

THE SOCIAL NETWORK OF NEW ZEALAND DIRECTORS: AN EXPLORATORY STUDY

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Abstract

The paper has two primary aims. First, to develop an appropriate network analysis to investigate whether any individual directors comprising the social network of New Zealand company directors is sufficiently connected so as to be in a position to exercise any form of cohesion, control or exertion of power. Second whether any directors could be identified as being in a position of power to take advantage of the network? This paper uses social network analysis to map and measure the structural features and patterns of relationships of the directors of companies listed on the New Zealand stock exchange and alternative exchange. The social network analysis was performed using the social network software Pajek™. The techniques used in the study reveal that the vertices (directors) in the network are moderately connected. The findings suggest that there is a small group of directors who are in a position to exercise cohesion, control and power over the network.

Keywords: board of directors, New Zealand, social network

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Introduction

The increasing influence of large corporations has long been the subject of academic and public interest. Of the 100 largest economies in the world today, 49 are countries, while 51 are corporations (Kentor & Jang, 2004, p. 356). Recent media coverage of high profile corporate collapses, accounting irregularities, corporate corruption, remuneration excesses and inadequate disclosure practices have significantly affected confidence in markets, and has focused the minds of the public on corporate governance (Hendry & Kiel, 2004, p. 500).

It may be useful therefore to understand the relationships between directors who govern large corporations and other directors in comparable positions of influence. Analysis of interlocking directorates is one method by which the individuals who control these powerful corporations can be examined and held to account for their actions. Many of these actions are undetectable without detailed examination however, and interlocking directorate analysis gives insight into the structure of control of these corporations (Kentor & Jang, 2004, p. 357), and adds to the transparency of said control structures. Board structure and linkages have come under scrutiny as a central corporate mechanism

Boards are thought to use their links to add value in three ways: Firstly as a co-optive mechanism to extract resources and obtain support from external stakeholders critical to the organisations performance. Second, board members serve as boundary spanners providing channels for communication of information with the external environment. Finally, boards are thought to play an important role in enhancing organisational legitimacy (Nicholson et al., 2004, p. 56).

‘Interlocking directorships’ is the term to describe the connections between corporations arising from the personal and professional connections of their directors. Directors within a company are connected by their mandatory relationship with the company on whose board they serve. Interlocking directors serve on multiple company boards and connect multiple companies. These director interlocks are conceptualised as facilitating exchanges of information (Haunschild & Beckman, 1998, p. 839). Collective relationships between company directors give rise to social networks, sets of people or groups of people with patterns of interactions, or ties between them (Newman, Watts & Strogatz, 2002, p. 2566).

The objectives of this paper are twofold. First, to develop an appropriate network analysis to investigate whether any individual directors comprising the social network of New Zealand company directors is sufficiently connected so as to be in a position to exercise any form of cohesion, control or exertion of power. Second whether any directors could be identified as being in a potential position of power to take advantage of the network? The paper is structured as follows. The review of literature first examines board composition, including outside directors and corporate governance. Next interlocking directorates are examined including advantages and disadvantages of this practice. Finally the characteristics of the network of company directors and social network analysis will be investigated including modern social network analysis techniques. The method used to undertake social network analysis is then detailed. The results are then discussed and conclusions drawn.

Board composition and interlocking directorates

The composition, responsibilities and expectations of the board of directors is a heavily regulated area of law designed to increase impartiality in corporate decision-making. However, the effects of interlocking directorates and their influences fall outside the scope of current legislation.

Interlocking directorates have an effect on director recruitment and selection decisions, and there is evidence to suggest that managers select directors who have board ties that enable them to provide unique information and other valued resources to the firm (Seidel & Westphal, 2004; Seidel & Westphal, 2002). The suggestion follows that managers may favour directors who increase a firm's centrality in the board interlock network, for example, directors who currently hold positions on other boards not held by existing directors. This increases the firm's access to information about successful strategic practices within other companies (Seidel & Westphal, 2004; Seidel & Westphal, 2002). Furthermore board ties form a network of socio-political support for corporate leaders, so managers may select directors who have board ties that increase their tendency to support the CEO's leadership (Seidel & Westphal, 2004, p. 230).

However, directors serving on multiple boards of directors can face conflicts between their duty to keep certain information confidential and their responsibility to provide information that will be helpful to the company on whose board they sit (Haunschild & Beckman, 1998, p. 818). Guedj & Barnea (2007, p. 2) argue that boards of large firms are populated by a fairly homogenous group of directors, most of whom are associated with firm executives either by working with them directly or by interacting with them in various professional or social contexts.

Being directly or indirectly known to management or the firm's main owners and shareholders is likely to be a strong comparative advantage in obtaining a seat on a board (Kramarz & Thesmar, 2006). Furthermore, if selection involves choices between individuals not known personally to managers it may be the case that directors of large companies are more frequently asked to be directors of similarly large companies because they are in a position of greater visibility (Chua & Petty, 1999).

The role of Outside Directors

Directors are seen as either 'inside' (executive) or 'outside' (independent). Inside directors are selected from within the management of a firm. Outside directors are appointed from the external environment from areas ranging from political to academic fields, experts in a company's field, or from other firms. The role of outside directors is important in the analysis of interlocking directorates as it is usually these directors who attain more positions and increase the connectivity of the network.

It has been argued that an organisation's reputation depends on its board (Nicholson *et al.*, 2004). The presence of prestigious or influential persons in a board helps reinforce a perception of the value and worth of an organisation. The appointment of outside directors can be an important signal to society.

Outside directors have an important role to play in a firm's strategic decision making (Kang, 2008, p. 537). They are expected to be more-or-less independent; that is, to make impartial decisions about a firm's strategies without succumbing to management pressures, or being burdened with involvement in a firm's operations. Outside directors are seen, in theory at least, as independent advisors not easily persuaded to conform to the status quo or norms of an organisation. An outside director is seen as both a part-time expert, and a supervisor to the executive management (Kramarz & Thesmar, 2006, p. 2). The

most commonly used indicator of board independence is the ratio of outside to total directors (Zajac & Westphal, 1996, p. 517). The proportion of outside directors can also affect the relative power and decision-making capacity of the CEO in the CEO-board relationship (Zajac & Westphal, 1996).

In their study of international director networks, Carroll & Fennema (2002) noted a shift in board composition internationally toward outside directors in the period 1976-1996. This reflects an increase in the perceived importance of director independence. The value that outside directors can bring is recognised in New Zealand: listed companies are required by the NZX Corporate Governance Best Practice Code to appoint at least one independent director.

Boards of directors and corporate governance

The term corporate governance refers to systems by which corporations are directed and controlled, and is commonly defined as ‘the rules and norms that guide the internal relationships among various stakeholders in a business enterprise (Carroll & Fennema, 2002). Corporate governance structures specify the distribution of rights and responsibilities among different participants in the organization, such as the board, managers, shareholders and other stakeholders, and spells out the rules and procedures for making decisions on corporate affairs (Interpraxis, 2004, p. 1). During the last thirty years, corporate governance has become one of the major topics of economic research (Prinz, 2006).

As the highest authority in governing a firm, boards of directors play a key role in the establishment and practices of corporate governance. Much of the literature in the area is based on the premise that independent boards are more likely to constrain managerial preferences which may conflict with shareholder interests (Seidel & Westphal, 2002, p. 1). This emphasises the importance of outside directors who, as noted above, are assumed to be freer from managerial influence.

Sitting on multiple boards provides a communication network for the managerial elites (Guedj & Barnea, 2007). It is important therefore to inquire to what extent association of board members has an economic consequence on the firm, and how such association impacts the board's capability to perform its governance duties. There may be significant negative effects in a more densely interlocked governance system, such as the proliferation of aggressive accounting, or adoption of excessive remuneration schemes (Nicholson *et al.*, 2004, p. 65). Carroll & Fennema (2002) make a strong case for the usefulness of analysing interlocking directorates in studies of corporate governance.

Interlocking directorates

A key characteristic of the development of the global economy over the past two decades is the significant increase in the number of linkages among the boards of directors of the world's largest corporations (Kentor & Jang, 2004). The rate of increase in interlocks internationally exceeds current domestic growth (*op cit*, p. 358).

Interlocking directorates are fundamental in creating and maintaining networks of company directors. The basic character of such networks is directors connecting boards by virtue of their relationships.

Social networks of this type are seen by some commentators as variously, mechanisms for inter-firm collusion and cooperation (Haunschild & Beckman, 1998); as facilitating the production and reproduction of general class policy (Burris, 1991); and as supporting belief systems about the legitimate role of corporations in society (Zajac & Westphal, 1996, p. 509). Interlocking directorates can be seen as a type of diffusion instrument through which various forms of information is disseminated through a network (Chua & Petty, 1999, p. 102). Burris (2005) sees interlocking directorates as “transcendent networks”, in which each localised tie assimilates and transmits the influence of innumerable other ties, both proximate and remote.

The CEO-board relationship can also significantly affect the formation and dissolution of board interlocks (Zajac & Westphal, 1996). CEO's perceptions about their relationship to directors and the potential benefits from board network ties affects the selection and retention of directors thus affecting interlock networks (Seidel & Westphal, 2002, p. 4).

Advantages of interlocking directorates

There are a variety of ways in which interlocking directorates are seen as advantageous for corporations. A few are discussed below.

Interlocking directorships can act to support legitimacy of firms seeking initial public offerings (Kang, 2008). Interlocking directors exhibit attributes investors may rely on when forming perceptions of accounting practices and board monitoring in associated firms (*op cit*). Directors who have participated in strategic and/or structural changes on other boards bring their views and experiences, which can then lead to changes in the norms of to a new board (Zajac & Westphal, 1996, p. 510).

Interlocks enable firms to reduce dependence on formal company communications, and/or co-opt, control, and monitor other firms (Haunschild & Beckman, 1998). Interlocks allows firms to obtain valuable information about other firms, as the primary function of interlocks is to manage dependence through cooptation and control (Haunschild & Beckman, 1998, p. 817). Interlocking directorates can therefore be seen as devices of power and influence for one company over another.

Research shows that business leaders can conceive of board ties as possible sources of strategic information (Seidel & Westphal, 2004). Experience, knowledge and numerous network contacts make it attractive for a firm to hire an interlocking director because seat accumulation enables the director to acquire specific and potentially valuable knowledge of company strategies and investment opportunities (Prinz, 2006, p. 11). The flow of inter-organisational knowledge through interlocks is one means through which firms can obtain useful information (Haunschild & Beckman, 1998, p. 816).

Positive correlations have been found between interlocks and firm profits (Haunschild & Beckman, 1998, p. 815; Prinz, 2006). This finding is consistent with a view of directors as reliable sources of valuable information. In firms facing greater business environmental uncertainty, those with more interlocks exhibited superior performance as measure by sales growth and return on equity (Nicholson *et al.*, 2004, p. 56). The collective influence of directors' experiences on other boards may frequently outweigh the effect of socialization (eg the tendency to uncritically follow management guidance) on a board (Zajac & Westphal, 1996).

Interlocks also enable managers to achieve an optimal “business scan” of the latest business practices and overall business environment (Haunschild & Beckman, 1998). Frequent meetings of a limited number of highly qualified and experienced directors have great potential to enhance the exchange of information and knowledge between firms which can contribute to organisational learning and further corporate prosperity (Prinz, 2006). While interlocks may facilitate ‘negative’ collusion (eg, to determine production quantities and to raise prices), but also may act to diffuse more positive practices. Chua & Petty (1999) find evidence that the practice of ISO quality accreditation is diffused through interlocking directorates.

A study by Haunschild & Beckman (1998) revealed executives brought firsthand knowledge of the actions of other firms to their own firms through interlock contacts, and this knowledge affected their firms' activities. Interlocks provide information sources that have proved to be inexpensive, trustworthy and credible and as directors are required for all public firms, the information that comes from a director is thus an inexpensive by-product of such mandated relationships (Haunschild & Beckman, 1998, p. 817). And interlocks are seen by some as could be instrumental in forging some sort of consensus among corporate directors, thus contributing to the production and reproduction of a ‘community’ of business (Carroll & Fennema, 2002).

Disadvantages of interlocking directorates

While there exist some significant advantages arising from director interlocks, research also indicates potential downsides to the practice. These are discussed below.

Multiple board appointments can cause conflicts of interest. As a consequence of control laxity in areas where decisions are influenced by conflicts of interest, shareholders may suffer diminished returns in terms of financial underperformance and lower market values (Prinz, 2006). Interlocks can be perceived as a mechanism for personal career advancement (motivated by self-interest) for directors which can

result in conflicts of interest (Haunschild & Beckman, 1998, p. 815). The cost of career advancement is assumed to be borne by shareholders. Interlocking directorates can therefore weaken firm governance, promote cronyism and boost agency costs, according to Prinz (2006, p. 9).

Reputational effects from interlocking directors can occur in a negative fashion, as director interlocks can act as channels whereby reputational penalties experienced by one firm spill over to other firms (Kang, 2008). The presence on a board of interlocking directors – especially ones affiliated with an underperforming company/ies - can increase uncertainties about accounting practices and the effectiveness of board monitoring in associated firms (Kang, 2008). Interlocking directorates allows collusion in the board of directors or between directors and auditors in a company (Barbi, 2000, p. 6).

Social networks among corporate elites can affect CEO (CEO) compensation because CEO's are able to influence directors to vote favourably for their initiatives by offering more directorships (Guedj & Barnea, 2007). Firms whose directors are better connected and whose connections are with better connected director's award their CEOs significantly higher salaries and total compensation (Guedj & Barnea, 2007, p. 27). Boards featuring a high degree of interlocking facilitate the diffusion of executive compensation practices (Conyon & Muldoon, 2006); if CEOs are mutually interlocked via the board, CEO compensation is significantly higher compared with non-interlocked CEOs. As well as this, the probability of CEO turnover (due, for example to poor firm performance) is inversely related to the number of interlocks (*op cit*). Through selection and retention, powerful actors in the CEO-board relationship can 'manage' board interlocks so as to reinforce or increase their control (Zajac & Westphal 1996). These organizational linkages increase the potential for collusive activities among these organizations and the individuals who control them, resulting in perceived threats to democratic control over business organisations (Kentor & Jang, 2004, p. 356).

Director social networks can operate in order to prevent pressure from investors and support the private interests of a restricted control group in a firm (Barbi, 2000, p. 3). Examples cited in the literature include adoption of anti-takeover mechanisms such as 'poison pills' as well as the spread of 'golden parachutes' (Conyon & Muldoon, 2006); and the finding that likelihood of financial statement fraud is positively related to the number of board appointments outside directors hold (Prinz, 2006). Interlocking directorates can lead to mutual management entrenchment and scheming against effective control by shareholders, financial markets, and other control instruments (*op cit*).

In Perry & Peyer's (2005) "Busyness Hypothesis", it is argued that as directors with multiple appointments become overcommitted and suffer from serious time constraints, they are less able to assure effective and meaningful control of the management board. Their multiple directorships erode the control and monitoring functions expected of directors.

There is evidence to suggest director interlocks help form and/or maintain a separate class segment in society; that is, promote upper-class cohesion (Haunschild & Beckman, 1998, p. 815); a finding supported by Carroll & Fennema (2002, p. 399) who argued that interlocks promoted consensus and class formation. Burris (2005) also discusses this tendency in terms of the ability of this separate class structure to influence organisational and individual political behaviour.

Formal & Informal Director Social Connections

Two principal types of relationship affect the establishment of director social networks. One is the formal mandated relationship, established because of a mandatory connection to a company by way of a directorship. Second, is the less easily measured system of informal social relationships between directors, established through a wide variety of means, from former school connections, to social clubs, or non-corporate boards.

It is argued in the literature that these two relationship forms can be substituted for each other because they involve similar source and message characteristics. For example, Burris (2005) maintains that the distribution of information about company related material could just as easily take place at a social outing as take place at a corporate board meeting. The importance of interpersonal ties - created through various social and other non-corporate engagements, including membership on non-corporate boards of directors, kinship relations, common attendance at elite boarding schools and universities, or membership in exclusive clubs - should not be underestimated. Informal social relations can affect formal mandated

company relations. This study focuses on the formal relationships between directors, and assessing these relationships for the possibility of collusion. However, conclusions drawn about the general state of the company directors' network cannot be made without proper reference to the informal social networks operating alongside the formal network.

Properties of director social networks

The network of directors comprises two separate networks: Firstly, a 'membership network', a network all directors participate in by virtue of their position as a director; and secondly, a 'relationship network', arising from relations within a specific membership network. The two networks, membership and relational, exist side by side and interpenetrate (Breiger, 1974, p. 183). Newman & Park (2003) argue that for this reason, director social networks are fundamentally different from other types of networked systems.

Any study of formal relations between directors must take into consideration the structures of individual interlocking directorship networks, since it is personal director network analysis that is critical to the creation and maintenance of social capital rather than corporate networks (Barbi, 2000, p. 3; Nicholson *et al.*, 2004, p. 54). Network relations can also be based on other social capital forming elements, such as a common formation, the same social background or common participation in business associations (Prinz, 2006). It has been argued that in a capitalistic economy, as a consequence of economic power concentration, a special social type emerges spontaneously, a cohesive group of multiple directors tied together by shared background, friendship networks, and economic interest, who sit on boards as representatives of capital in general (Battiston & Catanzaro, 2004, p. 345). It is therefore possible that the effects of interlocking corporate directorships are both reinforced and complemented by other social networks with which they are intertwined (Burris, 2005, p. 276).

Social networks are characterized by assortativity (generally, the principle of 'like with like', eg. tendencies for introverts to associate with other introverts, and extraverts with extraverts) (Battiston & Catanzaro, 2004, p. 346). In the context of the present discussion, assortativity reflects a preference for a network's nodes to attach to others that are similar in some way. Though specific measures of similarity may vary, network theorists often discuss assortativity in terms of a node's 'degree of correlation' (Newman, 2003, p. 1).

Social networks are often described as 'clustered'. That is, there is a tendency for one's acquaintances to be acquainted with each other (Conyon & Muldoon, 2006). This very short chain of intermediate acquaintances was found to be of typical length of only about six (Milgram, 1967, p. 60), a result passed into folklore by John Guare's 1990 play *Six Degrees of Separation*. It has since been shown that many networks have a similar small world property (Newman *et al.*, 2002, p. 2566). The language of social networking uses terms 'groups' and 'communities', and these divisions can produce both degree correlations and clustering note Newman & Park (2003).

The director interlock affiliation network can be modelled as a 'bipartite' graph with two vertices—one each for boards and directors—that has edges connecting directors with the boards on which they sit (Conyon & Muldoon, 2006, p. 1326).

A bipartite graph consists of two separate classes of nodes, while an edge always connects a node of one class to a node of the other one... A node represents alternatively a director or a company. A link between two nodes represents the fact that the director sits in the board... an interlock [exists] when a director serves on the boards of two companies. If two directors of a given board serve together as well in another board, we then have a multiple interlock (Battiston & Catanzaro, 2004 p. 347).

The two degree distributions are; (a) the distribution of the number of boards that directors sit on, and (b) the number of sitting directors (Newman *et al.*, 2002, p. 2570). Mapping those bilateral relations results in a complex web of ties (Prinz, 2006, p. 2).

The boards of the largest corporations of a country combined with individual directors form a dense bipartite network (Battiston & Catanzaro, 2004). Shown below is an example of a bipartite graph and a one-mode projection (Figure 1). The nodes are labelled by numbers correspond to boards of directors, and

the nodes labelled by letters correspond to the directors which make up those boards (Battiston & Catanzaro, 2004). To model the director network of large companies in New Zealand using the PajekTM software, it is necessary to perform a two mode to one mode network translation – ie to separate out the companies to focus on directors only.

In social networks generally, there is a stronger tendency to cluster than by chance (Newman & Park, 2003, p. 36122-1). Battiston & Catanzaro (2004) generated random comparison social networks and compared these to board and director networks, finding that both networks to be much less sparse than the comparison networks. Further, as well as being highly clustered, it has been found that in many networks, the distribution of actors' degrees is highly skewed, with small numbers of actors having unusually large number of ties (Newman *et al.*, 2002, p. 2566). Social networks of directors exhibit properties not found in other types of networks. This feature needs to be considered when analysing director's networks.

Social Network Analysis

Social network analysis is the mapping and measuring of structural features or patterns of relationships and information flows between people, groups and organisations, (Nicholson *et al.*, 2004, p. 58). Social network analysis has a long history in sociology, the literature on the topic stretching a back at least half a century to the pioneering work of Rapoport, Harary, and others in the 1940s and 1950s (Newman *et al.*, 2002, p. 2566).

Ties between actors in a network are differentiated as 'strong' and 'weak'. Consideration of this difference is important, as there is some debate between those who emphasize the benefits of strong network ties, for example providing social support and influence; and those who advocate the benefits of weak ties, eg. providing access to original information (Seidel & Westphal, 2004, p. 228).

The strength of interlocks is also conceptualised and measured. 'Thick' (or 'primary') ties denote boards that share at least two members, while 'thin' (or 'secondary') ties describe two boards connected by a single board member (Kentor & Jang, 2004, p. 356). In cases where a pair of corporations is linked by a thick tie there may well be a hierarchy of control in place, or at least a formalised coordination of business strategies. But in the case of single-director, non-officer interlocks – that is, a thin tie - no such conclusion can be reasonably drawn (Carroll & Fennema, 2002, p. 400). Therefore an analysis of thick and thin ties should be carried out on a study of director networks in New Zealand.

One of the pressing needs of social network analysis is to understand the relationship between class organisation and corporate organisation in modern capitalism (Burris, 1991). This analysis will enable conclusions to be made as to the possibility for corporate collaboration and the production and reproduction of a separate, 'elite' social class. Analysis of the size of the network and its connectedness will give an indication of the ability for this type of collaboration to occur (Nicholson *et al.*, 2004).

Battiston & Catanzaro (2004) conducted analysis of director networks from various periods and found that all the networks they considered were 'small world' networks, assortative and highly clustered. Furthermore they all have a highly connected giant component states (Battiston & Catanzaro, 2004). These properties should be examined in a study of director networks in New Zealand.

Nicholson *et al.* (2004) argue that the formal models, procedures and techniques developed in social network analysis can be applied to individual-level networks among directors. Measures such as the clustering measure, which represents an ideal way to investigate the 'clique' or 'clubby' aspects of boards (Conyon & Muldoon, 2006, 1322), will be useful to determine structural properties of director networks in New Zealand.

One of the biggest problems in studying social networks is the presence of uncontrolled biases in the empirical data (Newman *et al.*, 2002, p. 2570). However, the study described in this paper focuses on an affiliation network, a social network in which actors are joined by a common membership (in this instance company directorships), which minimises uncontrolled bias (Newman *et al.*, 2002, p. 2570). Investigating the network of director interlocks will highlight any differences between the corporate networks and individual director networks (Nicholson *et al.*, 2004, p. 64).

Method

This study uses social network analysis to examine the relationships of directors of New Zealand listed on the New Zealand Stock Exchange (NZSX) and New Zealand Alternative Exchange (NZAX). Two of New Zealand's largest co-operatives, Fonterra Co-Operative Group Limited and Zespri Group Limited, were included in the study as they were considered to be significant players in the New Zealand economic environment.

The NZX Deep Archive database was used to obtain a list of 165 entities listed on the NZSX and NZAX in July 2008. This database also provided the director information for these entities. The director's information was cross checked against the Companies Office website by searching the companies register and checking the directors currently listed on the website. These results were then compiled in an Excel™ spreadsheet comprising the companies name, the director's name and address. If an entity listed on either of the New Zealand Exchanges were trusts, trustee information was included in the dataset. The maximum number of entities that an individual oversaw was 7.

The information was then recorded in a format able to be recognised by the Pajek™ network software. This involved listing the director's names alphabetically down the spreadsheet and recording the reporting entity name across the top of the spreadsheet. For every instance where a directorship occurred a 1 was recorded in the appropriate cell. The 'fill function' of the UCINET™ for Windows Spreadsheet application was executed to complete the matrix with "0's" where in the cells where no "1's" existed. The spreadsheet was then saved as a UCINET™ network file (.Net extension). The Bipartite transformation function in UCINET™ was used to convert to convert the bipartite network into a form that Pajek™ can analyse.

To analyse the network of interlocking directorates required the two mode (bipartite) network to be transformed into a one mode network. This was necessary as this study focused on the relationship network of individual directors rather than an integrated director/reporting entity two mode network. This required the creation of a partition labelling the two sets of vertices, namely directors and boards of reporting entities. Once the partition had been created the transform network function was executed in Pajek™. The resultant network comprised all the possible ties between individual directors. The procedures described by Nooy *et al.* (2005) were then used to analyse the network.

The network of New Zealand directors comprised 754 individuals. As this network was large, a random partition of 5 was generated to shrink the network to approximately one fifth the size of the original network (155). This resulted in a network that was easier to visualise, and enabled an approximation of the characteristics of overall network to be obtained. This shrunk network is shown in Figure 2.

The density of the network was then calculated. A measure of degree was undertaken by generating a partition using the degree function in Pajek™ and then using the information menu to produce a report on this partition. The average degree was then calculated using a vector. The k-neighbours method was the final density measure used to measure the density of ties among directors. K-neighbours measured the density of ties of directors with the chosen director in the centre of the graph network display. The distance of individual directors from the chosen director determined their neighbourhood position.

The strength of interlocks was then measured. 'Thin' ties indicate two boards that are connected by a single board member, while 'thick' ties denote boards that share at least two members (Kentor & Jang, 2004, p. 356). In order to carry out this measure the original two mode network which shows thick and thin ties was analysed. Analysis of thick and thin ties was carried out on the original two mode network by random count sample on portions of the network. Another measure of the strength of ties can be obtained through structural holes analysis. Structural holes analysis assigns values to the ties within a network which are indicative of the degree of constraint on those ties. This analysis determines which of the directors in the network in positions of power through their ability to negotiate between the mass of directors in the network and isolated directors. Therefore the network has a structural hole when this circumstance arises.

Connectivity measures were carried out next. Strong component analysis was employed to graph the overall connectivity of the network through dividing the network into strongly connected subcomponents and colours the vertices accordingly. This enables visual analysis of the connectivity of the directors in the network. Geodesic path length was measured as a second connectivity measure. Geodesic path lengths provide an indication of the connectedness of the network. The shorter the path the more connected the network. Finally k-core analysis was used to as a final measure to assess connectivity of network. K-core returns sub-networks which are maximally connected. The number and sizes of these k-core sub-networks provides insight into the overall connectedness of the network.

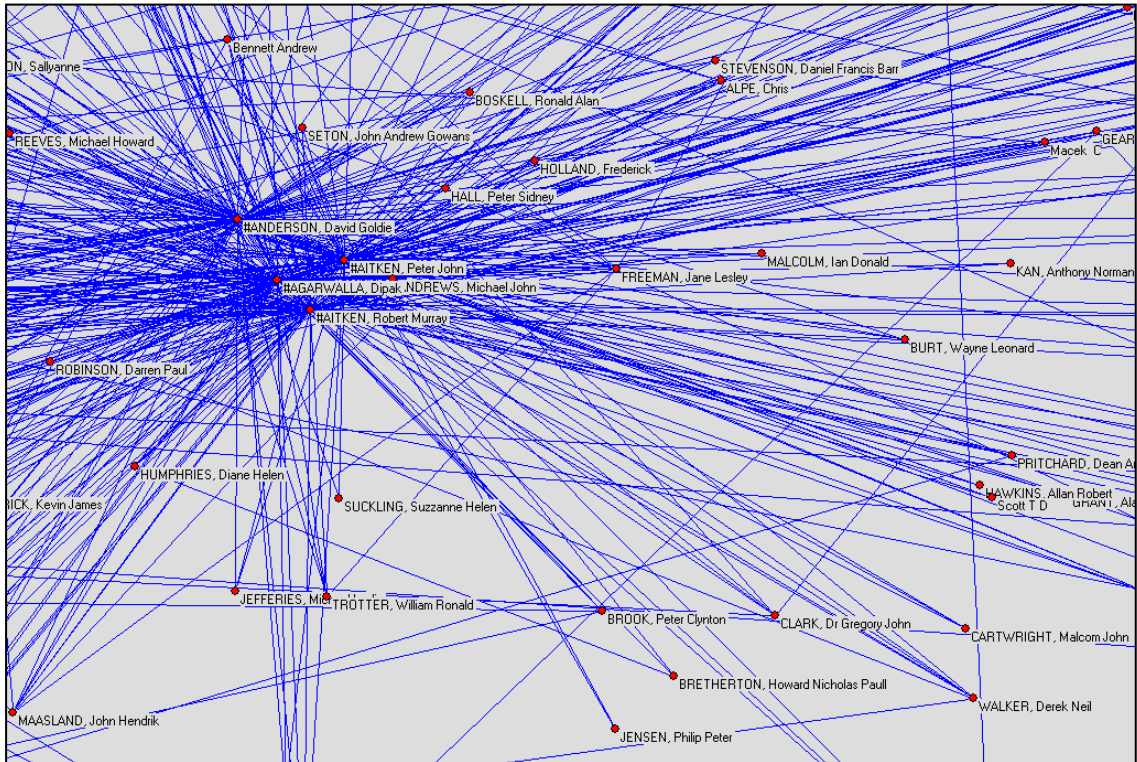


Figure 2. Network shrunk to 155 members

In order to assess if there was the potential for cohesion and the exertion of power within the network, m-slice was used to establish whether potentially cohesive sub-groups exist. M-slice divides the network into weakly connected sub-components with greater than 1 tie. A further measure to determine the potential for cohesion and exertion of power is structural balance analysis. This is a numerical technique which determines whether the network is balanced or clustered. Pajek™ uses an error rate defined by the user to determine a solution with minimal errors. If a solution with minimal errors is found the network is balanced, however if no such solution is found the network is clustered. A clustered network provides the potential for cohesion.

The final technique employed was betweenness centrality. This measures the centrality of the network and was employed both on the overall network as a numerical measure and as a graphical display. This technique was also employed on 'David Jackson' as he was the most connected director in the network.

Results

Density

Density is one measure to determine the possibility of cohesion. The density measure for the network is relatively small, at 0.0084824. However, density is inversely related to network size. The larger the social network, the lower the density because the number of possible lines increases rapidly. When the randomly shrunk network, which has only 155 members is measured for density the result is 0.0440375, (4.4%) which is more aligned to expectations described by Nooy *et al.* (2005).

The degree of a vertex is the number of vertices that the particular vertex is connected to by a tie. The degree of a vertex (a director) measures the number of lines incident with it (Nooy *et al.*, 2005, p. 63). The degree measures the number of connections that each director has with other directors in the network and tabulates these results. The results are detailed in Table 1.

Table 1. Degree of Vertices within network

Network All Degree Centralization = 0.03810					
Time spent: 0:00:00					

1. All Degree partition of N1 (754)					

Dimension: 754					
The lowest value: 1					
The highest value: 35					
Frequency distribution of cluster numbers:					
Cluster	Freq	Freq%	CumFreq	CumFreq%	Representative

1	4	0.5305	4	0.5305	DAS, Jayshree
2	42	5.5703	46	6.1008	BAKER, Grant Keith
3	51	6.7639	97	12.8647	BARNES, Craig Anthony
4	104	13.7931	201	26.6578	ALLOTT, Murray George
5	176	23.3422	377	50.0000	AITKEN, Robert Murray
6	124	16.4456	501	66.4456	ACARWALLA, Dipak
7	101	13.3952	602	79.8408	BAGNALL, John Andrew
8	26	3.4483	628	83.2891	BAINES, Paul Edward Alex
9	20	2.6525	648	85.9416	BAY, Stuart Bruce
10	30	3.9788	678	89.9204	ALLEN, Simon Christopher
11	12	1.5915	690	91.5119	DIDSBURY, Richard John
12	15	1.9894	705	93.5013	ARMER, Colin Charles
13	12	1.5915	717	95.0928	APPLEBY, David Robert
14	7	0.9284	724	96.0212	CASHIN, Michael James
15	6	0.7958	730	96.8170	CUSHING, Sir Selwyn John
16	2	0.2653	732	97.0822	MEYER, Raymond Francis
17	4	0.5305	736	97.6127	GIBBS, Anthony Ian
18	7	0.9284	743	98.5411	CLEMENTS, Andrew John
19	1	0.1326	744	98.6737	FRANCE, George Roger Wayne
20	2	0.2653	746	98.9390	MAASLAND, John Hendrik
21	2	0.2653	748	99.2042	CHRISTIE, Richard Gordon Maxwell
22	1	0.1326	749	99.3369	FREEMAN, Jane Lesley
23	1	0.1326	750	99.4695	NATTRASS, Stuart John
24	1	0.1326	751	99.6021	BITTLE, Richard Gilbert
26	1	0.1326	752	99.7347	WATERS, Ralph Graham
27	1	0.1326	753	99.8674	SMITH, Keith Raymond
35	1	0.1326	754	100.0000	JACKSON, David Alexander

Sum	754	100.0000			

The maximum number of ties a director has in this network is 35. This director, David Alexander Jackson, holds only 4 directorates. This result suggests that degree centrality calculation provides a more complete understanding of a director's connectedness (the ability of a director to tie with other directors in the network) rather than examining the number of directorates held.

The k-neighbours function was the final analysis measure used to determine density of ties among vertices (neighbours in this analysis). As the most connected director in the network, David Alexander Jackson was analysed using the k-neighbours function. The results of this analysis are displayed in Figure 3.

The analysis shows a large number of the directors are within 1 step of David Alexander Jackson, with the longest path being of 4 steps. Figure 3 also displays the "giant component" described by Battiston & Catanzaro (2004). The giant component is the large component of closely connected vertices within a social network. In Figure 3 the giant component is the large component in the centre of the image in which there are so many directors that distinguishing individuals is difficult.

Strength of ties

The first measure used to investigate the strength of ties was an analysis of thick and thin ties. This analysis is only able to be carried out on the original two mode network as this is where thick and thin ties

are visible. Analysis was carried out on this network based on random count samples. The results yielded only 4 thick ties from approximately 250 ties sampled. Following the rationale of (Carroll & Fennema, 2002) it is reasonable to conclude that a wide spread adoption of control hierarchies is not in place in the network.

The strength of ties was also measured through the use of structural holes analysis. This technique measures the strength of the ties within a network as well as the constraints on those ties. Figure 4 displays the ego-network of a randomly selected director, Colin Ernest Dawson.

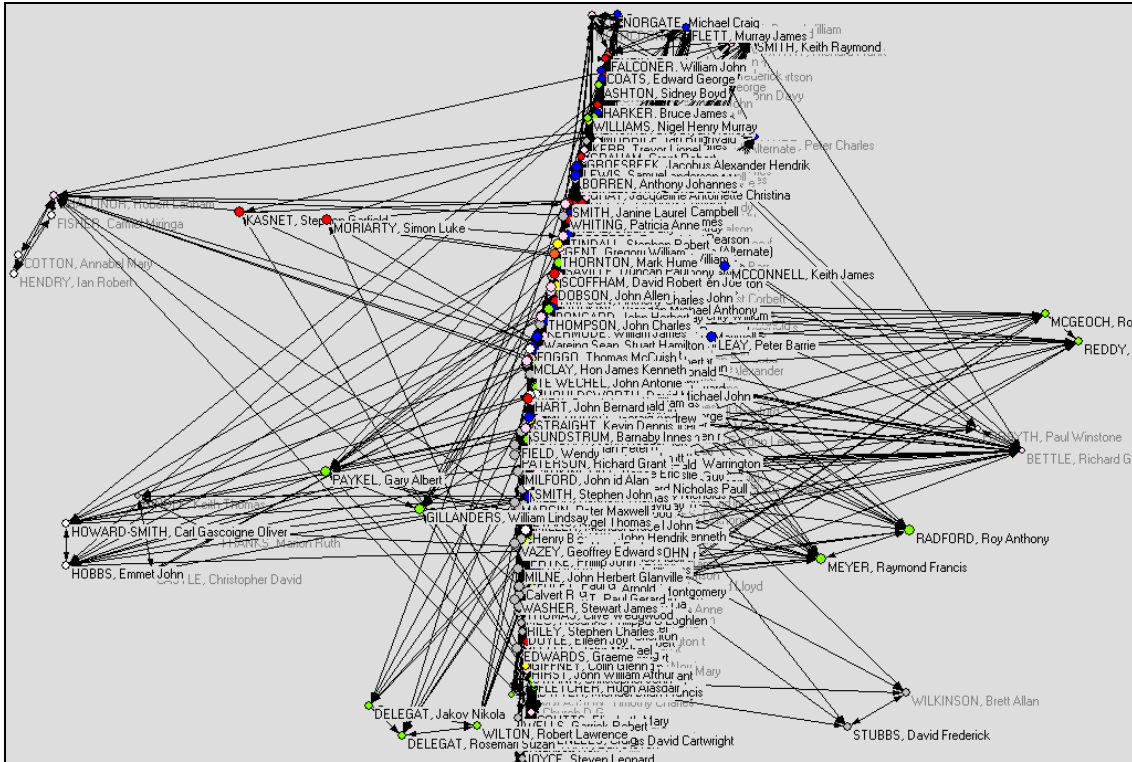


Figure 3. K-neighbours for David Alexander Jackson

The value of 0.35 alongside Colin Ernest Dawson's name shows the constraint on this director. The other directors connected to Colin Ernest Dawson all have equal constraints of 0.48. The unequal constraint between Colin Ernest Dawson and the directors Colin Ernest Dawson is connected to create a structural hole in the network. The reason for this is the other directors are more constrained than Colin Ernest Dawson, approximately 37 per cent more and Colin Ernest Dawson is in a position of power to relay information from these directors to the other directors in the network. On the lower right hand side of Figure 4 are two isolated directors. These directors are both equally constrained and unable to reach the network. The score of 1 alongside each of them equates to 100 per cent constrained.

Figure 5 details the structural holes within the network. This figure shows that many clusters of directors are constrained by individual directors. This illustrates the ability of certain directors within the network to exert power over and influence otherwise isolated groups of directors.

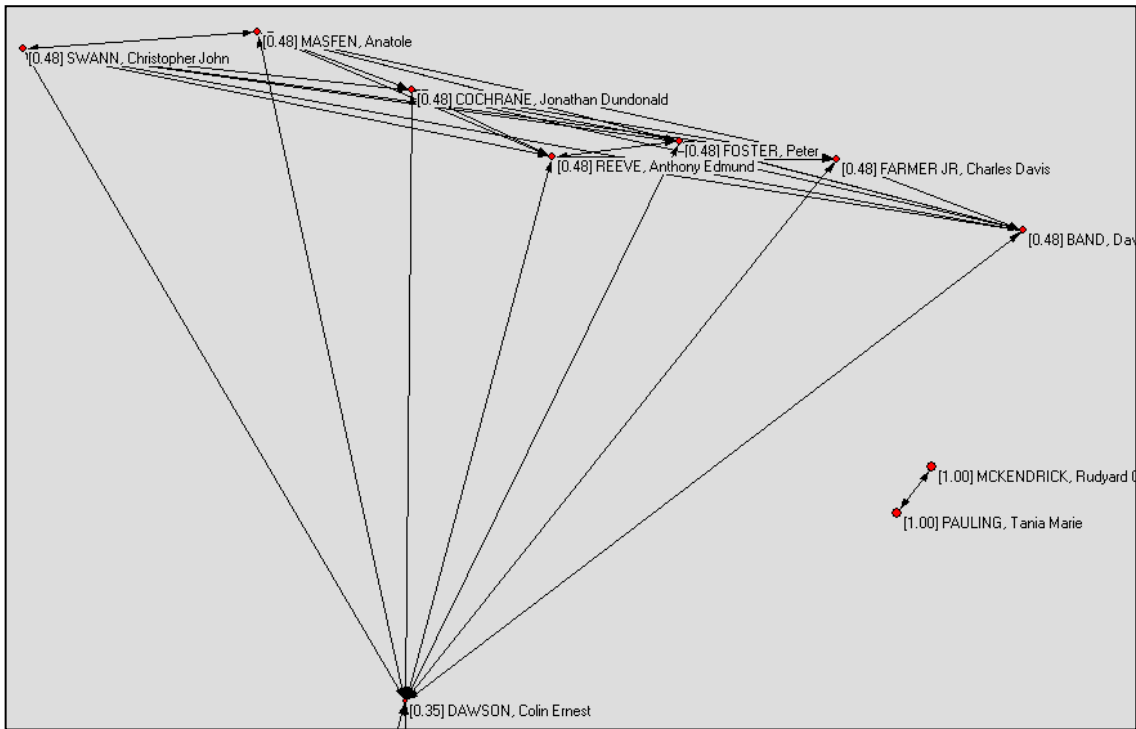


Figure 4. Structural hole created by directors connected to Colin Ernest Dawson

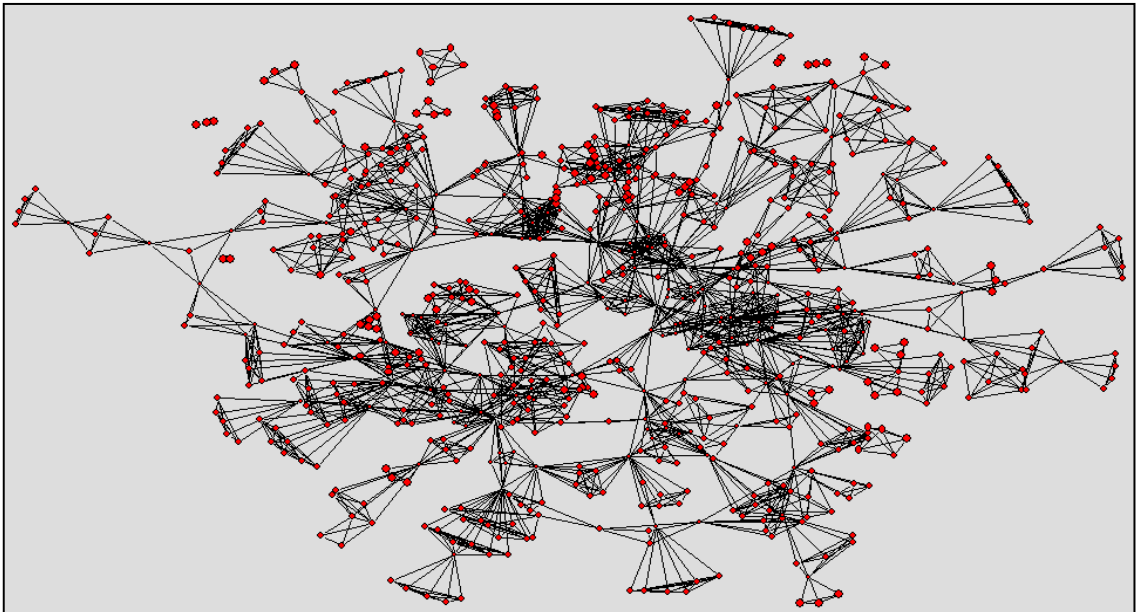


Figure 5. Whole network energized in order to reveal structural holes

Connectivity

Strong component analysis was the first method used to test the network for connectivity. This analysis split the network into maximally connected components. The more components in the network the less connected the network is overall. The strong component analysis is shown in Figure 6.

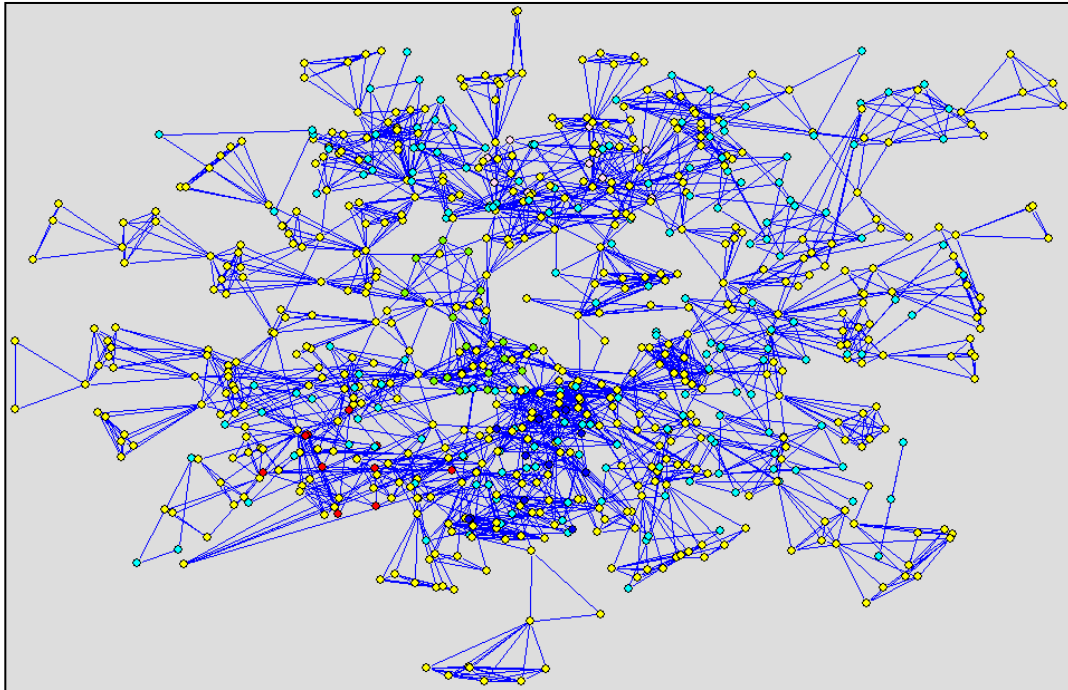


Figure 6. Network divided into strong components

The network in Figure 6 shows a large strong component represented by yellow vertices. There are nine other components in the network the next largest of which is the light blue component. Overall ten components is an averagely connected result. The size of the two main components is indicative of good connectivity while the other smaller components indicate reporting entities isolated from the network. This analysis indicates a moderate level of connectivity within the network.

Geodesic path sampling was used to test the ability of one director to reach another. The analysis of geodesic path lengths was also carried out for 6 directors. This analysis revealed that of the ten paths sampled only six were reachable. These results demonstrated a lack of overall connectivity within the network as many of the directors would be unable to contact other directors within the network. However, of the paths sampled the longest was length 7, which is within expectations. Six degrees of separation (a geodesic path of length 6) was advocated as an acceptable level (Newman *et al.*, 2002, p. 2566). Figure 7 details the distance from Donald Trow to Bernhard Zinkhofer, one of the paths sampled during the analysis.

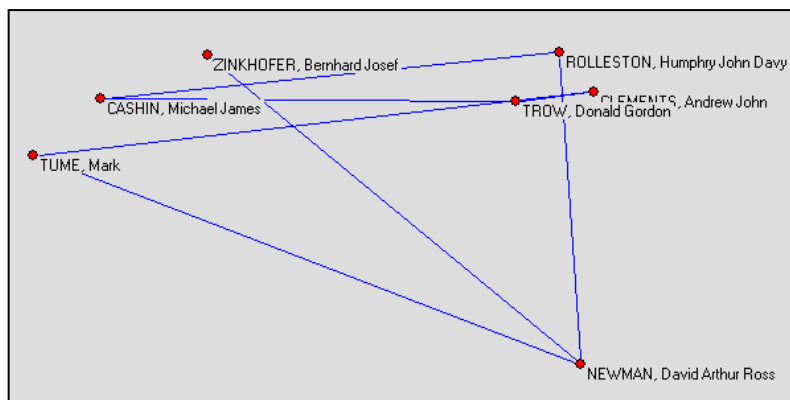


Figure 7. Geodesic path from Donald Gordon Trow to Bernhard Josef Zinkhofer

The final measurement of connectivity employed was k-core analysis. K-core analysis divides the network into maximally connected sub-components in order to reveal the highest connected sub-network possible within a network. K-core analysis was carried out on the network to reveal local concentrations

of ties around individual directors. The analysis produces sub-networks of size k which illustrates the connectedness of the directors within those sub-networks.

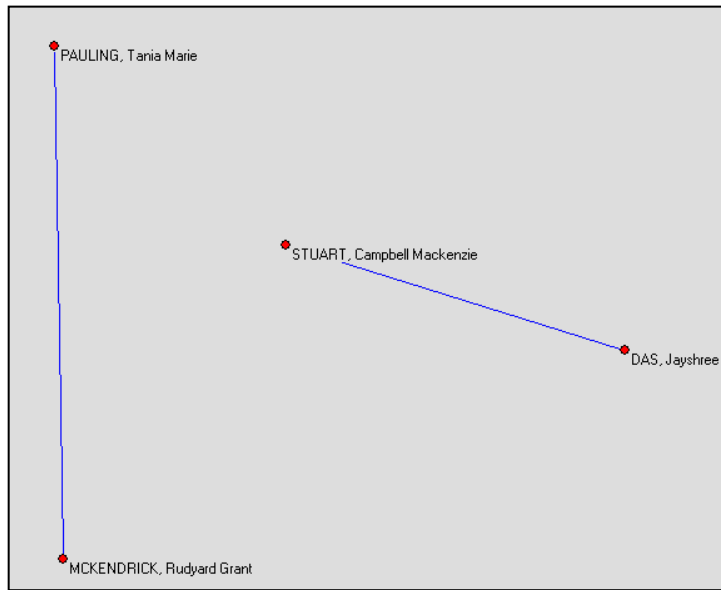


Figure 8. K-core sub-network of size 1

Figure 8 shows the lowest k-core sub-network from the network. This is a 1-core network containing 4 directors. The size of the k networks created by this process ranged from 1 through to 13. This range of k-core sub-networks indicates a moderately connected network as the k-core of 13 represents a large number of ties. Figure 9 details the maximal k-core network created from the k-core analysis showing a sub-network of 13 directors all who are maximally connected.

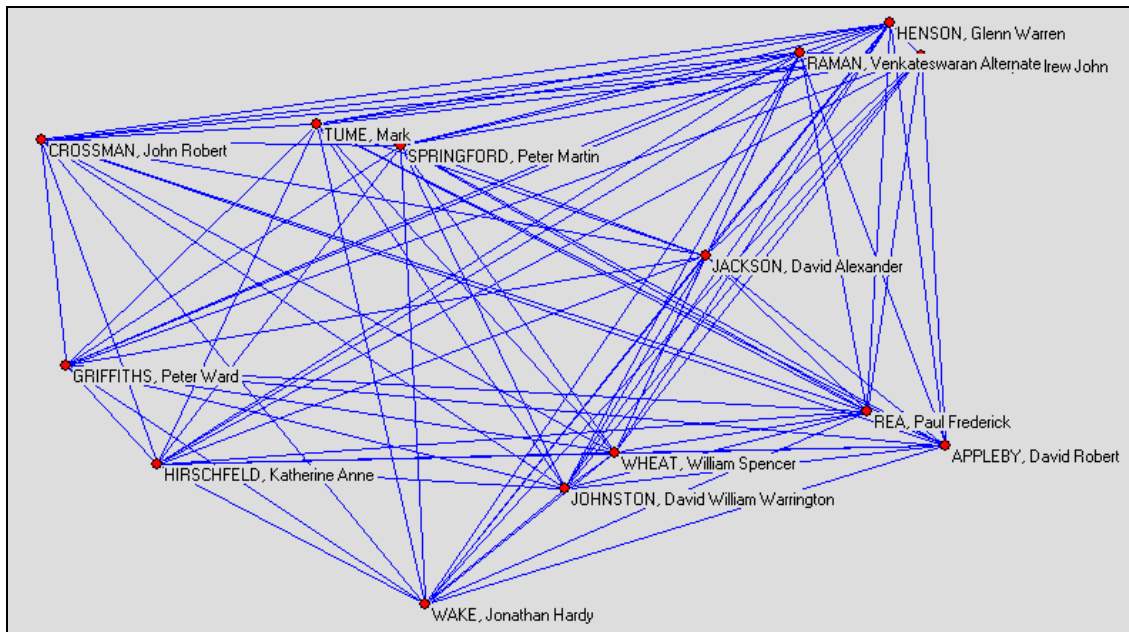


Figure 9. K-core sub-network of size 13

Assessing the potential for cohesion and exertion of power

The first analytical tool used to assess the potential for cohesion and exertion of power was m-slice. M-slice is a technique used to establish whether cohesive subgroups exist in a network. In order to do this an

m-slice procedure is completed on the network. In order to find cohesive subgroups within a particular m-slice a function was executed to remove all lines with a value lower than 'm.' This is necessary to enable the identification of weak components of the resulting sub-network (Nooy *et al.*, 2005).

Table 2. M-slice partition table

Valued Core Partition		
working...		
First threshold: 0.000 step 1.000.		
m	Num	Threshold
0	0	0.000 or less
1	713	(0.000-1.000]
2	30	(1.000-2.000]
3	8	(2.000-3.000]
5	3	(4.000-5.000]
Sum	754	

The m-slice partition for the network is detailed in Table 2. This table shows that the majority of directors have a maximal m-slice of 1 suggesting there is little potential of cohesion. The remaining 41 directors form cohesive subgroups which could possibly collude and exert power across the network through their individual connections. The m-slice of the network is show in Figure 10. This figure shows the cohesive sub-groups contained within the network. The unconnected vertices are at m = 1 and are therefore unlikely to form cohesive sub-groups.

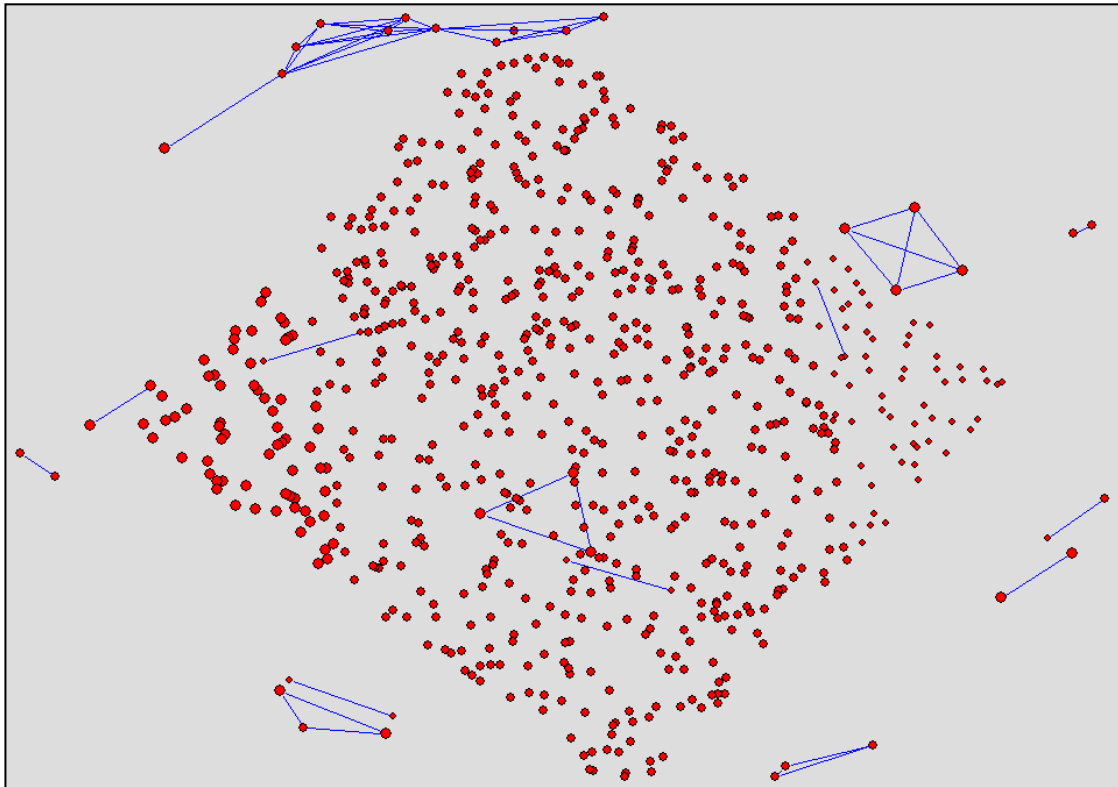


Figure 10. M-slice of the network with vertex values of 1 removed

The final technique employed to measure for the possibility of cohesion and exertion of power was structural balance analysis. This reveals whether a social network is more balanced or clustered than may be expected by chance. If a network is balanced then there is a reduced possibility of cohesion. However if a network is clustered, then cohesion and exertion of power can occur. This technique produces a report outlining the number of errors in finding a balanced network. Three error weights were used in the analysis of the network, 0.5, 0.75 and 0.875 each produced errors of 160, 91, and 40 respectively. This demonstrated that even with a heavily adjusted error weight the network was not sufficiently balanced to reduce errors to an acceptable level, below 10. Therefore this analysis has revealed that the network is clustered rather than balanced. These two measures of cohesion, m-slice and structural balance have yielded results that indicate the network is established in a way that may permit cohesion and the exertion of power.

Betweenness centrality

Betweenness centrality is the proportion of all geodesics between pairs of other vertices that include this vertex (Nooy *et al.*, 2005, p. 131). In the network the betweenness centralisation was 0.141. Figure 11 details the betweenness centrality applied to a single director, David Alexander Jackson, the most connected director by degree calculation. This figure displays the distribution of directors in their relative centrality to David Alexander Jackson. While there are a few outliers the figure clearly shows that this particular director is closely connected to a substantial portion of the network.

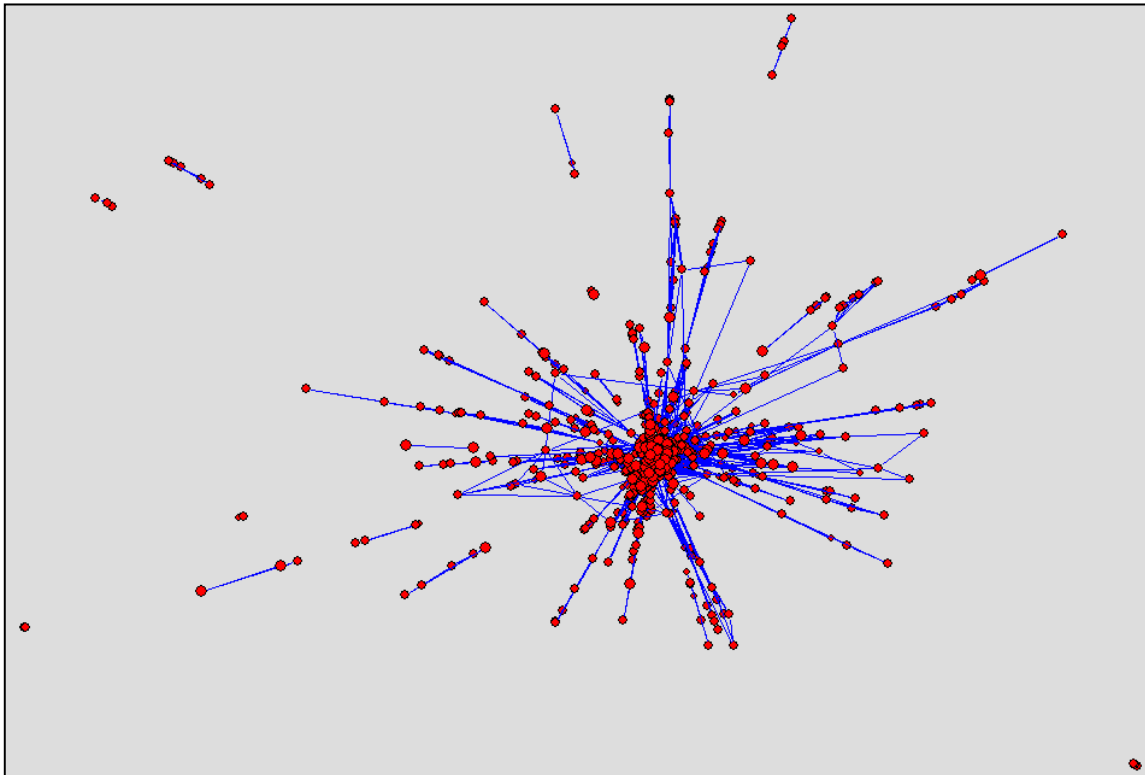


Figure 11. Betweenness centrality of David Alexander Jackson

A further representation of betweenness centrality is to scale the size of the vectors to highlight directors who because of their centrality in areas of the network are in a position of power within the whole network.

Discussion

Social network analysis involves measuring the ‘opportunity network’ that interlocking directorates provide a board within a national corporate governance system (Nicholson *et al.*, 2004). While social network analysis can provide an indication of the opportunities available within a social network, it

cannot confirm whether these relationships are being utilised as the network fosters. For example one of the geodesic paths sampled in the network revealed a 7 step connection. This means that one director would have to network through 6 other individuals before making contact with the desired director. While these directors do have a connection, it is questionable whether this connection would be utilised.

The social network analysis techniques employed in this study considers only one variable of social connections between directors namely that obtained through membership on company boards. Numerous other social connections are available to company directors including sports and social clubs, 'Old boy' networks and University affiliations such as Alumni's. These informal social connections could also tie directors who, in the directors' social network, are unconnected. This would fundamentally influence conclusions drawn about the director social network. The influence of informal social ties cannot be discounted as directors are just as likely to be influenced at a social occasion as in formal contact with another director. Analysing social networks is difficult when ties among actors are multiplex (Khanna & Rivkin, 2006). The idea that a group's constituents can be identified purely on the basis of a single type of tie, such as interlocking directorates is controversial. Thus even a ban on director interlocks would not destroy nor even seriously impair the important group relations and patterns (Khanna & Rivkin, 2006, p. 335). Therefore informal social relations are an important variable which affect relations between directors.

It is important to acknowledge that social network analysis in the affiliations network of directors in this study does not take into account assortativity. The reason for this is that the relationships being studied were not socially established. This does not mean that assortativity does not play a part in directors' relationships. Although all directors on a board share a connection, within this board there will be introverts and extroverts. Merely because individuals are members of the same board it does not mean that they will interact socially. Although directors have to co-operate while serving on a board, assortativity may influence their ability or desire to co-operate with their fellow directors in exploiting network relationships.

Companies choose directors based on their centrality in the network (Seidel & Westphal, 2004, p. 230). The analysis of this social network indicates that network centrality is not easily determined without the use of social network software. The best indicator an organisation would have without the use of this software is the number of directorships held by an individual. This study revealed the most connected director held only 4 directorships which was significantly less than the director with the most, at 7. Therefore in order for companies to make appointments based on centrality, companies would have to employ social network analysis techniques.

The number of directorships held by a person can be interpreted as an indicator of the director's quality. Multiple appointments can therefore be seen as a proxy for the reputational capital of a director (Prinz, 2006, p. 11). CEOs prefer to appoint individual who are well connected to boards and award them more directorships (Guedj & Barnea, 2007). This illustrates the importance of social networks on the inner workings of boards and ultimately on firm governance (Guedj & Barnea, 2007, p. 1). The corporate governance of the largest companies in New Zealand is impacted by the social influence CEO's perceive they can gain from prospective directors.

The director network in New Zealand fosters the communication of ideas and practices between enterprises. A sufficiently connected director social network will diffuse information efficiently enough to reduce any first mover advantages. Information asymmetry or innovation advantages would not last long in a larger network (Nicholson *et al.*, 2004). When sufficiently connected, a large network such as the one examined in this study, permits new techniques or understandings to be circulated rapidly. This may act as a disincentive for innovative organisations to appoint experienced professional directors for fear of losing their competitive advantage.

There are two types of ties that a CEO can have with a prospective director. Strong ties, which are an allegiance from the director to the CEO or weak ties, which means the CEO may not necessarily enjoy the support from that director. In the case of weak ties, the director will nevertheless have access to innovative information. Weak ties strengthen over time once all innovative information has been extracted from the relationship and if not will likely result in replacement of director unless the director can maintain a constant flow of innovation.

The study of the New Zealand director social network is a study of formal relations. However, a formal connection between directors does not mean that this form of communication maintains the network. Although formal communications occur within a boardroom setting, informal communications takes place outside this setting. This is significant as it indicates that a study of formal relations still must take into account informal communication.

The social network of directors within New Zealand forms part of a much larger international network of directors. The large number of directors in the New Zealand network located overseas provides evidence of the international network creating global ties. This international network has become more efficient. Despite a drop in the overall density of interlocking, the connectivity of the international network has increased (Carroll & Fennema, 2002). Therefore further investigation into the relationship of New Zealand company directors with international companies is important.

Conclusion

This study has examined three issues. First the network was examined for cohesion, control and exertion of power. Second whether the network is sufficiently connected to permit enable cohesion, control and exertion of power. Third whether any of the directors were in a position to take advantage of the network. Measures of degree, k-neighbours and betweenness centrality were used to test the network for the capability of power exertion. The degree measure revealed that there were directors with much larger numbers of ties compared with the average director in the network and therefore were in a position to exert power by lobbying their larger social sub-network. The k-neighbours function revealed a power capacity for certain directors in densely populated positions. Finally, the betweenness centrality revealed that throughout the network due to their centrality amongst sections of the network there were a number of directors who occupied positions of power.

The next element measured was the existence of control by certain directors in the network. There were two measures used to test for evidence of control, strong ties testing and structural hole analysis. Strong ties testing didn't reveal wide scale evidence of strong ties throughout the network. The structural holes analysis revealed that although many directors were constrained, a number of them were able to exercise control due to their bargaining position. The control element of this network is only moderate as there insufficient evidence of strong ties within the network. Their bargaining position within the network means that a number of directors are able to exercise control.

M-slice and structural balance were used to test for the existence of cohesion or the possibility of cohesion. M-slice revealed a moderate level of cohesion within the network with 41 directors in a position to exercise cohesion. The structural balance analysis revealed a clustered network providing evidence of cohesion for certain directors rather than balance.

Three measures were used to examine the connectivity of the network, strong component analysis, geodesic path sampling and k-core analysis. These techniques revealed that the network was moderately connected and therefore power, cohesion or control could be exercised within this network. The efficiency with which these properties could be exercised is diminished when compared with an optimally connected network. Measures of power, control and cohesion have revealed that these elements exist within the network for key directors, which are interlocking directors who are central to the network or have sole connection to otherwise isolated directors. The connectivity of the network is sufficient to enable these elements to be adequately exercised. Finally there are a small group of key directors who are in a position of power to exercise power, control or cohesion.

The results of this analysis provide evidence that a small numbers of directors within the New Zealand are able to exercise a certain amount of power and influence. This confirms the findings of Haunschild & Beckman (1998) who argue that the implicit assumption that all interlocks have uniform importance should be reconsidered.

Another important characteristic from this investigation is that the directors who are in positions to exert power are generally visible to others of the same classification. One possible explanation for this is that a director who sits on few boards has colleagues on the same boards. Analogously, a director who sits on many boards has colleagues who are also members of many boards. This is described as 'homophily'—the tendency for like to associate with like (Conyon & Muldoon, 2006). The collusion of some of the

more connected directors in the New Zealand network could have far reaching implications for New Zealand's corporate governance system such as price fixing and establishment of oligopolies, which could ultimately lead to a legislative change.

Another practical implication from the study of director social networks is a possible restriction on the number of directorships that an individual may hold. There are many possible ways in which this restriction could be imposed, Firstly there could be a restriction on the overall number of directorates that a director can have, however this would include both publicly listed and privately listed companies which would mean the number of directorates would have to be relatively high. Alternatively there could be a restriction on the number of publicly listed companies that a director can hold a directorship on. This would enable the director to have a large number of private company directorships but limit the number of public company directorships where the responsibility of providing governance concerns a larger number of public investors. Restricting the number of directorships that a director can have would increase their availability for the lesser number of entities on whose board they serve which would mean they provide better governance for the entity.

Further research is necessary in the area of informal ties. An investigation into the impact of informal ties on director social networks and the decision directors make would increase the value of director social network research. When carrying out social network analysis the importance of the relationship depends on whether the connecting person only occupies an outside directorship or whether he or she is a main executive in one of the firms tied by him or her (Prinz, 2006).

This study is subject to a number of limitations. First it is limited to publicly listed companies and two co-operative companies. Although this captures the majority of large New Zealand reporting entities, large privately owned reporting entities were excluded. Including large private companies in the study would also increase the value of director network research as it may reveal additional ties between directors and provide a more holistic set of findings. Second, the role that board positions within reporting entities occupied by directors and which may influence director ties has not been investigated. Third, social networks are assortative (Battiston & Catanzaro, 2004, p. 346). For example extroverts associate with other extroverts while introverts generally associate with other introverts. As the network in this study is an affiliations network, assortativity is not considered as the associations within the network are mandatory and not socially established.

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