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Social Networks, Social Computing and Knowledge Management

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2.1 Introduction

Social networks are the 'connections' that individuals utilise through various modes of communication to conduct their work. These communications come in the form of email, instant messaging, phone calls, wikis, blogs, face-to-face interactions, etc. These connections make up the central nervous system of information intensive organisations. The information that workers use to analyse, explore, understand and make decisions about their environment often flows through these connections. Understanding these connections can therefore provide important insights into how the information structure of a firm affects its performance.

Knowledge management is defined as the 'systematic application of actions to ensure that an organisation obtains greatest benefit from the information that is available to it' (Marwick 2001). Knowledge here is seen as the experience of the people within an organisation (tacit knowledge) combined with information from documents within the organisation, as well as access to relevant reports from the outside world (explicit knowledge). As such, knowledge management combines the use of ICT systems with an insight into the social processes around the movement and production of information.

Knowledge management systems are now moving to a position of exploiting the insights gained from analysis of social structure, and from the dramatic rise in popularity of social networking systems both inside and outside the enterprise. For example,

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the Facebook¹ system was seeing monthly rises in the number of unique visitors of 80% in mid-2007. Similarly, a recent survey revealed widespread interest in corporate use of social computing and related technologies (McKinsey 2007).

Considering knowledge management trends in recent years, we can distinguish three broad phases: first, the repository-centric view characterised by one or more central information repositories with a set of corporate contributors and reviewers; second, the move to smaller, facilitated knowledge communities; and finally, previous knowledge management archetypes have been broadened and complemented by a trend termed 'social computing' (Charron *et al.* 2006). Brown (2007) further describes the current situation:

Front-line business people continue to tug at the fringes of hierarchical, bureaucratic, IT architectures by downloading and installing themselves productivity tools like desktop search, wikis and weblogs . . . the water cooler conversation, now lives somewhere between your instant messaging network, email discussion threads, and the public blogosphere.

The structure of this chapter is as follows. We begin with a discussion of the importance of analysing social networks with the enterprise. We then describe applications of social computing to knowledge management and conclude with a discussion of trends for future enterprise-wide social computing applications.

2.2 Do Social Networks Matter?

The answer to this question is simple: social networks matter far more than we have ever imagined.

In the USA, information workers account for nearly 70% of the labour force, and contribute more than 60% of the total value added to the US economy (Apte and Nath 2004). Information workers make decisions and actions that generate value-added information products, instantiated as advice, reports, designs or legal contracts that are subsequently sold at a premium.

If information is the critical input to 70% of the work being conducted in today's economy, then the social avenues and channels that distribute information among individuals, groups and populations are possibly the supply chains of knowledge-intensive industries. The networks of relationships that connect people are perhaps the most important avenues through which information flows in the business world, and social networks offer a structure for the systematic analysis and measurement of information flows in business networks.

Social networks are conduits for communication flows, and communication flows contain the lifeblood of companies: information. Information, and the knowledge instantiated within it, is a critical success factor in business. What if social networks could help answer questions such as:

- Does the size or shape of a person's social network matter to performance?
- Does a larger social network cause information overload and poor performance?

¹<http://www.facebook.com/>.

- What are the communication and information practices of effective workers?
- How do ICT-enabled processes change work organisation and business processes in the context of information work?
- How do new ICT-enabled processes change communication flows and how do these flows in turn impact productivity and performance?

Past and recent research at the Massachusetts Institute of Technology (MIT) Center for Digital Business and at other leading universities, suggests that the answers to these questions are at hand. By collecting email, instant messaging, phone and face-to-face communications data, social networks reveal patterns of performance. These data offer a view into how information moves between information workers as they do their jobs. With this information in hand, individuals, managers and organisations have an opportunity to optimise workflow and to improve performance.

2.2.1 Social Networks and Measuring Individual Information Worker Productivity

While social networks can be used to uncover patterns of information flow that predict efficiency, quality, error rates or more repeat business, the focus of this section is productivity and the reasons why social networks matter to the productivity of information workers.

Ichniowski, Shaw and Prennushi (1997) and others were able to specify and measure production functions for blue collar workers, such as those working in steel finishing lines. This has greatly advanced the understanding of the effects of work practices and technology on productivity for these workers. In contrast, there has been little work measuring the productivity of information workers. Even measuring the impact of technology investment on productivity at the company level has proved difficult (Brynjolfsson and Hitt 1996). Since then, recent research has focused on explaining variance in the benefits gained through IT spend (Aral and Weill 2007), and modelling and measuring how information flows and ICT use impact the productivity of information workers.

Van Alstyne *et al.* (Aral *et al.* 2006; Bulkley and van Alstyne 2006; Aral and van Alstyne 2007; Aral *et al.* 2007) collected data from detailed access to three US-based executive recruiting firms and set out to analyse the data for patterns of information flow as indicators of productivity. Included in the data was information on 1300 projects, 125,000 email messages, accounting information, semi-structured interviews, a detailed survey and the regional socio-economic conditions in which the firm's services were delivered. Several measurable outputs were calculated from these sources, including:

- revenues per person and per project;
- number of completed projects;
- duration of projects;
- number of simultaneous projects;
- compensation per person.

The results obtained from analyses of these data matched with individual and collective social networks were profound. While the analysis is ongoing, the findings to date include a set of results on topics ranging from information overload to multitasking, project duration and completion, to incentive theory and sharing, to ICT skills, to social network structure and information advantage, and to information diffusion dynamics.

Here are three concrete examples:

1. Information Diffusion. Using the data gathered, Aral *et al.* (2006, 2007) explored a set of questions around the diffusion of information within a company, the impact of social networks and the use of information technology upon behaviours. What are the productivity effects of information diffusion in networks? What predicts the likelihood of receiving information diffusing through a network, and receiving it sooner? Do different types of information diffuse differently? Do different characteristics of network structure, relationships and individuals affect access to different kinds of information?

The results indicate that those people who act as 'information hubs' in the social network are more productive; information hubs are those that communicate with a broad set of people within their own organisation and that have high communication volume. Aral and van Alstyne (2007) found that larger social networks deliver diverse information but with a decreasing rate of return. In turn, productivity increases with novel information, but again at a declining rate. Thus, there will be an optimum size for a person's communication network.

In the case of these particular firms, adding more than 15 or 20 people to one's own internal social network had little additional impact on productivity, output or performance. In a different industry, the size of an optimum network may, for example, be 75 people: the optimum network size for a particular enterprise is dependent upon a number of variables, such as the type of knowledge work and the complexity of interactions.

So, the recent media interest about 'aggressive networking' and the value of becoming a 'social butterfly' has real limits especially if we consider the time and effort required to make and to maintain relationships. The main insight highlighted the cognitive bottleneck of the human mind: while information is no longer scarce, attention is. The data indicate that employees with diverse social networks receive more novel information and are therefore more productive; productive people are those that connect to multiple different parts of an organisation. In essence, networks that deliver the right information are highly valuable, but adding more contacts is less valuable the larger your network becomes.

So how is it possible to translate this analysis to the bottom line? Given the availability of team, project, accounting and compensation data, the research team was able to create a fine-grained analysis. For example, having access to new information sooner is a predictor of higher productivity. In the case of the recruiting firms studied, seeing an additional name of a new candidate within 1 week of its first emergence in the communication network was worth \$321 to a recruiter's bottom line revenue generation, compared to \$115 if seen within the first month. Timeliness and relevance were key variables in performing a search within the

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recruiting firms. For example, if a new candidate's name circulated quickly through the communication network, then that candidate could be included in ongoing recruitments.

2. Information, Technology and Multitasking. Popular press has suggested that new information and communication technologies are driving business at 'the speed of thought', or putting today's labour force on the 'information superhighway'. Initial estimates from the data analysis demonstrated strongly that the use of ICT was associated with more revenue generation and more projects completed per unit time, but that using ICT was also associated with longer average project duration. ICT was slowing work down but was also enabling workers to do more and to generate more revenue per unit time.

ICT was changing how people worked, rather than just speeding up traditional ways of working. Recruiters who used the information systems of the firm more heavily and who were in positions to be information hubs in the social network structure of the firm were multitasking more and multitasking more effectively. ICT and access to information were enabling these information workers to handle more simultaneous projects without slowing down any one individual project completion rate. Up to a certain point, more multitasking improved productivity, but after reaching an optimum level, taking on additional work made employees less productive.

3. Information Overload. The pervasiveness of email has given rise to what many workers consider information overload. On a statistically significant basis, four key email traits suggest effective use of email. First, those people who are central nodes of information, who bridge structural holes in the social network, are significantly more effective workers. Second, those who send short email messages have higher productivity. Third, those who communicate via email with accurate, concise subject descriptions receive better email response rates. Fourth, those who invest in building their social network early in their careers are better able to exploit the network for productivity gains later.

The data from this research have identified a number of principles of effectively managing information in a social network with direct bottom line implications. Each of these principles has a basis in the underlying analysis of the social networks in three recruiting firms, but they may differ for other types of information workers:

- ICT does not just speed up tasks; ICT changes how those tasks are achieved.
- The productivity of an information worker is affected by how quickly his or her colleagues respond to information requests.
- Information workers who use the company's knowledge systems are more productive.
- Information workers who use ICT for higher value information processing are more productive.
- Information workers who gather information from a more diversified social network are more productive.
- Information workers who optimise the management of information contacts over time gain greater benefit over their career life cycle.

2.3 Knowledge Management Applications

The purpose of knowledge management can be broadly defined as seeking to maximise the benefit to an organisation of its information assets. Given the productivity benefits for information workers identified above, it is instructive to consider the place of social computing and the social networking capabilities it offers in the wider knowledge management context. Marwick (2001) suggests that effective knowledge management requires a combination of organisational, social and managerial initiatives alongside the development of appropriate knowledge access technologies. Furthermore, knowledge sharing software supports the activities to collate, categorise and distribute information (Davies *et al.* 2005).

It is important to state that there are different forms of knowledge that are processed differently by individuals and by the enterprise as a whole. In particular, it is useful to differentiate between explicit and tacit knowledge: Nonaka (cited by Marwick 2001) formulated a theory of organisational learning that focused on the transformation of tacit into explicit knowledge and vice versa. Tacit knowledge is held internally by each knowledge worker, and is formed by past experiences, beliefs and values. Explicit knowledge is represented by some document, such as a web page or a video, which has been created with the goal of relaying some piece of tacit knowledge from one person to another. Organisational learning occurs as people participate in shared activities, and their knowledge is articulated, making it available to others. Typical activities involved in converting from one form of knowledge to another are shown in Figure 2.1.

These transformational processes are happening all the time, as an individual moves between different work situations and communities (Wenger 1999; Marwick 2001; Shneiderman 2003). All of the processes are important, but the emphasis of one process over another is a matter of balance and choice in which knowledge management is deployed. Brown and Duguid (1991, 2000) suggest that learning and knowledge sharing is a key activity supported by a community of practice: learning is essentially a social activity. The importance of a document or the relevance of a piece of information, to a particular community, is a by-product of how that information has been propagated: the importance and meaning of information is negotiated rather than being fixed and agreed in advance.

Tacit to Tacit <i>Socialisation</i> Team Meetings, Discussions	Tacit to Explicit <i>Externalisation</i> Answering explicit questions, writing of a report
Explicit to Tacit <i>Internalisation</i> Reading and learning from a web page	Explicit to Explicit <i>Combination</i> Using a search engine, emailing a report to a colleague

Figure 2.1 Converting between forms of knowledge (after Marwick 2001)

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Rogers (1995) suggests that people gather and share information unequally through their social networks, as a person tends to trust information from similar people. However, those people with strong social connections tend to only know similar information. Granovetter (1973, 1983) terms this as the 'strength of weak ties', where new or useful information tends to be found at a lower personal cost through weak social contacts. Constant *et al.* (1996) suggest that in a situation where opinions are required rather than a definitive answer, the more possible solutions, the better. Thus, community systems that allow access to a greater number of weak ties will have a better perceived utility. However, this has to be balanced against the cognitive load to understand the alternative suggestions.

Information gathering and information sharing are separate but connected activities (Hyams and Sellen 2003a, 2003b); information gathering involves a significant amount of collation and learning rather than directly finding a particular fact. Annotations that users will make for their own private usage will tend to be different from those annotations made for 'public' consumption (Marshall and Brush 2004). Information sharing requires that a feedback path is available from the information recipient back to the sender. Feedback from recipients is a powerful motivational tool to encourage sharing, but also allows information publishers to tailor information to more of the recipients' needs and business context (Golder and Huberman 2006).

Knowledge management can thus be seen, in part, as the use of social computing within the enterprise. Collaborative systems, such as the content creation process found in wikis, will enable communities within the company to reach a consensus via collaborative working. Social computing applications explicitly make use of collaboration, communities and network effects, where the utility of an application increases with a greater number of users (Hinchcliffe 2006; Heath *et al.* 2007): word of mouth recommendations greatly accelerate the take-up of such systems.

While, Wikipedia² has become one of the most referenced knowledge sources on the Internet, social computing technologies are not solely applicable on the Internet, but are also seen as viable enterprise solutions. Companies such as Dresdner Kleinwort Wasserstein are using wiki technologies to enable the co-creation of information, avoiding complicated email exchanges; wikis are seen as 'more participative and non-threatening' than other collaborative technologies (Nairn 2006). The lessons learnt from the growth of applications in the consumer space are being applied to enabling new ways of working and boosting employee productivity. Lightweight social computing technologies encourage sharing, as each person is able to easily contribute a small piece to a growing body of information.

Though ICT systems are not able to enforce an attitude to share information within an enterprise, facilities can be put into place to encourage and support those knowledge sharing activities (Kings *et al.* 2003, 2007; Davies *et al.* 2005; Bontcheva *et al.* 2006). In effect, the ICT system becomes a 'place' that enables or disables certain forms of interactions (Raybourn *et al.* 2003): a culture of sharing can be fostered by an awareness of the underlying social norms, and the artefacts within a system that expose support that culture.

²<http://www.wikipedia.org/>.

2.4 Future Research and Trends

From the perspective of the future of ICT, whether ICT delivers productivity benefits comes down to how technologies are used by individuals and organisations. This point goes a long way towards explaining why companies with the same ICT expenditure can perform so differently (Aral and Weill 2007). As with most research, several important new questions have emerged from our analyses. For instance, applying the same techniques to different industries and different types of workers may lead to different principles. Future questions to explore include the following:

- What technologies and practices are most effective for various types of work?
- How does collaboration correlate with performance, at the individual and organisational level? How does collaboration differ across different media (for example, IM compared to email)?
- What practices, incentives and culture are correlated with increased collaboration? What should managers do, and what should they avoid doing?
- How can qualitative measures improve our productivity measurement?

Future knowledge management systems will build upon the positive experiences of massively collaborative Web 2.0-type knowledge articulation processes, such as the tagging process (as seen, for example, in delicious³ or flickr⁴), the collaborative content creation process found in wikis and the content sharing approach found in blogging systems. Currently, the power of these systems stems from their massively collaborative nature and their easy and intuitive handling while being restricted to resource annotation (in the case of tagging) and generation of interlinked document-style content (in the case of wikis and blogs).

Collaborative content annotation and creation process can be raised to the level of knowledge articulation with increased expressivity by exploiting semantic technologies, while still retaining intuitive and collaborative Web 2.0-style tools. Semantic technology offers a unified, more formal structure against which to annotate knowledge, facilitating shared access and more sophisticated information analysis, for example, by creating a task-specific search tool (Duke *et al.* 2007).

Mika (2005) suggests that the Semantic Web has been defined to facilitate machine understanding of the World Wide Web; however, the process of creating and maintaining that meaning is a purely social activity. Each ontology is created in a process that requires a group, or community, to build and share an agreed understanding of the important concepts for that community. An understanding of social presence is crucial in understanding how an ontology evolves and gains acceptance.

Much of the life of an enterprise is represented through the interaction of informal knowledge processes. Much of these interactions occur in the form of communications like emails, blogs, wikis, reports and other types of documents that are created, processed and archived within or in relation to the enterprise. Part of such document flows is regulated by business processes or policies, while the other part originates from

³<http://del.icio.us/>.

⁴<http://www.flickr.com/>.

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While processing the informal knowledge, a knowledge worker is frequently dealing with many tasks and much incoming information in parallel, and has to switch often between tasks and between various kinds of documents. Thus, a critical aspect of future knowledge systems will be the modelling of the user's differing contexts and offering support for context management. Here, context is comprised of various aspects including the user's current tasks, interest profile and experience, running applications, device, role, and so on. At times, the system will suggest to the user to switch context, and at others, to suppress incoming alerts and tasks which could lead to unwanted context interruption. Thus, the management of context, combined with formal and informal knowledge processes, will be key constituent of future knowledge management systems.

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