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MANAGING INFORMATION OVERLOAD; EXAMINING THE ROLE OF THE HUMAN FILTER

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Abstract

With the increasing processing power and plummeting costs of multimedia technologies, our ability to ubiquitously access and disseminate information continues to become indefinitely easier. However, emerging research shows that we are struggling to process information as fast as it arrives. The problem of information overload is a significant one for contemporary organisations as it can adversely affect productivity, decision-making, and employee morale. To combat this problem, organisations often resort to investing in technical solutions such as business intelligence software or semantic technologies. While such technical approaches can certainly aid in making sense of information overload, less attention has been directed at understanding how social behaviours within inter-personal networks – the primary conduit of information – have evolved to deal with the surge of digital information. Using social network analysis and interview evidence from two information intensive firms, this study finds a small number of information specialists who emerge to filter useful information into and around the intra-organizational network. The article concludes with a discussion of the theoretical and practical implications of our findings.

Keywords: Information overload, Web technologies, Social networks, Social network analysis.

1. Introduction

Consider the volume of data produced by mankind from the dawn of civilisation to the year 2003. According to Google CEO Eric Schmidt, we are now producing the equivalent volume of data every two days (TechCrunch.com 2010). At the heart of this information explosion is technology. With the increasing power and plummeting costs of multimedia technologies, our ability to ubiquitously access and disseminate this information continues to become indefinitely easier. This ability has led to many important business and societal innovations such as the ability to spot business trends, prevent diseases, combat crime, and so on. Yet, there are also numerous downsides associated with information abundance, the most notorious being the problem of information overload. Underpinned by transactive memory theory (Wegner 1987; Wegner 1995; Hollingshead 1998), the purpose of this paper is to explore how digitally enabled social networks (i.e., inter-personal networks where interactions are conducted through both face-to-face and digital media) organise to deal with information overload. Specifically, this paper seeks to address the following research question: *how do digitised R&D social networks filter the relevant technological information from the non-relevant information?*

The dilemma of having more information than one can assimilate (Butcher 1998) or being burdened with a large supply of information, only some of which is relevant (Edmunds and Morris 2000), is generally what is meant by information overload. This problem is a significant one for contemporary organisations as it can adversely affect productivity (Waddington 1997; Gonzalez and Mark 2004), decision-making (Waddington 1997; Rutkowski and Saunders 2010), and employee morale (Waddington 1997). For example, International Data Corporation (IDC) conservatively estimates that an organisation with 1,000 employees loses at least $2.5 million per year in worker productivity due to the inability to find existing information, search for outdated information, or recreate information that is outdated and poorly designed (IDC 2006). Viewing this in terms of daily productivity, the same study estimates that knowledge workers spend only one hour and 48 minutes of an eight-hour day doing productive work - most of the rest of the time is spent duplicating work or searching for information. Yet, it must be noted that information overload is not a new phenomenon. The earliest examples can be traced back to the library of Alexandria where archaeological evidence shows that there was more information in one place than one human being could deal with in one lifetime (Shirky 2008). What is new, however, is the almost zero cost involved in publishing and disseminating information through modern Web-enabled platforms such as email, blogs, Facebook, and Twitter. No longer restricted by centuries-old production and distribution costs, anyone can be a publisher today (Hemp 2009). While the great advantage of the Web is that anyone can publish their thoughts, users need to be concerned as to the accuracy and reliability of that information. As noted by prominent IS scholar Eric Brynjolfsson: "*…it's true that everyone can weigh in on just about every topic on the internet today, that doesn't mean everyone always should…you don't have to be a climate change expert to edit the Wikipedia entry on global warming…*" (MIT 2007). As a consequence, authors such as Clay Shirky have argued that the abundance of information is not the problem, but instead the problem is one of filter failure (Shirky 2008). The emergence of Web technologies may have cut out middlemen like the traditional print press publisher, but it was the publisher who acted as an information filter, checking for quality and deciding what was to be published and disseminated.

To filter the relevant information from the non-relevant, today's organisations often resort to investing in technical solutions such as intelligent agents, semantic technologies, business analytics, or recursive machine-learning. While such technical approaches can certainly aid in making sense of information overload, less attention has been directed at understanding how social behaviours within inter-personal networks – the primary conduit of information - have evolved to deal with the surge of digital information. This paucity of research is surprising as the social life of information has been a prominent research theme in the information systems field in recent years. The objective of this paper is to explore these social mechanisms. To achieve our research objective, we examine the R&D divisions of two multinational corporations (MNCs) and gather social network analysis and interview evidence. The R&D function was specifically selected for study because of the high information processing requirements needed to keep up-to-date with emerging scientific and technological developments (Allen 1977; Chesbrough 2003). The findings of this study will be of value not only to researchers interested in understanding the interplay between the social and technical aspects of technology enabled social networks but also for organisations interested in addressing the problem of information overload. We now discuss our theoretical lens of transactive memory systems, then present our research methods and findings, before ending with a discussion of the implications of those findings.

2. Theoretical Lens

This paper seeks to address the following research question: *how do digitised R&D social networks filter the relevant technological information from the non-relevant information?* For the organisation and analysis of the data, we draw on the literature of transactive memory systems (Wegner 1987; Wegner 1995; Hollingshead 1998), which has also been widely acknowledged and applied by researchers in the information systems field (Griffith, Sawyer et al. 2003; Nevo and Wand 2005). We believe this theoretical lens is appropriate to study information overload as it is specifically considers information flow and collective action.

The idea of transactive memory provides a useful way of understanding how people think together (Wegner 1987). Transactive memory is the specialised collective division of labour with respect to the encoding, storage, and retrieval of information from different substantive knowledge domains that develop during the course of work relationships (Wegner 1987; Moreland 1999; Monge and Contractor 2003). People in a group develop expertise in different areas, thereby reducing the load on individuals to develop expertise in all areas. This division of cognitive labour reduces the amount of information for which each individual is responsible, yet it provides all members with access to a larger pool of information across all knowledge domains. When one person needs information in another’s area of expertise, they can simply ask for it rather than spend time and energy learning it on their own. Such memory systems tend to emerge organically as the organisation grows and its information processing needs increase (March and Simon 1958; Tushman 1977). However, an important qualification of the original Wegner *et al.* theory is that transactive memory systems are only effective if individuals choose to share what they know (Hollingshead 1998). Information systems scholars have also extended the original theory to demonstrate that domains of knowledge are distributed throughout human and technical repositories in information networks (Griffith, Sawyer et al. 2003; Nevo and Wand 2005).

Three stages are involved in the creation and maintenance of transactive memory systems: 1) information allocation, 2) retrieval coordination and 3) directory updating (Wegner 1987). *Information allocation* is the process by which new information enters the network and is allocated to the person who is perceived by the network as the expert on the topic. This expertise differentiation can develop naturally within the network or be imposed by defining roles and allocating responsibilities. For example, a hotel reservation manager is formally responsible for information related to the reservations and guests of the hotel. However, she may also develop an interest in technological innovations and therefore become the informal expert on new technologies that may be useful for the hotel (Nevo and Wand 2005). In either case, relevant information that enters the organisation is allocated to her. A number of studies have provided indirect evidence of the positive impact on group performance when specialists are responsible for the acquisition and encoding of information (Henry 1995; Stasser, Stewart et al. 1995; Hollingshead 1998). Yet, recent studies also show that the ease and speed which all employees at all levels can access and disseminate novel information through Web technologies has resulted in a more complex information processing environment (Whelan, Teigland et al 2010). In our fieldwork, we utilise the information allocation component of transactive memory theory to explore what role, if any, is performed by specialist R&D

professionals in filtering relevant technological information, from the mass of content accessible online, into the internal R&D social network.

Retrieval coordination is the process by which a network member wishing to retrieve some information will first assess his or her own ‘‘feeling of knowing’’ on the topic and then - if necessary - will evaluate other network members that may possess this information (Wegner 1987). Retrieval coordination begins when the person who holds the information internally is not the one asked to retrieve it. For instance, Tom asks his boss for information that the boss has no idea about - but thinks that Helen may know. If Helen can produce the item and pass it along to Tom, information retrieval comes to a successful conclusion. The information may be modified during this phase in order to make it more retrievable (Loftus, Miller et al. 1978). In small networks where everyone knows each other’s expertise, information retrieval is usually a straight forward process. When the network membership goes beyond a certain size, retrieval becomes more complex due to cognitive difficulties in maintaining awareness of many people’s expertise. Yet, if transactive memory systems are to be effective, a directory of who knows what is essential. IT systems such as searchable expertise profiles or online yellow pages have been touted as an effective solution for such purposes (Nevo and Yand 2005). However, empirical evidence suggests that such systems are rarely used (Whelan 2010). Instead, people tend to rely on their network of contacts to access the information they need to know. Rob Cross and colleagues have studied extensively the role of the central connectors in corporate social networks (Cross, Borgatti et al. 2002; Cross and Prusak 2002; Cross and Parker 2004). Central connectors are the ‘go-to’ people of the network as they possess a disproportionate number of direct ties with other network members. Through their networking expertise, they develop an intimate knowledge of who knows what. As a result, connectors can swiftly refer their colleagues to others whom they know can provide the information or expertise they request. In recent years, networks have become Web enabled, making information - such as that related to the latest technological developments - widely available. In this context, our fieldwork explores the information filtering activities of R&D network connectors, i.e., do they play a role in making Internet sourced information relevant to their organizational colleagues?

Directory updating is the process by which people update their directory of who knows what within the network. Network members create directories of meta-memories containing information about the memories held by others. These meta-memories usually include information about the subject and location of the knowledge but also – tacitly - some perceptions about the individual’s own and others’ expertise on each subject. Information seekers require a measure of the retainer’s legitimacy and reliability when retrieving knowledge. For example, Borgatti and Cross (2003) studied the information seeking behaviours of scientists at two pharmaceutical firms and found that the decision to seek information from a specific other is a positive function of knowing what they know but also valuing their knowledge and skills. For the purposes of our research, we focus on how R&D professionals manage the information overload problem by seeking and accepting technological information from some sources but avoiding and rejecting that information from other sources. Specifically, we focus on information contained in email messages. Recent reports have highlighted the problem of ‘inbox overload’ with many users wasting hours reading and responding to emails (Waddington 1997; IDC 2006). In terms of disseminating technological information, our fieldwork explores why certain email communications are viewed positively and others are simply deleted.

3. Research Methodology

For the purpose of our research, we conducted interpretative case studies (Walsham 1993) on the R&D divisions of two multinational firms. This section describes our case study sites and then elucidates the different methods used to gather data.

3.1 Case Study Settings

Data were gathered from two medical device firms operating in Ireland, MedSci and StentTech[1]. These firms were selected for study as they met the screening criteria established by the researchers (i.e., high-tech industry, more than 30 R&D group members, focused on product development, and operating globally). Additionally, management at both firms were very receptive to the study and confirmed in preliminary interviews that information overload was a significant concern in their R&D divisions.

MedSci designs and develops technologies and products that assist medical device manufacturers improve outcomes for patients. The company is Irish owned, employs approximately 400 people, and has an annual turnover of approximately $37 million. MedSci's R&D division (referred to in the rest of the paper as Group A) consists of 42 engineers, most with design and mechanical engineering backgrounds. The R&D group primarily provides design and development expertise for other medical device companies who wish to outsource their device design. As such, the group has to be able to demonstrate that it is at the cutting edge of the medical device technology in order to win client contracts. The group is organised into three project teams with 10 to 15 people on each team. Each team will usually redesign an initial concept and bring it right through to a stage where it can be manufactured for commercialisation and market release. The average length for such a project is around two years.

StentTech is an American multinational that employs 25,000 people worldwide and has an annual turnover of $8.3 billion. The company has advanced the practice of minimal-invasive medicine by providing a broad and deep portfolio of innovative products, technologies and services across a wide range of medical specialties. To keep StentTech at the forefront of the medical device industry, R&D continuously scans the external environment in order to identify opportunities, address new disease areas, and develop new technologies that can reduce risk, trauma, cost, procedure time and the need for aftercare. The company has numerous R&D units located around the globe. Data were gathered from one such unit (referred to as Group B in the rest of the paper), which is located in Ireland. Group B consists of 76 R&D professionals. The group includes the design owners of certain StentTech products, and it is the responsibility of Group B to advance those designs. Group B is organised on a functional basis into four specialist subgroups. Members of each subgroup are specialists in a particular medical technology.

3.2 Methods

Our research methodology can be summarised in two major steps. The first step involved analysing the flow of technological information into and around each R&D group using social network analysis (SNA) techniques. SNA is an established social science approach of studying human behaviour and social structures by mapping and measuring the relationships and flows between people, groups, organisations, computers or other information processing entities (Scott 2000). Stemming from transactive memory theory, the purpose of this phase was to identify the people playing a key role in acquiring and disseminating technological information in each network. We labelled these individuals as 'technology scouts' (Chesbrough 2003) and 'central connectors' (Cross and Parker 2004). To collect these data, all group members were asked to complete a short online questionnaire on their information acquisition and dissemination activities. We used the SNA software package UCINET v 6.0 (Borgatti, Everett et al. 2002) to illustrate the information network. To increase validity, only reciprocated interactions between network members were included in the analysis. This ensured that network members who reported higher than actual interactions did not distort the analysis.

The second step involved gathering data by means of semi-structured interviews. In total, 21 interviews were conducted across both sites. The individuals interviewed were specifically selected based on their position and prominence in the information network, as depicted by

[1] Fictitious names as both firms requested to remain anonymous

the network analysis in step 1. The purpose of conducting semi-structured interviews was to explore the information overload problem and the filtering activities of those who occupy key positions in the social network. All interviews were conducted face-to-face and ranged in length from 30 minutes to 75 minutes. The procedures outlined in the dramaturgical model (Myers and Newman 2007) were adopted in order to ensure that high-quality interviews were conducted. Interview data analysis was performed using the NVivo software package and followed established inductive qualitative methods: coding, data categorisation, and pattern identification (Miles and Huberman 1984; Eisenhardt 1989; Yin 1994). Table 1 provides a summary of our data collection approach.

Methods	Group A (MedSci)	Group B (StentTech)
Phase 1 - Social network analysis	Online survey issued to all 42 group members, 38 returned completed (90% response rate)	Online survey issued to all 76 group members, 70 returned completed (92% response rate)
Phase 2 - Semi-structured interviews	10 recorded and transcribed, consisting of 3 technology scouts, 4 connectors, and 3 rank-and-file members.	11 recorded and transcribed, consisting of 4 technology scouts, 4 connectors, and 3 rank-and-file members.

Table 1 Summary of Data Collection Approach

4. Findings

In this section, we present the results of our analysis. The findings are organised in three subsections, each corresponding to the components of our theoretical lens: information allocation, retrieval coordination and directory updating. The quotations that we present in this section are those we consider to be the most representative of our data.

4.1 Information Allocation

Figure 1 illustrates the information network in Group A. Each numbered node corresponds to a member of the R&D group and the lines represent the flow of technical information between them. The more connected nodes tend to gravitate towards the centre of the network while those nodes with fewer connections tend to be found on the periphery. An analysis of the data revealed that individuals varied greatly in their number of internal and external connections. At one extreme are those individuals who tend to monopolise information flows either by being well connected outside the company or by possessing the ability to keep in touch with many people internally. We label those in the top 10% of the external connections distribution as ‘technology scouts’ as the interviews reveal this title accurately captures the activities of these individuals. Those with the most connections internally (i.e., the top 10%) are termed ‘central connectors’. At the other extreme are the isolates - nodes 2, 11, 38, and 42 – whom have no reciprocated interactions with other colleagues. The same analysis was conducted for Group B but given the size restrictions of this paper, only the Group A sociogram is presented here.

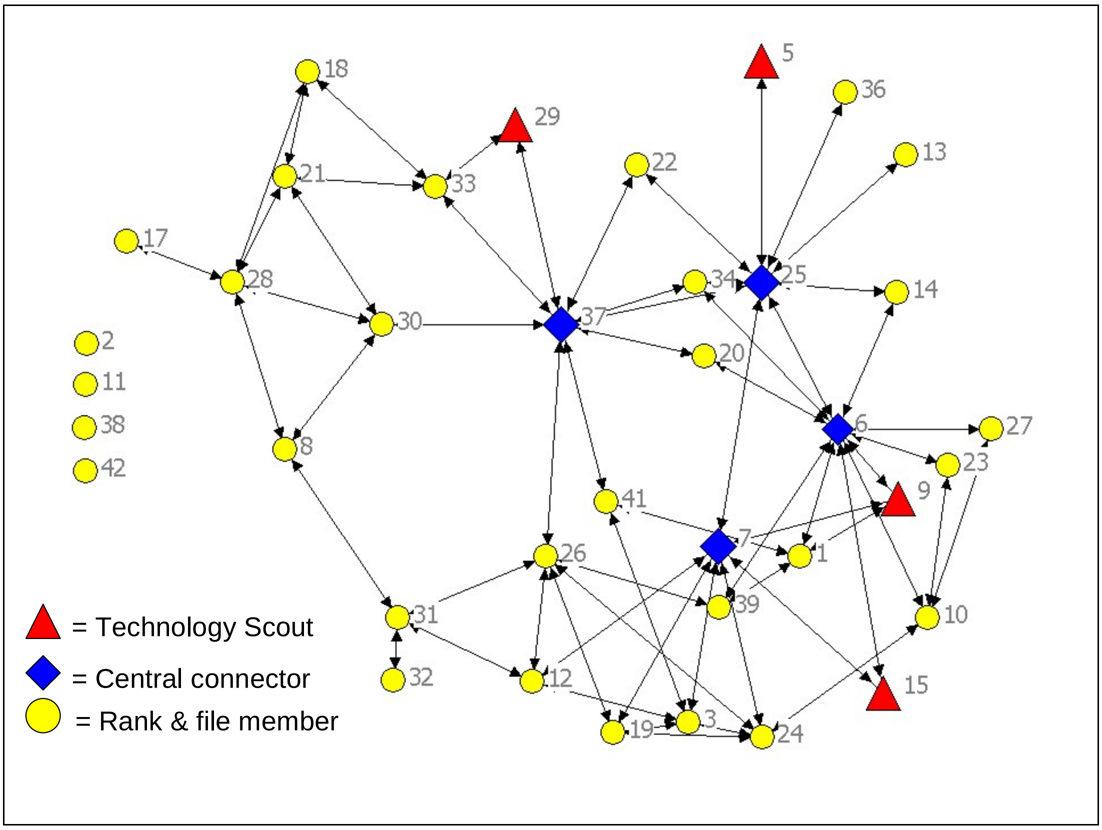

Figure 1 *The Group A Information Network*

To explore the information allocation process and its applicability to information overload, we focus on the information filtering activities of the technology scouts (e.g., nodes 5, 9, 15, and 25 in figure 1). The interviews confirmed that these individuals act as the firm's antennae, scanning the outside world for emerging scientific and technological developments relevant to the work of their R&D colleagues. Yet, none of the individuals who perform the technology scouting role were formally appointed to this task. Most explained that they take on this role because they have a genuine interest in keeping themselves, and their colleagues, abreast of the latest industry developments. Across all the technology scouts interviewed, there was a clear consensus that the primary medium through which this information is accessed is through the Web, e.g.,, online forums, RSS feeds, industry blogs, and Google searches. This sentiment is summarised in the following quotation from a technology scout in Group A:

> *The Internet is probably the most important tool we have in our industry and definitely the most widely used. Trade shows and subscription to academic journals are useful, but you can find an awful lot on new technologies just by doing a Google search.*

Our network analysis clearly shows that while technology scouts are strongly connected outside the firm, they tend to have few connections internally. The reasons for this specialisation were explored in the interviews and the problem of information overload was found to be central. Due to the ubiquitous nature of Web technologies, the modern R&D group is saturated in potentially useful information. It would seem that filtering the relevant from the non relevant in the vast amount of external information available is a complex and time consuming process which necessitates the attention of a specialist. The 'rank & file' group members acknowledged that certain colleagues possessed the interest and the analytical skills to sort through this abundance of information, and they were happy for these technology scouts to take responsibility for that role. The following quotation is from Tom, one of Group B's technology scouts. He explains how he uses the Web to keep abreast of external developments; however, with so much information freely available, identifying what is relevant is not straight forward:

> *What I need to know about is what is new in our field, whether it's new stent devices, or medical devices in general, new drugs that are out there, new coating types that are out there, new test methods and things like that. So, my window to all of that is through the Internet. OK, sometimes it's information overload and it can be an ordeal…but you need to be able to say, 'I want to see this and this and this – but I don't need to know the rest of it.' Finding the gems of information on the Internet is certainly time consuming…you can do it but you do need to have time and patience.*

4.2 Retrieval Co-ordination

Technology scouts specialise in filtering external information into the R&D group. As a result, their knowledge of who knows what inside the group tends to be limited. Instead, our interviews reveal that they rely on the central connectors to distribute the information they acquire to their counterparts who are best equipped to exploit that information. As is evident in figure 1, each technology scout is linked to a central connector in Group A. We found a broadly similar pattern in Group B. However, the connector does not just simply redirect information to a colleague with the relevant expertise. They play a central role in filtering this valuable information so as to ensure its consumption by others. This filtering of information internally is necessary because email is the dominant communication system in each R&D group. Consequently, many interviewees complained of suffering from 'inbox overload' as they could easily receive up to 100 emails per day. The interviewees explained that they have their email client set to preview mode whereby only the subject line and the first 3-4 lines of the email are displayed. If the receiver is not satisfied that the email is directly relevant to them, then the email will usually be deleted.

The following example of Susan (node 6 in figure 1) is representative of how most central connectors operate. If information on an emerging technology is passed to her, Susan uses her extensive knowledge of the internal social network to inform other R&D colleagues who possess the expertise to potentially exploit that information. She usually uses email to inform these targeted individuals of the new development. However, external information of this type will not be considered by the recipients unless it is firstly translated into terms relevant to them. As a result, Susan carefully constructs her emails so that information relating to new developments from outside the company gains the attention of the targeted recipients. An example of this translation process is provided in the following quotation from Susan. She is quite aware that her emails are competing for recipient's attention. She realises that most recipients will only scan the email and that the key to grabbing their attention is the first 3-4 sentences. In addition, she targets specific people as opposed to sending out 'blanket' emails:

> *You have to realise that most people here are overloaded with the number of emails they receive. Nearly everyone would read e-mails through the preview mode…and if someone sends out a blanket email, it's probably going to be deleted straight away. If I become aware of a new technology we should be interested in, I'll probably know the person who is best placed to examine it. I would probably send them an email first, but I'd always keep it short and explain why I think they should be interested in this information. If they are interested, they can come back to me and we'll have a chat about it over a coffee.*

As Susan alluded to in the above, the retrieval co-ordination process occurs when the email recipient seeks out the sender for a face-to-face discussion on how a new technology can be utilised by the group. In essence, the central connector filters the information before discussing it further with the domain expert.

4.3 Directory Updating

Directory updating is the process by which people update their directory of who knows what within the network. Our investigation reveals this process has important implications for managing the information overload problem. A small number of group members have gained a reputation for providing very relevant information on emerging technologies. These individuals tend to be the central connectors of the group and our interviews reveal that their emails are given careful consideration by recipients. Due to their reputation, central connectors are frequently sought out by their colleagues to discuss emerging technological developments. In contrast, we find in both groups the existence of certain individuals who have a reputation for using email to blast out non-relevant information to the rest of the group. One interviewee from Group B labeled these individuals as 'email jockeys' and explained that:

> *…rather than taking ten minutes out to walk over and discuss that new information with someone, these guys constantly FYI emails around to everyone. That's not really transferring knowledge. These email jockeys are useless…nobody ever reads the emails they send around anyway.*

The assumption within the group is that the 'email jockeys' do this in an attempt to bolster their own position by intimating that they are more clued into what is happening in the industry than everyone else. However, unlike the central connectors who carefully construct their emails, these individuals do not translate the new information into understandable and relevant terms and the message fails to be accepted. Most of the interviewees reported that they rarely ever read these emails and even believe that the person blasting out the email is aware that no one will read it, thus they avoid follow-up questions. These individuals gain a reputation for contributing to the problem of information overload and are rarely sought out by their colleagues for discussions on new technologies.

5. Discussion and Conclusions

Our findings have allowed us to answer our research question: how do digitised R&D social networks filter the relevant technological information from the non-relevant? Using the theoretical lens of transactive memory systems, we find that the abundance of information easily accessible through the Web necessitates that one set of individuals specialise in filtering external information into the R&D group, and another set specialise in filtering that information for internal use. In his seminal 1988 Harvard Business Review article, Peter Drucker rationalised that due to advances in IT, future organisations will require information specialists to coordinate its activities and ensure that the organisation does not become swamped in the data it produces (Drucker 1988). The findings from this case study suggest that Drucker's vision of the future has become a reality. We now discuss the theoretical and practical implications of our findings, as well as the limitations and areas for further research.

5.1 Theoretical implications

The theoretical implications are presented in the form of analytical generalisations (Yin 1994; Lee and Baskerville 2003). This approach involves previously developed theory being tested and extended by applying its propositions to a variety of situations. These generalisations are not meant to be treated as exact predictions but can be used to generate testable hypotheses.

> *Analytical Generalisation 1: In digitally enabled social networks, one type of information specialist, i.e., scouts, emerges to filter external information into the network.*

Transactive memory theory explains that certain network members are allocated the task of being the expertise holders in certain knowledge domains (Wegner 1987; Wegner 1995; Hollingshead 1998; Moreland 1999). We extend this aspect of the theory to also show that these information specialists – or technology scouts in our study – also provide the valuable function of filtering external information. This external filtering function is necessary as so much of the information on new technologies is sourced online. Thus, the accuracy and reliability of this information needs to be carefully examined. While all members of each R&D group can easily access information on new technologies through the Web, the majority are happy to allocate this function to the small number of specialists who possess the expertise and the personal interest to distil the relevant from the non-relevant information.

Analytical Generalisation 2: In digitally enabled social networks, one type of information specialist, i.e., connectors, emerges to translate and direct external information to the network member best equipped to exploit that information.

The study of social networks enjoys a long and rich tradition, particularly in the fields of sociology and anthropology, and more recently in the field of management science. This body of literature has discussed extensively the role of those few individuals who act as the hub of the network – whether they are labelled as 'opinion leaders' (Lazarsfeld, Berelson et al. 1948), 'gatekeepers' (Allen 1977), 'centrals' (Weimann 1982), or as in the case of this study 'connectors' (Cross and Parker 2004). Transactive memory theory views these individuals as a sort of human version of the yellow pages. Our study finds that this type of information specialist also acts as a second filter layer, thus playing an integral role in managing information overload. Not only will they direct an information seeker to the information source, they will also validate the reliability of that information source. Both R&D groups we studied rely heavily on email as a communication system and almost all the interviewees stated that they were often overloaded with the amount of messages they receive. A particular problem relates to the perceived abuse of email. Many of the emails received by group members are in no way relevant to them. To ensure that their colleagues are kept up-to-date with emerging technologies, the connectors will carefully construct their emails so as to avoid overloading the recipient. Emails of this type tend to be limited to a 3-4 sentence explanation of why the information contained is relevant to the recipient. If the information is of interest to the recipient, they then return to the connector and have a face-to-face discussion about how that information can be exploited.

5.2 Practical implications

This study confirms that information overload is a significant problem in contemporary organisations. It also highlights the importance of information literacy skills, i.e., the ability to analyse and evaluate information, in managing the problem. We find that Web technologies are a vital tool for accessing emerging technological developments and that certain people exist who have the innate interest and ability to locate and evaluate this information. The filtering of this information requires a combination of analytical and social skills, and practitioners need to ensure that their workforce possesses these skills. An effective transactive memory system does not leave the responsibility for information to chance (Wegner 1987). Thus, practitioners should take steps to ensure that the individuals who possess these information literacy skills are located in network positions that allow them to most effectively filter and disseminate information. Additionally, practitioners should implement email etiquette policies to reduce the burden of information overload. For example, we find that many of the emails disseminated internally are in no way relevant to the recipients. A policy could be implemented whereby people would only be cc'ed on emails if the information contained is directly relevant to them. Additionally, an interesting finding in both groups was the existence of certain individuals who constantly send FYI emails to their R&D colleagues. Rather than enhancing knowledge flows, the actions of these individuals are seen as a hindrance. The FYI phenomenon could become a significant problem if group members become overloaded with irrelevant messages and end up not considering the important messages.

When contrasting the findings from both firms, we uncovered one difference in relation to the role performed by the central connectors. In Group A, the central connector often took on an additional role of consulting with the technology scout to verify the accuracy and reliability of information acquired from the Web. The technology scouts in Group B performed this role themselves and did not consult with the central connectors. We believe this is a function of how each R&D group is organised. Group A is organised by project which involves R&D professionals being taken out of their functional disciplines and grouped in cross-disciplinary teams. The project organisational structure provides a more direct connection to the market; however, R&D professionals will find it more difficult to keep abreast of the latest developments in their particular specialty when they are organised into projects for a sustained period of time (Allen 1985). Thus, it would seem that the technology scouts in Group A lose touch with the latest developments in their speciality area and need to consult with trusted others in order to verify the accuracy and reliability of online information. In contrast, Group B is organised around technical specialties, disciplines, and technologies. In such a structure it is much easier for the technology scouts to stay current and to determine what external information is relevant. Thus, practitioners need to be aware that the organisation structure they adopt will have implications for information filtering and the management of the information overload problem.

5.3 Limitations and areas for future research

This study is subject to a number of limitations that future studies should aim to address. This study focused upon development-focused medical device engineers who were for the most part of Irish nationality. As explained by Yin (1994), this allows us to make analytical generalisations to previously developed theory, but it would be a mistake to attempt to make statistical generalisations to a wider population. For the purposes of statistical generalisability, future research studies should examine multiple technology enabled social networks in differing industries and cultural settings. Additionally, no performance data were gathered as part of this study. Such data would elucidate the effectiveness of each network. Future studies should measure the performance of technology enabled social networks and correlate this with the presence of information filters.

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