

The effect of social capital in new venture creation: the Cambridge high-technology cluster

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- *Earlier studies of business clusters have been carried out at the level of companies and industries as units of analysis. This paper explores the Cambridge high-technology cluster with individuals as the principal focus as they help to shed light on entrepreneurial processes, particularly on how their prior work experience together has shaped many of the start-ups and spin-outs from the University of Cambridge, local consulting organizations and other companies.*
- *This research explores serial entrepreneurship in the Cambridge high-technology cluster using a family tree and interlocking directorships approach. It reveals a mini-cluster of Cambridge entrepreneurs as the key influence on the success of the growth process and their links between the companies as the structural and relational social capital of the cluster.*

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Introduction

There are many contributing factors that have been cited for the success of the Cambridge high-technology cluster, such as the strength of university research, availability of finance (in the early days from Barclays Bank), and the relaxed approach that the university took to intellectual property transfer (Segal *et al.*, 1985, 2000). This paper seeks to highlight the importance of human networks that bind the Cambridge companies together in a close community. We believe that a better understanding of structural and relational social capital can begin to throw light on the formation and development of business strategy, especially as

it relates to this context. At the centre of these networks is a mini-cluster of key individuals (investors, academics and serial entrepreneurs) who have an important influence on success.

In *The Cambridge Phenomenon*, Segal *et al.* (1985) developed a complex family tree of spin-outs which provides a valuable basis for tracing the evolution of high-technology companies. This paper focuses at the level of individuals to illustrate the dynamics of social capital within the Cambridge cluster, to demonstrate that the role of individuals, especially of serial entrepreneurs, has been a significant contributory factor in explaining its emergence.

This paper is also informed by the works of Rosa and Scott (1999) and New (2003), where they demonstrated that the most successful entrepreneurs tended to hold multiple direc-

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torships or ownership stakes. They established a link between habitual entrepreneurship and multiple directorships.

The research presented here investigates (1) the key entrepreneurs in the Cambridge cluster by using the family tree diagrams of technology start-ups and (2) the prevalence of interlocking directorships with a view to quantifying the degree of interconnectivity between individuals within the cluster. The subsequent analysis draws together a critical review of literature on serial entrepreneurs, social network, social capital, multiple directorship and spin-outs/start-ups.

Entrepreneurs and social networks

The proximity of companies and institutions in one location and the repeated exchanges among them arguably fosters better coordination and trust (Porter, 1998). A key factor underlying the operation of industry clusters is an effective network of relationships that stimulates the creation of new ideas, innovation and entrepreneurship. Even though Porter's work may not explain the role of individual entrepreneurs in a cluster, his observations in this area are particularly relevant to this research.

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Increasing attention is being paid to entrepreneurs and their social network in generating new ideas and ventures. Neergaard (2002) differentiated the *alpha entrepreneur* (a lead entrepreneur) from other members of the entrepreneurial team by his or her networking behaviour and their ability to build and use networks strategically in founding and growing a new venture. It follows, therefore, that there may be a link between the alpha

entrepreneur's networking activities and venture performance.

The two principal assets that habitual entrepreneurs (Birley and Westhead, 1993; Rosa, 1998) appear to present to a new venture are described by Wright *et al.* (1998) as experience and networks. Shane and Stuart (2002) analysed a large number of spin-outs from the Massachusetts Institute of Technology (MIT) and established that founders with existing direct and indirect relationships with investors are more likely to receive funding (Wright *et al.*, 1997). Shane and Cable (2002) found that high-technology geographic clusters may result from the effect of social ties in the venture financing process. Entrepreneurs may need to locate their ventures in particular areas in order to take advantage of social ties that facilitate the funding process. This suggests a link between the social capital of the individual entrepreneurs and the wider environment of the cluster.

Social capital

Social capital (Coleman, 1988; Burt, 2000) is defined as the importance of networks of strong personal relationships that provide the basis of trust, cooperation and collective action (Nahapiet and Ghoshal, 1998). It is further distinguished between three facets of social capital, being structural, relational and cognitive. Structural social capital describes the configuration of linkages between people and units, while relational capital describes the personal relationships that people have developed through a period of interaction. Key factors in this type of capital are trust and trustworthiness based on a history of successful exchanges. Liao and Welsch (2001) suggest that social capital plays a significant role in affecting entrepreneurial growth aspiration and found that relational capital is positively related to it.

From the preceding discussion a number of trends emerge:

- A vibrant cluster may have a strong social network that facilitates the flow of informa-

tion, stimulates innovation and increases the rate of new company formation.

- Relatively little work has examined the importance of the individual entrepreneurs and their contribution in shaping the formation of clusters where their prior experience and networks in a technical and risky business area would be an advantage.
- Serial entrepreneurs (Westhead and Wright, 1998; Westhead *et al.*, 2003) may have developed high levels of social capital encouraging them to locate their multiple ventures in geographical proximity. Hence within a cluster we might expect to see 'mini-clusters' associated with serial entrepreneurs.

Spin-outs and start-ups

For the discussion to be found later in this paper, it is worth describing the terms *spin-out* and *start-up*. A *start-up* is a new business venture in its earliest stage of development while a spin-out is the division of an existing parent organization into one parent and one or more independent company(s) (Shah, 2004). A *spin-out* is defined as a new company that (1) is formed by individuals who were former employees of a parent organization and (2) is based on a core technology that is transferred from the parent organization (McQueen and Wallmark, 1982; Smilor *et al.*, 1990). Radosevich (1995) differentiated between inventor-entrepreneurs and surrogate-entrepreneurs who did not invent the technology but acquired the rights to commercialize it from the organization.

Roberts and Malone (1996) identified the *involved parties* in the spin-out process including: (1) the parent organization from which the technology is extracted, (2) the technology originator, (3) the entrepreneur who attempts to create a new venture centred on the technology, and (4) the venture investor that provides funding for the new company. Djokovic and Souitaris (2004) argued that only an entrepreneur and a parent organization are the *essential* parties in the spin-out formation and should be mentioned in a generic definition. They argued that often

either the technology originator is not distinct from the entrepreneur, or the technology originator does not get involved in the spin-out and therefore he or she has little relevance to the new venture. The venture investor is also not always necessary, since spin-outs can also grow organically funded by revenue, public research and development contracts or private partners.

Yencken and Gillin (2002) presented various taxonomies of spin-outs (spin-offs). *Direct research spin-offs* are set up to commercialize intellectual property (IP) arising out of a research provider organization where IP is licensed, usually through a patent, from the research provider organization to the new firm and usually involving staff transfer. *Indirect spin-offs* are set up by the staff drawing on their experience acquired during their time at the organization, but which have no formal IP licensing or similar relationships to the organization (Thorburn, 1997, Upstill and Symington, 1999).

Agreement on the definition of spin-out is still hugely questionable. In order to avoid the conflicts of interest by different parties in the spin-out process, we employ the term 'start-up' here, which is simply defined based on the founding entrepreneur's origin. For example, a University start-up is defined as a company which is founded by (or, the founding of which is partly or fully facilitated by) current and former University of Cambridge researchers, faculty, staff or students.

Method

The approach taken here combines the quantitative and qualitative approaches of Segal *et al.* (1985) and Rosa and Scott (1999). The approaches were tested extensively on:

- Mapping of the start-ups where key individuals were involved.
- Identification of key individuals, some of whom are serial entrepreneurs, who influence multiple companies within the Cambridge cluster.

- Mapping the level of interconnectivity between individuals through membership of common companies in a cluster.

The data used in this paper are collected from publicly available sources and open-ended interviews with several entrepreneurs and individuals. The interviews are intended to provide rich contextual evidence to facilitate interpretation of the data analysis.

Company selection

Many Cambridge companies believed to be connected to the University were retrieved from a number of sources:

- The reports of '*The Cambridge Phenomenon* (1985)' and '*The Cambridge Phenomenon Revisited* (2000)' by Segal *et al.*
- University of Cambridge start-ups by Tim Minshall, Institute of Manufacturing, Department of Engineering.
- The websites of major technology consultancies, science parks, incubators and networking organizations.
- Other sources such as public reports and consultation documents.

Entrepreneur selection

From pilot interviews and research (Beveridge, 2001; Langdon and Manners, 2001), a sample of 20 entrepreneurs was selected to investigate the connection between them and the companies, which represent the success of the cluster in its early days. For each entrepreneur, information about their involvement as a founder, director or investor was retrieved from company websites, press releases and published reports together with data confirmation through interviews with some entrepreneurs. Since the research here is concerned with relational social networks, the names of other key individuals who have repeatedly worked together as a director or member of the management team were also identified for network construction. Finally, the names of key investors were included in the quantitative analysis and served to identify directors with venture capital firms.

Analysis and results

The Cambridge cluster has been divided into two sectors: hi-tech and bio-tech (PACEC, 2003). Within the hi-tech companies are included the instrument engineering cluster, IT (computer services, computer networking and chip designs) and telecommunications; while the bio-tech companies include the biosciences, bio-informatics, medical devices, scientific instruments and bio-pharmaceuticals cluster. Based on the sector and the origin of the companies, the family tree diagrams were constructed in which the timeline and the key founding entrepreneurs are provided.

Figure 1 traces the formation of the hi-tech cluster from the early stages when start-ups of the University such as the Computer Aided Design (CAD) Centre and companies such as Acorn Computers and Topexpress emerged in the late 1970s and 1980s. With the convergence of information and communication technologies, the Cambridge hi-tech cluster continues to grow with new successful players such as ARM and Virata (now Conexant Systems), both of which are start-ups of Acorn and have become among Cambridge's biggest success stories.

Figure 2 maps the formation of major technology consulting firms: Cambridge Consultants Ltd (CCL, itself the offspring of the University in 1960, PACEC, 2003), which gave birth to the Generics Group, PA Technology and The Technology Partnership. These consultancies represent a distinctive element of the cluster and have continued to prosper into more rounded technology houses. They have established their own venture capital firms and invested in a number of start-ups including their own spin-outs.

Figure 3 was constructed for the bio-tech cluster. It maps the formation of the University start-ups in the late 1980s such as Cantab Pharmaceuticals and Cambridge Antibody Technology (CAT). It also shows others such as Enzymatix founded by Chris Evans and Alan Goodman. Both entrepreneurs are not related to Cambridge University, but they are active in the venture capital scene and have played

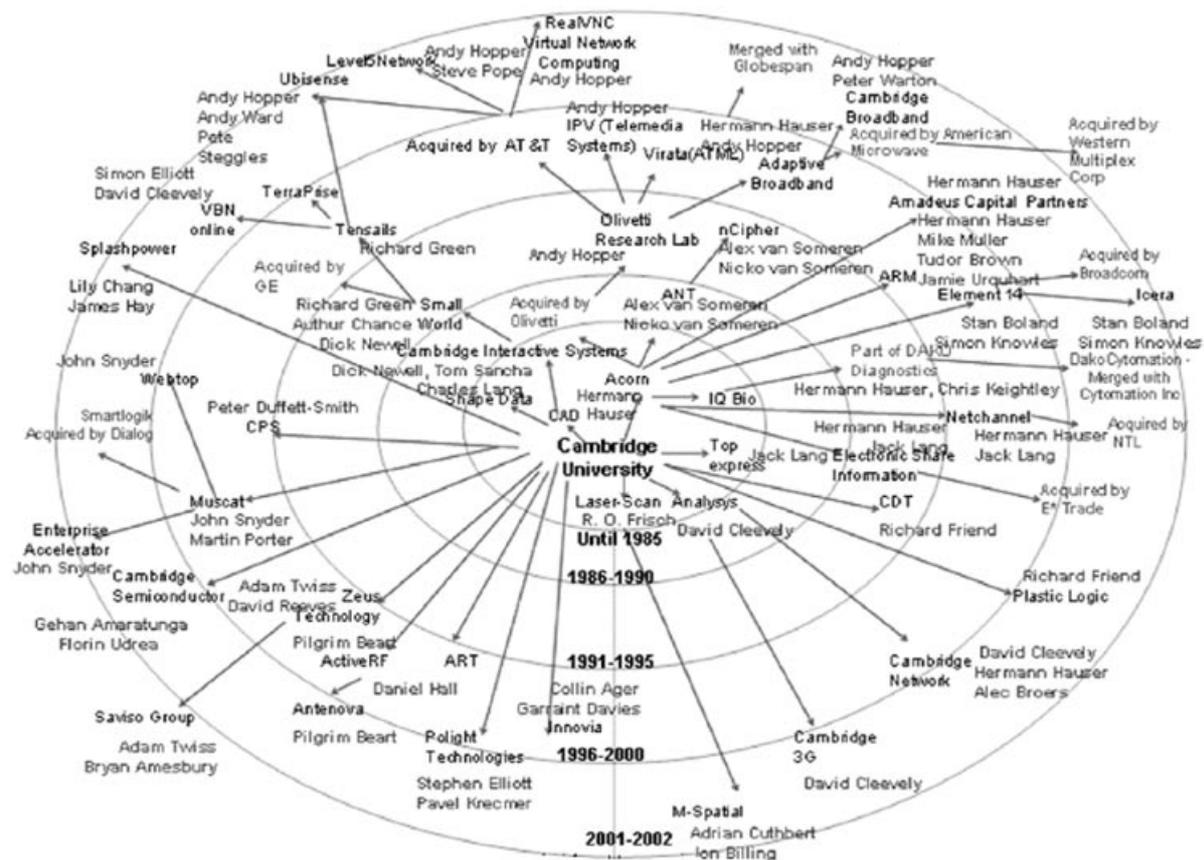


Figure 1. The hi-tech start-ups associated with Cambridge University.

crucial roles in developing new bio-tech ventures in the cluster. The Cambridge bio-tech sector is relatively young (about 15 years). Significantly, a smaller proportion of the University's start-ups are managed by the founding scientists.

These figures illustrate not only the role of the University in generating new start-ups, but also the links of key entrepreneurs who have repeatedly worked together for two or more companies. In summary, we can identify a significant feature of the Cambridge cluster:

The majority of high technology companies that have shaped the success of the Cambridge cluster are connected to a handful of serial entrepreneurs, business angels and venture capitalists, as their involvement in developing new ventures has been repeatedly evidenced in the diagrams.

Entrepreneur networks

The family tree analysis provides not only a means of identifying key individuals within the cluster, but also the links of entrepreneurs with prior association. The movement of people between organizations has indeed been truly phenomenal. It has demonstrated that individuals in Cambridge tend to work together in different organizations repeatedly and over time. This has been very much in line with the claims of several of the Cambridge entrepreneurs interviewed, that a history of working for a common company is one of the most important factors leading to today's network of relationships. Many of the current boards and management teams in Cambridge were constructed by entrepreneurs leveraging their relationships with former colleagues.

Stuart and Sorenson (2003) refer to this phenomenon in their discussion of the influence of network ties in business clustering. They

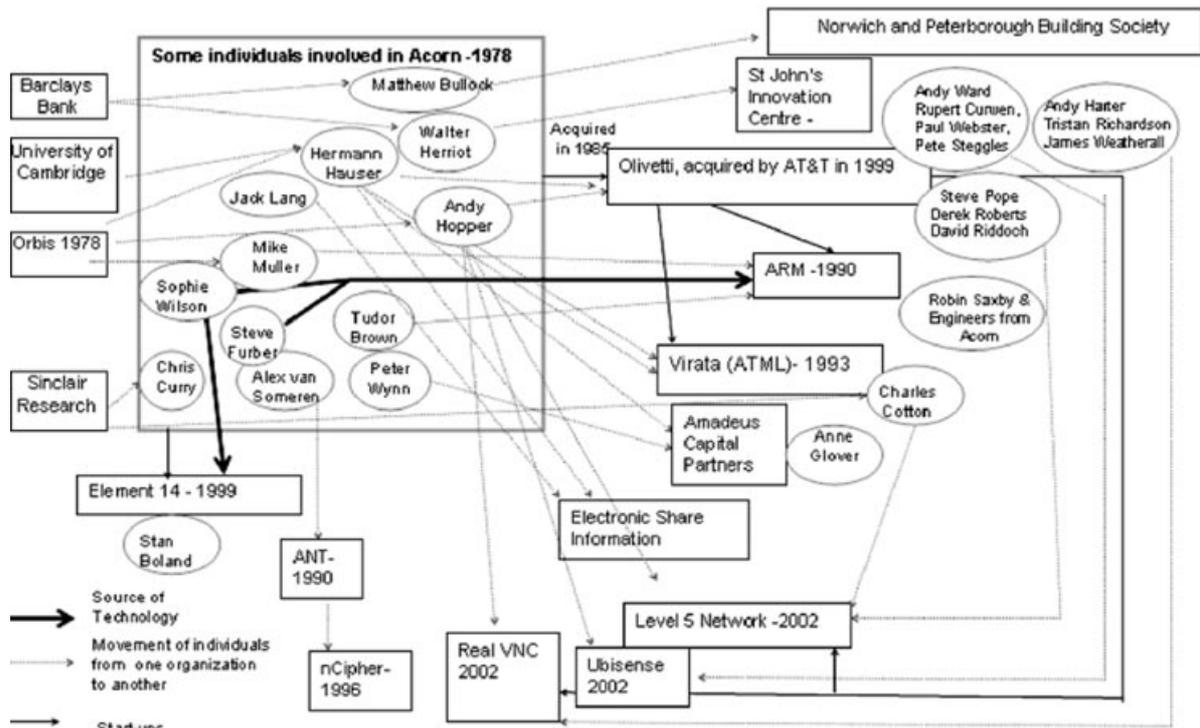
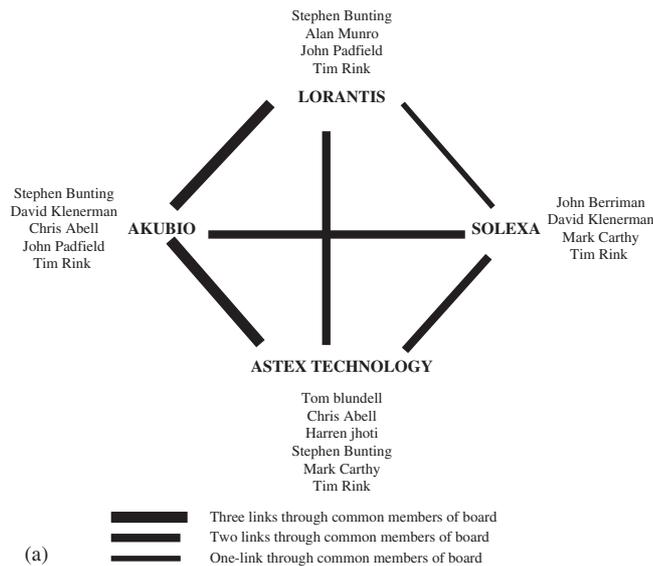
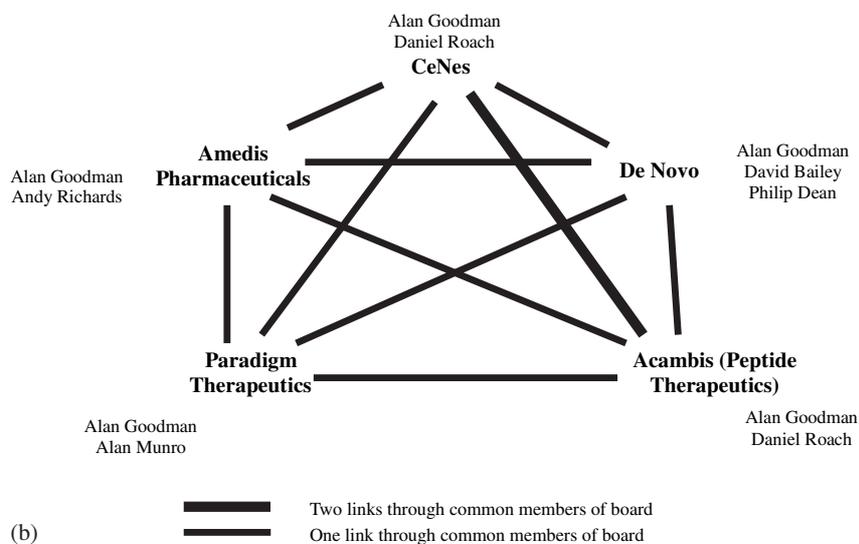


Figure 4. Acorn cluster.





The following factors explain these company links:

- The capital-intensive but highly risky hi-tech and bio-tech companies are usually funded by venture capitalists and business angels. There is usually a representative of the investors on the board of directors.
- The hi-tech sector tends to be highly networked through relational aspects, creating a cluster associated with the entrepreneur's social networks.

The application of multiple directorships in social capital

The presence of multiple common directors or founders through one or more companies is a common feature here. In their analysis of four-year-old Scottish companies, Rosa and Scott (1999) explored the rate of multiple directorships as a proxy for multiple business ownership amongst the directors of small firms. They showed that a high proportion of company directors in the general business population were associated with two or more firms, and through these links both their company and the individual directors could be associated with a portfolio of other companies. To examine the linkages within the cluster, each individual with multiple directorships was used as the link between his

or her portfolio companies. Their approach therefore provides a numerical measure of the interconnectivity between companies.

However, directorship analysis has two limitations. The first is that it can only provide one viewpoint at the firm level as it tracks the linkages between units/companies within the cluster — each individual with multiple directorships was used as the link between his/her portfolio. The second is that directorship analysis provides a means of mapping formal associations by linking companies and individuals through common directors or founders. Thus it provides only a picture of the current formal relationships (impersonal configuration of linkages between people and units) and ignores wider relational aspects. Several interviewees commented that the success of the Cambridge cluster and the structure of its current linkages are most strongly influenced by the history of social interaction in the region. Directorship analysis therefore has its limitations in explaining the Cambridge phenomenon.

Nahapiet and Ghoshal's (1998) concept of structural (impersonal configuration of linkages between people and units) and relational (personal relationships that people have developed through a history of interaction) social capital was examined previously. In order to account for the structural and relational social capital in directorship analysis, the data of

founders, directors and staff with repeated associations was arranged to identify names that appeared multiple times. These links led to a large number of interconnections between the individuals, as illustrated in **Figure 5a** for the hi-tech cluster and **Figure 5b** for the bio-tech cluster.

The Cambridge sample of companies has 63 individuals including entrepreneurs, venture capitalists, business angels and other professionals associated with two or more companies. Figure 5a illustrates the links of 35 individuals in the hi-tech sector and Figure 5b shows the links of 31 individuals in the bio-tech sector. There are a few prominent individuals identified by the study — Hermann Hauser, David Cleevly and Bob Pettigrew — whose names have appeared in both sectors.

Directorship analysis provides some interesting insights into the functioning of the Cambridge cluster and offers a powerful tool for rapidly highlighting key individuals as an illustration of their prevalence in the wider cluster. However, it suffers from a number of limitations, not least that it may exclude both links to other cluster members outside the sample and links to companies in other locations. Similarly, there are other formal groups to which these individuals may belong for business purposes, such as networking groups and industry committees.

In addition, it excludes another cluster of individuals who are not entrepreneurs by definition but business support individuals such as Matthew Bullock, Walter Herriot, Alan Barrell and others. Their influence on the Cambridge hi-technology start-ups cannot be reflected in lists, but they have been instrumental in a vast range of cluster developments. Since the beginning of the cluster evolution, they have played an active role in developing relationships with professional service providers such as law firms, accountants and government agencies in persuading them to adopt a positive approach to business development. Since then, the Cambridge infrastructure supporting the cluster has developed in parallel with its companies so that both new and current entrepreneurs find

it an attractive location. In short, it is clear that the Cambridge entrepreneurs and other individuals have played a vital role in the growth of the cluster:

- The success of the high-technology businesses that they have established over time provides a visible demonstration of 'technology' entrepreneurship. The pool of nascent entrepreneurs benefits from this experience when launching their own ventures.
- As some of them are business angels, they bridge the funding gap when low levels of investment are needed and they invest alongside venture capitalists, which further increases investor confidence.
- Their track record and established relationship reduces the risks associated with joining a new venture that can draw on the experience and credibility of senior business people (Storey *et al.*, 1987).

Conclusion

The research presented here emphasizes the importance of the human dimension in cluster development. It explores the social capital of the Cambridge cluster in more depth and the role played in the cluster by its serial entrepreneurs. The paper has identified that there is a high level of relational social capital in Cambridge arising from the association of individuals who have worked together in other companies over time. In particular, involvement in the founding and early successes of CCL and Acorn connects many of its most prominent hi-tech entrepreneurs. It has also been noted that the high level of structural social capital arising from interlocking directorships is supplemented by the clustering of VC investments and by membership of business angel groups and networking organizations.

Both types of social capital are vital to the dynamism of the Cambridge cluster but in different areas. *Structural social capital* is critical for the efficient functioning of the cluster. Formal links between companies increase awareness of opportunities for strategic

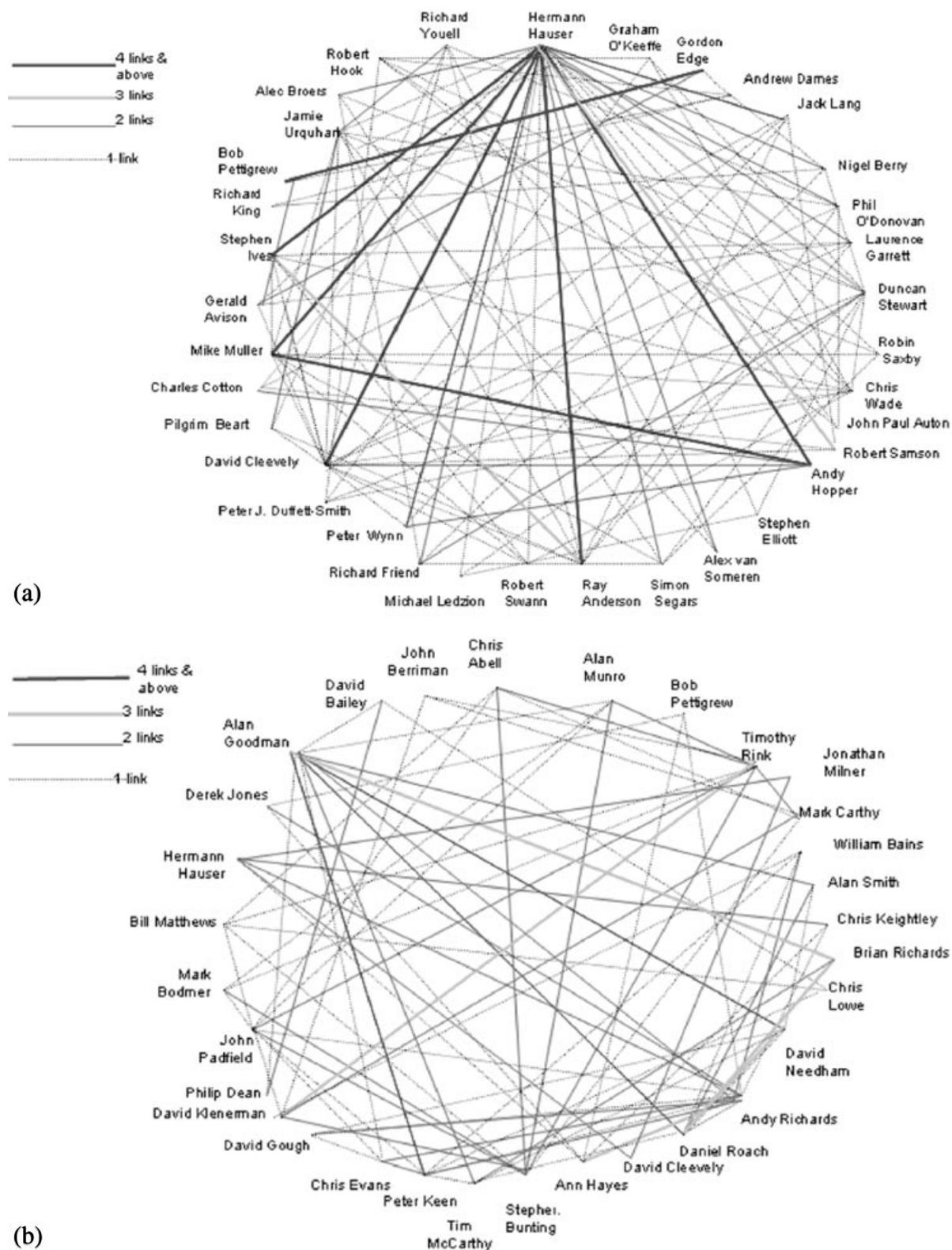


Figure 5. Structural and relational social capital in (a) the hi-tech cluster and (b) the bio-tech cluster.

alliances (that take advantage of complementary expertise) and for outsourcing activities for greater efficiency. They also provide a channel for information on industry trends, government initiatives and grants, laboratory space and new business opportunities.

Relational social capital, however, is leveraged extensively in the formation of new ventures for evaluating promising business opportunities, for forming connections between investors and entrepreneurs, and for staffing new enterprises with experienced management teams. In this area, the social capital of entrepreneurs is invaluable and plays a pivotal role in reducing barriers to entry for new companies.

This research also indicates that there are a limited number of individuals who have shaped the Cambridge high-technology cluster, and this is a principal finding for policy-makers and researchers of cluster formation. The same finding should guide nascent entrepreneurs and their advisers in understanding how local clusters work, so that they are better informed when making an approach to individuals and companies for accessing resources, funds, technology transfer and other reasons. A vibrant cluster needs a pool of individuals who are physically located in close proximity so that they are better able to interact, build and maximize both structural and relational social capital.

Biographical notes

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