

THE NETWORK PERSPECTIVE IN REGIONAL REGENERATION: AN ORGANIC ANALYSIS OF THE HUNTER REGIONAL NETWORK FOR ECONOMIC DEVELOPMENT (HUNTER VALLEY, NSW, AUSTRALIA)

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ABSTRACT Industrial regions facing economic restructuring commonly generate collaboration processes between organisations from the public sector, the private sector and the civic society. Economic theory offers little explanation of the collaboration processes underpinning coordination of projects and strategies for addressing regional economic imbalance. These processes can be analysed by focusing on the 'network capital' of regions, but to do that a specific methodology of network analysis has to be applied. This paper addresses the question of what is the best approach to analysing regional networks for economic development. The paper argues that the best approach is to work at two levels, the organic and the functional. Organic analysis focuses on the structure of communication and collaborative links amongst network members and on the position of organisations within the network. Functional analysis focuses on network impacts on regional development and the factors behind the network performance. The purpose of this paper is to argue that an organic analysis is a necessary step of the methodology for analysing the network capital of a region. An organic analysis of the Hunter regional network for economic development is presented as an example.

1. INTRODUCTION

It is not uncommon to see regions in industrial countries suffering from an uneven development of their economic bases. While the pressures from globalisation reaches all economic systems, adaptations to these pressures are happening at different paces. Regions heavily dependent on one economic sector go through processes of industrial restructuring and regional regeneration. In this context is easy to find emergent regional networks between organisations from the public sector, the private sector and the civic society.

This interesting phenomenon is nothing new but the evolution of several factors considered by economic and regional growth theories. While the static world of the neoclassical economics and the Marshallian externalities such as land, labor, capital, energy and transportation (Marshall, 1986) do not explain performance of a region as a whole or the emergence of networks, other authors discuss factors that are at the heart of regional networks. Coase's theory of the firm discusses the coordination factor in an economic system (Coase, 1937); Schumpeter's theory of economic development stresses the innovation factor (Schumpeter, 1961), Post-

Fordism literature focuses on flexible mode of production (Yeung, 1994), and industry cluster studies show how networks can be a vehicle of economic growth (Porter, 1990; Rosenfeld, 1995; William, 1997; Murphy *et al*, 1997; Martinez, 1998).

Regional growth theories have also discussed the emergence of regional networks. The social embeddedness of the economy (Ganovetter, 1985), the partnership and alliances phenomenon (McQuaid, 1998; Bruce, 1993; Nutt and Backoff, 1992), the grassroot development of economic communities (Henton, 1997), and the knowledge based economy (Maskell and Malmberg, 1995) are some of the studies contributing to this research field. Probably the most important effort in developing a framework for regional networks comes from Cooke and Morgan with their work on the network paradigm (Cooke and Morgan, 1993) and their latest work on the associational economy (Cooke and Morgan, 1998).

Although researchers are increasingly interested in the systemic socio-economic approach of regional networks, there is still a lack of clarity about the processes involved and their effectiveness. Methodological difficulties of dealing with processes involving multiple parties and the need of longitudinal studies add barriers to the study of regional networks and the definition of what constitutes the network capital of regions.

In this paper two notable theories contributing to the issues of regional growth and network capital will be discussed. The main argument to be advanced is that theories dealing with the issue of regional networks should first apply network analysis methodology to perform an organic analysis of the network. Only after that is it possible to perform a functional analysis linking to their contribution to regional growth. The network capital of the Hunter Valley will be organically analysed to exemplify this methodology.

2. REGIONAL GROWTH AND NETWORK CAPITAL

Economic and regional growth theories focus on factors and explanations of economic systems but does not explain performance of a region as an socio-economic system with emergent regional networks. However, to explain how and why Regional Networks of Economic Development (RENEDs) works for regional regeneration, there are some very useful discussions from the literature. This section wants to discuss two of them: *industry clusters* and the *associational economy*. These two streams of research are the closest to explaining the phenomenon of regional networks, though both lack an analytically methodological framework.

The regionalisation of production reflected by the proliferation of local industry networks has attracted a significant amount of research in different disciplines. The local industry networks are usually referred to as *clusters*. A cluster may be understood to be an informal association of firms, which are usually in geographical proximity, and which pursue deliberate practices of collaboration and innovation in order to heighten their competitive edge in regional, national and

international markets. Clusters cross organisational boundaries all the time, including not only firms but also government agencies and community associations. They are thought to be thus influencing regional governance, and reshaping the ways that firms and governments have interacted until now (Martinez, 1998). It is in the literature of clusters where most references can be found concerning the advantages of embracing government and community bodies in enhancing a region's development. The potential value of industry clusters in contemporary economic development lies in their articulation of strategies for fostering improvement in the areas of knowledge, technology and innovation amongst the participating firms. Industry clusters are about much more than connecting buyers with suppliers or growth centres. They are about industry regional representation and competitiveness on the global market (Held, 1996). What is new in this production system is that clusters have genuine objectives, organisational and structural characteristics, and specific factors impacting on their emergence and evolution, that are not shared by other organisational forms. The objectives of clusters pursue the development of knowledge, the creation of jobs and the fostering of economic growth in the region. The organisational characteristics of clusters include voluntary membership with no contractual relationships and with no defined boundaries as to the organisational shape. Structurally, clusters exhibit non-hierarchical relationships, with a core management structure sharing leadership between several members. As regards their emergence and evolution, clusters are affected by political responses to economic restructuring (which leads to a collaboration of forces by the business community), and also by the emergence of collaborative economics and civic entrepreneurs in what can be called "grassroots development" (Henton *et al.*, 1997).

Clusters are one of the manifestations of networks as driving forces of the new economic order, reshaping the way society works (Castells, 1996). This is indicated in the growth of partnerships and alliances at the regional level, especially those between public and private sector, showing that clusters expand beyond business networks. The relevance of partnerships to localities was pinpointed by Porter (1990) in his proposed new paradigm for understanding company competitiveness and new global strategies. This theory of clusters draws on several fields which address competitive strategies used by firms. Due to the continual redefinition of boundaries implied by the network definition, it is conceivable that local economies could compete in global markets with their own regulation and leadership. Increasing industry clusters point out an emerging "regionalism" as powerful as the flavor of the month "globalism".

It should be noticed that clusters now are including more agents and organisations from the public sector, enhancing their coordination effect. This is a factor that has not been seriously addressed before in the literature (Porter, 1990; Arthur, 1990; Fulton 1997, Williams, 1997, Murphy *et al.* 1997, Steiner, 1998). It could be argued that this indicates the incorporation of clusters into emergent regional networks. As such, they can take advantage of full resources and

indirectly participate in the regional strategic development. As a side effect, clusters can also stimulate awareness among the component organisations of the role of the regional network in the region's economic development.

Despite the relevant literature on the topic, there are not explicit references to a methodological framework on the study of clusters able to be replicated and tested. The problem is that if the unit of study [the cluster] is not clearly defined it will be difficult to measure any effect on regional growth or to conduct longitudinal research in the region, or comparative research amongst a set of regions.

Probably the most important effort in developing a framework for regional networks comes from Cooke and Morgan with their work on *The Network Paradigm* (Cooke and Morgan, 1993) and their last work *The Associational Economy: Firms, Regions and Innovation* (Cooke and Morgan, 1998). The network paradigm is a new trend in corporate and regional development that refers to regions in the process of restructuring which develop networking between agencies and organizations. Such regions are engaged in a productive learning and adaptation process based on intraorganisational and interorganisational networking. This intersects also with the concept of collaborative economic communities and social embeddedness discussed by Henton *et al* (1997), and Granovetter (1985) amongst others. The associational economy remarks the growing role of knowledge intensity in production and interchange of products where the network form of organisation is a competitive advantage in the knowledge based economy. This focus on "knowledge" is nothing new but the evolution of previous theories such as Schumpeter's theory of economic development (Schumpeter, 1961) and the extensive organisational literature on the network form of organisation (Rosegger, 1998; Miles and Snow, 1992; Hinterhuber and Levin, 1994; Biemans, 1996; Rosenfeld, 1994; Hanssen-Bauer and Snow, 1996; Fairtlough, 1994; Commonwealth, 1993; Suarez-Villa, 1998; Tödtling and Kaufmann, 1998; Powell, 1990; Yeung, 1994; Brown, 1987; Chisholm, 1997; Snow *et al*, 1992). A full discussion about the knowledge based economy of regions is also found on the work of Maskell and Malmberg on *Localised Learning and Industrial Competitiveness* (Maskell and Malmberg, 1995).

The work of Cooke and Morgan raises important methodological questions about how to study the processes that lead regional networks to growth or regeneration. One of the questions is how to analyse the network structure and its collaboration links. Analysing the structure of a regional network is important for measuring its effects on the region, to define the worth of the regional network capital, and to increase its effectiveness. Previous studies have not detailed the structure of regional networks, nor the connections between their component members. For instance, Cooke and Morgan (1993) examined network membership in a region. Their study outlined a network in the Basque country (Spain) based on organisations holding an office in the region. If they had measured the real communication links amongst the organisations part of the regional network it might have shown a different network membership. They defined the regional

network as depending upon the number of agencies supporting the business environment, and the development of business links between university or research organisations and industry. There is no reference to the structure of the network itself or to the actual frequency of communication links between the organisations components of the network. Communication links can only be found through a topological analysis of the network, which measures which organisation is linked to which, and the nature of the relationship. This is just one example to show the complexity of studying networks, and how easy it is for researchers to assume what a network is without previously developing a method to analyse its structure.

Network Analysis is the only body of knowledge that focuses on qualitative measures of network structure. The power of the network analysis approach resides in its ability to shed light on regional network structure. The object of network analysis is the study of the social structure underlying complex social systems. It is linked to systemic thinking and system analysis, a discipline usually applied to engineering, information technologies and computer program development, but also used in organisational psychology and planning (see Bertalanffy, 1955; Buckley, 1967, Catanese and Steiss, 1970). The systemic approach sees any entity as composed of different parts interrelated with each other. That interrelation is the foundation of the system's functioning, because changes in one of the entities will affect the other parts. Thus understanding and solving a problem must take into account the entire organisation range of separate entities and their relationships. What this emphasises is the need for understanding the structure of the system, not only as separate entities but also as a map of symmetric and asymmetric organisational links.

The contribution of network analysis is not its use of instruments to measure "social structure", but its conceptual understanding of what structure means. A social network consists of a finite set of actors and the relations defined amongst them. The presence of relational information is a critical and defining feature of a social network (Wasserman and Faust, 1997, p.20).

While network analysts do not deal specifically with regional networks, the perspective they are developing (towards a general theory of network analysis) is critical to the understanding of the social structure of regions and the implications of relational ties between the different entities operating in the region. Network analysis can give precise definitions of regional structure, through the analysis of political, economic and social relational aspects. Network analysis offers useful insights into the definition of clusters, partnerships and alliances, and the process of mapping them. Several authors have been addressing how and why network analysis can make a difference to the understanding of any kind of organisational form [Granovetter (1985), Scott (1995), Lewin (1951), Freeman (1989), Hagen *et al* (1997), Mizruchi and Galaskiewicz (1994), Tichy *et al* (1979) and Turk (1977)]. Network analysis permits visualisation of the structure of an organisation in terms of communication links and transactions between organisations. Analysing a RENED in terms of network analysis will show its structure in terms of the links developed within and outside the network, focusing on the frequency of

communication, the density of the network, its level of centrality, and leadership components.

The next section in this paper will show an organic network analysis of the Hunter region of New South Wales (Australia), where some useful measures are presented.

3. ORGANIC ANALYSIS OF THE NETWORK CAPITAL OF THE HUNTER VALLEY

The big difficulty of studying regional networks is to operationally define the network for studying its dynamics and effects as an entity, not as the sum of different organisations. The model argued in this paper offers a systemic approach to the study of regional networks that reach a greatest understanding of both their dynamics and effects on regional regeneration. This section will present the results of the organic analysis of the of the network capital of the Hunter region. This organic level will allow research and further investigation into the role and effects of the network.

The organic analysis focuses on structural properties of networks, which are defined in terms of frequency of interactions and in terms of collaboration in projects of economic development. Several measures qualify the network. One measure looks into the centrality position of the organisations part of the network. A second measure analyses cohesion and density of the network. A third measure analyses centrality and central positions. All these measures present the network as an inclusive entity which components and dynamics can be studied and relate to their performance on regions in economic restructuring.

This analysis is drawn from a survey conducted on 1998 amongst Hunter region organisations working on economic development. The response rate was 96%.

4. NETWORK STRUCTURE

Two measures of the Hunter network were taken in order to study its structural components. One measure refers to the frequency of communication amongst the organisations part of the network. The other measure accounts exclusively for the collaboration links in projects of economic development for the region. These measures built two matrixes, which are the basis of the network analysis applied to study its structural characteristics.

Two figures can be presented from these matrixes. The first one shows the frequency of communication between network organisations at four levels: very often communication, often communication, not very often communication, and casual and no communication. This matrix served for eliminating isolated organisations from the network. The second figure (below) shows the Hunter RENED as drawn from their exclusive collaboration links in projects of economic development. It is understood that it constitutes a true representation of the

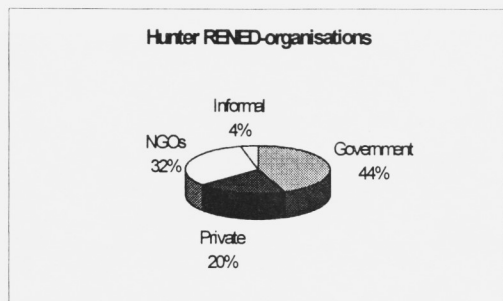


Figure 1. Hunter RENED Organisations Network Demographics. The Hunter RENED is composed of twenty-five organisations distributed in eleven government organisations or institutions, five private enterprises, eight non-governmental organisations (NGOs) and one informal group.

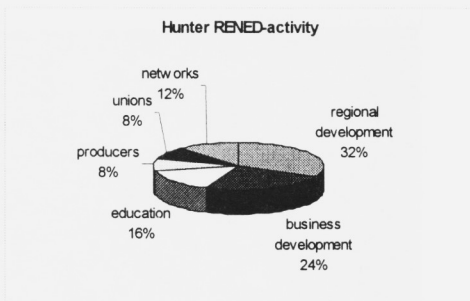


Figure 2. Hunter RENED Activity The main activity of the network organisations is divided into six groups. Eight of the organisations work on regional development, six work in business development, four are education and research institutions, two are producers, two are unions, and three are focussed network groups.

functional network which impact on regional growth. The figure has three components: nodes, lines and arrows. Each node represents one organisation and an identification number can be read close to it. Lines between nodes represent a collaboration link between those organisations. Arrows represent the direction of the link, as reported by the informants. Organisations close to the centre of the figure are those more central to the RENED, that is, participating in a highest number of projects. Those organisations in the periphery indicate a minor number of collaborations in projects. The figure has been generated with two computer programs of network analysis: UCINET 5.0 (Borgatti *et al*, 1999) and PAJEK 0.41 (Batagelj and Mrvar, 1998).

The figure shows a dense network of 25 organisations. Network cohesiveness measures are presented in Table 1. All network measures have been generated with UCINET 5.0 (Borgatti *et al*, 1999).

Table 1. Hunter RENED-Network Properties

Density		Valued Density		Average Distance
Average	Standard Deviation	Average	Standard Deviation	
0.73	0.44	1.52	1.30	1.832

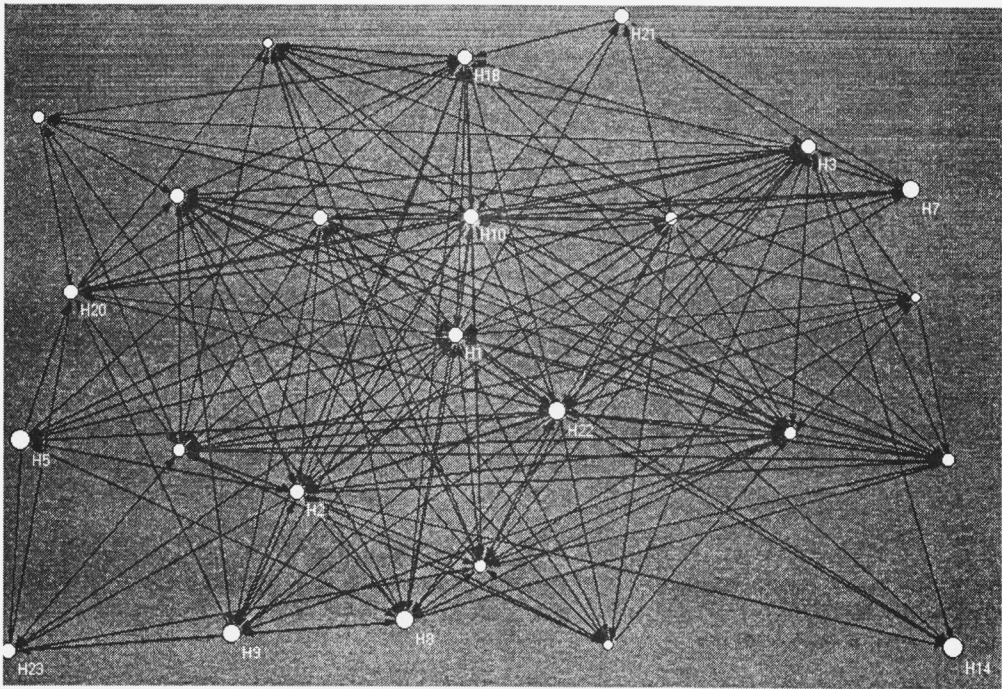


Figure 3. Hunter RENE

[Government organisations: H18, H3, H25, H11, H24, H19, H17, H10]

[Private organisations: H22, H16, H1, H12, H13, H2, H7]

[NGOs: H23, H14, H20, H6, H9, H15, H4, H5, H21]

[Informal group: H8]

The average density is a value that goes from a minimum of (0), if no lines are presented between organisations, to a maximum of (1), if all lines are present. The valued density measures the average strength of the lines reflecting frequency of communication, which was measured from a minimum value of (0) for no communication, to a maximum value of (4) for very often communication. The average distance indicates the average number of edges in the shortest path between the RENE organisations. The Hunter RENE has a high density in communication (0.73), with an average frequency between casual and often (1.52). It has to be noticed the presence of extreme values in the periphery of the network reducing the average strength of links. The network has, on average, less than two edges between organizations (1.832), which is a short path to reach organisations (the shortest will be one). These measures indicate a dense and cohesive network.

Another group of measures of the network structure refers to “centrality”. Centrality identifies the most important actors in a network, the ones who have more ties connected to other members. For example, the central organisations in the Hunter RENE are the organisations more actively involved with others.

Centrality also identifies isolated actors, those not very well connected to the rest of the actors and belonging to the periphery of the network. It is also possible to identify the "prestige" of an actor depending on the number of ties directed to it. To measure centrality at the group level, which allows comparison of different networks, a centralization measure is used. There are several measures of centrality and a full discussion is found in Wasserman and Faust (1997). For the purpose of this paper four measures are presented: Freeman's Degree Centrality and centralization, betweenness centrality, and Bonacich Power.

Freeman's Degree Centrality measures the degree of activity of each node of the network, and differentiates between "OutDegree" and "InDegree" centrality. OutDegree measures the activity of each actor in interacting with other nodes of the network. In the Hunter RENEED it identifies which organisations are more active in interacting with other organisations. InDegree is a measure of "prestige" in the network. It identifies the nodes that are more frequently nominated by others. In the Hunter RENEED identifies the most and less popular organisations. The higher the value of these indexes the higher the interaction activity and the prestige in the network. Figure 4 shows both indexes in the Hunter RENEED.

Most of the organisations show homogeneity between both indexes, indicating that they are as active seeking interaction as others looking for them, although there are two extreme cases that show big differences between the two indexes. One is "H3", a government development agency, which has the highest prestige index of the network, but a low level of activity in seeking interactions with others. The high prestige index is justified by the fact that the government agency is responsible for many of the funds available for projects of regional development. The second extreme organisation is an educational institution. In this case the highest index corresponds to Outdegree, indicating that this organisation is the most active in seeking interactions amongst network organisations, even though the prestige's index is in the average. This result suggests two interpretations. One is that in the Hunter region being active in seeking interactions does not guarantee a high prestige amongst the other organisations. The other suggestion refers to the possibility that this organisation overestimates its activity efforts in seeking interaction with others. There are three organisations that have a high and homogeneous centrality: "H1" (private development organisation), "H24" (council), and "H5" (NGO). These organisations have high prestige in the network and also are active in seeking interactions. It is also important to note the indexes of "H22", a private organisation which is currently supporting regional projects with several funds. Despite this support, the prestige's index is still in the average group along with organisations with less dollar contribution. This result suggests that funding contribution is not a fundamental variable of prestige in the Hunter RENEED. Prestige in this region could be defined by political and economic power, which explains the highest prestige of "H3" the government agency.

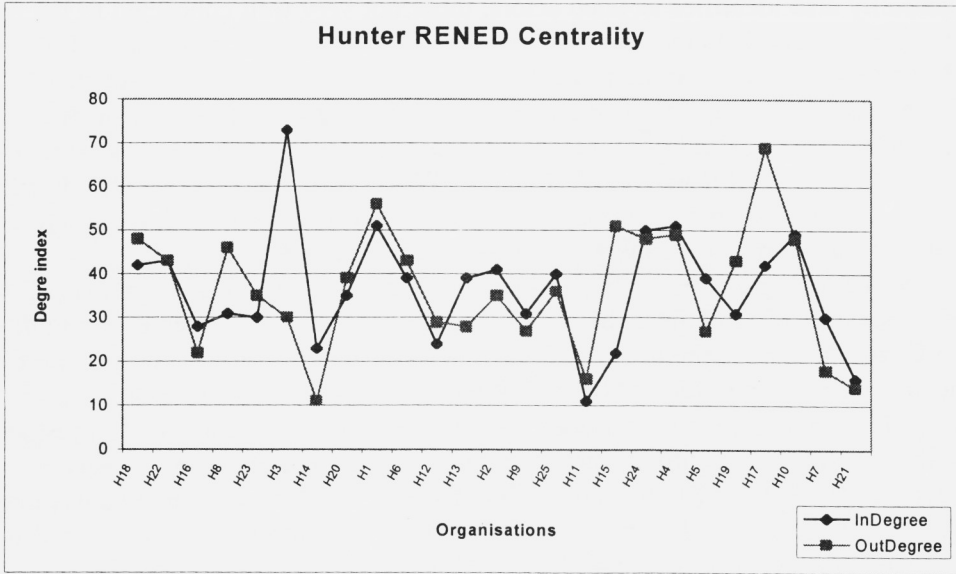


Figure 4. Hunter RENE D- Degrees of Activity (OutDegree) and Prestige (Indegree)

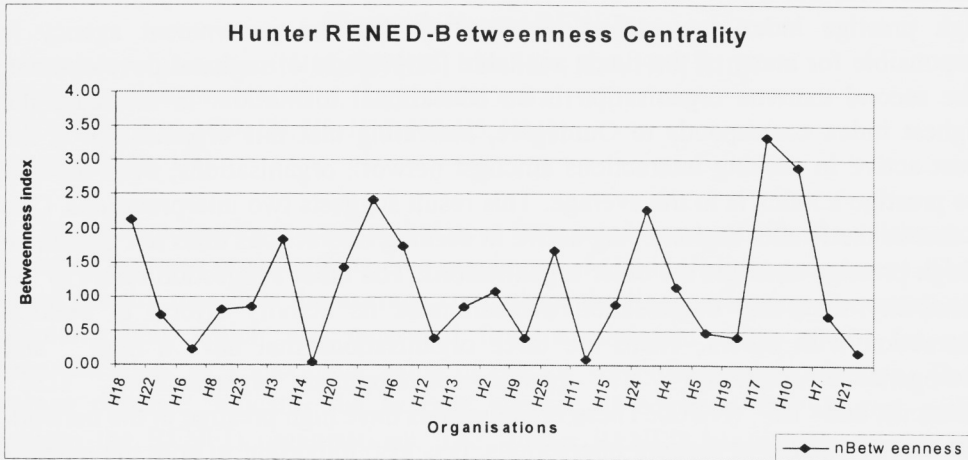


Figure 5. Hunter RENE D- Betweenness Centrality

The network centralization index is (0.289), which indicates a low degree of central actors in the network. The index attains its minimum value of (0) when all nodes in the network are equal. The maximum value of the index is (1) when there is one central node in the network. The Hunter RENE D centralization index shows no single central actor, but several across the network, which appears to show equal members or several leaders than a central organisation as sole leader.

A more strategic measure of centrality is “Betweenness”, which measures control in communication. It measures the degree of a node that is between two others, so for the information flows that node has to pass the information from one to another. Betweenness finds the “gateways” of the network, ie. those organisations in the Hunter region which have strategic positions between other organisations. The higher the index the higher the level of gatekeeping. Some authors suggest that such central nodes play important roles in the network (Shimbel, 1953; Cohn and Marriot, 1958). Figure 5 shows betweenness index for the Hunter RENED.

The figure shows “H17” and “H10” (education government organisations), “H1” (private development organisation) and “H24” (council) as holding the most strategic positions in the network. Notice also that “H22” (private organisation) is in a higher strategic position than the average organisations even though its prestige was not really high.

The Betweenness centralization index for the Hunter RENED is (0.0227), which is a measure of the heterogeneity of the betweenness of the members of the network. The minimum value (0) occurs when all actors have exactly the same actor Betweenness index. The index suggests homogeneity amongst the RENED organisations.

The last measure of centrality is “Bonacich Power”. This index ranks the organisation’s prestige as a weighted sum of the ranks of those organisations who choose that organisation. According to Wasserman and Faust, ‘Large rank prestige or by many others with low to moderate rank prestige’ (Wasserman and Faust, 1997; p.207).

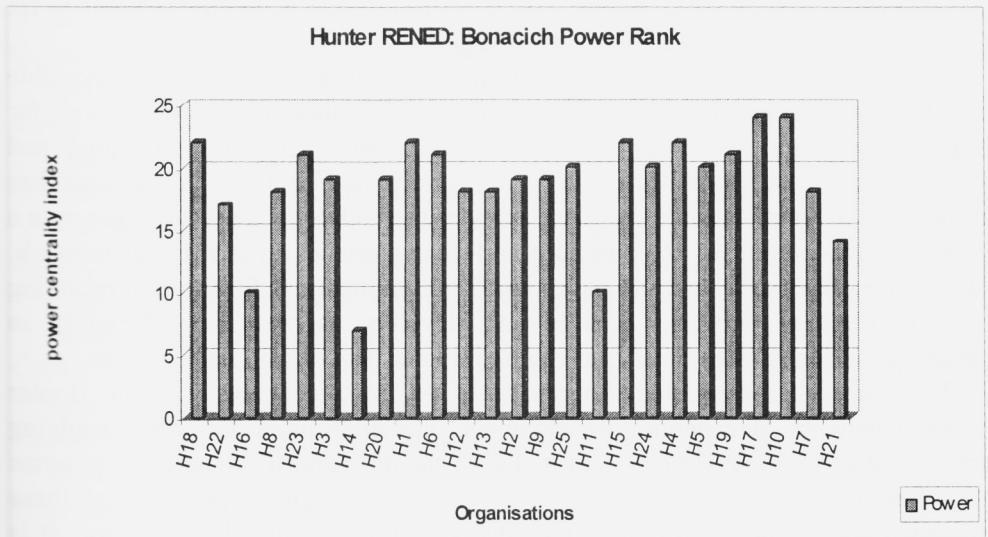


Figure 6. Hunter RENED- Bonacich Power Centrality

Regarding the Hunter RENED, "power centrality" ranks the organisations most frequently chosen for communication purposes. Figure 6 shows this index.

The graph shows the organisations more and less frequently chosen to establish communication. Amongst the highest in the rank appear "H1", "H10" and "H17", organisations already identified as having high centrality in the RENED by the other centrality measures. These organisations, constantly central in the network, indicate an informal leadership role. Power is the most sophisticated centrality measure calculated here and it is understood as a structural characteristic of activity and recognised interactivity of actors in a network.

To summarise, the structure of the Hunter regional network shows a high participation of government organisations (44%) and non-governmental organisations (32%) and a good participation of the private sector (20%). Cohesiveness measures of the network show a high density of the communication links between the RENED organisations, although the strength of the link is not very high (average communication is between casual - less than once a month, and often - once a month). Centrality measures show an emergent informal leadership structure with three organisations (two from the public sector, one from the private sector) being identified by prestige index and as gatekeepers of information flow. These organisations are playing an informal leadership role in a network that shows high homogeneity amongst all its members.

CONCLUSION

Regeneration of regions suffering industrial dislocation has brought the attention of several streams of research in regional economics and regional growth theories. These regions often present networks amongst the public sector, the private sector and the civic society, creating strong socio-economic systems to fix the complex problems impacting on their regions.

The literature has focussed on reporting of this phenomenon and possible effects on the region. However, there is a lack of methodological framework for analysing regional networks in a way that studies could be replicated and longitudinal measures of life cycle of networks could be taken. This paper has argued that the application of network analysis methodology is useful to generate a deeper understanding of the structure and characteristics of a regional network. The nature of network structure have significant implications for the understanding of how regional networks emerge and develop, as well as differences in performance and effectiveness in pursuing regional growth and regeneration.

This paper has presented the results of an organic analysis of the Hunter regional network of economic development. The analysis is performed applying network analysis methodology, and it shows the structure of the network in terms of cohesiveness, homogeneity and leadership fabric. The application of these measures allows the definition of the network capital of the Hunter region. It is suggested that the organic analysis could be used in longitudinal and comparative studies of regional networks, as well as on analysis of effectiveness of the network on affecting the regeneration of the Hunter region.

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