

CONSTRUCTING PROFESSIONAL RESOURCE NETWORKS FROM CAREER

BIOGRAPHICAL DATA

ABSTRACT

Advances in technology and its usage have resulted in vast quantities of information being available on the public domains accessible via the internet. Particularly, research on populations not easily accessible, for collection of data through conventional techniques such as surveys and interviews, benefits greatly from such public information. In this study, we explore one method of using information that has already been collated, to construct a network of the professional resources of a population not easily accessible - corporate director.

CONSTRUCTING PROFESSIONAL RESOURCE NETWORKS FROM CAREER BIOGRAPHICAL DATA

The importance of social networks to the way we live has been more than adequately demonstrated (Christakis and Fowler, 2009; Goyal, 2007). Social networks affect our emotional well-being (Kawachi & Berkman, 2001), job satisfaction and performance (Balkundi and Harrison, 2006), creativity (Perry-Smith, 2006) and organizational innovation (Phelps, 2010) to name just a few outcomes. Social capital is a social network characterized by a value defined by the relationship on which the network is founded (Coleman, 1988). Therefore, the value of the network lies in the relationship and not the actors¹. We offer a proposition of a capital that is derived from both the relationship and the actor and is specific to a context - profession. Our proposition of a professional resource network is different from conventional social networks in two respects – temporality and non-specificity of relationship. The professional resource network spans the entire career of the ego and alters are not defined by a specific type of relationship. The differences are based on the notion that in professional contexts, actors regardless of type of relationship; whether collegial, personal or social, interact and engage in exchange behaviors; depending on situational dynamics. The time element is really what defined the probability of such an engagement i.e. the length of time that an ego is associated with an alter is likely to affect the probability of engagement with the alter. Therefore, the professional resource network substitutes the relationship element of social networks with the time element. The relationship element is subsumed in the fact of a professional association between the ego and actor. As such, in a professional resource network, the alter becomes a resource available to the ego and the length of association is indicative of the probability that the resource will be engaged by the ego.

Professional resource networks are useful in assessing the professional resource span of an ego. Traditionally, educational qualification and professional experience are considered as the professional

¹ *ibid.*

capital (more commonly known as human capital) of a person (Ng, Eby, Sorenson and Feldman, 2005). Anecdotally though, it is commonly known that the people that a person knows makes a considerable contribution to the suitability of a person to a professional position; as indicated by the aphorism “It is not what you know but, who you know that makes a difference”. Research on professional mobility has also shown that the types of people one knows and the route one takes to approach a job opportunity affects outcomes such as the likelihood of an offer, salary and position (Lin and Dumin, 1986; McDonald, Lin and Ao, 2009). Such resources act as both sources of information, knowledge and material resources as well as signals of capability (Lazega, 2001). In order to for an alter to be either one of those, it follows that the alter is the most optimal of sources available. For actors who are at lower levels of the management hierarchy, supervisors tend to be the optimal source for all resources. The reason for relying on the supervisor is the absence of one’s own professional resources; being at the early stages of a career as well as the absence of a reputation on the basis of which resources may be obtained from alters. As one reaches higher levels of management hierarchy, colleagues become professional resources; particularly those who rise to equivalent positions. The assumptions of preference for ties with actors who are structurally equivalent being based on the principle of homophily that has been found to be one of the strongest determinants of ties in social networks (Ibarra, 1992; McPherson, Smith-Lovin and Cook, 2001).

Based on the factors described above, the professional resource network is most useful in studying professional resources of actors at the highest levels of management hierarchy. There are two reasons for this prescription – the first being that for actors in executive positions, the breadth of professional resources contributes to professional success (Granovetter, 1982; Burt, 1992) and second, at those positions, there is not just one supervisor channel but several stakeholder channels that act as channels of both resources and constraints. The multiple channels and the general topography of push-pull forces can be mapped through professional resource networks. Therefore, professional resource networks indicate not only the professional net worth of actors in top management positions but also

probable links in organizational activity. Such a network can be analyzed for both individual capability but also systemic channels of cooperation and co-optation within and between groups of top management executives.

Professional resource networks

Professional resource networks as defined in this study are ego networks comprising all colleagues of the ego over the period of her/his professional career. Under the term colleagues, we include contemporaries from all the organizations of which the ego was a member including educational institutions, career organizations and social collectives. Therefore, each node in the network represents a colleague, in college, career organizations and social institutions of which the person is a member. To illustrate with a simple example, suppose *A* went to college with 20 other students in her/his program, had a career that spanned 20 years and 6 companies and is a member of a social club with 100 members; *A*'s network will comprise the 20 students with whom she/he was in the program, all colleagues who were her/his contemporaries in the 6 companies over the period of 20 years and the 100 members of her/his social club. Each node is clearly denoted with its origin allowing for analysis of the composition of the network. Ties, however, are a more complicated entity. In professional resource networks ties by definition are a proxy for co-membership. In order to compensate for the lack of information regarding actual relationship, rules were set up that approximate acquaintanceship based on period of co-membership in the same or closest hierarchical level. Therefore, while the actual relationship is unknown, the likelihood of collegiality is used as a proxy for the actual tie (Huckfeldt, 1983). To sum, professional resource networks are complete and structural ego networks. Being complete networks, they offer an opportunity to examine structures of opportunity and constraint, in the given environment. The opportunities and constraints are evident from the categorical composition and patterns of arrangement of nodes in the network.

Assumptions supporting the construction of professional resource networks are resource dependency (resource acquisition) and legitimacy (reputation signaling). Primarily, if a network is

construed foremost as a carrier of personal capital, then its primary components become those who can bestow such capital (Bourdieu, 1986). As such, professional resource networks comprise the capital that organizational members acquire over the course of a career. Therefore, all the nodes in the ego's network are characterized by as much, if not more, professional capital as the ego. For instance, A and B are colleagues in year 1; then the assumption is that by year 20, both A and B have more or less equal professional resources. It is important to remember that the assumption is of equivalence and not equality. Absence of equality is subsumed into the notion of resource dependency, given that for board members a variety of resources is as much valuable as depth of resources. Secondly, the legitimacy and credibility of the ego is affected by the characteristics of alters in the ego's network (Kilduff and Krackhardt, 1994). Lin and Dumin (1986) found that the probability of desired outcome is affected by status of the channel of transmission. If professional resource networks are then one of the channels of communication of the ego's reputation, the quality and range of transmission of reputation will be affected by the characteristics of alters in the ego's network. For instance, consider an ego's network that is comprised largely of lower status alters; in the organizational context, individuals such as women or members of lower hierarchical tiers. Then it can be expected that such a network will not be as effective in building a reputation credible for a higher management position. For the above reasons, characterizing alters in the ego network by hierarchical tiers will assist in ascertaining the effects of professional resource networks on the odds of board membership for women.

Composition

Alters in professional resource networks are defined by category of membership like collegial, career or social associates. Some may say the name 'collegial network' is more appropriate than professional resource network. However, the choice of 'professional resource network' was made to indicate that the period of the network is the entire tenure of the ego's career. As a catalogue of all colleagues that an ego accumulates over the career tenure, the professional resource network is comprised of various groups each representing an organization in which the ego had membership. Nodes can also be categorized by time period to recognize recurring colleagues. Such categorization is also a good way of

labeling “ties” by strength, though still only an approximation. However, it is quite plausible that an alter who recurs in any particular type of organization through the tenure, or who recurs in multiple organizations and finally a combination of both, is also far more likely to have a relationship with the ego than an alter who appears less frequently.

Structure

The structure of professional resource networks is characterized by multiplexity and longitudinality. The network is inherently multiplex because it encompasses colleagues from educational institutions, employers, social institutions. Given the comprehensiveness of the network, it is not unreasonable to assume that some nodes will appear more than once in the network. The other characteristic of professional resource networks is the time element as it is drawn over the entire tenure of a person’s career. Longitudinality of the network allows the researcher to examine the network in slices of time periods or career stages or any other definition of time.

Antecedents of professional resource networks

Drawing professional resource networks is not an entirely new method. The idea that networks function as opportunity structures was proposed by Blau (1967; 1977; 1994). Opportunity and constraint are affected by not only all the nodes in the environment but also the manner in which they are arranged (Blau, 1994; Cross and Parker, 2004). The use of archival data to construct networks has long been under exploration (Pool and Kochen, 1978; Alexander and Danowski, 1990; Padgett and Ansell, 1993). But, these studies were still consistent with conventional social networks as there was an explicit relationship that identified the ties among the nodes in the network. The use of internet-based data is relatively new despite which the use of such data has been widely availed in research on networks (See Costa, Oliviera Jr., Travieso, Rodrigues, Boas, Antiqueira, Viana and Rocha, 2011 for a comprehensive review). It is also in some instances in the use of internet-based data that joint membership has been used in lieu of an explicit relationship such as in the study of musicians (Gleiser and Danon, 2003) and movie actors (Eom, Jeon, Jeong and Kahng, 2008) and researchers (Newman, 2004) to name a few. The method of using

known information to draw networks that can allow the approximation of other links is most prominent in criminology (Sparrow, 1991). In studies pertaining to networks in organizations, researchers have mostly resorted to collecting data on actual relationships directly from respondents while limiting “non-relationship” networks to those of corporate interlocks.

Comparing professional resource and social networks

The advantages of a professional resource network over social networks drawn from data collected through conventional methods are the completeness of the network and inclusion of alters from various groups but, possibly more fundamentally, access to data that is unavailable through conventional methods of network related data collection.

Possibly, the first use of networks without an explicitly defined relationship between the nodes was in criminology. The reason being that criminal activities involve more than a single person and event (i.e. the appropriate kinds of crime) but, not all the elements involved are known to law enforcement forces. Some nodes are known, be they people or events; some can be presumed while the remaining have to be approximated based on the known and plausible data. It was in this step, that network analysis is generally applied in analyzing crimes (Senator, 2005). At around the same time, information scientists were analyzing the World Wide Web to understand the dynamics of this gigantic network as well as the ways in which information and people travelled through it (Barabási and Albert, 1999; Dezsö, Almaas, Lukács, Rácz, Szakadát and Barabási, 2006). In the social sciences, possibly the most prominent use of this method has been in the study of social networks in the general population (Travers and Milgram, 1967) and citation networks (Price, 1965) where the topology of nodes was the focus more than the relationships arranged in the structure. The point that emerges is that archival data is used only in those situations where the data is not directly accessible from the people in the network or when it is the structure of the network more than the ego that is of interest to the researcher. In that respect, professional resource networks do facilitate drawing the networks of a population that is not accessible. But, it is also an ego network as the network is constructed around the professional contacts of a single person.

Therefore, professional capital and social networks differ in three respects – accessibility of data, completeness of network and absence of relationships.

Accessibility of data

Conventional means of drawing networks, particularly in social sciences, involve collecting information on relationships directly from respondents. Methods of data collection usually are surveys, interviews, either one of those in combination with organizational artifacts like charts, collaborations and teams. The techniques used to get the data from respondents are quite varied from direct listing of specific relations-based others (friends, kin, mentors etc) to using telephone books to assist in recall of alters. Any of the methods available for collecting network data involves the participation of the egos whose networks are being drawn. Directors of corporate boards command a great deal of resources and a large proportion of their resources are the people to whom they have access. In this respect, their professional resource networks as the name suggests networks of resource exchange possibilities. Therefore, it is understandable that they prefer to keep this information private. Access to data on professional resource networks of directors on boards of corporations is highly restricted and most likely not obtainable from the directors themselves. This is evident from the very few studies on the actual networks of members of top management teams.

Completeness of network

In the event of having obtained access to a set of corporate directors and convinced them to provide the data on their professional resource networks, there is still the obstacle of recall. Corporate directors are usually highly experienced professionals with a fortune in professional capital. It can be reasonably assumed, given the importance of networks in career development, that a large proportion of the professional capital is the network they nurture in and as a result of their professional capacities. From research on ‘old boy’s networks’ we know that collegial connections are often very strong and survive entire career spans (Lazega, 2001; Branson, 2007). Therefore, the requirement to construct a network that most closely approximates the professional resource network of corporate directors is a list of all colleagues based on their current status. Homophily in status is an important factor in constructing the

professional resource network because it is unlikely that a colleague who does not attain similarly high status will be considered professional capital. Such a person could very well be a friend but unlikely to be a professional resource. To construct a closely approximated professional resource network, we need data on all the colleagues of the director who are of a similar professional status at the time of drawing the network. This means that not only will a respondent have to recall all colleagues over a lengthy career but also segregate those by their suitability to be categorized as professional capital. Even in the case of simple relational ego networks, it has generally been found that recall rates are only around 50% (Kashy and Kenny, 1990; Brewer, 2000). Naturally this proportion is directly proportional to the frequency of interaction. Therefore, conventional methods of data collection; given access to the population, are not entirely suitable to construct networks of professional capital of senior professionals such as members of top management teams.

Absence of relationships

Professional resource networks are based on joint membership, which is not a relationship but an occurrence. Though such associations may not be defined relationships, research has shown us that they hold merit, particularly in terms of careers (Granovetter, 1982; Burt, 1998; Christakis and Fowler, 2009). The absence of relationships does affect the utility of the network in analyzing those characteristic effects such as power relations and so on. But, it is possibly not a very severe shortcoming in professional resource networks because of the very nature of such networks. In a context such as the upper management echelons of corporations, relationships may not be as clearly defined. A colleague may wear many different hats in different contexts such as being a supervisor, mentor, co-member on a charitable committee as well as be a contemporary from college. Therefore, in the specific context of members of top management teams, defining a relationship may not offer improvement proportionate to the effort. There is considerable research on the role of boards as resources for the organizations; be it as a signal to stakeholders or as mediators of resource exchanges among organizations (Pfeffer, 1972; Boone, Field, Karpoff and Raheja, 2007). We also have evidence in the public domain of instances where people retain alters in their network despite their participation in events, which if in the social space would have

resulted in ostracism such as CEOs embroiled in unethical activities and so forth (Sonnenfeld and Ward, 2007). The point being that in that arena, where resources are a critical commodity, connections are maintained. Therefore, our inclusion of all colleagues; adhering to the principle of status homophily, while possibly an over-estimation is not in error.

Having said the above, it remains that nodes must have edges for it to become a network with a topology. Therefore, in lieu of the absent relationship data, duration and frequency of co-membership are used as a proxy for relationship. Duration of co-membership is used to denote strength of the association and frequency of co-membership is used to indicate multiplexity of the association.

Construction of professional resource networks

We tested the plausibility of constructing professional resource networks using career biographies of members of the board of a sample of public corporations. The choice of population was determined by the difficulty associated with obtaining network information of directors. Primarily, directors are a population not easily accessible for surveys. Even in the situation when they are available, their professional contacts are quite vast to rely solely on memory to enumerate, a problem quite common among social network researchers (Brewer, 2000; Butts, 2003). Apart from the issue of recall, director career biographies are available on a variety of public domain such as SEC filings and corporate documents like annual reports. Boardex, a corporation engaged in the compilation of this information, was used to obtain the information.

Boardex like any database is an accumulation of records. Primarily it is a collection of the professional resumés of over 300000 directors serving on board of public and private corporations all over the world. The information on each director includes their education, alma mater, career history, membership in social organizations such as clubs, cultural, educational and charitable institutions as well as demographic details like age, sex and race. There is an additional convenience for network researchers in the form in records of co-memberships in organizations. Not only are individual records available but

in a further refinement, records have been created of individual connections. For instance, if *A* is a director whose professional resumé is available on Boardex; then also available are individual records detailing the connections of *A* to *B*, *C* and *D*. Each record of such connection includes information regarding the organization in which they served together, the title of *A* and *B*, the years in which they began and stopped serving together. An illustration of the database is drawn in Figure 1.

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Insert Figure 1
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Each director has as many such records as there are connections. From this data, one can calculate the duration for which any pair of nodes was together in an equivalent hierarchical role in any given type of organization. In the instance of a pair of nodes being co-members in more than one type of organizations, one is able to capture that as well. Using search algorithms, data can be extracted to create socio-matrices of any number of degrees along with all relevant attributes. For our study, we chose to extract only first degree associations in an effort to construct ego networks of the directors in our sample.

Rules used to create the sociomatrices

The process of transforming the data from individual records to sociomatrices started by defining what we wanted to sociomatrices to indicate. We were interested in the distribution of alters by their level in the hierarchy and sex. Therefore, the first step was to create a set of hierarchical levels. Before we began, we had imagined that we would use the job titles for this purpose but quickly found out that it is the least efficient of ways given the abundance of titles. There were multiple titles that essentially indicated a single level in the hierarchy for instance there are multiple chief officers by function but, except for the chief executive officer, everybody else is at the same level in the organizational hierarchy. We were thus able to create 4 categories for the top management which indicate board-level officers which included members of the board and CEOs who were also on the board. The second category comprised heads of organizations who were not members of the board like all the variants of chief officers, executive directors, partners and so on. Regional and divisional leaders were placed in the third

category with everyone else falling in the fourth. This categorization was applied within each type of organization that an alter could belong to – public corporations, private companies, not-for-profit organizations and social institutions. Alma maters are included within social institutions. The actual rules used in the writing of the code for the algorithm is as presented in Appendix 1.

In organizations hierarchies are also indicative of lines and order of communication which on an individual basis run from bottom to top. In other words, it is highly unlikely that a member of the top management team would have an open line of communication with a managerial level employee. In order to keep the associations most plausible, we decided to allow associations only within a category and between adjacent categories. Given that we included all non-organizational-leadership roles in a single category, we decided to allow associations for the fourth category to be restricted to only within-category to minimize the probability of falsely inflating the network size. To sum, alters belonging to any of the first three categories could associate within themselves or with the adjacent category with the exception of the fourth who could associate only among themselves. These rules as used to create the algorithm are also to be found in Appendix 1.

The final rule to be placed in the algorithm was the network boundary. At the time of beginning in this study in 2010, the sample of directors included those who had been newly appointed to a corporate board in period of a year. Our secondary interest, after studying the structure of these networks was to explore if it could be shown that the networks had a differential impact on likelihood of men or women attaining board membership. In order to explore propositions related to that notion, we limited the associations that had been created to the year 2008 – two years prior to their appointment to the board that they were on at the time of sampling. The reasoning behind this decision was that the search for directors begins at fairly long interval prior to their appointment. But, without any actual information regarding the lead time allowed for such a search, we decided to err on the side of caution and allow two years.

The algorithm in its final form searched through over 10 gigabytes of individual director records to extract the associations that met the conditions coded into it. Beginning with the identification number of the first director in the sample, the algorithm first matched the association cut-off date of 2008. If the

association was current, it was disqualified from being included in the sociomatrix for that particular director. If an association qualified, it then matched the categories to which both the director and the associated alter belonged to; to verify that they fulfilled the within and adjacent category rule of association (See Appendix 2 for a flowchart of the algorithm). When all three conditions were met, the identification number of the associated alter was listed in the first row and column of the sociomatrix and the corresponding cell was populated with the duration for which the association was recorded. Along with the duration of association, attribute information was also extracted for the associations that became alters in the network – the type of organization they belong to i.e. public corporation, private company, not-for-profit organizations and social institutions, the category to which the association belongs and sex of the alter. Figure 2 provides an illustration of a sociomatrix.

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Insert Figure 2
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Thus, the networks were constructed such that nodes are highly likely to have some manner of interaction. The strongest support for constructing the network in this manner came from the work of Putnam and Bourdieu who inferred that social capital constitutes both present and potential resources that may be embedded in and accessed through networks of relations, such relations being structural, relational, cultural or intellectual (Bourdieu, 1993; Putnam, 1993; Nahapiet and Ghoshal, 1998). The resulting network structure can be seen in the network representation shown in Figure 3 and 3a for a representative case in the sample.

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Insert Figure 3 and 3a here
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Research utility of Professional Resource Networks

Conventionally, professional resources were limited to educational qualification and quality of previous work experience (Wayne, Liden, Kraimer and Graf, 1999). Since the advent of the notion of social capital, that has been researched as one of the components of career development (Brass, 1985; Kilduff and Krackhardt, 1994; Ng, Eby, Sorenson and Feldman, 2005). However research on social

network effects on careers has been limited to the immediate social connections of employees (Brass, 1985; Kilduff and Krackhardt, 1994). While boundaries to the network are defined by the research question, it remains that rarely do we contemplate complete ego networks. Recall and measurements problems have been discussed as one of the plausible reasons for this deficiency. Therefore, the situation is that network analysis, particularly in organizational behavior, is limited by access to respondents and problems associated with obtaining network data (Jackson, 2008). The methods described in this paper allow for drawing complete networks while avoiding the pitfalls inherent in conventional network data collection techniques.

A marked deficiency of this method is the non-specification of the actual relationship among the alters. However, in contexts such as described earlier where the relationship is in itself not as definite nor as significant as the fact of association, this method is of great utility. Even in situations where there is a guarantee of consistency in a relationship of a particular nature, namely positive or negative, though strength may vary; this method is a suitable option. The advantage of this method lies in its ability to draw a network complete not just in its size but also time. Conventional methods tend to capture snapshots of network without allowing for evolution over time. The method described herein can circumvent this failing of conventional techniques by coding the time variant at the stage of data conversion into sociomatrices.

Therefore, the method of constructing networks described in this paper is appropriate in contexts where comprehensive information of associations exists in raw form. Proliferation of information on the internet means that several types of comprehensive data is now available, whether it is business transactions, alliances and social relationships. The extraction and collation of this information into appropriate tabular forms falls under the purview of data mining, hence outside the scope of this paper. However, once the data is collated into a database format, the method described for professional resource networks is an effective way of creating networks.

Figure 1: Illustration of directors career profile database (as compiled by Boardex Inc.)

Dir. ID	Dir. Name	Co. ID	Co. Name	Director ID	Director Name	Overlap Year Start	Overlap Year End	Role	Associate Role	Org. Type
1	A	18814	123 Inc.	1213	E	1988	1992	FD (Non-Brd)	Independent NED (Brd) (SD)	Quoted
1	A	18814	456 Inc.	1213	E	2001	2004	CEO (Brd) (ED)	Senior Independent NED (Brd) (SD)	Quoted
1	A	18814	123 Inc.	1285	F	2001	2010	CEO (Brd) (ED)	Independent NED (Brd) (SD)	Quoted
2	B	18814	123 Inc.	1286	A	1988	1992	FD (Non-Brd)	Chairman (Executive) (Brd) (ED)	Quoted
2	B	18814	123 Inc.	2588	A	1988	1990	FD (Non-Brd)	Various Positions (Non-Brd)	Quoted
2	B	18814	123 Inc.	2588	G	1990	1992	FD (Non-Brd)	Financial Controller (Non-Brd)	Quoted
3	C	18814	789 Inc.	3190	G	2001	2003	CEO (Brd) (ED)	ED (Brd) (ED)	Quoted
3	C	18814	456 Inc.	3626	G	1996	2001	MD (Brd) (ED)	NED (Brd) (SD)	Quoted
3	C	18814	456 Inc.	3626	G	2001	2010	CEO (Brd) (ED)	NED (Brd) (SD)	Quoted
4	D	18814	456 Inc.	4625	H	1985	1988	Various Positions (Non-Brd)	Independent NED (Brd) (SD)	Quoted
4	D	18814	789 Inc.	5824	I	2004	2008	CEO (Brd) (ED)	Independent NED (Brd) (SD)	Quoted
4	D	18814	789 Inc.	8091	J	2000	2001	MD (Brd) (ED)	ED (Brd) (ED)	Quoted
4	D	18814	790 Inc.	8091	J	2010	Current	CEO (Brd) (ED)	NED (Brd) (SD)	Quoted

Figure 2: Illustration of a sociomatrix

Org. and Group ID	Sex	Dir ID	A	B	C	D	E	G	H	I	J	K	L	N	O
Sample-director	M	A	0	1	2	5	5	4	4	2	7	9	5	11	4
Public-1	F	B	1	0	0	0	0	0	0	0	1	1	1	1	1
Public-2	M	C	2	0	0	0	0	0	0	1	2	2	0	2	0
Public-Non-board-CEO	M	D	5	0	0	0	5	4	4	0	0	2	0	5	0
Private-2	M	E	5	0	0	5	0	4	4	19	0	2	0	5	0
Public-2	M	G	4	0	0	4	4	0	4	0	0	1	0	4	0
Private-Non-board-CEO	F	H	4	0	0	4	4	4	0	0	0	1	0	4	0
Private-4	M	I	2	0	1	0	19	0	0	0	2	0	0	0	0
NFP-3	F	J	7	1	2	0	0	0	0	2	0	7	5	6	4
Other-1	M	K	9	1	2	2	2	1	1	0	7	0	8	8	4
NFP-1	M	L	5	1	0	0	0	0	0	0	5	8	0	4	4
Private-1	M	N	11	1	2	5	5	4	4	0	6	8	4	0	4
Public-1	M	O	4	1	0	0	0	0	0	0	4	4	4	4	0

Figure 3: Illustrative Professional Network Map categorized by organization type and hierarchy

	Public – Board/CXO
	Public – Non-board TMT
	Public – Regional TMT
	Private – Board/CXO
	Private – Non-board TMT
	Private – Regional TMT
	Private – Others
	NFP – Board/CXO
	NFP – Non-board TMT
	NFP – Regional TMT
	NFP – Others

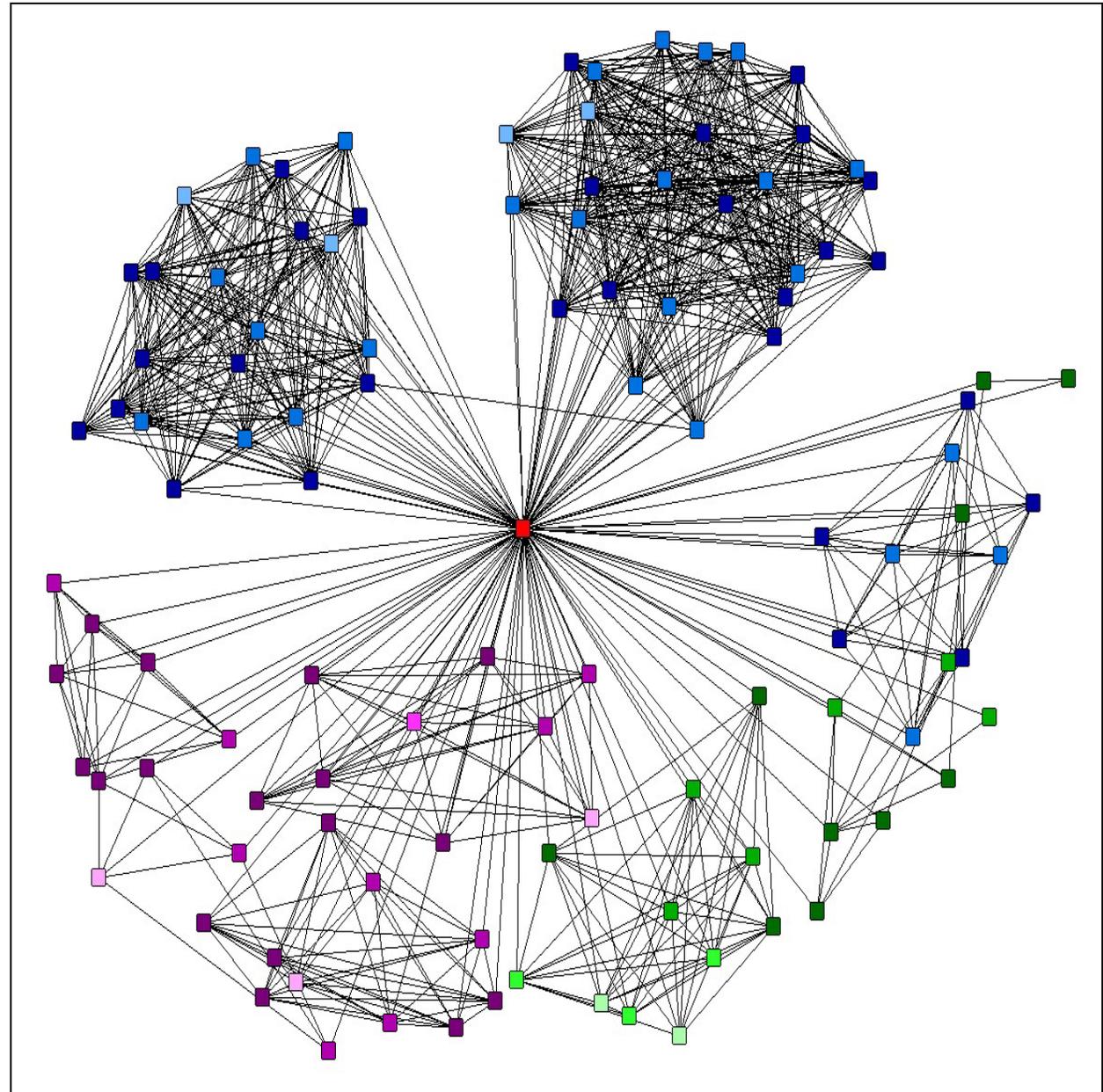
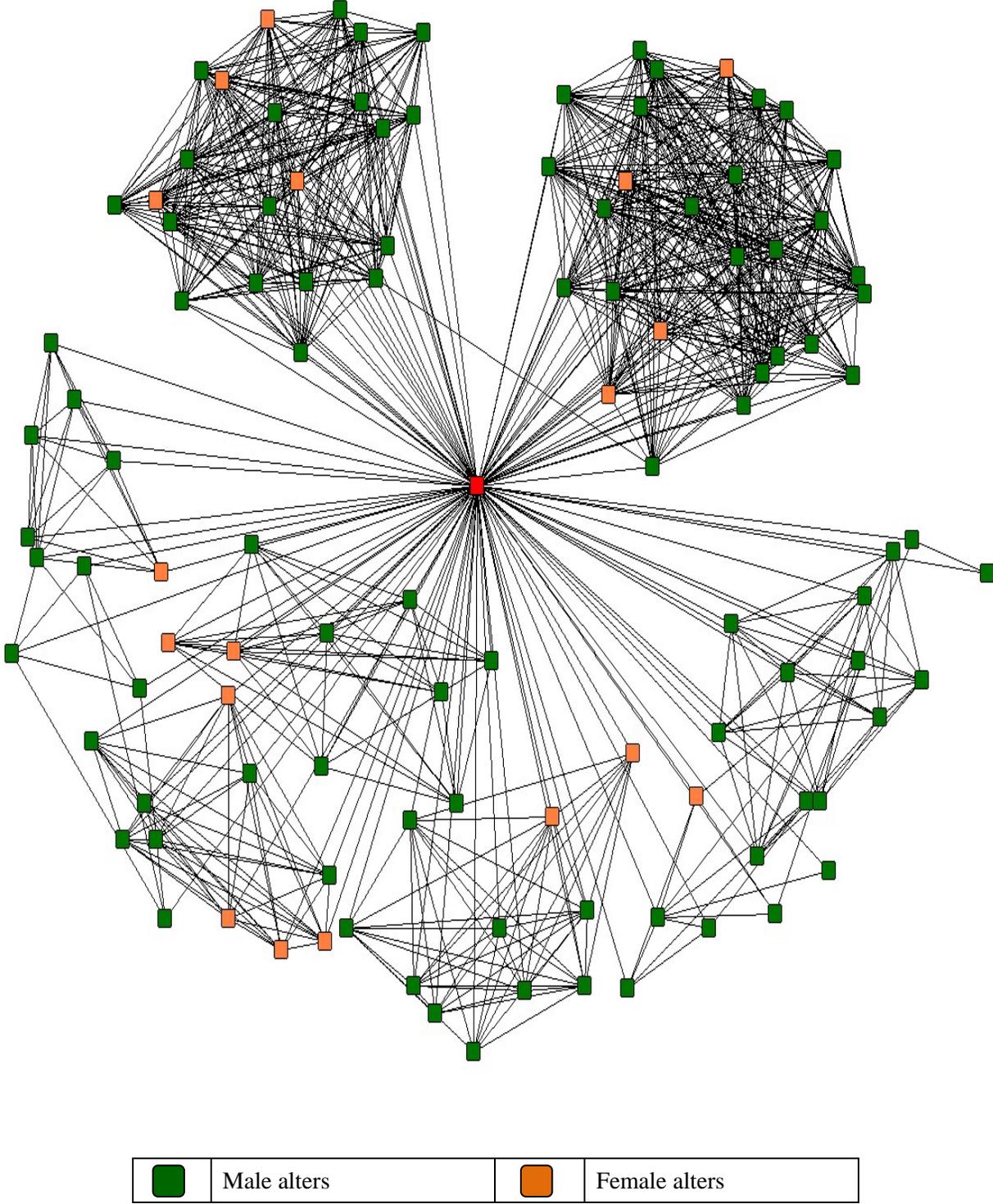


Figure 3a: Illustrative Professional Network Map categorized by sex



REFERENCES

- Alexander, M. C. & Danowski, J. A. 1990. Analysis of an ancient network: Personal communication and the study of social structure in a past society. *Social Networks*, 12: 313-335.
- Balkundi, P. & Harrison, D. A. 2006. Ties, leaders and time in teams: Strong inference about network structure's effects on team viability and performance. *Academy of Management Journal*, 49(1): 49-68.
- Barabási, A-L., & Albert, R. 1999. Emergence of scaling in random networks. *Science*, 286: 509-512.
- Bilimoria, D. 2000. Building the Business Case for Women Corporate Directors, in Burke, Ronald J. and Mattis, Mary C. (Eds.), *Women on Corporate Boards of Directors: International Challenges and Opportunities*: 25-40. Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Blau, P. M. 1977. A macrosociological theory of social structure. *American Journal of Sociology*, 83(1): 26-54.
- Blau, P. M. 1994. *Structural contexts of opportunity*. Chicago, IL: The University of Chicago Press.
- Blau, P. M. & Duncan, O. D. 1967. *The American occupational structure*. New York, NY: The Free Press.
- Boardex Database. 2011. *Directors of public companies listed in the Standard & Poor 500 index*. New York, NY: Boardex.
- Boone, L. A., Field, L. C., Karpoff, J. M. & Raheja, C. G. 2007. The determinants of corporate board size and composition: An empirical analysis. *Journal of Financial Economics*, 85: 66-101.
- Borgatti, S.P., Everett, M.G. & Freeman, L.C. 2002. *Ucinet for Windows: Software for Social Network Analysis*. Harvard, MA: Analytic Technologies.
- Bourdieu, P. 1986. The forms of capital. In J. G. Richardson (Ed.), *Handbook of theory and research for the sociology of education*: 241-258. New York, NY: Greenwood.
- Bourdieu, P. 1993. *Sociology in question*. London, UK: Sage Publications.
- Branson, D. M. 2007. *No seat at the table: How corporate governance and law keep women out of the boardroom*. New York, NY: New York University Press.
- Brass, D. J. 1985. Men's and women's networks: A study of interaction patterns and influence in an organization. *Academy of Management Journal*, 28(2): 327-343.
- Brewer, D. D. 2000. Forgetting in the recall-based elicitation of personal and social networks. *Social Networks*, 22: 29-43.
- Burt, R. S. 1992. *Structural holes: The social structure of competition*. Boston, MA: Harvard University Press.
- Burt, R. S. 1998. The gender of social capital. *Rationality and Society*, 10(1): 5-46.

- Burt, R. S. & Lin, N. 1977. Network times series from archival records. *Sociological Methodology*, 8: 224-254.
- Butts, C. T. 2003. Network inference, error and informant (in)accuracy: A Bayesian approach. *Social Networks*, 25: 103-140.
- Christakis, N. A. & Fowler, J. H. 2009. *Connected: The surprising power of our social networks and how they shape our lives*. New York, NY: Little, Brown and Company.
- Coleman, J. S. 1988. Social capital in the creation of human capital. *American Journal of Sociology*, 94: S95-S120.
- Costa, L., Oliveira Jr., O. N., Travieso, G., Rodrigues, F. A., Boas, P. R. V., Antiqueira, L., Viana, M. P. & Rocha, L. E. C. 2011. Analyzing and modeling a real-world phenomena with complex networks: A survey of applications. *Advances in Physics*, 60(3): 329-412.
- Cross, R. & Cumming, J. N. 2004. Tie and network correlates of individual performance in knowledge-intensive work. *Academy of Management Journal*, 47(6): 928-937.
- Cross, R. & Parker, A. 2004. *The hidden power of social networks: Understanding how work really gets done in organizations*. Boston, MA: Harvard Business School Press.
- Dezsö, Z., Almaas, E., Lukács, A., Rácz, B., Szakadát, I. & Barabási, A-L. 2006. Dynamics of information access on the web. *Physical Review E*, 73: 1-6.
- Daily, C. M., & Certo, S. T. 1999. Entrepreneurial ventures as an avenue to the top? Assessing the advancement of female CEOs and directors in the Inc. 100. *Journal of Developmental Entrepreneurship*, 4(1): 19-32.
- Eom, Y-H., Jeon, C. & Jeong, H. 2008. Evolution of weighted scale-free networks in empirical data. *Physical Review E*, 77: 1-6.
- Freeman, L. C. 1977. A set of measures of centrality based on betweenness. *Sociometry*, 40(1): 35-41.
- Freeman, L. C. 1979. Centrality in social networks: Conceptual clarification. *Social Networks*, 1: 215-239.
- Garson, G. D. 2011. Multivariate GLM, MANOVA and MANCOVA. *Statnotes: Topics in Multivariate Analysis*. <http://faculty.chass.ncsu.edu/garson/pa765/statnote.htm>.
- Gleiser, P. M. & Danon, L. 2003. Community structure in Jazz. *Advances in Complex Systems*, 6(4): 565-573.
- Granovetter, M. 1982. The strength of weak ties: A network theory revisited. In P. V. Marsden & N. Lin (Eds.), *Social structure and network analysis*: 105-130. Beverly Hills, CA: Sage Publications.

- Goyal, S. 2007. *Connections: An introduction to the economics of networks*. Princeton, NJ: Princeton University Press.
- Huckfeldt, R. R. 1983. Social contexts, social networks and urban neighborhoods: Environmental constraints on friendship choice. *Journal of Sociology*, 89(3): 651-669.
- Ibarra, H. 1992. Homophily and differential returns: Sex differences in network structure and access in an advertising firm. *Administrative Science Quarterly*, 37(3): 422-447.
- Ibarra, H. 1993. Personal networks of women and minorities in management: a conceptual framework. *Academy of Management Review*, 18: 56-87.
- Jackson, M. O. 2008. *Social and economic networks*. Princeton, NJ: Princeton University Press.
- Kashy, D. A. & Kenny, D. A. 1990. Do you know whom you were with a week ago Friday? A re-analysis of the Bernard, Killworth and Sailer studies. *Social Psychology Quarterly*, 53(1): 55-61.
- Kawachi, I. & Brekman, L. F. 2001. Social ties and mental health. *Journal of Urban Health*, 78(3): 458-467.
- Kilduff, M. & Krackhardt, D. 1994. Bringing the individual back in: A structural analysis of the internal market for reputation in organizations. *Academy of Management Journal*, 37(1): 87-108.
- Krackhardt, D. 1992. The strength of strong ties: The importance of *Philos*. In N. Nohria & R. Eccles (Eds.), *Networks and organizations: Structure, form and action*: 216-239. Boston, MA: Harvard Business School Press.
- Kumra, S. 2010. Exploring career “choices” of work-centered women in a professional services firm. *Gender in Management*, 25(3): 227-243
- Lawrence, B. S. 2006. Organizational reference groups: A missing perspective on social context. *Organization Science*, 17(1): 80-100.
- Lazega, E. 2001. *The collegial phenomenon: The social mechanisms of cooperation among peers in a corporate law partnership*. New York, NY: Oxford University Press.
- Lin, N. & Dumin, M. 1986. Access to occupations through social ties. *Social Networks*, 8: 365-385.
- Lorsch, J. W. (with MacIver, E.). 1989. *Pawns or potentates: The reality of America's corporate boards*. Boston, MA: Harvard Business School Press.
- Lyness, K. S. & Thompson, D. E. 2000. Climbing the corporate ladder: Do female and male executives follow the same route? *Journal of Applied Psychology*, 85(1): 86-101.

- Mace, M. L. 1971. *Directors: Myths and reality*. Boston, MA: Harvard University.
- McDonald, S. , Lin, N. & Ao, D. 2009. Networks of opportunity: Gender, race and job leads. *Social Problems*, 56(3): 385-402.
- McPherson, M., Smith-Lovin, L. & Cook, J. M. 2001. Birds of a feather: Homophily in social networks. *Annual Review of Sociology*, 27: 415-444.
- Mehra, A., Kilduff, M. & Brass, D. J. 2001. The social networks of high and low self-monitors: Implications for workplace performance. *Administrative Science Quarterly*, 46(1): 121-146.
- Mills, C. W. 1956. *The power elite*. New York, NY: Oxford University Press.
- Moore, G. 1988. Women in elite positions: Insiders or outsiders? *Sociological Forum*, 3(4): 566-585.
- Ng, T. W. H., Eby, L. T., Sorenson, K. L. & Feldman, D. C. 2005. Predictors of objective and subjective career success: A meta-analysis. *Personnel Psychology*, 58: 367-408.
- Nahapiet, J. & Ghoshal, S. 1998. Social capital, intellectual capital and the organizational advantage. *Academy of Management Review*, 23(2): 242-266.
- Newman, M. E. J. 2004. *Coauthorship networks and patterns of scientific collaboration*. Paper presented at a colloquium of the National Academy of Sciences, Irvine.
- O'Neil, D. A., Hopkins, M. M. & Bilimoria, D. 2008. Women's careers at the start of the 21st century: Patterns and paradoxes. *Journal of Business Ethics*, 80: 727-743.
- Padgett, J. F. & Ansell, C. K. 1993. Robust action and the rise of the Medici, 1400-1434. *American Journal of Sociology*, 98(6): 1259-1319.
- Perry-Smith, J. E. 2006. Social yet creative: The role of social relationships in facilitating individual creativity. *Academy of Management Journal*, 49(1): 85-101.
- Pfeffer, J. 1972. Size and composition of corporate boards of directors: The organization and its environment. *Administrative Science Quarterly*, 17(2): 218-228.
- Phelps, C. C. 2010. A longitudinal study of the influence of alliance network structure and composition on firm exploratory innovation. *Academy of Management Journal*, 53(4): 890-913.
- Pool, I. & Kochen, M. 1978. Contacts and influence. *Social Networks*, 1: 5-51
- Price, D. J. 1965. Networks of scientific papers. *Science*, 149(3683): 510-515.
- Putnam, R. D. 1993. The prosperous community: Social capital and public life. *The American Prospect*, 13: 35-42.
- Ridgeway, C. L. 1993. Gender, status and the social psychology of expectations. In P. England (Ed.), *Theory on gender/Feminism on theory*: 175-198. New York, NY: Aldine De Gruyter.

- Roth, L.M. 2004. The social psychology of tokenism: Status and homophily processes on Wall Street. *Sociological Perspectives*, 47(2): 189-214.
- Senator, T. D. 2005. Link mining applications: Progress and challenges. *SIGKDD Explorations*, 7(2): 76-83.
- Shivdasani, A. & Yermack, D. 1999. CEO involvement in the selection of new board members: An empirical analysis. *Journal of Finance*, 54(5):1829-1853.
- Sonnenfeld, J. & Ward, A. 2007. *Firing Back: How great leaders rebound after career disasters*. Boston, MA: Harvard Business School Press.
- Sparrow, M. K. 1991. The application of network analysis to criminal intelligence; An assessment of the prospects. *Social Networks*, 13: 251-274.
- Sparrowe, R. T., Liden, R. C., Wayne, S. J. & Kraimer, M. L. 2001. Social networks and the performance of individuals and groups. *Academy of Management Journal*, 44(2): 316-325.
- Travers, J. & Milgram, S. 1969. An experimental study of the small world program. *Sociometry*, 32(4): 425-443.
- Tsai, W. 2001. Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance. *Academy of Management Journal*, 44(5): 996-1004.
- Useem, M. 1984. *The inner circle: large corporations and the rise of business political activity in the U.S. and U.K.* New York, NY: Oxford University Press.
- Wayne, S. J., Liden, R. C., Kraimer, M. L. & Graf, I. K. 1999. The role of human capital, motivation and supervisor sponsorship in predicting career success. *Journal of Organizational Behavior*, 20: 577-595.
- Weick, K. E. 1969. *The social psychology of organizing*. Reading, MA: Addison-Wesley.
- Westphal, J. D. & Zajac, E. J. 1995. Who shall govern? CEO/Board power, demographic similarity and new director selection. *Administrative Science Quarterly*, 40(1): 60-83.
- Wharton, A. S. 2005. *The sociology of gender: An introduction to theory and research*. Oxford, UK: Blackwell Publishing.

Appendix 1

Rules of interaction for the creation of sociomatrices for organizational networks

Categorizing into groups by roles

- All board members or "trustee" or "council *and* chairman *or* co-chairman" or "governor" or "advisor" or "board *and* member" belong to group 1
 - CEOs who are on the board get labeled as **Board-CEO**
- All roles containing "chairman", "chairwoman", "chairperson", "chief & officer", "C & O", "ED", "SD", "commissioner", "patron" or "committee *and* member", "emeritus", "managing" *and* "director" *or* "partner", "senior" *or* "executive" *and* "vice president" *or* "VP", *starting with* "president" in the title belong to group 2
 - CEOs/COOs who are not on the board get labeled as **Non-board CEO**
- All roles containing "regional", "division", "additional", "assistant", "deputy" *and* "president" *or* "vice president" *or* "VP" *or* "director" *or* "partner" *or* "head" or "honorary *or* senior *and* fellow", "treasurer", "commission *or* corporation *and* member" in the title belong to group 3
- All other titles belong to group 4

Creating sociomatrices

Match dirbrdid (only) from sample director list with dirbrdid in associations dataset

- Check for overlapstartyear; it must be 2008 or prior (not 2009 or 2010)
- Check if role (sample director) and associate role (connection) are in compatible groups
 - Both roles are in the same group
 - Role (sample director) is in group 2 and associate role (connection) is in group 1
 - Role (sample director) is in group 3 and associate role (connection) is in group 2
 - Both are in group 4
- **When role (sample director) is in group 4, it cannot network with associate roles (connections) in any other group. Role (sample director) in group 4 can only network with associate role (connection) in group 4.**

Appendix 2

Flow chart for converting association data into sociomatrices

