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Abstract

In this paper we analyze the success of startups in Germany by looking at the social network structure of their founders on the German-language business-networking site XING. We address two related research questions. First we examine university-wide networks, constructing alumni networks of 12 German universities, with the goal of identifying the most successful founder networks among the 12 universities. Second, we also look at individual actor network structure, to find the social network attributes of the most successful founders.

We automatically collected the publicly accessible portion of XING, filtering people by attributes indicative of their university, and roles as founders, entrepreneurs, and CEOs. We identified 51,976 alumni, out of which 14,854 have entrepreneurship attributes. We also manually evaluated the financial success of a subsample of 80 entrepreneurs for each university.

We found that universities, which are more central in the German university network, provide a better environment for students to found more and more successful startups. University networks whose alumni have a stronger "old-boys-network", i.e. a larger share of their links with other alumni of their alma mater, are more successful as founders of startups. On the individual level the same holds true: the more links founders have with alumni of their university, the more successful their startup is. Finally, the absolute amount of networking matters, i.e. the more links entrepreneurs have, and the higher their betweenness in the online network of university alumni, the more successful they are.

Keywords: entrepreneurship, online social networks, founder networks, startup success

1. Introduction

It is well known by now that entrepreneurs who are well-connected are more successful in their endeavors. Whether it is software startups in Israel (Raz & Gloor 2007), biotech entrepreneurs in Canada (Baum et. al 2000) or Boston (Allen et. al 2009), managers in the apparel industry (Uzzi 1997), creative artists in the Broadway musical industry (Uzzi & Spiro 2005), or membership in industry-alliance networks (Schilling & Phelps, 2005), network structure among entrepreneurs matters. In this paper we investigate if these results hold true also in the online world, comparing online social networking behavior of entrepreneurs with business success. In particular, motivated by research by Cohen et. al. (2007) we explore if membership in online university "old boys networks" is a predictor of success for founders of "brick and mortar" startups.

We look at the social networks forming around alumni of universities. In particular, we analyze the networking behavior of entrepreneurs in Germany through the emergent structures of their online social networks. Most of these founders are part of the generation of the twenty to forty year olds who are making heavy use of the Internet. According to the Pew Internet Survey (Jones & Fox 2009) over half of the adult Internet population in the US is between 18 and 44 years old, and using the Internet for entertainment and social networking. Likewise, a study by "Forschungsgruppe Wahlen" (2009) reveals that 72 percent of the adult German population uses the Internet (over 90 percent of the people between 18 and 49). These studies show that Blogs, Facebook, MySpace, LinkedIn, and Twitter have become major means of communication to stay in touch with friends and business partners, complementing established communication channels such as e-Mail and the phone. While private interaction on social networking platforms has become an active field of research (Ellison et. al. 2007; boyd 2008, boyd & Ellison 2008), less research had been done on the commercial value of keeping business contacts on social networking platforms such as LinkedIn (O'Murchu et al. 2004). In this project we look at the entrepreneurial success of alumni of 12 major German universities. We analyze the relationship network of entrepreneurs as it is represented in the German social networking site Xing, investigating if social networking structure predicts entrepreneurial success.

This article is structured as follows. Section 2 illustrates the reasons for extending this stream of research and introduces four research hypotheses. Section 3 describes the data collection and methods employed. Section 4 highlights the findings. Finally, sections 5-7 discuss the theoretical and managerial implications of the findings, note their limitations, and provide some suggestions for further research.

2. Motivation and Hypotheses

We try to answer the research question if certain types of online social networking patterns of entrepreneurs predict their success. Based on prior work on comparing social networking structure of individuals and companies with successful outcome of their work activities we would indeed expect that such a correlation exists.

Research on this topic has investigated the effect of network structures on the performance of the individual (e.g. Ahuja et al. 2003; Bulkley and Van Alstyne 2006; Cross and Cummings 2004; Gloor et. al. 2008; Mehra et al. 2001; Moran 2005; Sparrowe et al. 2001), groups (Balkundi and Harrison 2006; Brass 1981; Mayo and Pastor 2005; Reagans and Zuckerman 2001; Sparrowe et al. 2001) and organizations (Ahuja 2000; Podolny and Barron 1997; Powell et al. 1996; Raz and Gloor 2007; Uzzi 1996).

Based on this stream of research, our hypotheses are structured in two parts. In the first part, we propose two hypotheses that examine the effects of structure and position of a university alumni network on the success of their entrepreneurial activities. In the second part, we present two hypotheses regarding the structure and position of individual entrepreneurs as an antecedent for their success.

2.1 Performance of the alumni network

On the university level, we analyze the cohesiveness of the social network of alumni of a university. Motivated by research by Mayer & Puller (2008), who by analyzing friendship networks on Facebook of university students found that same university, race, and interests were the strongest predictors of friendships, we expect to find cliques of alumni of the same university in the German founder network. We would therefore expect similar behavior for groups of entrepreneurs made up of old-boys networks.

Actors in decentralized networks are typically more interdependent, which leads to an increased willingness to cooperate. With respect to the effect of group density on performance, Reagans and Zuckerman (2001) note that tighter group density leads to improved performance. This result is also confirmed by Balkundi and Harrisons' (2006) meta-analysis. One theoretical argument in favor of this is that the propagation of implicit knowledge is more difficult in sparse workgroups (Hansen 1999). Additionally, a large number of interactions between team members is indicative of mutual dependencies (Sparrowe et al. 2001) which in turn promote collaboration and thus improve the group's performance (Molm 1994). Hence we propose,

H1: The higher the cohesiveness of an alumni network defined as the ratio of internal links to external links, the higher the probability for its aggregated entrepreneurial success.

Authors such as Levi et al. (1954) conclude that increasing centralization of group leaders improves the performance of the groups. In their analyses, Raz and Gloor (2007), Cross and Cummings (2004), and Balkundi and Harrison (2006) also conclude that teams that occupy a central position within the inter-group network, or are led by a group manager with a central position in the intra-group network, perform better. Another study has shown that network efficiency is measured on the basis of the aggregate centrality of agents (Schweitzer et. al. 2009). The results of these studies might be explained by the fact that more centralization in the group network provides access to relevant resources. Hence, we propose

H2: The higher the centrality of a university alumni network, the higher the probability that the aggregated entrepreneurial performance of the alumni network is comparatively high.

2.2 Performance of individual entrepreneurs

It has been shown that CEOs of startups are more successful if they communicate more with their peers (Raz & Gloor, 2007). In particular, Raz & Gloor (2007) analyzed 100 software startups in Israel in 1997, before the e-Business bubble burst. In 2004 they checked back on which startups were still around. They found that the communication intensity of the CEOs with their peers significantly correlated with the probability of survival of the CEO's startup. Baum, Calabrese & Silverman (2000) obtain a similar result when analyzing the Canadian Biotech industry, where they found that the chances of success of a startup increased with the size of its alliance network at the time of founding. Cummings & Cross (2003) examined 182 work groups in a global organization and found that certain network structures are related to performance. Uzzi (1996 & 1997) was also studying social structures and the consequences of embeddedness for the economic performance of organizations. In general, he found that up to a certain threshold embeddedness has positive effects on economic performance. In the online world Pasek et. al (2009) found that high participation in the Facebook social network correlated with offline civic engagement. Hence we propose,

H3: The higher the centrality of an entrepreneur, the higher the probability that she or he is successful in comparison with other entrepreneurs.

On the individual level, it has already been shown that people connecting structural holes are more successful (Ahuja 2000, Burt 2004). On the other hand, we also speculate that people well embedded into the old-boys network of their university are more successful. Murray (2004) suggests that academics who start biotech firms use their social capital to recruit collaborators through their local laboratory networks. Gulati (1995) found that business relations commonly grew from prior friendship ties. McPherson, Smith-Lovin & Cook (2001) also studied homophily in social networks. They argue that people's personal networks are homogeneous with regard to many sociodemographic, behavioral, and

intrapersonal characteristics. The concept of homophily applies to offline and online social networks. Based on extensive research on the success of "old-boys networks" (Simon & Warner, 1992) it has been shown that employees recruited through old-boys networks get higher salaries and are more successful on the job, while mutual fund managers get higher returns if they invest into companies run by members of their "old-boys network" (Cohen et. al 2007).

H4: The better connected an entrepreneur is with peers of her or his alumni network compared to links with outside peers, the higher the probability that she or he is successful.

3. Research Design

To test the proposed hypotheses, we automatically collected the social network of business relationships of students, entrepreneurs, and executives as captured on Xing (http://www.xing.com). Xing is the leading German language business networking Web site, similar to LinkedIn. People on Xing have the option of either hiding or disclosing their profile to the outside world, as well as of hiding or disclosing their friends. Our analysis is restricted to people choosing to make their profile publicly accessible, while also showing their friends. According to its own Web site (July 2009) Xing has over 7 million active user profiles.

For our analysis we focus on 12 German universities which can be classified into three groups: (1) large public universities: University of Cologne, HU Berlin, University of Hamburg, University of Hannover, and University of Mannheim. (2) We added five of the newly selected elite institutions of Germany: LMU Munich, FU Berlin, RWTH Aachen, TU Munich, and University of Karlsruhe. (3) In addition, we included two well-respected privately run business schools: European Business School of Oestrich-Winkel (EBS) and WHU Otto Beisheim School of Management.

For our research we systematically parsed the publicly accessible alumni profiles of the above universities. In the profiles we searched for keywords such as "Chief", "Inhaber", "Besitzer" (owner), "Unternehmer" (entrepreneur), "Jungunternehmer" (junior entrepreneur), "Gesellschafter" (shareholder), "Geschäftsführer" (CEO), "Geschäftsführender" (CEO), "Gründer" (founder), "Teilhaber" (Co-owner), "Enterpriser", "Entrepreneur", and "Startup" for Xing members from the 12 above mentioned German universities. Overall we collected 654,193 users and 4,456,393 relations from Xing as of April 2009; out of this large data sample 15,143 were founders and entrepreneurs with 232,390 relations whose profile matched the keywords above (see table 1 for detailed data). Note that out of all actors in our analysis, only 15,143 are founders and alumni from one of the 12 universities, while 130,390 are their Xing friends, either alumni from the 12 universities or from other external institutions.

University	*Total students Ø 2004-07*	*Graduates Ø 2004-07*	*Graduating quotient*	*Alumni (Xing sample)*	*Founders (Xing sample)*	*Founder quotient*
U Cologne	45158	5019	11%	7826	2210	28%
LMU Munich	43722	6025	14%	6504	2726	42%
U Hamburg	37518	4982	13%	9128	2526	28%
FU Berlin	33646	4356	13%	6172	1608	26%
HU Berlin	29570	3683	12%	1650	383	23%
RWTH Aachen	29441	2960	10%	5769	1266	22%
U Hannover	22144	2650	12%	3500	857	24%
TU Munich	21237	3740	18%	3076	1262	41%
U Karlsruhe	17579	2089	12%	3577	821	23%
U Mannheim	11089	1380	12%	3562	826	23%
EBS	1270	285	22%	554	173	31%
WHU	444	158	36%	658	196	30%

Table 1. Basic data for all 12 universities

In addition to the social network data, we gathered data on the number of inscribed students and the number of students graduating each year from 2004 to 2007 of the 12 universities (left columns of table 1). The two columns on the right in table 1 "Alumni" and "Founders" list the basic data we collected from Xing.

To measure the performance of both university alumni networks and entrepreneurs we define the following metrics: *graduating quotient*, *founder quotient*, *economic impact of founder network*, and *economic impact per founder*.

As a first success metric for a university we take the "*graduating quotient*", i.e. the number of students graduating per year among all students registered[1]. According to this measure the two private schools WHU and EBS are the leaders. Since private universities usually offer shorter duration of study e.g. due to less students per class and a tighter organization of the study schedule as well as asking for substantial tuition, while public universities in Germany are basically free, this comes as no surprise. However, the two large state universities in Munich (LMU Munich and TU Munich) are also efficient in guiding their students to graduation in short time.

Our second performance metric for a university is the *founder quotient*, i.e. the propensity of alumni of a university to found businesses. It is calculated as the percentage of company founders and entrepreneurs among all alumni of a university (based on the Xing data). The values for each university can be found in

[1] The graduating quotient corresponds to the average study time a students spends at a university, e.g. a graduating quotient of 20% would correspond to a study time of 5 years, however the graduating quotient offers a more fine-grained level of comparison.

table 1. Figure 1 illustrates that there is a (non-significant) correlation between the graduating quotient, i.e. the percentage of students graduating per year and the founder quotient (R=0.30, p=0.34).

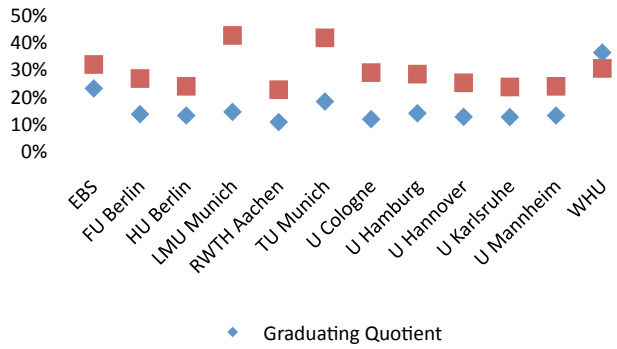

Figure 1. Correlation between graduating and founder quotient

To measure financial success, we randomly picked 80 founders from each university. We then looked at the characteristics of the companies they started. We put the companies into five categories, based on number of employees (1 employee, 2-10, 10-50, 50-200, 200-1000) and calculated the average annual revenue based on annual average individual income for these categories (Mercer 2009) (€33k/employee, €33.88k/employee, €34.76k/employee, €35.64k/employee, €36.52k/employee). It has been found elsewhere that the larger the size of the company, the higher the average income of the employees (Frank-Bosch 2003). In addition we looked at the legal form of the startup, adding the amount of equity required to register the company (€50k for an incorporated company (AG), €25k for a limited partnership (GmbH)).

University	*Relative Economic Impact*	*Economic Impact per Founder*	*Total Economic Impact of Founder Network*
LMU Munich	47,994,000 €	599,925 €	1.4 Billion €
TU Munich	43,867,280 €	548,341 €	622 Mio €
WHU	42,789,560 €	611,279 €	108 Mio €
U Hamburg	37,886,760 €	473,585 €	1 Billion €
U Cologne	36,278,360 €	518,262 €	1 Billion €
EBS	32,152,040 €	434,487 €	68 Mio €
FU Berlin	27,643,400 €	337,115 €	487 Mio €
U Karlsruhe	24,815,880 €	310,199 €	229 Mio €
U Mannheim	20,450,960 €	296,391 €	220 Mio €
HU Berlin	15,252,040 €	186,000 €	64 Mio €
RWTH Aachen	13,398,520 €	191,407 €	218 Mio €
U Hannover	12,692,480 €	158,656 €	122 Mio €

Table 2. Economic impact of university on region per year

Table 2 lists the annual contribution of each university to the German economy based on the calculations described above. The column *Relative Economic Impact* shows the average economic contribution of the 80 founders of each university computed according to the above formula. The column *Economic Impact per Founder* is the contribution of an individual founder. It is calculated by dividing the relative economic impact of a university by the number of distinct companies founded by the 80 founders. For relatively small universities like WHU and EBS in our 80 people sample there is more than one founder involved in the same company which means that there are less than 80 distinct companies. This is not the case for large universities like e.g. Humboldt University Berlin, where the 80 founders established 80 distinct companies. Nevertheless, even when we take this into account, the economic impact per founder is still much higher at WHU and LMU Munich, because their startups are much more successful.

The *Total Economic Impact of Founder Network* in table 2 contains an estimate of what the founders of each university that we identified on Xing contribute to the GDP of a region, computed by multiplying the number of founders from of the Xing sample from table 1 with the economic impact per founder from table 2. Obviously, the larger a university, the higher the total number of founders and entrepreneurs and thus the higher the total economic impact. E.g. University of Cologne has a total economic contribution of 1 Billion €, although it is only ranked 4th when looking at revenue generation per founder. Nevertheless, LMU Munich stands out, because although being a large state university, it is also second best in revenue generation per graduate, leading to a staggering contribution of 1,4 Billion € per year. However, because these are absolute numbers we only use the *relative economic impact* and the *economic impact per founder* for further analysis.

To better understand the interrelationship between individual success and social networking behavior, we also looked at the accomplishments of the 80 entrepreneurs whose companies we analyzed, categorizing them into five levels of success.

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

Table 3. Success categories for individual entrepreneurs

Table 3 lists the criteria we applied to rank entrepreneurial success of the 80 individuals we had picked at random from our dataset on a scale from 1 to 5. We read the Web sites and checked business accomplishments of each startup in business databases and assigned each individual to a success level. Table 4 shows the number of entrepreneurs from the 12 universities in each of the five success categories.

University	Success Level 1	Success Level 2	Success Level 3	Success Level 4	Success Level 5	Sum
LMU Munich	0	7	33	33	7	80
TU Munich	0	19	48	10	3	80
WHU	2	7	34	32	5	80
U Hamburg	0	7	40	29	4	80
U Cologne	1	15	42	20	2	80
EBS	0	3	44	29	4	80
FU Berlin	0	13	37	28	2	80
U Karlsruhe	0	10	37	29	4	80
U Mannheim	3	18	45	13	1	80
HU Berlin	0	22	42	14	2	80
RWTH Aachen	2	18	41	19	0	80
U Hannover	0	14	51	14	1	80

Table 4. Number of entrepreneurs from the 12 universities in each of the five success levels

We computed the (normalized) group degree centrality, (normalized) group betweenness centrality and the ratio of nodes to edges for each of the 12 alumni networks and for the overall network consisting of all alumni networks (Everett & Borgatti 2005, Wasserman & Faust 1994).

For each university we calculated in-group (alumni network), and out-group (full network) statistics (table 5). We retrieved the number of actors and edges for the full networks by considering all links from alumni of a university to people from other universities or external organizations. We also calculated the ratio of nodes to edges for all alumni and full university networks. Note that the lower this value, the higher the degree of connectivity of the network, because there are proportionally more edges connecting the actors. This gives us a simplified measure of how strongly connected the actors in the different in-group and out-group university networks are. Cummings & Cross (2003) use a similar measure. They study the implications of different network structures on group performance and argue that more integrative structures will be related to higher performance.

4. Results

We first look at the results on the university level, discussing findings of interest to university leaders to increase entrepreneurial capabilities of their student bodies as well as to students with entrepreneurial interests, to choose the university best suited to their needs.

4.1 Alumni Network Structure and Performance

We analyze the impact of the founder network on economic performance on two dimensions: (1) we compare social network metrics of each university network with university-wide performance metrics, and (2) we measure how "alumni-centric" or "tribal" the old-boys-network of each university is by comparing the "alumni" network (in figure 5) against the "full" network pictured in figure 3. Table 5 shows the values for the metrics we introduced in the previous section.

University	"tribal" (in-group) BC	"tribal" (in-group) Degree	Ratio Tribal Nodes/ Tribal Edges	Node Tribe-ness	Edge Tribeness	Group Between-ness of full network	Group Degree of full network	Ratio Full Nodes/ Full Edges	Average Tuition per year in period 2004 - 2007
EBS	0.0999	0.0499	0.9231	0.021	0.0213	0.2591	0.0876	0.9151	12250
FU Berlin	0.0424	0.0286	1.2441	0.0181	0.0133	0.1072	0.0169	0.8984	0
HU Berlin	0.0059	0.0367	1.7333	0.0053	0.0031	0.1599	0.0448	1.0199	0
LMU Munich	0.0946	0.0146	1.0397	0.0273	0.0224	0.1781	0.0295	0.835	0
RWTH Aachen	0.1557	0.0304	1.0871	0.0219	0.0193	0.0921	0.0182	0.941	0
TU Munich	0.0564	0.0431	0.9472	0.0248	0.0248	0.0768	0.0091	0.921	0
U Cologne	0.0792	0.0241	1.0455	0.0226	0.0193	0.3124	0.0998	0.8787	0
U Hamburg	0.0917	0.0137	0.9834	0.0312	0.0264	0.0656	0.0166	0.8101	0
U Hannover	0.0075	0.0237	1.383	0.0212	0.0149	0.0806	0.0157	0.9602	0
U Karlsruhe	0.0526	0.0253	1.2147	0.0189	0.015	0.1206	0.0316	0.9473	0
U Mannheim	0.0328	0.0362	1.2345	0.0134	0.0105	0.2519	0.0613	0.9585	0
WHU	0.351	0.1848	0.5246	0.0258	0.0421	0.1684	0.0533	0.823	11865

Table 5. SNA metrics and tribeness factors of 12 universities

(1) First we are looking at the social network metrics of the networks. As table 6 shows, there is significant correlation between the alumni network metrics and some of our four metrics of performance (Graduating Quotient, Founder Quotient, Relative Economic Impact, and Economic Impact per founder). Interestingly, there are no significant correlations between social network metrics of full university networks and metrics of performance.

The higher alumni group betweenness centrality and alumni group degree centrality, the higher the graduating quotient, i.e. the faster students are in getting their degrees (R=0.81**, R=0.93**, respectively). This means that a centralized university alumni network, which has a few superconnectors, is an indicator for a university that gets out students fast. We speculate that the type of person who has "superconnector" characteristics, i.e. a person with many Xing-friends, is more attracted to a private university with high graduating quotient such as WHU and EBS. There is also significant correlation between alumni group betweenness centrality and economic impact per founder (R=0.62*). The question here is: do superconnectors breed success, or does success breed superconnectors? To put it in other words: is an alumni network, which has superconnectors, better in creating startups that are successful? It could also be that successful entrepreneurs will just get many friends, as everybody will want to be associated with them? We are not

yet in a position to give an answer to this question, let us wait until we have looked at characteristics of individual entrepreneurs in the next section.

(2) As a second step of analysis of group performance we measure the openness of the old-boys network to the outside world. We determine the strength of the tribe of alumni of a university – the degree of "tribeness". We define "tribeness" as the ratio of the number of actors and edges within the old-boys network to the number of actors and edges in the outside (external) network of a university:

Node Tribeness = # alumni nodes/# external nodes
Edge Tribeness = # alumni edges/# external edges

The higher Node Tribeness, the more of the friends of an alumnus are also alumni. The higher Edge Tribeness, the more of the links of the full alumni networks (i.e. all the links alumni have with other people, be it alumni or non-alumni) are with other alumni. As a metric for the density of the alumni network we also measure the ratio of alumni nodes to alumni edges. The smaller this ratio, the higher is the connectedness of the alumni network. As table 6 illustrates, we get significant negative correlation for these metrics. This means that the more densely connected the actors in the alumni network are, the better is the university in getting students out, and in creating startups that are financially successful. This would again imply that the university should invest into building a cohesive alumni network.

In table 6 we list the tribeness values based on nodes and edges for all universities. Note that the higher the node tribeness, the less external actors are connected to members of the alumni network and thus the more the network has the characteristic of a tribe. The amount of "edge tribeness" depends on the number of links from members within the alumni network to the outside world.

We observe that both measures of tribeness have positive significant correlation with the relative economic impact of the university and the impact per founder (R=0.80*** for edge tribeness and economic impact per founder). These findings indicate that it pays off to be a tribal community and that creating a university with a strong in-group feeling promoting strong bonding among alumni is a means to success. Edge tribeness also positively correlates with the graduating quotient (R=0.77**), meaning that having more links within the tribe than with people outside the university promotes fast graduation.

University	"tribal" (in-group) BC	"tribal" (in-group) Degree	Ratio Tribal Nodes/ Tribal Edges	Node Tribe-ness	Edge Tribeness	Group Between-ness of full network	Group Degree of full network	Ratio Full Nodes/ Full Edges	Tuition
Model 1									
Graduating Quotient	0.81**	0.93**	-0.72**	0.27	0.77**	0.13	0.24	-0.43	
Founder Quotient	0.14	0.06	-0.46	0.53+	0.46	0.02	-0.08	-0.49+	
Relative Economic Impact	0.53+	0.39	-0.78**	0.68*	0.76**	0.19	0.16	-0.82**	
Economic Impact per founder	0.62*	0.49	-0.83**	0.65*	0.80**	0.29	0.28	-0.82**	
Model II									
Graduating Quotient	0.92**	0.97**	0.91**	0.89**	0.93**	0.89**	0.90**	0.90**	0.88**
Corr: network	0.40*	0.62**	-0.29	0.13	0.39*	-0.19	-0.23	-0.19	
Corr: tuition	0.61**	0.41**	0.70**	0.86**	0.65**	0.94**	0.99**	0.82**	
Adjusted R-Square	**0.82**	**0.93**	**0.78**	**0.74**	**0.84**	**0.75**	**0.77**	**0.76**	

Table 6. Graduating and founder quotient and social network statistics for both the alumni and the full alumni networks for the 12 universities (N=12) (+p≤0.1; *p≤0.05; **p≤0.01). (Goodness of fit for normal distribution tested with Kolmogorov–Smirnov). Model I correlates SNA and tribeness metrics with different performance metrics. Model II introduces tuition as second independent variable.

To resume, we have proven hypothesis H1 – the more tribal an alumni network is, the higher the economic output of the university's founders, and hypothesis H2 – the more centralized a university network is, the higher the success of the university's entrepreneurs.

4.2 Individual Network Structure and Performance

To compare the individual network position of entrepreneurs with the economic performance of their company, we are analyzing their individual network structure properties. In addition to actor degree centrality, we define three metrics based on degree and betweenness centrality, namely (1) *Actor Tribe Factor,* (2) *Actor Weighted Tribe Factor*, and (3) *Actor BC (Betweenness Centrality) Tribe Factor*.

The *Actor Degree Centrality* is computed as the number of links the actor shares with actors of the overall network (Wasserman & Faust, 1994).

The *Actor Tribe Factor* is determined as the ratio of the number of links actors have with other actors of their alumni network (the in-group) to the number of links actors have with people outside of their alumni network (the out-group):

Actor Tribe Factor = actor in-group degree / actor out-group degree

This measure allows us to assess how much entrepreneurs are tied to their alumni network compared to their connections with entrepreneurs who did not study at the same university.

The combination of these two measures allows us to calculate the *Actor Weighted Tribe Factor*, to also include the overall size of an individual's network:

*Actor Weighted Tribe Factor = actor degree centrality * (actor in-group degree/actor out-group degree)*

We also define *the Actor BC Tribe Factor* based on the relationship of the betweenness centrality (BC) of an actor in the in-group network and the BC of an actor in the external network. The BC is a measure of a founder's importance in the network, therefore we expect to get a good predictor of an individual's influence in a tribe. This means that the more individuals invests into the old-boys network compared to the outside network, the larger is their tribal BC and the higher their affiliation with the own tribe.

Actor BC Tribe Factor = in-group betweenness centrality / out-group betweenness centrality

Assessing individual success, we found that individual degree, weighted tribe factor, and betweenness centrality tribe factor and success are all positively correlated (table 6). This means that successful entrepreneurs have proportionally more links with other alumni from their alma mater than with outside people.

The significant correlation between individual degree, i.e. the total number of links entrepreneurs have and their success in running the business means that having many Xing friends is an indicator of business success. But as already noted above, this correlation alone obviously does not answer the question of causality. Based on previous research however (Raz & Gloor, 2007), where we found that startups that have larger informal communication networks increased their chance to survive external shock, we speculate that having many friends in the online world is indeed supportive of later business success, we will look into this in more details in the discussion section.

Level of success	*N*	*Individual Tribe Factor*	*Individual Degree*	*Individual Weighted Tribe Factor*	*Individual BC Tribe Factor*
1	8	0,008578431	4,625	0,039675245	0
2	153	0,040709206	18,56663794	0,755833095	0,084218183
3	494	0,050239415	19,27711734	0,968471104	0,134987332
4	270	0,047471916	26,75919432	1,270310223	0,197464277
5	35	0,02769131	35,09325397	0,971778168	0,191814664
Correlation	960	0.42	**0.97****	0.81+	**0.96***

Table 6. Average tribe factors for all manually examined actors of all universities (N=918) (+p≤0.1, * p≤0.05, ** p≤0.01)

The actor BC tribe factor correlates significantly with success levels, which means that the higher a founder's embeddedness with the own tribe, the more successful she or he is in running the business.

It could be, however, that there is an optimum after which investing too much into the tribal network becomes counter effective. We speculate that tribeness has the same characteristics as the concept of embeddedness as studied by Uzzi (1996 & 1997). Uzzi argues that the positive effect of embeddedness (firms organized in tightly connected networks have higher survival chances) reaches a threshold, after which the effect reverts itself. Applying Uzzi's results would imply that there is a threshold after which being a loyal member of the tribe does not pay off anymore. In analogy to Uzzi's findings we observe that the most successful entrepreneurs in table 6 (on success level 5) have somewhat lower values for all individual tribe factors. This means, that the most successful founders have proportionally somewhat more links to the outside world than within their own tribes than founders on success level 4.

To resume, we have proven hypotheses H3 – the more online friends an entrepreneur has, the more successful she or he is, and H4 – the more tribal an entrepreneur is, the more successful she or he is.

5. Discussion

Extending previous work in the same field (e.g. Raz & Gloor 2007, Uzzi 1996 & 1997, Cummings & Cross 2003) we were studying networking structures of entrepreneurs and founders in cyberspace to predict an entrepreneur's success. Through analysis of the largest German business social networking platform Xing we could identify clusters of entrepreneurs at 12 major German universities. Our main goals were to find out how their online networking behavior and the choice of the alma mater affect success of founding new businesses. We divided our analysis into two parts: In the first part, we examined the relationship between structure and position of a university alumni network and the success of their entrepreneurial activities. In the second part, we presented two hypotheses regarding the structure and position of individual entrepreneurs as an antecedent for their success.

"Birds of a feather flock together". Many studies dealt with this phenomenon and found that social groups are not random samples of people, but communities unified by a shared purpose, goal and vision (e.g. Mayer & Puller 2008, McPherson, Smith-Lovin & Cook 2001, McPherson, Popielarz, Drobnic 1992). It has also been shown that the intensity of communication of these groups has an impact on performance (Raz & Gloor 2007). In this study we identified similar effects in an online social network, with successful alumni swarming together to support each other in their goal of starting a new company.

We have shown that there are certain structural properties of these networks that explain success. Tribal betweenness centrality and connectivity of the alumni network were strongly correlated with the efficiency of a university. We measured the efficiency of a university by looking at the average number of students graduating each year depending on the average number of total students inscribed. We found that universities with hierarchically organized alumni networks and higher degree of internal connectivity were faster in getting their students out. Universities whose alumni prefer friends from the same university seem to be more successful in creating new businesses and generating higher economic contribution per startup founder. Additionally, in our – admittedly small sample – we found that it does not make a difference for the entrepreneurial success whether a founder studies at a private or state university. This contradicts the image of private universities being particularly focused on imprinting their students with the "entrepreneurship gene".

We also found that university alumni networks that were successful in founding startups – measured by their average economic contribution – are organized as tribes. Results on the individual founder level show that the more founders are embedded in their own tribe, the more successful will the business be. We found that their tribeness, the strength of their internal cohesiveness or their negative degree of openness to external actors correlates strongly with their economic success. For a university this means that it should foster and encourage students to

build up more and closer connections with alumni. Porter et. al. (2005) demonstrated that nearly all university-educated founders retain some form of affiliation with their universities after successfully starting their business. But as we have found there might be a threshold of embeddedness (Uzzi 1996 & 1997) after which the positive effect of connecting to the own people might tamper off. For growing an environment for the most successful business leaders, the founder also needs connections to external people and institutions to a certain extent. In our own data this became particularly evident when analyzing success on the individual level. For the most successful founders (level 5 in our analysis), their tribe affiliation was slightly lower than for founders on the level right below. Proportionally, they were having somewhat more links to external actors than to people within their university.

The popularity of online social networking is unbroken. People use these sites to connect with family, friends, and business contacts. For many people, particularly in the generation of the 15 to 30 year olds, it is a substitute for email or phone.

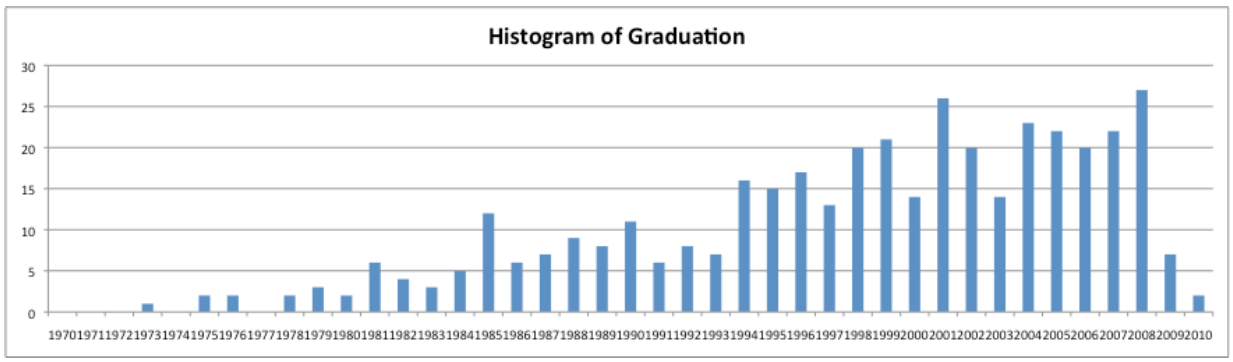

Figure 2 Histogram of Graduation (N=403, x-axis: year, y-axis: number of graduates per year)

Figure 2 shows the demographics of 403 of the 960 founders we manually checked for our study (the remaining 557 founders did not include information about the graduating year in their profile on Xing). As we can see, most of them graduated between 1998 and 2008, which indeed puts them in the age group of the online-social-networking-savvy 26 to 36 year olds.

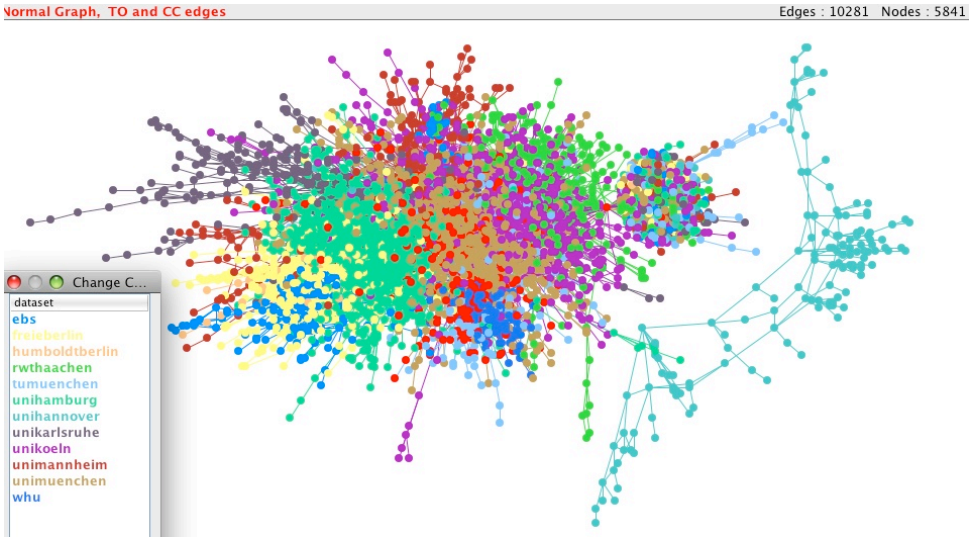

Figure 3. Full network of all founders with more than 5 links (n=5841); light brown dots are alumni of LMU Munich

Figure 3 displays the full founder network of all 12 universities as well as their external friends where each actor has at least 5 connections. On the university level there is a major cluster of alumni of LMU Munich in the center of the network, while the dark blue cluster of WHU alumni is also quite central. This visually confirms our findings from tables 5 and 2, with WHU and LMU Munich having the highest economic impact per founder. Figure 4 shows the same network, with

all individual founders for the same university collapsed into one single virtual actor representing each university.

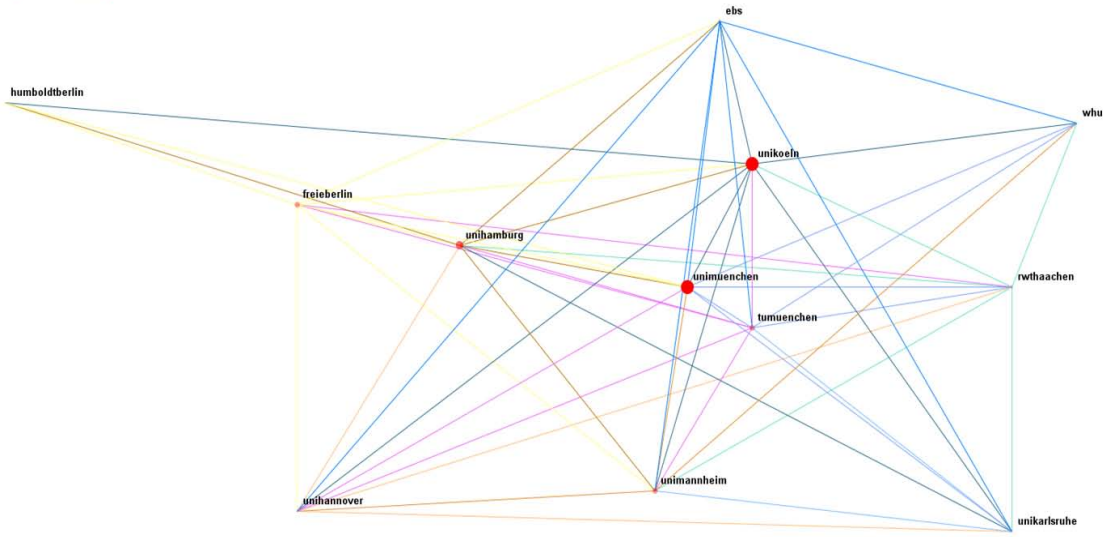

Figure 4. Network of universities with all individuals combined into one single actor representing each university

Figure 5 displays the full network of EBS alumni, with the alumni shown as dark blue dots, all others as light blue dots. While the dark blue actors are much fewer in number, they are the most connected, and have the highest betweenness. This illustrates Node and Edge Tribeness as introduced in section 4.1

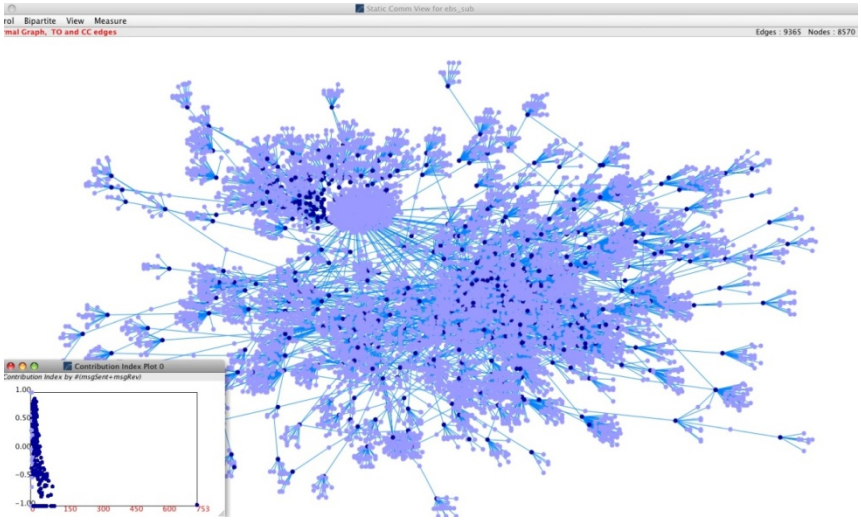

Figure 5. Social network of EBS alumni and their friends (dark blue=EBS alumni, light blue=non-EBS actors), lower left shows contribution index (Gloor et. al. 2003)

Motivated by earlier research, where we had compared the full and the group-internal network of students (Joo et. al 2005) to find the most influential members of a group, we also analyzed the internal "alumni network" of university alumni only (figure 6).

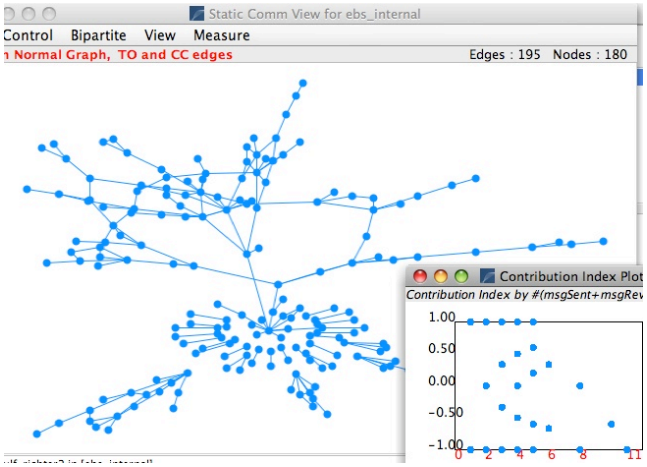

Figure 6. Alumni Social Network of EBS alumni, small window at right shows contribution index

Figures 6 and 7 show two alumni networks of successful universities, with public university LMU Munich being considerably more successful with an economic impact per founder of EUR 599,925 compared to private university EBS with EUR 434,487. The two pictures visually illustrate our findings again, that density of the network matters, with LMU Munich having a much denser network than EBS. Also note the superconnector cluster at the bottom of both figures 6 and 7. In both instances the central actor is the manager of the university's startup incubator whose job it is to help founders launch their new companies. In the case of LMU this hub is highly connected, but also for EBS this actor is an order of magnitude more connected than any other actor.

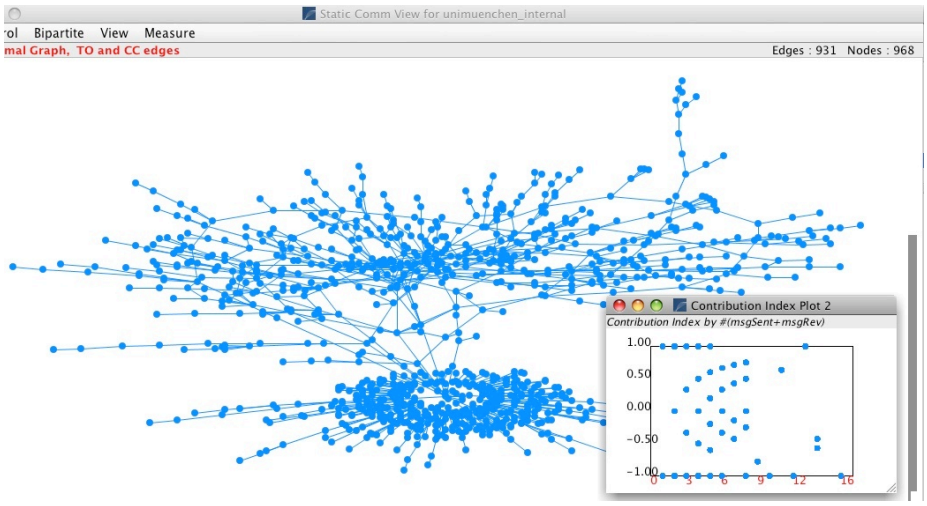

Figure 7. Alumni Social Network of LMU Munich alumni

One of the questions we have not answered yet is the question of causality. Are entrepreneurs successful because they have many alumni friends, or do they have many alumni friends because they are successful? Unfortunately our database is not detailed enough to give a final answer. Based on the sequence of events: entrepreneurs go to university first where they build their social network, and build the company later, we speculate that having many alumni friends to start with, i.e. high degree centrality, is helpful for building a successful business later on. This sequence would also correspond to our earlier research, where we found that a high degree of connectivity of a CEO predicted survival of her/his company eight years later (Raz & Gloor 2007).

6. Limitations

The main issue to answer is if our Internet-based sample is relevant of the entire population of German founders? On the one hand one can argue that there is a significant proportion of particularly older, forty to sixty year old founders who do not have a profile on Xing, LinkedIn, or Facebook. However, the online world has become a mirror of the real world. Trendsetters such as founders of new businesses use online media to communicate and stay in touch. These entrepreneurs, whether they are in the Web savvy age group of twenty to forty year olds or older, have a high likelihood of using tools like Xing to stay in touch.

One can also make the argument that our technique of sampling the entrepreneurs by choosing 80 profiles randomly per university distorts our results because the likelihood of finding multiple founders of the same business in the

subsample is higher for small business schools with smaller overall numbers of students. But on the other hand this reflects reality in the sense that students from a small cohesive group are more likely to start a business together than from a sprawling public university. Also, we have taken care of this effect by relying in our analysis not on the relative economic impact of the university, but on the economic impact per founder normalized by the number of businesses started by the 80 founders.

We drew a random sample from all alumni present in the Xing database. Because it is not a random sample of the entire population of alumni from the universities (since not everyone is registered in online social networks) we can only derive reliable conclusions about the Xing alumni population. Because 70% Pew Internet survey of 24-35 year olds are social networking site users, we nevertheless think that our insights are valid for the overall German population of startup founders. We might miss many blue-collar startup founders such as butchers, hairdressers, carpenters, and the like who might not be on Xing, but these are not part of our study anyway, as the emphasis of this research project is on university alumni.

7. Future Work and Conclusion

It will be necessary to complement our findings with more studies of the offline world. For example, a complementary offline survey of university alumni might give us an additional view of the embeddedness of alumni in their real-world social network.

We also intend to further analyze existing activities of universities of educating their students in entrepreneurship or starting a business and put this in relationship to our metrics of economic success.

Looking at the content or type of information flow between people in an online social networking platform could reveal deeper insights into the kind of relationship and the strengths of the ties (e.g. casual acquaintance against close collaboration), it could be that not all types of ties support the same level of success (Aral & Van Alstyne 2007). Usually ties in an online social network and especially on Xing do not hold such information directly. We speculate that in the Granovetter (1973) sense they mostly reflect weak ties. However, it might be possible to extract information from the profiles of the connected actors and derive the type of the relationship through a content analysis of the affected profiles.

Nevertheless, we have shown that it pays to have many contacts also in the online world, and to choose these contacts among the members of your alma mater – the better you are embedded into your swarm, the more successful your business will be.

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