STRUCTURAL HOLES IN HOSPITAL ORGANISATIONS: EXPLORING THE BROKERAGE POTENTIAL OF FACILITIES MANAGERS FROM A SOCIAL NETWORK PERSPECTIVE

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In delivering effective support to health care delivery, the process by which information is exchanged between different non-clinical support services is critical. Using a case study approach and a social network perspective the brokerage role of facility managers in achieving this is explored. The results indicate that when communication exchanges between different non-clinical functional support units are identified and mapped, information brokerage opportunities exist. This increases the strategic influence for facilities management by exposing significant untapped value in the delivery of health-care services.

Keywords: communication network, healthcare facilities management, information brokering, structural holes.

INTRODUCTION

Within the healthcare industry there are different types of facilities used to deliver healthcare to the community. These include small and medium scale facilities ranging from health centres, day procedure units, rehabilitation centres, mental health facilities, to birthing centres and community health centres. On the larger and more complex end of the scale, facilities such as acute and tertiary hospitals are typical. Tertiary hospitals, which are the focus of this paper, are complex healthcare facilities which commonly comprise a full suite of clinical and non–clinical services (Carr, 2008). AHFG(Centre for Health Assets Australasia, 2007:18) defines a tertiary hospital as 'a complex [set] of buildings, structures, roads and associated equipment ... that represents a single management unit for financial, operational maintenance or other purposes'. A hospital organisation is therefore the management structure and resources responsible for the financial and operational maintenance of a hospital facility.

While a hospital organisation's primary aim is to deliver healthcare service to the public, the delivery of non-clinical support services is typically provided by a facilities management (FM) organisation. It is clear that although hospital FM operations are not the front-end services that patients are exposed to, it is nonetheless a critically important function in maintaining effective healthcare delivery (Featherstone and

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Baldry, 2000). The support provided by an effective FM organisation is crucial in ensuring a health facility responds effectively to the many changes in the healthcare operating environment. As Valin and Salter (1996) point out, these changes include: new technologies; new modes of treatment or services which require new functional space; demographic influences that increase demand for services; political changes that affect delivery of health services; the relentless levels of public expectations; epidemic and disease crises; and re-structuring of the hospital organisation, which may necessitate relocation of hospital facilities; facility moves or expansions.

Gathering and channelling critical business information to support the FM function is difficult to achieve in practice (Carder, 1995; Then, 1999). In hospitals these problems are exacerbated by the large, complex, politicised and fragmented nature of hospital organisations which need connecting and coordinating if the hospital infrastructure is to perform effectively (Diamond *et al.*, 2002). As Cameron *et al.* (1995) points out, the FM core team is usually not in a position to demand that other business units share their information. For political and tactical reasons, associated with exerting power over scarce and valuable space-related resources, many individuals with specialised knowledge and information are often unwilling to share it, thereby creating pools of disconnected information throughout an organisation (Stoner and Freeman, 1992). As Leebov and Scott (2002) have pointed out, this can significantly constrain an organisation's capability to respond to changes in health delivery.

The aim of this paper is to explore the extent to which this is true in the health sector and the associated opportunity for facility managers to improve the management of healthcare infrastructure.

BROKERING AND STRUCTURAL HOLES

It is well accepted that FM is a multidisciplinary and cross-functional practice where facilities managers are required to communicate and coordinate with different parts of an organisation (Grimshaw, 1999; Barrett, 2000). This inter-departmental communication and coordination is necessary to ensure that effective solutions to FM problems are integrated across different organisational functions. In effect, FM is a 'strategic brokerage' activity aimed at coordinating a wide range of FM support services to ensure the effective operation of any core business (Akhlaghi, 1996; MacDonald and Price, 2007) .

The notion of information brokerage can be traced back to two schools of thought. The first school adheres to the 'network closure' perspective as advocated by Coleman (1990) who argues that dense connections between network members are useful for creating trusting relationships and control benefits. The second school is strongly influenced by Burt (1992) who, as a network theorist, uses the 'structural hole' to describe an abstraction of gaps in information flow between different clusters of people. Burt (1992:18) defined a structural hole as: 'a relationship of non-redundancy between two contacts. The hole is the buffer, like an insulator in an electric circuit. As a result of the hole between them, the two contacts provide network benefits that are in some degree additive [instead of] overlapping'. In simple terms, if a hole is redundant it means that the connections across are not needed for the effective functioning of an organisation or the necessary information can be provided through other equally effective and efficient routes. However, if they are non-redundant, new direct connections are required and are the most efficient way to ensure an organisation operates effectively. In short, structural holes are places where people are unconnected in an organisation, disrupting the flow of information needed to make it function effectively (Monge and Contractor, 2003). While this can be a problem for organisations, it also holds untapped value adding potential which can be released through brokerage activities that represent new entrepreneurial opportunities for those who can facilitate them.

The identification of structural holes in organisations is primarily based on indicators of structural autonomy (Burt, 1992). This explains how access to information is limited or facilitated through connections to other network members. For example, a structural hole may appear to exist when one considers direct connections but information may be able to flow to actors around the hole through other less direct connections – albeit far less efficiently. To demonstrate the concept of a structural hole, Burt (1992) employed three algorithms known as effective size, efficiency, constraints.

According to Taylor and Doerfel (2003), effective size is a measure which indicates the ability to access other network members beyond the initial contact of a focal network member. Effective size thus ranges from one to the number of observed contacts in the network. If for example, an actor is able to access all other contacts then the potential for brokering structural holes is high. Efficiency, on the other hand, measures the number of non-redundant contacts that can be leveraged to maximise value yield by brokering a hole (Burt 1992a). For example, if there are many non redundant contacts around a hole then the potential to extract value from brokering it, is greater. Efficiency measures range from zero to one, where one indicates that every contact is non-redundant to a focal network actor, down to a minimum approaching zero that then indicates high contact redundancy and therefore low efficiency. Constraint is a measure to indicate the degree to which an actor's contacts are connected to each other. In this sense, high constraint means that an actor's contacts are already connected together and therefore there is lower opportunity to broker them. By contrast, a low constraint score reveals a potential to broker the actor's contacts given that they are not yet connected to each other. These three measures when taken together become proxies for highlighting the brokerage potential of a network member.

Network density and structural holes

Network density reflects the proportion of ties present, relative to those that are possible (Wasserman and Faust, 1994). The density of a communication network is a value that ranges from zero to one. A zero value reveals that no communication occurs between actors, whereas the maximum value of one indicates that all the actors in a network communicate with each other. A high density value implies that the network is cohesive and is likely to exhibit lower numbers of structural holes. However, as Cross *et al.*. (2002) argue, a fully connected network is not desirable because the time and energy needed to maintain the relationships is obstructive to efficiency. The idea, therefore, is to invest in developing and maintaining relationships that have strategic value (are non-redundant). In addition, a large number of communication linkages does not necessarily provide a manager with a higher degree of social capital. As Leenders and Gabbay (1999) have argued, social capital is conveyed by a network position only when the relationships work to assist the network member in the attainment of goals.

Centrality

Centrality measures the extent to which an actor is central to communications. There are two measures which are useful for detecting structural holes: degree centrality and 'betweenness' centrality. Degree centrality measures the number of communication ties attributed to a network member. Hence, a member with a large degree centrality can be described as being in direct contact with many others, acting as a hub for information flow, and occupying a central role within a network (Wasserman and Faust, 1994). In contrast, members with low degree centrality are peripheral to the network and at times may be relatively isolated from the rest of the network members. Networks with higher centrality are unlikely to have as many structural holes since more communication goes through fewer actors. For example, when everything goes through one central person then it is easy for actors to access information to the same extent as everyone else in the network. 'Betweenness' centrality refers to the extent to which a network member lies between other network members in the flow of information. It shows the contribution to the flow of information based on an actor's location within the network and therefore measures positional advantage in a network for shifting information. A network member with high 'betweenness' centrality is in a strategic position to act as a broker between members separated by a structural hole.

METHOD

The brokerage potential of facilities managers in the health care setting was explored using a case study approach. The case study was a tertiary hospital with a capacity of 975 beds. It offered a comprehensive range of medical, surgical, orthopaedic, rehabilitation, obstetric and paediatric services and was located in the western metropolitan area of Sydney, Australia, which has a population of 1.5 million people. The Hospital houses a Dental School and a unit for emotionally disturbed children. Hospital's patients are admitted by referral and through an extensive Accident and Emergency department. Nearby the hospital are 14 multi-storey staff residential buildings that accommodate 540 people. The Hospital further provides staff recreational facilities such as a clubhouse, swimming pool and tennis courts.

Relational data to construct the FM organisation communication network was collected using a snowball sampling approach which is a typical method used to collect relational data in social network research (Wasserman and Faust, 1994). As the name implies, network actors are identified using an initial set of actors (first order) who are asked to provide nominations of other contacts (second order) who are in turn asked to do the same etc. The core group in this case was the executive FM group. The list of contacts can grow quickly when using this approach and where contacts are repeatedly nominated the process stops. In line with the snowball approach, a socio-metric survey questionnaire was developed to collect this relational data from each person nominated. The first question of the questionnaire asked respondents to indicate the names of key contacts from other departments with whom they communicated on a range of FM issues which were defined. The second question required respondents to indicate the departments of the nominated contacts. The third question indicated the frequency of communication using a scale of 1 to 5 (infrequent to very frequent), allowing the strength of ties between actors and their departments to be established. The fourth and last question required respondents to indicate the subject matters of communication for each respective contact they had identified across a predefined list of options and the value attached to each.

Using a snowball approach to collect network data often results in the problem of analysing the boundaries of the network structure. This in turn creates a problem regarding the inclusion of actors for the network structure. The problem of specifying a network boundary can be resolved by either approaching it from a realist or nominalist stance (Laumann, *et al.*, 1992). Under the realist approach, the boundary is based on the natural occurring boundary that is created by the actors themselves. Alternatively, under the nominalist approach, when a natural boundary is not present, researchers can impose a conceptual framework constructed to serve the analytical purpose of the study (Laumann *et al.*, 1992). The latter approach was used in this study since there was no predefined limit that was applicable. In this sense, it is important to first classify and identify the different actors to differentiate the diverse groups. In any organisation, different occupational clusters emerge through natural workgroup boundaries. According to Longest, Rakich and Kurt (2003), hospitals can be grouped into distinct groups as listed below:

1. Governing body
2. Senior management cluster including Chief Executive Officer
3. Administration and corporate services cluster (can be clinical and non-clinical staff)
4. Clinician cluster (clinical staff)
5. Nursing cluster (clinical staff)
6. FM group of services cluster (non-clinical)

Since this research focused specifically on the core set of actors within the FM group, the above list allowed nominated actors to be assigned into occupational clusters and hence provided a normative boundary to the overall communication networks captured. Actors that were outside the core FM group were considered as external actors to FM operations. However, this does not signify that the external players were not important to the communication networks. Whenever such actors were identified by others as highly critical to the nature of FM operations, such actors were included in the analysis.

DISCUSSION OF RESULTS

One hundred and eighteen nominations were collected from the social metric survey. These nominations stretched across diverse functional units and hierarchy levels. A breakdown of the number of contacts across diverse groups is shown in Table 1.

Table 1: No of actors within different clusters

	Clusters	No. of Nodes
1	FM core group	15
2	Senior Management	11
3	Clinical Senior Management	5
4	Clinical Services	12
5	Non-Clinical Support Services	75
	Total number of nodes	118

These 118 nominations were assigned into clusters based on their functions in the hospital to represent occupational groupings. The resultant communication network is illustrated in Figure 1 and the acronyms are defined in Table 2.

Table 2: Acronyms used within the communication network

Services Category	Functional Unit /Services	Acronyms Name of Departments
FM Directorate	Corporate Services	CorpServices
Estate management services	Maintenance Operations	MaintOps
	Energy Management	EnergyMgt
Environmental management services	Environmental Services	EnvServices
	Fire Safety	FireSafety
Hotel services	Food Services	FoodServices
	Linen Service	LinenSvc
Site support services	Security	Security
	Telecommunication	Telecommunication
	Portering	Portering
	Accommodation	Accommodation
Business support services	Transport	Transport
	Information Technology Department	InfoTechDept (ITD)
	Supply Services	SupplyServices
Space management support services	Facility Development Unit	FacDevtUnit

The network in Figure 1 was created using UCINET 6 (Borgatti et al., 2002), which was the software used to analyse the data. UCINET is a widely used social network analysis software that generates an E-I Index, a structural holes index and a betweenness and degree centrality index for any input network. In Figure 1, the communication linkages of the FM core team (circular shaped nodes) reveal that they extend out laterally and vertically towards different functional units and hierarchies. The communication ties between the FM core team and senior management of administrative and clinical services (square and triangular nodes) are also evident.

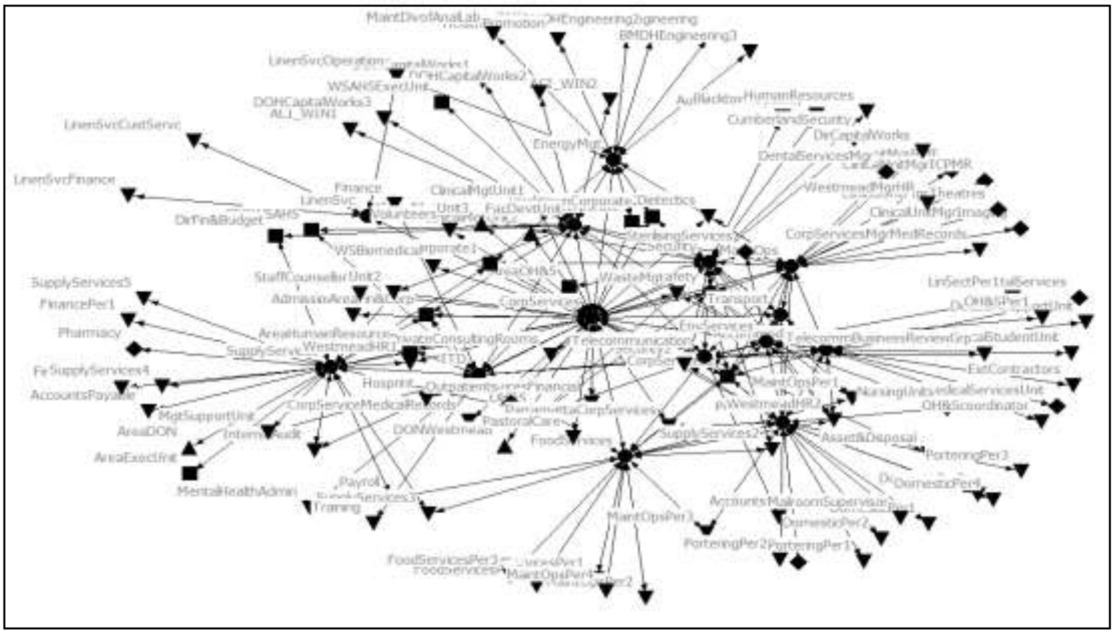

Figure 1: Communication linkages of FM core team and external groupings

The results of the social network analysis show that the central segment of the network coalesced departments which were highly active in FM communications. The overall network centralization was 61.54%. This implies that the communication network was moderately concentrated on a few departments.

It should be noted that network centralisation reaches 100% when there is only one central actor in a network. This means that, overall some departments had better positional advantages. Notably, Corporate Services was the key broker in the network. Other brokers included Maintenance Operations, Telecommunication and Environmental Services. This is summarised in Figure 2.

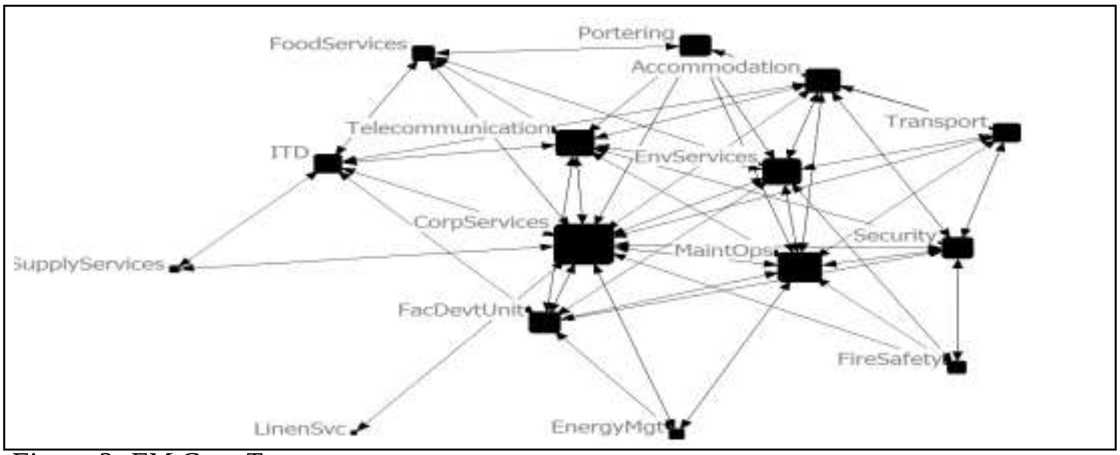

Figure 2: FM Core Team

In contrast to the central segment, the network periphery contained FM services such as Supply Services, Linen Service and Energy Management which were less active and had lower numbers of linkages. Their positions implied a lower potential to broker the other departments within the FM core team. In contrast, these positions were useful in spanning the FM boundary and connecting to other parts of the hospital.

Error! Reference source not found. shows the degree centrality results which show that the four central FM services were maintenance operations, corporate services, telecommunications and environmental services. These central actors within the FM communication network were therefore strategically positioned to take advantage of any brokerage opportunities.

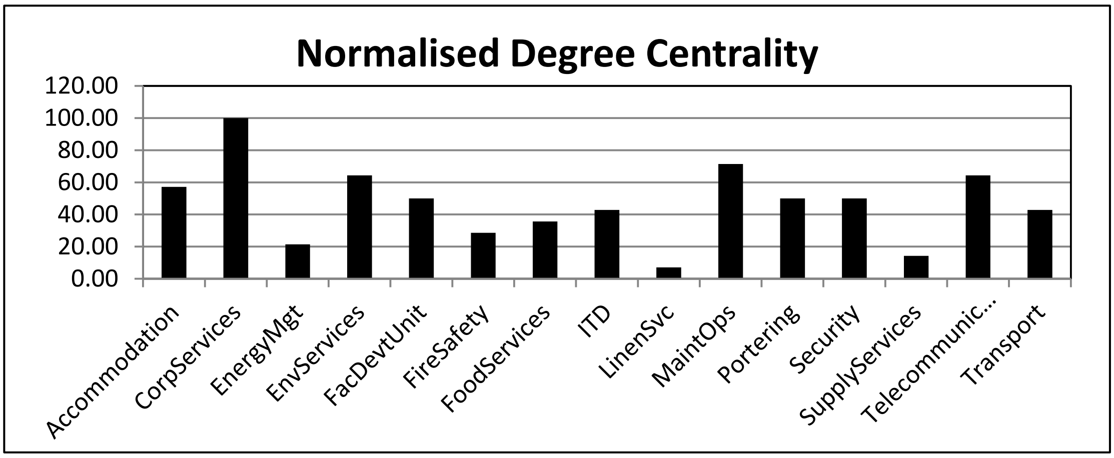

Figure 3: Normalised degree centrality of FM core team

The density of the network was found to be 33% indicating significant brokerage potential in that many actors and departments within the FM core team were not communicating. This was supported by the data in Table 3 which illustrates measures of structural hole potential using the indicators of effective size, efficiency and constraints as discussed above.

Table 3: Structural holes results of core FM core team

	Effective Size	Efficiency	Constraint
Corporate Services	11.29	0.81	0.21
Maintenance Operations	6.27	0.63	0.36
Telecommunication	5.31	0.59	0.37
Environmental Services	4.87	0.54	0.41
Accommodation	4.80	0.60	0.37
Information Technology	3.88	0.65	0.42
Facility Development Unit	3.70	0.53	0.42
Security	3.27	0.47	0.44
Portering	3.26	0.47	0.45
Food Services	2.36	0.47	0.52
Transport	2.35	0.39	0.47
Fire Safety	1.38	0.34	0.56
Energy Management	1.12	0.37	0.60
Supply Services	1.10	0.55	0.68
Linen Service	1.00	1.00	1.00

The results in Table 3 show that the effective size of Corporate Services was the largest at 11.29 (which means it has extensive contacts), the contact efficiency of Corporate Services was highest at 0.81 (which means that it has a high degree on non redundancy in its network) and its constraint was lowest at 0.21 (which means its connections are not connected to each other through alternative paths). This data indicates that there was no lack of structural holes surrounding the contacts of Corporate Services within the FM communication network. Moving to the next set of potential brokers within the FM communication network, Table 3 shows that Maintenance Operations, Information Technology Department and Accommodation, Telecommunication and Environmental Services possessed moderate values of effective size and efficiency compared to Corporate Services. When compared to the rest of the network members, such as Supply Services and Linen Service, their network positions had lower numbers of non-redundant contacts. Additionally, the constraint values of these departments were found to be moderately low. Hence, this set of FM services possessed brokerage opportunities within the FM communication network. It is also important to state that the efficiency and constraint value of 1 should be interpreted with caution because it is based on linkage with a single other contact which is Corporate Services (see Figure 2). Hence, an efficiency and constraint value of 1 will be obtained since all its contact will be non-redundant and lead back to a single member.

Table 4 shows the betweenness centrality of members of the FM core team. There was a lot of variation in the betweenness results among the departments (values ranging from 0 to 33.49). There was also high variation across the mean values (standard deviation = 8.10 relative to a mean betweenness of 3.73). This indicates considerable difference in brokerage potential between the different departments. The betweenness value for Corporate Services was the highest in the communication network, showing that it was positioned between many other actors. At the lower end of the table, the zero value for Energy Management, Supply Services and Linen Service showed that they were not located between others in the network. As shown in Figure 2, these departments were positioned on the periphery of the network because of their lack of communication contacts within the FM core team.

Table 4: Betweenness centrality of actors in FM core team

Actors		Betweenness
Corporate Services		33.493
Maintenance Operations		5.51
Environmental Services		3.7
Telecommunication		2.91
Information Technology Department		2.617
Facility Development Unit		2.343
Accommodation		1.96
Security		1.583
Portering		0.95
Food Services		0.45
Transport		0.343
Fire Safety		0.143
Energy Management		0
Supply Services		0
Linen Service		0
		Betweenness
1	Mean	3.733
2	Std.Dev.	8.104
3	Sum	56
4	Minimum	0
5	Maximum	33.493

CONCLUSIONS

The aim of this paper was to explore the brokerage potential of facilities managers in the health care sector. Using structural hole theory and social network analysis we have demonstrated a way to do this using a single case study of a large tertiary hospital in Australia. Actors in FM networks that have high betweenness centrality, high effective size, high efficiency and low constraint in their social networks have high potential to take advantage of the non redundancy that surrounds them. Although one cannot generalise from the results of this single case study, they do suggest that the structure of FM teams in hospitals may contain significant structural holes and potential for improved efficiency and effectiveness through their brokerage. This needs to be further investigated using these techniques, given the importance of health care infrastructure to the quality of health care delivery in communities.

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