The application of Social Network Analysis to Knowledge Management

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Abstract

Relationships play an important role in tacit knowledge transfer. At the same time, it is difficult to understand the relationships individuals have with one another in the workplace. One technique for doing so is that of Social Network Analysis (SNA). We examine the role that SNA can play in determining whether tacit knowledge is being transferred between personnel. The outcomes from our research suggest that firm size, level of IT usage and meeting type will affect how likely tacit knowledge can be transferred within an organisation.

Keywords

Social Network Analysis, tacit knowledge, knowledge flows

1. INTRODUCTION

Tacit knowledge management has become recognised as a critical feature in successful organisations (Horak 2001). Despite its acknowledged importance, most tacit knowledge research is still focused on its definition and discussion of its existence. Few approaches attempt to measure or capture it. Some avoid the problem, as tacit knowledge is generally defined as that which generally cannot be made explicit (Leonard and Sensiper 1998). We do not wish in this paper to join the debate, but for the purposes of our work in the IT domain we focus on that aspect of tacit knowledge which could be referred to as the articulable implicit IT managerial knowledge that IT practitioners draw upon when conducting the "management of themselves, others, and their careers" (Wagner and Sternberg 1991a; 1991b). This approach to the IT managerial nature of articulable tacit knowledge (aTK) follows closely along the lines of Bassellier, Horner-Reich and Benbasat (2001). When such tacit knowledge is shared from mutual experience and culture it gains a dimension within an organisation.

2. BACKGROUND TO THE STUDY

Granted the study of tacit knowledge has a long history beginning with Polanyi (1968; 1967; 1958), the majority of research that seeks to perform tests on it at an empirical level takes place in psychology where the emphasis is on testing at the individual level, along the lines of who possesses more tacit knowledge than others. The most well known work in this area is the work of Sternberg at Yale (1995) who uses the responses of experts and novices to workplace scenarios to measure tacit knowledge in the individual. We are interested in not just the individual but comparison of the behaviour and characteristics of experts compared to novices and whether transfer of tacit knowledge within an organisation is likely. From an interpretivistic analysis of the tacit knowledge literature we concluded (a) the importance of organisational domains, (b) the contextual nature of tacit knowledge and (c) the highly individualistic nature of the knowledge leading to a number of conclusions regarding our research directions. Firstly our research should ideally be conducted within an external workplace (the IT industry), rather than a purely academic domain, which in the case of the latter implies testing on undergraduate populations. Secondly, that the use of case studies is appropriate given the practical nature of the research. Thirdly that intra-organisational testing was appropriate given the contextual nature of the knowledge. In other words that testing take place amongst a group of personnel within each organisation. Furthermore that these participants choose colleagues they consider to be rich in experience and therefore tacit knowledge. Fourthly, given the individualistic nature of tacit knowledge uncovered through the qualitative analysis, the usage of an individual questionnaire was felt to be appropriate.

We developed a triangulated approach which incorporated (a) a Sternberg based psychological testing instrument which uses an inventory of workplace scenarios and answer options; (b) Social Network Analysis (SNA) (Scott 1991) as a tool to track the soft knowledge dissipation cycle, and (c) Formal Concept Analysis (FCA) (Wille 1997) as a means to model the behaviour (that is, scenario responses) and characteristics (that is, biographical features) of the respondents (Figure 1).

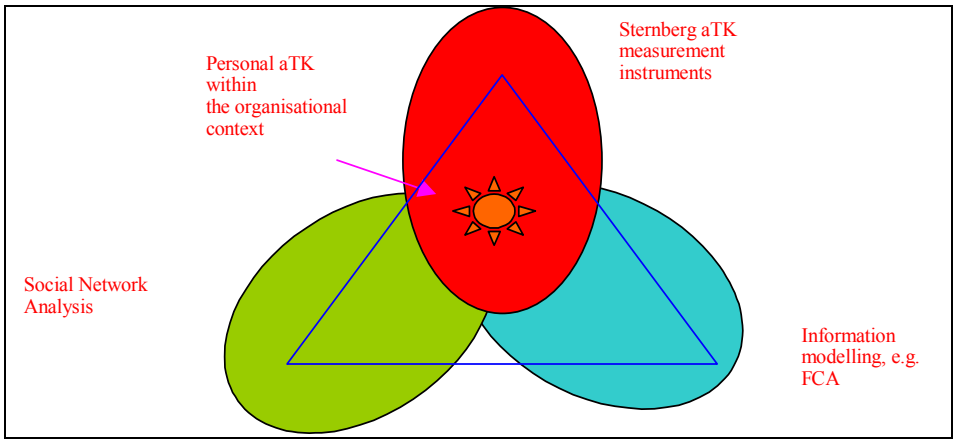

Figure 1: Macro-methodology utilising triangulation to test for aTK (source: Busch and Richards 2000)

2.1 Three organisations

In order to better ground the research, three case studies involving three organisations were conducted, that we refer to as Organisation X (large), Organisation Y (also small) and Organisation Z (small). We were concerned only with IT personnel within these organisations. For example Organisation X is an insurance company, however what is referred to as Organisation X in this paper is in fact the IT support group for the wider organisation. Organisation Y differs insofar as it is a management consultancy with a specialisation in IT. To that end the staff under study represents the core of the organisation, rather than the IT support staff, as is the case in Organisation X. Organisation Z is a home and office furniture supply company. However what is referred to as Organisation Z here is the IT group providing support to the logistics of storing and selling furniture items. Thus Organisation X and Z under study are similar insofar as they provide a service role to the wider organisation. Organisation Y differs, as its mission is to deliver IT/IS managerial expertise. The population of the companies not surprisingly reflects this. For example Organisation Y is made up of predominantly senior mono-cultural 'first language is English' personnel. The other two organisations have a much broader staff profile with a far higher level of multiculturalism.

3. SOCIAL NETWORK ANALYSIS

In this paper we focus on briefly describing the use of Social Network Analysis within our methodology and consider its role in the management of knowledge. We begin with an introduction to SNA and its key concepts. Raghuram (1996) provides an informal introduction to the benefits of SNA in the following quote:

> In the traditional workplace, organisational members can interact with each other frequently, thereby converting existing tacit knowledge to new tacit knowledge. Very often, these meetings with colleagues follow an impromptu mode where people 'bump' into each other, be it near the elevator, the coffee percolator or the photocopying machine. Meetings might also take the less impromptu form of going out for lunch or for an after hours' drink. Invariably these informal meetings follow a pattern where people share news about their work related problems and how they went about solving these problems… (:862).

More specifically …

> social network analysis is a general set of procedures that use indices of relatedness among individuals to produce representations of the social structures and social positions that are inherent in dyads or groups by attending to the reciprocal interactions among two or more network members. A social network is simply a set of actors – individuals or other social entities – and their relationships with each other (Koehly and Shivy 1998 :3).

Not only is tacit knowledge typically transferred in this manner within an organisation, but in order for the knowledge to be passed, the groups are on average required to be very small, because "larger communities of knowledge can share certain practices, routines, and languages, but for new tacit knowledge to emerge through socialization the group must be small" (von Krogh, Ichijo and Nonaka 2000 in Allred 2001 :162). This teamwork then permits knowledge to be transmitted back into the organisation, through various but characteristically social means.

We were motivated to use SNA in conjunction with the survey-based workplace scenarios due to our desire to map possible tacit knowledge flows. Scott (1992, 1990) used participant observation in her triangulated methodology dealing with nursing interaction in order to validate whether respondents did indeed act in the way they claimed to in the Sternberg-like survey. However, validation of the survey responses using SNA was not our intention. Our intention was to determine who met with whom and the nature of the meeting (for example, essential, informal and daily). Participant observation was unsuitable for this purpose as we could not be physically present in the field of study and would not be able to simulate the scenarios in our tacit knowledge inventory. We were hindered in being physically present in the organisation for reasons of information confidentiality, that is to say management would not have been comfortable with outsiders present. Furthermore subjects being studied are likely to alter their behaviour given that they are being observed (Yin 1994). Participant observation also tends to be useful if the subjects are undertaking physical tasks, which lend themselves to observation. Direct observation (Leedy 1997) rather than participant observation would have been more appropriate in our studies given the tendency of Information Systems work to be undertaken at a computer monitor where body language and otherwise obvious workplace activities are minimised. We consider an even more appropriate technique to be the application of Social Network Analysis (Paxton *et al*. 1999; Koehly and Shivy 1998; Wasserman and Faust 1994) which has been used to ascertain how articulable Tacit Knowledge (aTK, in other words that component of tacit knowledge that can actually be explicated) is conveyed from one individual to another. Our SNA questions were incorporated into our aTK inventory questionnaire so that we could determine with whom personnel in organisations are experiencing positive and negative working relationships. We would expect for instance, that a negative working relationship is likely to diminish the transfer of aTK, a positive relationship enhancing transference however. Furthermore using SNA both sides of a relationship may be mapped, reducing the likelihood of one-sided bias (Cavusgil, Calantone and Zhao 2003). The addition of social network analysis nevertheless significantly complicated the research effort, for it does not allow the tacit knowledge questionnaire to be anonymous, as participants need to identify one another. Apart from the increased difficulty of gaining university ethics committee clearance, it also naturally meant that respondents would naturally be less inclined to participate in case they felt they could be identified.

3.1 Social Network Underpinnings

Social network analysis has as its basis four major underpinnings. Firstly, actors or participants in the system are viewed as interdependent upon one another, rather than independent. Such an assumption highlights the holistic nature of SNA research. Social Network Analysis does not in other words adopt a methodological-individualist stance. The second underpinning is that relations among actors are considered as channels or thoroughfares of resources. Third, the interaction among actors is directly constrained or aided by the structure of the relationships themselves. Finally, the relations that take place between the actors determine all economic, political and social structures (Galaskiewicz and Wasserman 1994 in Koehly and Shivy 1998; Wetherell 1998; Wasserman and Faust 1994). The second and third points are particularly relevant for the tacit knowledge research undertaken here, insofar as an assumption is made that articulable tacit knowledge will be transferred from actor A to actor B and vice versa, depending on the directions of the relationships. Admittedly SNA is not without censure, for "critics argue that SNA's excessive focus on structural relationships tend to minimise the role of individual agency, and that this represents a major weakness of the approach" (Wetherell 1998). Wetherell nevertheless states that SNA has strong support among community network analysts who consider human behaviour as instrumental and that humans tend to interact with one another quite consciously.

3.2 Whole network versus Egocentric Network approach

When undertaking SNA research, one is faced with the choice of undertaking such research at what may be termed the Whole Network (WN) or Egocentric Network (EC) approach (Wetherell 1998). The former method attempts to model all ties between all actors in the system, the boundary for which will have been determined at the commencement of the research. The latter technique concentrates on particular individuals and seeks to focus on selected individuals and how they interact with one another. To a large extent this research takes the former approach. All actors were modelled in the system design, although not all were chosen to participate in the research. The focus on the research is to study the macro information flows between the actors in the system to determine whether tacit knowledge bottlenecking is taking place.

3.3 Membership Rules

Membership defines the actors who will participate in the study for the purposes of SNA. Our research involved three case separate studies in three organisations of sizes small, small to medium and large. Information Technology workers were nominated by a senior manager in each organisation to participate in the studies. Given the closed membership nature of the research, little difficulty was inherent in choosing personnel who

would participate in the study. A whole network approach was taken which included all staff members nominated to participate by the Chief Information Officer (CIO) or their appointee.

3.4 Sociomatrices

In creating social network analysis datasets, the first approach tends to be conversion of the questionnaire data into sociomatrix format. Sociomatrices are as their name suggests square, although they need not be symmetric. Data represented in the *ij*th cell of a sociomatrix refer to relationship information from actor *i* to actor *j*. Actors *i* tend to be represented in rows, whilst actors *j* are represented in columns. Data represented in each of the cells may be either binary if the data in its simplest format is to represent whether a relationship takes place between actor *i* or *j*, in which case a 1 is present, and 0 otherwise. Valued relations tend to make use of positive or negative integer values that express the intensities (supportive or antagonistic) of relationships between the actors. We may see an example of a sociomatrix in figure 2. The row data in this instance presents titles in full, of respondents who have participated (e.g. 3014 …. 3020E). Column titles on the other hand have been shortened to include only the initial integer value of the same value represented in the rows. Multi-valued data has been used which indicates relationship strength from 0 (no relation) through to 7 (maximum or highest strength of relation). Note that a symmetrising pre-processing step on the sociomatrix may need to be performed where the responses of one participant disagrees with the response of another before we can perform visual interpretation or the calculation of quantitative functions such as degree.

		1	2	3	4	5	6	7
		3	3	3	3	3	3	3
		–	–	–	–	–	–	–
1	3013E	0	7	7	6	6	6	5
2	3014	6	0	0	6	6	6	6
3	3016E	6	6	0	6	6	6	6
4	3017	6	6	5	0	5	6	4
5	3018E	7	6	6	0	0	0	0
6	3019E	6	6	6	6	6	0	6
7	3020E	0	5	5	4	4	5	0

Figure 2 providing an example of a sociomatrix

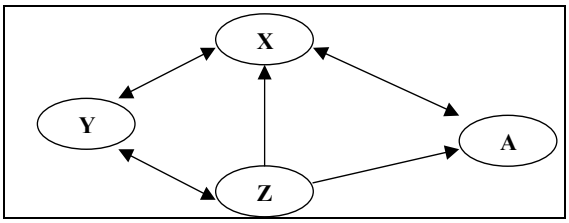

Figure 3: Illustrating in and out-degree

3.5 Degree

Degree is an important SNA concept insofar as it can relate to higher order SNA concepts dealing with actor power, centrality and prestige. Degree relates to the ties an actor has with another. Formally we may express this as $d(n_i) = \sum_j X_{ij}, = \sum_j X_{ji}$. The concept of degree in turn tends to be broken down into indegree and outdegree. "The indegree of a point is the total number of other points which have lines directed towards it; and its outdegree is the total number of other points to which it directs its lines. The indegree of a point, therefore, is shown by is column sum in the matrix of the directed graph [formally, $d_I(n_i) = \sum_j X_{ji}$], while its outdegree is shown by its row sum [formally $d_o(n_i) = \sum_j X_{ij}$]" (Scott 1991 :72; [relevant formalisms from Wasserman and Faust 1994]). From a graphical perspective, figure 3 provides an example of in and out-degree. For instance we can see that node X has a degree of 3. An in-degree of 3, and an out-degree of 2. Node A has a degree of 2, an in-degree of two an out-degree of one. In-degree and out-degree relations can reflect the popularity or extroverted-ness of an individual, respectively. In this study, an expert with a low in-degree factor, would suggest their advice is not sought by others, a low out-degree measure indicates that they are ineffectively transmitting their knowledge to others.

3.6 Centrality and prominence

Connected with in and out degree, centrality relates to an actors level of social prestige. Should relations between actors prove non-directional, the centrality of people is determined by the number of ties relating to each of the actors (Koehly and Shivy 1998). Where ties are directional however, "a central actor is one who sends many ties, either directly or indirectly, to other network members, and a prestigious actor is one who receives many ties from others" (Koehly and Shivy 1998 :9). Centrality may however be further distinguished as local or global. Local centrality tends to refer to an actor, who has a high degree of connectedness with actors directly around them, ignoring the indirect links this actor may have with other actors further away. Local centrality is not concerned with any central point existing in the network of actors. Global centrality on the other hand is based upon what Freeman (1979, 1980 in Scott 1991) proposes as a 'closeness of points'. We can see with regard to figure 3 above that none of the actors are particularly central, save that individuals X and Z may be considered more so than actors Y and A. Extending such a concept is what has been termed betweenness (Freeman 1979 in Scott 1991). In other words actors may have more than one path available to them to transfer

information from actor A to actor B. The logic behind betweenness is that actors are likely to use the shortest path for information transfer. One would hope that the tacit knowledge experts possess a high betweenness centrality enabling their soft knowledge to be easily transferred.

3.7 Density and inclusiveness

Density may be taken as a sign of how many interactions are taking place between actors. We define the density of a non-directed graph as the number of links between actors as a proportion of the maximum possible number of links. Formally Scott (1991) illustrates this concept as: $1 / (n(n-1)/2)$. Where l is the number of lines present. If for example 4 actors are connected by a maximum possible number of ties which would be 6 links, then the inclusiveness of our graph would be 1.0, in other words complete, there being no isolated nodes or actors. The sum of the degrees in the case of 4 actors and 6 links would be 12, there being an in-degree and out-degree for each of the links. The density of this complete graph would also be 1.0, in other words complete. There can be no other connections between the actors, for all means of connectivity or knowledge communication flows will have been achieved. If however our four actors are all joined by only 4 links then our inclusiveness will still be 1.0. In other words our actors are all still connected with one another, however not all directly, it will be necessarily for communication flows for some actors to have to pass through another, rather like an IBM Token Ring network. Given 4 links, our sum of in and out-degrees becomes 8, instead of 12, with our network density being 0.7, instead of 1.0 (Scott 1991).

3.8 Cliques and discrete networks

The clique is one of the fundamental components of social network analysis and may be thought of as a "sub-grouping" of a network. This sub-grouping is built up, or developed out of the combining of dyads and triads into larger, but still closely connected structures. Cliques form an important social construct due to the fact that they are formed by all subgroup members choosing one another. More formally we may state a clique is a " 'maximal complete sub-graph' (Luce and Perry 1949; Harary 1969 in Scott 1991). That is to say a clique is a sub-set of points in which every possible pair of points is directly connected by a line and the clique is not contained in any other clique" (Scott 1991 :117). If we were to have three actors participating in a clique this would mean that the number of links connecting them would be three.

Depending on the software utilised, it is possible to identify 'emergent groups' potentially as "discriminant analysis could be performed to evaluate statistically whether actor attributes such as gender actually differentiate such group memberships" (Arabie 1984 in Koehly and Shivy 1998 :12). For as Wasserman and Faust (1994) point out, what makes data far more meaningful are the composition variables, which provide the attribute related data, in this case for respondents who have taken part in the tacit knowledge questionnaire. We may note from figures 4 and 5 below for example, that a clique has formed based on Cantonese being used by the clique members as a second language. In other words, these group members have chosen each other to associate with based on their first language other than English. We see more specifically in figure 5 that the Cantonese speakers are nonetheless interspersed with other staff in the company, the Cantonese speakers do not completely isolate themselves.

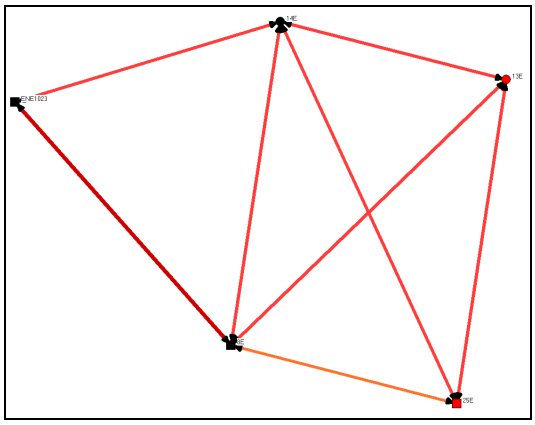

Figure 4: illustrating clique (or emergent group) (left hand side) of Cantonese speakers (source Organisation X)

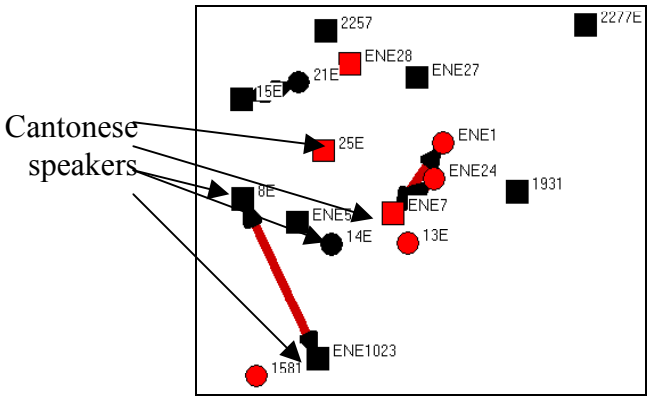

Figure 5: Illustrating specific area where Cantonese clique is based.

3.9 Sociograms

Having established a sociomatrix for SNA data, and having performed numerical processing on the data in question, leads typically to the establishment of a sociogram or network diagram. Sociograms represent sociomatrix data by way of graph theoretical constructs, insofar as objects such as respondents are implemented as nodes, whilst relations between respondents are illustrated as edges or lines connecting the nodes. A difficulty arises when the graph includes more than a limited number of nodes, in that the edges of the graph soon begin to cross over. "One common technique has been to construct the sociogram around the circumference of a circle, so that the pattern of lines becomes more visible" (Scott 1991 :149). Figure 6 illustrates such an approach, which can be diagrammatically powerful through the appropriate use of colour to highlight attribute based data, such as age groups and gender. Note the use of colour in this instance to indicate gender. Blue represents males, and green females. Red indicates that respondents have not indicated their gender as part of the questionnaire.

A disadvantage with circular diagrams however is their loss of mathematical information, for "the points are arranged in arbitrary positions, and the drawn lengths of the various lines reflect this arbitrary arrangement. It is not possible to infer anything about the actual position of points relative to one another or about the distances between them" (Scott 1991 :150). To that end social network analysis has moved towards producing more mathematically true graphs utilising Multi Dimensional Scaling (MDS). Utilising graph theory, MDS calculates the number of lines connecting two nodes, and based on this measure is able to determine the distances apart the nodes should be spaced (figure 7).

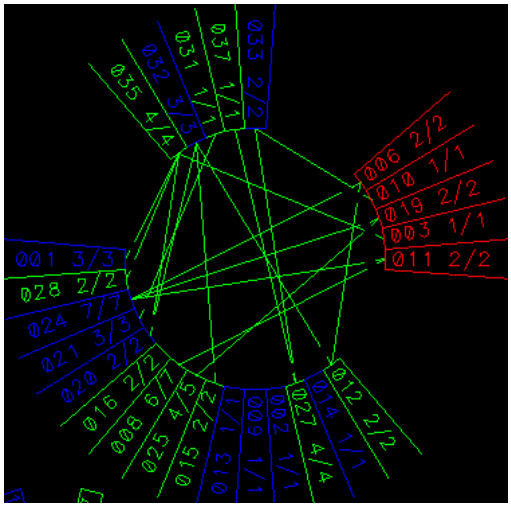

Figure 6: illustrating a sociogram

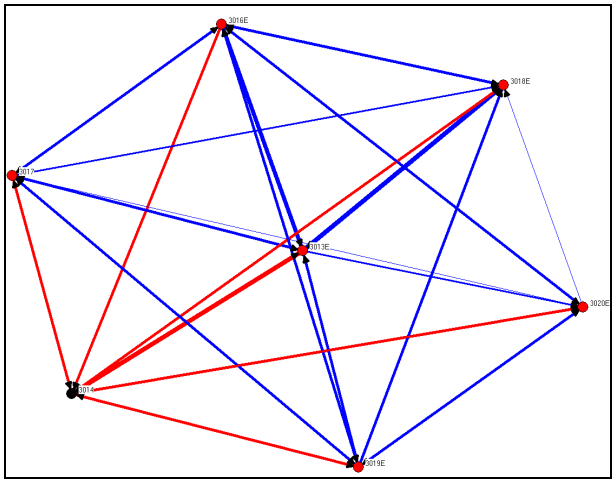

Figure 7: illustrating an example of multi-dimensional scaling

4. THREE CASE STUDIES

In this paper we only present the briefest of results of the studies, which are related to tacit knowledge flows. To demonstrate the nature of the conclusions we were able to draw via SNA we offer a partial summary of each organization. A detailed analysis of the communication patterns and networks with the identification of potential bottlenecks was produced and provided to the respective CEO or designate of each organisation (X, Y and Z). Space limitations naturally prevent us providing a detailed analysis here.

4.1 Organisation X summary

What were we able to glean from Organisation X in terms of the likelihood of tacit knowledge flows? A brief examination of the SNA sociogram for this Company gives some idea of the complexity of interpreting the data (figure 8). Firstly that there is a potential that some of the tacit knowledge of contractors is not being transferred to the extent that it could be. The contractors whilst not necessarily interacting with either themselves or only other contractors did not tend to form as long a term relationship with permanent staff, as other permanent staff did with their own kind. There can potentially be a danger in over-employing temporary staff who will take their soft knowledge with them when they leave the firm Another finding for this company was that certain key members, such as ENE 20 (expert non-expert or expert-novice number 20, that is to say individuals not identified by peers as experts in the survey but who gave responses to the scenarios similar to the identified experts) did seem to be pivotal in transferral of knowledge from one section of the organisation to another. We were able to ascertain from examining the SNA graphs that ENE20 was acting as a link between macro-cliques

in the firm, but provided the only bridge between the actors in each of these cliques. On the one hand it is positive that at least the macro-cliques communicated with another. On the other hand one must consider the potential impact of this situation were ENE20 to be leave the firm or be transferred elsewhere.

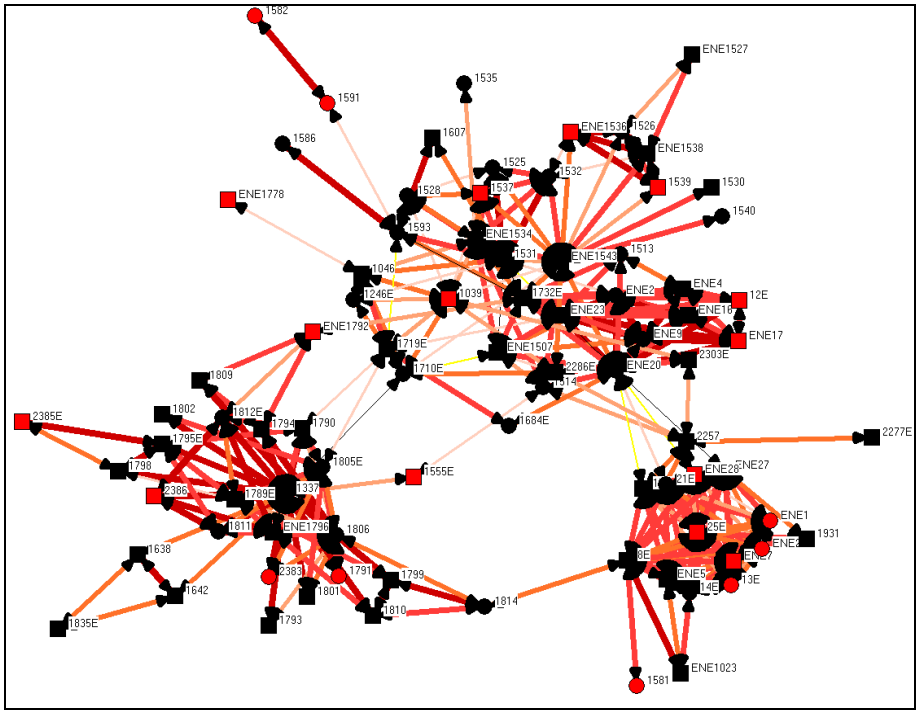

Figure 8: Sociogram illustrating all actors participating in Organisation X

Further examining the SNA graphs, we could ascertain that intra-clique communication patterns were quite dense. We found there existed many (54) 'micro' level cliques, where a clique had to comprise at least three actors. Certain micro-cliques did not involve the presence of experts or ENEs, so that consequently some novices had limited access to experts. On the positive side, most novices did have access to at least one expert or ENE. If knowledge can be said to represent power, then the access to the knowledge that experts possess can be helpful for less experienced personnel. At the opposite extreme, the SNA results revealed that there existed 'power' cliques made up almost exclusively of staff who were either experts or ENEs. Although a novice may not outwardly realise the clique is made up exclusively of experts (so named or otherwise), joining such a clique would likely prove beneficial for the uninitiated. Finally, the SNA measures of degree, centrality, information centrality and betweenness indicated there was not necessarily a perfect or even strong positive correlation between expertness or expert non-expertness and higher scores on these parameters. That is to say more expert actors were not necessarily as centrally located in the cliques as they could have been. While experts on the whole were involved in quite a number of different cliques, which meant their expertise could be spread, the downside of being involved in so many cliques included the possibility that their communication links were likely to be more superficial than those actors involved in fewer cliques. Finally there also appeared to be a number of communication contacts between actors in this organisation where only electronic means of communication {faxes, email} were brought to bear. There is some evidence that such a limited means of communication can be detrimental to soft knowledge transferral.

4.2 Organisation Y summary

Organisation Y had very different communication patterns. Firstly, the small 'cottage industry' size of the organisation indicated higher densities of communication patterns with fewer actors acting as communication bridges. The seven actors who participated in the research were all well connected (figure 9). The lack of electronic means of information communication increases the probability that tacit knowledge could be easily transferred. The fact that all staff met face to face regularly (at least daily, if not hourly) would further indicate a high confidence in the tacit knowledge transfer process. That the staff appeared to have no major areas of conflict in terms of not wishing to see colleagues indicated harmonious working relationships. The numerical values of information and other measures of centrality, along with values given for degrees, indicated that the one novice actor played a role as important or 'central' to *most* of the experts, with the exception of perhaps one of the managing directors (also an expert). The mission of the Company Y was overwhelmingly focused on

knowledge transfer given its role as a management information systems consultancy. The SNA measures indicated there was little likelihood of soft knowledge bottlenecking.

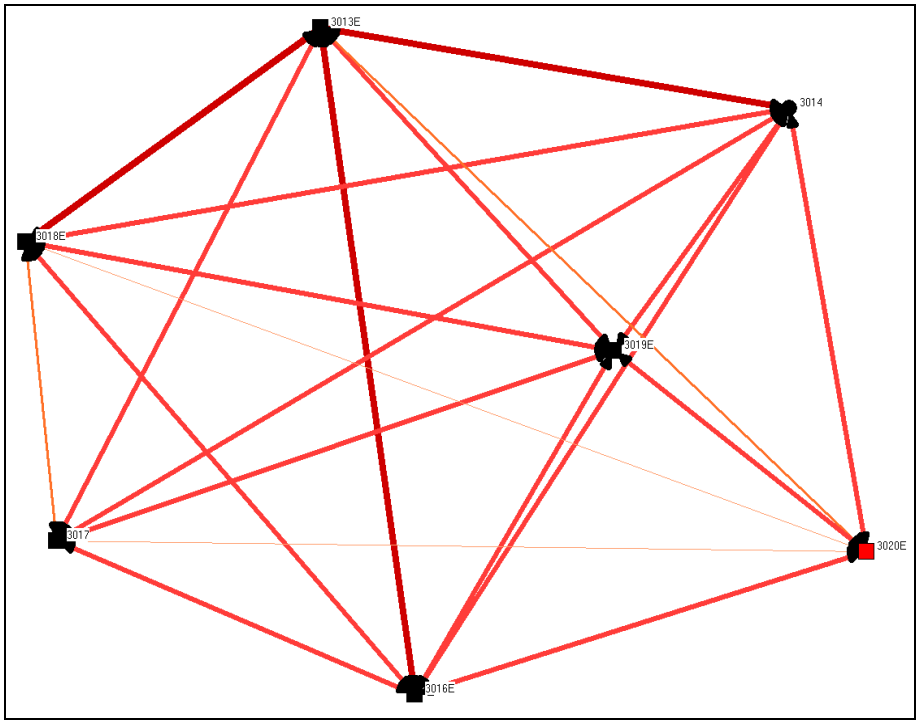

Figure 9: Sociogram illustrating all actors participating in Organisation X

4.3 Organisation Z summary

In Firm Z (figure 10), the SNA metrics indicated there were a large number of cliques (thirteen) with experts and the CIO participating in almost all cliques. On the basis of power, a 35-39 year old contractor and a 20-24 year old help desk support officer tended to outrank some of the experts. It appeared again that the experts had lower network densities.

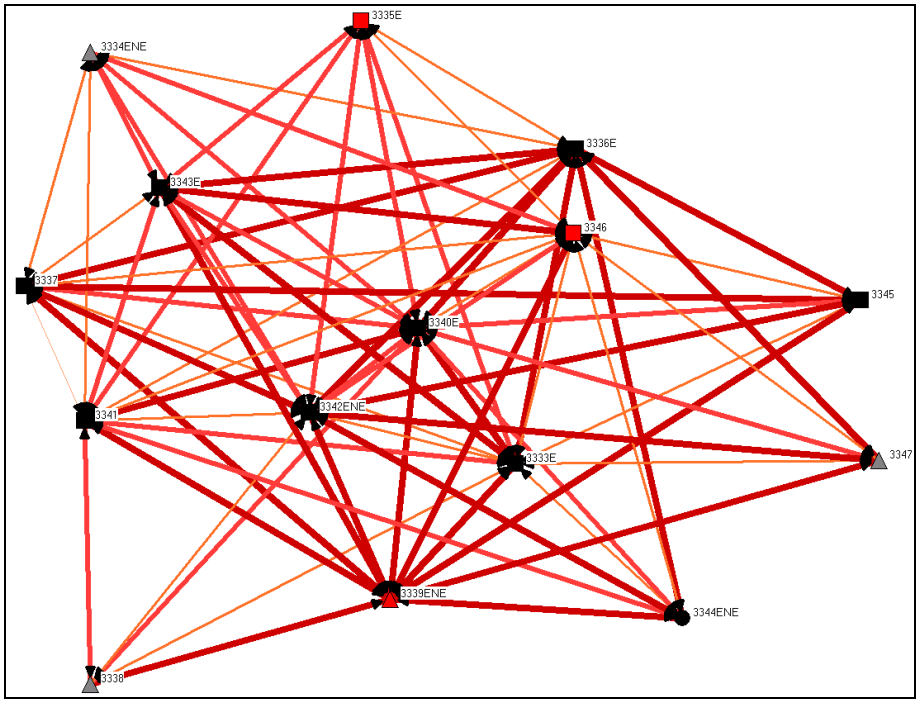

Figure 10: Sociogram illustrating all actors participating in Organisation X

Concurrently, these people tended to be connected with a higher number of individuals. With regard to degrees, a pattern emerges that indicates whilst experts may not be the most oft contacted, or making contact, they do generally appear to have the highest prestige rating in relation to values of person importance. The size of the Organisation would tend to indicate quarterly or monthly meetings are not appropriate and so the least people see each other is weekly, with daily meetings involving an overwhelming proportion of the staff as well. Most staff are involved in formal meetings but it would appear most people, particularly experts, are 'bumped into'. Because of the relatively diverse ethnic nature of Organisation Z, there does not appear to be any significant cliquing on the basis of language other than English. There does appear to be some superficial antagonism between a few of the people (4 in all) in terms of one of the expert non-experts attempting to avoid seeing three others, however this is the only such example. We note one individual who exhibited behaviour similar to the peer-nominated experts who has high centrality, but not prestige. It appears they may be a good spreader of tacit knowledge, but that they are not typically approached in relation to tacit knowledge. While phone conversations are limited, email is used extensively and typically sent to experts.

5. SUMMARY

Tacit knowledge bottlenecking is a key concern for any organization. From our use of SNA we concluded that while tacit knowledge is not likely to be severely bottlenecked in Organisation Z, the authors are of the opinion that transfer is likely to be far less easy than for example in Organisation Y. Organisation X on the other hand will almost certainly not achieve the same level of tacit knowledge diffusion as Y. From our comparative analyses of the three organisations we proposed a number of features of the optimal organisation for tacit knowledge flow. In summarising the methodological underpinnings used in this study, one needs to bear in mind the suitability of means for assessing tacit knowledge diffusion. The Sternberg means of testing for tacit knowledge is considered to be the most practical approach for undertaking research in the organisational domain. One of the underpinnings of adopting psychological approaches to testing however is that they tend to typically rely very heavily on both descriptive and analytical statistics. Statistical techniques were used but not solely relied upon in this study since access to participants was controlled by the organisation (thus sample sizes were not a design parameter we could choose) and the research was going to be conducted in a non-anonymous format partially negating the benefits of using a purely statistical approach to data analysis. An alternative means of thus displaying the data was trialled. Formal Concept Analysis (Wille 1997) based on lattice theory permits the visualisation of questionnaire data whilst at the same time still providing legitimacy to data interpretation. However, this paper has been focused on the other major component of the research concerned with assessing the soft knowledge flows within three specific organisations. We chose to use Social Network Analysis as this approach by its very nature is not only less intrusive than participant observation, but is able to be incorporated into the same questionnaire, meaning that employees would be disturbed for an overall lesser period of time. Indeed the last point is of particular relevance when conducting research with active professionals who do not necessarily represent a captive audience. We offer two recommendations for tacit knowledge diffusion and the usage of SNA based on the results of our study:

1. A technique such as SNA should be employed to identify staff interaction patterns where for example personnel may be avoiding one another (as we saw to some degree in Organisation X) or where access to experts (both peer-identified and those behaving like experts) is limited. Based on the SNA findings firms could rearrange its staff to better allow for soft knowledge communication.

2. Another recommendation would be for companies to permit staff to socialise in a carefree environment. Encouragement might be given for socialisation after hours or perhaps for recreational facilities to be made available for knowledge workers whereby they are able to exchange their ideas in relaxed and non-judgemental surroundings.

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