Developing new categories of knowledge acquisition, translation and dissemination by technological gatekeepers.

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1. INTRODUCTION

Technological gatekeepers have been described as one of the elementary agents of knowledge based development (Carrillo et al., 2010). The concept of a technological gatekeeper was initially developed to aid an understanding of an emergent (Whelan et al., 2010a) and informal (Sturges, 2001) role occupied by those few employees in research and development departments who acquired external knowledge on scientific developments (Allen and Cohen, 1969) and who acted as boundary spanners between external and internal environments when translating knowledge (Allen, 1977) so that it could be disseminated to appropriate colleagues in the firm, (Tushman and Nadler, 1986). The literature reviewed in section 2 considers how the concept of the gatekeeper was initially conceived, its development over time, as well as the types of research settings in which this literature was situated. It builds on recent work (Whelan et al., 2009, Whelan et al., 2010a, Whelan et al., 2010b, Whelan et al., 2013) that examined how the gatekeeper role has changed due to new information and communication technologies, particularly when access to the internet has brought about the ability for all individuals to become gatekeepers within their specialised knowledge domain, (Teigland and Wasko, 2003). Indeed Whelan et al. (2010a:401) argue that *"we still have a limited understanding of how the role and tasks of the gatekeeper are changing due to the ability of every professional in an R&D group to quickly and easily access external information through web-based channels".*

This research provides two important contributions to the literature on gatekeepers. Firstly it seeks to extend the gatekeeper concept to a new firm context; that of a product support department in a large multinational company. Secondly instead of focusing on external systems or internal e-mail as was previously the case a case study site was selected that enabled the role of corporate information systems on gatekeeping activity to be examined. This provides an opportunity to extend the existing literature by identifying new distinctions and categorizations within the traditional gatekeeper roles of knowledge acquisition, translation and dissemination.

2. THE GATEKEEPER ROLE

Developed by Allen and Cohen (1969) the technological gatekeeper concept was subject to initial research (Allen, 1977, Tushman and Katz, 1980, Tushman and Scanlan, 1981a, Katz et al., 1995, Nochur and Allen, 1992, Allen and Reilly, 1973) withthe role then being re-examined due to developments in information and communication technologies, (Whelan et al., 2009, Whelan et al., 2010a) and the digitisation of social networks (Allen et al., 2007, Whelan et al., 2013). Research on gatekeepers focused both initially (Tushman and Scanlan, 1981a, Allen and Cohen, 1969) and more recently (Whelan et al., 2013, Whelan et al., 2010a, Allen et al., 2007) on research and development groups. Later studies expanded the concept, applying it to other contexts such as universities, (Petruzzelli, 2008, Petruzzelli et al., 2010) EU funded networks (Cassi et al., 2008), industrial districts (Morrison, 2008, Albino et al., 1999), regional networks (Graff, 2011) as well as search engine companies (Vogl and Barrett, 2010) and medicine (Carlsen and Norheim, 2003, Shumsky and Pinker, 2003). While the notion of firms as gatekeepers or individuals within R&D departments acting as gatekeepers has been extensively examined little research has focused on other departments within the firm boundary. Given firms' increasing knowledge intensity across all functions this is a gap in the literature which this study seeks to address through its choice of a non-R&D department as one of its case selection criteria.

Gatekeepers act within a defined technical domain (Myers, 1983). Klobas and McGill (1995) argue that they can also be identified within professions as well as within organisations and industries. In addition they may also include front line employees, involved in service delivery and those having access to customer information should act as gatekeepers for crucial market information (Lievens and Moenaert, 2000). It was identified by Taylor (1986) that even in a dynamic research environment with organisational change the same people were continually identified as gatekeepers.

The initial benefits of gatekeepers included improvements in project performance for the organisation (Tushman and Katz, 1980) as well as improved promotional opportunities (Katz et al., 1995) for the gatekeeping individuals. In addition they help continuous innovation, enable reduction in lead times and improve production quality (Albino et al., 1999) as well as positively and directly affecting both quality and budget

(Gemunden et al., 2007). Their presence was found to be a characteristic of successful clusters by (Graff, 2011) with their presence generating positive externalities in their local area. The community with the strongest density of interactions was weakest regarding knowledge sources that locked it into a 'declining learning path' (Morrison and Rabellotti, 2009) showing the absence of gatekeepers was disadvantageous. Recently however, the degree of information availability and overload have given rise to new problems (Whelan et al., 2009). Traditionally the gatekeeping process was seen as a two-step one where the 'technological gatekeeper' firstly accessed external knowledge and secondly distributed it to R&D group members (Allen and Cohen, 1969) as outlined in figure 1.

Figure 1 Two Stage Gatekeeper Model.

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(Adapted from Allen 1977).

It was later argued by Harada (2003) that because distinctive skills are required translate external knowledge then the flow of communication was better represented using three rather than two stages as shown in figure 2. Whelan et al., (2010a) found that it was very rare for an individual to be engaged in all stages of the gatekeeper role, concluding that the acquisition of knowledge was separate from its dissemination and identified specialisation of labour in the gatekeeping role. One type of gatekeeper, termed an external star', sought, identified, verified and acquired external information before then passing it on to an 'internal star' who then identified to whom in the organization the information should be channeled. The next three sections outline the three identified phases of gatekeeper activity, acquisition, translation and dissemination in more detail.

Figure 2: Three Stage Gatekeeper Model

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Source: Whelan et al. (2010b).

2.1 KNOWLEDGE ACQUISITION

Every research and development laboratory needs to import external information so as to keep abreast of the latest scientific and technological developments (Allen and Cohen, 1969) with gatekeepers enabling their fellow researchers to be kept aware of the 'broad world' of research (Sturges, 2001). It was argued by Brown & Utterback (1985) that to understand how the gatekeeper phenomena operates effectively requires an understanding of the conditions under which it arises; in particular an understanding of environmental uncertainty the more environmental uncertainty that exists the more likely it is for gatekeepers to be present, as there is a need for information to be externally acquired when there is a high rate of change in technologies. Therefore the pace of technological change in the information technology industry would make this an ideal research focus. Edler & Meyer-Krahmer (2001) found most common method of monitoring technology among large corporations was to have a core person responsible. One aspect of the gatekeeper role is to scan and search the external environment for technological and scientific developments identified as 'relevant' to the firm (Morrison, 2008, Whelan et al., 2010a). This may be because gatekeepers rate information channels consistently more highly than others (Weedman, 1992) as well as being found to have a genuine interest in emerging technologies within their specialty (Whelan et al., 2010). External stars 'verify' information for reliability before discussing it with others in the firm (Whelan et al., 2010a). In this context external, according to Lu (2007), has meant unfamiliar or unknown and not within the immediate reference of the individual. Gatekeepers may therefore influence organisational innovativeness based on the information that they allow to enter the firm (Emmitt, 2001). Searching and sharing with external sources, according to Morrison (2008), requires both parties to share some degree of similarity of background and be competent in the knowledge domain of their counterpart.They can thus provide a linking role by acting as boundary spanners between separate groups or networks (Tushman and Scanlan, 1981a, Tushman and Scanlan, 1981b) particularly where disparities exist between the internal and external environments 'coding schemes' (Tushman and Scanlan, 1981b).

To know if an external development is really new requires considerable expertise (Whelan et al., 2010a). The person involved in this function was identified by Allen and Cohen (1969) to have published more and held more patents than colleagues. Whelan et

al. (2010a) argue that these 'external stars', a term coined by Tushman (1981), possess deep rather than wide knowledge of a domain. Such deep knowledge would be particularly evident in knowledge intensive firms possessing a high degree of specialization of labour. Though an objective of this stage is to identify new knowledge Teigland and Wasko (2003) maintain that the external knowledge may be, in some cases, so novel that it is not possible to apply it to any existing solution. Indeed absorptive capacity, according to Graff (2011), was what mattered when acting as a gatekeeper. Technological gatekeepers play a key role in connecting a 'weak-core' within the firm to external knowledge sources by Morrison and Rabellotti (2009).

Taylor (1975) identified a tendency for gatekeepers to occupy front-line supervisory positions**.** Though important, gatekeeper functions were not part of any formal job description (Sturges, 2001) with attempts by mangers to appoint people to the role being unsuccessful (Nochur and Allen, 1992). Later work by Whelan et al. (2010a) found that groups or individuals were not appointed to the gatekeeper role but that it emerged organically, through the employee activities.

Given these requirements it is perhaps not surprising that only a small number of people have been identified as possessing such extensive external contacts (Allen and Cohen, 1969, Whelan et al., 2010b). Due to the time taken to develop a communication network it was rare to find a gatekeeper with less than 5 years experience (Macdonald and Williams, 1993). Harada (2003) maintains that information gathering was negatively related to organisational tenure as those with long experience had less incentive to communicate externally as it threatened to disrupt current practices (Katz and Allen, 1982, Tushman and Katz, 1980). It is possible to reconcile these seemingly opposing perspectives in circumstances where the time required to develop a communication network could be reduced or replaced by the availability of information and communications technologies.

The external sources of knowledge that gatekeepers can access have also changed over time. Allen and Cohen (1969) identified two ways of acquiring external information: consulting knowledgeable people outside the lab or through reading the scientific

literature, finding some gatekeepers relied more on the literature, others on external contacts while for Brown and Utterback (1985) external communication sources included : attending symposia, papers presented, papers published, periodical read, contact outside the lab. Technical information was imported into the firm by gatekeepers through oral rather than written material (Allen, 1977, DeMeyer, 1985, MacDonald and Williams, 1994). Behaviours that distinguish gatekeepers as outlined by Klobas and McGill, (1995) were: their library use, attendance at conferences, electronic information resource use, and participation in user-group activities. Contact with external research R&D colleagues was seen as more important for applied research, while contact with other corporate areas was more important in development activities (Allen et al., 1979).

More recently external stars admitted, according to Whelan et al. (2009), that much of the information that they needed to do their jobs was available on the internet which was their most widely used source of external information (Whelan et al., 2010a) with preferred media being primarily internet based including Google searches, materials websites and online communities. It was possible for knowledge workers to seek solutions, discuss ideas and share their experiences with similar individuals beyond their local social network (Wasko et al., 2004). Even with increasing access to external information, via new technologies, the numbers of individuals engaging in this activity were still found to be low (Whelan et al., 2010a). Using search engines to precisely identify information was difficult, and given the amount of information returned, so that individuals good at this activity were termed ‘advanced search agents’ who knew where and how to find information on the internet (Whelan et al., 2009). Deep expertise was needed to filter through the large information provided by internet searches to identify relevant information (Whelan et al., 2010b). When seeking to acquire external information Teigland and Wasko (2003) identified that there was an expectation of reciprocity when individuals were 'trading' information across organisational boundaries: a consequence of this was that it couldbe difficult to build reciprocal relationships in extra-organizational electronic networks as the people may not meet face to face and, due to the anonymous and voluntary nature of the network and may have little social influence over each other. A recommendation by Petruzzelli et al. (2010) was to promote ties between organisations by promoting the development of alliances that were long-

term in duration so as to favour the development of a trustworthy environment. While the role of information and communication technologies was absent in earlier studies and later research focused on external sources of knowledge and internally on e-mail there is a dearth of studies that examine instances where gatekeepers rely on corporate information systems. This gap will also be addressed in this study with the use by gatekeepers of such systems being another case selection criterion.

Gatekeeper firms guarantee the quality of content that they screen and transfer to local partners (Morrison, 2008) as well as performing quality control on codified knowledge (Venkitachalam and Bosua, 2014). Emmitt (2001) argues that technological gatekeepers are needed due to increasing information overload. Aconsequence of the digitisation of the R&D social network is that the gatekeeper role has been split into specialised roles (Whelan et al., 2013). Recent research (Whelan et al., 2010a) has found that identifying relevant from non-relevant information has become both complex and time-consuming, resulting in specialisation by those they term 'external stars' who acquire knowledge for their own use but lack the skills to effectively disseminate it.

2.2 KNOWLEDGE TRANSLATION

The way work is organisationally defined and operationalised creates 'local norms, values and languages' that insulate the unit and create a communication boundary (Harada, 2003). A principle contribution by a gatekeeper is their ability to translate between boundaries such as the R&D department and the external environment that are created by the existence of divergent coding schemes (Allen, 1977, Tushman, 1977, Tushman and Katz, 1980) and, having translated it, deliver the information acquired in such a way that it can be used by others in the R&D group (Macdonald and Williams, 1993), making it meaningful to them (Morrison, 2008, Whelan et al., 2009). As well as translation to technical colleagues (Whelan et al., 2010a) gatekeepers also translated information to make it meaningful for managers (Katz et al., 1995).

There is an inverse relationship between extra-organizational communication and R&D performance (Allen, 1977, Baker et al., 1967). The reason for this Harada (2003) argues is

that the ability to translate between different coding schemes is difficult to obtain and is not common as those involved have to be familiar with the external coding schemes as well as the local shared language, with this latter capability taking several years to develop. Whelan et al. (2010) found that only a small number of people were 'targeted' by colleagues to perform this translation function. After verifying the information 'external stars' then go on to discuss it with their go-to people in the R&D group which (Whelan et al., 2010b) termed ‘internal communication stars’ who were well placed to understand how the information can be best exploited by the R&D group and will usually identify those best placed to use the information and translate it to them.

Beccattini and Rulliani (1996) examined translation taking place at the industrial district level with scientific knowledge produced outside the area being rendered understandable to the local members. Some gatekeepers had the ability to disseminate 're-elaborated' knowledge to local collocated firms (Ferretti and Parmentola, 2012). Knowledge transformation was necessary so that it could be used to efficiently solve problems, as internal employees might find it difficult to use immediately for problem solving (Harada, 2003). While an individual may 'trade away' proprietary knowledge the ability to turn the knowledge acquired into an innovation requires the ability to integrate new knowledge into an existing knowledge base (Teigland and Wasko, 2003).

External information is translated and transformed into knowledge that is 'organization specific' and then transmitted to other members of the organisation by what are termed 'internal communication stars' or 'knowledge transformers' (Harada, 2003). This is different to earlier studies that conceptualise a single gatekeeper as acquiring, translating and disseminating information. Harada (2003) breaks this role into acquisition by boundary spanning individuals who then pass it to internal communication stars that translate and disseminate it. Harada (2003) maintains there is a negative relationship between information gathering and organisational tenure because those with tenure have less incentives to disrupt the status quo by going outside the organisation: this is an explanation for Katz and Allen’s (1982) ‘not invented here’ syndrome.

2.3 KNOWLEDGE DISSEMINATION

Organisations active in research networks were often unaware of opportunities for knowledge diffusion (Cassi et al., 2008) with gatekeepers involved in disseminating knowledge to other organisations with geographic and organisational proximity and a similarity in terms of knowledge bases and experience (Petruzzelli, 2008). Brown and Utterback (1985) found gatekeepers perceived a higher level of uncertainty than colleagues, with gatekeeper actions reducing uncertainty for others in their group. Part of a gatekeepers expertise lay in knowing who is doing what inside the firm (Whelan et al., 2010a) so that they can distribute external information to appropriate colleagues (Tushman and Nadler, 1986). They have been characterised as being a 'clearing house for technical knowledge' (Maidique, 1980). A corporate incubator may take on the role of a gatekeeper when it cannot supply the required knowledge so that it acts as a knowledge broker (Gassmann and Becker, 2006).

In the case of nominated boundary spanners Nochur & Allen (1992) found that such individuals failed to disseminate new knowledge to other organisational members, rather such contacts were more likely to be made by colleagues seeking technical information. Those who accessed the information were found to not disseminate it further (Nochur and Allen, 1992). Recent research identified information was disseminated principally via 'internal communication stars', who had 'extensive comprehension' of internal operations of the R&D department and understood how information could be best exploited. Based on this knowledge they then decided whom to disseminate to and translated knowledge to that targeted person, tending to use e-mail and oral mechanisms as their preferred media (Whelan et al., 2010a).

E-mail and face-to-face interaction were used to disseminate knowledge; information received in a digitised format was e-mailed while face-to-face meetings were used when the source was orally-based (Whelan et al., 2009). Dissemination involved sending e-mails with attached content to employees the internal communications star knew would be interested (Whelan et al., 2010a). Gatekeepers were also able to control access to the retrieval and storage of content (Venkitachalam and Bosua, 2014). Effective

dissemination of knowledge required that, beyond merely e-mailing a colleague, the person could have a discussion with the recipient on how that knowledge could be exploited (Whelan et al., 2010b), what Sturges (2001) calls an 'informal information counseling' function with colleagues. In addition to individuals, dissemination could also be to teams (Venkitachalam and Bosua, 2014). A key challenge identified by (Whelan and Carcary, 2011) was network mentoring where peripheral experts were mentored by internal stars who could aid in the distribution of knowledge on the formers behalf. While the two step model has the advantage that there are less steps between the external source and ultimate recipient resulting in more precise information transmittal resulting in more efficient problem-solving the three step mode provides more translation, providing additional guidance and suggestion on how the information can be used (Harada, 2003). A key issue regarding the use of corporate systems by gatekeepers is the degree to which they can replace or reduce the need for gatekeepers to develop extensive interpersonal or electronic social networks.

The purpose of this paper is to examine how the traditional role of technological gatekeepers in acquiring, translating and disseminating external knowledge is affected when using corporate information systems in a new, non-R&D context and to extend the existing gatekeeper literature by identifying new distinctions and categorizations.

3. METHODOLOGY

Given the purpose of this study as outlined above an interpretive case study methodology was chosen. It is a popular choice according to Darke et al. (1998), being well suited to aid an understanding between organisational contexts and information technology-related innovations. It is also used to access some of the 'rich detail' of how information systems are used (Howcroft and Wilson, 2003) by examining the phenomena in its natural setting (Benbasat et al., 1987).

The case company was selected on the basis that it met certain theoretical criteria (Moisander and Stenfors, 2009, Stake, 2003, Johnson et al., 2010, Cabantous et al., 2010). The first criterion was that in addition to employees using knowledge for their daily tasks it was necessary that a certain portion of their work involved elements of all

three phases of gatekeeper activity, though it was not required that all phases were undertaken by a single individual. Given the gaps in the literature identified in section 2 regarding technologies already investigated and the typical focus on R&D departments it was necessary that there was heavy reliance on corporate information systems to accomplish work and finally, that a non-R&D environment was selected. As this research focused on examining day-to-day activities of employees a single case was, like Kaplan (2011), deemed suitable.

> *"Nobody will come in here with the skills they need to do the job, we can't hire people in this country who have this experience so we have to bring in people with industry experience and train them on our own products so it takes a good 4 or 5 months before anyone is really of any benefit."* MANAGER

Access was arranged through one of the department managers who introduced the researcher to the individual responsible for all knowledge management activities for the site. It was the latter who provided an initial overview of the work and access to a set of pilot interviews to confirm that the case selection criteria were met. These pilot interviews were used to identify topics and issues for subsequent discussion and elaboration upon (Moisander and Stenfors, 2009) in later interviews and included experienced and novice employees from both departments. Interviews followed a discussion guide consisting of topics centring on informal work practices and relating to how knowledge and systems were used. As with Orlikowski (2002) interviewees were asked to describe their everyday activities or situations, with a focus on how workers used information systems in practice. At this stage it was possible to identify that gatekeeping activities were present but took place in a particular set of circumstances. As a result questions were modified to focus on work practices that involved supporting novel cases which arose as a result of supporting new products and cases at the more difficult end of the spectrum.

Interviews were conducted with product support centre workers of all levels of experience as outlined in Table 1 and lasted from 30 minutes to 2 hours. Like Johnson et al. (2010) interview topics and questions were not structured around theory in order to avoid interviewees being led to provide data that was structured in terms of the theory

on gatekeepers. The objective was to get employees talking about the nature of their work and how they used various information systems on a day-to-day basis. One way of achieving this was by presenting material to interviewees that provided them the opportunity to describe and explain how work as carried out (Ahrens and Chapman, 2006). The use of more unstructured interviews provided respondents with more room to answer questions in terms of what was important to them (Strauss and Corbin, 1998) and questions were used to prompt descriptions (Johnson et al., 2010) of how work was performed in practice. This was important given the nature of the gatekeeper role as being one that emerges informally, (Whelan et al. 2010a).

Table 1: Interviewee Level

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Though Walsham (1995) warns that there is the risk interviewees might be less frank, nonetheless interviews were recorded and transcribed verbatim like similar studies (Orlikowski, 1996) and which, as argued by Seidl et al. (2010), minimises both the risk of inaccuracies and enables line-by-line coding. The researcher listened to recordings each evening to write up memos on topics and to identify areas where clarification or elaboration was required, adding prompts for further interviews. The interview data was coded using the NVivo qualitative software package using micro-coding and open-coding. This software also held contemporaneous notes relating to issues and observations of the case site by the researcher. Also included were memo documents that traced the researchers thinking as concepts were developed. The use of this package was, as argued by Seidl et al (2010), both an aid to coding and also as a way of maintaining the traceability of coding. After an initial set of codes were identified and it was necessary to merge similar codes and delete those found to rarely occur in order to create a more manageable list. Once this was in place all interviews were re-coded. A reason for this was that the interviewer realised that codes identified in later interviews were applicable to earlier interviews though their presence had not been clear at the time. Analysis involved multiple interpretive readings of field notes, interview transcripts and documentation (Orlikowski, 2002, Schultz and Orlikowski, 2004) through which a number of themes emerged (Orlikowski, 2002, Rodon et al., 2011). The key codes developed

around work practices centred on: searching for knowledge, divergence from formal procedures, allocation of work, mentoring, help-giving and receiving and working with solutions. Clarification on system capabilities and system use were also achieved by observing employees as they carried out their work. Interviews ended when there were no new issues were emerging and theoretical saturation (Gill and Johnson, 1991; Strauss and Corbin, 1998) was reached.

While not to have any propositions is legitimate, when exploring a topic(Yin, 2002), Walsham (1995) argues that previous knowledge can provide a 'sensible theoretical basis' which can inform the approach and topics in early empirical work. Similar to Johnson et al. (2010) the principles of induction were applied but sought to build upon existing theory. The data relating to work practices was then examined with reference to the gatekeeper literature. Practices in the case company relating to each of the three gatekeeper roles were identified and were compared to the existing literature. Explanations for any differences in activities were identified through an iterative moving back and forth between the data and the literature. The objective was not generalizability to a population but to develop an understanding that can be used to inform other settings (Fitzgerald and Howcroft, 1991). The purpose of this research was to seek a better understanding of how corporate information systems were used for non-R&D gatekeeper activities rather than to try and identify how typical or widespread those activities were.

4. CASE COMPANY DESCRIPTION

The case company was a large multinational corporation supplying storage hardware and related software to companies of medium to Fortune 100 size. Clients' technical problems with the case company's products were analysed in the first instance by Level 1 product support, the focus of this study. More difficult issues were escalated to two higher levels of support.

The case company installed software to monitor how its hardware and software products functioned on clients' systems. This software could identify problems, collect relevant information on errors and transmit this in what was called a 'dial-home' to the level one

product support department. This could take place without the client even being aware that there was an issue. As customers used the firms products in broadly similarly ways when problems arose they tended to be recurrent across the customer-base.

The majority of work faced by Product Support Engineers (PSEs) at level 1 of the product support centre was highly technical and repetitive in nature. It required the reuse of detailed context specific solutions held in a corporate knowledge management repository. During interviews and when reviewing these solutions it was established that there were also times when internal knowledge was insufficient to solve particular problems. These came about due to the implementation of new hardware and software products from the firm as well as by third party vendors that caused issues when interacting with the case companies products. In addition client configuration changes to existing technologies could lead to new problems for which the knowledge needed to develop internal solution did not exist.

5. CASE COMPANY GATEKEEPER ANALYSIS

This study focuses on the minority of instances where external knowledge was required by PSEs to complete their work. The research on technological gatekeepers was identified as a lens that could be used to make sense of this activity. This section will provide an examination of the activities undertaken by employees at each of the three gatekeeping phases identified in Section 2. It will explore how employees used information systems and identify different categories of activity that took place during each phase.

5.1 ACQUISITION OF KNOWLEDGE

5.1.1 EXTERNAL KNOWLEDGE ACQUISITION: PROACTIVE AND REACTIVE

PSE's in the product support department were found to acquire knowledge in two distinct ways: proactively and reactively. Proactive knowledge acquisition occurred when team leads were made aware when and what new hardware and software products that their team would have to support, typically getting about 3 months notice. They then

designated a team member to research this new technology. Sources of knowledge for this included technical hardware and software specifications, vendor support forums as well as product related discussion groups. The knowledge acquired was not to solve an immediate problem but rather to ensure that when problems arose the relevant specialist team would have already collected relevant external knowledge and have an expert available both to solve problems and be a source of advice to others in their team. It was stored on shared hard drives to which colleagues had access. This work provided such employees with the opportunity to gain peer recognition through being the possessor of new and specialised knowledge. It also gave them the opportunity to deepen their skills in a developing knowledge domain which as consequently provided them with a head-start over colleagues with longer tenure.

External knowledge was also acquired in a more reactive fashion when needed to deal with a 'dial-home' for which no internal solution existed. Organizational norms required employees to take cases categorized as 'high' severity first, then 'medium' ranked cases that had been longest in the work queue. When following these norms every employee has an equal chance of accepting cases that would require external knowledge acquisition. Reactive acquisition should therefore occur as an integral part of every employees work. Work was vertically specialised and so level 1 employees had the option of immediately escalating the more difficult cases that required reactive knowledge acquisition to a higher support level so that they had the ability to only select cases for which they knew a solution existed. However when taking this route some employees would informally tell a team member who had an expertise in the area that such a case was available. Those who wanted to try and develop a solution to a problem had a limited amount of time in which to attempt this. Reactive acquisition had a narrower, more specialised focus than proactive acquisition. Rather than developing a broad understanding it required knowledge that could be applied immediately to a narrow specific context. When considering acquisition in our case context in addition to considering the range of external sources of knowledge (figure 2) we found that it was also important to consider whether the gatekeepers' focus was broad or narrow and so we incorporate this into our model as outlined in figure 3.

Table 2: Types of Knowledge Acquisition

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5.1.2 VALIDITY OF KNOWLEDGE ACQUIRED

Each solution in the organisational repository recorded both the sequence of actions to be taken as well as the errors and context in which the problem arose. Another system monitored if the problem, after a fix procedure was applied, reoccurred. This meant that it was possible to validate the knowledge held as explicit solutions.

External knowledge was acquired from a number of third party sources and included technical specifications, vendor identified problems and resolutions, vendors' own support forums as well as more general discussion boards. For knowledge that was external to the department, but within the firm boundary, sources were similar, with higher support levels providing validated 'technical advisory' documents that outlined current problems on which they were working along with details of the availability of intermediate solutions such as software patches. Level one PSEs also had access to higher support levels draft working documents for more difficult problems that outlined issues as well as current thinking on a problem and attempted courses of action so that validity was not present in this source.

5.2 TRANSLATION FUNCTION

Having acquired external knowledge the next step was to translate it into a series of actions that solved the current problem so it could be used in the new problem context, i.e. devise a 'fix procedure. Fixes were contextually validated when the actions taken solve the client's problem.

Reactive knowledge was translated more quickly to solve current problems while knowledge proactively acquired had to wait until the underlying technologies were implemented by clients. Whether proactively or reactively acquired the knowledge is in the first instance translated to solve an immediate problem facing a client and takes place

at the individual (PSE) level. Subsequent translations could then occur as new instances of a problem occur in similar but discernibly different contexts.

5.2.1 TRANSLATION IN USE

Where an employee solved a problem by acquiring and translating knowledge to suit the new problem context they were then expected to document this translation as a solution in the knowledge repository to aid subsequent dissemination. Each solution included details of its author. This allowed PSE's to engage in informal peer assessment on the basis of the quality of the solutions that others had authored.

> *"I have 2 people on my team* [of 22] *who are just superstars, they write no end of solutions and they get great praise and great involvement but yet it's not enough to encourage anyone else to really jump."* Manager

Though aware that their translation had worked in practice, i.e. was validated in a particular context, some employees were not sufficiently confident that they possessed the technical competence to write a solution that would be widely disseminated fearing that it would be re-used inappropriately.

> "I find that people who arrive at solutions don't know enough about what actually happened." Experienced Product Support Employee

> *"A number of people may modify your solution but not comment on what they did. If anything is done wrong your name is shown as the original author in the solution, even though someone later may have 'butchered it' afterwards"* Product Support Employee

As they were the only person to know that the initial translation had taken place some PSEs chose to ignore the organisational mandate to document it: I.e. there was translation without dissemination. However, if a colleague faced such a problem and asked for help they would disseminate their translation on a one-to-one basis.

5.2.2 'RATIONALE-ISED' TRANSLATION

Where an employee translated knowledge for a particular problem context but were concerned that it could be re-used incorrectly if disseminated in a written format, and they had a good understanding of the problem area, they were able to engage in further translation to overcome this eventuality. Translation-in-use, outlined in the previous

section, involves only sufficient translation of acquired knowledge for a particular context to solve a problem.

> *"The solution as documented may provide a number of steps to follow- some people will elaborate in the solution so that learning is easier. Where there is an elaboration of the rationale then the person using the solution can relate the solution to the rationale and to their experience so that if the context changes they can realize that the solution is relevant for documenting a new solution. Without a rationale people may not be able to relate a solution outside of the problem within which it was created."* Head of Knowledge Management.

Before making their translation available for wide dissemination as a solution some PSEs engaged in additional 'Rationale-ised' translation. They examined if and how the current translation, clear to them, could be further clarified or elaborated upon to make later dissemination more comprehensible and re-use more effective. Rationales were included that explained when and why a translation worked and outlined possible situations in which the current translation may be inapplicable or potentially problematic. The ability to engage in this activity required not only a technical understanding of the problem and solution but also an understanding of the different levels of ability of potential users of the translation.

TABLE 3: Partial Solution Containing Rationale

-----INSERT TABLE 3 HERE-----

5.2.3 TIERED TRANSLATION

> *"don't say I issued such and such a command Alpha Charlie comma something- you know you don't ever say that like because it's useless I mean, the person that will read it will be the customer engineer and they won't have a clue what that command means so it's pointless".* Team Lead

Solution authors needed to be cognisant of the technical proficiency of potential readers when translating acquired knowledge. Another way of managing this was by engaging in what we term tiered-translation. A number of reader types were categorised as outlined in table 3. They included those at higher levels of product support who are more experienced, departmental peers who could be presumed to possess a similar knowledge

base and lexicon, as the writer and novice members of their department who required more guidance when assessing the applicability of available fixes. Finally, the organisation made its knowledge management repository available to its clients' technical support staff. This group had varying levels of technical knowledge which focused on their own information systems portfolio rather than specifically on the firm's products making them the least knowledgeable of all readerships. Thus when translating acquired knowledge for others there existed a number of audiences, with varying levels of ability to consider. Rather than having to write differing translations of the same solution for each audience authors could take advantage of a knowledge management repository feature: 'statement level security'. Each statement in a solution could be associated with a user group level. Statements were viewable by the defined user level and above. This capability allowed writers to provide a basic translation for external audiences while providing varying levels of additional details for different internal audiences.

TABLE 4: User Categorisations:

-----INSERT TABLE 4 HERE-----

The model developed by Whelan el al. (2010b) outlined in figure 2 focuses on external and internal stars in the translation phase whereas the model developed in this paper (figure 3) identifies different activities undertaken by the two categories of gatekeeper, proactive and reactive, examined in section 5.1. Within the translation phase reactive gatekeepers were found to engage in three types of translation which are integrated into out model as providing a link, for rationalized and tiered instances, between the reactive gatekeeper and the corporate repository.

5.3 DISSEMINATION OF KNOWLEDGE

The dissemination of acquired and translated knowledge could be either interpersonal or electronically.

5.3.1 INTERPERSONAL DISSEMINATION

Interpersonal dissemination was provided by two categories of worker: mentors and specialists. Mentors were provided to new staff for their first year with the company. They helped teach novice employees how to acquire knowledge and worked with them on a one-to-one basis to develop novices' translation skills from the standard cases for which solutions existed, to which novices were initially introduced, to more difficult cases.

> *"Usually it's easier to rotate the mentor so that their good habits and their experience would move on to the next 3 people and on to the next 3 people after about every -3 months".* Team Lead.

PSEs could also seek help from specialist peers rather than mentors. These specialists were fellow level one PSE's who had developed an expertise in a particular type of problem. This expertise had been developed informally through case selection within a particular problem domain.

> [Informal specialists] *"have been around for a lot longer and as well they tend to favour certain types of cases, I mean some of them would prefer power issues but they wouldn't go near memory and stuff so.*" Product Support Engineer.

They were identified through their authoring of solutions in the repository. This allowed workers in the Irish product support site to access help from specialists at any of the company's two other level one product support locations. This interpersonal practice not only aided knowledge dissemination but also knowledge translation by providing an opportunity to discuss the rationale for the series of actions to take in a particular situation, thus enabling wider learning to occur. This proved a useful dissemination mechanism for novel or difficult problems though it was slower that if the solution were documented. This is illustrated in the model presented in figure 3 as a direct link between proactive and reactive gatekeepers and knowledge recipient without recourse to either a shared drive or the corporate repository.

5.3.2 ELECTRONIC DISSEMINATION

> *"There's one guy out there he's been here in about the last year but if someone came in and saw the way it works you'd think he was here about 3 years. He's fairly eager so, he kind of, if he hears a problem, he'll go over and get stuck into it*

> *even though it's someone else's he's still listening so he's kind of eager to find out what's going on here, what's going on here and then he knows how to use the tools as well. Like he started off he got to use the tools that were available to him but he wanted more knowledge so if we had a serious problem or as well, like he started off he got to use the tools that were available to him."* Team *Lead*

Through the use of information systems PSE's could disseminate knowledge in four ways. Firstly, when a suitable knowledge translation was not possible the case was escalated to higher product support level, using a case management system. This system contained the 'dial-home' details originally presented to the PSE as well as case notes made by the PSE during the knowledge acquisition and attempted knowledge translation phases e.g. their lines of thought on a problem, courses of action taken but which did not work etc. This enabled dissemination of the current status of a case to a new person taking over the problem.

Secondly, external validated knowledge, in the form of product specification documents, white papers etc. when gathered could be made available to everyone in the product support department while more specialised knowledge could be disseminated to specialised workgroups through the use of shared drives and indexing software.

Thirdly, when a PSE identified the correct series of actions to resolve a problem it was expected that they would document this as solution in the knowledge management repository. The case company took the default position that unless a reason was identified to the contrary all solutions would be available to clients' technical support staff via a self-service portal: what might be termed open dissemination.

A fourth case was where there were reasons to restrict access, such as where the solution contained a lexicon that was known to PSEs but would be onerous to disseminate to external parties. In these instances PSEs used the statement level security feature to create a form of 'tiered dissemination'. This made certain sections available to those at the customer access level so as to provide basic details of the problem while

hiding a more detailed explanation that was only available to the firm's own product support staff. In circumstances where even a basic description of the problem was to be avoided PSEs replaced the problem detail with only a generic problem description and a request that the reader, who had to be a customer, contact product support quoting a particular reference number.

The first instance is beyond the scope of this paper. The second instance, using shared drives to disseminate knowledge is present in figure 3. It is different from previous models in two respects: (1) dissemination occurs prior to translation and (2) translation is undertaken by the recipient rather than the gatekeeper. The remaining two cases involve rationalized and tiered translations being disseminated electronically through the organizational repository which removes the need for interpersonal interaction between gatekeeper and recipient as show in figure 3.

------- INSERT FIGURE 3 HERE ------

The purpose of this research, as stated in section 2, was to examine how the activities undertaken by gatekeepers during external knowledge acquisition, translation and dissemination were impacted through the use of corporate information systems in a non R&D context and to identify and categorise new distinct activities. As a result of this study a number of new gatekeeper activities were identified in each of the three phases. During first phase distinctions were drawn as between knowledge that was acquired reactively and that acquired proactively as well as categorizing knowledge based on its degree of validity. For the translation phase this research identified instances where knowledge was acquired and translated without being then disseminated, and where the presence of a corporate repository led to translations being developed while considering the form that their electronic dissemination would take leading to the development of rationales and , in what we term 'tiered' translations, considering categories of future recipients. While interpersonal dissemination, like previous research, was present in the case company the existence of a repository meant that the majority of dissemination took place electronically. Thus while all the gatekeeper phases were present in the case

company the activities present within them were different from previous studies and these differences will be examined in the next section.

6. DISCUSSION

6.1 KNOWLEDGE ACQUISITION

The high degree of technological change in case context was, like Brown & Utterback (1985) a reason for knowledge acquisition. That the case company segmented work into specialised knowledge domains had a number of implications. Those occupying the gatekeeper role possessed both a 'deep' knowledge similar to Harada (2003) and a similarity of background across boundaries like Morrison (2008), as opposed to the dissimilarity between coding schemes identified by Tushman and Scanlan (1981). It also meant that unlike Teigland and Wasko (2003) the external knowledge to be acquired was never so novel so that it could not be subsequently applied. This underlined the need for Gatekeepers to possess deep knowledge in a particular domain.

Even with this high degree of specialisation there was still a need for the Gatekeeper to make acquired knowledge relevant (Morrison, 2008, Whelan et al., 2010a) though how this occurred depended on the mode of acquisition. For proactive acquisition the application of acquired knowledge to problems which gave it relevance were in the future. This meant those engaging in proactive acquisition required a broader understanding of the problem domain (Sturges, 2001) when assessing what knowledge might be of future relevance (Morrison, 2008, Whelan et al., 2010a).

A distinction between modes of knowledge acquisition was not present in the gatekeeper literature. The proactive category was most closely aligned with the extant literature on technological gatekeepers within organizations (Tushman and Scanlan, 1981, Allen and Cohen, 1969, Whelan et al., 2009, Whelan et al., 2010a, Whelan et al., 2010b, Whelan et al., 2013, Allen, 1977, Tushman and Katz, 1980, Katz et al., 1995, Allen and Katz, 1986). For proactive knowledge acquisition the case company, like Nochur and Allen(1992) designated particular people for this activity. Designation was more successful in this

research site because the knowledge to be acquired was more focused and would be actively sought by colleagues to solve pressing client problems.

In addition to previous research, such as (Allen, 1977, Harada, 2003, Whelan et al., 2010a, Whelan et al., 2010b) in which gatekeepers acquired external knowledge for the benefit of others, this research identified some external acquisition that was collected initially for the individual's own benefit. That 'reactive' acquisition was facilitated by specialisation of work and dial-homes that ensured the problem was well defined, presented a clear and immediate need that focused the search criteria to be used. While these factors supported the original objective to get employees to engage in reactive acquisition as an integral part of their everyday work we found, like Allen and Cohen (1969) and Whelan et al. (2010), only a limited number of members engaged in this activity. This created, albeit at the intra-organisational rather that at the intra-organisational level identified by Morrison and Rabellotti (2009), a 'weak core' of level one employees that needed support from those taking on a gatekeeper role.

Our findings concur with (Whelan et al., 2009, Whelan et al., 2010) on the importance of the internet as a source for acquiring external knowledge. Both modes of acquisition sought knowledge that existed in an electronic format. This had the effect of diminishing the necessity of gatekeepers to develop and maintain social networks in contrast to (Wasko et al., 2004, Teigland and Wasko, 2003). The need for gatekeepers to engage in reciprocal 'knowledge trading' (Teigland and Wasko, 2003) during this stage was absent in this study as the acquisition was from electronic rather than human sources.

6.2 KNOWLEDGE TRANSLATION

Traditionally gatekeepers were identified as possessing many years of experience (Whelan et al., 2010, Tushman and Scanlan, 1981) however constant technological change (Brown and Utterback, 1985) and specialisation of labour meant that employees could become specialists in narrow problem areas quickly thus reducing the length of time required to develop sufficient expertise to become a gatekeeper. Specialisation of work meant that in the case company the translation process occurred between specialists in well defined areas so that differences between internal and external

communities (Harada, 2003) were not present. This made the translation process easier as less epistemic boundaries existed.

Proactively acquired knowledge was typically stored in shared electronic spaces. In the case of straightforward problems with new technologies employees could develop a solution on their own by electronically accessing and translating this proactively acquired knowledge. This 'recipient translation' resulted in a new situation whereby the gatekeeper was not involved in identifying what acquired knowledge was relevant to a problem and was not directly involved in its subsequent translation. The necessity for the gatekeeper to develop extensive internal social networks was also diminished in this instance. This was a situation where there existed both temporal distance between acquisition and translation and physical distance between gatekeeper and recipient.

The availability of designated and informal experts, as well as searchable electronic repositories, changed the sequence in which gatekeeper activities could occur. The inclusion of an author field supported the identification of gatekeepers by colleagues. In the case company examined the internal recipient sought out they gatekeeper rather than the gatekeeper identifying to person to whom they would impart knowledge. This reduced the need for gatekeepers to develop the extensive internal social networks for knowledge trading and reciprocity identified by (Teigland and Wasko, 2003, Wasko et al., 2004).

A consequence of employees acting as gatekeepers over narrow domains within teams meant that reciprocity was present not between firms or departments (Teigland and Wasko, 2003) but rather help was sought and provided by multiple specialised gatekeepers within the product support department. Cases were even identified where newer employees who specialised in emerging technology could help colleagues with longer tenure.

Dissemination only needed to be considered where the translator believed the underlying problem would reoccur across the client base. The translation could be very tightly defined and structured within the solution repository. To get the most value from the repository there was a trade-off between writing translations so narrowly that

dissemination involved restructuring solutions and so broadly that solutions could be inappropriately reused. Those authors who were identified as successfully converting their translations into a format for successful dissemination were those who considered the wider implications of their translation to related contexts. Their objective was to provide sufficient contextualisation beyond merely describing the actions to be taken. A factor which mitigated against this was the limited time available to employees to convert translations into solutions for dissemination. If contextualisation for dissemination was too onerous and time consuming then the risk of misuse would lead to a decision to forgo dissemination entirely.

In contrast to previous research where the translation process involved applying acquired knowledge to a particular problem or opportunity this research found that after translation had taken place the participants would then consider how the translation, or variants of it, could be of value to the firm and the form in which these could be disseminated as discussed in the next section.

6.3 KNOWLEDGE DISSEMINATION

Dissemination was found to take place through interpersonal and electronic channels but in discernibly different ways and with different consequences to recent research (Whelan et al., 2009, Whelan et al., 2010a, Whelan et al., 2010b, Whelan et al., 2013).

As already argued in section 5.3.1 interpersonal dissemination was initiated by the recipient rather than the gatekeeper making this situation more similar to Nochur and Allen (1992). This was supported by the high degree of work specialisation and the ability to identify the authors of electronic solutions. A consequence was to reduce the necessity for the 'internal star' function (Whelan et al., 2013, Whelan et al., 2010). Rather than gatekeepers disseminating via e-mails a push strategy in the case company examined in the research they were 'pulled' by colleagues.

The case context involved more sophisticated information technologies to support dissemination in comparison to email (Whelan et al., 2009, Whelan et al., 2010, Whelan

et al., 2013). These technologies allowed dissemination for straightforward problems without any interaction between the gatekeeper and recipient. The knowledge repository facilitated dissemination as a 'clearing house' (Maidique, 1980) for technical knowledge.

A risk present during traditional dissemination was a reliance on the extent of the gatekeepers social network (Tushman and Scanlan, 1981a, Tushman and Scanlan, 1981b, Wasko et al., 2004, Teigland and Wasko, 2003, Allen et al., 1979, Whelan et al., 2010) which could result in the planned or inadvertent exclusion of colleagues who would benefit from dissemination (Whelan et al., 2010b). This risk was not present in this research as the knowledge was stored in an accessible electronic format. This removed the issue identified by (Tushman and Nadler, 1986) where gatekeepers had to decide which colleagues were deemed appropriate for dissemination.

It was possible to use technological features to avoid misunderstanding of electronically disseminated knowledge by drawing on the SLS feature through creating tiered disseminations. The question became not the identification of specific colleagues to target, but rather to identify what degree of knowledge should be disseminated to broad categories of recipient. It also supported dissemination to recipients outside the firm boundary. In addition to the formal SLS feature gatekeepers also included additional informal comments to provide rationales for the actions outlined to aid correct dissemination so that both formal and informal actions were taken to aid electronic dissemination.

7 CONTRIBUTION

Whelan et al. (2010a) maintained that our understanding of the role and tasks of gatekeepers using information technologies was limited. This research provides a number of theoretical contributions to this research stream. The context chosen was different from previous research that focused on gatekeepers within the R&D

departments of firms (Allen and Cohen, 1969, Allen, 1971, Katz and Allen, 1982, Allen et al., 2007, Whelan et al., 2009, Whelan et al., 2010a, Whelan et al., 2010b, Whelan and Carcary, 2011, Whelan et al., 2013) by choosing a product support centre setting where external knowledge acquisition, translation and dissemination was also required. A number of key differences were identified. Though problems faced by the case company were more narrowly defined that in R&D groups more sophisticated information systems were used. Choosing to examine one site in detail offered the opportunity to explore gatekeeper roles and tasks in richer detail and our exploration identified a number of alternative activities taking place at each phase as summarized in figure 3. While not arguing that the categorizations from one case are generalizable (Fitzgerald and Howcroft, 1991) we do believe that they provide some useful avenues for future research to develop and extend our understanding of gatekeepers and their use of information technologies. The study illustrates how the phases in the traditional model could be re-sequenced as a result of a high reliance and use of information systems in companies.

This research also provides some useful implications for managers. Designation of employees to a gatekeeping role was found to be effective when the knowledge domain was narrow and the knowledge acquired would be actively sought by potential recipients rather than a reliance on the gatekeeper to disseminate it. Information systems were shown to have a number of effects. They enabled dissemination to take place without translation and could leverage dissemination to a wider number of recipients. While there was a risk of inappropriate re-use technology could be used to contextualize knowledge and limit its dissemination on the basis of broad user categories.

8. CONCLUSION

In this paper we have examined how the traditional gatekeeper functions of knowledge acquisition, translation and dissemination were instantiated in a knowledge intensive product support department. In general the findings support arguments (Whelan et al., 2009, Whelan et al., 2010, Whelan et al., 2013) that new technologies have changed the gatekeeper role. By focusing on the case study of a company in which gatekeeping

activities were allied with a high reliance on information systems our research was able to extend the traditional literature in a number of ways.

Thus study found that knowledge was acquired proactively and reactively by employees and outlined the key differences between these forms of acquisition in terms of triggers, work allocation, time scale focus of activity and the type of workers involved in each. Consideration is also given to the validity of the acquired knowledge. Employees engaged in a number of different translation activities; workers translated knowledge on an as-needed basis for themselves (translation-in-use), with consideration for the wider context (rationale-ised translation) and with consideration for how that translation could be used by others (tiered-translation).

Gatekeeping was a more distributed activity across the product support department. Rather than the firm having a small number of gatekeepers (Allen and Cohen, 1969; Whelan et al., 2010b) it sought to have a wider range of employees acquire knowledge- but in more narrowly defined areas of responsibility.

A consequence of the increased use of information systems in the case company resulted in a difference in emphasis: there was a focus on the problem over the person in large part due to the role played by technology and supported by how technology defined and categorised knowledge to a high degree of granularity.

The use of a case study of a single organisation limits the ability to generalise and replicate results (Fitzgerald and Howcroft, 1991; Baroudi et al., 1986) though it can be used or the purpose of exploration (Benbasat et al., 1987). This study did not seek statistical generalizability seeking it rather within the case setting (Lee and Baskerville, 2003) through the use of 'rich insight' to generate concepts, (Walsham, 1995b). While this was a limitation we suggest that this exploratory single case study could be followed with future multiple case studies (Benbasat et al., 1987) to establish its generalizability in new settings through empirical testing, (Lee and Baskerville, 2003) particularly in contexts where there is a high reliance on information systems.

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