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Business Process Management, Social Network Analysis and Knowledge Management: A Triangulation of Sorts?

Peter Busch
Macquarie University, peter.busch@mq.edu.au

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Dr. Peter Busch
Department of Computing
Macquarie University
North Ryde, 2109, Australia
Email: peter.busch@mq.edu.au

Abstract

As its name suggests, Business Process Management seeks to manage the processes companies typically undertake on a day to day basis. In line with many management techniques, improvements can made through analysing at varying granularity how processes are actually undertaken compared to how management may consider they are being accomplished and vice versa. One innovative way Business Process Management may be improved is through the use of Social Network Analysis to observe actual working relationships among employees. This latter technique permits the workflow manager specifically to consider how well matched employees are to their workflow and as a result of this, we have a means of either reconstructing workflows or alternatively employee practices. A small research-in-progress case study is presented illustrating how these principles may be applied in practice. Overall one may consider such improvements as aiding in the knowledge management of the organization as a whole.

Keywords

Knowledge Management, Business Process Management, Social Network Analysis, Process Mining, Workflow Mining

INTRODUCTION

The fields of Social Network Analysis (SNA) and Business Process Management (BPM) are both comparatively recent and represent approaches to better understanding the human factor, typically at a relationship level in the case of the former and workplace task level in the case of the latter. In the case of the former and older discipline, the focus has been almost exclusively on human interaction and the resulting informative patterns that emerge as a result of these. Business Process Modelling on the other hand is somewhat more technocratic, focused as its name suggests in the business domain and amongst other things includes modelling of workflows to aid in better aligning employees with work practices or vice versa. Some (e.g. Busch, 2008) would argue that Knowledge Management (KM) comprises a related and perhaps parent discipline whereby the former two approaches can contribute to the organisational 'big picture' of managing a company's intellectual capital. Others (e.g. Fettke in Houy et al., 2010), see KM as being equal to, rather than above the former two approaches, having originated at roughly the same time as BPM, the 1990s (Houy et al., 2010). Very little scholarship and even less research has been conducted to date on the juncture of the three approaches and this research in progress paper seeks to partly redress that problem, but focused more so on the confluence of BPM, SNA and KM specifically.

KNOWLEDGE MANAGEMENT

Knowledge Management is a recent field of study, the underlying principles of which include maximising knowledge utility and optimising work practices similar to the practices advocated by Taylor (1911) a century ago. Since then, there has been a more recent return to worker self-empowerment with individuals seeking a sense of belonging and greater fulfilment in the workplace, particularly amongst generation Y (b. 1977-1994) (Amar, 2004; Busch, 2008). As evidence for this, there is recent appreciation for 'Human Capital' (Jorgensen, 2004) that is to say the intellectual capital of the organisation as a whole; coupled with acknowledgement of 'Social Capital': incorporating the complex relationships of trust, reciprocity and norms necessary for the achievement of workplace goals which are "valuable to an organization because it improves efficiency of action and facilitates the development of new forms of association and innovation" (Jorgensen, 2004 p. 97).

Other compelling reasons for organisations to consider knowledge management practices have been the acknowledgement of knowledge, not necessarily superseding financial capital, but certainly replacing the latter in prominence amongst certain CEOs (Tiwana, 2000). Also, there is the consequence of globalisation (Hustad, 2004) as Multinational Corporations (MNCs) spread their operations globally but act locally i.e. 'glocally' (Hustad, 2004). Such 'glocal-isation' introduces complications of cultural operating differences from one region

to the next, not to mention placing differences in value on knowledge types. For example in both Japanese and Chinese firms, implicit knowledge is prized, more so than in western firms, but in Chinese firms specifically, knowledge tends to flow upward, unlike in the Japanese example (Burrows, Drummond and Martinsons, 2005). Furthermore there is also the acknowledgement in KM circles to potential knowledge loss due to currently retiring Baby Boomers (b. 1945-1963), as their knowledge may not be effectively transferred to Generation X (b. 1964-1976) or Generation Y (b. 1977-1994) (Amar, 2004; Busch, 2008). As a result of such parameters, a particularly important element of knowledge management is in better understanding intra-organizational knowledge flows and much scholarship in recent years has been devoted to this (Davenport and Prusak, 1997; Guzman and Wilson, 2005; Liebowitz, 2005). The importance of the receiver understanding the knowledge being delivered is of importance as are temporal issues, for there is little point in transferring irrelevant knowledge at inconvenient times.

One means of understanding knowledge flows or bottlenecks is 'mapping' the relationships between employees, with whom they communicate, how often and so on as a means of better grasping the inter-personnel communication of employees (Busch, 2008). In so doing new staff are able to more easily acclimatise to company culture as well as better grasp at a macro level at least, what pools of intellectual capital may exist within the firm. From management's viewpoint, knowledge mapping allows them to better understand the effects of loss with the departure of key members of staff, whether the staff are openly acknowledged to be key to the company or not. Finally, it has been noted that two approaches to knowledge transfer are considered feasible; either treating knowledge as an *object* which can be observed, stored and so on (Albino et al., 2004), or treating it as a process, in which case we may visualise changes in people who learn (Sveiby, 1997). The approach adopted in this paper aligns with the latter viewpoint.

BUSINESS PROCESS MANAGEMENT

Knowledge Management as an overall concept of managing the organisations intellectual, human and social capital is well researched and widely acknowledged and reported (Busch, 2008). From an extensive review of the literature, the author has observed that what is not so widely covered is the crossover of KM with Business Process Management. One exception is Business Process Oriented Knowledge Management (BPOKM), where an open acknowledgement is given to aligning KM with business processes (Gudas, 2009; Kaner and Karni, 2004), nonetheless little scholarship to date has focused on micro-examining the relationships existing between staff as a means of improving the entire management process. As with many management approaches, BPM incorporates a lifecycle; and recent work by Houy et al. (2010) provides an aggregation of BPM lifecycles which they consider to be comprised of six steps: Stage one considers the strategic management of business processes; stage two represents the definition and modelling of relevant processes; stage three implements processes in the company; stage four is the actual execution of processes; stage five monitors and controls process execution; finally stage six optimises and improves business processes, and the cycle by definition begins again. Let us now turn our attention to BPM.

BPM: A SUBSET OF KM?

> ……a knowledge management approach capable of supporting the accumulation, sharing and reuse of knowledge and experience in a distributed development environment is required for effective and successful development and implementation of enterprise systems (Ho et al., 2004 p. 440).

Consequently, there would appear to be a relationship between KM approaches and enterprise systems to which BPM plays a key role, and that *role* is the fine tuning of business processes. For example Ho et al. (2004) are of the opinion that much KM research to date has focused on strategies and methodologies from a purely overarching organisational perspective. For truly effective KM business methodologies and software functionality to support this requires thorough examination of business process characteristics; as such they recommend the "(i) identification of target business processes and their characteristics and (ii) identification, analysis and modelling of involved knowledge" (p. 440). Lewis et al. (2007) acknowledge that one way to achieve success in this area is to have a number of employee roles such as 'process analyst' who can concern themselves with developing conceptual models "with a rich understanding of interdependencies, directionalities, inputs, and outputs associated with a business process" (p. 9). 'Workflow designers' can then assess the conditions and constraints affecting what are often interdependent work activities and search for new ways of coordinating such activities. At an overarching level 'workflow managers' may then structure the social and IT environment to best harmonize the human to technical interface.

Methodologies for improving BPM efficiencies *with a specific focus on the human parameter* are however few and far between. Magdaleno et al. (2008) comment on the relatively scarcity of BPM maturity models that truly consider the human component, such that they name but two; that proposed by Fisher (2004) and another by Rosemann and colleagues (Rosemann and de Bruin, 2005; Rosemann et al., 2006). Certain other approaches are

noteworthy; within the related study of enterprise architecture we find the Zachman framework (Neaga and Harding, 2005; Zachman, 1999, 1996), which is not a methodology *per se* as it lacks specific processes or methods for handling the collection of information, but the framework does nonetheless attempt to define relationships between organisational entities with an emphasis given to the human parameter. Another enterprise architectural technique is 'thinklets' or "packaged, repeatable, and transferable facilitation techniques that can he deployed to create predictable patterns of collaboration among a group of people with a shared goal, during a collaborative process" (Deokar et al. 2008 p. 14). One approach for which there is very little evidence in BPM circles, which is ideal for assessing concepts of knowledge transfer is that of Social Network Analysis (Wasserman and Faust, 1994), and it is SNA to which we turn our attention next.

SOCIAL NETWORK ANALYSIS

A useful tool for conducting research on the interaction of human relationships is that of Social Network Analysis (Hanneman, 2002; Wasserman and Faust, 1994). Where as once researchers may have hand-drawn the relationships between people or actors (to use the SNA term), today software provides a means to achieve relationship display more accurately and in a fraction of the time. The central belief is that actors exist within networks and these networks of family units, neighbourhoods, even entire societies are researchable social entities in themselves. The SNA scholar is thus interested in interpreting the structures of these networks through the strength of the links illustrating who is in contact with whom (Hanneman, 2002). SNA research is often conducted in an workplace setting and we are interested in seeing how departments and employees therein collaborate, in effect providing us with a knowledge map aiding in the knowledge audit process (Liebowitz, 2005).

Social Network Analysis has four major underlying principles; first, actors or participants in the system are viewed as interdependent upon one another, rather than independent: such an assumption underlines the holistic rather than methodological-individualist nature of SNA research. Second, relations among actors provide access to resources. Third, the relationships that exist among the actors are determined by and in turn determine the structure of the actor interactions. The final point is that the interactions between actors determine their social, economic and political structures (Wasserman and Faust, 1994; Wetherell, 1998). Arguably, the second and third points are most relevant for the scholarship of knowledge exchange, leading to better understanding of business process improvements.

One final consideration when undertaking Social Network Analysis research, relates to whether the Whole of the Network (WN) or an Egocentric Network (EC) approach should be considered (Wetherell, 1998). The latter approach concentrates on the relationships of the individual rather than the whole of organisational network (Hanneman, 2002; Liebowitz, 2005). From a BPM point of view, we would argue the WN approach is preferable as we are less interested in how one individual performs a process and with whom, rather we would like to establish efficiencies across the organisation as a whole. Other than potential ethical concerns, there would be little reason why management might not want to concentrate on the relationships of an individual employee.

Let us return briefly to the notion of the knowledge audit process. From an SNA specific point of view, Organisational Network Analysis (ONA) provides us with a means of interpreting (normally professional) workplace relationships. Johnson-Cramer et al. (2007) observe that SNA theorists have traditionally focused on the structural properties of networks rather than the types of relationships connecting a network which they summarise along the following lines: "while some network research has explored expressive or emotional aspects of relationships - such as friendship, personal or career support, and trust - few have considered how these deeper relational dimensions affect important organizational outcomes such as change and innovation" (p. 101). Also of relatively recent SNA interest has been the area of networked customer relationships, more characteristic of the private sector; for example, Wu et al. (2009) note that apart from the usual Customer Relationship Management (CRM) aspects of completely recording the customer-business association, CRM-specific adoption of SNA enables the categorisation of the customer base on the basis of their business history. The benefit of such an SNA directed approach permits marketing to a clientele that is far more targeted, and in turn more efficient for the targeting business. Example research questions for the business that can be answered include: "how to compare the long-term effects on group customer value of different advertising approaches and product selections or pricing? who is a leader that has the most influence in a group? how a leader plays a role to keep a group for a longer life? what is the lifetime value of a group compared with other groups and how to increase the group value effectively?" (Wu et al., 2009 p: 3-4).

A TRIANGULATION OF SORTS

As was mentioned in the introduction, each of the disciplines of Knowledge Management, Business Process Management and certainly Social Network Analysis have relatively well established profiles, but the *intersection* of them do not. Having undertaken an extensive literature review, it is apparent that a merging has taken place of

the last two decades of KM and BPM specifically, as both disciplines have come of age at roughly the same points in time (figure 1). They both tend to be organizationally focused; they are both concerned with managing flows of knowledge; and they are both concerned with truly understanding the 'human social dimension' in the workplace context. Whilst the two methods are clearly not the same (KM could be construed to be more sociological in interpretation with BPM up until now more being technocratic in focus), there would appear to be a merging or at least an overlap in the disciplines over the last decade. It is through the medium of actors and related activity roles of personnel that we explore the intersection of the two approaches and Social Network Analysis provides an ideal means of doing so. The value of examining activity roles of actors or employees is that we can examine the mapping of tasks to personnel at a relatively low level of granularity, asking questions of the relationship of staff with their work processes, or of their working relationships with other colleagues. Let us examine BPM as a discipline and its relationship to KM before we examine how SNA can play its part in the confluence of these two approaches.

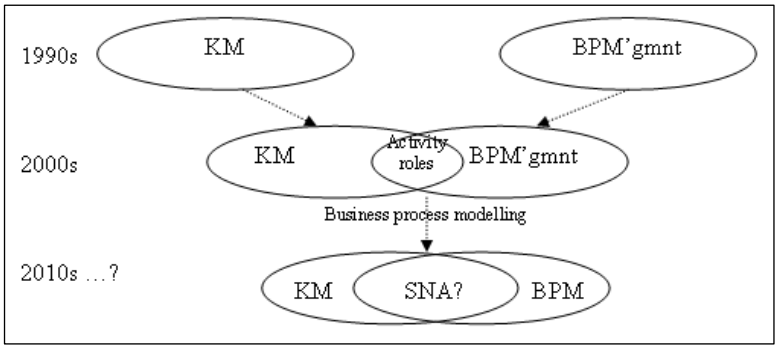

Figure 1: An interpretation of the merging of KM and BPM, with utility provided through SNA (I argue that Business Process Management (i.e. 'gmnt') has evolved to become the BPM we are familiar with today).

(Business) Process Mining

Most of relevance in this paper is the use of SNA with BPM as an way of engaging in Knowledge Management. Business Process Management has as one of its primary goals, the comprehensive elicitation of knowledge relevant to work processes (Fettke, 2009). More specific to modelling employee work processes within BPM, is that sub-area concerned with *workflow modelling* (Papazoglou and Ribbers, 2006); such modelling attempts to accurately interpret how employees conduct their day to day activities and then find ways to improve them, thus gaining organisational time and consequently cost efficiencies. Traditionally the means of acquiring such workflows from staff has taken place via systems analysts either conducting questionnaires with employees or observing them undertaking their tasks in the workplace. Naturally such efforts are prone to flaws in as much as staff may not accurately predict with whom they work or pass work on to or receive work from, and in the case of observation, staff are prone to changing their behaviour if being observed.

Once Workflow Management Systems have been implemented, theoretically there *should* be improvement in workflow processes. Unfortunately such improvements are not so simple; inevitably there exist differences between that which workflow systems prescribe as workflows and workflows employees conduct in practice, even after supposedly successful examination through systems analysis (van der Aalst, 2005). To that end a very useful approach to better understand *actual* work processes is that of *business process mining*. Process or workflow mining as it is otherwise known (Hanachi and Khaloul, 2008; van der Aalst, 2005; van der Aalst et al., 2007) provides the BPM community with an opportunity to *more accurately* gauge workflow communication amongst staff, for "workflow mining analys[es] the execution traces of a collaborative system in order to create a workflow" (Hanachi and Khaloul, 2008 p. 93). In modern workflow systems, activities are stamped with a beginning and end time point; an event log thus retains information on the length of tasks, the time they started and consequently finished and usually some form of identification relating to the personnel who undertook them (van der Aalst et al., 2007).

To provide an analogy, the use of SNA in relation to process mining may be likened to reverse engineering software; for through feeding already existing workflow logs in to SNA techniques we build a truer organisational picture with regard to how work is *actually* being undertaken as opposed to how the system *thinks it is* (Hassan, 2009; Koschmider et al., 2009; van der Aalst et al., 2005; Weber and Scharff, 2010). Instead of just designing the system from top down, we can actually modify the system design (stage 6, Houy et al., 2010), from bottom up as well as top down. Through the incorporation of SNA we can analyse the intensity of working relationships and determine the strength of workplace ties. For example, a seminal paper by Hansen (1999) had noted the variance in tie strength with regard to conducting knowledge transfer in the work process: weak organisational ties forced employees to look outside their work group for information conducive to conducting their tasks; stronger ties conversely meant employees tended to satisfy their information needs within their group. In addition, Bruque et al., (2008/2009) noted that *information networks* in particular (as opposed to purely emotionally laden supportive networks) tended to be characterised by high density ties in which "people [could] avoid duplicating the work of others in obtaining valuable information on what their contacts ha[d] been engaged in" (p. 183). The implications of such findings are that business processes can be realigned more effectively; for example whereas re-aligning processes along closer geographic intra-organisational lines, may produce performance improvements (Hansen, 1999; Reijers et al., 2009), there is in fact more to it than that, for "the use

of workflow technology in itself is not sufficient to level geographic barriers between team members and … additional measures are required for a desirable performance" (Reijers et al., 2009 p. 307). As contemporary workflow systems do not actually represent work practices in a pragmatic sense through a completely valid association between work items and knowledge workers (van der Aalst and Kumar, 2001), SNA at the very least provides a number of measures, approaches or techniques for evaluating alternative process designs (Hanneman, 2002; Hassan, 2009), examples of which include centrality, cliques and network density, all designed to gauge the 'closeness of fit' of employees to one another.

From the BPM side, there are a number of approaches to modelling business processes with particular consideration being given to the social aspects of working together. Perhaps one of the more commonly known ones is that of Business Process Modelling Notation (BPMN); another approach developed as part of the *Architektur Integrierter Informationssysteme* (ARIS: Architecture of Integrated Information Systems) by the Scheer group of Germany, is that of *Ereignisgesteuerte ProzessKette* (EPK) or Event-driven Process Chains (EPCs) in English (Scheer, 2001). Regarding *empirical* output specifically, the author has located comparatively little scholarship that combines BPM and SNA; none the less the work of van der Aalst's group has been informative (van der Aalst et al., 2005; van der Aalst et al., 2007). With the application of SNA techniques to workflow mining we can begin to determine how staff actually undertake their tasks and with whom. Furthermore with the use of Delta Analysis (Ingvaldsen and Gulla, 2006; van der Aalst, 2005), we have a technique to compare as-is with to-be processes to build a more realistic picture of how work practices may be re-aligned; figure 2 provides an insight in to the overlap of SNA with regard to BPM in a firm; in as much as the business process captured in the BPM model will have roles and personnel allocated to the processes which can then be compared to the sociograms of actors in an SNA approach.

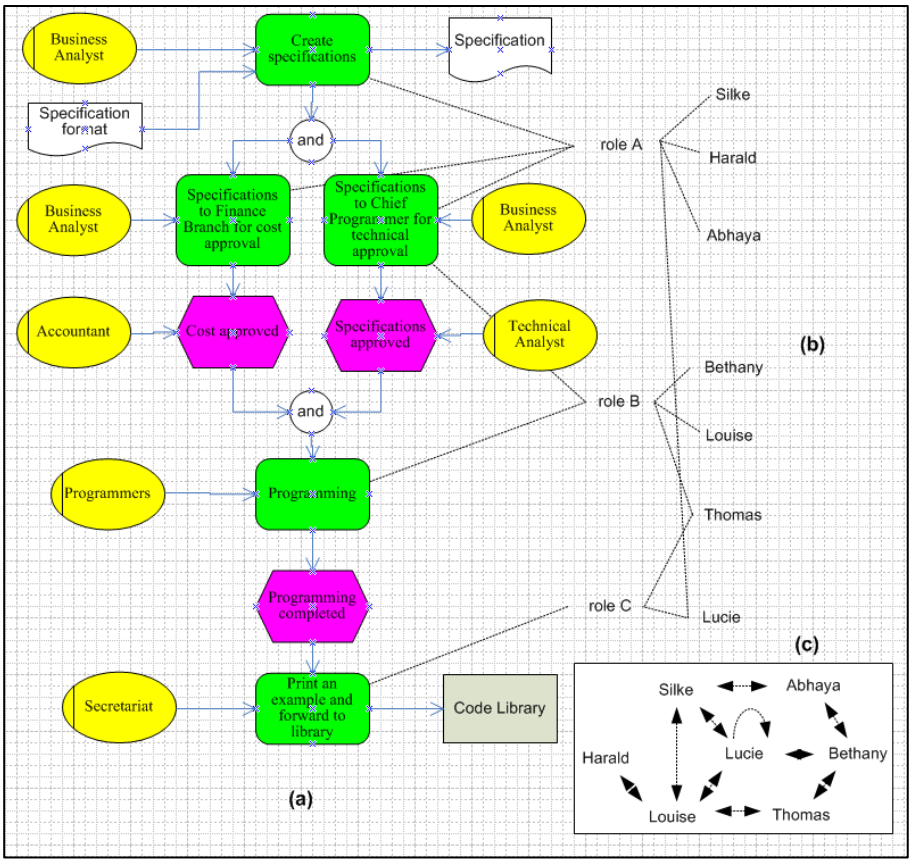

Figure 3 (a: EPK model, b: roles and c: sample sociogram): Organization Beta: Conceptualisation of program coding process (inspired by van der Aalst et al., 2007).

The application of SNA to BPM

Remember what we seek to examine is the role SNA can play in aiding the BPM lifecycle mentioned earlier. With regard to strategy development (stage 1, Houy et al., 2010), SNA decisively helps in identifying individuals as well as work groups who play central roles in the organisation; at the same time SNA is quite capable of discerning holes or bottlenecks in a network (Serrat, 2009). Through better understanding many of the informal networks in the organisation we can better map business processes to how employees actually undertake their tasks or indeed vice versa. With regard to stage 2 (Houy et al., 2010), definition and modelling, the sociomatrices and sociograms map quite closely with the workplace roles outlined in EPKs or BPMN. In fact there can be virtually a one to one mapping. By comparing the two techniques we can establish the 'closeness of fit' of personnel to actual versus perceived work practices. For stages 3, 4 and 5 (Houy et al., 2010), SNA plays a less direct role, but it is useful in performing before and after checks of employee networks and then comparing these to improved BPM routines. Re-running SNA questionnaires or alternatively delta analysis after improved BPM processes, leads in turn to stage 6 (Houy et al., 2010) optimization and improvement.

Observe in figure 2a, an EPK (or related BPMN) diagram provides the reader with an indication of a stepwise business process. What is not visible in figure 2a is *who* performs the process. Certainly roles of sorts are provided (the ellipses), but not the complete truth relating to who specifically are undertaking these roles in practice. Extrapolating such information with the aid of event logs obtainable from many modern day workflow systems allows us then to determine the '*who'* of the EPK model (figure 2b). Certainly, we gain some understanding of different roles existing in figure 2a from an official workplace standpoint, but we do not adequately visualize *who* is actually undertaking these roles in practice. Taking the information gleaned from figure 2b and then processing this information through SNA, we can develop the sociogram illustrated in figure 2c. Now we see that employee Lucie has passed some work related process back on to herself and that she is contacted by employees Silke, Bethany and Louise. Also note Harald is only contacted by Louise and also contacts her, but appears not to be in contact with anyone else; he is in SNA terms a relative 'isolate. Examining figure 2b in closer detail it is evident that Silke, Harald, Abhaya and in fact Lucie share role A; Bethany, Louise and Thomas share role B and Lucie (in combination with Thomas) share role C. Role A involves creating specifications, sending these to the finance branch for cost approval as well as to the chief programmer for technical approval. Role B relates to actual programming but also involves some technical liaison with the chief programmer. Role C involves printing the completed code and sending it to the code library.

Figure 2a would seem to indicate that role C is performed by the secretariat only; however Thomas is actually a programmer as we see later in table 1. Why is a programmer spending time printing code and sending it to the library? This may be reasonable; alternatively it may be an expensive use of his time? As a BP manager what we wish to know is whether the processes we have planned are actually being conducted by the people we thought they would be. Another way of phrasing this, is 'have we designed our processes to best utilize our staff'?, for as Hassan (2009) notes "managers began to realize in the 1980s that people were not the source of most problems; instead, it was the system or process holding people hostage that caused most … problems" (p. 62). Taking this further and re-organizing business processes are noted by Weber and Scharff (2010): "Knowledge-intensive business processes are characterized by the fact that different people, information objects and knowledge objects are related to each other. ……For the conversion of knowledge-intensive business, it is ... important to know, which objects interact with one another. If this is known, there is a simple algorithm to convert a set of processes with their objects in a network" (p. 14; *translated from the German*). What does this mean with regard to a working example? Next we briefly introduce an organization and show how a simple set of work processes may be mapped in SNA to determine the closeness of fit to work practices.

DISCUSSION: ORGANIZATION BETA

Organization Beta is a hypothetical Small to Medium Sized (SME) firm in Australia employing in the order of 70, with a small number of IT staff (12 personnel). The staff vary in their experience, one is their CIO, the rest possess roughly three to five years IT experience. Whilst a total of 12 staff make up the IT team, only 7 of them are featured in the study here, namely Bethany, Louise, Harald, Silke, Abhaya, Thomas and Lucie (table 1). To obtain data for a study such as the one presented here, the researcher could use a number of data gathering techniques: one approach is that of a questionnaire incorporating Social Network Analysis in line with previous such approaches (e.g., Busch, 2008); an alternative is that of obtaining event logs from management (e.g. van der Aalst et al., 2005); or simply interviewing management and the employees themselves to determine whom they interact with and which workplace tasks they are responsible for. In the case of this research-in-progress study I simply present a working example illustrating how SNA and BPM can compliment the other, beginning now with a walkthrough of the SNA approach. Assuming we have collected SNA data by way of a questionnaire, we can take the relationships data and place it first of all in a sociomatrix (table 2).

Table 1: Actor attributes.

Name	Gender	Age	Position	Fin. Exp.?
Bethany	F	44	CIO	No
Louise	F	53	Programmer	Yes
Harald	M	28	Help desk	No
Silke	F	28	Technical Writer	No
Abhaya	M	26	Analyst	Yes
Thomas	M	34	Programmer	No
Lucie	F	55	Clerical	No

Table 2: Sociomatrix illustrating Org. Beta actor/employee contact frequency.

	Bethany	Louise	Harald	Silke	Abhaya	Thomas	Lucie
Bethany	0	6	2	4	2	7	3
Louise	6	0	1	4	7	2	4
Harald	2	1	0	0	5	4	5
Silke	4	4	0	0	0	2	5
Abhaya	2	7	5	0	0	1	6
Thomas	7	2	4	2	1	0	2
Lucie	3	4	5	5	6	2	0

Next we can convert the sociomatrix data in to a sociogram (figure 3) to visualise the working lives of the employees to see how this relates to the business process model for the tasks they undertake. We begin first of all by recording data; our first table (1) represents the attributes of the actors; their name, gender, position and if they possess financial expertise. Perhaps more important is the sociomatrix (table 2) created either manually or in this case in UCINET© SNA software to illustrate the relationship of the actors to one another. In this case the higher the integer value the more frequent the contact of the actor to one another. Note the diagonal line is

composed of zeros to signify the neutral relationship of the actor to themselves. Reading the matrix (table 2), Bethany has a contact frequency of 6 with Louise, we can interpret this to mean she sees Louise virtually on the hour, whereas she has a contact frequency of 2 with Harald, meaning Bethany sees Harald perhaps once a week. We can interpret the data similarly for each of the other actors and so forth. The actual representation of each of the integer values in this instance is indicative only, however the lower the value the less 'intense' the relationship between each of the actors. As an added complication, when actors are asked for such information they may provide conflicting information, for example Bethany would claim she sees Louise every hour, whereas Louise may claim she sees Bethany only daily. *Symmetrisation* is possible in SNA software where the values can be 'equalised' either by the average of the two values, the maximum value (every hour) or the minimum (e.g. daily). In this case the highest value was taken.

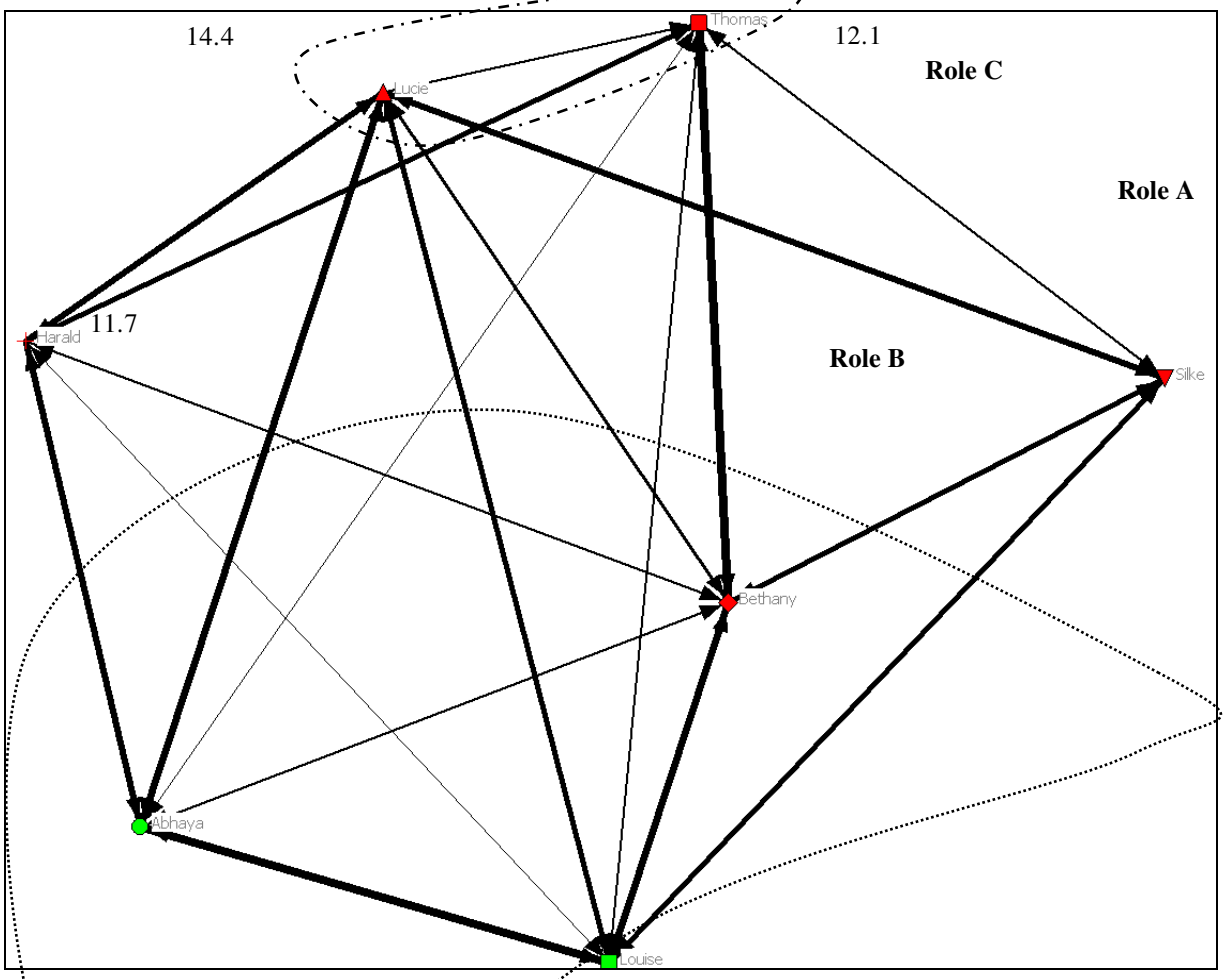

Figure 3: Sociogram illustrating relationships of actors to one another (**Role A**: *dotted* line; **Role B**: *dashed* line; **Role C**: *dashed-dotted* line)

Examining the sociogram (figure 3) which is derived by the SNA software from the sociomatrix (table 2), we can note a number of parameters. The layout through a technique referred to as Multidimensional Scaling (MDS) has mathematically deduced that the actors are roughly the same distance (as far as direct or indirect connections are concerned) from one another, hence the layout of the actors in an approximate circle; although many sociograms do not necessarily show this actor 'neatness'. In addition, we are able to note a number of other parameters. Actor nodes can be identified by certain other symbolism: circles in this case represent analysts, diamonds are CIOs, upright-triangles are clerical staff, rounded squares are programmers and down-turned-triangles are technical writers. Red coloured actors have no financial expertise, green actors do (colours appear prominently in SNA, although are difficult to replicate in black and white papers). Finally a real numerical value appears next to each actor, in this case representing an information centrality value (Abhaya 12.8; Bethany 14.0; Harald 11.7; Louise 14.0; Lucie 14.4; Thomas 12.1; Silke 10.9); this parameter is a statistical measure of the likelihood of information transfer between actors (Hanneman, 2002). The higher the numerical value the more likely information will be passed from one actor to the other; Lucie is most likely to be a conductor of information and Silke the least so. Last but certainly not least, examining the edges in the sociogram, note the line thickness variation between the actors; high relationship strength exists between Thomas and Bethany, between Louise and

Abhaya and Abhaya and Lucie. Relationship strength is weakest between Louise and Harald, Thomas and Silke and Abhaya and Thomas.

If we examine the overlays (roles A, B and C in figure 3) and role A (Silke, Lucie, Harald and Abhaya) specifically, we can now explore the types of relationships they have with one another through the sociomatrix (table 2) at the same time. Lucie has an integer value of 5 with Silke, 5 with Harald, and 6 with Abhaya. Yet Silke's relationship with Harald and Abhaya is 0 (table 2). A value of 5 indicates meeting on a daily basis, 6 is hourly and 0 not at all. From a social network point of view this would indicate that information that is being passed from Silke must take place through someone like Bethany. Re-examining figure 2a and 2b this is cause for management alarm, given these three employees 'apparently' work closely together on role A (the creation of program specifications and sending those specifications to the financial and technical staff concerned). We can perform a similar set of actions for the remaining role overlays in addition to viewing the sociogram (figure 3) to see how the social relationships map back to the EPK/BPMN modelled work processes. We can also ascertain from figure 3 that employees are closely linked but that some staff who do work on the same tasks (e.g. role C, figure 3b) such as Thomas and Lucie appear to have a weakened relationship (figure 3), which 'may' be cause for concern if their task requires them to work closely together. At the same time Abhaya and Louise appear to have a strong relationship according to figure 3, but do not undertake any of the same tasks at all (figure 3b); could this be a cause for concern, e.g. they 'loitering on company time'?; whilst not entirely negative, if however clerical processes with the customer are affected then management may choose to re-examine working relationships and physical placement of staff. The relevance of such an exercise in regard to the BPM lifecycle mentioned earlier, is that 'process analysts' constructing 'As-Is' models in stage 1 of the lifecycle could pass such SNA-rich information on to workflow designers who could then take social relationships in to account when designing the relevant organisation 'To-Be' models. The to and fro nature of the mapping between SNA and BPM at all stages of the BPM lifecycle (stages 1 to 6, Houy et al., 2010), now starts to have some Knowledge Management implications. Whereas KM has traditionally been focussed at a supra-organisational level (Busch, 2008), KM is now quite powerfully enriched with another tool in the organisation's arsenal to better managing the knowledge assets of its employees through better collaboration in work processes. Admittedly the one simplistic example illustrated here is far from all-inclusive, however the technique portrayed in this paper is *relatively* novel.

CONCLUSION AND FURTHER DIRECTIONS

This paper has introduced a different from of 'triangulation' incorporating Knowledge Management at an underlying (or overarching) level and then illustrated how the combination of Business Process Management and Social Network Analysis can improve the organisational 'bottom-line'. More specifically, a working example has been presented where the application of SNA to Business Process Management EPK modelling provides a means of 'mapping' workplace relationships; the sum of this approach in turn providing a means of 'extending' KM (figure 1). The benefit of this approach is that participant observation as a means of examining the overlay between modelled business processes in BPMN/EPK and SNA data obtained through questionnaires or observation also become unnecessary. With the use of techniques such as workflow or process mining and delta analysis, the employer, work designer, or organisational researcher/practitioner (subject to ethical approval) now has a means to examine the closeness of fit between what managers (or employees) may think employees are doing, and what employees are *actually* doing. Admittedly there are limitations to this study. First of all the example presented was *theoretical*, merely to illustrate how we could examine the crossover of business process management with that of Social Network Analysis, again the idea being management would gain a clearer understanding of the roles *apparently* conducted against those *actually* conducted. Second, the sample shown was minuscule; a more realistic study would gain access to event logs for a 'whole of organisation' approach and then compare these logs against what a 'whole of network' SNA data set reveals. A next step is to trial the technique on a larger dataset and utilise more intensive use of statistical SNA parameters exploring how employee cliques map to their corresponding workplace roles.

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