2008

Knowledge Diffusion in R&D Groups: The Impact of Internet Technologies

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KNOWLEDGE DIFFUSION IN R&D GROUPS: THE IMPACT OF INTERNET TECHNOLOGIES

Abstract

Knowledge flows are the lifeblood of any R&D organisation. These firms are increasingly discovering that the knowledge they require is often located beyond their boundaries. In this paper, we investigate how R&D groups acquire and diffuse external knowledge and the role Internet technologies play in this process. The focus of our study is on the technological gatekeeper. Previous studies have found that gatekeepers are key nodes in the innovation process. These sporadic individuals have the skills to identify useful knowledge outside the firm and disseminate this among their local colleagues. However, much of the seminal gatekeeper research has been conducted over two decades ago. In the time since, there have been huge advances in ICT and especially Internet technologies. These technologies have dramatically altered how knowledge workers source and share their information. Our objective is to advance the gatekeeper theory into an era where the knowledge worker is saturated with information. Using case study methods, we examine knowledge flows in the R&D group of an Irish medical devices firm. Our results indicate that due to advances in Internet technology, the traditional gatekeeper no longer exists to any great extent. Instead, the modern R&D lab acquires and diffuses external knowledge through a combination of a 'web gatekeeper' and a 'knowledge transformer.'

Keywords: Technological gatekeeper, knowledge management, open innovation, internet, web 2.0

1 INTRODUCTION

In today's rapidly changing business environment, few firms can afford to remain completely self-sustaining. For firms competing on knowledge and the ability to innovate and adapt, it is essential that they keep abreast of the latest scientific and technological developments. Increasingly, this knowledge is dispersed outside the firm's boundaries (Chesbrough, 2003). How does this external knowledge which is critical to success get integrated and diffused around the firm? A large body of literature exists which highlights the importance which informal social networks play in transferring knowledge within and between organisations (Hansen 1999; Allen and Cohen 1969; Wenger et al. 2002; Wasko and Faraj 2005). It has been found that within these informal networks, there exist a small number of key people upon whom others rely heavily for information (Allen and Cohen 1969; Allen 1971; Allen 1977; Tushman 1977; Katz and Tushman 1981; Tushman and Scanlan 1981). These 'technological gatekeepers' scan the external environment for useful knowledge and disseminate this among their local colleagues. They are critical nodes in the innovation process as they keep the organisation up-to-date with technical advances beyond their firms' boundaries.

It is therefore surprising that the technological gatekeeper concept has received scant attention in the past 20 years. This is all the more surprising in the current era when innovation is at the top of many managers' agendas. Previous gatekeeper studies have shown that external knowledge gets integrated into the firm in a two step process – the knowledge seeker contacts their gatekeeper for specific knowledge, the gatekeeper then sources this knowledge from the external environment. With the emergence of the Internet, nowadays everyone in the organisation can easily gather information from the external environment, thus potentially negating the need for specialised gatekeepers. But is this actually the case? The gatekeeper theory as it stands may no longer be relevant to the 21st century where we have easy access to the information super-highway.

The objective of this study is to build a theory of how the traditional gatekeeper function of diffusing external knowledge is performed in an ICT rich and information saturated environment. Such an extension to the gatekeeper theory needs to be built as knowledge flows are the lifeblood of any R&D organisation. The gatekeeper was the hub that orchestrated the flow of this knowledge but it is unclear how their functions are now performed in contemporary R&D organisations. Maybe search engines like Google have become the new gatekeeper? All the indications are that knowledge workers will rely more heavily on ICT to support knowledge flows in the coming years. For example, a recent McKinsey Consulting survey which examined how businesses are using Web 2.0, reported that over 75% of executives say they plan to maintain or increase their investments in technology trends that encourage online user collaboration (McKinsey Quarterly 2007). Therefore, it is critical to R&D organisations that they understand how these ICT advances impact knowledge flows within and between organisations. The research question addressed by this paper reads as follows: *"How does the Internet impact the technological gatekeeper role of accessing and disseminating external knowledge?"*

This paper is structured in the following manner; in section 2 the role of the technological gatekeeper in the innovation process is discussed. Section 3 reviews how advances in ICT impact the information sourcing and distribution practices of today's knowledge workers. Our research strategy and data collection methods are considered in section 4. Section 5 presents the preliminary findings from our study. A discussion of these findings is given in section 6 with a conclusion to the paper in section 7.

2 THE TECHNOLOGICAL GATEKEEPER DEFINED

Technological gatekeepers are defined as those key individual technologists who are strongly connected to both internal colleagues and external sources of information (Allen and Cohen 1969; Allen 1971; Allen 1977; Tushman 1977; Katz and Tushman 1981; Tushman and Scanlan 1981). Gatekeepers are also capable of translating technical developments and ideas across contrasting coding

systems. They keep up-to-date with new technical developments outside the organisation by reading the more technically sophisticated literature and by communicating with external technical experts. The gatekeeper is frequently consulted by local colleagues because they have demonstrated their technical competence in a particular field. Allen and Cohen (1969) noted when studying gatekeepers in the research & advanced technology division of a large aerospace firm that *"..if one were to sit down and attempt to design an optimal system for bringing in new technological information and disseminating it within the organisation, it would be difficult to produce a better one than that which exists"*. Though not essentially innovators themselves, gatekeeper conversion is the key to launching an idea or an innovation (Barabasi 2003).

Allen (1966, 1969, 1970, 1977) has made seminal contributions to the research of gatekeepers. His research has focused on the intra-organisational aspects of knowledge flows and he has made some interesting findings. While direct communication by all project members may be effective for internal communications, the particular method for effectively keeping up-to-date with technical advances outside the organisation are very different. Similar studies have found that when the work involves locally-defined tasks which require the integration of external knowledge, then it is more effective to have only a small number of gatekeepers (Allen and Cohen 1969; Katz and Tushman 1981). In fact, the presence of a high number of gatekeepers in these types of projects has a detrimental effect on performance. In explaining these findings, Allen and Cohen (1969) concluded that most engineers are unable to communicate effectively with external information sources. Thus, only a few key actors should have external links. Widespread direct contact by all project members is not an effective method for transferring technical knowledge into a project from external sources.

Given their ability to scan and interpret information from external areas and to transfer this information to the innovating unit, persons filling these boundary spanning roles can be seen as an important information processing mechanism in the innovation process. In fact, Brown and Duguid (2000) conclude that the key to competitive advantage is a firm's ability to coordinate autonomous communities of practice internally and leverage the knowledge that flows into these communities from network connections. Figure 1 illustrates the two-step process through which gatekeepers mediate the transfer of information from external information areas into the organisations internal communication network.

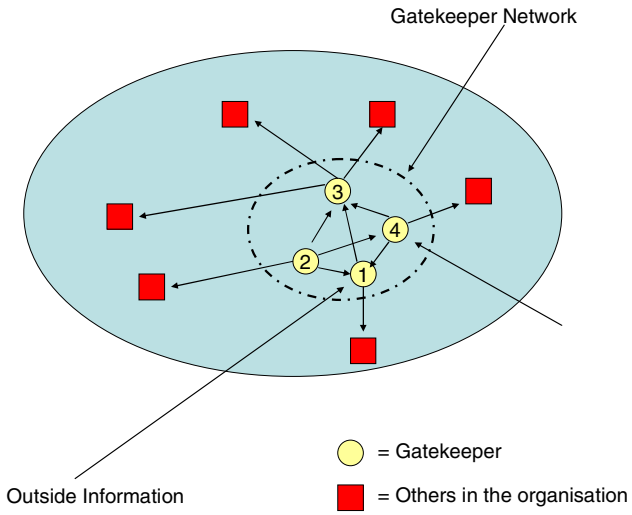

Figure 1 *The function of the gatekeeper network. New information is brought into the organisation by 1. It can be transmitted to 2, 3, and 4 via the gatekeeper network. It reaches its eventual users (squares) through their contacts with gatekeepers (Adapted from Allen and Cohen 1969).*

The knowledge brokering cycle offered by Hargadon & Sutton (2000) provides an insight into the brokering practices of gatekeepers and how they contribute to innovation. Gatekeepers occupy a 'structural hole,' a gap in the flow of information between subgroups in a larger network. They act as the broker transferring knowledge from the group that has it to the group that needs it. Table 1 demonstrates the knowledge brokering processes.

Brokering process	**Description**
1. Capture good ideas	Knowledge brokers scavenge constantly for promising ideas, sometimes in the likeliest places. They see old ideas as their primary raw material.
2. Keep ideas alive	To remain useful ideas must be passed around and toyed with. Effective brokers also keep ideas alive by spreading information on who knows what within the organization.
3. Imagine new uses for old ideas	This is where the innovations arise, where old ideas that have been captured and remembered are plugged into new contexts.
4. Put promising concepts to the test	Testing shows whether an innovation has commercial potential. It also teaches brokers valuable lessons, even when an idea is a complete flop.

Table 1 Knowledge brokering cycle (Hargadon and Sutton, 2000)

In one of the few recent papers examining the gatekeeper concept, Harada (2003) actually found that the usual definition of a gatekeeper (being both high internal and external communicators) did not apply in the R&D group of a Japanese tool manufacturer. Instead, he found that knowledge is brought into the firm by boundary spanning individuals who do not necessarily have high internal communication. These boundary spanners are connected to internal stars who translate the external knowledge into organisational specific knowledge and subsequently transmit it to other members of the firm. He calls these individuals 'knowledge transformers.' Harada suggests that the Japanese lifetime employment approach may be the reason why few gatekeepers existed in this firm. All the engineers surveyed never worked outside the organisation, thus the daily routine plays a huge role in the R&D group. Less attention is paid to external developments because firm specific knowledge is so important with such a company. If new engineers were entering on a regular basis, firm specific knowledge may not be so important.

3 THE IMPACT OF ICT ON THE GATEKEEPING PROCESSES

This paper argues that the gatekeeper concept needs to be revisited as advances in ICT have radically altered how external knowledge gets integrated into the firm. In the time before the World Wide Web, any efforts to interact with others outside an organisation's legal boundaries were often fruitless since they could be time-consuming or cumbersome. Individuals may not even have known whom to contact or how to find a relevant person. Furthermore, if management did not provide the resources to attend external conferences or other events, finding other like-minded individuals with whom to discuss work-related problems often proved difficult. The costs for the average employee of sourcing knowledge directly from the external environment were extremely high. Consequently, the locally constrained employee turned to the gatekeeper to mediate between them and the external environment, thus substantially reducing the knowledge transfer costs.

The situation is quite different nowadays. Due to the emergence of Web technology, the cost of participating in collaboration has plummeted. Processing, bandwidth, storage and memory all just continue to get cheaper. Likewise, expertise barriers to putting content on the Web have basically vanished. If you get a Blogger account, you do not need even basic HTML skills to start getting your thoughts up on the Web. In addition, the search costs of actually finding the information you need have decreased significant in the Internet age. Google have made a huge leap forward in Internet search quality by taking advantage of the information contained in links between Web pages. Links are an excellent guide to what is important and provide structure to online content. The 'best' pages are the ones that are most frequently linked to. Tagging is also a recent phenomenon which has

improved the categorisation of Web content. Some sites on the Web aggregate large amounts of content, then outsource the work of categorisation to their users by letting them attach tags – simple, one word descriptions. These sites – such as Flickr for photos, Technorati for blogs and del.icio.us for Web site bookmarks – dramatically reduce the costs of finding what you want.

Sharing information with like-minded individuals has become even easier with the emergence of social networking sites, wikis, blogs, podcasts and folksonomies. These digital platforms for generating, sharing and refining information are hugely popular on the Internet, where they are collectively labelled 'Web 2.0'. User-driven online services, such as Facebook, Wikipedia, YouTube and SecondLife, are to the fore of Web 2.0 technologies. McAfee (2006) believes that these technologies are particularly noteworthy because they can potentially knit together an enterprise and facilitate knowledge work in ways that were never possible before. He adds that *"Wikis, blogs, group-messaging software and the like can make a corporate intranet into a constantly changing structure built by distributed, autonomous peers – a collaborative platform that reflects the way work really gets done."*

If one wants a preview of how the knowledge worker of the future will use these Internet technologies, one only has to look at the activities of today's teenagers;

- The Internet is now the 2nd most popular source of information for students aged 11 to 16 years (e.g. Wikipedia, Google etc), after asking a parent, other members of the family or teachers
- This audience spends an average of 3 hours per session online
- 30% of teenagers actively generate their own online media
- 50% of this audience access the Internet on a daily basis
- 45% have experimented with their own blog
  (Source Comscore Media Matrix April 2006)

Unlike the teenagers of the 1980's and 90's, this 'Net generation' do not spend their evenings watching hours of TV. In the autumn of 2004, teens aged 12 to 17 spent 12.9 hours a week in front of the TV, two hours less than in 2003 and almost three hours less than five years ago (www.statcan.ca). TV is a medium which offers very little in the way of interaction. The Net generation have grasped the tools that enable peer-to-peer collaboration. Pass any Internet café today and you are bound to see groups of teenagers playing multi-player online games such as Quake and World of Warcraft. Such games are characterised by collaboration – players from all over the world can connect to the same server and form a team. The team have a strategic mission to complete and players co-operate together using instant messaging or voice via a headset. These knowledge workers of the future are not constrained by geographical boundaries. They use ICT tools to cross these boundaries, building their knowledge along the way. Tapscott and Williams (2006) argue that it is inevitable that they will bring the same mindset with them when they move into industry.

Recent years have also seen the emergence of online innovation marketplaces such as InnoCentive (www.innocentive.com) and FellowForce (www.fellowforce.com). These innovation marketplaces are changing the face of R&D for corporations, government agencies, and not-for-profits by employing their prize-based method to engage innovators in many industries from around the world (Tapscott and Williams 2006). Drug maker Eli Lilly launched InnoCentive in 2001 as a way to connect with brainpower outside the company. This web-based community match top scientists to relevant R&D challenges facing high-tech companies from around the globe. Companies submit complex problems on the InnoCentive website where more than 125,000 engineers, scientists, inventors, business people, and research organisations in more than 175 countries are invited to solve them for a financial reward. This model for solving complex problems is commonly referred to as crowd sourcing. It works on the premises that the more eyes looking at a problem, the more likely a solution will be found. With the Internet, anyone in the world can potentially be part of the 'crowd.'

Today's knowledge worker has become overloaded with information as a result of ICT. Many people routinely receive upwards of 100 emails each day, of which only a small percentage is of any relevance. A recent Silicon Valley survey shows that 33% of IT staff now receive 200-plus emails daily, compared to just 23% in 2005. Where once the problem was accessing information, the problem is now how to wade through and make sense of all the information that is at one's fingertips. The technological gatekeeper theory was formed at a time when it was difficult and costly to search and acquire external knowledge. What we know is that the gatekeeper was a key node in the innovation process because he or she had the skills to connect the firm to external knowledge sources. What we do not know is how external knowledge is acquired and diffused in the ICT rich and information saturated environment of today's world and, what role, if any, the gatekeeper now plays in this process. This paper aims to contribute to our understanding of this neglected field of study. The following section describes the methodology used to provide the data to investigate this problem.

4 RESEARCH SETTING AND METHODS

The purpose of this study is to build onto the gatekeeper theory. Most of our knowledge of the gatekeeper concept stems from research that was conducted over two decades ago. Advances in ICT have impacted the gatekeeper function but we have a limited understanding of what those impacts are. We do not even know if the traditional gatekeeper still exists. To extend the gatekeeper theory, we need to investigate the complex social processes involved in seeking and giving assistance. Case study methods are justified for this purpose because of the rich qualitative data produced. The required insight into these complex social processes are not easily revealed through quantitative methods (Eisenhardt and Graebner 2007).

This study was carried out at the R&D division of a medium-sized Irish medical device firm. This firm designs and develops innovative technologies and products that assist medical device manufacturers improve outcomes for patients. The R&D group primarily provides design and development expertise for medical device companies who wish to outsource their device design. The group's core competence is in the area of catheter-based minimally invasive devices. The group numbers 42 in total, mostly consisting of design and mechanical engineers. The new product development work performed by this group involves identifying existing and emerging technologies and applying these to solve a particular technical problem.

Our case study data was gathered during the months of October and November 2007 and consisted of two phases. *Phase 1* involved analysing the communication pattern of the R&D group. The purpose of this phase was to identify who the internal and external communication stars of the group were. To collect this communication data, all 42 group members were asked to complete a short online questionnaire which sought responses on their level of internal and external communication. 38 completed questionnaires were received giving a response rate of 90%. We used a technique called social network analysis (SNA) to visually illustrate the communication pattern within the group (see figure 2). In *phase 2* we conducted 10 semi-structured interviews with selected group members. The interviewees were selected based on our analysis from phase 1. We categorised each individual as being a gatekeeper, an internal communication star, an external communication star or a non-star. To get a non-biased view of how knowledge flowed around the group, we interviewed 2 gatekeepers, 2 external communication stars, 2 internal communication stars and 4 non-stars. We also ensured that all levels of the formal group hierarchy were represented in the interview sample. All interviews were conducted face-to-face and ranged in length from 30 minutes to 1 hour. In addition, all interviewees gave permission for the interview to be recorded.

5 FINDINGS

5.1 Existence of gatekeepers

Figure 2 illustrates the flow of technical information within the R&D group. A particular SNA software package called UCINET (Borgatti et al. 2002) was used to produce this diagram. The nodes in the diagram are the individual members of the 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 are found on the periphery. Nodes 4, 16, 35 and 40 did not complete the questionnaire, hence the reason they are isolated on the left. Nodes 2, 11, 38 and 42 are in the same position because they have no reciprocated interactions with another group member. Following the approach of Allen (1977) those group members who are in the top fifth percentile of interactions are considered to be internal communication stars. The internal communication stars of this group are nodes 6, 25, 37, 3, 26, 7, 24, 28.

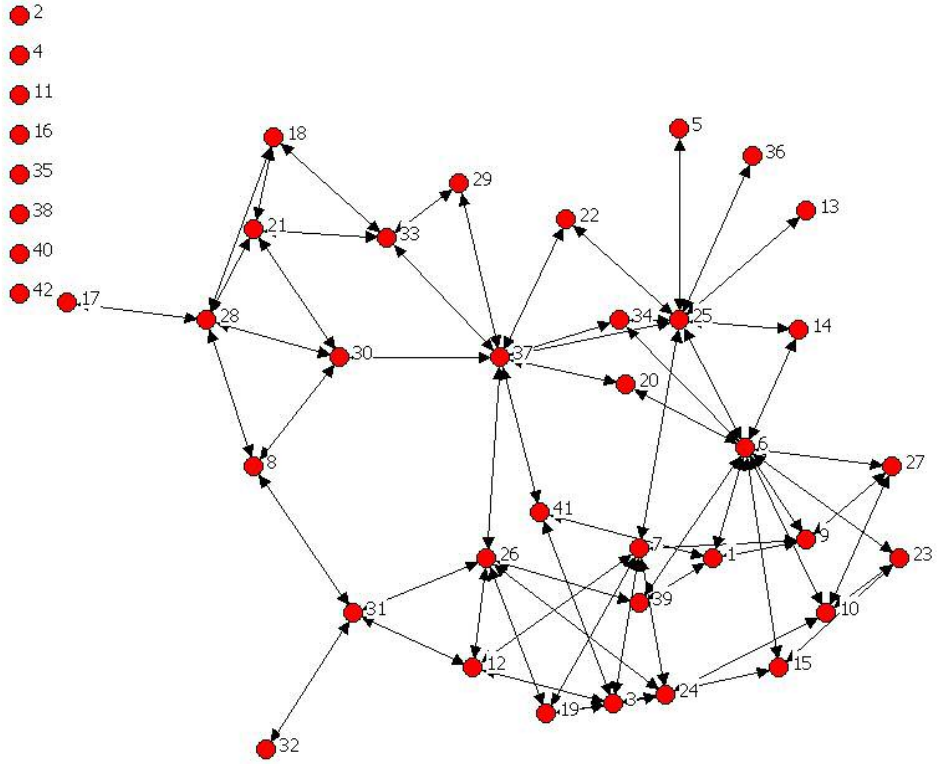

Figure 2 The social network analysis of the R&D group

We identified external communication stars using the same logic. Each respondent was asked how often they use each of the four external sources of information i.e. more than once a day, once a day, once every two days, once a week, once every two weeks, once a month, or more seldom. The analysis of this question revealed that some group members relied heavily on external sources while others did not. The external communication stars are those in the top fifth percentile and these were nodes 9, 11, 15, 33, 17, 37, 7, 5 and 29.

Gatekeepers are those individuals who are in the top fifth of *both* internal communication and external communication measures (Allen 1977). The analysis of group communication pattern reveals that only two group members, nodes 7 and 37, can be defined as gatekeepers.

5.2 The impact of ICT

Rather than relying on an intermediary, the engineers in this R&D group primarily use the Internet to bring in new knowledge and to keep up-to-date with technical advances outside the firm. One of the gatekeepers interviewed explained the importance of the Internet in the following manner:

> *"It's a necessity these days. One of the questions I ask when I'm being interviewed for a job is…do you have Internet access? Is it high speed? I don't even use rolodex anymore [instead] I put their website in my favourites….Internet is huge because all your vendors are on there right now…I use it like a card system."*

When faced with a technical problem that they are struggling to solve, the engineers from this group turn to the Internet for knowledge that will lead to a solution. Before the widespread availability of Internet technologies, these engineers would more than likely have turned to their local gatekeeper for assistance. It would seem that the advances that Google have made in search have contributed to the decline of the gatekeeper. An external communication star recalls an instance where Google Images provided an unlikely solution:

> *"We were trying to design a handle for a shaft that would be fitted to a catheter. We had a brainstorming session but we just couldn't come up with a solution. We decided to type a couple of key words from the design idea into Google Images and see what results we got back. In all, it threw up images of around 10 different devices…one in particular that used the same design we were after. That device was a ball point pen…and we ended up using a similar shaft design to the pen for our device. We would never have thought of that otherwise. It worked perfectly as it turned out."*

5.3 The web gatekeeper

Many of the engineers interviewed acknowledged that much of the useful information they need for their job is available on the Internet. However, even with the advances of Google, finding the exact information they want on the Internet can be difficult. As a result, the average engineer turns to a local colleague who is more competent in ICT and Internet search. We call this individual a 'web gatekeeper'. The web gatekeeper possesses is an intimate knowledge of where certain information can be found on the web - a human search engine of sorts. Web gatekeepers are external communication stars who assist their local colleagues in finding the specific information they want. The Google search engine and online discussion forums would seem to be their external communication medium of choice. The following quote from a project leader emphasises the important role which web gatekeepers play. This team were given a project to complete on a topic which they did not know much about:

> *"We had it in here when we had a project on gammo induction… We generically knew it wasn't going to be great for us...and this person went off and they came back in half a day and had reams of information…some people are just really good at finding stuff out on the Net, [whereas] some people are just type in gammo induction and print off the first page they find. There's two people I have, if you want to find something out…they'll find it out and it will all be off the Net."*

5.4 The knowledge transformer

Although the engineers find the Internet an extremely useful information source, much of the information gathered from it is of a very generic and non-specific nature. The following quote from an internal communication star is reflective of many of the interviewees' opinions:

> *"The Internet is good for finding analytical and theoretical stuff…it's really good for that calculation stuff, you find that there really really quickly. But for the more specific industry stuff, you don't find that there, or if you do find it, it's very very difficult to get the exact information you want from it. Companies that make glue for instance, you'll get all the data*

you need on glue gaps, the Internet is good for finding that kind of stuff. But if you have a specific question about something, that stuff is very hard to find you know…is this catheter going to track into the artery? Does it have the right flexibility? That stuff is very hard to find."

To be useful to the R&D group, this generic information from the Internet needs to be turned into knowledge and applied to the specific technical problems facing the group. Likewise, with so much information freely available on the Internet, determining the reliability and validity of this information is an issue. We found that a small number of experienced individuals are frequently consulted by the rest of the group with these issues in mind. This experienced person is usually an internal communication star – one of the 'go to' people of the group. We call this individual a 'knowledge transformer' (Harada 2003) as they help transform information from the Internet into the knowledge to solve a particular problem. The following quote from one such knowledge transformer in the quality management field emphasises the information validation role she plays and the type of questions she gets asked:

"Some of the project managers do go off and look for quality information off the FDA websites…they are well capable of finding out that information themselves but they double check that they have done it correctly with me. So, they are capable of finding information themselves but they don't run with it until they have had the OK…Is this the way I should be doing this? Do you know of a better way of doing it? How did we do it previously?"

6 DISCUSSION

Our analysis of this R&D group's communication pattern reveals that the traditional gatekeeper does not exist to any great extent. Only 2 out of the 42 group members could be classified as gatekeepers. Four decades ago, (Allen and Cohen 1969) found that 20% of engineers in an energy conversion R&D lab acted as gatekeepers. If the traditional gatekeeper still existed, we would have expected to see 7 or 8 individuals in our case study group conforming to this profile, instead of just 2. The traditional gatekeeper was a 'jack of all trades' – well connected to external sources of information and also well connected to internal colleagues. From the analysis of our interview data, we find that the traditional gatekeeper has been replaced by separate individuals who are either internal or external communication specialists. External knowledge enters and diffuses around this R&D group through a combination of web gatekeepers and knowledge transformers. Our findings are consistent with those of Harada (2003) who also found that separate communication specialists have replaced the traditional gatekeeper.

Figure 3 contrasts the traditional two-step process to integrating external knowledge along with the two new ICT facilitated paths that we have discovered. Route 1 reflects the traditional gatekeeper role. The gatekeeper acts as an intermediary between the knowledge seeker and the external environment. Step 1 sees the knowledge seeker contacting their gatekeeper for external knowledge. In step 2, the gatekeeper sources this knowledge from the external environment. In route 2, ICT enables knowledge workers to essentially become their own gatekeeper. When they need external knowledge, they search the Internet (step 1). However, the knowledge sourced from the Internet is of a more explicit, generic and codified form. In step 2, in order to relate this explicit knowledge to the organisational context the knowledge seeker will have to discuss this knowledge with an experienced colleague, a knowledge transformer. A two-step process still exists but the order is reversed. In route 3, the knowledge seeker first contacts the web gatekeeper to assist them in finding the external knowledge they want. They then follow the same path as in route 2.

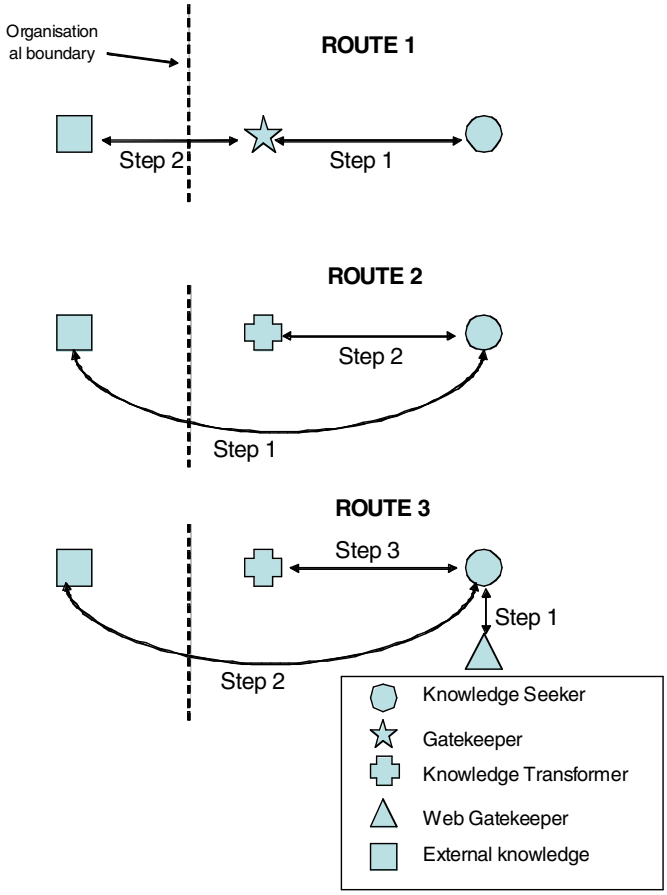

Figure 3 Accessing External Knowledge; Three Routes

Although we cannot say with absolute certainty that advances in ICT have led to the extinction of the technological gatekeeper, our analysis of the interview data does point to such a scenario. With a couple of clicks of their mouse, the R&D engineer can access vast amounts of external knowledge relevant to their particular field. One possible reason why the prominence of the gatekeeper is eroding may be due to the fact that the knowledge seeker incurs less cost when they search the Internet for information. Many authors have noted that knowledge does not transfer smoothly between people because there are certain costs involved in asking others for assistance (Szulanski 1996; von Hippel 1994; Teigland and Wasko 2003; Hansen 1999). If the knowledge source demands a cost which the seeker feels is too high, then the knowledge transfer is unlikely to take place. Esteem and reputation issues come into play when seeking help from others as we are motivated to maintain positive self images and so often seek out information that confirms a positive sense of self (Lee 1997). For example, admitting ignorance on a given topic to a colleague is too high a cost for many to bear. This cost "*…lies in the expected damage sustained by the ego if one's question is met with a critical response. To be told you have asked a dumb or foolish question is the ultimate in rebuffs. Few people are willing to entertain such a risk."* (Allen and Cohen 1969).

There are very strong differences between the profile of a traditional gatekeeper and those of a web gatekeeper and a knowledge transformer. In table 2, we provide a comparison of these three categories of communication stars.

	Traditional Gatekeeper	Knowledge Transformer	Web Gatekeeper
Industry Experience Level	More than10 years	More than10 years	More than 3 but less than 10 years
Communication Specialisation	Both internal and external communication star	Internal communication star only	External communication star only
Preferred Information Source	Social contacts (mostly external contacts). Technically sophisticated journals	Social contacts (mostly internal colleagues)	Internet (Google, online discussion forums, RSS feeds)
Oral Communication Skills	High	Medium	Low
Primary Function	To gather external knowledge and diffuse locally. To help local colleagues interpret their external communications.	To validate the reliability of external knowledge and to diffuse locally. To help local colleagues interpret their external communications.	To gather external knowledge. To assist local colleagues in gathering external knowledge
Formal Position	Middle Management	Middle Management	Junior – 1st line supervisor
Preferred Communication Medium	Oral	Oral and electronic	Electronic

Table 2 A Comparison of the Technological Gatekeeper with Modern Gatekeepers

7 CONCLUSION

This paper investigates the impact of Internet technologies on the traditional gatekeeper role. The seminal gatekeeper research by Tom Allen, Ralph Katz and Michael Tushman shows us that gatekeepers are critical nodes in the innovation process. They are the social conduits through which knowledge of new technologies, potential markets, customer needs, and competitor offerings enter the firm. We conducted a case study of the R&D group of an Irish medical device firm. Our findings indicate that the traditional gatekeeper no longer exists to any great extent. With the aid of a web gatekeeper, most R&D engineers use the Internet to find the external knowledge they need. This knowledge is then validated and distributed internally by an experienced colleague called a knowledge transformer.

The findings of this paper are of benefit to both theory and practice. We contribute to the advancement of the gatekeeper theory into the 21st century. However, our findings our based on only a single case study. Future research studies should examine multiple R&D groups in differing industries. Practitioners are increasingly aware that innovative knowledge is located beyond the boundaries of their firm. This study shows that the Internet is a vital tool for accessing this knowledge and that certain people exist who have the innate ability to find relevant knowledge on the Internet. It will be increasingly important for R&D firms to find people with these skills. In their recent book entitled 'Wikinomics', Tapscott and Williams (2006) argue that we are only beginning to see how the Internet can be used for mass collaboration and gathering innovative knowledge. With the Internet being so engrained in the everyday lives of today's youth, we will really only see these advances come to fruition when this 'Net generation' moves into industry. Thus, it is vital that we now begin to understand how ICT impacts how external knowledge gets integrated into the firm.

We see two additional areas for future research. Firstly, the gatekeeper theory states that effective communication with the external environment can only be done by these few key individuals. As a result, R&D project teams that contain a gatekeeper are more likely to be higher performers. Nowadays, all knowledge workers can easily access knowledge from outside the company through the Internet. A future area for research is to investigate how this impacts project performance. Secondly, social networking sites like LinkedIn or Facebook poorly support the knowledge gathering work of web gatekeepers. We foresee a need for social networking research that investigates innovation and knowledge gathering, and how these social networking sites could work inside the company.

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