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Towards employee based knowledge interactions to facilitate group learning within a team collaboration tool: An exploratory case study analysis

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Abstract. The indent of this study is on a case study analysis of organizational knowledge nexus and related collective learning in customer support operations of a high-tech company. The unit of analysis was an existing information flow as knowledge related interaction within a customer support process. The study was focused to organizational learning targets as strengthening of effectiveness of the organization's knowledge building and management. The exploratory social network analysis denotes that experience and tenure within the company is a common denominator of key personnel. In addition, employees' contribution ratio to community progress over time as they gradually shift from learners to mentors. The findings derived from the social network analysis of a team collaboration tool needs be further researched in conformity studies.

Keywords. Social Network Analysis, Organizational Learning, Case Study

1 Introduction

During the last decades, the rapid development of information technology has changed the way to produce services. Because the change has become constant for new digital services to update frequently, users have less time to adapt new features and understand how to use them. In this constant change, companies need to provide a channel for users to get instant help when problems occur, then, it is an emerging trend and has increased the responsiveness from company to its customers [1].

In this environment, the term "social networks" were seen as a specific set of linkages among a defined set of persons, with the additional property that the characteristics of these linkages as a whole may be used to interpret the social behavior of persons involved [2]. The social network approach views organizations as objects joined by relationships.

In this study, the term "network analysis" is concerned with the structure of the relationships and addresses to understand their causes and consequences [3]. It was expected, that Social Network Analysis (SNA) for a collective learning network within the software company may advance insights regarding the research question how knowledge co-creation and collective learning within organizations occur, confer

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references: [4]; and an additional element of understanding learning models and co-creation of knowledge in digital era [5].

In this study, knowledge management is understood a discipline concerned with the analysis and technical support of practices used in an organization to identify, create, represent, distribute and enable the adoption and leveraging of real-world practices, which were used in collaborative learning and management settings and, in particular to organizational processes. In this sense, effective knowledge management is an increasingly imperative shared source of collaborative and rationale advantages and a key to success in hi-tech organizations bolstering the collective and shared expertise of its employees, actors and partners.

In this context, information sharing and collective learning is related to the ontology of information technology, data exchange capabilities, communication protocols, technological artifacts and digital infrastructures. Although standardization is indeed an essential element in sharing information, information sharing effectiveness requires going beyond the syntactic nature of information technology and delving into the human interactions at the semantic, pragmatic, critical realist and social levels of organizational semiotics.

In this approach, the integration of information services or systems is understood as a complex process involving multiple overlapping and iterative tasks that address co-creativity as well as a methodological approach that involves thinking, building, improving and evaluating a successful information system and its communication, which fits the needs of the applied domain, information sharing interactions and implementation of nexus related viewpoints.

The term “external validity”, in this study, refers to establishing the expanded domain in which the study’s findings and conclusions can be generalized. This study adopts the methodology of increasing understanding through information systems research and integration facilities, such as utility and communication, integration and networked realization capability.

The company under study has 12 employees locating in Finland. It has had € 3 million turnover in 2014 and average annual growth of 18% in period 2010-2014. The company’s core business is to develop and sell proprietary financial management software and to provide maintenance and support for over 2500 users. It is a part of a large corporation that operates in seven countries with over 2300 employees. The author of this study works in the company as a part of the technical staff.

The urgency of this study is based on the fact that the company is growing rapidly and faced major changes in personnel in past two years. Since the company is developing proprietary software, educating that to new personnel requires big financial efforts. Therefore, it was expected that one of the key factors to understand collective learning efforts and appropriate knowledge co-creation is to visualize information flows among actors. Social network analysis can provide a subtle tool to measure organizational activity and how learning and trust occurs in this and such context.

For understand participation in learning, we concentrated on the following questions: who is involved with the co-creation of knowledge and learning process in the research domain; how active the participants are; and does the organizational knowledge reformation and collective learning happen over time?

2 Open organizational climate facilitate learning and tacit knowledge sharing

Recent studies imply that information sharing has positive effects on group performance in organization [6]. Open and trustworthy relationship to customers is an establishment of innovative organization culture and climate. Highly innovative companies appear to place equal emphasis on the technical side as well as the social side of the organization.

Free information flows look to nurture not only technical abilities and expertise but also promote a sense of sharing and togetherness. In opposite, less innovative firms tend to create environments of independence, whereas innovative ones create environments of co-operation [7]. When group members share information, their expertise, knowledge and experience develops and they are capable of doing better decisions. This enhances co-operational activities and increases knowledge of other members' fields of expertise. Free information flows between different operations improve knowledge management processes in company.

This paper studies information flows where tacit knowledge is shared within team collaboration tool. According to Nonaka and Takeuchi [8], tacit knowledge becomes externalized through iterative, mutual interaction. SNA is used [9] in IT to examine formal and informal interactions reached a conclusion that tacit knowledge is diffused in human-to-human interaction. Because an intuition may reflect tacit knowledge of the knower [10], social interaction between employees should be fostered and measured.

Knowledge Management (KM) is planning, organizing, motivating and controlling of people and systems to ensure the knowledge-related assets are improved and effectively employed. KM processes directly improve organizational processes, such as innovation, collaborative decision-making and individual and collective learning [11]. KM systems such as Flowdock utilize tacit information flows among actors. Ensuring free flows of information increases the effectiveness of KM practices in many organizations.

Effective communication and knowledge flows are paramount towards achieving an innovative and agile organization [12]. Group chats are examples of such egalitarian networks. These types of networks foster knowledge sharing and advocate total integration of learning and work in teams [13]. This study is part of an overall effort to visualize the flows of information and knowledge within an organization. Moreover, the network analysis examines how the connections are embedded to work together.

3 Research methodology

This paper approaches the research questions with conducting an exploratory case study analysis. Yin [14] states that a case is an empirical inquiry that investigates a contemporary phenomenon with its real-life context. Having access to and reporting on real-life IT experiences, case researchers allow both academia and practice to keep up with the rapid changes occurring in the IT world as well as in organizations [15]. Considering these facts, this subject is studied using an exploratory case study methodology. Previous studies [4, 16, 17] confirm it is a valid method to study key characteristics of interactions among organizations and people when a phenomenon is complex and a holistic investigation is needed.

There are two approaches to organizational learning. The first approach examines learning from a cognitive perspective and sees a company as a whole. The company is

depicted as a large brain composed of the members of the organization. The second view looks at learning as community based, where the practitioners create knowledge in their own networks to pursuit of a common practice [18]. This study concentrates on the latter.

According to Krebs [19], the SNA assists in mapping and measuring the relationships and the flows between people, groups, organizations and other information/knowledge entities. It has been also utilized in anthropology, biology, communication studies, economics, geography, information science, organizational studies, social psychology, and sociolinguistics, and has become a popular topic of speculation and study [20]. Rather than focusing on permanent attributes of people, the SNA approach seeks answers to question that who influence others. Are there linkages between the most influential individuals and who are isolates within their groups [3]. Alterations within the network have ripple effects on the whole.

4 Data collection and the respondent properties

In order to analyze the learning in the company the internal support chat was targeted. Data for measurement was collected fetching all messages with Flowdock API during the nine-months period. The respondents were labeled with a prefix according their department. Secondly, the respondents were classified with length of service, tenure.

This study focuses only on help desk (n=6) and technical (n=4) persons who contribute the most of the customer support operations. The gender rate among the respondents was that all help desk persons were female and all technical persons were male, resulting ratio of 40% female and 60% male. The company has a relatively flat organizational structure resulting that management contributes to help desk and technical operations along with other staff.

Table 1. Respondent properties

Label	Department	Tenure
A1	Help Desk	A
A2	Help Desk	B
A3	Help Desk	A
A4	Help Desk	C
A5	Help Desk	C
A6	Help Desk	A
T1	Technical	C
T2	Technical	A
T3	Technical	B
T4	Technical	C

Table 1 presents the properties of respondents (n=10). Tenure measures the experience of respondent. It is labeled as follows: A) 0 < 1.5 years, B) 1.5 < 4 years, C) 4 < 20.

Describing a clear path from data collection to analyzed results increases reliability and validity of the research [15]. This study contains a nine-month period of internal support conversations in 2015 the support team had within a team collaboration tool Flowdock.

Data collection started with writing a shell script to fetch the messaging history of given period using the Flowdock API. Flowdock supports a threaded messaging model,

similar to online discussion forums, meaning that when a person initiated a new conversation, others respond inside this thread. The script searched the sender of the initial message (source) and attached respondents (targets) and timestamps (n=5063) to form edge lines into a CSV file.

Table 2. Actor degrees calculated from the collaborative messaging

Label	Degree	In-Degree	Out-Degree	Contribution ratio
A1	1330	153	1177	0.12
A2	1354	246	1108	0.18
A3	1419	246	1173	0.17
A4	2	1	1	0.50
A5	927	402	525	0.43
A6	338	36	302	0.11
T1	812	738	74	0.91
T2	445	305	140	0.69
T3	741	699	42	0.94
T4	2483	2136	347	0.86

A weighted degree centrality matrix between source and target was calculated from the data and is shown in Table 2. Degree centrality is defined as the number of links incident upon a node and it determines the relative importance of a vertex within the graph [20]. Weighted Out-Degree declared in rows is the number of messages in conversations initiated by the person. Respectively, columns indicate Weighted In-Degree value meaning how many times a person has responded to conversations initiated by others (for example a node "T1" received 74 comments to conversations he initially started and contributed with 738 comments to conversations initiated by others). There was also a group Sales & other staff fetched in the overall data but they were omitted, because they are outside the scope of this study. The data was imported to Gephi [21] to calculate SNA metrics and draw a visual graph enhanced with Fruchterman-Reingold [22] algorithm to inherent symmetry of nodes and edges.

To analyze learning over time, another script was written to count a contribution ratio on weekly basis. These results were grouped by tenure classes and transformed into CSV format. At the end, the outcome was imported into Infocaptor, a cloud-based visualization and reporting software, for further analysis.

5 Exploratory analysis of the results

This is a qualitative research and no inferential statistical tests were lead from the data. SNA results are used to describe the learning processes as they took place within the theory of Organizational Learning. The quantitative nature of the data was used to make comparisons, in relative terms, but not for inferential purposes.

The density values show that the overall connection between the participants is especially high on both, directed 90.3% and undirected 100%, which suggests that the respondents are closely collaborating on their task. This indicates how tightly knit this community is; no one is left out completely. The high density was expected, because Flowdock plays a major role in the communication between teams, the measuring period was nine months long and the overall network size is rather small.

5.1 *Exploring individual and group activity with SNA*

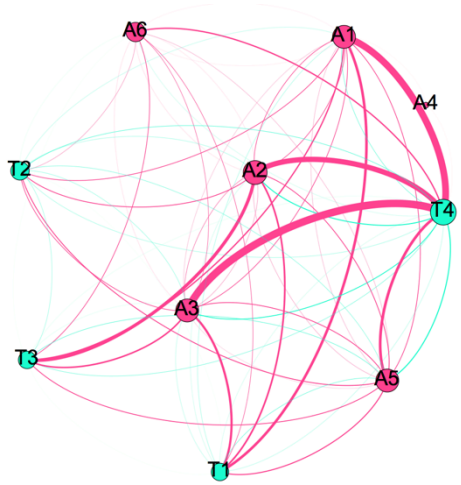

Figure 1. The respondent collaboration activity, edges colored by source

The answer to "Who were the active participants?" was deducted by viewing the thickness of the lines illustrated in Figure 1. A key contributor seems to be node T4 who has the relatively thick counter-clockwise red lines curving towards A1, A2 and A3 nodes. As opposite, A1, A2 and A3 are the most active to start new conversations and seek for knowledge. It is clear that T4 is a hub node whose contribution (43% of overall In-Degree activity) is far beyond others. The executives should take a closer look at the actor's position and evaluate the risks it poses to the whole network.

The least active is node A4 by contributing only one opening line and one comment line in the studied period. To understand its inactivity, one should know that it is one the company executives whose main contribution is to arrange training sessions and acquire new customers. However, many management principles stress that the executives should lead by example and increasing the ones activity is encouraged.

5.2 *The evolution of learning over time*

According to del Campo, Sánchez de Pablo González et al. [16] the In-Degree of a vertex is a number of arcs it receives, i.e., it represents the percentage of workers within the organization who learn from person in reference to total employees. Moreover, this paper argues that in this case, the contribution ratio (a proportion of In-Degree to overall Degree) of personnel is an important value to measure if learning happens. If the value is more than 0.5, a node is contributing knowledge and thus can be seen as a mentoring participant. On contrary, if the value is less than 0.5, the participant is more in learning position.

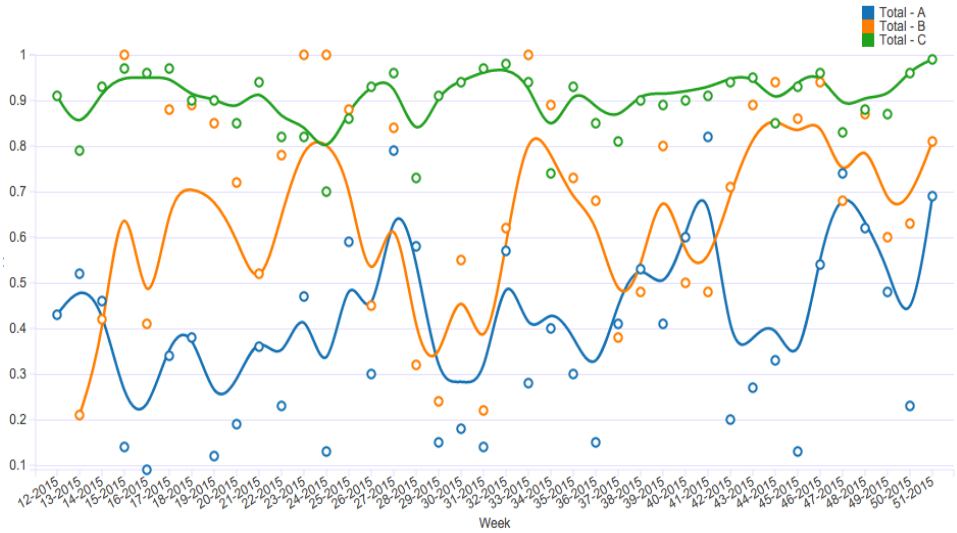

Figure 2. The progression of contribution ratio grouped by tenure classes

To answer, "Does the organizational knowledge reformation and collective learning happen over time?" a visual presentation of the contribution ratio for each tenure class separately (Appendix 1) is illustrated in Figure 2. As seen on the graph, weekly values are widely scattered and activity varies a lot. Therefore, a smoothing spline is drawn upon the control points to help revealing a possible learning pattern. This method helps detecting the visual trends from a set of noisy observation data.

The group C with the longest tenure has relatively tight set of observations and the contribution ratio has the flattest trend. On contrary to that, a spline suggests a progressive trend for group A and B, which concludes that actors have increased their mentoring contribution over time. Secondly, the lines are aligned with tenure; group A is the lowest, group B in the middle and group C presented on the top. These results indicate that there has been learning over the studied period and those with more experience are more keen to contribute knowledge to community. This evolution can be described as a progressive contribution ratio in which learners become mentors over time.

6 Conclusions and discussions

This paper argues that the participant activity patterns change over time. That is why it is important to use methodology that reveals the patterns of interactions between the participants. To achieve results, this paper not only illustrates figures based on interactions between employees in collaborative group chat, but also argues that a contribution ratio provides a valid unit to measure progress of learning over time. SNA provides a valid tool for this task, one that helps to explore network activity and reveal the interaction patterns that develop in collaborative group work. It is a promising method to enable researches to explore properties of networked learning organizations. In order to explore this argument, the paper is divided into two sections. First, we

provided a general account of SNA, and how it may be used to analyze conversations made available through Flowdock history data. Second, a brief example was provided how SNA analysis can be used in combination with other analytical techniques.

This paper introduces an original approach to study a Finnish IT company's group chat messaging with SNA metrics to evaluate learning patterns over time. The study was conducted to investigate the effectiveness of free telephone assistance personnel who closely collaborate with technical staff to solve customers' problems in group chat. Results are new in this context and environment but support other studies [11] where the utility of the knowledge management systems have been proven. Similar studies [23, 24] have been focusing more on email messaging between closed entities rather than the open group chat environment presented in this study where any staff member with a valuable piece of information can contribute.

Selecting the nine-month measurement period before this study was even planned increased the independence and validity of data. Therefore, the author's role didn't affect on the overall results that were derived from the data. Triangulation was reached through conversations with the company executives. SNA as widely adopted methodology studying organizational networks increases reliability of this study.

Despite the good overall validity of the study, there are a few shortages to denote. First, three out of four of employees with the shortest tenure belong to help desk, which has low In-Degree by nature. Secondly, two out of three (excluding the inactive node A4) with the longest tenure were Technical staff whose main job is to answer questions resulted a very high contribution ratio. Third, a contents analysis was left undone due to vast amount of messages. Therefore, a portion of messaging does not provide any useful information in case of learning but are more likely to be just interjections and hesitation fillers typical in spoken language. Fourth, because the number of studied personnel is small, the interpretation of these results only applies on the described context. However, the splines in Figure 2 denote that there is a correlation between tenure and knowledge contribution. These findings are consistent with recent studies [4, 16], which propose the greater the experience of an employee in a certain field, the bigger the probability those coworkers will seek to learn from this person.

The results on this and other studies [16, 17] indicate that the emphasis of the company should be to focus on knowledge management to ensure learning from past throughout the organization. Based on this view, the selected approach helped the organization to improve and enhance their learning practices in future. Moreover, the SNA approach emerges as an important management tool to improve help desk responsiveness to customers' support requests and complaints and to promote user satisfaction.

In summary, the overall patterns of communication illustrate the social nature of learning and mentoring. These patterns are inline with the learning theory that it is no longer an individualistic activity but more an interdependent process [5]. By using a time line analysis when studying learning, this paper denotes while participants mastered new skills they become more responsive to contribute knowledge to their community. Moreover, this study proposes similar implications as other studies [4, 16] for executives to focus in order to organize their employees and foster learning.

More studies in this field need to be conducted to find additional support for the provided results. These results apply only to communities in a specific setting, while to allow for a generalization of implications further research from companies of various sizes, different industries and other countries is required.

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Appendix 1. Weekly contribution ratio values grouped by tenure classes

Week	A (< 1.5 years)	B (1.5 < 4 years)	C (4 < 20 years)
12-2015	0.43		0.91
13-2015	0.52	0.21	0.79
14-2015	0.46	0.42	0.93
15-2015	0.14	1	0.97
16-2015	0.09	0.41	0.96
17-2015	0.34	0.88	0.97
18-2015	0.38	0.89	0.9
19-2015	0.12	0.85	0.9
20-2015	0.19	0.72	0.85
21-2015	0.36	0.52	0.94
22-2015	0.23	0.78	0.82
23-2015	0.47	1	0.82
24-2015	0.13	1	0.7
25-2015	0.59	0.88	0.86
26-2015	0.3	0.45	0.93
27-2015	0.79	0.84	0.96
28-2015	0.58	0.32	0.73
29-2015	0.15	0.24	0.91
30-2015	0.18	0.55	0.94
31-2015	0.14	0.22	0.97
32-2015	0.57	0.62	0.98
33-2015	0.28	1	0.94
34-2015	0.4	0.89	0.74
35-2015	0.3	0.73	0.93
36-2015	0.15	0.68	0.85
37-2015	0.41	0.38	0.81
38-2015	0.53	0.48	0.9
39-2015	0.41	0.8	0.89
40-2015	0.6	0.5	0.9
41-2015	0.82	0.48	0.91
42-2015	0.2	0.71	0.94
43-2015	0.27	0.89	0.95
44-2015	0.33	0.94	0.85
45-2015	0.13	0.86	0.93
46-2015	0.54	0.94	0.96
47-2015	0.74	0.68	0.83
48-2015	0.62	0.87	0.88
49-2015	0.48	0.6	0.87
50-2015	0.23	0.63	0.96
51-2015	0.69	0.81	0.99