July 2008

HOW CAN WE MANAGE COLLABORATION NETWORK VIA COMMUNICATION?

Hiroyasu Yuhashi
NTT DoCoMo, Inc. Mobile Society Research Institute, youhashi@eos.ocn.ne.jp

Junichi Iijima
Tokyo Institute of Technology, ijima.j.aa@m.titech.ac.jp

HOW CAN WE MANAGE COLLABORATION NETWORK VIA COMMUNICATION?

Hiroyasu Yuhashi, Mobile Society Research Institute, NTT DoCoMo, Inc., Sanno Park Tower 2-11-1 Nagata-cho Chiyoda-ku Tokyo, Japan, yuuhashi@nttdocomo.co.jp

Junichi Iijima, Graduate School of Decision Science and Technology, Tokyo Institute of Technology, Ookayama 2-12-1-W9-66 Meguro-ku Tokyo, Japan, ijima.j.aa@m.titech.ac.jp

Abstract

Now that a wide range of products and services are being commoditized globally, corporations are increasingly seeking to derive their competitiveness from the knowledge work of their staff. They are considering various measures, such as ways of management focusing on the organization of the company; among them is an approach in which knowledge born in the workplace is turned into organizational strength. More recently, indications are growing that social networks are also important.

In reality, however, it is often the case that only information sharing is encouraged, and that the perspective of actually understanding a situation and thereby taking control of it is missing. This paper uses the example of company Y, which has been evaluated highly for its management utilizing ICT, and provides a quantitative association between communication and collaboration, thereby clarifying causal relationships. Based on the acquired results, we propose a management method, which allows the management of collaboration within a company by encouraging the networks of communication.

Keywords: Social Network, Knowledge Work, Communication, Collaboration, Structural Equivalence, CONCOR.

1   INTRODUCTION

As the globalization of the economy develops, a wide range of products and services have become commoditized. Within this environment, corporate management strategies within similar industries are becoming increasingly homogenous. As a result, the effective utilization of organizational abilities and management resources built up within a company has become a major area of focus as a source of competitiveness (Hamel and Prahalad, 1989, 1990, 1994).

In the study of management methods focusing on internal organization of a company, Senge introduced the theory and practice of organizational learning (Senge, 1990), after which Nonaka presented the SECI model for knowledge creation frameworks (Nonaka, 1991, 1995). Labeling objective knowledge that can be expressed using language or similar ways as "explicit knowledge", and subjective individual knowledge - such as that held by artisans regarding their craft - as "tacit knowledge", Nonaka clarified the process by which knowledge is created through the mutual conversion between these two types, and the process by which organizational strength can be created from this knowledge. In the process of knowledge creation, the employee should do the collaboration mutually to convert individual knowledge into the knowledge of the organization, or to convert the knowledge of the organization into individual knowledge. The collaboration activity promotes the knowledge creation, and the corporate competitiveness is strengthened. It could be said that he developed the idea of organizational learning into the concept of managing the place in which knowledge creation takes place.

In discussing organizational learning from the viewpoint of methods to develop the necessary community, Wenger and Snyder alluded to the fact that such community and the social network are in a complementary relationship (Wenger and Snyder, 2001). Furthermore, Davenport points out that the most competent 40 knowledge workers glean most of their important information from social networks, and that if management can find an effective way to support social networks, this will lead to increased organizational strength (Davenport, 2005).

Is it not possible, therefore, to stimulate the community in which knowledge works of employees are developed and conducted through encouraging social networks? That is the consideration on which this paper is focused. The authors analyze the case example of Company Y, cited two years running by the Ministry of Economy, Trade and Industry (METI) in its "Top 100 IT Businesses", and add considerations according to the following procedure:

(1) Extract a network of collaboration within the company based on the business collaboration relationships. The validity of the extraction work is verified. In addition, the validity of the extraction work is confirmed by using the log of the use of the system of the voice mail and employee's job content.

(2) Clarify the relationship between the network of communication and the network of collaboration.

Based on the analysis of (1) and (2), It is considers that the collaboration network is controlled   by appeal to employee's communications act for dynamic management.

2   RELATED WORKS

There are various kinds of early researches on appliance of the social network among corporate organizations. Burt analyzes how a social network of higher management influences on the promotion

---

Deleted: この SECI モデルの知識変換プロセスでは、

Deleted: 個人の持つ知識を組織の知識とするために、もしくは組織の知識を個人の知識とするために、従業員同士がコラボレーションをおこなう必要がある。

Deleted: コラボレーション活動が知識創造を促し、企業の競争力を強化する。

Formatted: Font color: Auto

Deleted: ¶

by using the high-tech firm in the United States (Burt, 1992). Burt defined the following part "a structural hole": the loss part of the immediate relation or the indirect relation through other employees. The more the relation with employee is divided, the more the employees' autonomy is raised. It is confirmed that the promotion for the executive job who builds a lot of structural holes is taken place. It is a relation research that proves a related structure influences employee's performance. However, the suggestion of the action agenda among each employee was obtained. It is not related enough to the management.

One of researches related to management is Cross and Parker (2004a). Cross et al clarified the effect of a social network. Cross clarified systematic strategy that tied employees mutually and intimately after they explained the effect of a social network. The purpose to try to manage the social network is the same as the purpose of this research. However, the presented strategy is about sharing the organization's purpose and holding the event to make the employees relate mutually etc. It is not premised to do management dynamically knowing the state of a social network.

In the genealogy of the knowledge management research, Lesser et al discusses the brewing of an intellectual property to organize (Lesser, Fontaine and Slusher, 2000). The organization in which information is shared mutually is called "Communities of practice". It explains how are the systematic knowledge made, shared and used. However, the intellectual knowledge that arises from the employee's activity is a result. Therefore, if participation in the process is not examined, the method of the management cannot be devised.

One of the methods for participation in the process is a collaboration that is related to share and to use the knowledge. Gloor presented a concept named "Collaborative innovation network (COIN)." the concept shows ideal condition that gives good influence on business. COIN: A COIN is a cyber team of self-motivated people with a collective vision, enabled by the Web to collaborate in achieving a common goal by sharing ideas, information, and work. Several ways are explained: the requirements for COIN, the ways of employees' participation and how a formal organization changes in COIN.

From the analysis of cases such as DaimlerChrysler and IBM, It explains that there are three common steps in the process with which COIN is formed. In the first step, a small core team hits on the idea of COIN. In the second step, the idea is shared in a bigger team. The function of COIN is made from increasing of the number of members and the activities. In the third step, the team aims at communications with the outside for the target. This is a process of the COIN formation. So that the manager may do a social network in the enterprise in management, the manager should understand which state of the social network is. However, He didn't refer to this angle.

Deleted: ¶

Deleted: ¶
¶

However, all of the past research is statically analyses that catch a corporate organization at certain time. The advanced level of this research is a dynamic aspect that the state of the organization changed every day is caught and it ties to management.

3   SCOPE OF ANALYSIS

Company Y, which is the focus of analysis within this paper, is a small business operating as a sales agent for office equipment and supplies provided by a major Japanese mail-order company. The company has 27 employees, but despite its small size, predicts sales of 3.2 billion yen for the current fiscal year, placing it within the top 10 among the domestic agents for the mail-order company (as of September 2007). 85% of its sales are comprised of stationery, office supplies and living ware, with the remaining 15% comprising office furniture. It has also recently begun a recycling business for copier paper.

The office supplies mail order business is based on the partnership of three entities: a planning company, which establishes the product line-up and produces catalogues based on the company's business model, a logistics company, which manages inventory and deliveries, and the agent, which

develops new customers and conducts proposal-based sales to corporate clients within its service area. Company Y is assigned the western part of Tokyo (Shinjuku and Shibuya) as its agency service area.

Almost all office supplies are commodities, and the competition between mail-order sales and store-based retailing adds to the difficulty of increasing sales through a catalogue, however attractively it is designed and presented. Company Y has been implementing the management utilizing ICT, and engaged in proposal-based sales to corporate clients based on its know-how to improve workplaces. It also has a call centre, which receives orders and complaints from customers, within its own corporate structure; they do not outsource their customer service.

With respect to ICT use, Company Y has a thoroughly developed website and utilizes groupware. In addition, it also has a unique ICT structure in that it employs a Voice-Mail system that uses mobile phones. The Voice-Mail system is an asynchronous communication method like e-mail. The system, however, allows the verbal communication of nuances and emotions, which cannot be fully communicated by e-mail. In addition to one-on-one interaction between employees, messages can also be communicated in a multi-address transmission to members of a designated work team or to the company as a whole. Almost all the indirect communication through information communication devices taking place within Company Y is carried out using this system. During September 2007, for example, the average number of Voice-mail messages sent and received by an employee using the system was 1,001.7, and the average system usage time was 13 hours 47 minutes, showing that the system has been amply used as a method of day-to-day communication. As shown in Figure 1, however, usage conditions vary considerably depending on the individual employee.
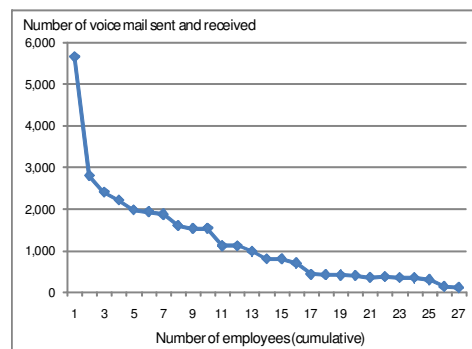

Figure 1.   *Number of Voice-Mail transactions (During September 2007)*

In addition to this system, every time an employee receives advice or assistance regarding his/her works from another employee, they send the employee who helped them a handwritten Thanks-Card. This practice of exchanging Thanks-Cards enhances the employee's motivation for collaboration between them.

The analysis in this paper was conducted in relation to 21 employees of Company Y who had been in office between October 2005 and September 2007.

4 SOCIAL NETWORK IN COMPANY

A company's employees, in addition to belonging to a formal organizational structure as a command structure, are involved in informal social networks as they carry out their work.

Burt states that structural characteristics of a social network cause an imperfect competitive environment, in which a social network may provide opportunities to certain employees while the network may not offer the same opportunities to other employees (Burt, 1992).

While an employee's individual abilities and the resources invested in him/her cannot be ignored, his or her performance at work will also be significantly influenced by the characteristics of the social networks to which he or she belongs, and by his or her positioning within these networks.

The relationships seen in the exchange of Thanks-Cards at Company Y are the results of employees' business collaboration. Just because there is a Thanks-Card exchange between an employee and a manager does not necessarily mean that there has been a path developed between them on the social network. Cross et al evaluated the social networks occurring in more than 60 different companies across a wide range of industries, and classified them into three categories, according to the types of relationships employees build inside and outside the company (Cross, Liedtka and Weiss, 2005). Based on their indications, we would like to consider the extraction of a social network, focusing on the types of relationships between employees.

If employees A and B belong to the same networks and their relationship patterns would not be changed even if they were to be exchanged for one another, they have a structural equivalence. While Cross et al classified the social networks based on their qualitative characteristics; quantitative extraction of the employees' social networks may be possible by focusing on structural equivalence.

Deleted: Rob

We can use a method called Convergence of iterated Correlations (CONCOR) to categorize structurally similar employees. In an adjacency matrix, the correlation of the value of the employee is taken. The value is settled to 0 or 1 by repeatedly calculating the correlation coefficient. The employee who has the same value is arranged as the same block.

There are a lot of methods of extracting the sub network from the network. Newman has extracted a high relation of the density by cutting an unnecessary edge in the network (Newman et al., 2003, 2004a). In this research, It is necessary to value employee's role for examine the method of management.

As a test, CONCOR was applied to the Thanks-Card exchange network, which allowed the authors to classify employees into the four following groups (Table 3). The degree mentioned here corresponds to the number of relationships an employee has built in the course of his/her work. When focusing on a specific employee, it gives an indication of the employee's centrality within the network to which he/she belongs. Now we would like to explain the characteristics of each group.

Table 1.   *CONCOR groupings*

Group Name	No. of Voice-Mails sent and received	No. of deliveries of Thanks-Cards within one group	Average degree of the groups
Group A	127,242	868	4.43
Group B	93,391	1,371	5.29
Group C	23,686	2,984	4.86
Group D	28,584	311	1.24

Group A is the group of employees who have frequent communication outside the group. At the same time, it appears that they don't have a high level of degrees which allow them to frequently switch their collaborative relationships in accordance with their work. From Figure 2, which shows the

relationships between the groups, Group A is in the position of receiving Thanks-Cards from the other groups as a result of its work, and it appears that the group is in the position of supporting the work of other groups.

Group B consists of employees who have relatively high degrees, which represent the number of relationships of an employee, compared to those in the other groups. Therefore it can be considered that they change their relationships within the group in accordance with the work they are doing, in order to facilitate their work. With respect to the relationship between the groups, they tend to be in the position of issuing Thanks-Cards to members of other groups, and it appears that they are supported by other groups as they go about their work at the forefront.

Group C is comprised of people with lower degrees, and Thanks-Cards issued by its members are distributed mainly within the group. Accordingly these people have limited working relationships and appear to go about their work in a regular day-to-day process.

Group D comprises people who engage in low levels of communication and rarely send and receive Thanks-Cards. Therefore these people are considered not to have formed a social network. (From this point onwards, Group D is excluded from considerations).
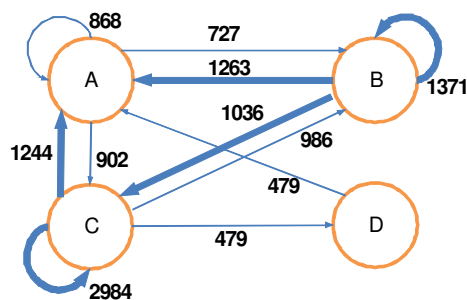
Figure 2.   Thanks-Card exchange relationships between the 4 groups

*The numerical value is a number of circulations of Thanks-card.

Analysis of the job content of the employees making up Group A shows that the group comprises management officers, accounting managers and some full-time employees (Five people). Group B includes sales managers and full-time employees engaged in proposal-based sales to corporate clients (Six people). Employees categorized into Group C include system managers and part-time employees in the company's call center (Six people). And Employees categorized into Group D include Adviser, Non-regular employee and some regular members (Four people). As described above, qualitative information also suggests that our categorization by CONCOR method has achieved a high level of validity.

Under the topic of Knowledge management, which was outlined in chapter 1, various debates have been made regarding methods of converting the sharing of knowledge into organizational strength. Despite this, within a marketing organization, it would appear that it is more important to support employees at the front line with a background of social networks. Cross et al specified a pattern known as Modular Response as one of the three social networks they classified. This type of social network is appropriate for gathering specialist knowledge and supplying solutions. This pattern, which combines modularized specialist knowledge and technical skills in the organization according to the circumstances, closely resembles the characteristics of Group B, comprising a social network of

employees within Company Y who are responsible for proposal-based sales business. For this reason, the authors decided to focus on Group B when applying their considerations.

5   COMMUNICATIONS AND COLLABORATION

Luhmann presented concepts relating to the formation of social systems: he assumed that communication is understood as an action, and after that relationships and regulations are created cognitively (Luhmann, 1973). At the time, since no analysis was available that backed up his ideas relating to such temporal causal relationships, he instead discussed the formed regulations function as a social system, creating a border with external environments. The technical evolutions taking place in recent years in the ICT sector, however, mean that it is now becoming possible to verify his hypothesis.

It could be retested with the example of Company Y, by taking the log of usage of Company Y's Voice-mail system as data relating to communication action, and examining its relationship to collaboration networks. For that purpose, we used multiple regression analysis as a verification method.

5.1   Determination of explanatory variables

It thinks about data concerning the act of communications. The following four categories from Company Y's Voice-Mail system use log were taken as explanatory variables, because these categories did not overlap with each other in terms of content.

- No. of logins/month:$X1$(The number of logins to the Voice-Mail system via a mobile phone.)

- No. of minutes used:$X2$(The number of minutes spent using the Voice-Mail services after login.)

- No. of Voice-Mails sent:$X3$(The number of Voice-Mails sent)

- No. of Voice-Mails received:$X4$(The number of Voice-Mails received)

Next, it thinks about the explained variable for the situation of the collaboration network. In looking at a specific employee in a network, we define the relationships comprised only of that employee and other employees to which his/her paths are directly connected as an egocentric network. Hereafter, the index that shows the feature of an egoism centric network is set to the explained variable and a heavy regression analysis is done.

5.2   Network size

The fact that employees have a large social network means that they have many more resources available. We defined this variable as Y_1. In addition, we also used the degree, which is one of the indicators of an employee's centrality, as a variable, in order to examine weather an employee is in an advantageous position within the egocentric network.

The results of analysis of the egocentric network size (Y_1) showed an extremely high multiple correlation coefficient R of 0.840528, and R^2 of 0.698102 when adjusted for degrees of freedom.

Table 2.   *Results of analysis of network size*

	Coefficient	Standard margin of error	t value	P value
Intercept	1.872949	1.212586	1.54459	0.124703
No. of logins/month	0.023474	0.008667	2.70836	0.007605
No. of minutes used	-0.00555	0.001791	-3.09688	0.002363
No. of Voice-Mails sent	0.005632	0.001597	3.527491	0.000568
No. of Voice-Mails received	0.022266	0.002979	7.47556	7.62E-12

As for the intercept, the coefficient was 1.872949, with standard margin of error calculated as 1.212586. Since the t-value was 1.54459 and the p-value 0.124703, it was considered that the figures were not statistically significant at t-test. For the number of logins (X_1), the coefficient was 0.023474 while the standard margin of error was 0.008667. The t-value was 2.70836 and p-value 0.007605, indicating that it reaches the 1% level and therefore statistically significant. Explanatory variables from X_2 (number of minutes used) to X_4 were also proved to be statistically significant, as shown in Table 2.

5.3   Centrality

We also used the degree, which is one of the indicators of an employee's centrality, as a variable, in order to examine whether an employee is in an advantageous position within the egocentric network. We defined this variable as Y_2. The results of analysis of the degree (Y_2) of the egocentric networks showed an extremely high multiple correlation coefficient R of 0.815136, and R^2 of 0.654859 when adjusted for degrees of freedom.

Table 3.   *Results of analysis of degree*

	Coefficient	Standard margin of error	t value	P value
Intercept	-60.8961	26.98022	-2.25707	0.025552
No. of logins/month	0.471717	0.192847	2.446071	0.015683
No. of minutes used	-0.10914	0.039841	-2.73936	0.006957
No. of Voice-Mails sent	0.127708	0.035523	3.595115	0.000448
No. of Voice-Mails received	0.424087	0.066273	6.39909	2.19E-09

5.4   Betweenness

We defined the betweenness as Y_3, which indicates whether an employee serves as a mediator between other employees.

In regard to the betweenness (Y_3), analysis showed passable results of a multiple correlation coefficient R of 0.594446, and R^2 of 0.334891 after adjustment for degrees of freedom.

Table 4.   Results of analysis of betweenness

	Coefficient	Standard margin of error	t value	P value
Intercept	- 3.22812	2.231776	- 1.44644	0.15029
No. of logins/month	0.010184	0.015952	0.638411	0.524249
No. of minutes used	- 0.0098	0.003296	- 2.97485	0.003454
No. of Voice- Mails sent	0.013417	0.002938	4.566035	1.08E- 05
No. of Voice- Mails received	0.016165	0.005482	2.948683	0.003741

As a result of estimating and testing each regression coefficient, it has been proven that, while the values for the betweenness are somewhat weak, there is a relationship between the act of communication and the status of collaboration networks.

6   MANAGEMENT ON COLLABORATION NETWORK

Based on the ideas of Luhmann (1973), it can be assumed that the act of communication precedes a change in the status of collaboration networks. To test this, we performed multiple regression analysis on datasets of communication activities preceding the change in collaboration network by one month, and datasets of communication activities preceding by two months.

The results showed the highest R^2, after adjustment for degrees of freedom, for the size of egocentric network and degree using the synchronous datasets. They also showed, however, in terms of the betweenness, that the act of communication takes place a month in advance of any effect on the status of collaboration networks.

Table 5. R^2, after adjustment for degrees of freedom, and datasets

	Synchronous dataset	Dataset preceding by one month	Dataset preceding by two months
Size of egocentric network	0.697345241	0.601636388	0.520645339
In- degree and out- degree	0.654197312	0.554023438	0.461210938
Ego betweenness	0.334623143	0.361317389	0.309113345

This indicates that the size of egocentric networks and degree fluctuate immediately when communication is enacted in response to an instruction from management. In terms of the betweenness, however, the results are presumed to be due to the fact that a slight time lag occurs before a relationship constructed through business can be utilized by another employee for his or her own business purposes.

It is thought that the hypothesis of Luhmann was verified from the above-mentioned. Next, it has the participation of management in communications, and the method of controlling the state of the collaboration network is examined. When using multiple regression analysis, a standardized partial regression coefficient must be used for comparison in order to confirm which independent variables may explain the dependent variables.

Defining the standard deviation of X_i as S_{Xj}, and the standard deviation of Y_i as S_{Yi}, the standardized partial regression coefficient (β'_i) can be expressed with the coefficient β_i as formula 1 below:

$$\beta'_i = \frac{S_{X_i}}{S_{Y_i}} \beta_i \quad \text{--- (formula 1)}$$

The results of the calculation are as shown in table 6 in group B. The number of messages received is the principal factor for the size of egocentric network and the degree of centrality. The number of messages sent, however, was the principal factor for the betweenness.

Table 6. Determination of principal factors （Standardized partial regression coefficient）

	No. of logins/month	No. of minutes used	Total no. of Voice-Mails sent	Total no. of Voice-Mails received
Size of egocentric network	0.315819	-0.36575	0.274131	0.637267
In-degree and out-degree	0.003125	-0.35194	0.294337	0.607859
Ego betweenness	0.110496	-0.52149	0.526682	0.373097

Cross et al proposed that a key point in management is the ability to integrate a range of knowledge when implementing a solution. This idea can be further substantiated based on the considerations of this paper.

In order to support the activities of knowledge workers using the strengths of social networks, there is a need to place those employees in a more central position in the structure of such networks.

In order to do this, the flow of communication must be controlled to ensure that information is constantly being fed to the employees.

7   CONCLUSION

In this thesis, the management technique of the interpersonal relationship network on the business that comes in the place of the knowledge work has been being examined aiming at the competitive edge strengthening of the enterprise. Company Y evaluated by management that used ICT was analyzed. We were able to extract social networks by applying the CONCOR method, which categorizes business collaboration relationships based on structural equivalence between employees. The group that engaged it in proposal type business was taken up. The act of communications was confirmed and the situation of the collaboration network confirmed the correlation the index that showed by a heavy regression analysis. Moreover, the act of communications clarified the factor that influenced the collaboration network. And it proposes the method of management based on the analysis result. If the result is arranged, it becomes the following two points.

The first result is that we were able to confirm the strong correlation that exists between the act of communication and collaboration relationships between employees. We were also able to clarify the causal relationships relating to this.

The second result is that, by identifying major factors for the correlation stated above, we were able to define the point to focus on to encourage employees' communication activities. Accordingly, we have established the possibility of managing collaboration networks.

The past, each one of the employee was a unit of execution of the business that management understood. In the target collaboration network for management, the operation possibility of the knowledge work has risen.

When other enterprises analyze it, it will become the object case with the bench mark in the future. Because the company Ｙ＇ｓ case is evaluated by management that uses ICT. But the issue of generalization of the results still remains unverified, and we need to examine whether similar results could be achieved with a major corporation.

Within this paper, we looked in detail at the group of employees who are engaged in proposal-based sales business to corporate clients. There remains the strong possibility that the social networks of desk-based workers, engaged for example in call center work, and the social networks of management-level employees may show significantly different attributes. In the future, a comparison of the groups classified by CONCOR is thought to be necessary.

References

Burt, R. S. (1992). *STRUCTUAL HOLES: The Social Structure of Competition*. Harvard University Press.

Breiger, R., Boorman, S. and Arabie, P. (1975). "An algorithm for clustering relational data, with applications to social network analysis and comparison with multi-dimensional scaling," *Journal of Mathematical Psychology*, December, 328-383.

Chung, K. S. K., Hossain, L. and Davis, Joseph. (2007). "Individual performance in knowledge intensive work through social networks," In Special Interest Group on Computer Personnel Research Annual Conference, Proceedings of the 2007 ACM SIGMIS CPR conference on 2007 computer personnel doctoral consortium and research conference: The global information technology workforce, p. 159-167, SESSION: Virtual community contributions, St. Louis, Missouri, USA.

Cross, R. and Parker, A. (2004a). *The Hidden Power of Social Networks: Understanding How Work Really Gets Done in Organizations*. Harvard Business School Press.

Cross, R., Cummings, J.N. (2004b). "Tie and network correlates of individual performance in knowledge-intensive work," *Academy of Management Journal*, available at: http://ccs.mit.edu/fow/cross_cummings.pdf

Cross, R., Liedtka, J. and Weiss, L. (2005). "A Practical Guide to Social Networks," *Harvard Business Review*, May-June, 158-163.

Davenport, T. H. (2005). *Thinking for Living: How to Get Better Performance and Results for Knowledge Workers*. Harvard Business School Press.

Gloor, P. A. (2006). *SWARM CREATIVITY: Competitive Advantage through Collaborative Innovation Networks.* Oxford University Press.

Gloor, P. A., Paasivaara, M., Schoder, D. and Willems, P. (2007). "Find collaborative innovation networks through correlating performance with social network structure," *Journal of Production Research*, available at: http://www.islp.uni-koeln.de/venus/Material/Gloor_Schoder.pdf

Deleted: ¶

Formatted: Font: Italic

Formatted: Font: Italic

Deleted: ¶

Deleted: .

Formatted: Font: Italic

Deleted: .

Formatted: Font: Italic

Formatted: Font: Italic

Formatted: Font: Italic

Formatted: Font: Italic

Deleted: "

Formatted: Font: Italic

Gloor, P. A., Dynes, S. B. C. and Zhao, Y. (2003)."Visualization of communication patterns in collaborative innovation networks: Analysis of some W3C working groups," In Proceedings of the twelfth ACM CKIM International Conference on Information and Knowledge Management, p. 56-60, New Orleans, USA.

Gloor, P. A., Heckmann, C. and Makedon, F. (2004). "Ethical issues in collaborative innovation networks," available at http://www.ickn.org/documents/COIN4Ethicomp.pdf.

Hamel, G. and Prahalad, C. K. (1989). Strategic Intent. *Harvard Business Review*, May-Jun, 63-76.

Hamel, G. and Prahalad, C. K. (1990). The Core Competence of the Corporation. *Harvard Business Review*, May-Jun, 79-91.

Hamel, G. and Prahalad, C. K. (1994). *Competing for the Future*. Harvard Business School Press.

Lesser, E., Fontaine, M. A., Slusher, J. A. (2000). "Knowledge and Social Capital: Foundations and Applications," Butterworth - Heinemann.

Luhmann, N.(1973). "Vertrauen: Ein Mechanismus der Reduktion sozialer Komplexitat," Stuttgart.

Newman, M. E. J. (2003). "The structure and function of complex networks," *SIAM Review*, 45, 167-256.

Newman, M. E. J. And Girvan, M. (2004a). "Finding and evaluating community structure in networks," *Physical Review*, 69, 026113.

Newman, M. E. J. (2004b). "Fast algorithm for detecting community structure in networks," *Physical Review*, 69, 066133.

Nonaka, I. (1991). "The Knowledge-Creating Company," *Harvard Business Review*, Nov-Dec, 96-104.

Nonaka, I. and Takeuchi, H. (1995). *The Knowledge Creating Company*. Oxford University Press.

Senge, P. M. (1990). *The Fifth Discipline*. Doubleday.

Wenger, E. C. and Snyder, W. M. (2000). "Communities of Practice : The Organizational Frontier. Core Competence of the Corporation," *Harvard Business Review*, Jan-Feb, 139-145.