THE CHANGING IMPORTANCE OF STRUCTURAL HOLES AND SOCIAL CAPITAL IN AN EMERGING INDUSTRY: EVIDENCE FROM THE INTERNET INDUSTRY

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THE CHANGING IMPORTANCE OF STRUCTURAL HOLES AND SOCIAL CAPITAL IN AN EMERGING INDUSTRY: EVIDENCE FROM THE INTERNET INDUSTRY

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ABSTRACT

Although there is substantial agreement on the importance of firm networks and social capital for new startup firms, there has been little work examining how they develop in an emerging industry and how they change over time. To answer these questions, we examine changes in the firm networks of a sample of leading US Internet firms over the period 1990-2000. Our results suggest that new firms exploit structural holes during early phase of industry but that social capital becomes increasingly important as the industry matures.

INTRODUCTION

There is now a substantial literature on the importance of firm networks to acquire critical resources in entrepreneurial firms (e.g., Aldrich & Zimmer, 1985; Dubini & Aldrich, 1991; Starr & MacMillan, 1990; Zhao & Aram, 1995). However, there is considerably less agreement on how networks evolve in an emerging industry and what firm characteristics are most advantageous at different stages.

On the one hand, several studies show that emerging firms tend to rely initially on social capital, for example, ties with entrepreneurs' family members and friends to gain the key resources needed to establish firm viability (e.g., Larson and Starr, 1993). An opposing view argues instead that firms that bridge structural holes within networks gain the most advantage (e.g. Burt, 1992; Zaheer et al., 2005). Therefore, two distinct outcomes are predicted depending on the strategies adopted by firms. Strategies built solely on enhancing social capital would lead to networks with highly dense local environments. If, on the other hand, firms mainly try to pursue a strategy of filling structural holes in their own network, less densely connected local environments would result.

As some researchers (e.g. Aldrich and Reese, 1993) have argued, a more dynamic approach may help to reconcile these two different network perspectives. For instance, Hite and Hesterly (2001) considered the question of whether cohesive networks of socially embedded ties or sparse networks rich in structural holes are more conducive to the success of new firms and proposed that as firms emerge, their networks consist primarily of socially embedded ties drawn from dense, cohesive sets of connections but as firms move into the early growth stage, their networks evolve toward more ties based on a calculation of economic costs and benefits. Other researchers examining interfirm networks (Verspagen and Duysters, 2004; Baum et al., 2002; Gulati and Gargiulo, 1999; Kogut and Walker, 2001; Nohria and Garcia-Pont, 1991; Walker et al., 1997) have also suggested that social capital and structural hole effects vary, in some cases creating “small worlds”, characterized by highly clustering but at the same time, short path length between any two sites. However, there appears to have been little work that examines how social capital and structural holes change in industries over time and how these changes create opportunities for new firms. Therefore, this paper makes a start by examining how the alliance network of leading firms in the emerging Internet industry changes over time and how incumbent and startup firms have taken advantage of the opportunities created.

CONCEPTUAL BACKGROUND
There is now extensive research that shows networks play a central role in successful firm emergence and growth (e.g. Birley, 1985; Dubini and Aldrich, 1991; Aldrich and Reese, 1993; Larson and Starr, 1993). According to the resource-based view (Penrose, 1959), the firm’s network relationships represent critical avenues for the acquisition of resources necessary for firm survival and growth (Gulati, 1998; Jarillo, 1989).

The newly created firm, often lacks critical internal resources and capabilities to ensure the successful survival of the firm (Baum, 1996), lower degrees of legitimacy and reputation (Katz and Gartner, 1988). The development and growth of young technology-based firms are particularly dependent upon innovatively combining their own firm specific knowledge with that of external partners because young firms are typically resource constrained and because young technology-based firms depend upon knowledge-based resources to survive and grow (Autio, Sapienza, and Almeida, 2000). Given the lack of necessary resources or legitimacy many young firms adopt the strategy of forming partnerships with larger, more established firms that have greater resources and legitimacy (Jarillo, 1989; Gomes-Casseres, 1997; Alvarez and Barney, 2001; Yli-Renko et al., 2001; Baum et al., 2000; Stuart et al., 1999).

There are two main theoretical perspectives on the dynamics governing the formation of firm alliance networks. The first perspective emphasizes the importance of social capital (Bourdieu, 1980; Coleman, 1990). Social capital can be defined as "the sum of the resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition" (Walker et al., 1997, p. 109). Putting the concept of social capital in a network context, Walker et al. have argued that the density of network relations is a good proxy: "Some firms occupy positions that are embedded in regions filled with relationships, indicating a high level of available social capital, but other positions are located in regions with few relationships, suggesting a low social capital" (Walker et al., 1997, p. 111). In general, one can argue that firms with more social capital will have access to a larger pool of information sources and will be able to attract better partners (Gulati, 1998).

The second perspective on networks stems from the work by Burt (1992), who argued that a firm interested in using networks as a source of information should attempt to fill the structural holes in between the dense areas of a network rather than replicate existing partnerships that are already in place. From this perspective, the primary strategic aim of forming partnerships becomes the desire to serve as “bridges” between two relatively unconnected parts of a network.

The “social capital strategy” and the “structural holes strategy” will lead to quite different network structures. Firms dominated by a “social capital” view of the world will seek out a number of partners with whom they build strong and repeated ties. This will result in an overall network structure in which local environments of a firm are densely populated with alliances, but where path length to other local environments is long. Alternatively, in a network dominated by firms pursuing strategies aimed at bridging “structural holes”, local environments will tend to be populated less densely, while paths through the network will tend to be shorter. Some suggest that there is some degree of trade-off involved between social capital (density of network) and path length, where higher social capital leads to longer paths.

A number of empirical studies have shown that networks of firms are frequently characterized by uneven structures composed of regions in which firms are more or less densely interconnected and are often consistent with small world networks, which have a relatively high clustering coefficient together with low characteristic distance. Typically these networks have the following characteristics. One is that they are sparsely connected with actual ties between firms representing only a small proportion of possible relationships (Kogut & Walker, 2001; Walker et al, 1997). A second is that they tend to be
characterized by the presence of competing subgroups consisting of both central and peripheral firms (Baum & Ingram, 2003; Gulati & Gargiulo, 1999; Nohria & Garcia-Pont, 1991). A third is that they tend to form cliques, with most partners of any given firm connected to each other and not to outsiders (Gulati & Gargiulo, 1999). Lastly, many networks also exhibit a fourth feature, spanning ties that connect firms in one clique to firms in other cliques.

Baum et al. (2002) identify both exogenous and endogenous factors that may lead to such structures. Exogenous factors include the need to share the costs and risks of undertaking large-scale projects, to develop existing markets or enter new ones, to pursue resource specialization, or to reduce competition. Such objectives make firms interdependent with other firms that possess the capital, knowledge, complementary assets, and technical capabilities that can help them to achieve their ambitions. Endogenous factors include relational, structural and cognitive embeddedness of organizations. Relational embeddedness refers to the effects of dyadic ties between firms on subsequent cooperation between them (Gulati & Gargiulo, 1999). For example, through previously established ties, partners can learn about the competencies and reliability of the other, increasing trust and diminishing uncertainty. Structural embeddedness refers to indirect channels of information, reputation, and referral. Firms tied to a common partner can obtain reliable information about each other indirectly from that partner. Cognitive embeddedness refers to the tendency for firm networks to be further reinforced by shared beliefs and mental models about how and with whom to cooperate and compete.

Verspagen and Duysters (2004) found that the balance between the two effects varied by industry sector and suggested that the nature of the technology and knowledge transfer in the industry could be factor. Thus, the network in the chemicals and food technology field showed a high value for social capital as the industry comprises many small firms with specialist knowledge and the large firms have adopted a strategy of tapping into this knowledge base by means of many alliances with these small specialist firms.

We suggest in this paper that balance between the forces of social capital and structural holes varies depending on the stage of development of the industry. This in line with calls in the literature for a more dynamic perspective of entrepreneurial networks and their evolution (e.g. Aldrich, Reese, & Dubini, 1990; Hite & Hesterly, 2001; Larson & Starr, 1993) and previous research which suggests that networks change as firms search for resources to ensure their survival (Hite & Hesterly, 2001; Larson & Starr, 1993). Hite and Hesterley (2001) have commented that the dynamic nature of firm resource needs suggests that a more dynamic approach to understanding the firm’s network is required and may help to reconcile these two different network perspectives (e.g., Aldrich and Reese, 1993; Larson and Starr, 1993; Salancik, 1995). However, while they focus on changes in the firm’s network over time, we focus here on changes in the industry network of alliances over time.

Previous studies have shown that industry networks change over time in response to industry events. Madhavan et al. (1998) distinguished the effects of structure-loosening and structure-reinforcing events. Structure-loosening events reduce the benefit of previous centrality and create opportunities for peripheral players to improve their position, and increase their centrality. Structure-reinforcing events provide highly central firms with an opportunity to increase their centrality while making it more difficult for peripheral players to attract partners.

We similarly distinguish between structure-loosening and structure-reinforcing events but we hypothesize that structure-loosening and structure-reinforcing vary as the industry develops. In the initial phase of industry development, few firms have established a dominant position so we hypothesize:

**H1:** In the initial phase of a new industry, the structure will be loose as firms vie to establish their position in the industry.
As the industry matures, some key firms increase their dominance in the industry and their attractiveness as partners so we hypothesize:

\[ H2: \text{As the industry matures, the network structure will be reinforced with key firms increasing their centrality in the network.} \]

**METHODOLOGY**

First, we selected two samples of leading US Internet firms from the “Internet 50 index” listed on USA TODAY website (http://www.usatoday.com/tech/techinvestor/internet50.htm):

1. a sample of 25 top e-business companies
2. a sample of 17 top e-consumer companies.

Second, the alliances of each company were then determined from the database of IT alliances provided by ReCapIT (http://www.recapit.com/). In the third stage, we also examined the secondary alliances formed by alliance partner.

The database covers alliances over the period 1989-2000, so we were able to examine the development of the alliance networks from the start of the boom in the Internet industry to just after the dotcom crash. We also checked the completeness of the database by double-checking against the SDC database of alliances so we are confident that we captured all of the significant alliances made by the sample firms and their alliance partners over the period.

We then determined the network characteristics and network position of firms in the network using UCINET (Borgatti, Everett and Freeman (2002). First, the clustering coefficient and characteristic distance of each network were calculated for each year for which we had data. Second, we measured the social capital and structural hole positioning of each firm in the network at annual intervals. We measured social capital using the Freeman degree centrality (the number of ties of each firm in the network), which has previously been shown to be a good measure of a firm’s influence in a network (Mizruchi and Bunting, 1981) and has been previously used to measure social capital (Ahuja, 2000; Koka and Prescott, 2002). We measured structural holes using the constraint score in UCINET (Zaheer and Bell, 2005. (According to Burt (1992), constraint effectively measures a firm’s lack of access to structural holes.)

**FINDINGS**

Both networks followed a pattern of development as follows

- an initial phase of disparate clusters forming around certain key firms
- linking of the clusters by other firms
- increasing clustering around dominant firms in the industry

Table 1 shows a gradually increasing clustering coefficient along with decreasing characteristic distance in both networks. In the network of e-business firms, there were only two relatively small clusters of e-business alliances in 1994 (figure 1). In the next stage of network formation, several disconnected clusters were formed around Macromedia, Sun, Cisco and VeriSign. In 1996 there were signs of increasing links between previously developed clusters with new startups focusing on filling structural holes in the network while already established companies added more alliances (figure 2). Examples of the former in the e-business network are: InfoSpace (linking 4 clusters), Netscape, Aris. Examples of the latter include Check Point Software, Sun, Oracle, Cisco.
A similar pattern was observed in the network of e-consumer firms. The network showed an increasing clustering coefficient along with decreasing characteristic distance. However, in case of the e-consumer network, only one large fragment of the network was formed at the early stage (figure 3), including Earthlink, Apple Computers, IBM, Beyond.com, Microsoft, Intuit, Concentric Network and Netscape Communications. As in the e-business network from 1996 onwards there were signs of increasing links between previously developed clusters with new startups focusing on filling structural holes in the network while already established companies added more alliances (figure 4).

An examination of strategies of firms in the networks showed some significant differences between the two networks. In the e-business network, most central firms were firms from the IT industry e.g. IBM, Microsoft, Intel, Motorola, Dell, Compaq Sun, Oracle, the exception being Cisco. Only 5 firms showed a strategy of filling structural holes in the network. Of these, most (3) were incumbent firms from the IT industry (Nokia, Samsung and JD Edwards). An analysis of the strategies of these firms as stated in their annual reports and press releases confirmed that these firms explicitly set out to fill in a structural hole in the industry by integrating disparate technologies. An examination of a subsample of the “satellite” firms (i.e. least central firms) in the e-business network showed that most (85%) were startups, 45% forming their first alliance in their first year of operation (table 2).

The e-consumer network showed less dominance by IT firms. Some are still quite central (Microsoft, Intel, Motorola, Compaq) but Internet startups are more significant (Yahoo, Aether Systems, Net2phone, CNET, Intuit and Earthlink). Only one firm (Net2phone) the subsample showed a strategy of seeking structural holes. Net2Phone provides retail Voice over IP services and was the first company to bridge the Internet with the public switched telephone network and formed the alliances with firms in a number of sectors to support their new business model. Like the e-business network most (82%) of the subsample of “satellite firms” in the e-consumer examined were startups, but unlike the e-business network only 10% formed their first alliance in the first year of operation (table 2).

DISCUSSION

The findings generally confirm our hypothesis that different strategies of seeking social capital and structural holes dominate in different phases of industry development. However, they also suggest that, contrary to arguments suggested by some other researchers, the social capital and structural holes hypotheses of network development should be viewed as complementary rather than competing hypotheses. In both of our networks the general tendency of firms was to increase social capital at the same time as decreasing structural constraints. Nevertheless, it was also clear that a few firms managed to significantly increase their social capital compared to the rest, the result being a hub and spoke structure with a few firms at the center of largely distinct subnetworks.

The findings suggest that whether incumbent firms or new startup firms achieve central positions in these networks depends to some extent on the resources required. The finding that firms that were central in the e-business network were mostly existing firms from the IT industry can be explained by a number of factors such as greater setup costs, access to key technologies and access to existing business clients, all of which would favor existing firms. In contrast the finding that startup firms had greater success in achieving central positions in the e-consumer network might be explained by the lower initial resource requirements as well as the fact that, unlike e-business firms, few existing firms had much experience in e-consumer markets. Unlike e-business where the technologies are largely a development of existing technologies possessed by firms in the IT industry, e-consumer firms require a combination of consumer marketing and Internet technology capabilities, which few firms at the start of the Internet industry possessed.
The differences between the two networks in prevalence of startup strategies based on filling structural holes also suggests that whether or not structural holes appear or firms take advantage of them may depend on the technology or other factor that affects the need for firms to collaborate. One reason why there was a greater frequency of firms filling in structural holes in the network is that these firms were taking advantage of the opportunity or need to link various technologies together. It is noteworthy that the three firms that most clearly showed evidence of filling in a structural hole in the e-business network (Akamai Technologies, Samsung and Nokia) pursued clearly stated strategies of technology integration. There was less need for such “intergroup” linking in the e-consumer network, except in the case of Net2phone, which by the nature of its business its needed to collaborate with partners in telecommunications, software and e-retailing.

CONCLUSIONS

First, we confirm the findings of other researchers that a common strategy for startups, particularly in technology-based firms, is to form an alliance with an existing firm. However, our study also suggests a strategy of seeking partners with existing social capital in the form of existing alliances is is more common than a strategy of seeking structural holes. We also find that the prevalence of startup strategies seeking structural holes as opposed to seeking partners with high social capital varied depending on the industry. We suggest that resources required to compete in the industry as well as capabilities of the existing firms in the industry are key factors.

We also suggest that the social capital and structural holes hypotheses should be viewed as complementary rather than competing hypotheses. Either effect may dominate at different stages in development of the industry network and the pattern observed in our networks was one of

- initial emphasis on social capital building around certain key firms
- filling of structural holes in the network by new firms
- increasing development of social capital around emerging industry leaders

However, we recognize the limitations of our study. First, we only examined one industry and only the networks of some key firms in the industry. Further research is required to determine whether the same general pattern occurs in other industries and what other factors may influence network development. Second, we only briefly examined how the publicly stated strategies of a few key firms affected their network positioning but we did not examine other factors and how these might have influenced their position in the network or vice versa. Further research could examine, for example, resource constraints and need to establish legitimacy through alliances. Finally, further research could also examine the performance implications of different strategies, for example, whether a strategy of filling structural holes leads to better performance than one of building social capital or seeking partners with high social capital.

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REFERENCES


Table 1. Changes In Network Parameters Over Time

<table>
<thead>
<tr>
<th>Time Interval</th>
<th>Clustering Coefficient</th>
<th>Characteristic Distance</th>
<th>Time Interval</th>
<th>Clustering Coefficient</th>
<th>Characteristic Distance</th>
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<td>1989-1997</td>
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<td>1989-1998</td>
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<td>0.226</td>
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<td>1989-1999</td>
<td>0.224</td>
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<tr>
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<td>0.228</td>
<td>3.198</td>
<td>1989-2001</td>
<td>0.256</td>
<td>3.113</td>
</tr>
</tbody>
</table>
Table 2. Percentage of startups versus existing firms in satellite firms in e-business and e-consumer networks

<table>
<thead>
<tr>
<th></th>
<th>E-business network</th>
<th></th>
<th>E-consumer network</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of firms</td>
<td>%</td>
<td>No. of firms</td>
<td>%</td>
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<td>Incumbents</td>
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<td>Incumbents</td>
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<td>Total</td>
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<td>100.0</td>
<td>Total</td>
<td>58</td>
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</table>
Figure 1. E-business alliances (1994)
Figure 2. E-business alliances (1996)
Figure 3. E-consumer alliances (1995)
Figure 4. E-consumer alliances (1996)