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Comparing the structure of virtual entrepreneur networks with business effectiveness

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Abstract

In this paper we look at the effectiveness of business networks created by alumni of different universities. In particular, we analyze the networking behavior of entrepreneurs in Germany through the emergent structures of their virtual social networks. We automatically collected the publicly accessible portion of the German business networking site Xing.com by crawling the Web. We then filtered the people by attributes indicative of their university, and roles as founders, entrepreneurs, and CEOs. We constructed alumni networks of 12 German universities, identifying over 50,000 alumni, out of which more than 15,000 had entrepreneurship attributes. We also manually evaluated the financial success of a subsample of 80 entrepreneurs for each university.

Universities, which are more central in the German university network provide a better environment for students to found more and more successful startups. People in alumni networks whose members have a stronger “old-boys-network”, i.e. a larger share of their links with other alumni of their alma mater than with outside people, are more successful as founders of startups. We repeated this analysis on the individual level, combining all 15,000 founders, confirming the same result. 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: online social networks, founder networks, startup success

1. Introduction

In this paper 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

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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), little 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 presents the related literature and illustrates the reasons for extending this stream of research. In the same section we develop four research hypotheses. Section 3 describes the data collection and method 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. Related Work and Hypotheses

We try to answer the research question if certain types of online social networking structures of entrepreneurs predict an entrepreneur’s 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 friendships 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 from 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 Harrison’s (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 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 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. 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.

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. The Empirical Study

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. If people choose to make their profile publicly accessible, while also showing their friends, this information is accessible to search engine crawlers. 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) University of Cologne, HU Berlin, University of Hamburg, University of Hannover, and University of Mannheim are among the largest universities in Germany. (2) In addition, we included two well-respected privately organized business schools, European Business School of Oestrich-Winkel (EBS) and WHU Otto Beisheim School of Management. (3) Finally, we added five of the newly selected elite institutions of Germany, LMU Munich, FU Berlin, RWTH Aachen, TU Munich, and University of Karlsruhe.

3.1. Data Collection and Sample

For our research we systematically parsed the publicly accessible alumni profiles of the above universities and were thereby searching 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 users from the 12 selected 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 we retrieved 15,143 founders and entrepreneurs with 232,390 relations whose profile matched the keywords (see table 1 for detailed data).

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 3 columns on the right of table 1 list the basic data we collected from Xing.

3.2. Measures

This section describes the measures we used for our analysis. The paragraphs 3.2.1-3.2.4 present our estimate of the performance of both university alumni networks and entrepreneurs. In this context we define the following new measures: Graduating quotient, founder quotient, economic impact of founder network, and economic impact per founder. The paragraphs 3.2.5 and 3.2.6 define how we computed the network structure of the alumni networks and the network position of each actor.

3.2.1. Graduation Quotient

As a first performance measure for a university we take the “graduating quotient”, i.e. the number of students graduating per year among all students registered. According to this measure the two private schools WHU and EBS are the leaders. Since private universities usually offer shorter durations of study e.g. due to less students per class and a tighter organization of the study schedule this comes as no surprise. However, the two large state universities in Munich (LMU Munich and TU Munich) are also very efficient in guiding their students to graduation in a short time.

3.2.2. Founder quotient

Our second performance measure is called “founder quotient”. 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 table 1. Figure 1 illustrates that there is also a (non-significant) correlation between the efficiency of a university, defined as the graduating quotient, i.e. the percentage of students graduating per year, and the propensity of alumni of a university to found businesses, defined as the founder quotient, i.e. the percentage of alumni in Xing listing themselves as founders ($R=0.30$, $p=0.34$).

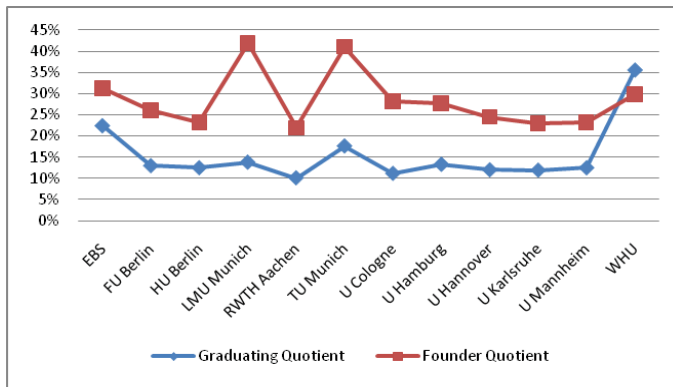


Figure 1. Correlation between graduating and founder quotient

3.2.3. Economic Impact

To measure individual and university 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) (Frank-Bosch 2003) and calculated an average annual revenue based on annual average 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 share of an individual founder. It is calculated by dividing the relative economic impact of a university through the amount 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 founded 80 distinct companies. Nevertheless, even when this is taken 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 identified out 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 on 4th place 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 and are not directly comparable we only use the relative economic impact and the economic impact per founder for further analysis.

3.2.4. Company Success

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.

Level of success	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 category. Table 4 shows the summary of the number of entrepreneurs from the 12 universities in each of the five success categories.

University	Level of Success				
	1	2	3	4	5
LMU Munich	0	7	33	33	7
TU Munich	0	19	48	10	3
WHU	3	6	32	26	3
U Hamburg	0	7	40	29	4
U Cologne	1	14	35	18	2
EBS	0	3	40	27	4
FU Berlin	0	13	39	28	2
U Karlsruhe	0	10	37	29	4
U Mannheim	3	17	36	12	1
HU Berlin	0	22	44	14	2
RWTH Aachen	2	16	37	15	0
U Hannover	0	14	51	14	1

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

3.2.5. Network structure and group measures

We computed the (normalized) group degree centrality (GDC), (normalized) group betweenness centrality (GBC) 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 (tribal network), and out-group (full network) statistics. 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 institutions. We also calculated the ratio of nodes to edges for all tribal and full university alumni networks. Note that the lower this value, the higher the degree of connectivity of the considered 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 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.

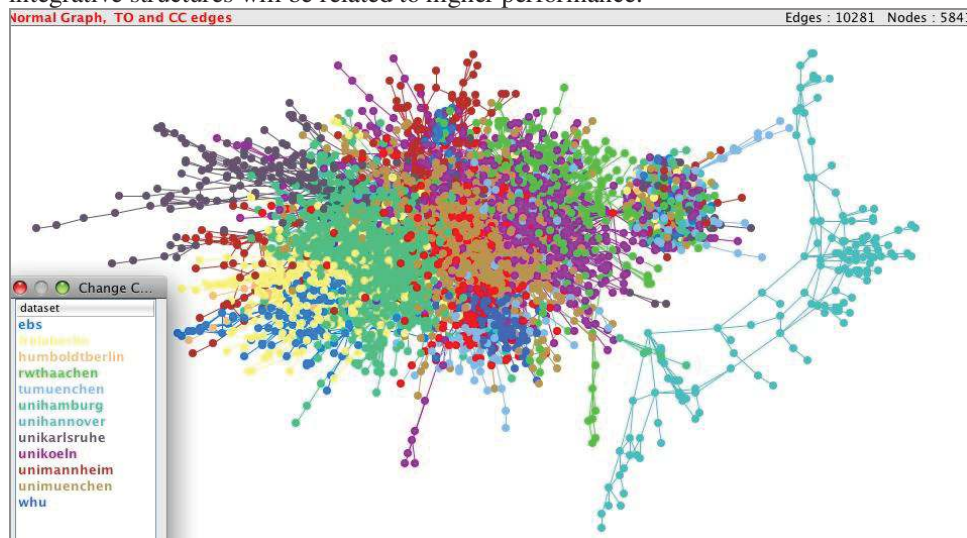


Figure 2. Full network of all founders with more than 5 links (n=5841); light brown dots are alumni of LMU Munich

Figure 2 displays the full founder network of all 12 universities as well as their external friends where each actor has at least 5 connections. 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. On the university level there is a major cluster of alumni of LMU Munich in the center of the network.

3.2.6. Network structure and individual network position

Figure 3 displays the full network of the 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.

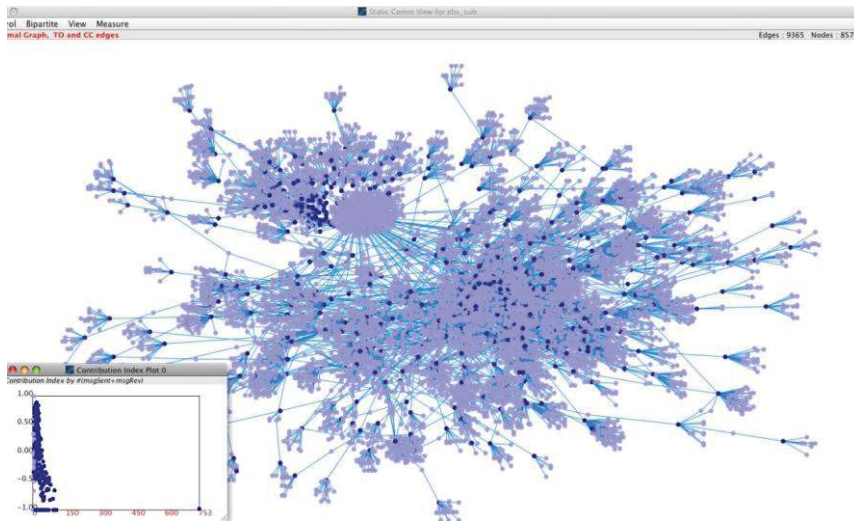


Figure 3. Social network of EBS alumni and their friends (dark blue=EBS alumni, light blue=non-EBS actors), lower left shows contribution index

Motivated by earlier research, where we had compared the full and the group-internal network (Joo et. al 2005) to find the most influential members of a group, we also analyzed the internal – or as we call it in this paper – the “tribal network” of university alumni only (figure 4).

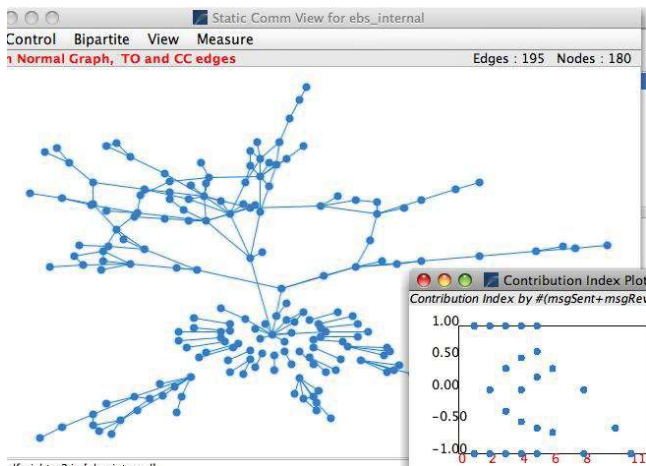


Figure 4. Tribal Social Network of EBS alumni

4. Results

In this section we present the results from our hypotheses testing. We first look at the results on the university level, discussing findings of interest to university presidents 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. Network structure and group 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 (such as e.g. shown in figure 3 and 4) with university-wide performance metrics, and (2) we measure how “tribal” or “incestuous” the old-boys-network of each university is by comparing the “tribal” network (in figure 4) against the “full” network pictured in figure 3.

(1) First we are looking at the social network metrics of the networks. As table 5 shows, there is significant correlation between the tribal network metrics and some of our four measures 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 measures of performance.

The higher tribal group betweenness centrality and tribal 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 tribal group betweenness centrality and economic impact per founder ($R=0.52*$). The question now 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, but let us wait until we have looked at characteristics of individual entrepreneurs in section 4.2.

(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:

$$\text{Node Tribeness} = \# \text{ tribal nodes} / \# \text{ external nodes}$$

$$\text{Edge Tribeness} = \# \text{ tribal edges} / \# \text{ external edges}$$

As a metric for the density of the tribal network we also measure the ratio of tribal nodes to tribal edges. The smaller this ratio, the higher is the connectedness of the tribal network. As table 5 illustrates, we get significant negative correlation for these metrics. This means that the more densely connected the actors in the tribal 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 tribe!

In table 5 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 tribal network and thus the more the network has the characteristic of a tribe. The edge tribeness is different in the sense that the amount of “edge tribeness” is determined by how many links go from members within the tribal network to the outside world.

We observe that both measures of tribeness have strong positive significant correlation with the relative economic impact of the university and the impact per founder. These findings indicate that it pays off to be an “incestuous” 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, 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 Tribeness	Edge Tribeness	Group Between- ness of full network	Group Degree of full network	Ratio Full Nodes/ Full Edges
EBS	0.0999	0.0499	0.9231	0.0210	0.0213	0.2591	0.0876	0.9151
FU Berlin	0.0424	0.0286	1.2441	0.0181	0.0133	0.1072	0.0169	0.8984
HU Berlin	0.0059	0.0367	1.7333	0.0053	0.0031	0.1599	0.0448	1.0199
LMU Munich	0.0946	0.0146	1.0397	0.0273	0.0224	0.1781	0.0295	0.8350
RWTH Aachen	0.1557	0.0304	1.0871	0.0219	0.0193	0.0921	0.0182	0.9410
TU Munich	0.0564	0.0431	0.9472	0.0248	0.0248	0.0768	0.0091	0.9210
U Cologne	0.0792	0.0241	1.0455	0.0226	0.0193	0.3124	0.0998	0.8787
U Hamburg	0.0917	0.0137	0.9834	0.0312	0.0264	0.0656	0.0166	0.8101
U Hannover	0.0075	0.0237	1.3830	0.0212	0.0149	0.0806	0.0157	0.9602
U Karlsruhe	0.0526	0.0253	1.2147	0.0189	0.0150	0.1206	0.0316	0.9473
U Mannheim	0.0328	0.0362	1.2345	0.0134	0.0105	0.2519	0.0613	0.9585
WHU	0.3510	0.1848	0.5246	0.0258	0.0421	0.1684	0.0533	0.8230
Correlations								
Graduating Quotient	0.81***	0.93***	-0.72***	0.271	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	0.42++	0.28	-0.71***	0.67**	0.70**	0.15	0.11	-0.80***
Economic Impact per founder	0.52*	0.38	-0.78***	0.66**	0.75***	0.26	0.23	-0.81***

Table 5. Graduating and founder quotient and social network statistics for both the tribal and the full alumni networks for the 12 universities (*p<0.1; **p<0.05; ***p<0.01; + p=0.13 ++p=0.17,+++p=0.16)

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. Network structure and individual performance

To compare the 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 defined three additional metrics based on degree centrality, namely (1) Individual Tribe Factor, (2) Individual Weighted Tribe Factor, and (3) Individual BC Tribe Factor.

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

The Individual Tribe Factor is determined as the ratio of the number of links a user has with actors of her or his alumni network (in-group) to the number of links the user has with people outside of her or his alumni network (out-group):

$$\text{Individual Tribe Factor} = \text{In-group Degree} (= \text{tribal links}) / \text{Out-group Degree} (= \text{external links})$$

This measure allows us to assess how much an entrepreneur is tied to her or his alumni network compared to her or his connections with entrepreneurs who did not study at her or his university.

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

$$\text{Individual Weighted Tribe Factor} = \text{individual degree centrality} * (\# \text{ tribal links} / \# \text{ external links})$$

We also define a tribe factor based on the relationship of the betweenness centrality (BC) of an individual in the tribal network and the BC of an individual in the external network (Individual BC Tribe Factor). The BC is a precise measure of a founder's position in the network, therefore we expect to get a good predictor of an individual's membership to a tribe. This means, the more an individual invests into the old-boys network compared to the outside network, the larger is her or his tribal BC and the higher her or his affiliation with the own tribe.

$$\text{Individual BC Tribe Factor} = \text{tribal betweenness centrality} / \text{external betweenness centrality}$$

Assessing individual success, we found that individual degree, weighted tribe factor, and betweenness centrality tribe factor and success are positively correlated (table 6). This means that a successful entrepreneur has proportionally more links with other alumni from her/his alma mater than with outside people.

The highly significant correlation between individual degree, i.e. total links of an entrepreneur and her or his success in running the business means that having many Xing friends is an indicator of business success. But as already remarked above, this correlation alone 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.

<i>Level of success</i>	<i>N</i>	<i>Individual Tribe Factor</i>	<i>Individual Degree</i>	<i>Individual Weighted Tribe Factor</i>	<i>Individual BC Tribe Factor</i>
1	8	0.008578431	4.625	0.039675245	0
2	150	0.042017913	17.95903212	0.754601042	0.086672447
3	472	0.049580305	19.71417444	0.97743479	0.136807269
4	254	0.045653527	27.49223998	1.255117729	0.21345296
5	34	0.028472560	35.09325397	0.999194773	0.19420585
Correlation	918	0.41	0.98***	0.83*	0.94**

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 individual BC tribe factor correlates on a highly significant level with our five success levels, which means that the higher a founder's embeddedness with the own tribe, the more successful she or he is in building up 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 some common characteristics with the concept of embeddedness as studied by Uzzi (1996 & 1997). Uzzi argues that the positive effect of embeddedness that firms organized in tightly connected networks have higher survival chances reaches a threshold, after which the effect reverts itself. Extrapolating Uzzi's results would imply that there is a threshold after which being a tribe does not pay off anymore. In analogy to his findings we observe that the most successful entrepreneurs in table 5 (on success level 5) have somewhat lower values for all individual tribe factors. This in other words 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

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. Based on previous work in the same research 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 goal was to find out how their online networking behavior affects their success of founding new businesses. We divided our analysis into two parts: In the first part, we verified two hypotheses that examine the effects of the structure and position of a university alumni network on 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 out that social groups are not random samples of people (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). Most of the work was done with offline social networks, e.g. by studying work groups or organizations. In this study we could identify similar effects in an online social network (Mayer & Puller 2008).

We assumed that there are certain structural properties of these networks that will explain success. Group 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.

We also found that university alumni networks that were successful in founding startups – measured by their average economic contribution – are organized as tribes. 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 could mean that it should foster and encourage students to build up more and closer connections with alumni. Porter et. al. (2005) found 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 taper 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 we especially found this while analyzing success on an 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.

Findings on university level and on individual founder level show that the more a founder is embedded in her/his own tribe, the more successful will the business be. 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.

6. Limitations

The main question is if our 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 is higher for small business schools with smaller overall number of students.

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 would give us a more comprehensive overview of the embeddedness of an alumnus in her/his 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 insights about the kind of relationship and whether there are differences among 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. 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 business contacts also in the online world, and to choose these contacts well – the better you know them as alumni of your own university, the more successful your business will be.

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