This is the author’s final peer reviewed version of the item published as:


Dynamic Knowledge Integration in Socio-technical Networks:

An Interpretive Study of Intranet Use for Knowledge Integration

Sharman Lichtenstein*
Craig M. Parker
Alexia Hunter

School of Information Systems
Deakin University
221 Burwood Highway
Burwood 3125
Australia

Email: sharman.lichtenstein@deakin.edu.au
Email: craig.parker@deakin.edu.au
Email: alexia.hunter@bigpond.net.au

* Corresponding author

ABSTRACT

A major challenge facing firms competing in electronic business markets is the dynamic integration of knowledge within and beyond the firm, enabled by internet-based infrastructure and emergent fluid socio-technical networks. This paper explores how social actors dynamically employ intranets to integrate formal and informal knowledge within evolving socio-technical networks that emerge, permeate and extend beyond the organisational boundary. The paper presents two case studies that illustrate how static intranets can be useful for dynamically integrating knowledge when they are interwoven with other knowledge channels such as e-mail through which flows the informal knowledge needed to make sense of and situate formal organisational knowledge. The findings suggest that businesses should carefully examine how employees integrate intranets with other channels in their work, and the shaping of knowledge outcomes that flows from such use. There are practical implications for the proper skilling of the people who share and integrate knowledge in this way. The paper also provides a framework for dynamic knowledge integration in socio-technical networks, which can help underpin future research in this area.

Keywords: knowledge integration, socio-technical networks, intranets, knowledge sharing

1 INTRODUCTION

The development of dynamic integrative and network capabilities is an important challenge for firms competing in contemporary electronic business markets (Brass et al., 2004; Daniel & Wilson, 2003; Teece et al., 1997). Seeking to respond to emerging opportunities and threats in real time, companies must dynamically integrate information and knowledge distributed across systems, disciplines, organisational boundaries, communities, time zones and regions (Alavi & Tiwana, 2002; Bradley & Nolan, 1998). Formal knowledge found in static components of
organisational memory must be blended with informal knowledge found flowing through interactive channels (Conklin, 1996; Euzenat, 1996, Papavassiliou & Mentzas, 2003; Ruggles, 2004). Therefore, competitive organisations require the capability to source, collect and integrate distributed formal and informal knowledge in real time.

Existing knowledge integration mechanisms focus on routines and rules, problem-solving groups, boundary spanners, projects and knowledge brokers (Alavi & Tiwana, 2003; Grant, 1996; Kogut & Zander, 1992; Lamb, 2003; Huang & Newell, 2003). However, such approaches do not account for the evolving patterns of informal interactions between people and technologies that characterise situated emergent knowledge work in progressive organisations. We propose that the organisational form - socio-technical networks - is a potentially valuable dynamic integrative mechanism (Boland et al., 2003; Ing & Simmonds, 2000; Malhotra, 2005). A socio-technical network is “the enactment of patterns of interaction and relationship which occur between individuals, within and between organisations and institutions, and through information and communications technologies (ICT) which embed, and are embedded in interactions” (Davidson & Lamb, 2001, p.1).

Guided by the published academic and popular literatures, we still know little about how and why knowledge workers choose particular ICTs to share and integrate knowledge in socio-technical networks. With few exceptions, we discovered in the knowledge integration literature an emphasis on the organisational and social aspects in isolation from the technological issues. However recently, experts called for a refocussing by information systems researchers on the role of ICT artefacts in systems and organisations while still heeding the social aspects of technologies (Kling, 2000; Orlikowski & Iacono, 2001). This call has been buoyed by recent findings of links between ICT-based enterprise resources, the capabilities required to develop and apply them, firm performance and competitive success (Bharadwaj, 2000; Wade & Hulland, 2004).

This study has a focus on the role of intranets in integrating knowledge in socio-technical networks. Intranets, with their open non-proprietary architecture, are considered key tools for sharing and integrating information and knowledge (Bra & Rolland, 2000; Choo et al., 2000; Detlor, 2004; Lamb, 2003; Skok & Kalmanovitch, 2005). From two case studies exploring knowledge sharing and integration using intranets (reported more generally in Lichtenstein et al., 2004), it was revealed that knowledge workers were often using intranets in conjunction with other electronic channels, using the resources of socio-technical networks. These results are the focus of this paper.

A theoretical framework was developed from relevant literature and described in this paper after the initial study, as there was a need to frame the findings. The framework conceptualises dynamic knowledge integration in emergent ad hoc socio-technical networks that originate, permeate and extend beyond an organisation. Intranets play a special integrative role in our framework. It makes an important contribution to the knowledge management literature as previous frameworks that theorise knowledge integration (i) focus on static knowledge integration and do not adopt a dynamic approach, (ii) do not recognise the potential value of ad hoc socio-technical networks as an organisational form for facilitating dynamic knowledge integration, (iii) neglect the symbiotic relationship between formal and informal knowledge and (iv) overlook the potential integrative value of intranets.

This framework suggests that an important aspect of understanding dynamic knowledge integration lies in understanding the socio-technical considerations that shape the strategic mix of humans and ICT channels such as intranets. The framework was developed as a result of the initial exploratory research involving two case studies (Lichtenstein et al., 2004) and is used in
this paper to frame the case findings. The paper provides preliminary support for the usefulness of the framework for analysing dynamic knowledge integration underpinned by socio-technical networks. The findings are also useful in suggesting ways that dynamic knowledge integration might be supported in organisations, and how intranets in particular may fulfil previously unrecognised, valuable roles.

An outline of the rest of the paper follows. In the next section, we propose and describe a theoretical framework for dynamic knowledge integration in socio-technical networks, highlighting a potential role for intranets as an important element of the dynamic synthesis of informal and formal knowledge. Following a review of the research design, we present some of the main empirical findings from a larger study of knowledge sharing in two case studies of intranet use for knowledge sharing and integration in organisations. After reflecting on theoretical and practical implications, we summarise the paper, draw conclusions, outline several limitations of the study and propose future research directions.

2 THEORETICAL FOUNDATIONS

We propose a theoretical framework for dynamic knowledge integration in socio-technical networks, highlighting the role of intranets and their complementary use with other ICTs (figure 1). The framework is based on concepts introduced in the previous section and explored in this section. We do not intend in this paper to validate the framework, but rather to illustrate its theoretical concepts and to use it to frame the later empirical analysis. The framework is first summarised, following which its elements are reviewed in greater depth.

Figure 1: Dynamic knowledge integration in socio-technical networks
In the framework, the impetus for dynamic knowledge integration derives from a practical problem requiring the gathering and integration of dispersed knowledge. The distributed knowledge exists as fragments within and outside the company, and can be a combination of formal and informal knowledge. A distributed organisational memory comprises social actors (actors), processes, norms, standards, and technologies (Ackerman & Halverson, 2000). Actors tap into knowledge found in organisational memory and the external environment (for example, the World Wide Web or business partners) using ICTs where needed in order to synthesise gathered knowledge and develop a solution or decision for actioning. Dispersed formal and informal knowledge are integrated during interaction and negotiation enabled by network norms, processes, standards and ICTs. Knowledge that has been integrated extends organisational memory. Following, we review key elements of this framework in depth, beginning with a discussion of knowledge and two important types of knowledge – formal and informal knowledge.

2.1 Formal and informal knowledge

Among many existing perspectives of knowledge, the division of knowledge into formal and informal knowledge proves useful to a study of dynamic knowledge integration by networks of people, as will be shown in this section. Before introducing these two types of knowledge, we first define knowledge by referencing Barabba and Zaltman’s (1991) transformational view of data, information, intelligence and knowledge. In this view, codified observations are obtained from a marketplace of data which, when placed in some decision context, are transformed into information. In the analysis of information, intelligence is developed. When high levels of confidence are developed in a body of intelligence, knowledge is created. We adopt the epistemological position that knowledge has dual, complementary forms – tacit and explicit – and that knowledge is embedded in practice and thus has a social aspect (Hislop, 2003; Tsoukas, 1996).

As introduced earlier, knowledge can also be divided into formal and informal knowledge. Formal knowledge is the product of knowledge workers and includes reports, papers, plans, spreadsheets, designs, memos and structured formal business processes. Such knowledge is general and rule-like and has been called “know-what” (Garud, 1997). Some formal knowledge has longevity and is reused frequently over an extended period. Such knowledge can be stored in shared repositories such as intranets where it can be easily accessed and updated. Due to the phenomenon of multiple fragmented specialised knowledge silos reported in the literature (e.g. Newell et al., 2001a), such formal knowledge can be difficult to locate, retrieve, understand, contextualise and integrate with other knowledge.

Informal knowledge includes knowledge that is created and used in the process of creating a final result and comprises knowledge such as the answer to the reflective question: “why did we do it that way?” (Conklin, 1996, p.7). Conklin goes on to list different types of informal knowledge such as ideas, facts, assumptions, meanings, questions, decisions, guesses, stories and points of view. Informal knowledge is as important in the work of the knowledge worker as formal knowledge. However, Conklin mentions that informal knowledge is rarely captured in Western societies which tend to value results rather than what happened on the way to the results. Informal knowledge usually flows through and beyond organisations and can be difficult to access.

Experts have attempted to categorise the different types of informal knowledge. One type of informal knowledge is “know-why” (Garud, 1997). “Lessons learned” is an example of know-why. A second type of informal knowledge - “know-how” - is the ability to put “know-what” into
practice from experience or interactive assistance (Garud, 1997). A third category of informal knowledge is the weakly structured business processes that are increasingly prevalent in businesses yet difficult to define (Papavassiliou & Mentzas, 2003). Procedures that make up such processes are subject to ad hoc modification. As Papavassiliou and Mentzas observed: “knowledge-intensive processes tend to be characterized by dynamic changes of goals, information environment, constraints, and highly individual and ad hoc communication and collaboration patterns” (Papavassiliou & Mentzas, 2003, p.19).

Conklin suggests that informal knowledge can act as the glue that holds formal knowledge together and provides context (Conklin, 1996). Ideally, both formal and informal knowledge in organisations should be available to actors as components of organisational memory (Euzenat, 1996).

Integrating the different types of knowledge relies on strategies of knowledge sharing (Grant, 1996; Hansen et al., 1999). Hansen and colleagues describe three basic approaches to knowledge sharing. In the codification strategy, knowledge is articulated, codified and stored in repositories for later retrieval and application. As mentioned above, formal knowledge is often shared this way. The personalisation strategy relies on interaction to negotiate meaning and stimulate learning. This approach can employ ICTs such as e-mail or groupware for connection and collaboration, and informal knowledge is often shared this way. In the community perspective, knowledge is formative, socially constructed, and utilises and produces shared understandings that can be useful in integration (Wenger, 1998). There are technologies such as groupware that support such communities.

Shared knowledge is integrated through integrative mechanisms. Recognised knowledge integration mechanisms include rules, coordinative routines, virtual teams, cross-functional projects, and communities of practice (Alavi & Tiwana, 2002; Becker, 2002; Grant, 1996; Huang & Newell, 2003). In this paper, we explore dynamic knowledge integration in socio-technical networks, where we suggest that dispersed formal and informal knowledge can be dynamically integrated, with a key role played by intranets.

2.2 Organisational memory

Organisational memory is “the collection of historical corporate knowledge that is employed for current use through appropriate methods of gathering, organising, refining, and disseminating the stored information and knowledge” (Nilakanta et al., 2006). Nilakanta and colleagues provide a comprehensive review of organisational memory (Nilakanta et al., 2006). However, we are interested here primarily in the centralised/distributed nature of organisational memory and its ability to integrate formal and formal knowledge. A centralised memory is comprised of the knowledge of an organisation compiled and integrated over time and is stored in global repositories structured by global ontologies or in shallow structures accessed through information retrieval (Van Elst et al., 2004).

In distributed memories, as shown in figure 1, organisational memory retains the distributed knowledge of actors, processes in which memory is also embedded, norms, standards, and technologies (Ackerman & Halverson, 2000). The advantages of a distributed memory centre on the undiluted individual local value represented by each component, while enabling that knowledge to be called upon and integrated as needed. Researchers have recently proposed a shared ontological structure to link distributed group memories (e.g. Van Elst et al., 2004). However, such a structure may be ineffective in rapidly changing environments and neglects informal knowledge. Transactive memory systems to support group memory were proposed by
Nevo and Wand (2005). Based on Borgatti and Cross (2003), a promising organisational form that supports flexibility, the development and use of distributed memories, and the need to combine formal and informal knowledge is socio-technical networks.

2.3 Dynamic knowledge integration in socio-technical networks

Emerging organisational network forms can transform organisations, institute new styles of governance and replace hierarchies, systems and markets (Grabher, 2003). Such networks have a social element that shapes their operation. Granovetter was the first expert to highlight the importance of establishing particular types of linkages - weak and strong ties - between people in order to enable effective knowledge sharing and integration (Granovetter, 1973). Many experts have since discussed the value of social networks for enabling knowledge work (e.g. Cross, 2004). However, only recently have researchers addressed the socio-technical elements of such networks. Actor-Network Theory, which originated with Latour (1987), attempts to account for human-machine interaction within a multiplicity of roles constituting socio-technical networks.

Socio-technical networks coalesce around people who use ICTs, with such “users” recently reconceptualised as “social actors” (Lamb & Kling, 2003) – henceforth termed actors for brevity – who need and trust one another for communication, collaboration, and knowledge work, and who use ICTs to support their work.

In socio-technical networks, knowledge may be integrated by actors who intelligently and efficaciously access local components of organisational memory and external sources. Such networks coalesce around the cooperation and collaboration of fluid, transient configurations of actors across and beyond organisations, underpinned by Web-based technologies (Davidson & Lamb, 2001; Tiwana, 2003). Synergies can be found in the collaborative interactions found in such networks (Weick & Roberts, 1993). Actors are empowered (Fuchs, 2003; Powell, 1996) and may bypass established communities of practice and other organised networks if they adjudge that the knowledge that is needed is best shared or retrieved in informal networks enacted according to immediate knowledge needs. Further, a wider, flexible, responsive pool of knowledge-based resources is accessible including business partners (Bradley & Nolan, 1998). Such networks also serve to mobilise valuable social capital to support future knowledge sharing (Cross, 2004).

Despite their apparent potential as an integrative mechanism, socio-technical networks have not been well-explored for this purpose. The coordination of integrative work in such networks can be difficult as alternative outcomes are unknown ex ante (Minkler, 1993) with actors not knowing precisely what knowledge or information they are seeking, although they can recognise it when they find it (Beunza & Stark, 2004; Van Elst et al., 2004). Any actor or technology is potentially important. Actors will contact others whom they know or suspect to possess the knowledge or who can access it for the purpose of sharing (Becker, 2002; Grabher, 2003). Some actors who are contacted may access technological repositories in organisational memory or elsewhere to retrieve and contextualise knowledge that is needed by themselves or others. Importantly, actors orient their use of different technologies according to social as well as technical factors (Lamb & Kling, 2003). Thus, we posit that social issues such as capturing others’ attention, influencing others, leveraging existing relationships and the exercise of power may affect actor choices of technologies and their use.

Network interaction and coordination patterns are guided by shared understandings and negotiation rather than managerial directives (Ekbia & Kling, 2005; Parhankangas et al., 2004). However, dispersed actors may lack pre-established social relationships and shared mental
models, and may also operate from different platforms and disciplinary traditions, suggesting the need for managerial support.

2.4 Integrating intranets, channels and knowledge

In the past decade, intranets have proliferated in medium and large businesses globally (e.g. DTI, 2003; European Commission, 2004; Singh, 2006). The nature of intranets is constantly evolving, with recent predictions of growth in enterprise workplace applications, acceptance of intranets as part of doing business, innovative and pervasive intranets, usability, real-time applications due to Ajax technology, blogging trends, Real Simple Syndicate (RSS) feeds, and use of small targeted wikis (Singh, 2006). By providing shared Web-based access to formal knowledge and the use of a common technical platform, intranets can ground actor integration efforts in a common knowledge base (Braa & Rolland, 2000; Choo et al., 2003; Lamb, 2003; Skok & Kalmanovitch, 2005). In this role, intranets constitute boundary objects for open knowledge work carried out between disparate actors (Hall, 2004; Star, 1989).

Recent accounts have portrayed corporate intranets as collections of independent intranet silos (e.g. Lamb, 2003; Newell et al., 2001a; 2001b) with this trend expected to continue (Singh, 2006). To be useful at a broader dynamic level, such static informational intranet silos must be integrated with one another and with valuable formal and informal knowledge located elsewhere. Enabled by socio-technical networks, the formal and generic informational content of intranets may be accessed and combined with informal knowledge flowing in other ICT channels (such as e-mail) where a symbiotic relationship exists. Such integration may provide the necessary contextualisation of intranet-based knowledge for application in a new and unpredictable context.

Key actor concerns about intranets centre on the technical and taxonomical issues limiting the findability of knowledge and information, untimely content, and insufficient time to contribute knowledge (Kautz & Mahnke, 2003). Researchers have also attributed limited intranet use to organisational factors such as lack of integration with everyday work and social factors including network effects (Bansler & Havn, 2004; Stenmark & Lindgren, 2004). More recently, a political role for intranets was identified (Hall, 2004). Clearly, intranets require effective strategy and management.

Discussions surrounding intranet strategy centre on comparing the benefits obtainable from centralised management (Damsgaard & Scheepers, 2000) with those attainable from adopting an evolutionary distributed approach (Stenmark, 2003). The benefits of a centralised approach include the potential to have a single view of information across the organisation (that is, a centralised organisational memory). However, such intranets tend to be unwieldy, inflexible, and difficult to redesign. In contrast, the benefits of a grass-roots distributed approach include enabling more focused local content that reflects the needs of immediate actors. An evolutionary strategy also provides a greater opportunity for users to hone local intranets to meet rapidly changing local needs while sharpening their integrative value. Recently, Stenmark and Lindgren suggested integrating intranet use with everyday work tools to better link intranet use with corporate objectives, avoid storage of knowledge not immediately needed, and sidestep the common employee lament of insufficient time to contribute (Stenmark & Lindgren, 2004).

However, actors may have already appropriated the intranet for dynamic knowledge integration. An influential study by Straub and Karahanna (1998) suggests that actors will choose communication channels where the target audience is expected to be present. In other words, if an actor wishes to reach a particular audience, she will share knowledge by a channel where the target audience is expected to attend. Further, actors may share knowledge in order to have an
impact on their target audience (Lichtenstein et al., 2004; Firth, 2004). As some channels are “push” channels (e.g. e-mail, face-to-face) while others are “pull” channels (e.g. intranets), it is argued that if an actor wishes to share knowledge for application, then attaining the fast attention of others who need to know and integrate the knowledge will be considered important in their channel choices and usage. This suggests that actors will try to reach others with whom they need to share and integrate knowledge immediately, by using a “push” medium with fast and targeted reach that will attract audience attention. For example, when actors are distributed geographically or temporally, e-mail is a popular choice of channel as its messages attract attention (Lichtenstein & Swatman, 2003).

What is the role of intranets in such a scenario? As mentioned earlier, some knowledge is formal, “know-what”, lacking context, and stored in a repository such as an intranet, where it may undergo revision over time - for example, formal business processes that are revised from time to time. Such knowledge can be shared and integrated with informal knowledge through a combination of e-mail (attracting audience attention and reaching the audience quickly) together with a hyperlink to an intranet where formal knowledge resides. Situated informal knowledge providing context and other relevant knowledge such as clarification can be shared within the body of an e-mail message. This example scenario highlights the combination of e-mail and intranets for dynamically integrating formal and informal knowledge. Other scenarios are clearly possible, as emerged empirically.

3 RESEARCH METHODOLOGY

We conducted two interpretive case studies at a large Australian retail organisation, OzRetail, and the Australian headquarters of a large multinational information technology corporation, GloTech. Both companies had deployed intranet technologies for several years, although GloTech’s intranet use was considerably more advanced, and only GloTech possessed a formal knowledge management strategy. These differences enabled insights to be developed that related to managerial versus grass roots effects of intranet evolution. Units studied comprised teams of system developers, analysts, web developers, corporate marketers, testers, team leaders and technical team managers. Thus, the views of actors with a very good understanding of knowledge technologies and related socio-technical issues were tapped.

Data comprised seventeen audio-taped semi-structured single interviews; audio-taped observations of several meetings; observations of knowledge sharing and application venues and intranet use; and relevant documents at GloTech and OzRetail. Interview questions were based on an extensive literature review of key reference domains, and focused on exploring the wider context of knowledge sharing and seeking choices that may affect the eventual selection and use of an intranet for knowledge sharing and integration. This paper focuses on those questions that revealed the dynamic integration of intranets with other channels in response to immediate knowledge needs. Semi-structured interviews of an hour’s duration were conducted. Following qualitative content analysis techniques (Krippendorf, 1980), coded categories and concepts discovered in the interview transcripts were inductively developed. Concepts evolved to conclusive states over iterative readings and were grouped into themes at the end of analysis. The remaining data were used to cross-validate and enhance themes.

4 INTRANETS AT CASE COMPANIES

A brief overview of each company’s intranet deployment and utilisation follows. In GloTech’s Australian head office, the official knowledge management strategy had not filtered down to the
team level, as employees interviewed were unaware of such a strategy. Nevertheless, many teams had developed their own sections on the corporate intranet from management directives, and were actively publishing, sometimes using the services of an internal Web Services team. Intranet sections existed for human resources, quality control, finance, marketing, and corporate news, among many others. Some sections were accessible by partners, who in some cases were providing content. For example, an agency developed advertisements for events which were e-mailed to the company which published the advertisements on the marketing team’s intranet which was publicly viewable. Knowledge sharing largely took place within teams or units either face to face at desks, by e-mail, or in meetings. As there was a high turnover of contract staff within teams, relationships were relatively (c.f. OzRetail) undeveloped. Finally, there were no incentives for sharing knowledge and knowledge was shared on a “need-to-know” basis.

In contrast to GloTech, at OzRetail there were no formal knowledge management initiatives in the company. Most intranet sites had evolved as group initiatives and were group-oriented in content. Few intranet sites existed apart from the main corporate portal and a few product brand sites that managed marketing and selected sales. The intranet sites were maintained by three technical teams who worked closely together to develop applications, together with an external software provider. Others in the company were unable to publish, although they could submit requests for publication to a technical team. Formal business processes were the main type of knowledge stored. The architecture of the official intranet pages promoted group-based content, leading employees to take little direct interest outside their own group’s intranet site. Many of the people in the teams studied had worked at OzRetail for five to twenty years, and held close working and social relationships with others both in and outside their teams. While most knowledge was shared within teams, there was more inter-team sharing occurring than at GloTech, in some part because of these relationships.

Nonetheless at both companies whenever there was a perceived knowledge need which could not be answered within the group, employees interacted electronically with other dispersed employees, partners, providers, customers and suppliers, to integrate knowledge informally, enacting ad hoc socio-technical networks through their interactions.

5  DYNAMIC INTEGRATION OF KNOWLEDGE

We discuss key findings in relation to the theoretical framework shown in figure 1. In the following discussion, the study’s participants are representative of the actors shown in the figure. All illustrative quotes included were articulated during the semi-structured interviews held at GloTech, but were indicative of the views of OzRetail participants unless otherwise specified. We discuss the knowledge available in organisational memory, knowledge flows in socio-technical networks, and the dynamic integration of knowledge when intranets were involved and socio-technical networks employed.

5.1 Organisational memory

The organisational memory identified in the findings comprised employees, business processes, norms, standards, e-mail messages, personal computers and two corporate intranets. We focus here on the intranets, which were used by employees to share business processes, events, and various other types of formal knowledge and information. What had emerged at both companies was mainly a collection of intranet sites that were treated by participants as distinct intranets, supporting the findings of Newell and colleagues (2001a) and Lamb (2003) of intranet silos. Each team maintained team-based knowledge on its intranet.
As each team was specialised, its knowledge was stored in specialised sections which were effectively isolated by team member password protection and/or lack of interest from others outside the team. Thus, participants did not seek knowledge from (most of the) other intranet sections as they had little understanding of how such knowledge stored related to their work. As one developer remarked:

“Most users may only need information in their division, so it is easy for them to go to their department’s section on the intranet to find what they are looking for.”

[Developer]

Moreover, lack of time and inadequate awareness had resulted in a lack of familiarity with other sites:

“I generally don’t have enough time to look at GloTech news. [Also] I didn’t know GloNet existed until two months into working here, probably because I never had to use it.” [Analyst]

This insular pattern of knowledge seeking led to difficulties when actors needed specialised knowledge that lay outside their domain:

“I use a search engine to find information I need on other teams’ pages and if I can’t find what I am looking for using this search engine, then I will ask other employees. As a last resort, I will ask my manager.” [Marketing administrator]

The consensus from most participants at both companies was that the information on intranets was only about eighty percent accurate at any given time, leading participants to distrust intranet content. Explanations offered for the inaccurate content was that the publication process was tedious and cumbersome and, further, there was not enough time to publish:

“I have papers in my drawers explaining the minor details that have been left out of the eGlo procedures pages which I use when I complete some tasks at work. I might update these pages to include these details at a later date but that will depend on time”

[Developer]

Contractors working for GloTech mentioned that updating content was considered unproductive by managers and that they were being paid to show results (which apparently did not include updating). Updates did not present a visible contribution and were considered boring:

“The truth is that no one ever enjoys documentation, and that’s why they won’t do it.” [Analyst]

In both companies, intranet publishing was not directly integrated with everyday work practices, supporting the findings of Stenmark and Lindgren (2004), thus contributing to their outdated content:

“We don’t update the intranet pages that often. Since I have been here I have not updated the intranet pages, ever.” [Developer]

Content management was recognised as needed for an accurate intranet component of organisational memory:

“the intranet also has to be updated a lot, so you have to have someone in the team who is dedicated to documentation and updating that documentation that is stored on the intranet” [Analyst]

However, because of small team sizes, managers considered that a technical position of this kind for each team was too costly.

Other organisational memory components identified, apart from intranet content, included e-mail messages and informal tacit understandings of business processes and other business issues. Some participants were outsourced contractors and thus their knowledge was not considered part of the organisation’s memory, although their knowledge could theoretically be accessed for the
duration of a contract. Having described the key components of the organisational memory we turn to findings concerning the different media used to share formal and informal knowledge.

5.2 Formal and informal knowledge

Formal and informal knowledge were shared by different media. The profile of knowledge shared directly by e-mail was: informal, ad hoc, “what is done,” descriptive, situated, time-sensitive, accountable, personalised, contextualised, detailed, fragmented, urgent, important, unapproved, reflective, and customised. In contrast, the profile of knowledge shared directly by intranet was: formal, structured, one-to-many, generalised, incomplete, static, complex, non-urgent, not immediately relevant, long lifespan and prescriptive.

E-mail was the main channel used for sharing knowledge when there was an ad hoc need:
“Each contractor works irregularly on different days so most of our knowledge is shared by e-mail or by phone.” [Intranet manager]

“E-mail is our primary form of contact with clients, so I use it all day at work”
[Intranet manager]

If the knowledge was urgent, e-mail was often chosen to share it:
“If there is something that is urgent that the group needs to know about it’s either sent through e-mails or basically I just turn around and talk to our team” [Developer]

If the knowledge to be shared had to be recorded, as well as shared immediately, e-mail was also chosen:
“E-mail [is chosen] so that the message is documented, so if they forget or if I forget what I have said, they or I can go back to the message and check. “[Systems engineer]

Intranets were mainly consulted on the first occasion that a process was needed, however later the participant knew the process and was able to share it with others:
“Once you get used to completing your daily tasks on a routine basis you no longer have to look at eGlo procedures regularly” [Web services developer]

Intranets were used by participants to share business processes, events, and various other types of formal knowledge and information. The size of the audience for whom the knowledge was relevant was also a factor in intranet choice:
“If it is a common process that they and others within the team need to know then I will publish a page of eGlo procedures on the intranet” [External intranet contractor]

Intranets also provided links to other actors:
“We have applications that we use on the intranet for locating people in the organisation”
[Systems engineer]

5.3 Dynamic integration of knowledge

Supporting the framework in figure 1, formal and informal knowledge were found to be integrated via ICTs and other channels. In this section we focus on dynamic integration of knowledge where intranets were involved. Participants described two paths where intranet formal knowledge was integrated with informal knowledge flowing in other channels when fulfilling everyday, unanticipated knowledge application needs.
5.3.1 Distillation

Regular distillation of intranet knowledge was mentioned by most participants. At both companies, e-mail was integrated with intranets when it was used to market and/or informally contextualise intranet content as follows. A distilled version of intranet content was despatched by e-mail to actors across and beyond the organisation, together with a hyperlink to an intranet page:

“If you put the knowledge on the intranet and provide the main points and a [hyper]link in an e-mail, that is more effective.” [External intranet contractor]

“The most recent event that was advertised on the intranet was for a charity event. It was advertised mainly through e-mail blasts containing a URL to an intranet site with all the details... For this event, a web form embedded in an e-mail was sent out to everyone, who can then register via reply.” [Marketing publisher]

However, this practice served to perpetuate the habit of not reading the content on the corporate intranet:

“I don’t read it [company news] on the intranet because we get e-mails detailing any important news updates, and I just read them.” [Developer]

5.3.2 First port of call

Another integrative approach described by eight of the seventeen interviewees from GloTech and OzRetail was the use of an intranet as a “first port of call”. By a sequenced selection of media, formal prescriptive knowledge on intranets could be integrated with informal descriptive knowledge accessible by an interactive channel. Intranet inaccuracies were sometimes handled this way:

“I use the intranet as a starting point, knowing it is probably not accurate. Then I ask someone for the rest of the information.” [Analyst]

Participants also expressed a desire to know how business processes really worked (informal knowledge) in addition to what procedures were supposed to be carried out for a business process (formal knowledge):

“If I know that it is on eGlo procedures intranet then I will first read it there and then I will contact the person who wrote the procedures, if I need to know more or clarify anything on the procedures pages.” [Intranet manager]

“eGlo procedures site is easy to use, however on the times I have used it I have still had to refer to the expert because the person who wrote those procedures assumed past knowledge that a new person would not have acquired yet” [Developer]

“After reading about a process published on the procedures section [of the intranet] and I am still not sure, then I can go around and ask people if it is not published or if it is not clear.” [External intranet contractor]
5.4 Emergence of socio-technical networks

In the above findings we have identified and discussed key elements of the theoretical model in figure 1 and shown how socio-technical networks were enacted by patterns of interaction.

Importantly, we discovered that social interpretations of technology had led to collective assumptions or myths about each of the technologies that, in turn, had been shaped by past experiences. These assumptions had become self-fulfilling prophecies (as also found by Bansler & Havn, 2004), shaping channel choices and uses for knowledge sharing and integration. The key assumptions that participants had made were:

- people could not rely one hundred percent on intranet content accuracy and value;
- it was too difficult to publish on an intranet;
- it was difficult to find anything on other teams’ intranets;
- people read their e-mails if short and relevant but would not browse intranets.

6 CONCLUSION

In this paper we have reported a study investigating the dynamic integration of dispersed formal and informal knowledge in socio-technical networks in an organisational setting. The paper presented key findings from two case studies that illustrate the use of the framework by showing how static intranets can be useful for dynamically integrating knowledge when the intranets are interwoven with other ICTs such as e-mail through which flows the informal knowledge needed to make sense of and situate formal organisational knowledge. Dynamic knowledge integration was clearly supported by fluid socio-technical networks. The paper has made several important theoretical contributions to the knowledge management literature, as follows.

First, the paper proposed a new theoretical framework for dynamic knowledge integration in socio-technical networks (figure 1). The findings from the two case studies provide some degree of confidence that our framework offers a rich theoretical basis for analysing the complex interrelationships between the human and ICT channels through which dynamic knowledge integration can occur. Future research involving additional case studies in other contexts is needed, however, to determine whether the framework requires further refinement, because the framework was developed after the empirical research to frame our findings.

Second, the findings from the two case studies indicate that – supporting current theories of organisational technology drift (Ciborra et al., 2000) and intranet drift (Stenmark, 2003) – actors in socio-technical networks shape intranet use in ways that:

- match their need to interact in transient socio-technical networks that include other workers, partners and other third parties;
- attract attention to intranet content in a considerate way;
- integrate different channels and formal/informal knowledge;
- contextualise, personalise and integrate knowledge for the target audience.

Third, the case studies suggest that the availability of alternative channels with relative advantage for knowledge sharing as perceived by actors in a socio-technical network may shape the choice and use of media for integrating knowledge.

Fourth, several strategies were identified from the case studies where intranets were integrated with other channels and knowledge, illustrating that intranets can be valuable as integrative
mechanisms in socio-technical networks. Future research can explore other cases to identify additional integrative scenarios in other organisational contexts.

Fifth, as other researchers have also found, we saw that work practices can be transformed over time as a result of the ongoing appropriation and embedding of ICT (c.f. Ngwenyama & Lyytinen, 1997).

Finally, a recently proposed methodology for informing the design and implementation of intranets begins by co-analysing a company’s information ecology and information behaviour (Choo et al., 2003). In their methodology, however, Choo and colleagues do not examine the specific ways in which intranets can be effectively interwoven with other channels, such as e-mail and face-to-face, to achieve dynamic knowledge integration in unpredictable circumstances. The findings from this paper may be used to extend Choo and colleagues’ approach.

In addition to the theoretical contributions outlined above, this paper has important practical implications for organisational knowledge management leaders. Managers should be aware of the power that is invested in knowledge workers who distil intranet knowledge in e-mails and thereby influence the integrated outcome. As Firth (2004) observed, employees who share knowledge with others may be attempting to influence them. It is important that the actors who distil knowledge in this way are sufficiently knowledgeable and skilled so that they develop effective and valuable distillations. What are the consequences if receivers do not later read the intranet page that is linked and merely rely on the distilled e-mail version? As Orlikowski (1992) has cautioned, technology not only enables, but constrains. It is important the employees are not deceived by possibly slanted fragments of knowledge appearing in e-mail when the complete version on the intranet may tell a different story. A second important implication for knowledge managers is that when intranet use is evaluated, the integration strategies revealed in the case studies should be among the aspects evaluated.

The findings from this study have several limitations. First, the findings are limited to only two organisations and the intranets examined are comparatively rudimentary in the degree of functionality provided. Our goal in this paper was not to consider specific features of the integration framework (figure 1), however, but rather to use it to consider the ways in which intranets can be integrated with other channels and their knowledge integrated with other different types of knowledge in socio-technical networks. Whether other types of integration are possible can be explored by conducting research in different organisational and inter-organisational contexts.

Bhatt observed that “what kind of knowledge is shared and how knowledge will be shared are determined by the professionals, not by the management” (Bhatt, 2002, p. 33). Our study clearly highlighted this effect in that although one company had a formal knowledge management strategy and the other did not, similar integrative mechanisms had evolved. Socio-technical influences are often more powerful than managerial influences and this must be kept in mind in the new electronic business networks that employ powerful Web-based technologies.

ACKNOWLEDGEMENTS

An earlier version of this paper was presented at the Seventeenth Australasian Conference on Information Systems (ACIS 2006) where it won the 2006 ACIS Best Paper #1 (first place) Award. The authors also wish to thank the anonymous reviewers for their helpful comments.
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