Finding the hidden value in SME networks

Rian van der Merwe

User Experience Research – eBay,
San Jose, CA, USA

Leyland Pitt

Simon Fraser University,
8888 University Drive,
Burnaby, BC, Canada V5A 1S6 BC

Bradley R. Barnes*

Kent Business School,
University of Kent,
Canterbury CT2 7PE, UK
Fax: +44-1227-761-187
E-mail: b.r.barnes@kent.ac.uk
*Corresponding author

Pierre R. Berthon

Department of Marketing,
Bentley College,
Waltham, MA, USA

Esmail Salehi-Sangari

Lulea University of Technology,
97187 Lulea,
Sweden

Abstract: Drawing on both social network and social capital theory, this study explores the formation of 'elusive ensembles' on the internet in BioTech Small and Medium-Sized Enterprises (SMEs). Social network and structural hole theories are combined to identify the social capital associated with a network, and this in turn is used to signal entrepreneurial opportunity. Interestingly the findings outline areas where better network coordination is possible. Specifically, the research suggests that entrepreneurial opportunities exist (1) to develop better relationships with those key actors who can exert influence on the network and (2) for enhancing value in the distribution channel by taking on the role as a network intermediary where suitable.

Keywords: Small and medium-sized enterprises; SMEs; biotech; networks; online networks.

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Biographical notes: Rian van der Merwe is a Researcher with eBay in Silicon Valley, California. He received both his Bachelor's degree in Engineering and his Master's degree in Information Science with distinction from the University of Stellenbosch, South Africa. He then received a PhD in Marketing from Curtin University of Technology, Perth, Australia. His research interests are focused on social network theory and its impact on the internet and marketing. His work has been published in journals such as *Industrial Marketing Management*, *European Management Journal*, *Journal of Brand Management* and *Corporate Reputation Review*.

Leyland Pitt is a Professor of Marketing in the Faculty of Business Administration, Simon Fraser University, Vancouver, Canada and is also a Senior Research Fellow, Leeds University Business School, Leeds University, UK. He has also taught on executive and MBA programmes at major international business schools such as the Graham School of Continuing Studies at the University of Chicago, the Graduate School of Business of Columbia University and London Business School. His work has been accepted for publication by such journals, as *Information Systems Research*, *Journal of the Academy of Marketing Science*, *Sloan Management Review*, *California Management Review*, *Communications of the ACM* and *MIS Quarterly* (which he also served as Associate Editor), and in 2000 he was the recipient of the Tamer Cavusgil Award of the US Marketing Association for the best paper in the *Journal of International Marketing*.

Bradley R. Barnes is a Professor of International Management at Kent Business School. He initially studied for his undergraduate degree at Sheffield Business School, before completing his Masters in Marketing at the University of Huddersfield and PhD from the University of Leeds. Bradley has published in a number of academic and practitioner-led journals, including *Industrial Marketing Management*, *European Journal of Marketing*, *Journal of Marketing Management* and *Journal of Business-to-Business Marketing*, among others.

Pierre R. Berthon is the Clifford Youse Professor of Marketing at Bentley College, Waltham, Massachusetts. He has held academic positions at Columbia University in the USA, Henley Management College, Cardiff University and University of Bath in the UK. He has also taught or held visiting positions at Rotterdam School of Management, Copenhagen Business School, Norwegian School of Economics and Management, University of Cape Town and Athens Laboratory of Business Administration. A number of his papers have won awards in the USA and in the UK. He was Bentley Scholar of the year in 2003. His work has appeared in journals such as *Journal of the Academy of Marketing Science*, *Sloan Management Review*, *California Management Review*, *Technological Forecasting and Social Change*, *Information Systems Research* and *Business Horizons*.

Esmail Salehi-Sangari is a Professor and Head of the Department of Industrial Marketing, and also Vice-President International, in the Lulea University of technology, Lulea, Sweden. He also heads the Doctoral programme in e-Commerce at this institution, and teaches on its programmes around the world, including Ghana, Iran, Spain and Costa Rica. Educated in the USA and Sweden, his research interests are in the areas of B2B e-Commerce and his

work has been published in journals such as the *European Journal of Marketing* and *Industrial Marketing Management*.

1 Introduction

It is widely accepted that successful networking can help Small and Medium-Sized Enterprises (SMEs) to survive and compete with larger firms (Copp and Ivy, 2001; Lipparini and Sobrero, 1994; Masurel and Janszen, 1998). This study aims to identify new avenues to expand SME network associations to improve their effectiveness, usefulness and ultimately, their social capital and financial returns. Following van der Merwe et al. (2004), we argue that ‘elusive ensembles’ are an important form of strategic alliances that exist between SMEs. Social network theory provides a useful foundation to explain the mechanisms and structures that individuals use to accumulate power in social settings, leading to the related construct of social capital (Scott, 1991; Wasserman and Faust, 1994). This can be viewed as an asset benefiting the actors who have possession of it and constituting a resource available to an actor defined by its function (Coleman, 1990).

Contingent to the theory of social networks is the theory of structural holes (Burt, 1992). Structural hole theory views social capital as entrepreneurial opportunities inherent in structural disconnects. Hence “Structural holes are disconnections or non-equivalencies between players in the arena... Structural holes are entrepreneurial opportunities for information access, timing, and control” (Burt, 1992). Drawing on both social network and social capital theory, this study explores the formation of elusive ensembles on the internet in Australian BioTech Small and Medium-Sized Enterprises SMEs. Social network analysis is used to identify key nodes in the network. Once the key nodes in the network have been identified, the distinguishing characteristics of these actors are described in managerially useful ways in order to increase the strategic value of the association. More specifically, structural hole theory is used to find entrepreneurial opportunities in these networks.

2 Social network theory and the theory of structural holes

Social network theory is based on the *network concept*, which “emphasizes the fact that each individual has ties to other individuals, each of whom in turn is tied to a few, some or many others, and so on” (Wasserman and Faust, 1994). It is possible to model these relationships between individuals to represent the structure of the network. These models use *actors* and *ties* to represent networks. *Actors* are defined as “discrete, individual, corporate, or collective social units ... e.g. people in a group, departments within a corporation, public service agencies in a city, etc.” (Wasserman and Faust, 1994).

Ties are the relationships between actors. Through network analysis techniques it then becomes possible to “study the impact of the structure on the functioning of the group and/or the influence of this structure on individuals within the group” (Wasserman and Faust, 1994). Social network theory thus provides an alternative to the

notion that actors function independently, that they make their own choices without consideration of the actors around them with which they have ties or relationships. Moreover, its strong theoretical and mathematical basis provides a framework for testing hypotheses about social relationships and their influences.

Closely related to social network theory is the theory of 'social capital', which deals with the intrinsic value of network structures. In general terms, social capital "consists of resources embedded in social relations and social structure, which can be mobilized when an actor wishes to increase the likelihood of success in a purposive action" (Lin, 2001a). Lin (2001b) points out two important components concerning this definition. Firstly, resources are embedded in *social relations* rather than in the *individual*. The properties of the network and an actor's position in that network are more important than the actor himself.

Secondly, access and use of these resources is dependent on an actor being aware of their presence. If an actor is not aware of ties or relationships between him and other actors, he cannot use the resources available to him. Social capital then seems not to exist, and will only come into existence for that actor once he becomes aware of it. The ability to identify networks and key role-players in these networks will therefore make it possible to identify social capital where the relevant actors may be completely unaware of them. The goal of finding the key actors in a network can therefore be likened to gauging the social capital of a network and finding the value in networks where it was not previously observed. From the definition it is inferred that social capital depends first on an actor's *position* in the network (are they in the right place to access the resources?) and second it depends on the nature of the *resources* in the network (are the resources worth accessing?).

The many and varied benefits of social capital underpin our goal to explore the value of elusive ensembles. Adler and Kwon (2000) summarise three benefits as follows:

- 1 social capital provides actors in the network with (1) access to broader sources of information at lower costs
- 2 extended power and influence
- 3 solidarity between actors, as strong networks encourage compliance with rules and customs without the need for formal controls.

An important extension of social network theory is Ronald Burt's theory of 'structural holes'. This theory aims to explain "how competition works when players have established relations with others" (Burt, 1992), and argues that networks provide two types of benefits: *information benefits* and *control benefits*. *Information benefits* refer to who knows about relevant information and how fast they find out about it. Actors with strong networks will generally know more about relevant subjects, and they will also know about it faster.

According to Burt (1992) "players within a network optimally structured to provide these benefits enjoy higher rates of return on their investments, because such players know about, and have a hand in, more rewarding opportunities". Control benefits refer to the advantages of being an important player in a well-connected network. In a large network, central players have more bargaining power than other players, which also means that they can, to a large extent, control many of the information flows within the network. Burt's theory of structural holes aims to enhance these benefits to

their full potential. A structural hole is “a separation between non-redundant contacts” (Burt, 1992). The holes between non-redundant contacts provide entrepreneurial opportunities that can enhance both the control benefits and the information benefits of networks.

3 Social network theory and business networks

It is important to understand social network analysis to appreciate the contribution of this study. We focus on very simple network structures, namely one-mode directional and non-directional networks. *One-mode networks* are made up of a single set of actors, for example, people or organisations. *Directional ties* in a network have an origin and a destination, for example, person A regards person B as a close friend, which does not necessarily mean that person B regards person A as a close friend as well. *Non-directional ties* have no direction, for example, if person A lives near person B, it automatically implies that person B lives near person A. We use graph theoretic notation to represent maps of the social networks. These graphs are also referred to as sociograms (for a more detailed description of graph theory and other theoretical approaches to social networks, see Wasserman and Faust (1994)).

An important concept relevant to our discussion is that of *redundancy*. Contacts are redundant when they lead to the same people, and therefore to the same information (Burt, 1992). The actor dynamics especially (centrality, prominence and prestige) can be very useful for business networks on the internet, as this will identify the most influential actors in the network. To enable network analysis for networks on the internet, we classify distinct websites as the *actors* or *nodes* in the network. Further, we classify the hyperlinks provided on one website to go to one of the other websites as the *relationships* or *links* between these nodes. For each of the websites in question, it is thus asked *does website X link to website Y?* It is important to note that if X links to Y, it does not necessarily mean that Y links to X. We are therefore interested in *one-mode directional networks*.

An important issue that needs to be addressed here is the question of whether or not passive hyperlinks between websites accurately reflect the relationship between those organisations. Does a hyperlink imply a strategic alliance between two organisations? In general, the answer is no. In fact, an argument can be made that these external links are often completely random and left to the whim of web designers. However, the fact remains that a hyperlink does mean a *flow of information* between the two organisations, and that is our focus point. A link may be random, but if it exists, a flow of information exists. We argue that such an ‘elusive’ link can in fact become a strategic alliance by identifying and enhancing the intrinsic social capital created by that link. Obviously this requires a leap of faith, but if two firms are linked, and neither of them is aware of this, then an opportunity is lost. If one or both become aware of the link (in other words it is no longer elusive), then the potential exists for cooperation between them. We therefore assume that a hyperlink is the best possible indication of an elusive ensemble between the two organisations.

Based on the theories already discussed, this study adopts the following methodology approach to explore SME networks. First, we will construct a sociogram of the network using websites as nodes and hyperlinks as links between the nodes.

Next, we will use social network analysis to identify the most prominent actors in the network. We will then use structural hole analysis to identify possible entrepreneurial opportunities in the network. Finally, we will interpret these results to enhance social capital and explore the strategic value of the associations that were identified.

4 Social networks and structural holes applied to biotech SMEs in Australia

The \$28 billion biotechnology industry in a broad sense uses organisms, cells or molecules isolated from cells to make products or solve problems. Scientific breakthroughs in the 1970s allowed companies to capitalise on biotechnology techniques to make products ranging from better pharmaceutical drugs to enzymes that stonewash blue jeans. Today, about 1500 companies worldwide employ more than 179,000 people in research, development, manufacturing, sales and other types of jobs. Most of these companies are SMEs.

We chose Australia as the venue for this study for a number of reasons. Firstly, most research in this regard is carried out either in Europe or north America, and we thought it would be both interesting and useful to provide information from another part of the world. Secondly, Australia has been condemned by economists such as Blainey (1966) to 'death by distance'. We wanted to see whether this was in fact still true in the age of the internet, where international links are as easy as local ones. Finally, bio-tech is a large business in Australia and the nation contributes internationally at a level far above its size in economic terms.

Our methodology for this research is well-grounded in previously published studies (Pitt et al., 2006). We began by identifying three different biotech SMEs whose websites formed the starting point of the network. Obviously the number chosen and the specific firms selected are somewhat arbitrary, however, a start does need to be made, and of course, the more seed firms chosen, the more complex the networks become. We then visited each of these websites and recorded all the hyperlinks on these sites that refer to external websites. Using *SiteSweeper 2.0* software, we identified all the external links. Next, we visited the websites of each of these external links and recorded

- 1 whether or not they link back to the originating website
- 2 to which external websites each of them link in turn.

Next, we visited each of the external websites identified in this iteration to check whether or not they link back to the site from which the link originated.

Having thus identified the relevant links, we constructed a sociogram of this network. Note that this network is constructed in three levels of intensity. The *first level* is the original website of the SME. The *second level* is the external websites that these originating websites link to. The *third level* is the external websites that each of the websites in the second level link to. We then analyse the data in two stages. First, we used *Cyram Netminer 1.5* to perform the prominence analysis (centrality measures and prestige measures). Next, we employ *STRUCTURE* (software developed by Ronald Burt), to conduct the structural hole analysis. These forms of software are all 'tried and tested' and represent useful tools for analysing network data.

5 Findings and analysis

The interpretation process is progressive and recursive, as each stage is important not only to the next, but each stage also calls the analyst back to the previous. For example, prominence measures largely determine the nodes on which structural hole analysis will be performed (structural hole analysis is interpreted using the prominence measures). Each of these stages will now be discussed. Three Biotech companies were identified to undertake this analysis on:

- 1 *Agen Biomedical Ltd.* (www.agen.com.au), a company that develops advanced medical and veterinary diagnostics.
- 2 *VRI BioMedical* (www.vribiomedical.com), a company that develops products for the prediction, prevention and treatment of disturbances of the body's natural defence systems.
- 3 *SOLBEC Pharmaceuticals Ltd.* (www.solbec.com.au), a drug discovery and development company that develops new drugs and technologies for the advancement of human and animal healthcare.

Using *SiteSweeper*, external links were identified for each of these websites up to the third level, as explained earlier. An excerpt of the resulting sociogram is shown in Appendix A. Figure 1 shows a visual map of this network. The numbers on the network refer to the different websites that were visited, as shown in Appendix B. It is difficult to draw meaningful conclusions just by looking at this network, mainly because of its size (73 nodes). It is therefore necessary to turn to social network analysis techniques to discover *which* of these nodes are most prominent in the network.

Figure 1 Biotech SME network

6 Prominence analysis

Three centrality measures were computed, namely *Degree centrality*, *Closeness* and *Betweenness*. Degree centrality calculates a normalised value of the amount of actors adjacent to a particular actor. This is an important measure because it provides “an intuitive notion of how well connected a point is within its local environment...the corresponding agent is central in the sense of being ‘well-connected’ or ‘in the thick of things’” (Scott, 1991). Because this is a directional network, we divided this measure into two parts, namely out and in-degree. *Out-degree* computes the number of links *sent* to another actor, while *in-degree* refers to the number of links *received* by each actor (Valente, 1995).

Closeness measures how close an actor is to all the other actors in the network. As Wasserman and Faust (1994) explain, “an actor is central if it can quickly interact with all others... actors occupying central locations with respect to closeness can be very productive in communicating information to other actors”. The measure finds actors with the shortest communication paths to the others. Again, different measures for Out and In-Closeness were calculated. The third and last dimension of centrality that was measured is betweenness. Betweenness identifies actors that are between many actors in their linkages with each other. This measure is important because

“a point of relatively low degree [centrality] may play an important ‘intermediary’ role and so be very central to the network... The betweenness of a point measures the extent to which an agent can play the ‘broker’ or ‘gatekeeper’ with a potential for control over others” (Scott, 1991).

In this sense it is strongly related to structural hole theory.

The results of the analysis, performed with *Cyram Netminer*, are presented in Appendix C. Table 1 presents a summary of the results and the most prominent actors. Careful observation of this table shows us which of the companies/websites are the most prominent in this network. Websites that have high scores in most of the measures are: Corbett Research (15), Ranbaxy (55), Pharmanex (51) and Macromedia (35). It is easy to see why Macromedia’s website would appear in this list. Most companies these days use ‘Flash’ technology created by Macromedia to enhance the media on their websites. These sites usually provide a link to Macromedia so that users can download the software to run ‘Flash’, if they do not have it installed on their computers already. Referring back to Figure 1, we can see that all these sites are definitely prominent in the network.

Table 1 Prominence measures – SME network

<i>In-Degree</i>	<i>Out-Degree</i>	<i>In-Closeness</i>	<i>Out-Closeness</i>	<i>Betweenness</i>
15 Corbett Research	51 Pharmanex	1 Adobe	51 Pharmanex	51 Pharmanex
35 Macromedia	15 Corbett Research	35 Macromedia	2 AGEN	15 Corbett Research
1 Adobe	31 Indepth	39 Microsoft	68 VRI Biomedical	53 PNMC
8 ASX	55 Ranbaxy	15 Corbett Research	3 Agenix	35 Macromedia
55 Ranbaxy	3 Agenix	8 ASX	15 Corbett Research	2 AGEN
39 Microsoft		55 Ranbaxy	45 Nuskin	31 Indepth 68 VRI Biomedical

7 Structural hole analysis

The final stage of the findings – structural hole analysis looks at the three most prominent biotech websites (*Corbett Research*, *Pharmanex* and *Ranbaxy*) and aims to discover patterns and entrepreneurial opportunities that might not be evident from just looking at the visual map of the network. Burt's *STRUCTURE* software was used for this purpose. The analysis calculates several measures, the most important of which are:

- O_i , the lack of holes around the actor itself.
- c_{ij} , the constraint of absent primary holes. An actor's (i) entrepreneurial opportunities are constrained to the extent that another of his contacts (q), with whom he has a strong relationship, invested heavily and therefore also has a strong relationship with actor j . To put it another way, "your entrepreneurial opportunities are constrained to the extent that you have invested the bulk of your network time and energy in relationships that lead back to a single contact" (Burt, 1992). c_{ij} must therefore be low for structural holes (entrepreneurial holes) to exist.
- p_{ij} , the 'proportion of i 's network time and energy invested in each relationship' (Burt, 1992).

Structural holes occur around a specific actor when there is a large O_i (no or few structural holes around this particular actor); and there is a large p_{ij} and a small c_{ij} at the other end of a relationship with another actor (i.e. a large amount of time and energy invested in the relationship/small constraint on the actor's entrepreneurial opportunities). These conditions give rise to what Burt (1992) calls the *hole signature* of an actor. This visual representation of the difference between p_{ij} and c_{ij} provides an easy way to identify the structural holes around a specific actor. Structural hole analysis conducted on all three sites revealed an $O_i = 1$, which means that there are no structural holes around those actors. Table 2 shows the values for p_{ij} and c_{ij} .

Table 2 Structural hole analysis for Corbett Research, Pharmanex and Ranbaxy

Website		p_{ij}	c_{ij}	$p_{ij} - c_{ij}$
<i>Structural hole analysis for Corbett Research</i>				
A	ARMIN TEB	0.1111	0.0123	0.0988
B	Biolabo	0.1111	0.0123	0.0988
C	Gene Company	0.1111	0.0123	0.0988
D	MeltCalc	0.1111	0.0123	0.0988
E	Adobe	0.0556	0.0031	0.0525
F	Agen	0.0556	0.0031	0.0525
G	Brennan and Company	0.0556	0.0031	0.0525
H	General Biosystem	0.0556	0.0031	0.0525
I	Genotek	0.0556	0.0031	0.0525
J	genXpress	0.0556	0.0031	0.0525
K	Global Science	0.0556	0.0031	0.0525
L	Kem-en-Tec	0.0556	0.0031	0.0525
M	Microsoft	0.0556	0.0031	0.0525
N	Pyrosequencing	0.0556	0.0031	0.0525

Table 2 Structural hole analysis for Corbett Research, Pharmanex and Ranbaxy (continued)

<i>Website</i>		P_{ij}	c_{ij}	$P_{ij} - c_{ij}$
<i>Structural hole analysis for Pharmanex</i>				
A	Nuskin	0.08	0.006	0.074
B	Apple	0.04	0.002	0.038
C	CDC	0.04	0.002	0.038
D	CIDRAP	0.04	0.002	0.038
E	CRN USA	0.04	0.002	0.038
F	e-homoeopathy	0.04	0.002	0.038
G	FDA	0.04	0.002	0.038
H	Force for good	0.04	0.002	0.038
I	Healthscout	0.04	0.002	0.038
J	KFF	0.04	0.002	0.038
K	Macromedia	0.04	0.002	0.038
L	Microsoft	0.04	0.002	0.038
M	Newsalert	0.04	0.002	0.038
N	Newswise	0.04	0.002	0.038
O	Nourish the Children	0.04	0.002	0.038
P	Paho	0.04	0.002	0.038
Q	PDR	0.04	0.002	0.038
R	Real	0.04	0.002	0.038
S	Red Cross	0.04	0.002	0.038
T	Stanford Univeristy	0.04	0.002	0.038
U	USOC	0.04	0.002	0.038
V	VRI Biomedical	0.04	0.002	0.038
W	World Health Organisation	0.04	0.002	0.038
X	Yale	0.04	0.002	0.038
<i>Structural hole analysis for Ranbaxy</i>				
A	Doctor Anywhere	0.133	0.018	0.115
B	Ranbaxy USA	0.133	0.018	0.115
C	Rancs	0.133	0.018	0.115
D	Agen	0.067	0.004	0.063
E	Basics	0.067	0.004	0.063
F	Ecaverta	0.067	0.004	0.063
G	Macromedia	0.067	0.004	0.063
H	Medicines for Malaria Venture (MMV)	0.067	0.004	0.063
I	Ranbaxy for doctors	0.067	0.004	0.063
J	Reuters	0.067	0.004	0.063
K	SRL Ranbaxy	0.067	0.004	0.063
L	Thai Pharmacy	0.067	0.004	0.063

8 Interpretation and discussion

Firstly, the prominence analysis calculated three measures that can be used effectively to identify the most important actors in the network. By implication this will develop the social capital of that network, which will define elusive ensembles more clearly as strategic assets to an organisation. The specific measure(s) used in the interpretation depends largely on the nature of the network and what the marketer intends to accomplish in the network. For example, if the intention is to introduce information to a network of websites as fast as possible, *In-Degree centrality*, *In-Closeness centrality* and *Betweenness* would be the best measures to use, as these measures indicate which actors are most likely to be reached when someone visits one of the sites included in the network.

By studying measures for the Biotech network, we envisage the potential to introduce new information on websites like *Corbett Research*, *Ranbaxy* and *Pharmanex*. Centrality measures are also strongly linked to the diffusion of innovations. Valente (1995) notes “For networks, structural centrality is associated with more rapid diffusion for advantageous innovations and slower diffusion for more risky/uncertain innovations”. Centrality is therefore not only an important measure to decide *which* actors are the most influential in a network; it also directly affects the *speed* with which new information is disseminated.

Secondly, the structural hole analysis identified several possible entrepreneurial opportunities in the network. These opportunity relationships can now be investigated to see whether or not it is practically possible to find a *tertius* strategy. As with centrality measures these opportunity relationships can develop the social capital of the network, and the elusive ensemble then becomes strategic for the organisations in question. In this case, as an example, one of the interesting opportunities exists between *Ranbaxy* and *Doctor Anywhere*.

Ranbaxy is India’s largest pharmaceutical company. It has been rated the 11th largest ‘generic’ company worldwide. The company exports its products to over 70 countries, with ground operations in 25 and manufacturing facilities in 7 countries. *Doctor Anywhere* is an online portal for medical practitioners in India that links doctors with specialists nationwide. DoctorAnywhere.com is a B2B e-commerce service that offers access to medical specialists around India by medical practitioners requiring an expert opinion. Subscribers can select any specialist of their preference and consult them, thus seeking expert opinion through the internet. On its website, *Ranbaxy* links to a special section on *Doctor Anywhere* that deals specifically with advances in AIDS research.

A typical *tertius gaudens* strategy in this case would involve a third party organisation that puts itself *between* these two organisations and negotiates the relationship between them. An entrepreneurial opportunity for the third party organisation may be to serve as an intermediary between these two to control the flow of information and knowledge between them. At the moment, these companies are linked by their mutual interest in the advancement of AIDS treatments. However, it is entirely possible that these two companies may be able to link up on several more areas that they are both interested in. The third party organisation will then spend most of its resources on managing the complex relationship and the flow of intellectual capital between these companies. This intermediary could further expand its influence by approaching other biotech companies that could add to the knowledge

base of *Doctor Anywhere*, helping to create a medical portal that not only links doctors with specialists, but also provides an avenue where important medical research can be presented.

This would create a powerful network that can greatly improve cooperation and the advancement of medical research. The management of this complex flow of information between organisations where knowledge is the most important asset is of utmost importance, and a perfect opportunity for *tertius gaudens*. Every network will have a different structural hole analysis output, and each network should be analysed and interpreted separately. The Biotech case shows that although it is impossible to provide a set blueprint for interpreting the results, each network and its analysis will raise enough questions to point the researcher/manager in the right direction to identify entrepreneurial opportunities.

9 Managerial implications

The simplest, but still most striking observation of the analysis above is that in these days of the internet, a high tech firm will have international relationships, and be a part of global networks, whether these are intentional strategies or not. For example, Australian players are significantly connected to major Indian firms. Social network analysis enables managers to become aware of these links to explore the opportunities they may present, and perhaps to minimise the possible threats they may imply.

The prominence analysis calculated three measures that can be used effectively to identify the most important actors in the networks. By implication this will enable international managers to develop the social capital of that network, by defining concealed links more clearly as the strategic assets of an organisation. The specific measure(s) used in the interpretation depends largely on the nature of the network and what a firm intends to accomplish. For example, if the intention is to introduce information to a network of websites as fast as possible, *In-Degree centrality*, *In-Closeness centrality* and *Betweenness* would be the best measures to use, as these measures indicate which actors are most likely to be reached when someone visits one of the sites included in the network. Studying these measures for the biotech networks, the measures might therefore cause us to introduce new information on websites like *Corbett Research*, *Ranbaxy* and *Pharmanex*.

The structural hole analysis identified several possible entrepreneurial opportunities for global firms and suppliers of biotech products in the network. These opportunity relationships can now be investigated to see whether or not it is practical to find a *tertius* strategy. As with centrality measures these opportunity relationships can develop the social capital of the network, and the previously hidden network then becomes strategic for the organisations in question. As highlighted in this case, an interesting opportunity was presented here between the websites of *Ranbaxy* and *Doctor Anywhere*. As shown, a typical *tertius gaudens* strategy in this case may involve a third party organisation that puts itself *between* these two organisations. An entrepreneurial opportunity exists for such a third party organisation to serve as an intermediary and control the flow of information and knowledge.

10 Conclusions and directions for further research

This study examined the degree to which social network theory can be used to explore the formation of 'elusive ensembles' on the internet. Accordingly, we have demonstrated how sociograms can be created to represent elusive ensembles on the internet; how social network theory can enable us to identify important actors in a network and how social network theory, combined with the theory of structural holes, can be used by managers to identify and enhance the social capital in networks through identifying entrepreneurial opportunities. This study ultimately shows that through proper network analysis, elusive ensembles can constitute an important form of strategic alliance for SMEs. This study establishes a number of directions for future research. For example, to apply this method to more (and even larger) networks would be useful to strengthen the approach and findings.

There are a number of avenues that can be pursued for research in this regard in the future, for networks are identified in the business-to-business marketing literature as a critical issue (cf. Anderson et al., 1994; Borders et al., 2001; Ehret, 2004; Iyer, 2004; McAfee, 2000), and this is especially true in the global arena. Whereas this research has explored the links between firms, it is apparent that firms do not only link to other firms, but also to other organisations such as government departments and semi-government and non-profit bodies, many of which are in other countries. It would therefore seem fruitful to explore these links, and also the links between industries. For example, while biotech firms may have obvious links to other biotech firms, are there links and structural holes between the biotech industry and other industries, such as chemicals, information technology and electronics, which could provide opportunities for astute business-to-business marketers in the international environment?

Recently there has been a renewed interest in clusters and cluster dynamism in innovation research (cf. Carayannis et al., 2006; Onsager et al., 2007; Tikkanen and Renko, 2006), and important work on the crossovers between innovation networks and high-tech clusters (Cook and Pandit, 2005). An obvious fruitful area for further research exists that will examine these issues from a social networks perspective. Whilst the software used here proved useful for analysing quantitative data, a limitation of the approach is that further qualitative research and analysis could be undertaken to explore these networks in more depth. Such inductive research involving 'case study' investigations, etc will prove useful for enhancing the validity of the data.

Research could also expand on these preliminary findings and seek ways to formalise the argument for proper use in any industry. As mentioned in this study, and as illustrated in the Biotech SME examples, there are two main outcomes for different network analyses. Firstly, prominence analysis can be used to identify the most important actors in a network. This information is essential for managers who want to disseminate information across a network as quickly as possible. Prominence measures not only allow managers to identify the actors that will have the most influence on the network, it also shows them which actors to target if they want to distribute the information throughout the network in the fastest way possible. This observation finds a strong tie-in with, and is thoroughly backed up by diffusion of innovation theories (see Rogers, 1995; Valente, 1995).

Secondly, managers can use this information to identify entrepreneurial opportunities in the network, and it will also make them aware of the opportunities that may exist around themselves, that is, openings that may be exploited by third party organisations.

These two outcomes enable researchers and practitioners to enhance the social capital of informal associations on the internet. In a world that is increasingly global and virtual, this is an important contribution to our knowledge of business, marketing and strategy.

References

- Adler, P.S. and Kwon, S.W. (2000) 'Social capital: the good, the bad, and the ugly', *Knowledge and Social Capital – Foundations and Applications*, Butterworth Heinemann, Boston: E. L. Lesser.
- Anderson, J.C., Håkansson, H. and Johanson, J. (1994) 'Dyadic business relationships within a business network context', *Journal of Marketing*, Vol. 58, No. 4, pp.1–16.
- Blainey, G. (1966) *The Tyranny of Distance: How Distance Shaped Australia's History*, Melbourne: Sun Books.
- Borders, A.L., Johnston, W.J. and Rigdon, E.E. (2001) 'Beyond the dyad: electronic commerce and network perspectives in industrial marketing management', *Industrial Marketing Management*, Vol. 30, No. 2, pp.199–206.
- Burt, R.S. (1992) *Structural Holes: The Social Structure of Competition*, Cambridge, MA: Harvard University Press.
- Carayannis, E.G., Popescu, D., Sipp, C. and Stewart, M. (2006) 'Technological learning for entrepreneurial development (TL4ED) in the knowledge economy (KE): case studies and lessons learned', *Technovation*, Vol. 26, No. 4, pp.419–443.
- Coleman, J.S. (1990) *Foundations of Social Theory*, MA: Harvard University Press Cambridge.
- Cook, G.A.S. and Pandit, N.R. (2005) 'Clustered high-technology small firms and innovation networks: the case of post-production in London', in W. Daring, R. Oakey and S. Kauser (Eds). *New Technology Based Firms in the New Millennium*, Elsevier Publications.
- Copp, C.B. and Ivy, R.I. (2001) 'Networking trends of small tourism businesses in post-socialist Slovakia', *Journal of Small Business Management*, Vol. 39, No. 4, pp.345–353.
- Ehret, M. (2004) 'Managing the trade-off between relationships and value networks. Towards a value-based approach of customer relationship management in business-to-business markets', *Industrial Marketing Management*, Vol. 33, No. 6, pp.465–474.
- Iyer, G.R. (2004) 'Internet-enable linkages: balancing strategic considerations with operational efficiencies in business-to-business marketing', *Journal of Business-to-Business Marketing*, Vol. 11, Nos. 1/2, pp.35–59.
- Lin, N. (2001a) *Social Capital – A Theory of Social Structure and Action*, Cambridge: Cambridge University Press.
- Lin, N. (2001b) 'Building a network theory of social capital', in N. Lin, K. Cook and R.S. Burt (Eds). *Social Capital – Theory and Research*, New York: Aldine de Gruyter.
- Lipparini, A. and Sobrero, M. (1994) 'The glue and the pieces: entrepreneurship and innovation in small-firm networks', *Journal of Business Venturing*, Vol. 9, pp.125–140.
- Masurel, E. and Janszen, R. (1998) 'The relationship between SME cooperation and market concentration: evidence from small retailers in the Netherlands', *Journal of Small Business Management*, Vol. 36, No. 2, pp.68–73.
- McAfee, A. (2000) 'The napsterization of B2B', *Harvard Business Review*, Vol. 78, No. 6, pp.18–20.
- Onsager, K., Isaksen, A., Fraas, M. and Johnstad, T. (2007) 'Technology cities in Norway: innovating in glocal networks', *European Planning Studies*, Vol. 15, No. 4, pp.549–566.
- Pitt, L., van der Merwe, R., Berthon, P., Salehi-Sangari, E. and Barnes, B.R. (2006) 'Swedish BioTech SMEs: the veiled values in online networks', *Technovation*, Vol. 26, Nos. 5/6, pp.553–560.
- Rogers, E.M. (1995) *Diffusion of Innovations*, 4th edition, Free Press.
- Scott, J. (1991) *Social Network Analysis – A Handbook*, London: Sage Publications.

- Simmel, G. (1923) *The Sociology of Georg Simmel*, New York: Free Press.
- Tikkanen, J. and Renko, M. (2006) 'Developing innovation networks – the art of interorganisational collaboration in high-technology innovation', *International Journal of Entrepreneurship and Innovation Management*, Vol. 6, No. 6, p.6.
- Valente, T.W. (1995) *Network Models of the Diffusion of Innovations*, New Jersey: Hampton Press.
- Van der Merwe, R., Pitt, L.F. and Berthon, P.R. (2004) 'Elucidating elusive ensembles: the strategic value of informal internet networks', *European Management Journal*, Vol. 22, No. 1, pp.12–26.
- Wasserman, S. and Faust, K. (1994) *Social Network Analysis – Methods and Applications*, Cambridge: Cambridge University Press.

Appendix A

Excerpt of biotech sociogram

[illegible]

[illegible]

Appendix B*List of websites in the network*

1	Adobe	www.adobe.com
2	AGEN	www.agen.com.au
3	Agenix	www.agenix.com
4	Aladdin Systems	www.aladdinsys.com
5	American Depositary Receipts – BNY	www.adrbny.com
6	Apple	www.apple.com
7	ARMIN TEB	www.arminteb.com
8	ASX	www.asx.com.au
9	Bank of NY	www.bankofny.com
10	Basics	www.basics.de
11	Biolabo	www.biolabo.ch
12	Brennan and Company	www.brennanco.ie
13	CDC	www.cdc.gov
14	CIDRAP	www.cidrap.umn.edu
15	Corbett Research	www.corbettresearch.com
16	Corel	www.corel.ca
17	CRN USA	www.crnusa.org
18	CuteFTP	www.cuteftp.com
19	Desana	www.desana.com.au
20	Doctor Anywhere	www.doctoranywhere.com
21	Ecaverta	www.ecaverta.com
22	e-homoeopathy	www.e-homoeopathy.com
23	FDA	www.fda.gov
24	Force for good	www.forceforgood.org
25	Gene Company	www.genehk.com
26	General Biosystem	www.generalbiosystem.com
27	Genotek	www.genotek.es
28	GenXpress	www.genxpress.at
29	Global Science	www.globalscience.co.nz
30	Healthscout	www.healthscout.com
31	Indepth	www.indepth.com.au
32	Inno Biotech	www.innobitech.com.sg
33	Kem-en-Tec	www.kem-en-tec.com
34	KFF	www.kff.com
35	Macromedia	www.macromedia.com
36	Medical Library	www.medical-library.net

List of websites in the network (continued)

37	Medislim	www.medislimnatural.info
38	MeltCalc	www.meltcalc.de
39	Microsoft	www.microsoft.com
40	Milton Pharma	www.miltonpharma.com
41	MMV	www.mmv.org
42	Newsalert	www.newsalert.com
43	Newswise	www.newswise.com
44	Nourish the Children	www.nourishthechildren.com
45	Nuskin	www.nuskin.com
46	Optimum Health	www.optimumhealth.net.au
47	Paho	www.paho.org
48	PC User	www.pcuser.com
49	PC World	www.pcworld.idg.com.au
50	PDR	www.pdr.net
51	Pharmanex	www.pharmanex.com
52	Photodisc	www.photodisc.com
53	PNMC	www.pnmc.com.au
54	Pyrosequencing	www.pyrosequencing.com
55	Ranbaxy	www.ranbaxy.com
56	Ranbaxy for doctors	www.ranbaxyfordoctors.com
57	Ranbaxy USA	www.ranbaxyusa.com
58	Rancs	www.rancs.com
59	Real	www.real.com
60	Red Cross	www.redcross.org
61	Reuters	www.reuters.com
62	Solbec	www.solbec.com.au
63	SRL Ranbaxy	www.srlranbaxy.com
64	Stanford Univeristy	www.stanford.edu
65	Starweb	www.starweb.com.sg
66	Thai Pharmacy	www.thaipharm.com
67	USOC	www.usoc.org
68	VRI Biomedical	www.vribiomedical.com
69	Webxoffice	www.webxoffice.com
70	World Health Organization	www.who.int
71	Winzip	www.winzip.com
72	Yale	www.yale.edu
73	Zotal	www.zotal.co.il

Appendix C

Prominence analysis measures

In-degree Centrality

Out-degree Centrality

In-closeness

Out-closeness

Betweenness