Interpreting Overlaps in Business Process Mapping via Organisational Soft Knowledge Flows

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Abstract. Knowledge Management (KM) as the term implies, is broadly about improving knowledge use within an organisation. At a lower level, Business Process Management (BPM) is the set of management activities related to business processes that can ideally be arranged in a life cycle. Social Network Analysis (SNA) is a technique enabling the researcher to better understand interactions between people. Relatively little research has been conducted with regard to the crossover of social networks and workflows, with the aim of examining workflows as management views them, as opposed to the actual social interactions of staff. Improvements in the overlay of management interpretations of work and real social networks could potentially lead to improvements in business process efficacy. In this study SNA diagrams are examined in order to implement executable models and potentially enable automated analysis of workflows. A means of converting SNA data to Business Process workflows is presented and an example provided.

Keywords: Social Network Analysis, Business Process Management, Knowledge Management, Workflow, Formalisation, Petri Nets, Business Process Modelling.

1 Introduction

Knowledge Management (KM), Business Process Management (BPM), and Social Network Analysis (SNA) as areas of study have well established profiles, particularly the last discipline. Knowledge Management focuses on the efficacy of data, information and particularly knowledge as a resource within the firm and examines how it may be best utilised amongst staff [1]. Business Process Management (BPM) represents a means of "supporting business processes using methods, techniques and software to design, enact, control and analyze operational processes involving humans, organizations, applications, documents and other sources of information" ([2] p. 11). Social Network Analysis (SNA) on the other hand "is an established social science approach of studying human relations and social structures by disclosing the affinities, attraction and repulsions operating between persons and persons, and between persons and objects" ([3] p. 64). What is not well researched is the intersection

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of the above disciplines [1], namely examining how well business processes in companies actually match the working relationships of employees as viewed through the 'lens' of Social Network Analysis. This paper provides an approach that could be used to identify the individuals, teams, and units who play central roles; to detect information breakdowns, bottlenecks, structural holes, as well as detect isolated individuals, teams, and units and how these relates to workflow modelling.

2 Background

The application of Social Network Analysis (SNA) is extensive given the length of time this data analysis technique has been in existence. SNA has provided a means of measuring and mapping relationships between employees, but what SNA has not typically been used for is the analysis of business processes in organizations. SNA provides the researcher with a means of interpreting what facilitates or impedes knowledge flows binding interacting organisational units together; that is the "who knows whom, whom shares what information and knowledge with whom by what communication media" ([4] p. 2). In short "SNA is an established social science approach of studying human relations and social structures by disclosing the affinities, attraction and repulsions operating between persons and persons, and between persons and objects" ([3] p. 64). One advantage to applying SNA to business is to provide a more seamless customer service, for customer calls and emails for example can be routed more effectively with an internal social network in place [5], as well as provide the ability to highlight the roles and goals of workers which are not observed through applying other means of analysis [6]. [7] further mentions that knowledge workers typically waste 28% of their time due to poor workflow control mechanisms, claiming a need for a formalised approach to help workers achieve goals to structure the creation, maintenance, and re-use knowledge.

An added advantage to conducting SNA is for a researcher to be positioned external to an organisation in a positivist research-from-a-distance sense, rather than observing workplace relationships through an interpretivist researcher-involved-in-participant-observation sense. It is not enough however to simply observe the relationships of employees, rather what is sought is to compare such relationships with management's view of how processes should be conducted. Applying SNA techniques into business processes, especially workflows, would be a most significant approach to better understand current business process management issues. Furthermore, if there is a method to illustrate relationships in the workplace, then modeling employee work processes could be best represented by workflow modeling [8]. As such, we hereby combine data mining and social network analysis techniques for analyzing social interaction networks in order to improve our understanding of the data, as well as the modeled behavior, and its underlying processes. SNA uses two types of mathematical tools to represent information about patterns of ties among social actors: graphs or sociograms, and matrices [9].

2.1 Sociogram

A graphical model consists of points or nodes to represent actors and lines to represent relations or ties among actors. “When sociologists borrowed this way of graphing things from mathematicians, they re-named their graphics ‘sociograms’ ” ([9] p. 21). Graphs might represent a single type of relation or more than one type of relation among employees. Each tie between a pair of actors may be directed, or represent co-occurrence, co-presence or a bonded-tie. Graphs are a very effective means for presenting information about social networks, however when there are a number of actors or many kinds of relations, they become too complicated to visually display all relationships [9].

2.2 Sociomatrix

Social network information can also be represented in the form of matrices. Matrices are collections of elements in a tabular form of rows and columns. “Representing the information in this way also allows the application of mathematical and computer tools to summarize and find patterns. The most common form of matrix in social network analysis is a very simple one composed of as many rows and columns as there are actors in the data set, and where the elements represent the ties between the actors” ([9] p. 25).

3 Formalising SNA Data

“Once a pattern of social relations or ties among a set of actors has been represented in a formal way (graphs or matrices), we can define some important ideas about social structure in quite precise ways using mathematics for the definitions” ([9] p. 36). There are three main reasons for formalizing SNA data: matrices and graphs are compact and systematic; matrices and graphs allow us to apply computers to analyze data, and; matrices and graphs have rules and conventions. Formalizing SNA data also allows analysts to identify cliques of actors. “At the most general level, a clique is a sub-set of a network in which the actors are more closely and intensely tied to one another than they are to other members of the network” ([9] p.79). Here we use sociograms and sociomatrices to identify cliques of actors for analysis and resource utilization.

3.1 Workflows

What is required is not just observing employees in their working relationships, but understanding how this relates to workflow as management believes it takes place. Workflow systems represent a series of connected interactions between people and the IT systems of an enterprise, typically working towards the automation of a particular business process, supporting the necessary task, document, and information flow, governed in turn by a set of business rules [10] [11]. Accordingly, the key challenges to workflow management are efficient and effective automation of workflows and the ability to agilely handle the change inherent in enterprise transformation [10]. Business Process Management provides us with a means to understand and produce more effective and efficient workflows in many organisations at the operational level, with examples being reported at Toyota and Ford [12]. Business processes are essentially a completely closed, timely and logical sequence of activities which are required to work on process-oriented business objects such as an invoice or a purchase order. The business process which can be arranged as a lifecycle, also acts as an essential interface to the business partners external to the company [13]. The modelling of such work processes are naturally represented through workflow modelling in order to facilitate the coordination and integration of manual and automated processes into a cohesive whole [14] [8].

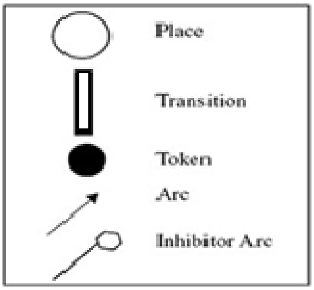
Data gathered for process models varies from questionnaire data to the use of an event log which records workflow events, whether by email, fax, voicemail, machine instruction and so forth [5]. Event logs may be defined as a chronological record of computer system activities which can be used for identifying users' actions or processes on the system [15]. Logs are often used on email traffic and phone-call records, however [16] note that e-mail is less useful, being difficult to analyse as real effort exists in "distinguishing between e-mails corresponding to important decisions and e-mails representing less relevant operational details" (p. 244). Instead using logs from an enterprise information system is suggested; such logs have relevant event data in a more structured form; for instance the logs in ERP, B2B and CRM systems involve specific operational details. The aforementioned examples represent automated output or steps in a work process. Probably the only alternative to using event logs in one form or another would be asking an employee what they have achieved or who they have collaborated with by way of a questionnaire.

3.2 Petri-Nets and Related Work

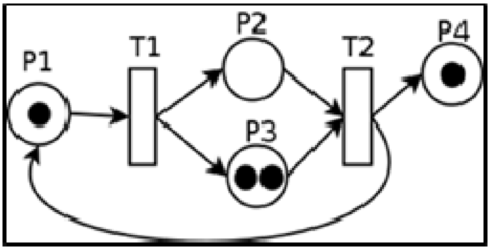
Regardless of the means of data acquisition, what is desired is the ability to take working relationships and model them as a means of determining the fit between employees versus management's view of workplace reality. This paper provides a working example of how such a process may be undertaken. Returning to the concept of SNA as a means of mapping relationships amongst employees, the models or sociograms utilised are relatively informal as they are graphical rather than mathematical in the true sense of the word. As such a degree of formalisation of executable models is required first [10]. Workflow nets are one means that provide the researcher with a formal means of modeling workflows based on Petri-nets, and may include 3 tuples (P, T, F). P: place in petri-net, indicates a condition; T: transitions in a petri-net, indicates tasks; where a token is a workflow state of a single case; finally F: is a flow relation between P and T [2]. The approach described is relatively novel, although [17] had used the XML Process Definition Language (XPDL) to similarly describe a related process formally, where the basic structural elements were activities, transitions, and participants. These three elements could be linked with tuples of the intended process model (Transitions -> P, Activities -> T, Participant -> R). [18] had also introduced a similar framework, namely that of workflow-based social network discovery and analysis, which provided ideas to develop automatic workflow to SNA conversion software. [18] had used Information Control Net (ICN) based workflows where ICN was an 8-tuple ($\Gamma = (\delta,\rho,\lambda,\varepsilon,\pi,\kappa,I,O)$) over a set (A) of activities, a set (T) of transition conditions, a set (R) of repositories, a set (G) of invoked application programmes, a set (P) of roles, and a set (C) of actors. From the ICN based workflow, social networks could be discovered using 'workflow-based social network discovery.' Without going in to elaborate detail, Song et al.'s [18] workflow-based social network had 4 tuples; the first tuple describing the social relationship: successors and predecessors, the second tuple represented acquisitions of activities, while the third and fourth tuples described the connections with external workflow-based social networks.

In short, a combination of SNA and Workflow-nets (WF-nets) can play a significant role in aiding the BPM lifecycle. These include the following advantages: the application of SNA techniques could be used to identify the individuals, teams, and units who play central roles; to detect information breakdowns, bottlenecks, structural holes, as well as isolated individuals, teams, and units [4]. The advantage of SNA is that it permits the researcher to compare existing workflows to build a more accurate organisational picture with regard to how work is actually being undertaken, as opposed to how management views processes [16]. The application of SNA techniques to a role-based workflow-net (WF-net) based on Petri-nets, allows for the determination of the centrality of a role or its degree of importance within the process, while identifying relatively disjoint roles. WF-net permits observing the workflow both conditionally and via parallel routing. Parallel routing requires finishing each task simultaneously for eliminating bottlenecks. From such a concept, the priority of assigning resources would be defined. Using Petri-nets as a formalism for BPM and WFM, it is clear that Petri-nets can serve as a solid foundation for BPM/WFM technology.

Workflows can be mapped into Petri-nets. The classic Petri-net consist of two node types called transitions and places. Places are represented by circles, and transitions by rectangles. These nodes are connected to each other via direct arcs. Each workflow task is represented by a corresponding transition, and places are used to display the pre- and post-conditions or resources needed for the flow of the work. Figure 1 (a and b) illustrates the basic properties of a Petri-net and a Petri-net-based workflow in general. The Petri-net illustrated has four places and two transactions. P1 and P3 are input places for transitions T1 and T2 accordingly. A transition node is ready to fire if and only if there is one token at each of its input places. For example a state transition will occur as the token in the input place P1 fires the transition T1 and moves the token to P2 or P3 as its possible output places.



(a)



(b)

Fig. 1 (a) (b): Illustrating the basic properties of a Petri-net and a Petri-net based workflow

4 Example Organisation

To illustrate the mapping of workflow management concepts onto a Petri-net we can consider examining the ‘Complaint Handling’ process in an organization in which the actors and their overlapping roles are illustrated in figure 2.

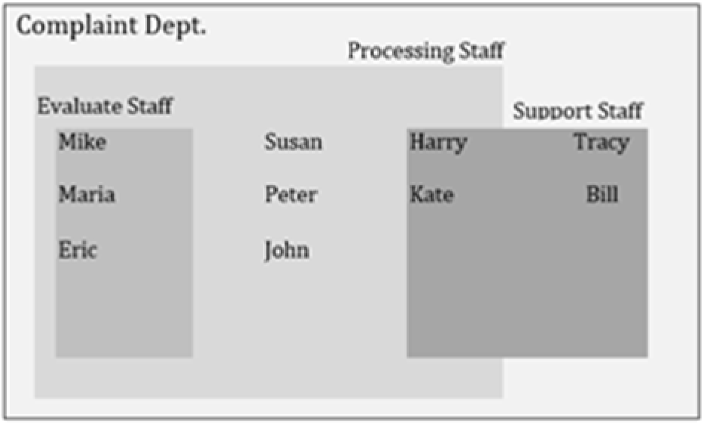


Fig. 1. Illustrating overlapping actors and their roles

The ‘Complaint Handling’ process which is illustrated in figure 3 shows that first the complaint is registered (task: Register), followed by two tasks, which are performed in parallel; a questionnaire is sent to the complainant (task: Send_Questionnaire) and the complaint is evaluated (task: Evaluate). The next step is a conditional routing; if the complainant returns the questionnaire within two weeks, the task process questionnaire (task: Process_Questionnaire) is executed. If the questionnaire is not returned within two weeks, the result of the questionnaire is discarded (task: Time_Out). Based on the result of the evaluation, either the com plaint needs to be processed or not (conditional routing with tasks: Process_Questionnaire or Time_Out). The actual processing of the complaint (task: Process_Complaint) is delayed until the questionnaire is processed or a time-out has occurred. The processing of the complaint is checked via task check processing (task: Check_Processing). If further processing is required then the task; 'process complaint' will be initiated as a result of iterative routing. Finally, task archive (task: Archive) is executed.

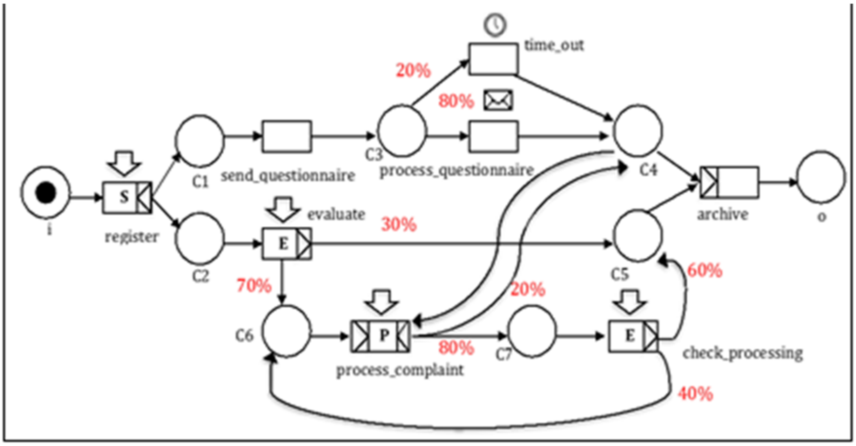


Fig. 2. The processing of complaints with triggering information

The tasks have been modelled by transitions. To model the states between tasks, conditions are added. Each condition has been modelled by a place (circle). For example place C2 corresponds to the condition 'ready to evaluate the complaint'. If a place contains a token then that condition is satisfied. For example C4 is true if the questionnaire is processed or a timeout occurs. In a multi-case model if a place contains many tokens, then this might indicate a bottleneck.

4.1 Applying SNA Techniques to a Role-Based Workflow-Net

To create a role-based workflow-net for handling the complaint process, we assign roles to the tasks or activities. The initials; S, P and E are used for the Support, Processing and Evaluate roles, and are shown in figure 3 above. This figure shows the processing of complaints extended with triggering information and building blocks for workflow modelling. In order to identify the relationship between the roles, their strengths/weaknesses and actors/employees degree of centrality, we need to identify the routings and count the arcs (flows).

There are four different types of routing in this process. *Parallel Routing* {Evaluate(E) and Send_ Questionnaire (S)}; *Conditional Routing* {Process_Questionnaire (80%) or Time_Out (20%); Processing_Required (70%) or No_Processing (30%); Process Complaint (80%) or Re-assessment_Required (or Archive)(20%)}; Processing_Ok (60% If processing is ok) or Processing_NOK (40% - if processing is not ok and requires re-work by the processor); *Sequential Routing* {Process_Complaint then Check_Processing; Process_Questionnaire then Process_Complaint}; *Iteration* {Processing_NOK back to Process_Complaint}. For conditional routings the proportion of possibilities are added as a percentage next to the task in figure 3. These figures represent a theoretical scenario, however in real conditions the figures will be based on the possibility of their occurrences being extracted from system's event logs. An arc is a flow between P(Condition) and T(Task). Every arc is valued at 1 except arcs in conditional routings, which are valued at their proportion, such as 40% or 60%.

The automated system tasks such as 'Time_Out' or 'Send_Questionnaire' are not considered in the routing process, however if a routing is directed to a user in the results of these tasks, the value of the arc is considered for the routing process. For example 80% of questionnaires, which are returned on time, are sent to a processor for processing purposes. This (task: 'Send_Questionnaire') is an automated task however initiated, and followed by support staff and in a successful process it will be routed to a processor. As there might be some re-assessment of the questionnaire, so there will be some contact between the support person and the processors, therefore and for this reason, the value of the arc connecting the tasks are weighted and considered in the calculation.

4.2 Sociomatrix of Roles

In examining the routing process, the results of counting arcs (flow between conditions and tasks) among different roles are shown in the matrix below (table 1). All SNA data begins as either binary, integer or real numerical values in sociomatrix format (table 1), from which point the values are then converted to a sociogram (figure 4) for better visual display.

Table 1. Sociomatrix of Roles

	Support(S)	Process(P)	Evaluate(E)
Support(S)	0	0.8	2
Process(P)	1	0	1.8
Evaluate(E)	0.9	2.1	0

The sociogram for roles which is illustrated in figure 4 shows that the relationship between Evaluate(E) and Process(P) is strongest and between Process(P) and Support(S) is weakest. At the same time Evaluate(E) has the highest worker or actor degree of centrality; that is the most important node or role in the network [19]. For example if a threshold of more than 1 is applied to the sociogram, the relation between E and P, and E and S will remain, while the relationship between P and S will be relatively disjoint.

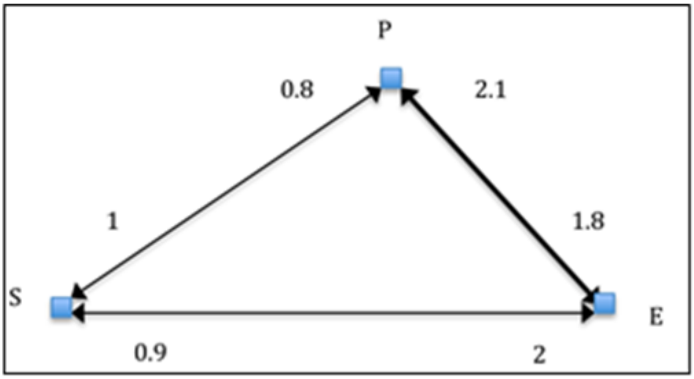


Fig. 3. #: Sociogram of Roles

From such a result, we may recommend actors/employees on the 'Evaluate' team, be placed on more important activities with a higher degree of involvement with other departments.

5 Social Network Analysis and Data Mining

In examining the relational network among employees based on a contact frequency, employees in a company were asked via a questionnaire to choose one of the options below for the frequency of contact with their colleagues. The contact frequencies are: 6.0 hourly contact; 5.0 every few hours; 4.0 daily contact; 3.0 once every couple of days; 2.0 weekly and; 1.0 bi-weekly. The result of the questionnaire is displayed in table 2 below.

Table 2. Sociomatrix of Actors /Employees

	Mike (E)	Marian (E)	Eric (E)	Susan (P)	Peter (P)	John (P)	Harry (PS)	Kate (PS)	Tracy (S)	Bill (S)
Mike (E)	0	2	3	3	4	6	1	1	5	2
Marian(E)	2	0	4	3	5	6	1	1	3	5
Eric(E)	3	4	0	6	4	3	3	3	6	4
Susan(P)	4	3	6	0	4	3	4	6	5	4
Peter(P)	4	5	4	4	0	3	4	5	3	3
John(P)	6	6	3	3	3	0	3	3	2	3
Harry(PS)	1	1	2	4	4	3	0	4	4	6
Kate(PS)	1	1	2	6	5	2	4	0	3	5
Tracy(S)	4	3	6	5	3	2	3	3	0	6
Bill(S)	2	5	3	4	3	3	6	5	6	0

Below are the sociograms (figure 5 a-f), illustrating relationships of actors to one another in terms of threshold. With space limitations it is not possible to illustrate all sociograms clearly. However examining the sociograms, which are derived by the SNA software (UCINET V6) from the sociomatrix (table 2) we can note a number of parameters. The layout of the actors/employees is in an approximate circle shape; meaning employees are roughly the same distance from one another (the SNA software uses Multi-Dimensional Scaling (MDS) algorithms to achieve this based on reported relationship distances of actors to one another). Actor nodes can be identified by their name with different symbolism. In addition a real numerical value appears next to each actor, in this case representing an information centrality value; this parameter is a statistical measure of the likelihood of information transfer between actors [9]. The higher the numerical value the more likely information will be passed from one actor to the other; Eric(E again for Evaluate) is most likely to pass information to Susan(P for Processing) and Tracy(S for support etc.), but share it less with Marian(E) or Mike(E). Furthermore, examining the edges in the sociogram, we may note the edge thickness variation between the actors; high relationship strength is displayed with thicker edges.

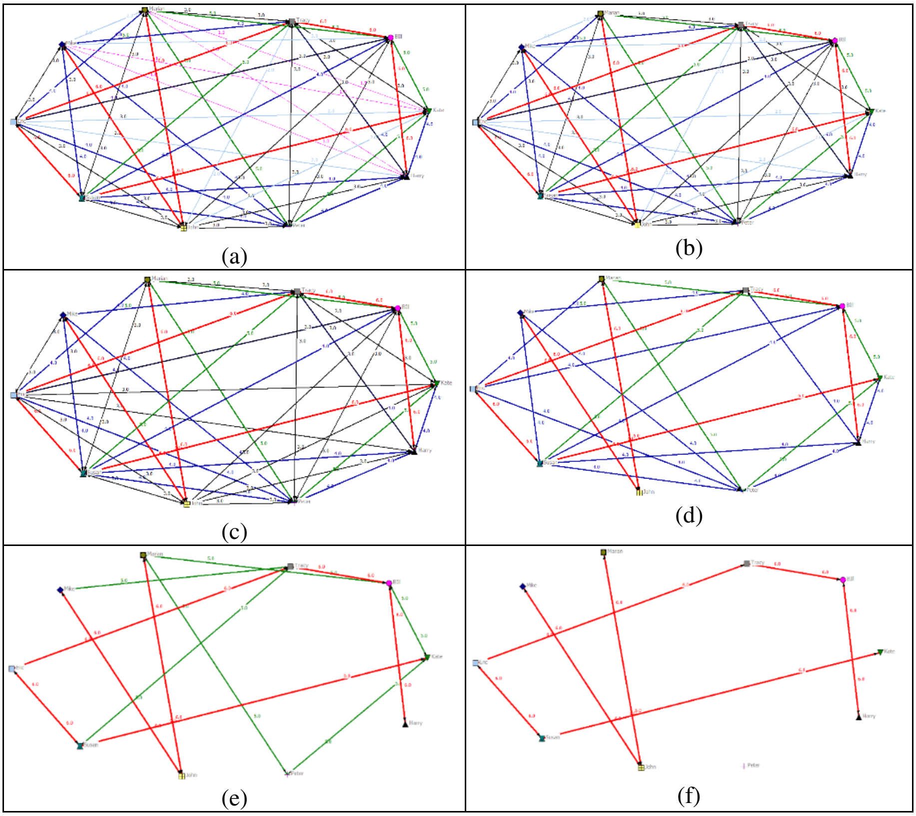


Fig. 4. Illustrating from top left to bottom right (a-f) {all thresholds, thresholds 2, 3, 4, 5 and 6)

At the same time edges are also colour coded; with red being the strongest relationship followed by green, dark blue, grey, light blue, with pink representing the weakest relationship. From figure 5 (a) to (f), by increasing the value of the related threshold, the arcs are progressively removed. In figure (e), the nodes are still connected via a closed loop for the contact frequency of every few hours (green edges), by (f) the remaining illustrated actors contact each other at least hourly. The nodes are connected via linear edges, and one actor; Peter(P) is an isolate. The clique, which has a high volume of frequency, can be found by applying the maximum threshold.

The above process can be formalised to discover the algorithm for ideal social networks among actors/employees. The threshold is increased until the network is disconnected. By increasing the threshold value we can identify the cliques who indicate groups having more frequent and therefore stronger relationships between actors [19].

The network of employees discussed above could be used for allocating resources and aiming to reduce the time lag between activities. We examine the cliques for two thresholds of 5 and 6, beginning with cliques with a threshold =5. The following are the optimal cliques for a threshold of 5: {Eric(E), Tracy(S), Bill(S), Kate(P,S), Susan(P)}, {Susan(P), Tracy(S), Bill(S), Kate(PS)}, {Marian(E), Bill(S), Kate(P,S), Peter(P)}; clique: {Eric(E), Susan(P), Tracy(S)}. As the Evaluate(E) role is the most important role with a higher degree of actor centrality, we examine each of the three evaluators and their relationships with other staff more closely.

Mike(E): Mike from the evaluation team has a contact frequency of a few hours with Tracy from the support team and John from the processing team. So the clique of {Mike(E), John(P), Tracy(S)} will be a good fit for processing a case from initiation until archive.

Marian(E): Marian from the evaluation team has contact frequency of a few hours with Bill from the support team and Peter from the processing team. So the clique of {Marian(E), Peter(P), Bill(S)} will be a good fit for processing a case from initiation until archive.

Eric (E): Eric from the evaluation team has a contact frequency of a few hours with Tracy from the support team and Susan from processing team. So the clique of {Eric(E), Susan(P), Tracy(S)} will be a good fit for processing a case from initiation until archive.

We can also conclude that Tracy(S) from the support team has a regular contact with two of three evaluators and processors. She seems to have a good relationship with many people from different departments.

The following represent the remaining pairs who have a contact frequency of every few hours: Bill(S)-Kate(P,S); Susan(P)-Tracy(S); Peter(P)-Kate(P,S); Tracy(S)-Bill(S); Bill(S)-Harry(P,S); Kate(P,S)-Susan(P). Probably some of these frequent contacts will affect work productivity. For example according to the sociograms of roles, the support and processing team has the weakest relationships, so if there are employees within these roles who have regular contacts of every few hours, then the company needs to re-assess the employee’s time or potentially reconstruct their practices.

Next we consider Cliques: Threshold=6; within this threshold the contact frequency is hourly. The following actors/employees have strong contact with each other: Eric(E)-Tracy(S); Tracy(S)-Bill(S); Bill(P,S)-Harry(S); Kate(P,S)-Susan(P); Eric(E)-Susan(P); Mike(E)-John(P); Marian(E)-John(P). According to the sociomatrix of roles, the strongest roles are between Evaluator(E) and Processor(P) following by Evaluator(E) and Support(S). In which case the best pairs for tasks involved in (E,S) is Eric(E)-Tracy(S) and for (E,P) is Eric(E)-Susan(P) followed by Mike(E)-John(P) and Marian(E)-John(P). The following represent the optimal cliques for a threshold of 6. They are better suited for processing a case initiated by the support team to be followed by evaluators and processors. Clique: {Tracy(S), Eric(E), Susan(P)} Clique: {Tracy(S), Mike(E), John(P)}; Clique: {Bill(S), Marian(E), John(P)}. If the organisation can maintain such a network on workflow, the maximum lag between activities would be reduced dramatically.

6 Application of SNA Results to WF- Nets

In this section we integrate the results from WF-nets and SNA data in order to group resources based on the SNA analysis. We then formalise the allocation of resources with regard to parallel routings and conditional routings.

Resources need to be allocated in the order of *parallel*, *conditional* and *sequential* routings. The first task for a Support(S) staff is a parallel routing for sending the questionnaire to the complainant and passing the case to an evaluator. For *parallel* routing we have the paths: Register(S), Evaluate(E), Process_Complaint(P) and Register(S), Send_Questionnaire(S/P) and Process_Questionnaire (P). For parallel routings, tasks need to be done concurrently, so it is important that an employee from the Support(S) team can work productively with employees from both Processing(P) and Evaluation(E) teams in order for the tasks to be completed and the case becomes ready for a 'checking' process without any delay. The reason for this is that the task 'Process_Complaint' cannot be completed until the questionnaire is processed. Beginning with Cliques: Threshold=5, the best clique for threshold 5 is: Clique: {Bill(S), Marian(E), Peter(P)} and for Threshold: 6 are: Clique: {Tracy(S), Eric(E), Susan(P)}, Clique: {Tracy(S), Mike(E), John(P)}, Clique: {Bill(S), Marian(E), John(P)}. For *conditional* routings we examine one of four cases illustrated in figure 3. Process_Complaint (P) then (80%, Check_Processing(E)) or (Process_Complaint(P) then (20% Process_Questionnaire(S), reassess). In this case there is an 80% chance that the case is sent for 'Check-Processing' so the most important roles involved are E and P, therefore the following pair of employees from E and P teams are suitable for undertaking these tasks. If a case needed further clarification between Processors and the Support team in regard to Process_ Questionnaire, then the best matched employees from P and S are identified. For Threshold=5 the best cliques are: {Marian(E)-Peter(P) (80%)},{Peter(P)-Kate(P,S) (20%)} and for Threshold: 6; {Eric(E)-Susan(P) (80%)}, {Mike(E)-John(P) (80%)}, {Marian(E)-John(P) (80%)}, for a 20% possibility of routing: {Susan(P)-Kate(P,S)},{Bill(P,S)-Harry(S)}.

In the process of handling complaints, the sequential routing is either between the Evaluate(E) team and Process(P) team or between the Support(S) and Evaluate(E) teams, which have already been discussed above, and the same cliques mentioned above can also be mapped for this routing.

7 Discussion

A simple working example has been presented through application of SNA to Business Process Management as an example of mapping workplace relationships. The results from WF-nets and SNA data have been integrated to group resources based on the SNA analysis. Then we formalised the allocation of resources with regard to parallel routings and conditional routings. This examines how a simple set of work processes may be mapped in SNA to determine the closeness of fit to work practices. The sociogram of employees clearly illustrates that some employees who need to work closely together on a particular case, appear to have a weakened relationship, and some who do have a strong relationship don't work together. For example Peter(P) does not appear to have a very close relationship with evaluators and the support team, which may be an issue if their task requires them to work closely together. John(P) seems to have a weakened relationship with support staff but strong contact with evaluators, which might be a cause of concern if he needs to follow up the case with the support team. Some employees such as Susan(P) and Kate(P,S) have a very high frequency of contacts, which might be a positive factor as both undertake similar tasks, however Kate(P,S) does not have a good relationship with any evaluators, which may have a negative influence on Susan(P). Furthermore Harry(P,S) who is supposed to be involved in both support and processing jobs, does not have a strong working relationship with employees in the evaluate team; this could be a cause for concern for the company if their task requires them to work closely together. As a result management may choose to re-examine the working relationships and physical placement of staff.

8 Conclusion

We have provided a way of assigning resources to parallel routing and conditional routing based on role-based workflows, assuming all tasks have the same elapsed time. In this paper we have briefly examined a means for combining workflows and Social Network Analysis data as an algorithm in pseudocode. Analysis of workflows can take place through the use of Petri-nets and we have chosen to do likewise. We have examined a hypothetical organisation with certain roles being conducted by particular employees. Through the examination of SNA data relating to the same organisation we have been able to map the most appropriate individuals for a task based on SNA measures such as centrality. Finally we have examined approaches to undertaking workflows, either parallelised or conditionally and in turn which employee cliques would be best suited, given our sample organisation.

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