

This is the manuscript of:

Cooke, L. & Hall, H. (2013). Facets of DREaM: a Social Network Analysis exploring network development in the UK LIS research community. *Journal of Documentation*, 69(6), 786-806.

It was accepted for publication on 12 December 2012. This version can be downloaded from:
<http://www.iidi.napier.ac.uk/c/publications/publicationid/13374039>.

The published version is available from Emerald at:
<http://www.emeraldinsight.com/journals.htm?issn=0022-0418&volume=69&issue=6>.

Facets of DREaM: a Social Network Analysis exploring network development in the UK LIS research community

Author Details

Author 1 Name: Louise Cooke

Department: Department of Information Science

University/Institution: Loughborough University

Town/City: Loughborough

State (US only):

Country: UK

Author 2 Name: Hazel Hall

Department: Centre for Social Informatics

University/Institution: Edinburgh Napier University

Town/City: Edinburgh

State (US only):

Country: UK

Corresponding author: Louise Cooke

Corresponding Author's Email: l.cooke@lboro.ac.uk

Acknowledgments

The authors wish to acknowledge the Arts and Humanities Research Council (AHRC) and the Library and Information Science (LIS) Research Coalition. The AHRC provided funding to Edinburgh Napier University for the Developing Research Excellence and Methods (DREaM) project, and the project benefited from the support of the member bodies of the LIS Research Coalition. We are also grateful to Professor Charles Oppenheim for his contribution to the work of the DREaM project, and his constructive feedback on an earlier draft of this paper.

Biographical Details (if applicable):

Louise Cooke is Senior Lecturer and Director of Postgraduate Studies, as well as MSc Information and Knowledge Management Programme Leader in the Department of Information Science at Loughborough University. Her research interests include the use of social network analysis as a methodological approach in the information sciences.

Professor Hazel Hall is Director of the [Centre for Social Informatics](#) within the [Institute for Informatics and Digital Innovation](#) at Edinburgh Napier University. Between August 2009 and July 2012 she led the implementation of the UK [Library and Information Science Research Coalition](#). She is the Principal Investigator of the DREaM project.

Structured Abstract:

- **Purpose** This paper reviews the value of Social Network Analysis (SNA) as a method appropriate to LIS research. SNA is used to investigate the effectiveness of a framework of methods adopted by the DREaM project to develop researcher-practitioner networks.
- **Design/methodology/approach** Following review of literature on SNA, the paper reports longitudinal research from a whole population sample of the DREaM cadre of LIS researchers. Data were collected using a questionnaire at the start of the first

DREaM project workshop, and at the final workshop. Data were analysed using Ucinet 6 software, and network diagrams were visualised using the Netdraw package.

- **Findings** Findings demonstrate that the combination of linked workshops and use of social media throughout the DREaM project was successful in increasing the density of the researcher networks, forging new connections among participants. SNA was found to be a useful technique in investigating network development.
- **Research limitations/implications** There is scope for further longitudinal research to investigate the sustainability and strength of the new network links forged.
- **Originality/value** The use of SNA in the context of the development of researcher networks is novel in LIS research. The findings from this project indicate the potential of the DREaM methodology as a replicable framework for developing further research networks in other contexts. This paper represents a unique contribution in demonstrating through the use of SNA the extent of the extension of research networks afforded by the DREaM methodology.

Keywords: Social Network Analysis, SNA, Library and Information Science Research Coalition, practitioner researchers

Article Classification:

Research paper

Facets of DREaM: a Social Network Analysis exploring network development in the UK LIS research community

Introduction

Social Network Analysis (SNA) is a research approach that focuses on relationships among social entities, and the patterns and implications of these relationships (Wasserman and Faust, 1994). The purpose of this paper is to review the value of SNA as a method appropriate to research in the domain of Library and Information Science (LIS). In addition to offering a

brief overview of the academic antecedents of modern-day SNA, the relevance of SNA to LIS research is illustrated through the presentation of a case study.

The case of the Developing Research Excellence and Methods (DREaM) project demonstrates how SNA may be deployed to evaluate the development of professional networks. In this instance a new network of LIS researchers – the DREaM network, made up of a mix of researchers, doctoral students and practitioner researchers – is considered in the context of specific interventions aimed at increasing and strengthening network ties among participants. Data from other sources, including a ‘before and after’ audit of network members’ skills and participant feedback on a series of face-to-face network events, serve to supplement the SNA output and strengthen the evidence base on the effectiveness of these interventions. The work discussed offers a useful model for nurturing and assessing network development that is applicable to, or may be adapted for, a broad spectrum of professional contexts.

Context

The broad inter-disciplinary nature of the LIS domain has led to a fragmentation of research in the field, with numerous bodies and individuals active in similar and related areas of research. Furthermore, there has traditionally been a lack of connection between those involved in LIS practice and those active in researching the domain, to the extent that each community is often unaware of the other’s efforts. Recognition of this fragmentation and the resulting disempowerment of the LIS research community, particularly with regards to access to research funding, was a core theme of a special event held in 2006 in memorial to Brian Perry, Director of the British Library’s Research and Development Department from 1984 until 1995 (see *Library and Information Research*, 2007). This recognition subsequently prompted action amongst some key players, including the British Library and the Chartered Institute of Library and Information Professionals (CILIP). As a result the Library and Information Science Research Coalition was formally established in 2009. Led by Professor Hazel Hall, the broad mission of the Coalition was to ‘facilitate a co-ordinated and strategic approach to LIS research across the UK’ (Library and Information Research Coalition, 2011a). As part of this mission, a strategic objective was to promote LIS research capacity in the UK. The Coalition aimed to do this, in part, by bridging the gaps between LIS practitioners and LIS academics, thereby encouraging a research-led approach to LIS practice (Library and Information Research Coalition, 2011a).

With funding from the Arts and Humanities Research Council (AHRC) awarded to Hall in late 2010, the Coalition was presented with an opportunity to operationalize its aim to develop a UK-wide network of LIS researchers through the Developing Research Excellence and Methods project (DREaM) [1]. The project began in January 2011. One of its goals was to facilitate the development and implementation of innovative methods and techniques for undertaking LIS research (Library and Information Research Coalition, 2011b). Five DREaM project events took place over a period of twelve months in 2011/12. These included a series of three linked workshops framed between a launch conference in July 2011, and a concluding conference one year later.

The workshops were designed to introduce LIS researchers and researcher-practitioners to qualitative and quantitative methods less commonly deployed in LIS Research. They were offered as a set of three to the *same* individuals. This group of participants comprised new and more experienced LIS practitioners from a range of different sectors, PhD students, and members of the LIS academic community. The decision to offer the workshop series only to those who were committed to attend all three over the seven month period was a deliberate strategy to encourage network cohesion. It was hoped that the focus on these individuals would create a network core, and that these LIS researchers would then independently sustain the network beyond the term of the project itself. These 33 individuals became known as the DREaM workshop cadre [2]. Other interventions to nurture cohesion amongst the cadre members included making provision for: (1) face-to-face social interactions on the evenings before and after each of the workshops (for example, the night before the last workshop in Edinburgh almost one third of the participants met for a meal together in a city pub); (2) easy online interactions between group members before, during and after each event (for example: there was a Twitter list for all DREaM event participants and a set of Twitter hash tags for the full series of DREaM events; all sessions were previewed, amplified, reviewed and archived online; and an online community was set up on Spruz [3] and managed for all associated with the DREaM project); (3) participants to lead elements of the workshops themselves (for example, each workshop included an ‘unconference half hour’ slot for individuals to give short updates on their research, and the last workshop exercise was designed so that the more experienced participants acted as team leaders for the discussions); (4) a subset of the group to be responsible for writing and posting blogged reviews [4] of the workshops within a week of event delivery.

SNA was one of the research methods introduced at the first of the three linked workshops in October 2011. In order to enliven the session, and to give a practical illustration of the potential uses and outcomes of the technique, the session presenter (Louise Cooke) undertook

an SNA exercise whereby the workshop participants themselves acted as data subjects. This demonstrated the practical application of SNA with live data to which all the participants could instantly relate. The exercise also provided the first set of data for the empirical work discussed in this paper. The same data collection exercise was repeated at the final session of the three linked workshops in April 2012.

It was hypothesised that the analysis of the two sets of data (i.e. that from October 2011 and April 2012) would reveal changes in (a) levels of integration among the different groups of participants within the DREaM cadre, and (b) network density among the group as a whole. The anticipated outcome was that integration and network density would increase. If this proved to be the case, then it would be possible to propose that (a) the specific model of network development adopted in the linked workshops is an effective methodology for developing professional networks, and that (b) this model could be replicated in other professional contexts. Although the use of SNA and theories about network development has a long history, it is believed that this is the first use of SNA specifically in an LIS context such as this. It is therefore worthwhile to situate findings of our research within the context of SNA. This is presented below.

Networks, social networks and social network analysis defined

In sociology a 'network' comprises of individuals, collectives or roles tied together in a social relationship (Marshall, 1998). Examples of such 'social' relationships include kinship, community structure, communication, friendship, authority, interlocking directorships or sexual contact (Marshall, 1998; Scott, 2000). They may focus on a person, a group, an organisation or a set of organisations (Monge, 1987). Such relationships can be examined through SNA, described by Scott (2000, p.37) as 'an orientation towards the social world that inheres a particular set of *methods*'. Structural or relational data is gathered from a community to test social and/or behavioural theories. The core theoretical concepts about a group's or a social system's relational structure can then be translated into formal definitions expressed in relational terms and patterns (Wasserman & Faust, 1994). The properties of the relational structure of the operating environment help the researcher understand the characteristics of the units under investigation and make formal statements about them. In the case reported here, SNA was used to explore social interaction and 'knowledge awareness' relationships among individual members of a new community: the DREaM cadre.

The strength of SNA lies in its facility to make sense of aspects of social organisation that cannot be adequately explained by collecting data on *individual* behaviour or attributes. It

overcomes the problems of validity associated with scaling up aggregates of individual attributes and perceptions in an attempt to represent the larger unit of analysis. Taking into account relations or higher order collective attributes through the use of SNA can provide a more representative picture of the system under investigation (Monge, 1987). It is argued that a social network approach is also useful in dealing with complexities associated with attempting to integrate several levels of analysis; in understanding how social structure is created through individual action; in determining how social structure constrains individual and collective action; and in explaining how attitudes and behaviours are determined by the social context in which action takes place (Marsden & Lin, 1982). SNA can be applied to many different areas of study (Molm, 1997). An extensive list of possible applications is suggested by Wasserman and Faust (1994), who identify topics ranging from the study of personal beliefs to the world economic system. The case study described in this paper demonstrates how SNA can be applied to analyse network development in a specific professional group: LIS researchers.

Pioneers of SNA

Wasserman and Faust highlight the contributions of a number of disciplines to the development of SNA when they state that the ‘concepts of SNA developed out of a propitious meeting of social theory and application, with formal mathematical, statistical and computing methodology’ (Wasserman & Faust, 1994, p. 10). Indeed, the origins of SNA have been traced back to Euler’s development of mathematical graph theory in the first half of the eighteenth century (Otte and Rousseau, 2002). According to Scott (2000), contemporary SNA developed from three traditions led by:

- (1) sociometric analysts interested in small groups and group theory (this group included key figures such as Moreno, Lewin, Heider, Cartwright and Harary);
- (2) Harvard researchers in the 1930s and 1940s, inspired by the work of the French sociologist, Durkheim and the British anthropologist Radcliffe-Brown, interested in relationships and the formation of cliques. (This group included Warner and Mayo, whose involvement in the studies at the Hawthorne electrical factory in Chicago was critical to the development of SNA through their use of sociograms to understand and represent group structure) ; and
- (3) Manchester anthropologists (including names such as Barnes, Mitchell, Bott and Gluckman) interested in community relations in tribal and village societies.

The individuals in each of these groups were mainly sociologists, social anthropologists (Scott, 2000) and social psychologists (Wasserman & Faust, 1994). Given the multidisciplinary nature of LIS research and its dual tradition of borrowed theory from, and the export of theory to, other fields such as computer science, engineering, business and management, sociology and cultural studies (Hall, 2003, pp.287-288; Cronin, 2008; Cronin and Meho, 2008) it is appropriate to consider how SNA may be applied to this domain.

Although members of the Harvard group were contemporaries of the small group of sociometric researchers noted in (1) above, it would appear that neither community was aware of the other's work in the 1930s and 1940s (Scott, 2000). It was not until the late 1940s that the two strands of research were brought together by George Homans, who attempted to synthesise small group research using Moreno's sociometry as a framework for applying theory to social situations at the same time as re-examining the work of the Harvard researchers (Homans, 1951). Scott explains that 'Homans' main concern was with the internal system, which he saw as a more scientific concept than that of the information organization to which it referred. His interest, therefore, was in the scientific elaboration of the insights of research on informal organization by translating these insights into propositions about the structure of internal systems' (Scott, 2000, p.25). Homans made hypotheses about why people interact together to create internal systems and cliques. Later on Homans' work became identified with social exchange theory (also of interest to LIS researchers: see for example Cronin, 1995) as he became interested in behaviourist and rational choice models.

The interests of the last group highlighted above, i.e. the Manchester anthropologists, in configurations of relationships were relevant to their research on the exercise of conflict and power. In particular, they found the traditional focus of describing social organisation in terms of institutions (e.g. religion, politics, kinship) did not sufficiently facilitate understanding of the behaviour of individuals in complex societies (Wasserman and Faust, 1994). They focused therefore more on *ego-centered* networks than 'global' features of networks in relation to particular aspects of social activity such as political ties, kinship obligations, friendship, work relations etc. In the case of the empirical work discussed in this paper, the focus falls on two aspects of the individuals' ties with one another in terms of (1) social interaction and (2) 'knowledge awareness', and what these reveal about the nature of the network as a whole.

Of this group it is perhaps the work of J. Clyde Mitchell (Mitchell, 1969; 1974) that has most relevance to contemporary SNA and exchange theory. Drawing on the combination of a

framework of sociological concepts and the mathematics of graph theory, his work focused increasingly on the *structural* properties of social organisation (Scott, 2000). Although he wrote about total networks Mitchell believed that it was only possible to research partial networks: an individual network should be seen as one part of a total network. Thus, for example, the network of DREaM cadre participants is situated within the wider network of over 200 individuals who engaged with the DREaM project in its 18-month duration. This itself is a subset of the wider community of UK LIS researchers, which in turn is part of a wider community that extends beyond the UK and includes library and information practitioners. Scott (2000, p.30) paraphrases the work of Mitchell in 1969:

Such interpersonal networks ... are built from two different ideal types of action that combine in varying ways to form concrete interaction networks. There is, first of all, 'communication', which involves the transfer of information between individuals, the establishment of social norms, and the creation of a degree of consensus. On the other hand, there is the 'instrumental' or purposive type of action, which involves the transfer of material goods and services between people. Any particular action will combine elements of both these ideal types and so particular social networks will embody both a flow of information and a transfer of resources and services.

According to Scott (2000, p. 310) Mitchell identified three concepts to describe the *quality of relations* in interpersonal networks: (1) reciprocity; (2) intensity; (3) durability. Some, but not all of these, involve transactions or exchange. He also worked on two concepts from graph theory and applied them to networks. The first of these is density, i.e. the completeness of the network. A network is counted as 'complete' if all possible relationships are active. The second concept adopted from graph theory is reachability. This refers to the ease with which members of the network can connect with one another. It will be seen below that the analysis of the DREaM cadre network discussed in this paper pays particular attention to the question of network density.

The three traditions described above (the early sociometric analysts, the Harvard small group researchers, and the Manchester anthropologists) were brought together by Harvard theorists in the 1960s and 1970s to forge contemporary SNA (Scott, 2000). The Harvard group insisted on the study of social - rather than individualistic - concepts and employed 'block modelling' for network members sharing the same pattern of contacts (Marshall, 1998). It was led by Harrison White whose influence spread as his colleagues and students disseminated the group's ideas (Scott, 2000). For example, the International Network for SNA [5] was founded at Toronto by Wellman, a former student of White. With the publication of work by

Granovetter (1973) on the impact of an individual's networks in job-seeking, SNA attracted interest from a wider audience, perhaps because Granovetter's work was not mathematical (Scott, 2000). At this point the possibilities for the application of SNA in corporations were raised, and the technique has subsequently been adopted with enthusiasm by consultancy organisations (Cross & Parker, 2004; Kilduff & Tsai, 2003; Scott, 2000).

Output of social network analyses

The data sought when using a SNA approach are unlike those collected using mainstream social or behavioural research methods (Wasserman & Faust, 1994). In particular, the term 'actor' in SNA can refer to both groups of individuals and single individuals (Wasserman & Faust, 1994), or indeed to inanimate objects, and it is perfectly feasible to study a network without reference (at all) to the attributes of the individuals involved. It is the ties that bind the actors (collectively known as 'relations'), rather than the actors per se, that are of primary importance (Wasserman & Faust, 1994; Hanneman & Riddle, 2005). Using a social network approach offers a number of advantages to researchers, particularly with reference to units of analysis, levels of analysis, aggregation, disaggregation and cross-level influences (Monge, 1987). For example, theories can be tested at the levels of dyads (two actors and their ties), triads (three actors and their ties), sub-groups and groups (Wasserman & Faust, 1994). It is however argued that SNA puts constraints on data analysis and modelling due to its focus on structural variables, rather than independent social actors (Wasserman & Faust, 1994). Nevertheless, it is perhaps a valid alternative to aggregating individual perceptions into a whole or asking respondents to a survey to arrive at a consensual view of their organisation (Monge, 1987).

The output of research employing SNA encompasses discussion of features of network articulation and measurement, relational ties and network roles. With regard to network articulation and measurement, a social network is a 'finite set or sets of actors and the relation or relations defined on them' (Wasserman & Faust, 1994, p. 20). Network articulation is the process of identifying the components of a network and sometimes the sole focus of SNA (Monge, 1987). Studies may consider *egocentric* networks, which usually depend on individual reports of networks; *systemic* networks, which are constructed in the basis of data from all participants in the network; or *diffusion*, which examines the shape and form of flows within the network (Marshall, 1998). The articulation results in the production of network models which conceptualise the network structure (be it, for example social, economic, political etc.) as patterns of relations shared by actors (Wasserman & Faust, 1994). This is done by arraying relationship links in a table as a sociomatrix, and then processing the data

into a sociogram (Marshall, 1998). In this graphic the actor set is represented as points, nodes or vertices and its relations as lines, linkages, arcs or edges (Monge, 1987). The patterns of connections in the system are described using concepts from graph theory (Wasserman & Faust, 1994; Marshall, 1998; Scott, 2000). As well as employing graph theory, social network analysts use statistical and probability theory and algebraic models for the purposes of network measurement (Wasserman & Faust, 1994). A summary of commonly measured network features is given in Table 1.

Table 1: Commonly measured network features

Network feature	Identified by examining
Network size	at the actor level - the number of linkages an actor has. at network level - the total number of linkages in the network.
Network reachability	the accessibility of points of the network based on a notion of 'path', i.e. the connected sequence of linkages by which it is possible to move from one point to another in the network. a point is <u>reachable</u> when there is a path between points.
Network density	the degree to which actors are linked to one another. parts of a path are dense if each of its points is reachable from every other.
Network centrality	the degree to an individual actor is near others in the network and the extent to which the person lies on the shortest path between others and thus has potential for control over their communication.

(Source: Monge, 1987, pp. 245-246.)

The description presented thus far could give the impression that SNA is concerned mainly with quantitative data analysis. This may be the case at the *network* level. However, in general, 'network analysis consists of a body of qualitative measures of network structure' (Scott, 2000, p.3). This is demonstrated when SNA is used to examine specific relational data

to discover the properties of systems of agents in a network. The study of relational ties allows the researcher to examine the transfer or flow of resources between actors (Wasserman & Faust, 1994). The unit of measurement is the property of those who hold the tie (Wasserman & Faust, 1994). These ties may comprise material transactions, flows of resource or support or affective evaluation of others (Wasserman & Faust, 1994). Examples of relational ties are listed in Table 2.

Table 2: Examples of relational ties

Tie	Example(s)
Evaluation of one person by another	Friendship, liking, respect.
Transfer of material resources	Business transaction, lending, borrowing.
Association/affiliation	Jointly attending the same social event, belonging to the same club.
Behavioural interaction	Talking together, sending messages.
Movement between places or statuses	Migration, social or physical mobility.
Physical connection	Co-location at work.
Formal relations	Authority.
Biological relations	Kinship, descent.
Communication relations	Sharing of publications, discussion of ideas.

(Source: Monge, 1987, p. 243; Wasserman & Faust, 1994, p. 18.)

Ties may be assessed for properties that demonstrate the strength or intensity of the relation, i.e. the ‘quantity’ or ‘amount’ of the relationship and interactions (e.g. frequency of conversation), and the degree to which the relation is symmetric/ asymmetric as assessed by the predominant direction of flow. Some relationships will be logically symmetric/ reciprocal

whereas others may not be so (for example, compare ‘co-authorship’ with ‘citation’; or, as in the study outlined in detail below, ‘awareness of the other’s research expertise’ against ‘have interacted with’). The degree to which participants report the nature of a relation can also be analysed. This feature is known as reciprocity. In a relation where reciprocity is said to be high actors will be in agreement about the nature of the relation. In low reciprocity relations their accounts will not match.

Although actors and actions are viewed as interdependent rather than independent units in SNA, attribute data relating to individuals may be also be collected. The measurement of actors is known as ‘network composition’ and can be incorporated into network models (Wasserman & Faust, 1994, p. 22). Data on actors can be used to determine which features of the structural environment motivate or impede certain behaviours (Wasserman & Faust, 1994).

Recent perspectives on SNA and its deployment in LIS research

Current perspectives on SNA are varied. The flavours would appear to differ according to subject domains. For example, Monge provided a set of three communication science perspectives of SNA for the 1987 edition of the *Handbook of Communication Science* (as summarised in Table 3). In particular, he identifies the ‘relational’ perspective that focuses on the evolving network roles within emergent and informal networks, pertinent to the study of the DREaM cadre. Since the concept of ‘community’ is at the forefront of communication science research it is not surprising that personal, organisational and societal networks featured prominently in the chapter (Monge, 1987). It should also be noted that in contrast with other material on SNA, Monge makes no mention at all of mathematics in his chapter, thus demonstrating the wide diversity of possible approaches and perspectives to be found in SNA research.

Table 3: Communication science perspectives of SNA

	Perspective	Features
1	‘Relational’	Focuses on direct and indirect connections between members with an emphasis on network roles. Identified with emergent rather than designated or formal networks.
2	‘Positional’	Based on sociological role theory. Theorists see the communication

		<p>network as a pattern of relationships and roles in society and institutions.</p> <p>Positions and roles determine who should say what to whom etc.</p> <p>The focus falls on structural equivalence, identifying social or communication structure based on similarities in patterns of relations.</p>
3	‘Cultural’	<p>Focuses on symbols and meanings that are used to transmit message content through communication networks.</p> <p>Their significance lies in their capacity to create language communities and cultures.</p>

(Source: Monge, 1987, pp. 246-247.)

The use of SNA within the LIS community has mainly focused on the domain of knowledge management (KM), and the potential of the technique to shed light on the dynamics of information and knowledge flows among individuals and groups, and citation analysis. Cheuk (2007), for example, explains how the British Council used SNA to support its KM programme when faced with the challenges of a globally dispersed workforce. Her results show that SNA can be used as a diagnostic tool to provide a focal point for discussion in improving knowledge flow – in particular, of the need to balance people to people networking against document exchange. With more direct connection to ‘pure’ information science research traditions, Johnson & Oppenheim (2007) used SNA to investigate the social and citation networks of three prominent information science academics. Their analysis identifies similarities between the social and citation networks of the research subjects, lending support to theories of social capital and social exchange. These findings reflect those of Rowlands (1999) from almost a decade earlier. Rowlands examined patterns of co-citation in the field of information policy and concluded that the networks of social, collaborative and intellectual relationships within information policy scholarship were highly convergent. Otte and Rousseau (2002) also discuss the increasing use and relevance of SNA as an analytical technique in information science, using co-authorship in the LIS discipline as the basis for their application of the method. Within the context of information science in China, Bei, Yi and Boutin (2008) have demonstrated the use of SNA for a wide range of investigations including scholarly communication patterns, architectural studies of library buildings, and tacit knowledge transmission.

Most recently, the advent of social media has provided rich opportunities for research in the information science domain, grounded in the use of SNA as a methodological approach. In particular, the combination of SNA with data mining algorithms and the wealth of open data available via social networking sites, has enabled light to be shed on complex social and business-related questions, as evidenced for example in the extensive body of work by Mike

Thelwall and collaborators (e.g. Zuccala, Thelwall, Oppenheim & Dhiensa, 2007; Prabow, Thelwall, Hellsten & Scharnhorst, 2008; Thelwall, 2008; Thelwall, 2009; Thelwall, Wilkinson & Sukhvinder, 2010). The continuing popularity of social media and the many interesting questions raised by new communication means suggests that this trend is likely to continue well into the future.

Research Design and Method

The empirical research discussed in this paper was designed to test the impact that the series of DREaM workshops exerted on network integration and density among the cadre of participants. Particular attention was paid to (1) individuals' awareness of the research expertise and knowledge of other participants, and (2) social/ interactional links across the network. As the intention was to investigate a developing, or *emergent*, network based on spontaneously formed ties, this research strategy sits within Monge's 'relational' perspective (see Table 1 above).

Data were collected from the whole population of workshop participants. It thus represents an example of 'full network method' (Hanneman & Riddle, 2005), albeit with the recognition that this network is a subset of a much wider community, as outlined above. In addition, data were cleansed to remove responses from those who did not return their second questionnaire. This was important so as not to invalidate the longitudinal perspective and the subsequent comparative calculation of density measures. This left a total of two sets of 33 completed questionnaires. The questionnaire was in hard copy form [6]. The one distributed at the start of the first workshop in October 2011 was almost identical to that issued at the end of the third workshop in April 2012. The only difference was the slightly altered wording to reflect the changed scenario.

In addition to collecting demographic data for name, gender and role [7], the questionnaire used a matrix data collection approach (as suggested by Cross & Parker, 2004; Hanneman & Riddle, 2005) to ask participants about their relationships with the others: were they aware of their research expertise, and had they interacted socially with them or discussed their work with them? It was thus a 'bounded or partial network approach' (Wasserman & Faust, 1994; Cross & Parker, 2004). Participants were not asked to respond about their relationships with actors outside the cadre. They were assured that the results would be reported in such a way that individuals would remain anonymous. Data were input manually into Ucinet v.6 (Borgatti, Everett & Freeman, 2002) and visualised network diagrams (sociograms) were

produced using Netdraw. The sociograms were produced with nodes differently shaped according to role, and also according to gender. Measures of density and degree centrality were calculated using Ucinet. The Ucinet and Netdraw software was found to be relatively user-friendly and fit-for-purpose, although electronic collection of data would have made the data input process much quicker and easier, as the software allows for automated import from Microsoft Excel spreadsheets.

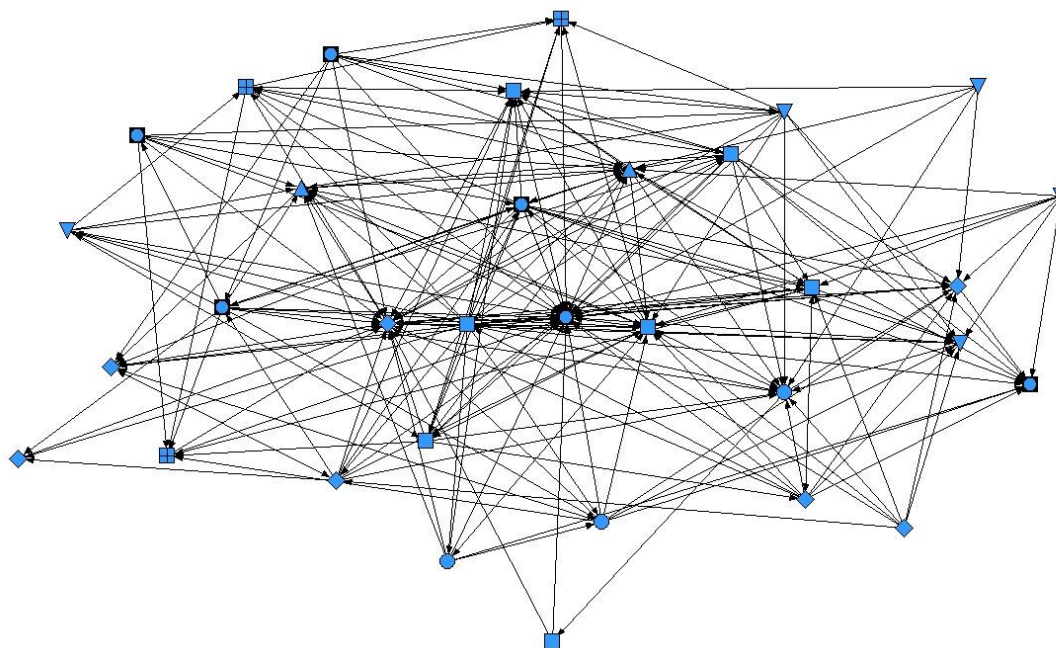
Caution needs to be taken in network research with regard to potential ethical issues. Relationship ties can obviously be sensitive, but the nature of network analysis means that it cannot be undertaken anonymously. Nevertheless, results can often be *presented* anonymously: in cases such as this one it may be sufficient to understand the network structure and composition without identifying the position of individual actors. Another note of caution is relevant to the interpretation of results, especially when looking at the role of individuals in the network. In an information-sharing network, for example, an actor with a high degree of ‘betweenness centrality’ [8] may be playing the role of either an information broker or a bottleneck. For most network patterns, multiple interpretations are possible, and it is therefore appropriate to follow up such analysis with qualitative research that seeks to explore likely explanations (Cross & Parker, 2004).

Findings

The findings from the first survey were presented to participants during the course of the DREaM workshop at Edinburgh Napier University in October 2011. Although they were displayed anonymously (participants were not shown the labels for individual actors), the structure and patterns of the network prompted some discussion as to their underlying meaning. For example, the sociograms highlighted the centrality of position of certain participants, prompting speculation as to their identity and the reasons behind this centralisation. Discussion also focussed on understanding the meaning behind some of the more isolated positions occupied by some of the outliers to the network. The visualised diagrams enabled participants better to grasp the usefulness of the technique in terms of shedding light on patterns of relationship that could not so easily be explored and understood by other means. Findings from the second iteration of data collection were presented (again anonymously) at the DREaM project concluding conference held at the British Library in July 2012. Many of the workshop participants attended this event, as did members of the wider DREaM community.

The findings from the first round of data collection demonstrated that in both relationship categories, i.e. (1) awareness of expertise, and (2) social or research-related interaction, the participant networks were not very highly connected. Density measures were $d = 0.1854$ and $d = 0.1944$ for expertise-awareness and interaction respectively. These figures indicate that approximately 18% and 19% of all potential ties in the network actually existed in practice. Each node had an average number of 6.6767 ties (this includes incoming and outgoing ties) for expertise-awareness. For social or research related interaction there was an average of seven ties. Moreover, the networks were heavily centralised around a small number of actors, all of whom were academic librarians or academic researchers. Public library practitioners and PhD students tended to sit on the periphery of the network. This is illustrated by the sociograms in Figures 1 and 2 respectively, where a loose mesh of connected nodes is portrayed. Nodes are labelled and shaped according to the role of the individual represented by the node.

Figure 1. Sociogram of ties relating to ‘Awareness of research expertise’ October 2011



Legend for sociograms:

Circle = Public Library Practitioner

Square = Academic Librarian

Triangle = Librarian in the Health Sector

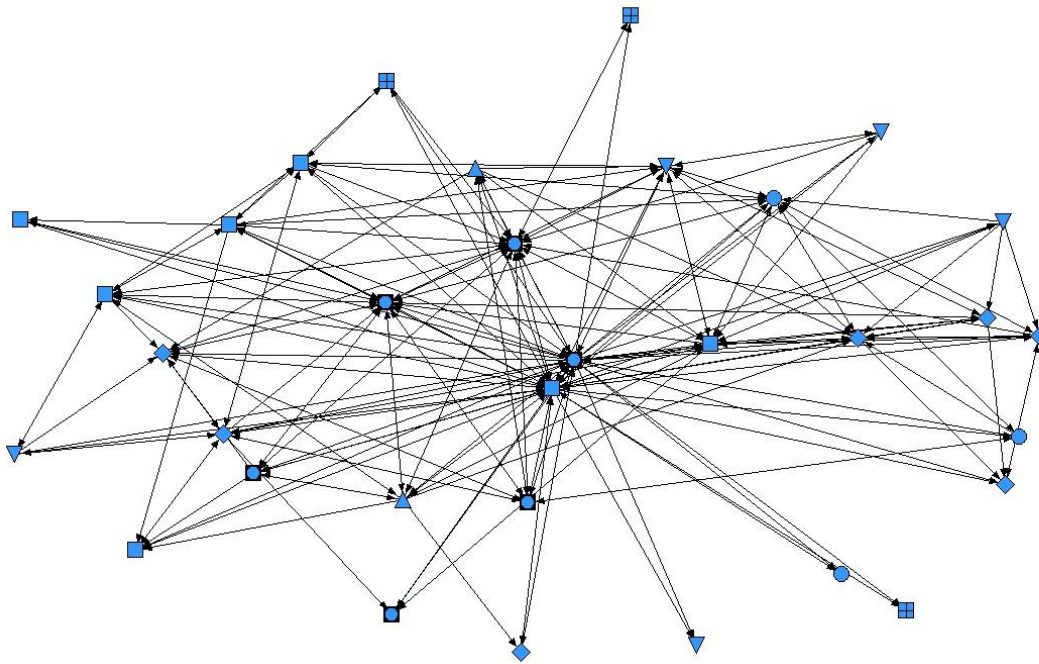
Hatched square = Librarian from another Sector

Inverted triangle = PhD student

Circle framed in square = Academic or University Researcher

Diamond = Other

Figure 2. Sociogram of ties relating to 'Social or Research-related interaction' October 2011

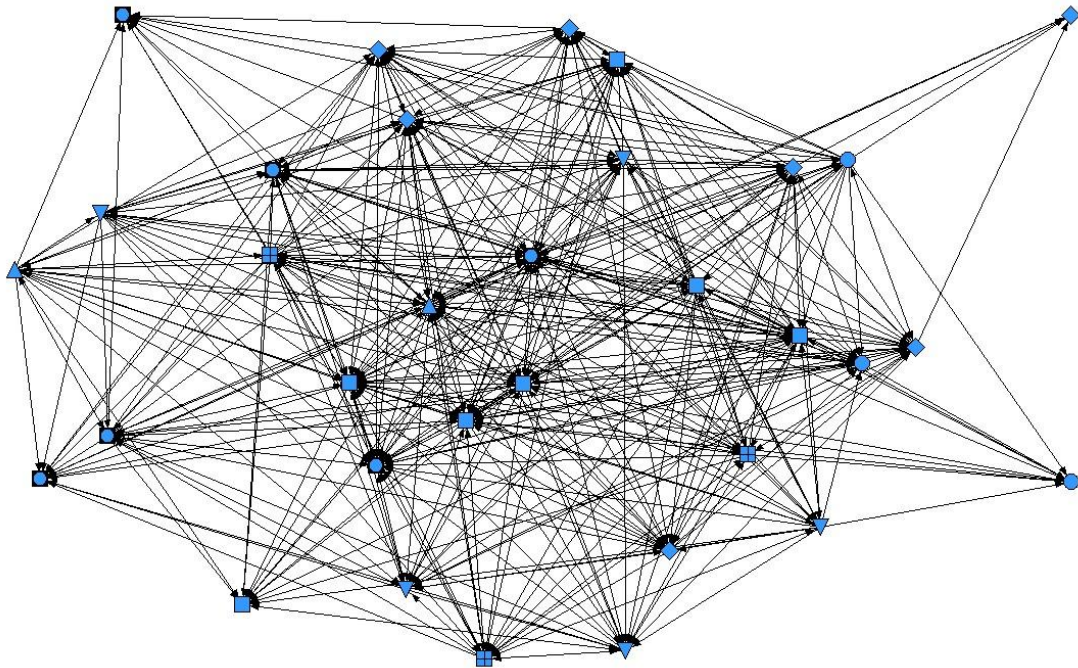


Analysis of data collected in the course of the final workshop reveals a demonstrable increase in network density: $d = 0.4216$ and $d = 0.3850$ for expertise-awareness and social or research-related interaction respectively. The average number of ties for each actor had increased to 13.9118 and 12.7059 respectively. This indicates a much more closely linked and more robust network. Moreover, the network was more evenly linked, with less dependence on two or three very densely networked actors. In addition, when analysed by role, PhD students and public library practitioners had moved into a more central position. Indeed, on both counts (expertise-awareness and social or research-related interaction) the three public library practitioners had linked with one other to form a 'clique', where there was a direct link between each actor. It is also worth noting that the overall number of cliques comprising three or more actors increased significantly with regard to both network relationships. For example, for 'social or research-related interaction' this increased from 25 to 36 for non-symmetrized relationships, and from 44 to 177 when ties are symmetrized. [9] Another interesting pattern was the apparent capability of academic library practitioners in network-building – whether this was a chance occurrence or whether it is a meaningful finding reflective of the skill set inherent to the role of the academic librarian is an aspect that would merit further research. There appears to have been a strong move by most academic librarians towards the centre of the network over the course of the seven months between the two surveys. It is worth noting that there were no evident pattern differences in initial or subsequent structural network

positioning according to gender. Therefore gender-differentiated sociograms have not been reproduced here [10].

The network changes in the second round of data collection are illustrated in figures 3 and 4 respectively.

Figure 3. Sociogram of ties relating to 'Awareness of research expertise' April 2012



Legend for sociograms:

Circle = Public Library Practitioner

Square = Academic Librarian

Triangle = Librarian in the Health Sector

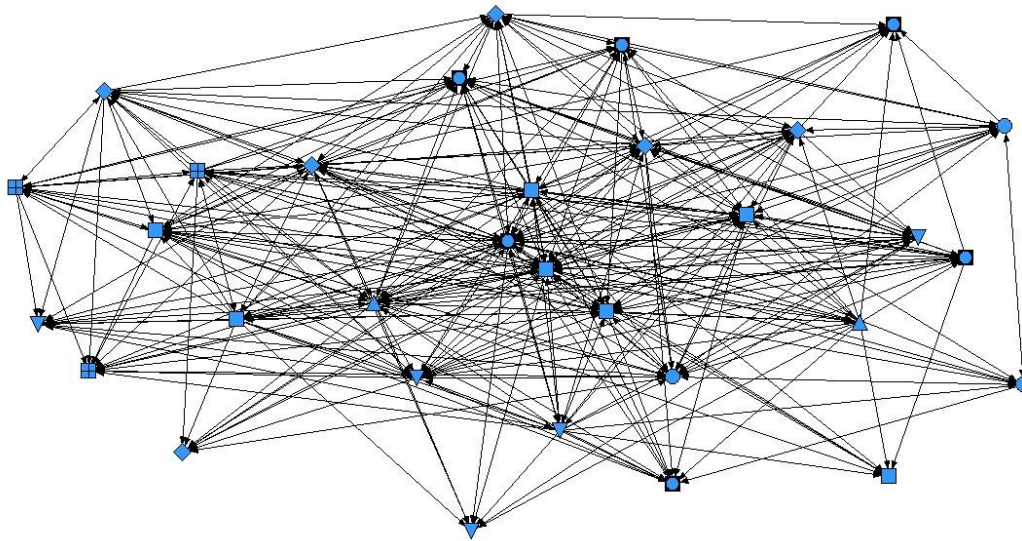
Hatched square = Librarian from another Sector

Inverted triangle = PhD student

Circle framed in square = Academic or University Researcher

Diamond = Other

Figure 4. Sociogram of ties relating to 'Social or Research-related interaction' April 2012



It is interesting to note that there was greater change in the density of the network with regard to 'expertise-awareness' than in that for interaction. This suggests that, by the end of the workshop series, even if participants had not had one-to-one interaction with another participant, they were still more likely to know of their area of research expertise. This aligns well with the original intention of the DREaM project to develop a *work-related* network rather than one that is primarily meant to be social. The denser mesh of the network is a clear indication that new connections had been forged between the various workshop participants, supporting the notion of the DREaM project as a mechanism to 'develop a formal UK-wide network of Library and Information Science (LIS) researchers' (Library and Research Coalition, 2011b). It is also encouraging to note that the increased network density was mirrored by a parallel growth in research expertise and awareness, as evidenced by the 'before' and 'after' skills audits carried out among the cadre (as reported by Brettle, Hall & Oppenheim, 2012).

Discussion

These results suggest that a model of combining workshops with social events and the use of social media is of intrinsic value above and beyond any formal learning might take place in the course of standalone workshop sessions. Communication and networking among researchers offers potential benefit, for example in terms of the opportunity to exchange

knowledge and thus broaden one's knowledge base. Equally it reduces the isolation often experienced by the researcher, and in particular the solitary, novice or practitioner researcher (Borg, 2001; Mac an Ghail, cited in Walford, 1991). Evidence from the hash tagged Twitter exchanges related to individual workshops and other contributions supports the notion of the network leading to the 'transfer of goods and services' as discussed above with reference to the work of Mitchell (1969, highlighted by Scott 2000, p.30): members of the DREaM cadre exchanged references, relevant contacts, and other sources of information and advice. Increased network density and integration also reduces the dependence of the network on a couple of actors for the continuation of links between participants, making the sustainability of the network more likely. This is a positive outcome from the SNA in terms of the long-term goals of the DREaM project, and aligns well with feedback from the last of the formal workshops where there was a clear appetite amongst the cadre members to continue to extend their relationships. This is evident in comments on the workshop evaluation forms:

- 'Very interested in continuing professional relationships and on-going projects'
- 'Hope that the group can stay in contact with social networking'
- 'I'd like to see effort on maintaining and extending the community'
- 'Thoroughly enjoyed participating – hope it continues in some form.'

The increased density in the network of 'awareness of research expertise' suggests that by the final workshop participants had gained a greater knowledge of 'who knows what' and to whom to turn for discussion of particular research ideas or dilemmas. This is an important result for a discipline that, as noted earlier, tends towards fragmentation across sectors, and suffers from a gap between researchers and practitioners. We would also argue that the more closely that the network is meshed the more likely that participants will be able to leverage the 'potential benefit, advantage, and preferential treatment for another person or group' that accrues from greater levels of social interaction and bonds (as noted by Robison, Schmid and Siles, 2002). This also potentially generates benefits at the level of the whole network, i.e. network capital, (as identified by Wellman, Haase, Witte and Hampton, 2001). These can in turn be extended to: (1) the wider LIS research community through stronger cohesion, identity and the development of a wider, more informed decision-base; (2) participants' employers (and/or tutors) through shared access to a wider knowledge base and more effective decision-making; and (3) the generation of academic and theoretical knowledge as an intrinsic and societal benefit. Internal density in a knowledge sharing network has been shown elsewhere to be positively related to group performance (Reagans, Zuckerman & McEvily, 2004).

The increase in density that is seen in the ‘before’ and ‘after’ networks suggests the effectiveness of a multi-faceted approach to researcher network development. In this case, it is not possible to assess the specific relative value of the facets of the highly social approach to network development that ran alongside the formal delivery of sessions on research methods. However, the use of ‘unconference half hour’ for researchers, the deliberate attempts to get delegates to socialise before and after events, the development of the online community, the heavy use of social media channels such as Twitter round each event, and the deliberate use of more experienced and well-networked individuals in particular leadership roles in the final workshop all aimed to contribute towards the development of relational capital among participants. These initiatives were all supplementary to the more formal aspects of the workshops themselves and provide a useful potential model for other events or disciplines to emulate.

Despite the apparent advantages to greater network cohesion, we should however also be wary of potential drawbacks and pitfalls. Higher density of network structures, and the formation of cliques, may pose a barrier to incomers and an increased homogenisation – ‘homophily’ (Lazarsfeld and Merton, 1954) – of the network that runs counter to the espoused aims of a project such as DREaM. The importance to innovation, opportunity and diversity of viewpoint of ensuring a network of loose ties that extend beyond the immediate close-knit circle has been demonstrated in multiple studies (e.g. Ehrlich and Chang, 2006; Granovetter, 1973). It is therefore critical to ensure that barriers to entry to the network remain low and individuals are encouraged to play an active role in boundary-spanning.

In the context of the DREaM project, this was achieved via the use of social media across all five events that extended their reach beyond the 213 “on-site” participants and 32 contributors and thus supported inclusion to an extent that, in practice, exceeded the aims of the initial project proposal. This was extended further using event amplification techniques as routine practice: these included previews of sessions and slides online prior to events; use of Lanyrd; live-blogging/tweeting on the day; and archives of materials, including delegate reviews, which were online within one week of each event. The value of such activities was increased by careful curation, of project blog posts, hash-tagged project tweets, PowerPoint slides, session summaries, session recordings, event reviews, and posts to the online community and Twitter list and to CoverItLive. Such activities were of particular value to practitioners, many of whom were unable to attend events in person due to work commitments, but were subsequently able to participate in the network remotely.

Conclusions

Investing in developing the next generation of LIS practitioners and researchers through mechanisms such as the development of supportive forums for networking and knowledge sharing is of critical importance in what has long been recognised to be an ‘ageing profession’ (Singer Gordon, 2006). We need to continue to build and sustain such links between the experienced and the less experienced.

At the start of the project described in this paper it was conjectured that an SNA would demonstrate the extent to which the DREaM workshops had changed the level of integration and network density of the DREaM workshop cadre. Assuming a positive outcome, it was proposed that the new network configuration would have the potential to increase the information and knowledge sharing amongst the UK LIS research and practitioner communities. It was also believed that the highly social approach to network building adopted by the DREaM project would demonstrate an effective methodology for developing communities of researchers in other contexts. The research findings show that for the two types of relationship ties investigated the network had increased considerably in density. In one respect (expertise-awareness) it had doubled, and in the other relationship tie (interaction), it had near-doubled.

In particular, therefore, the outcomes of this study suggest that the model adopted by the DREaM project has at least contributed towards addressing two of the broad aims of the LIS Research Coalition: to facilitate a more co-ordinated approach to LIS research in the UK, and to begin to bridge the gap between LIS academic researchers and LIS practitioner-researchers. An approach that focussed on building a tight cadre of enthusiastic and engaged LIS researchers committed to attending a series of linked workshops, as well as to engage in the social activity built around the events, appears to have been an effective strategy in the development of a nascent community of practice (Wenger, 1998), as suggested by the evidence of network development provided by the SNA.

It is reasonable to propose that this approach could be replicated in other disciplinary contexts to similar advantage. The challenge in the LIS community is now going to be to maintain the existing links and further develop the network so that it evolves into a self-sustaining and continuously developing supportive community for LIS research. Further exciting opportunities are offered through building on this work. These will be achieved by harnessing the methodology described here (a) to facilitate additional network links between

LIS researchers and practitioners, and (b) to extend the existing networks to build an international corps of research-practitioner network participants.

Originality and value of the research

The methods and theoretical proposition of this research – that network density and integration can be increased by structured and informal social and work-based interaction – are not original in themselves. However, by carrying out the longitudinal data collection on the workshop participants as part of the learning process, the analysis has played an important role of research-in-action, enabling participants to become actively involved and engaged in the research process. It also represents a unique contribution in terms of the specific context of researcher-practitioner workshops, suggesting that the overall benefit in terms of extension of research networks afforded by such workshops can be as worthwhile as any formal learning that takes place. Furthermore, the development of a model of network development adopting a multi-faceted approach combining a series of linked formal events, that also incorporates informal elements as outlined above has provided a transferable model that offers potential benefit to other disciplines.

Methodological reflections and limitations

The use of SNA to explore the longitudinal development of the research networks has been found to be a useful technique for assessing the extent to which one of the DREaM the project's key aims has been achieved. The ability to visualise the network development proved to be a powerful tool both in terms of understanding the network evolution and patterns, and in terms of demonstrating these to the participants themselves. Nevertheless, it must be recognised that there were some limitations to this approach. In particular, the ethical considerations of the research have limited the extent of this learning. Although it was never intended to explore particular individuals' network connections in their own right, it was apparent when analysing the data that some useful indications could have been gained by identifying the structural role of certain individuals. For example, not all of the 'key players' were those whom one might have expected to play such roles: there were a small number of relatively novice researchers who proved to be particularly strong networkers and were indeed central to the network structure. Further exploration of the meaning behind such phenomena would provide for some potentially rich learning. The limitations to the data collection and analysis possibilities imposed by the need to collect and analyse the data as part of an on-going workshop session also led to the investigation only of two basic ties between the actors: (1) their knowledge of others' expertise and (2) their interactions with the

other actors. This merely showed where links existed (or not), but did not allow for the measurement of tie strength. Moreover, the wording of such questions could potentially be interpreted somewhat differently by individual actors. A final limitation was that imposed by an incomplete final data set due to the failure of two participants at the final workshop to return their questionnaires. In order to maximise the trustworthiness of the findings it was necessary, therefore, to remove data from them or relating to them from both the first and the second iteration of data collection. In carrying out further such projects, it is suggested that there is potential to extend the source of data analysed, for example by drawing on records of online interactions among participants taking place during and between workshops via social media such as Twitter, blogs etc.

Nevertheless, we believe that the approach adopted was appropriate to meet the aims of this study and would recommend SNA as a research technique that has much to offer the LIS research community.

Endnotes

[1] <http://lisresearch.org/dream-project>

[2] The membership of the cadre is given at <http://lisresearch.org/dream-project/dream-workshops/dream-workshop-cadre/>

[3] <http://lis-dream.spruz.com/>

[4] See for example: <http://lisresearch.org/dream-project/dream-event-4-workshop-wednesday-25-april-2012/reviews-of-dream-event-4-workshop-edinburgh-25th-april-2012/>

[5] <http://www.insna.org/>

[6] Although an online survey would have been more convenient for participants and researcher alike, it was not practical to administer one in the workshop location.

[7] Options were public library practitioner; academic librarian; librarian in the health sector; librarian from another sector; PhD student; academic or university researcher; other – please specify.

[8] ‘Betweenness is a measure of the centrality of a node in a network, and is normally calculated as the fraction of shortest paths between node pairs that pass through the node of interest. Betweenness is, in some sense, a measure of the influence a node has over the spread of information through the network’. (Newman, 2005, p.39).

[9] In SNA a ‘clique’ does not necessarily imply the kind of negative connotations that we tend to assume in everyday life. It simply means that there is a direct connection between each actor in the clique. If we symmetrize the data, the analysis does not take into account the direction of ties (so, for example, actor A may have identified actor B, but actor B has not identified actor A – there is, nonetheless, a tie between them).

[10] Anonymised sociograms showing gender attribution may be obtained from the corresponding author on request.

References

Bei, L., Yi, Y. and Boutin, E. (2008), "Application of Social Network Analysis in information science", *Journal of the China Society for Scientific and Technical Information*, Vol. 27, No. 3, pp. 407-417.

Borg, S. (2001), "The research journal: A tool for promoting and understanding researcher development", *Language Teaching Research*, Vol. 5, No. 2, pp. 156-177.

Borgatti, S.P., Everett, M.G. and Freeman, L.C. (2002), *Ucinet for Windows: Software for Social Network Analysis*, Analytic Technologies, Harvard, MA.

Brettle, A., Hall, H. and Oppenheim, C. (2012), *We have a DREaM: the Developing Research Excellence and Methods Network*. Available at <http://www.slideshare.net/LISResearch/we-have-a-dream-the-developing-research-excellence-methods-network> [Accessed 20/8/12].

Cheuk, B. (2007), "Social network analysis: its application to facilitate knowledge transfer", *Business Information Review*, Vol. 24, No. 3, pp. 170-176.

Cronin, B. (1995), *The scholar's courtesy: the role of acknowledgement in the primary communication process*, London: Taylor Graham.

Cronin, B. (2008), "The sociological turn in information science", *Journal of Information Science*, Vol. 34, No. 4, pp. 465-475.

Cronin, B. and Meho, L. I. (2008), "The shifting balance of intellectual trade in information studies", *Journal of the American Society for Information Science and Technology*, Vol. 59, No. 4, pp. 551-564.

Cross, R. and Parker, A. (2004), *The Hidden Power of Social Networks: How Work Really Gets Done in Organisations*, Harvard Business School, Cambridge, Ma.

Denscombe, M. (2007), *The Good Research Guide: for Small-scale Social Research Projects*, Open University, Maidenhead.

Ehrlich, K. and Chang, K. (2006), "Leveraging expertise in global software teams: going outside boundaries", *IEEE International Conference on Software Engineering*, October 2006, pp. 149-168.

Granovetter, M.S. (1973), "The strength of weak ties", *American Journal of Sociology*, Vol. 78, No. 6, pp. 1360–1380.

Hall, H. (2003), "Borrowed theory: applying exchange theories in information science research", *Library and Information Science Research*, Vol. 25, No. 3, pp 287-306.

Hanneman, R.A. and Riddle, M. (2005), *Introduction to Social Network Methods*, University of California, Riverside, Ca, available at: <http://faculty.ucr.edu/~hanneman/> (accessed 19 September 2012).

Homans, G. C. (1951), *The Human Group*, Routledge and Kegan Paul, London.

Johnson, B. and Oppenheim, C. (2007), "How socially connected are citers to those that they cite?", *Journal of Documentation*, Vol. 63, No. 5, pp. 609-637.

Kilduff, M. and Tsai, W. (2003), *Social Network Analysis in Organisations*, Sage, London.

Lazarsfeld, P. F. and Merton, R. (1954), "Friendship as a social process: a substantive and methodological analysis", in Berger, M., Abel, T. and Page, C. H. eds. *Freedom and Control in Modern Society*, Van Nostrand, New York, pp. 18-66.

Library and Information Research. (2007) Special commemorative issue, Vol. 31, No. 97, available at: <http://www.cilip.org.uk/get-involved/special-interest-groups/research/publications/journal/pages/default.aspx> (accessed 17 January 2011).

Library and Information Research Coalition (2011a), "About the LIS Research Coalition", available at: <http://lisresearch.org/about/about-lis-research/> (accessed 12 December 2011).

Library and Information Research Coalition (2011b), "DREaM Project to Support Creation of UK-wide Network of LIS Researchers", available at: <http://lisresearch.org/2010/11/18/dream->

[project-to-support-creation-of-uk-wide-network-of-lis-researchers/](#) (accessed 12 December 2011).

Mac an Ghail, M. (1991), "Young, gifted and black: Methodological reflections of a teacher/researcher", in Walford, G., *Doing Educational Research*, Routledge, London, pp. 101-120.

Marsden, P. and Lin, N. (Eds.) (1982), *Social structure and network analysis*, Sage, London.

Marshall, G. (Ed.) (1998), *Oxford dictionary of sociology* (2nd ed.), Oxford University Press, Oxford.

Mitchell, J.C. (Ed.) (1969), *Social networks in urban settings*, Manchester University Press, Manchester.

Mitchell, J.C. (1974), "Social Networks", *Annual Review of Anthropology*, 3, pp. 279-299.

Molm, L. D. (1997), *Coercive power in social exchange*, Cambridge University Press, Cambridge.

Monge, P. (1987), "The network level of analysis", in Berger, C. and Chaffee, S. (Eds.), *Handbook of communication science*, Sage, London, pp. 239-270.

Newman, J. E. (2005), "A measure of betweenness centrality based on random walks", *Social Networks*, Vol. 27, No. 1, pp. 39-54.

Otte, E. and Rousseau, R. (2002), "Social network analysis: a powerful strategy, also for the information sciences", *Journal of Information Science*, Vol. 28, No. 6, pp. 441-453.

Prabowo, R., Thelwall, M., Hellsten, I. and Scharnhorst, A. (2008), "Evolving debates in online communication: a graph analytical approach", *Internet Research*, Vol. 18, No. 5, pp. 520-540.

Reagans, R., Zuckerman, E. and McEvily, B. (2004), "How to make the team: Social networks vs. demography as criteria for designing effective teams", *Administrative Science Quarterly*, 49, 1, pp. 101-133.

- Robison, L.J., Schmid, A.A. and Siles, M.E. (2002), "Is Social Capital Really Capital?", *Review of Social Economy*, 60, 1, pp. 1-21.
- Rowlands, I. (1999), "Patterns of author co-citation in information policy: evidence of social, collaborative and cognitive structure", *Scientometrics*, Vol. 44, No. 3, pp. 533-546.
- Scott, J. (2000), *Social network analysis: a handbook* (2nd ed.), Sage, London.
- Singer Gordon, R. (2006), *The NextGen Librarian's Survival Guide*, Information Today, Medford, NJ.
- Thelwall, M. (2008), "How are Social Network Sites embedded in the Web? An exploratory link analysis", *Cybermetrics: International Journal of Scientometrics, Informetrics and Bibliometrics*, Vol. 12, No. 1, available at:
<http://cybermetrics.cindoc.csic.es/articles/v12i1p1.html> [Accessed 18 July 2012].
- Thelwall, M. (2009), "Homophily in MySpace", *Journal of the American Society for Information Science and Technology*, Vol. 60, No. 2, pp. 219-231.
- Thelwall, M., Wilkinson, D. and Sukhvinder, U. (2010), "Data mining emotion in social network communication: gender differences in MySpace", *Journal of the American Society for Information Science and Technology*, 61, 1, pp. 190-199.
- Walford, G. (ed.) (1991), *Doing Educational Research*, Routledge, London.
- Wasserman, S., & Faust, K. (1994), *Social network analysis: methods and applications*, Cambridge University Press, Cambridge.
- Wellman, B., Haase, A.Q., Witte, J. and Hampton, K. (2001), "Does the Internet increase, decrease, or supplement social capital? Social networks, participation and community commitment", *American Behavioral Scientist*, Vol. 45, No. 3, pp. 436-455.
- Wenger, E. (1998), *Communities of Practice: Learning, meaning and identity*, Cambridge University Press, Cambridge.

Widén-Wulff, G. and Ginman, M. (2004), "Explaining knowledge sharing in organizations through the dimensions of social capital", *Journal of Information Science*, Vol. 30, No. 5, pp. 448-458.

Zuccala, A., Thelwall, M., Oppenheim, C. and Dhiensa, R. (2007), "Web intelligence analyses of digital libraries: a case study of the National electronic Library for Health (NeLH)", *Journal of Documentation*, Vol. 63, No. 4, pp. 558-589.