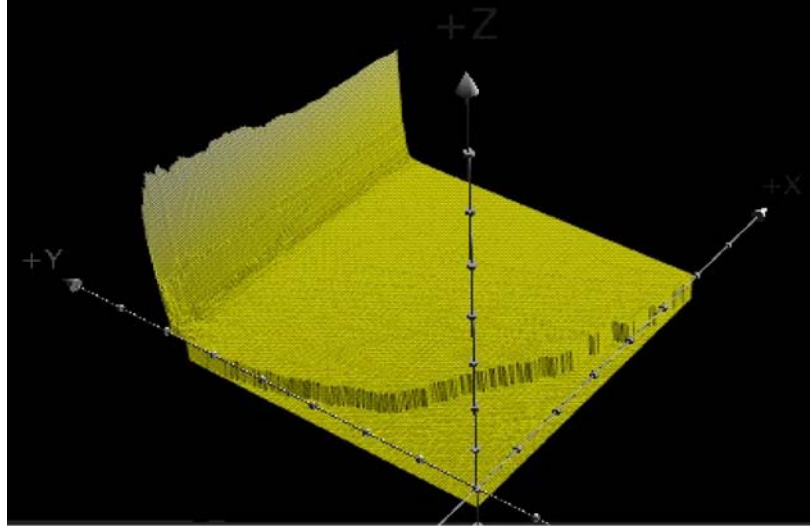
2.2 Find strongest organisational ties

We also wanted to categorise and characterise SHARE's outside connections. In particular, we wanted to obtain the most active external communication partners of SHARE. To determine with whom SHARE connects, we used TeCFlow to collect monthly statistics on the number of messages exchanged with outside organisations, as defined by the organisation part of the e-mail address. Figures 4 and 5 show in which countries (domains) and which organisations the most active external communications originated.

Figure 4 Most linked organisations to SHARE (for colours see online version)
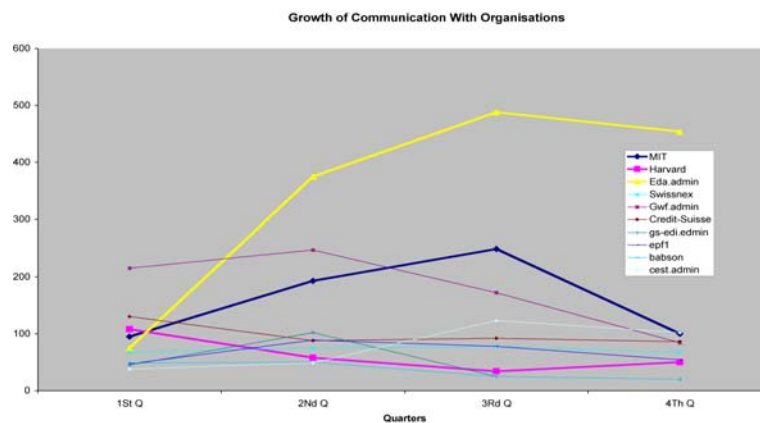
Figure 5   Most linked domains (for colours see online version)
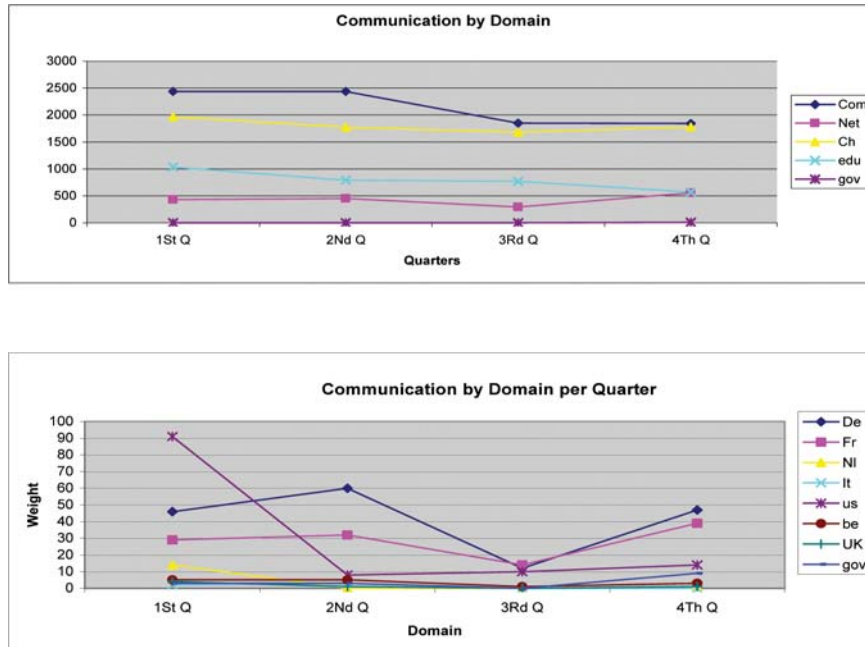
Not surprisingly, communication was most active with the Swiss government. Among local partners, SHARE communicated twice as often with MIT than with Harvard. This is in contradiction with the results of Allen (1984) about the correlation between physical proximity and frequency of communication. SHARE is situated at Broadway in Cambridge, right in between MIT and Harvard, although much closer to Harvard than to MIT. As it turns out, however, SHARE communicates much more with MIT. In the interviews with SHARE staff, we learned that they had several projects with MIT including an architecture exhibit and that MIT was home to a large number of Swiss-related postdocs.

Figure 4 also illustrates that the most frequent communication partner of SHARE is the Swiss Department of External Affairs, to whom SHARE reports. If this traffic – information from colleagues from other Swiss consulates, daily newsletters of information and project-related communications with administration partners (Eda.admin, Swissnex, Gwf.admin, Credit-Suisse and gs.edi.admin) – is excluded, the next-most active interaction is with MIT and Harvard. This is exactly how it should be, as SHARE was set up to foster interaction between the Swiss business and research community and Harvard and MIT.

We repeated the same analysis grouping communication by internet domains. It turns out that SHARE is communicating most with partners in the .com domain. Second most active domain is .ch, the Swiss domain, composed of traffic with Swiss authorities and Swiss companies and organisational institutions. The third most active domain is .edu, i.e. US educational institutions. This is positive news, as this shows that SHARE is fulfilling its charter of linking the business communities in Switzerland and the USA with the educational domain.

In addition, SHARE also fulfils a role as toehold for students of other European descent. The bottom half of Figure 5 illustrates intensive communication with users from Germany, France, the Netherlands, Italy, Belgium and the UK.

2.3 Roles of individuals

Figure 6 illustrates the activities of the different staff members at SHARE. As the main reason for its existence is brokering new connections, betweenness centrality (Freeman, 1979) is an excellent metric for the analysis of the different roles. Figure 6 illustrates the changes in betweenness centrality of key individuals at SHARE over 475 days.

Figure 6 Changes in Betweenness Centrality of key roles at SHARE (for colours see online version)
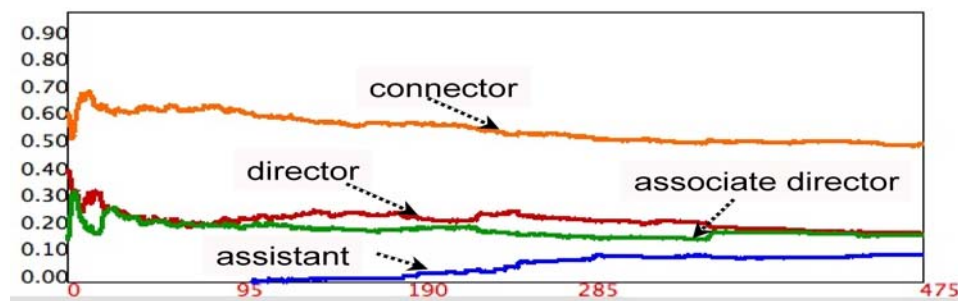
The main builders of the SHARE community, whom we have termed the 'connector', the director and associate director show a marked decrease in betweenness centrality during the observation period. This can be interpreted as a reduction in their role as central animators. Or in other words, the community is developing a life of its own, which is precisely the goal that SHARE is trying to reach.

To resume, a small team of professional connectors and community builders seems to succeed in building a growing and self-sustaining community. While the core members of SHARE are very central within the community, a reduction in their centrality is noticeable over time, which is consistent with the larger goal of fostering an active community.

A few results stand out. Counter to the expectation of having approximately the same amount of communication with Harvard and MIT, collaboration with MIT seems more intense. This might also be based on Switzerland's long tradition of successful innovation in high-tech such as Swiss watches, power plants and biotech – leading to strong interaction ties between Swiss technical universities such as Swiss Federal Institute of Technology (ETH) and MIT.

Also, besides the core community of SHARE staff members, few outside groups and project teams are recognisable. This is another area of improvement, where SHARE could assume an even more prominent role of a builder of bridges, connecting structural holes (Burt, 1992) between communities in different economical, geographical and cultural strata of society.

3   Measuring the impact of business networking

This section analyses growth of social networks of individual participants of a series of network-building events which took place approximately 10 months after the e-mail analysis described earlier was concluded. Through an in-depth SNA, we measured SHARE's network-building capacity on the individual event and individual actor level.

In particular, we studied an event jointly organised in spring 2006 by SHARE and another business networking hub located in San Francisco. In March 2006, the Swiss Federal Innovation Promotion Agency (CTI) organised a US network-building tour. The goal of the Swiss Federal Innovation Promotion Agency is to encourage and subsidise the transition of scientific results to the market, by funding highly innovative projects, encouraging national and international networking and formation of dedicated research consortia. To connect the delegates in Boston, 64 participants affiliated with 46 different organisations were invited to a series of events, while in San Francisco 56 participants from 52 different organisations participated in the programme. One first interesting finding – compatible with the respective reputations of the greater Boston area and the Silicon Valley – was the fact that in Boston a full 39% of participants were academics, while the rest were entrepreners, venture capitalists and consultants, i.e. from industry. In San Francisco, only 14% of the participants were academics, and 86% from industry. This fits well with the reputation of the Silicon Valley as the entrepreneurial hotbed of America.

In order to get quantitative data about the frequency of interaction between participants, two web surveys were conducted. We asked all participants in Boston and San Francisco to recall the number of times they had interacted with CTI members and people they got to know during the two events in Boston and San Francisco. We asked them to specify how many times they had interaction with each other by (1) face-to-face meetings, (2) phone calls or VoIP calls, (3) e-mail (4) social networking websites (e.g. LinkedIn, OpenBC).

We also conducted in-depth interviews with five actors to understand the sort of business relationships developed during the event. We gathered qualitative data through phone and in-person interviews, where key actors were asked to freely discuss topics such as follow-up opportunities generated from the CTI study tour, the financial value derived from follow-up opportunities, the meaning of the relation with specific actors, and if there had been other types of pre-existing relationships with participants (e.g. friendship). The goal of these interviews was to better understand the growth process of business relationships initiated at networking events. Interview partners were chosen according to actors' centrality in the network and the potential for business opportunities assessed by us. We interviewed two of the top managers of CTI, a business angel investor who was one of the most central actors among the participants, and two actors who had arranged the study tour.

We sent out by e-mail two web questionnaires to the 132 participants three and eight weeks after the CTI visit. Besides collecting quantitative data on the frequency of interaction, the web survey gave the possibility to provide free comments and suggestions to the event's organisers to improve collaboration.

In the next section we analyse the social network as reported in the online questionnaires. We first look at the entire network. In the second part, we compare network-building behaviour in Boston and in San Francisco.

3.1 CTI network-building analysis

Comparing the different types of networks led to some interesting insights. E-mail is the predominant mode for *developing* business relationships, with 65% of the total 3729 connections between pairs of actors; it is highly centralised around the SHARE coordinator and exhibits a more defined core/periphery structure. LinkedIn or OpenBC were mostly used for connecting CTI and SHARE participants; only 0.2% of the relations developed after the CTI event are relying on the use of 'social networking sites'; it seems that they were mainly adopted for *maintaining* already existing relations and less for creating new ones. The phone network is split into two disconnected groups, with SHARE and CTI staff members acting as bridges between the two disconnected groups. It represents the third most-used mode with 9.5% of the overall connections among participants. The face-to-face network, accounting for approximately 25% of the overall connections, is built around the two most central actors – the Boston business angel investor and the SHARE coordinator.

As shown in previous experiments (Grippa et al., 2006), this study again illustrates that face-to-face communications are very important for developing and maintaining complex, fast-changing relationships.

Comparing in-degree and out-degree of actors demonstrates that the CTI members are mainly receivers of communication rather than senders.

Figure 7 shows the contribution index of all participants (Gloor, 2006). Each actor represents a dot. The more actors are to the right, the more active, i.e., the more connected they are. The further up actors are, the more they are senders of communication, and the further down they are, the more are they receivers. In this analysis we would expect all actors to be on the 0-middle line, because each actor who lists a contact could also expect to be listed by the contact person. As the position of the red dots representing the CTI members indicates, they are listed by more people than they are listing other communication partners themselves. This further reinforces the impression of a somewhat passive communication behaviour, with the exception of the administrative staff member of CTI who was tasked with following up with the participants (the red dot in the upper right corner).

Figure 7 Contribution index of participants (green: Boston people; blue: Bay area people; red: CTI members) (for colours see online version)
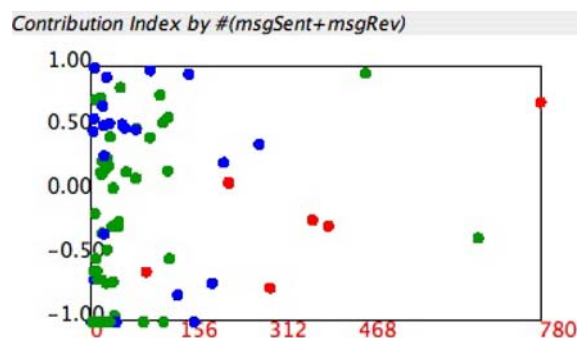

Figure 8 shows the social network of the participants after the two surveys had been completed. Nodes in blue represent participants from San Francisco, in green from

Boston and in red from Switzerland (CTI members). The first point to note is that there seems to be almost no communication 'across the continent' between actors from Boston and San Francisco, i.e., there are no links between the green and blue dots. The CTI members really are the connectors in this network.

Figure 8   Network of participants from Boston (green), San Francisco (blue) and Switzerland (red) (for colours see online version)
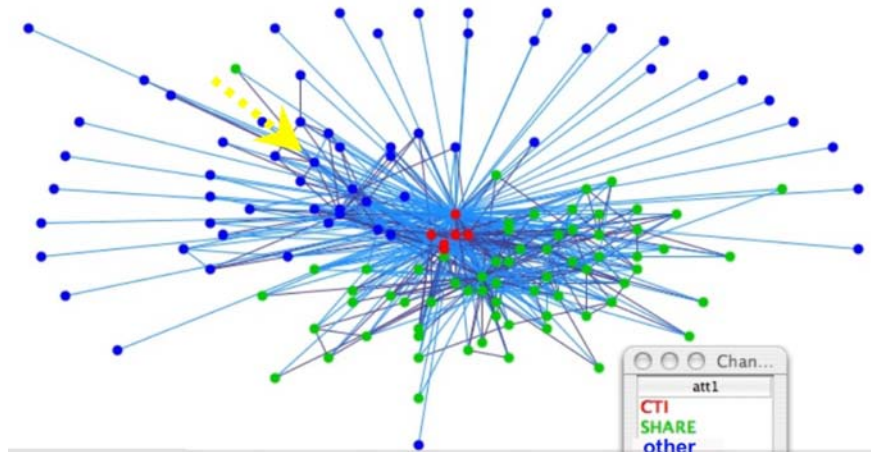
The most central actors by degree and betweenness are two members of CTI, followed by one of the main organisers at SHARE, a venture capitalist and the director of CTI.

As can be seen in Figure 8, members of the SHARE network (in green) form a highly connected cluster of higher density, while the Bay area participants have very little communication among themselves. There is a clear separation of Bay area participants into two tiers. Members of the outer tier are only connected to the network through one central broker, i.e. the member of the administrative staff of CTI who was tasked with following up with the participants.

Among the Bay area participants, one member of another business networking hub in San Francisco (marked by the yellow arrow in Figure 8) plays a crucial information brokering role, forming the core of a small online community (Gloor, 2006). This contrasts strongly with the SHARE community, where rich interaction between many different members of the community is clearly visible. This insight is confirmed in the adjacency matrix, where the intensity of the colour for each cell indicates the frequency of interactions occurred among participants (Figure 9).

As Figure 9 illustrates, the participants in the Boston area communicate much more than the participants in San Francisco. As a matter of fact, the quadrants in the top left side of the matrix are more densely coloured than the others, indicating a more intense exchange of information. Boston academics communicate more among themselves than San Francisco academics.

Analysing the in-degree centrality of CTI members, that is, the number of times participants reported to have contacted them using different modes of communication, we noticed that the academics are the only ones to increase over time their relationships with the Swiss delegation. The number of ties directed to them increased approximately 41% from the first to the second survey, that is, in 5 weeks. On the other hand, industrial

participants (venture capitalists, entrepreneurs and engineers) reported a reduced number of connections to CTI member over the 5 weeks (–32%). Using in-degree centrality as an approximation of the relative importance of people within the network indicates that the active participation of academics in Boston is one of the key factors for success.

Figure 9 Adjacency matrix of participants, sorted by region (Boston, San Francisco, Switzerland) and affiliation (academia, industry, CTI)
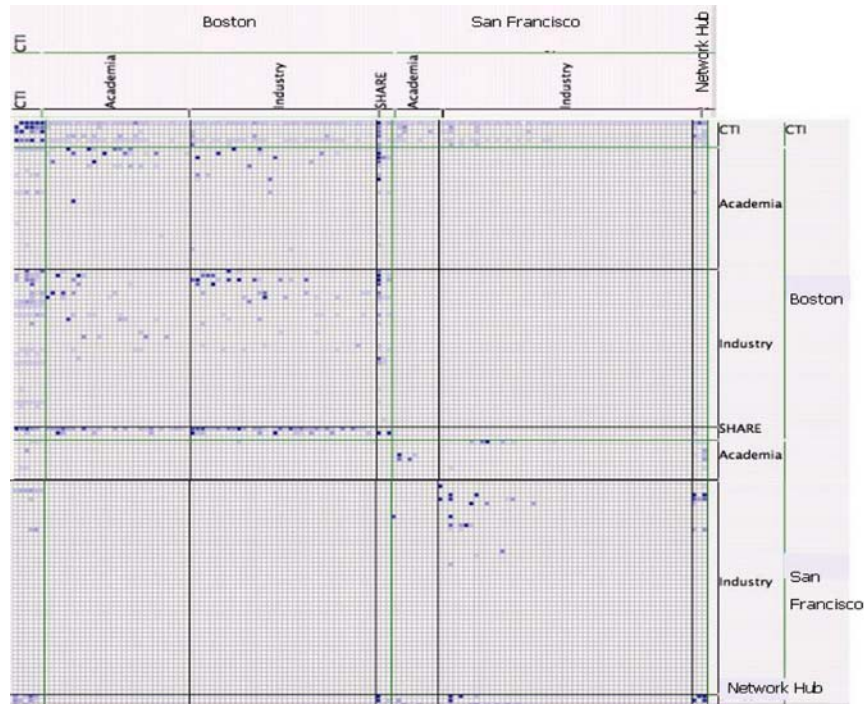

Boston area participants from industry also communicate more with other industrial participants than do their counterparts in San Francisco. The most interesting insight is the total lack of communication between academics and industrial participants in San Francisco. While there is rich interaction between Boston area academics and Boston area industrial participants, there is no communication between Bay area academics and Bay area entrepreneurs at this networking event.

Figure 10 displays the Boston part of the network illustrating this point further. SHARE's academic network forms a tight cluster, mixing participants from industry and academia, while the overall density of the network in San Francisco is much lower (see Figure 11).

This consideration is supported by the evidence coming up from a graph comparison, but also through the evaluation of network metrics. Indeed, while the overall network density in Boston is 0.0698, in San Francisco the density is 0.0418. Moreover, the network in San Francisco has a higher level of core/periphery structure (0.2887), indicating the presence of a more dense core and a sparse periphery (Boyd et al., 2004), whereas in Boston it is lower (0.2363), indicating a higher level of integration of peripheral actors within the network.

Figure 10 Boston-only network (red = academics, blue = industry, yellow = SHARE staff, green = CTI members) (for colours see online version)
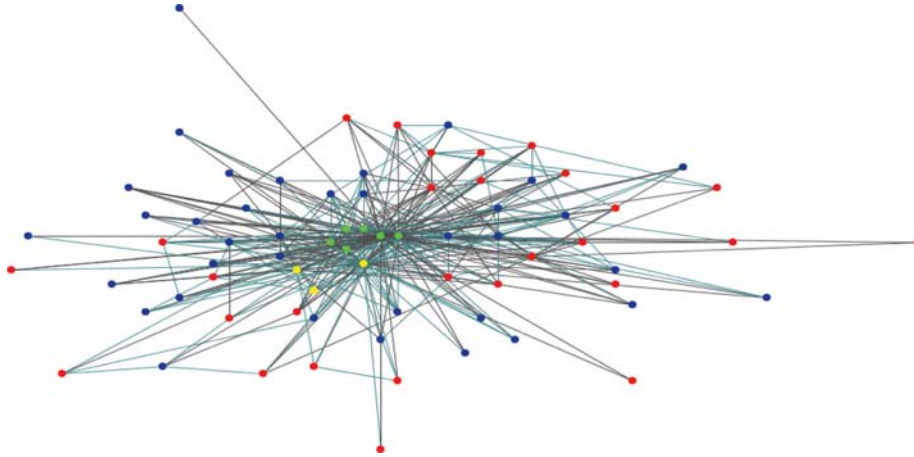
In Figure 10 CTI members (green dots) are clearly at the core of the network, with SHARE staff (yellow dots) also located in a central position. The network shows a slight separation between academia (the red dots mostly on the right side) and industry (the blue dots on the left side). But there is an active cross-fertilisation within and between the academic and industrial subcommunities.

Figure 11 San Francisco-only network (red = academic, blue = industry, yellow = networking hub staff, green = CTI members) (for colours see online version)
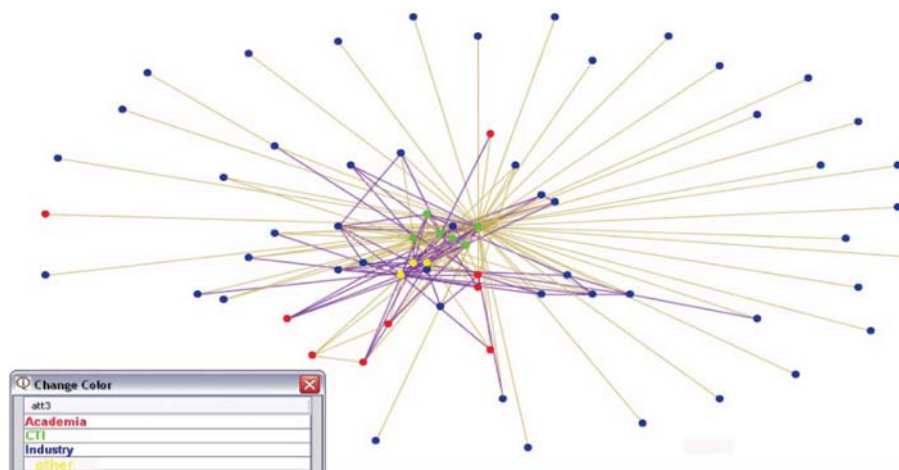

Figure 11 displays the network in San Francisco. It shows that the few actors from academia are mostly connected among themselves or with CTI and networking hub staff. There are almost no connections with the industry. Furthermore, there are very few connections among the members of the San Francisco entrepreneurial community. As stated by one of the academic actors involved in the focused interviews, "the core of

their follow-up strategy was to have a professor meet with CTI people". Despite of the efforts, it seems that 'there was no discernable follow-up'.

We can only speculate about the reasons for this huge difference in communication behaviour. Based on the analysis of academic-industry communication in Boston, it seems that the Boston area academics are acting as connectors not just between themselves, but also with Boston area entrepreneurs. An additional finding is that academic participation in Boston with an almost even split between academic and industrial participants is much larger than in San Francisco, where the majority of participants came from industry. Boston's academic participants acted as information brokers, building bridges between industrial participants from Boston and Switzerland. This ties in with other research noting the bridge-building behaviour of doctoral students and post-docs (Valente, 1996). One explanation is the much higher density of universities in the greater Boston area, where the two top universities Harvard and MIT are surrounded by at least a dozen other large universities, all within a radius of just a few kilometres, essential in fostering the Boston area high-tech cluster (Porter et al., 2007). This contrasts with the Bay area, where only two other sizeable universities are close to Stanford and Berkeley. And even these universities are geographically much further apart than in Boston, which has an unparalleled student density on relatively small space. As Thomas Allen (1984) found, physical proximity is the most significant indicator of increased communication. It is surprising, however, that the entrepreneurial community in the Bay area is not showing more network-building behaviour.

This richness in communication in Boston contrasts with Annalee Saxenian's (1994, 1996) results about the higher propensity of Bay area entrepreneurs over Boston entrepreneurs to network. Our admittedly anecdotal results tell another, much more favourable story – for Boston.

Our network analysis is also contrasting with the results of recent studies (Castilla, 2003; Castilla et al., 2000), which provide a different view of the network of industrial and academic business relationships. Emilio Castilla (2003), in his regional analysis of networks of Venture Capital (VC) firms in Silicon Valley, found that collaboration among VC firms is more pronounced and dense than in Route 128, because of both historical development as well as social network's structure. Our admittedly empirical and very restricted findings indicate the presence of a dense social network in Boston and a more disconnected network in San Francisco.

It seems that Boston's entrepreneurs, driven by the Venture Capitalists' subgroup, are becoming more aware of the importance of developing lasting connections with both the academic and the industrial base within their territory. The fact that venture capital firms were the most active contributors to raise 'regional connectedness' in New England may not be surprising, as their role determined by their specific business goals is built around their capacity of creating connections with key actors and institutions.

Based on this insight, one suggestion could be that programmes for helping increase regional economies should not only involve boundary-spanners such as venture capitalists and angel investors, but also actively include academics.

4   Conclusions

Network-based analysis is not a one-shot exercise (Iyer et al., 2006). The benefits of this kind of study derive from repeating observations periodically. Much more work is needed

to better understand the differences in networking behaviour between different economic regions, and the influence of business networking hubs on entrepreneurial network building.

Based on our analysis, it seems, however, that SHARE is contributing towards growing new social networks, connecting participants from academia and industry from Switzerland and Boston into sustainable communities. SHARE also seems to assist in building bridges between academia and industry. One area of improvement for SHARE would be to better connect industrial and academic communities in New England with Silicon Valley entrepreneurs. As the initial e-mail analysis has shown, SHARE staff was initially quite central in its communication behaviour: while communication with outside people was very intense, few new connections among outside people were brokered. As the follow-up analysis during the networking event has shown, this has substantially changed, with SHARE staff and customers being embedded into a tight web of communication. Outside people are now not just communicating with SHARE, but the direct discussion among them seems now to be quite active also.

This positive result, highlighting the effectiveness of the actions pursued by SHARE, may have been driven by different enabling factors, which should be investigated in a more systematic way. The ability of a networking hub like SHARE to provide the enabling context for the development of relationships also depends on the characteristics of the 'facilitating structure', that is, the system of policies and the whole structure of the regional economy as formulated by Lipsey (2000).

Therefore, the efforts of SHARE in connecting local and Swiss entrepreneurs need to be seen in context with the contribution of venture capitalist firms, biotech companies and the high concentration of universities in the greater Boston area.

This study, using a social network approach, provides visual and quantitative cues, indicating an awakening of industrial relationships driven by academic-industrial connections in the Boston area.

Obviously, the explanation for the observed vivacity of new relationships relies on multiple factors. Further investigation will be necessary to identify causal relations between the growth of connections at SHARE and the contextual influence of the greater Boston area.

Acknowledgements

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