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**GLASS NETWORKS: THE NETWORK STRUCTURE OF  
WOMEN DIRECTORS ON CORPORATE BOARDS**

**A thesis presented in partial fulfilment of the  
requirements for the degree of**

**Doctor of Business and Administration**

**at Massey University, Palmerston North,  
New Zealand.**

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**2010**

## **A philosophical dedication:**

*“Whenever nonlinear elements are hooked together in gigantic webs, the wiring diagram has to matter. It’s a basic principle. Structure always affects function.”*  
Steven Strogatz (2003:237) Sync: The Emerging Science of Spontaneous Order.

~~~~~

## **Abstract**

Boards of directors are overwhelmingly dominated by men. Globally, only 5-20% of directors of substantial corporations are women. Despite three decades of research and intervention this gender ratio has remained static except where affirmative action has forced change.

Using Carlile and Christensen’s (2005) management theory building methodology, I develop a new theoretical approach to the study of women on corporate boards of directors called Glass Network Theory. Using concepts from small-world and scale-free network theory, I suggest that semi-permeable invisible barriers or glass nets, rather than glass ceilings, permit limited directors through to become connector directors with multiple board seats.

Resistance to change in gendered director networks is framed as a structural and normative characteristic of dynamic networks. Like other natural and social scale-free networks, gendered director networks display an emergent and self-perpetuating order. Low levels of diversity are incorporated as adaptive features of stable self-similar director networks responding to environmental pressures and economic fluctuations. Nested director networks at global, national or local levels show self-similarity at all scales, particularly where ‘shoulder tapping’ or preferential attachment underpins the network formation.

Probing gendered director networks with social network analysis tools shows that women directors in global and national networks are more likely to be found in the largest connected component than in the unconnected network components. Both male and female director networks show the characteristics of small-worlds, that is, high clustering coefficients and short path lengths. Both male and female directors also show ‘positive assortativity’ where directors of high degree associate with other

directors of high degree. As the distribution of multiple directorships follows a power law, the model of the expected seat spreads is a useful tool to track the effectiveness of governance or affirmative action interventions such as quotas.

I conclude that female director networks are not inherently different from male director networks except in size.

**Figure 1.**

Image accompanying the Wall Street Journal article by Hymowitz and Schellhardt (1986) which introduced the term glass ceiling (Eagly & Carli, 2007a, p. 4).



## Acknowledgement

I am particularly indebted to my two supervisors. A heartfelt thank you goes to Professor Ralph Stablein, Department of Management in the College of Business, for his encouragement to range far and wide in my exploration of social networks. I have come to greatly appreciate his analytical ability, collegiality and inclusiveness.

A special thank you must go to my second supervisor Dr Stephen Marsland, Associate Professor in the School of Engineering and Advanced Technology, for taking over the role of first supervisor at short notice. I am particularly grateful for his scholarly generosity and commitment. To have a mathematician, who participated in the legendary Santa Fe community, as my supervisor has been more than fortuitous.

Most beneficial too was Professor Stablein's introduction to the Academy of Management and the group of international academics who research Women on Boards of Directors. In particular Susan Vinnicombe, Diana Bilimoria and Mary Mattis, have been inspirational. Here in New Zealand my deep respect and gratitude for the stellar example she sets to academics and practitioners alike, has to go to Professor Judy McGregor.

My thanks also go to Professor Gerald Davis, University of Michigan, for making the iconic 1999 Fortune US 1000 data set available. It seems fitting that this should be used in the first women directors' network analysis.

I would like to acknowledge another act of scholarly generosity from the 1970s. Professor Matina Horner, President of Radcliffe College, now merged with Harvard University, took the time to send me, then an Honours student at the University of the Witwatersrand, information for my thesis on fear of success in women. I was delighted to find Professor Horner in the 1999 Fortune US 1000 dataset as a connector director.

I would also like to acknowledge the intellectual stimulus provided by the work of Duncan Watts, Albert-László Barabási, Mark Newman, Steve Borgatti and the UCINET community. I have been walking in the minds of giants and through them have known the thrill of discovering truly awesome ideas.

I would like to acknowledge the assistance of Rodney Dormer and Adrian Sparrow as well as Liam Fitzgerald and Michael Allan in the data analysis.

Finally my thanks go to my husband, Michael and children Bryan and Robyn for co-existing with the 'Big T' for so long. Thank you to Bryan for the research assistance and the ongoing challenge as to which of us would be the first doctor in the family.

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## Glossary of Terms

\*New terminology developed in Glass Network Theory

|                         |                                                                                                                                                                                                                   |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Assortativity           | The tendency of network nodes to preferentially join others that are similar or like them.                                                                                                                        |
| Betweenness             | The proportion of shortest paths from one node to another that pass through a central node.                                                                                                                       |
| Clustering coefficient  | A measure of how close knit a group of directors are in relation to a director to whom they are all linked.                                                                                                       |
| *Connector director     | A director with two or more seats in substantive companies.                                                                                                                                                       |
| Degree                  | Average number of interlocks or links to a director.                                                                                                                                                              |
| Degree distribution     | A frequency distribution that is constructed by counting the number of directors that have one link coming into them, the number that has two etc.                                                                |
| Geodesic distance       | The length of the shortest path required to connect two nodes. For a network it is the average number of edges that must be traversed in the shortest path connecting any two nodes.                              |
| *Glass net              | A transparent but semi-permeable barrier that permits predictable and limited numbers of men and women through to the boardroom.                                                                                  |
| *Glass network          | The invisible or transparent network created when directors sit on common boards together as revealed through the tools of social network analysis.                                                               |
| *Glass Network Theory   | A theory developed from an exploration of change-resistant gendered director networks where a glass network or invisible network blocks the path of women directors to the boardroom rather than a glass ceiling. |
| Homophily               | Preference for the similar.                                                                                                                                                                                       |
| Edge, link or interlock | The relationship that a director has to his co-directors through sitting on a common board.                                                                                                                       |

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Power Law               | Mathematical law of the 'vital few and the trivial many'.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Preferential attachment | A preference of network nodes to attach to nodes that already have edges.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Queen bee               | A woman director with two or more seats, who by adopting the behaviour patterns of male directors is perceived as violating the norms of feminine behaviour.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Saliency                | Preference for notable and relevant characteristics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Scale-free network      | Networks characterised as having a degree distribution that conforms to a power law and is similar at all scales.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Seat                    | Alternative term for directorship to clearly distinguish individual directors from the many directorships they may hold.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Seat spread             | Frequency distribution of multiple directorships.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Self-similarity         | Repetitive smaller network segments which resemble the combined segments.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Shoulder tapping        | A method of recruiting directors through personal invitations to known colleagues and acquaintances.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Small-world             | A network with a low average geodesic distance between nodes and a high clustering coefficient.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Small-world Quotient    | In a director network of $n$ nodes with a mean of $k$ edges or links per node, let $L_{actual}$ equal the average geodesic or shortest path length between nodes in the largest connected component. Let $L_{random}$ equal the average geodesic in which the edges between nodes are random (approximated by $\ln(n)/\ln(k)$ where $\ln$ is the natural logarithm). Let $C_{actual}$ equal the average degree of local clustering in the largest connected component. Let $C_{random}$ equal the average degree of local clustering in the randomized network (approximated by $k/n$ ). Then: |

$$\text{Small World Quotient (SW)} = [C_{actual}/L_{actual}] * [L_{random}/C_{random}]$$