Effects of a Discussion Tool on Collaborative Learning and Social Network Structure within an Organization

Astrid Tomsic
University of Hawaii at Manoa
atomsic@hawaii.edu

Dan Suthers
University of Hawaii at Manoa
suthers@hawaii.edu

Abstract

This study investigated the social network structure of booking officers at the Honolulu Police Department and how the introduction of an online discussion tool affected knowledge about operation of a booking module. Baseline data provided evidence for collaboration among officers in the same district using e-mail, telephone and face-to-face media but showed minimal collaboration between officers in different districts. On average, knowledge of the booking module was low. After introduction of the online discussion tool the social network structure changed, showing an increase in collaboration between different districts and an increase in knowledge of the booking module, even though frequency of collaboration did not increase significantly. The study suggests that the formation of new collaborative ties and passive participation ("lurking") are more significant for learning through information sharing in social networks than raw frequency of interaction.

1. Introduction

This paper reports on a study that investigated the social network structure of booking officers at the Honolulu Police Department and how the introduction of an online discussion board affected knowledge about operation of the booking module in a Records Management System (RMS). We begin with a discussion of theories of learning in social settings, and draw on the literature to show how social structure can be effective for leveraging expertise of a group. We then discuss how computer support can assist in changing the social structure to allow increased collaboration among participants and encourage communities of practice. The remainder of the paper reports on the study itself.

A booking officer is a police officer who has the primary duty of processing arrestees as they are brought into a district police station. Depending on the severity of the crime or availability of holding cells, the booking officer may decide to transfer the arrestee to the Central Receiving Division (CRD), otherwise known as the main booking station. The first phase of the study documented the social network structure between four different physical locations (districts), the Central Receiving Division (CRD), and the Information Technology Division (ITD). The second phase of the study introduced an online discussion tool that allowed officers to collaborate with their colleagues in different districts. Social Network Analysis (SNA) confirmed that the introduction of the new software lead to a change in the social network between districts. The results of a second survey showed that there was also an increase in knowledge among booking officers using the online discussion tool.

2. Social Learning Theories

How might learning take place in an organization? Some theories of learning, such as constructivism (Piaget, 1976; von Glasersfeld, 1995) inform some of the other theories considered here, but do not focus on the social aspects of learning. Some social learning theories focus on small group interaction, particularly in asymmetric relationships between learners and teachers (Brown & Palincsar, 1989; Vygotsky, 1978), but do not emphasize the community aspects of learning. The most relevant theories for the present study are those that do have such an emphasis, including organizational learning (Bogenrieder, 2002), communities of practice (Wenger, 2002), and knowledge building theory (Scardamalia & Bereiter, 1996).

Bogenrieder (2002) argues that organizational learning is a combination of both social-relational and cognitive activity. The social-relational aspect consists of the social networks fostered by the organization while socio-cognitive conflict (Doise & Mugny, 1984) is the vehicle for nurturing cognitive activity. Socio-cognitive conflict has two conditions that must be met for learning to take place. The first is that a social relationship exists between the participants and the second condition is cognitive diversity. The differences in ideas that participants can contribute are a trigger that encourages learning. For example, in a police department officers have different educational backgrounds, levels of experience in police work and varied expertise in certain types of crimes. These differences can be used to advantage to encourage collaboration and learning because the sharing of ideas

produces better ways of solving and working more effectively to reduce crime.

Wenger, McDermott & Snyder, (2002) define a community of practice as a "group of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis". When such individuals are distributed throughout an organization in different teams, information technology can be valuable for bringing community members together to share and resolve problems.

Knowledge building theory (Scardamalia & Bereiter, 1996) refers to the intentional creation, elaboration and advances in collective understanding undertaken by a community. According to Scardamalia & Bereiter (1996), it is "work on the creation and improvement of ideas. The dynamic is social, resulting in the creation of public knowledge…public knowledge can itself become an object of inquiry and the basis for further knowledge building".

Sha & Van Aalst (2003) conducted a study using server log data to explore knowledge building in the classroom. The techniques of Social Network Analysis (Wasserman & Faust, 1995) were used to analyze student participation and interactivity in an online discussion database called Knowledge Forum. SNA was used to map the structure of relationships, the major lines of communication and patterns of interaction within the social network. It provided valuable insight into the effectiveness of the class's ongoing efforts to improve their knowledge building and the conditions under which knowledge building occurred. Other studies of collaborative learning have been conducted with college students (Brown et al., 2003; Farhaus et al., 1999; Le, 2001) but few studies examine how the unique opportunities of an online discussion tool can be used to improve collaborative learning in the context of workplace communities such as police departments.

3. Social Structure

Bogenrieder (2002) suggests that social architecture can be used as an instrument to build relationships for learning. Two conditions are necessary for organizational learning: the existence of cognitive diversity and contact between diverse people. The specific design for this contact depends on the characteristics of the problem situation that includes goal uncertainty and technical uncertainty. Goal uncertainty is "ambiguity about the preferences or goals the decision-maker aims to satisfy" and technical uncertainty is "uncertainty in parameters, input data and initial states (resulting from 'inexactness' and 'conflicting evidence')" (Weber, 2000). Where conditions of high goal certainty and high technical

certainty exist, instrumental network structures are satisfying. However, where high goal certainty and high technical uncertainty exist (as is the case in learning to use the RMS), knowledge is the common denominator of the network.

Laboratory studies have indicated that some types of network structures are more effective than others for diffusing information throughout a group (Cummings & Cross, 2003). However, the task is usually pre-defined by the researcher who establishes a correct path for the diffusion of information. In organizations, information flow depends on the expertise of the group. Therefore, while certain network structures may be more efficient for information diffusion in an experiment, these structures may not be effective for leveraging group expertise in an organization.

The literature suggests that from a cognitive perspective, network structures with greater integration (connectivity) may be more effective for leveraging group expertise. Studies of transactive memory suggest that groups benefit from knowledge of who knows what in the group (Liang et. al., 1995, Moreland & Myaskovsky, 2000). In the same way, work in diffusion suggests that hierarchical network structures are both inefficient and result in the degradation of information quality (Rogers, 1995; Valente, 1995).

4. Computer Supported Social Networks

Wellman (1996) claims that Computer Supported Social Networks (CSSN's) support a focus on information exchanges. "People can easily post a question or comment and receive information in return. Broadcasting queries through CSSN's increases the chances of finding information quickly and alters the distribution patterns of information. It gives those working in small or distant sites better access to experienced, skilled people." Additionally, "online information flows spill over unexpectedly through message forwarding, providing access to more people and new social circles, thus increasing the probability of finding those who can solve problems (Kraut & Attewell, 1993). Thus, it is expected that it will be beneficial for police officers and ITD staff to collaborate in a cooperative online environment.

The particular online discussion tool used in this study (Discus) was chosen because it used a standard threaded format, is accessible via a web browser and therefore is accessible from every computer that runs the booking module for the Records Management System (RMS). Questions could be posted as soon as an issue occurred, allowing the officer to access information anytime, not only when the ITD staff or CRD staff were available. Discus may be downloaded and previewed from

www.discusware.org. Figure 1 shows the layout of the threaded discussion format.

Topic	Posts	Pages	Last Post	Last Poster
Board Information				
📁 Posting Guidelines	1	1	02-29-00 03:26 pm	Admin
Installation Problems				
📁 Setup help - unix servers	1462	253	06-11-04 07:52 am	Kevin W. Paulisse
📁 Setup help - Windows servers	838	153	06-14-04 10:07 am	Kevin W. Paulisse
Running Discus				
📁 Post installation questions	10772	2060	06-14-04 10:07 am	Kevin W. Paulisse
📁 Customizing your site	3559	674	06-04-04 12:50 pm	CP Ssrebba
Product Development				

Figure 1. Layout of the threaded discussion format in the Discus tool

It can be argued that the online discussion board is an excellent tool to encourage the development of a community of practice within the Honolulu Police Department for the booking officers (Wenger et al., 2002). These officers are distributed across the HPD districts, yet are faced with a similar set of issues that non-booking officers may not be familiar with. They use the same software module in the RMS and are required to be familiar with specific procedures for booking. They must also be familiar with basic troubleshooting procedures because the software support staff (ITD) are separated from the officers who must put the knowledge to use. The online discussion board offers a shared and persistent forum for booking officers to increase their awareness of system-wide issues and booking practices. Other media such as face-to-face, e-mail and telephone lack persistence and are limiting for officers working in different districts or different shifts. Each medium has its limitations: the challenge for the booking officers and the ITD staff was to keep activity on the online discussion tool active, to maintain participation and to encourage the participation of new booking officers.

5. Motivation and Background

A new computerized Records Management System (RMS) was implemented at the Honolulu Police Department in August 2003. With it came the need to train officers on how to use the RMS to enter and search for information. Entering accurate data and being capable of searching criminal history records is a mandatory and vital part of a police officers' daily duty and essential to effective police work. The degree of knowledge that an officer has about how to use the RMS system to locate pertinent information has a direct bearing on the outcome of criminal cases. The overall result of more effective information use is to allow officers to better serve and protect the community by solving more cases and working more effectively to identify crime trends. Currently officers use a combination of e-mail, telephone, face-to-

face discussions and other means to collaborate with each other in order to locate information, raise issues and propose more efficient ways to use the RMS. The ITD staff has a good understanding of how to use the RMS in more general terms (e.g., search for a name), while police officers have a better understanding of what information they need to find and how it relates to business processes, but not necessarily the best way to find it. The current collaboration process between police officers and the ITD staff is inefficient because knowledge is spread over many media, and due to the nature of these media needs to be repeated frequently to different parties at different times, is often lost and cannot be easily located and improved upon. Coupled with this, officers do not have a clear understanding of who knows what and tend to communicate with a single ITD staff member for all information requests.

6. Research Questions

I. How will the introduction of an online discussion tool affect the existing social network structure at the Honolulu Police Department for officers learning the booking module for a new Records Management System?

II. Will knowledge of the booking module of the RMS increase as a result of using the online discussion tool?

7. Hypotheses

H1. There will be an increase in *collaboration* about the booking module of the RMS between participants in *different* districts using the online discussion tool compared to participants who do not, using pre and post interview instruments and SNA.

H2. There will be an increase in *frequency of collaboration* about the booking module of the RMS between participants using the online discussion tool compared to participants who do not, using pre and post interview instruments and SNA.

H3. There will be an increase in *knowledge* of the booking module of the RMS for participants using the online discussion tool compared to participants who do not, using pre and post survey instruments.

8. Method

8.1. Participants

Forty-two (42) police officers, civilian booking staff and seven (7) ITD staff participated in the study. The

officers were randomly selected from a pool of officers of different ages with different cultural and academic backgrounds from four (4) different locations (districts) on O`ahu. Group A consisted of twenty (20) officers from districts 5 and 8. Group B consisted of twenty (20) officers from districts 2 and 3. Each district collaborated with the ITD staff and CRD staff that were located in a different physical location than each of the districts. This method was used to prevent cross-collaboration between the two districts that have access to the online discussion tool and those that do not.

8.2. Procedure and Task

The study was conducted over a six-week period in March/April 2004. Participants were asked to complete two (2) surveys (pre and post) and two (2) interviews (pre and post). The interview layout and content was adapted from surveys created by Krackhardt & Haythornthwaite (1998). Both the surveys and interviews were piloted with two (2) officers who did not participate in the final study and was revised according to the officers' feedback and suggestions for improvement.

The pre-survey was used to determine current knowledge of the booking module of the RMS system. It consisted of five (5) questions with an estimated duration of ten (10) minutes. Each question consisted of typical search tasks related to the booking module in the RMS that an officer is required to perform on a daily basis. For example, "What is the report number for the FRAUD incident that occurred in sector 1 beat 150 on 10/19/2003?"

A pre-interview was conducted to determine the current social structure. It consisted of questions to determine with whom the participant collaborated about the booking module of the RMS during the prior three (3) weeks. It asked how well they knew this person, the frequency of these collaborations, and the media they used to collaborate. The estimated duration of the interview was twenty (20) minutes.

Participants in Group A, the ITD staff and CRD staff were asked to contribute to an online discussion tool. They were given introductory training on the online discussion tool and provided with a login and password to record questions, comments, ideas and suggestions about the booking module. Posting activity on the online discussion tool was initially slow, so the ITD staff posted what it thought to be useful tips on how to use the booking module in order to generate activity. The ITD staff checked the board on a regular basis to ensure that questions were answered in a timely manner. This was done to encourage participants from other districts to post questions. Group B continued to collaborate with the ITD

staff, CRD staff and each other using the traditional face-to-face, e-mail and telephone methods of collaboration.

A post-survey consisting of five (5) questions with an estimated duration of ten (10) minutes was given to Group A and Group B to determine whether any changes in knowledge had occurred. Similar to the pre-survey, the post-survey contained search questions on the booking module in the RMS but did not have the same questions as the pre-survey to avoid participants learning from the pre-survey. For example, "Who was the arresting officer for the arrest with report number XXXXXX?"

A post-interview was conducted with the same questions as the pre-interview to determine whether any changes had occurred in the social structure between the districts.

8.3. Measures and Analysis

Scardamalia (2000) developed twelve descriptors that represent the "best practices" of knowledge building. Chan, Lee & Van Aalst (2001) used a modified subset to organize course evaluation and to scaffold knowledge-building advances. These four principles are: 1. Working at the cutting edge, 2. Progressive problem solving, 3. Collaborative effort, and 4. Identifying high points in the discourse. Sha & Van Aalst (2003) conducted a study where they focused on the pedagogical knowledge principal of collaborative effort. They analyzed the characteristics of student's social interaction by measuring participation (posts), reciprocity (replies), connectivity (linked notes), social position (activity in the social network) and social interaction (reads).

Similarly this study measures characteristics of individual social interaction relating to collaborative effort, but groups these measurements into broader factors that investigate social interaction between districts. These factors are:

I. Knowledge – defined as the understanding, familiarity and proficiency of a participant with the booking module of the RMS. It is measured by the results of the search tasks in the post-survey and the pre-survey. Rated on a scale of 0 for the lowest score with no tasks correct to 5 for the highest score for all tasks correct.

II. Collaboration – defined as any new social ties between participants that had not previously communicated. This study is particularly interested in collaboration *between* districts. It is measured by the messages contributed to the online discussion tool and the interactions reported in the pre and post interviews. This includes messages posted, replied to and read.

III. Collaboration Frequency – defined as the number of interactions between participants in the social network. It is measured by the number of messages contributed to the online discussion tool and the number of interactions reported in the pre and post interviews. This includes the number of messages posted, replied to and read.

The UCINet suite of programs (Borgatti, Everitt & Freedman, 1996) was used to create the data sets for SNA and a visual depiction of the socio-centric social network in the form of social network analysis diagrams. Each participant is represented as a circle or node in the network with their interactions displayed as lines. These lines have arrowheads to show the direction of each collaborative interaction. The thickness of each line represents the number of interactions or tie-strength between each node. The minimum tie-strength is zero (0) and the maximum is ten (10). However, for the combined medium diagrams, the minimum tie-strength is zero (0) and the maximum is forty (40). The district that each node belongs to is shown by the color of the node. The score that each participant receives for the collaborative learning tasks is shown by the size of each node. The minimum score for no tasks correct is four (4) and the maximum score for all correct is nine (9). The minimum of four (4) was chosen instead of zero (0) so that each node is visible on the diagram.

Three (3) different SNA diagrams were created. The top of figure 2 shows the initial social network with all media combined, and the bottom of figure 2 shows the social network after the introduction of the online discussion tool with all media combined. These two diagrams allow comparison of differences in the social network. Figure 3 shows the collaborative interactions between the districts using the online discussion tool. SAS statistical software was used to tabulate and analyze the results of the knowledge scores.

Content analysis was used to gain a more in-depth understanding of what types of interactions were occurring on the online discussion tool. Each message posted on the discussion board was identified and categorized using a list of behaviors suggested by Rubin & Goldberg (1992). They include basic communication relations such as information seeking (IS) and information providing (IP). Other behaviors that Rubin & Goldberg (1992) term contractual relations are used to indicate messages where one participant posts a message in order to obtain a response. These are coded as confirming action (CA), seeking consensus (SC), and statement of problem (SP), statement of solution (SS). Other behaviors that showed an outcome from the discussion were coded as making a decision (MD), notifying the occurrence of an event (NE) and volunteering assistance (VA).

9. Results

From the first stage of the study, a benchmark for the structure of the social network has been established and some interesting social patterns emerged.

Table 1 shows the knowledge scores for each district for the pre and post surveys. The two districts (2 and 3) that did not use the online discussion tool received a lower score and the same score respectively on the post survey. Three out of the four districts (8, ITD and CRD) that used the online discussion tool received higher scores on the post-survey.

Table 1. Knowledge scores by district

Knowledge Stores by District (percent correct)

	2	3	5	8	ITD	CRD	Average
pre-survey	60.0%	30.0%	64.0%	53.0%	42.8%	60.0%	51.6%
post-survey	38.0%	30.0%	55.0%	88.0%	48.5%	100.0%	59.9%
% change	-22.0%	0.0%	-9.0%	35.0%	5.7%	40.0%	8.3%

Table 2 shows the results of the content analysis of the messages posted in the discussion tool. The most common behaviors were those of IS (Information Seeking) and IP (Information Providing). RA (Requesting Action) and CA (Confirming Action) were the next most common action.

Table 3 shows the number of posts, replies and reads in the discussion tool by district from the server logs. ITD was the most active in posting and replying to posts. All of the districts that used the discussion tool (5, 8, ITD and CRD) were more active in reading messages posted by others compared to posting. The ratio of reads to posts was almost 41:1 in the case if ITD, 50:1 for district 5 and 22:1 for district 8.

The top portion of Figure 2 shows the initial social network. The bottom portion shows the social network after the introduction of the discussion tool. The initial social network shows collaboration within each district but a lack of collaboration between districts. The post social network shows new collaboration between the districts (5 and 8) using the discussion tool.
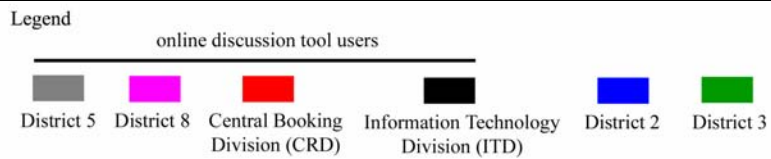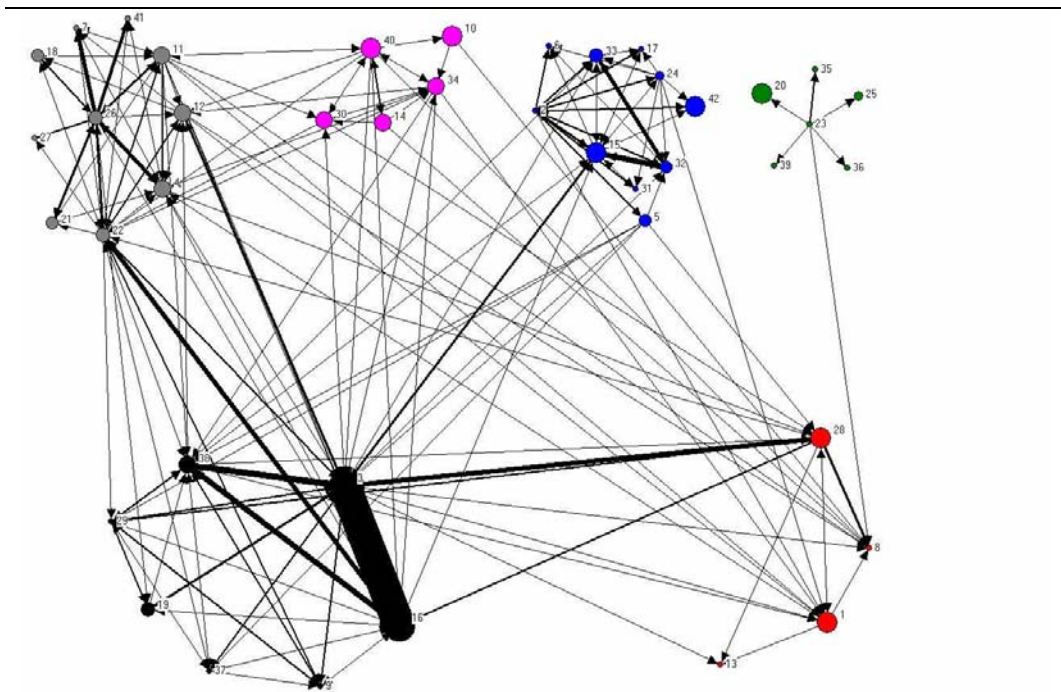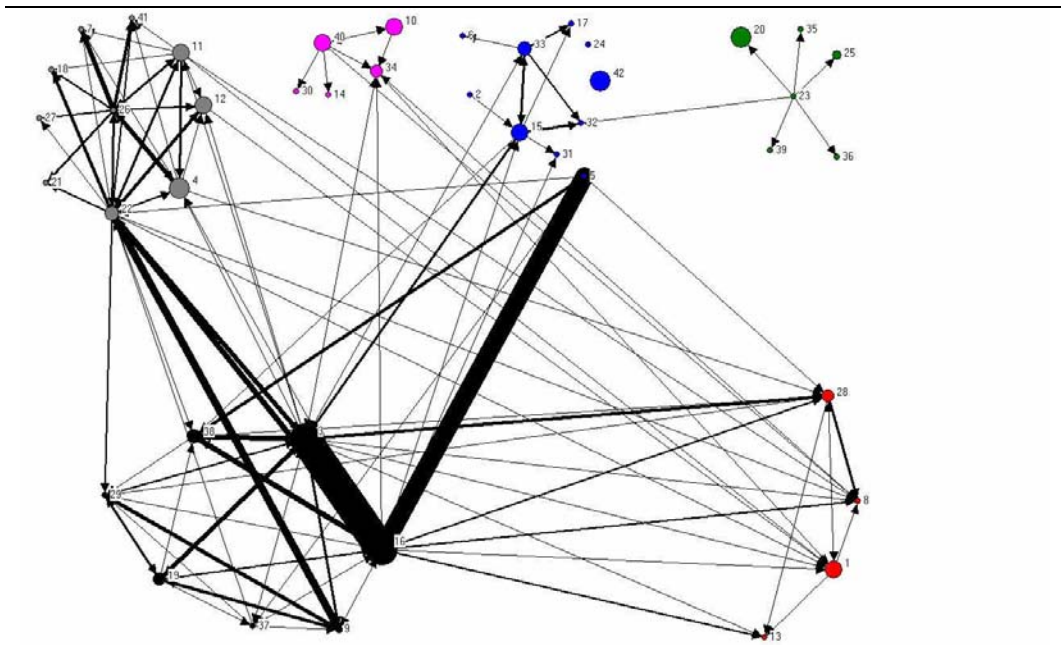
Figure 2. Social network diagrams before and after the introduction of the online discussion tool.

Table 2. Content analysis behaviors and breakdown of behaviors by district

Key to codes

Types of behavior			
IP	Information providing	MD	Making a decision
IS	Information seeking	VA	Volunteering assistance
RA	Requesting action	RF	Raising funds
CA	Confirming action	SF	Seeking funds
SC	Seeking consensus	PF	Providing funds
SP	Statement of problem	OP	Other people
SS	Statement of solution	H	Humor
NE	Notifying occurrence of event		

Breakdown of behavior per district

Behavior	2	3	5	8	ITD	CRD	Total per behavior
IP			5	2	10	2	19
IS			8	3	7	1	19
RA			2	2	2	4	10
CA			6	2	6		14
RF							0
SF							0
PF							0
SP					5		5
SS					4	1	5
SC				1	3		4
MD			1	1	1		3
VA							0
OP							0
NE				1	5		6
H							0
Total per district	0	0	22	12	43	8	85

Table 3. Number of posts, replies and reads by district from the online discussion tool

Breakdown of online discussion tool posts, replies and reads per district

	2	3	5	8	ITD	CRD	Total
POSTS	0	0	10	4	19	5	38
REPLIES	0	0	13	7	23	4	47
READS	0	0	502	156	791	62	1511

Figure 3 shows that there was new collaboration using the online discussion tool between district 5 and district 8 and that the overall knowledge scores (size of the nodes) had increased.
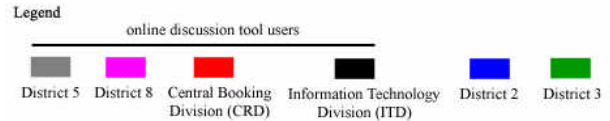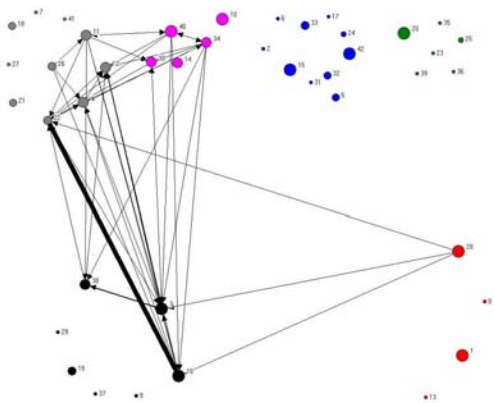

Figure 3. Social network diagram showing interactions using the online discussion tool.

10. Discussion

The purpose of this study was to examine the existing social network structure at the Honolulu Police Department and how the introduction of an online discussion board affected the knowledge of officers working with the booking module of a new RMS. The social network structure was operationalized using egocentric social network analysis. The results of changes to the social network, including collaboration patterns between individual participants and different districts and collaboration frequency will be discussed.

10.1 Social Network Structure and Learning

The results of the initial social network analysis indicate that officers tended to collaborate within their own districts for information and rarely chose to collaborate between districts. Furthermore, Figure 2 shows that there appeared to be significant collaboration between the nodes in the Information Technology Division (ITD), and especially between two of the central nodes (3 and 16). There is significant collaboration between individual nodes in the ITD and individual nodes in the Central Receiving Division (CRD). Each of the districts appeared to have a unique network structure, with the one commonality being a central or liaison node that collaborates with others outside the district. This central node is not necessarily the node that has the highest knowledge score (34, 15, 23). Similarly, some of the nodes (10, 42, 20) that are isolated received the highest knowledge scores, indicating that these nodes are underutilized. District 5 had an open structure with each node communicating with each other node in the district. Four of the nodes (22, 4, 12, 11) are boundary spanners that collaborate with nodes in other districts to bring new information into the district. District 8 has two boundary spanners (34, 40) that bring new information into the district via ITD and CRD. District 2 had two key nodes (15, 33), with node 15 bringing new information into the district by collaborating with ITD and node 33 distributed this information within the district. District 3 had the least collaboration, with one key node (23) that is both the central node for the district and the distributor of the information within the district.

The initial survey showed that the average knowledge score across all districts was 51.6%. This indicates that the

current social network structure is not the most conducive to collaborative learning. In addition, each of the districts had a different social network structure (Figure 2). The districts with the highest scores were district 5 with 64%, district 2 at 60% and CRD at 60% (Table 1). The similarity between the network structures of these 3 districts is that each of the individual nodes collaborates with other nodes in the same district and also with nodes in other districts. The collaboration is two-way. The network structure of the districts that received the lowest scores, district 8 at 53%, ITD at 42.8% and district 3 at 30% (Table 1) tend to have one or two nodes collaborate outside the district and then share the information within the district. The collaboration appears to be mostly one-way. Interestingly, ITD staff had one of the lowest overall knowledge scores. Relating this to Figure 2, it appears that two ITD nodes (3, 16) are over-utilized, creating a bottleneck in the network between other ITD nodes and other districts collaborating via these two nodes.

The results from the second survey showed an increase in average knowledge scores across all districts from 51.6% to 59.9%. This indicates that the changes in the social network structure (Figure 2) have improved learning. Knowledge scores across districts showed that three of the four districts (district 8, CRD and ITD) that participated in the online discussion tool showed increased knowledge scores, while the two districts that were not given access to the online discussion tool showed either constant (district 3) or decreased (district 2) overall knowledge scores.

The districts with the highest scores were CRD with the highest score at 100%, followed by district 8 at 88% and district 5 at 55%. It appears that CRD received the highest score due to the increase in knowledge by two key nodes (28, 1). Node 28 was the only node in CRD to contribute in the online discussion tool. The social network structure of district 8 changed noticeably, with increased two-way collaboration between nodes 30, 14, 40 and 34 (Figure 2). These nodes were active participants in the online discussion tool. Interestingly, node 10 did not participate in the online discussion and the knowledge score remained the same. The social network structure for district 5 remained essentially the same. Nodes 18, 21 and 26 increased their collaborative learning scores, however only node 26 participated in the online discussion tool. It appears that nodes 18 and 21 had increased two-way collaboration to other nodes (21 to 4, 11 and 18 to 12) that did participate in the online discussion tool (Figure 3). ITD marginally increased knowledge scores. This can be explained by the lack of participation by ITD staff in the online discussion tool. Only nodes 38, 3 and 16 chose to participate (Figure 3), with node 38 being the only node to increase its knowledge score. As part of the study design, district 2 and district 3 did not have access to the online

discussion tool. District 2's social network structure changed as a result of increased face-to-face collaboration. Nodes 5, 32, 15 and 24 marginally increased their knowledge scores. This may be explained by the social connections that these nodes have outside of their own district. District 3's social network structure remained the same, as did their overall knowledge score at 30%.

The results from the second survey supports H3 that states that there would be an increase in knowledge for participants using the online discussion tool compared to participants who did not. The results showed that there was an increase in knowledge scores for 10 out of the 14 nodes in the online discussion tool, with two of these nodes (3 and 16) receiving the maximum scores in both pre and post surveys (Figure 2). There was an increase in knowledge scores for 4 out of the 16 nodes that did not participate in the online discussion tool. These nodes were from district 2 and may be explained by the social connections that these nodes have outside of their own district.

Results from the content analysis of the messages posted using the online discussion tool indicated that all of the districts that had access to the online discussion tool used the board mainly to seek and provide information (IS = 19, IP = 19 in Table 2). District 5 displayed the most IS behavior. They have the most integrated network structure (Figure 2). It is interesting that all districts participated in information providing (IP), not just ITD and CRD as expected. The IS and IP categories are an indication of collaborative learning. To a lesser extent, the districts used the board to request actions (RA = 10) and confirm completed actions (CA = 14). An example of this is where a participant would ask participants in other districts to type data into the booking module in a certain way.

10.2 Collaboration Between Districts

The results from the social network analysis support H1, which states that there would be an increase in collaboration between participants in different districts using the online discussion tool compared to participants who did not. The results showed that there was a significant increase in collaboration between districts 5 and 8 (Figure 3) after the online discussion tool was introduced compared to the initial social network (Figure 2). The two districts that did not have access to the online discussion tool (2 and 3) showed collaboration within their own district but there was a lack of collaboration with any of the other districts (Figure 2).

10.3 Collaboration Frequency

H2 states that there would be an increase in collaboration frequency between participants using the

online discussion tool compared to participants who did not. The results from the social network analysis tie-strength did not show results that were significant enough to support H2. The results indicated that the online discussion tool encouraged new ties to be formed between nodes that had not previously collaborated. For example, there are new ties between nodes 28 and 3, 3 and 40, 3 and 30, 38 and 34, 38 and 12, 38 and 4 (Figure 2). The only significant increase in tie-strength was between nodes 3 and 12. There was increased collaboration between nodes in district 2 but this was mainly due to increased face-to-face collaboration. The level of participation in the online discussion database may explain why the frequency of collaboration between participants was low. To overcome this limitation, these results can be analyzed again once the online discussion tool has been used over a longer time period.

To understand the collaboration frequency for the users of the online discussion tool, the server logs were analyzed to see the number of posts, replies and reads made by each district (Table 3). The district with the most posts was ITD with 19, followed by district 5 with 10 and CRD with 5. It was evident that ITD actively posted when the board was started to encourage other districts to participate. ITD used the board to notify the districts of system-wide events such as scheduled downtimes (Table 5).

ITD had the most replies at 23, followed by district 5 with 13 and district 8 with 7. ITD also had the most reads at 791, followed by district 5 with 502, then district 8 with 156. The logs indicate that many of the participants chose not to post messages but were active in their reading of messages posted by others. The ratio of reads to posts was almost 41:1 in the case if ITD, 50:1 for district 5 and 22:1 for district 8. This indicates that the frequency of collaboration indicated by posting and replying to messages was low, with most participants preferring to only read messages. However, the learning of "lurkers" may be of significant advantage in some online communities (Wenger, et al. 2002).

Comments from officers indicated that Discus was particularly useful because it was available no matter what booking computer they were assigned to. One user commented that the ability to post attachments such as screenshots saved time by allowing other officers to refer to the screenshot, thereby reducing the amount of textual description needed to explain a point.

11. Conclusion

Findings from this study have indicated that the introduction of an online discussion tool had significant effects on the social network for officers working with a booking module of the RMS at the Honolulu Police Department. Results supported the hypothesis that there would be an increase in knowledge for participants using the online discussion tool compared to participants that did not. Results also supported the hypothesis that there would be an increase in collaboration between participants in different districts using the online discussion tool compared to participants that did not. The results did not support the hypothesis that there would be an increase in collaboration frequency between participants using the online discussion tool compared to participants who did not. However, the value of non-collaborative interaction such as reading others' messages should not be underestimated.

Implications of these findings for future research are that technology alone cannot support the social network. Various types of media accomplish collaboration within the social network. Technology supported media must support the process of learning how to use the technology, and how to adapt it to work processes and also social processes. This was evident by the need to maintain activity in the online discussion tool in order to encourage new activity. Technology supported media can be used to encourage collaboration between participants who would not necessarily collaborate through any other type of media. Further research into how different media are used for different work and social process will be of value. This study has focused on the social network structure at a police department. Further research into what types of social network structures are conducive to collaborative learning in different types of organizations would be of value.

13. References

[1] I. Bogenrieder, "Social Architecture as a Prerequisite for Organizational Learning", *Management Learning*, 2002, pp. 192-212.

[2] S. Borgatti, M. Everitt & L. Freeman. "UCINET IV Version 1.64", *Natick, MA: Analytic Technologies*, 1996.

[3] A. L. Brown, & A. S. Palincsar, "Guided, Cooperative Learning And Individual Knowledge Acquisition." In L. B. Resnick (Ed.), *Knowing, Learning and Instruction: Essays in Honor of Robert Glaser.* pp. 393-452. Hillsdale, NJ: Lawrence Erlbaum Associates, 1989.

[4] B. Brown, I. MacColl, M. Chalmers, A. Galani, C. Randell, and A. Steed, "Lessons From The Lighthouse:

Collaboration In A Shared Mixed Reality System". *Paper: People at Leisure: Social Mixed Reality*, 2003.

[5] C. Chan, E. Lee and J. Van Aalst, "Accessing and Fostering Knowledge Building Inquiry and Discourse". *Paper presented at the 9th Biennial Meeting of the European Association for Learning and Instruction*. Switzerland, 2001.

[6] J. N. Cummings and R. Cross, "Structural Properties of Work Groups and their Consequences for Performance", *Elsevier Science. Social Networks,* 2003, Vol. 25. pp. 197-210.

[7] W. Doise and G. Mugny, "The Social Development of the Intellect". *Oxford: Pergamon Press*, 1984

[8] E. Fahraeus, N. Bridgeman, J. Rugelj, B. Chamberlain, and U. Fuller, "Teaching with Electronic Collaborative Learning Groups". *Report of the ITiCSE'99 Working Group on Creative Teaching of Electronic Collaborative Learning Groups*, 1999.

[9] D. Krackhardt and C. Haythornthwaite, "A Social Network Study of the Growth of Community Among Distance Learners", *Information Research*, Vol. 4(1), 1998. (http://www.andrew.cmu.edu/~krack/)

[10] R. Kraut and P. Attewell, "Electronic Mail and Organizational Knowledge". *Working paper, Department of Social and Decision Sciences, Carnegie Mellon University*, 1993.

[11] D. Liang, R. Moreland, and L. Argote, "Group versus Individual Training and Group Performance: the Mediating Role of Transactive Memory", *Personality and Social Psychology Bulletin*, 1995, Vol. 21. pp. 384-393.

[12] T. Le, "Collaborate to Learn and Learn to Collaborate", *Australian Computer Society, Inc*., Presented at the Seventh World Conference on Computers in Education, Copenhagen, July 29–August 3, 2001.

[13] R.L. Moreland and L. Myaskovsky, "Exploring The Performance Benefits Of Group Training: Transactive Memory or Improved Communication", *Organization Behaviour and Human Decision Processes*, 2000, Vol. 82, pp. 117-133.

[14] J. Piaget, "The Grasp Of Consciousness: Action And Concept In The Young Child", *Cambridge : Harvard University Press*, 1976.

[15] E. Rogers, "The Diffusion of Innovations", *Free Press, New York*, 1995.

[16] K. Rubin and A. Goldberg, "Object Behaviour Analysis", *Communications of the ACM*, 1992, Issue 35, Vol. 9, pp. 48-62.

[17] M. Scardamalia, "Principles of Knowledge Building", *Fourth Knowledge Building Institute*, Toronto, Ontario, August 9-12, 2000.

[18] M. Scardamalia and C. Bereiter, "Rethinking Learning". In D.R. Olson, & N. Torrance (Eds.), *The Handbook of Education and Human Development: New Models of Learning, Teaching and Schooling.* pp. 485-513. Cambridge, MA: Basil Blackwell, 1996.

[19] L. Sha and J. Van Aalst, "An Application of Social Network Analysis to Knowledge Building", *Paper presented at the annual meeting of the Educational Research Association*, Chicago, April 21-25, 2003.

[20] T. Valente, "Network Models of Diffusion of Innovations", *Hampton Press*, Cresskill, NJ, 1995.

[21] E. von Glasersfeld, "A Constructivist Approach To Teaching". In L. Steffe & J. Gale (Eds.). *Constructivism in Education*, 1995, pp.3-16. New Jersey: Lawrence Erlbaum Associates, Inc.

[22] L. S. Vygotsky, "Mind in Society". M. Cole, V. John-Steiner, S. Scribner and E. Souberman. Cambridge, Mass., *Harvard University Press*, 1978.

[23] S. Wasserman and K. Faust, "Social Network Analysis: Methods And Applications", *Cambridge: Cambridge University Press*, 1995.

[24] B. Wellman, "For A Social Network Analysis Of Computer Networks: A Sociological Perspective on Collaborative Work and Virtual Community", Center for Urban and Community Studies, Univ. of Toronto, Canada, 1996.

[25] Weber, M. "Modeling Technological Change under Uncertainty in Integrated Assessment Models for Climate Change", *http://www.mpimet.mpg.de/~weber.michael/modeling_tc.html*

[26] E. Wenger, R. McDermott, and R. Snyder, "Cultivating Communities of Practice: a Guide to Managing Knowledge". *Boston: Harvard Business School Press*, 2002.