Facilitating Knowledge Creation with GroupWare:
A Case Study of a Knowledge Intensive Firm

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Abstract
Managing knowledge is a value creating process in most organisations and is particularly important in knowledge-intensive firms. This paper asks the question: how can GroupWare specifically facilitate processes of knowledge creation within knowledge intensive firms? Based on an analysis of an expert consultancy where e-mail is used successfully for information and knowledge search, and Lotus Notes is used with mixed results in project working, it is argued that the complexity of articulating the knowledge creation process can be reduced by using e-mail. Furthermore e-mail when considered in context is potentially a rich medium for the development of collective knowledge over time. It is also concluded that, although distributed Lotus Notes databases can alleviate temporal and spatial complexity, this media lacks the richness required for complex processes of knowledge creation. Thus where temporal and spatial constraints do not exist, there will be substantial barriers for using GroupWare to support the knowledge creation process, in this type of knowledge-intensive firm.

1. Introduction

Knowledge management is now recognized as a key process in achieving competitive advantage in firms [1] [2]. Managing knowledge however has always been a particularly pertinent and crucial issue for ‘knowledge-intensive’ firms (KIFs). These are organizations, such as R&D labs and high technology firms, which employ predominantly highly qualified individuals who are engaged primarily in work of an intellectual nature [3]. Thus within KIFs knowledge is considered to be the firms’ primary asset and more important than other kinds of inputs or resources, with regard to achieving competitive advantage [4]. Knowledge management systems are therefore considered to be potentially an important resource and tool for project working, particularly within consultancy firms that are heavily reliant on the knowledge and expertise of individual organizational members. However, much of the research to date suggests that a major problem or constraint here is motivating individuals to share their knowledge via a technological medium, in order to maintain the potential value and integrity of the system for processes of knowledge creation. [5] [6].

This paper reports an investigation into the way in which GroupWare technologies were used to facilitate the management of knowledge (specifically processes of knowledge creation and distribution) in a scientific consultancy, referred to here as ‘Universal Consultancy’.

Scientific consultancies are a good example of KIFs, employing highly qualified scientists and technologists (knowledge workers), and relying heavily on the integration and synthesis of their specialist knowledge to create novel products and processes in response to clients’ problems. They deal, then, during project working, mainly with processes of knowledge creation. Despite their importance, there have been relatively few systematic studies of scientific consultancies [7]. Two crucial issues have been identified for these kinds of KIFs [8]. The first concerns the management of individual consultants, who are a scarce resource the firm must strive to retain. The second issue concerns the management of knowledge, in particular, the structures and media for knowledge articulation, creation and distribution [9] [10] among experts within the consultancy. This includes, importantly, the design of information communication technologies (ICTs) [11] for the articulation and distribution of information and knowledge. These are seen as critical mechanisms for knowledge creation in high technology firms and KIFs [12] [13]. However different ICTs are characterized by different degrees of information richness (IR) [14] which more recent research has concluded is to some extent context dependent [15] [16]. Thus making particular ICTs more or less useful or applicable for particular types of interaction within specific organizational contexts. The aim of this paper then is to explore and analyse the way two particular GroupWare technologies, e-mail and Lotus Notes were used as means of supporting knowledge articulation, creation and
distribution during and outside of project work at Universal Consultancy.

2. Methodology

Universal Consultancy participated in a longitudinal research study that commenced at the beginning of 1996 and was completed in Spring 1998. The study focused on the way in which knowledge creation processes were sustained over time within this particular organizational context. An interpretive case study approach was employed and the main methodological approach adopted was the use of semi-structured interviews. A stratified sample of organizational members were formally interviewed (N= 15) across the firm. The firm was loosely structured accorded to scientific discipline and consultants were allocated to non-hierarchical divisions according to their particular specialism. The sample therefore included consultants from all seven divisions within the firm together with senior management including the Founder, Chairman and Human Resource Manager. Interviews were of between one and a half and two hours duration and all interviews were taped and transcribed.

Interviews focused on the way in which consultants interacted during project working both during the period of the research and historically. Content analysis of interviews was then conducted focusing on the structural (reward systems, level of formalization, availability of resources - including IT, etc), cultural and social (trust, power relations) conditions which either facilitated or constrained processes of knowledge creation. This paper reports primarily on the role of structural conditions (in particular, GroupWare) in processes of knowledge creation and distribution.

E-mail and Lotus Notes were established as being the GroupWare technologies available to consultants at Universal. Hence, questions sought to establish the individual’s usage patterns of these GroupWare and what were considered to be the advantages and disadvantages of these GroupWare for project working. There is clearly some reliance when interviewing, on the subjective beliefs and attitudes of both the interviewee and the researcher, which will inevitably be situation bound. The majority of interviewees however, were remarkably candid when describing what it was like to work at Universal Consultancy and the nature of project working and this is reflected in their comments in this paper. Whilst inevitably contradictions and inconsistencies emerged, there was considerable consensus regarding the use (and abuse) of GroupWare technology across the entire interview sample. In addition triangulation techniques were used which are outlined below to corroborate individual consultants’ comments and observations that were made during interviews.

One of the authors was invited to observe consultant / client interaction throughout the duration of one complete project. This involved attendance at 7 project meetings over a four-month period, early in 1997. Access was also provided to all of the discussion databases generated from another project where Lotus Notes had been used during project work. In addition, this researcher spent approximately one day every two weeks on site, over a four-month period in mid 1996. This period of non-participant observation provided further insights into project working and informal access to further 10-15 consultants who were prepared to engage in informal conversation. Access to secondary sources of data such as internal management reports was negotiated, as too was attendance at various company meetings (including a Board meeting) through 1996 and early 1997.

In Spring 1998, two final interviews were conducted, one with a consultant from the original sample and one with the IT manager, in order to establish what technologies (GroupWare or otherwise), were in use at this time for project working and to consider what changes, if any, had occurred regarding project working over the previous twelve months. Thus the interpretive case study design was characterized by the use of multiple, qualitative methods and sources in support of the outcomes reported here.

3. Knowledge work and the use of ICTs

This paper uses existing theoretical frameworks of knowledge creation and communication to analyze the way in which knowledge was managed in order to facilitate knowledge creation in Universal Consulting [17] [18] [19]. These frameworks offer rich conceptual understandings but do not specifically assess the role of information technology within processes of knowledge creation. In addition therefore, research that has been conducted on the use of GroupWare technology as media for communication and co-ordination [20] [21] [22] [23] will also be used to analyze and explain the way in which these technologies facilitated knowledge creation within Universal Consulting. This paper attempts, then, to extend this earlier work, by providing an empirically-based analysis of the role of particular GroupWare (e.g. e-mail and Lotus Notes), in processes of knowledge articulation, coordination and creation within a KIF.

Nonaka and Spender have both developed frameworks that aim to highlight the role of different knowledge types in processes of knowledge creation.

Nonaka identifies four mechanisms for knowledge creation (i) socialization, whereby one individual shares tacit knowledge with another; (ii) combination, whereby one piece of explicit knowledge is combined with another; (iii) externalization, whereby tacit knowledge is made
explicit; and (iv) internalization, where explicit knowledge is converted into tacit. The emphasis in this framework is on the interplay between tacit and explicit knowledge (i.e. internalization and externalization) at the individual level, as the basis for knowledge creation and learning within organizations. Spender however, argues for a four fold pluralist epistemology that recognizes both individual and social knowledge, as well as implicit (tacit) and explicit knowledge in processes of knowledge creation. Thus he identifies four types of organizational knowledge, (i) conscious, which is an individual’s explicit knowledge, (ii) automatic, which is an individual’s implicit knowledge, (iii) objectified, which is explicit, social knowledge and, (iv) collective, which is implicit, social knowledge. Spender suggests that collective knowledge, rather than individual knowledge, is the most strategically useful knowledge within the firm, in processes of knowledge creation and that this develops at a social level from the dynamic interplay between explicit and implicit (tacit) forms of knowledge.

Whilst then these may models may differ with regard to the level at which knowledge creation occurs, they suggest that for KIFs to maintain competitive advantage, it is important to manage this interplay between tacit (implicit) and explicit forms of knowledge and also the involvement (or exclusion) of individual experts. The major issue addressed here, then, is the impact of GroupWare on these processes of internalization and externalization [24], or (using Spender’s framework), the development of collective knowledge, within Universal. Information richness (IR) theory [26] suggests that the choice of communication media is heavily dependent upon the fit between task and medium. Different media can be characterized by the degree of media or IR they possess. This is defined as "a determinant of the extent to which information is given common meaning by the sender and receiver of a message" [27:103]. There are two aspects to IR, the variety of cues the medium can convey and the speed of feedback that the medium can provide. IR theory suggests therefore that highly complex or equivocal tasks, such as project working for knowledge creation require information-rich media, primarily face-to-face communication, considered to be the richest media because it provides a variety of social cues.

Adopting this theoretical prospective GroupWare technology is considered a fairly lean media, insofar as the medium provides a channel for asynchronous interaction but is limited to the written word. According to IR theory then this medium is potentially useful for the exchange of explicit information and knowledge across time and space but inappropriate and problematic for the communication and exchange of more complex, tacit knowledge. This suggests that in the context of project working within an Universal Consultancy, where the emphasis is on knowledge creation, GroupWare technology may be useful for the exchange, co-ordination and articulation of low-level information and explicit knowledge, particular if team members are geographically dispersed. However, given the complexity of project work in this context, based on IR theory, it is expected that the majority of work and tasks performed during project team working may require face-to-face communication. IR theory tends however towards positivism when determining choice of communication media. More recent research has highlighted that social factors may also affect choice of communication media, particularly between knowledge workers and professionals.

Recent research then has indicated that aspects of the social environment are also a determinant of the choice of media for communication and interaction, particularly in the case of knowledge workers [28]. Two dimensions of the social environment have been shown to influence the choice of communication media. The first is the presence of a critical mass of users and the second is the temporal availability of the recipient. This research suggests that knowledge workers only spend time learning and using GroupWare technology such as e-mail, if they are reasonably confident that most others within the firm are prepared to use the this medium and if the task is not particularly complex (requiring high social presence). Again, where the task in hand was complex, knowledge workers still preferred to use media that was information rich e.g. face-to-face communication, rather than attempting to use e-mail to convey complex information or knowledge. Straub and Karahanna’s research, whilst again routed in positivist research traditions, suggests that knowledge workers carefully consider the potential payback associated with time spent acquiring the new skills required to use particular technology, before deciding to use this media for communication. Assessment is also made of the potential for face-to-face communication, prior to choosing to use a technological media for communication. This research does then suggest that particular social, contextual conditions do mediate the choice of communication media, particularly between knowledge workers.

Other research on the choice and use of particular media for communication [29][30] has rejected the idea that particular communication media will be chosen for their objective rich or lean properties alone. This research suggests a more complex interaction between individuals, technology and organizational context, which requires an interpretive approach rather than positivist approach adopted in IR theory. This more recent work has sought to understand why several empirical studies [31][32] have identified serious conceptual weaknesses in IR theory. For example, it was found that managers’ actual media use was inconsistent with IR theory, as they used e-mail far more intensively than IR theory would predict. This research highlighted "that managers who received e-mail
were not simply passive recipients of data, but active producers of meaning” [33:154]. The richness afforded to a particular medium therefore depends on more than just the objective features of the medium it is also highly dependent on organizational context. For example, Lee asserts that the most appropriate communication medium will depend on individuals’ familiarity and skills with different media and their willingness, opportunities and resources available (e.g. time) to support learning of the capabilities of particular media, innovating uses for it etc. In the context of a KIF consultants faced with significant levels of dispersed work activities and a significant pace of work may have discovered innovative ways of using relatively ‘lean’ media for rich communication.

This research does suggest that within Universal Consulting, the availability of IT such as GroupWare may be a useful resource in project team working, particularly where team members are temporally unavailable and geographically dispersed. However, its level of utility cannot be estimated without detailed empirical investigation. Whilst, the complexity of the majority of tasks expert consultants engage in during project team working may require information rich media, consultants may have developed ways of using relatively lean media, innovatively, in order to overcome problems of temporal and geographical dispersion. This research has also shown that knowledge workers are only motivated to spend time learning how to use IT for communication and interaction if a sufficient number of others are also prepared to use the same media. In the following analysis a qualitative, interpretive approach will be used to assess the degree of media richness afforded to different GroupWare within this particular organizational context and to what extent different communication media facilitated knowledge creation processes. The existing literature in this field suggests that its role is highly situated and context dependent.

4. The use of GroupWare at Universal Consultancy

4.1. Context

Universal Consultancy was founded in 1986 and is based in the south east of England. Universal develops completely new ideas (inventions), which it markets to clients as Intellectual Property Rights (IPR), and also develops innovative solutions to organizational problems, using existing concepts, ideas and technologies in new ways. Inter-disciplinary team working, where scientists from different disciplines contribute to projects, characterizes the nature of the majority of the work carried out at Universal. The reputations of the senior organizational members (who, at the time of the research, all continued to work at Universal), are internationally acknowledged within the scientific, engineering and communication communities.

Over time the organisation has grown substantially, from ‘a handful’ of scientists who were predominantly specialist engineers and communications experts and expanded into other scientific disciplines. In 1998, it employed 137 people directly, of whom 116 were expert consultants with doctorates in the sciences, representing 19 different nationalities. It also employed a further 110 people on an associate basis in the US, Japan and Europe. Despite organizational growth, the Founder of the organisation had attempted to maintain an organizational configuration which is referred to in the literature as an ‘adhocracy’ [34]. The adhocracy is an organizational structure characterized as organic, flexible, non-hierarchical and highly informal and is considered to be one, which promotes innovation. During the period of the research it was evident that considerable efforts were made, to avoid the introduction or imposition of any formal protocols, systems or procedures upon consultants or project working.

4.2 E-mail

E-mail was adopted and implemented within Universal in late 1991 by which time over 100 consultants worked within the firm. Prior to this, knowledge had been managed and created purely through tacit exchange (socialization) and externalization in inter-disciplinary project team working. Hard copy project documentation was generated, which in conjunction with socially located knowledge, served to generate collective knowledge. Until this point in time, consultants had been allocated in a fairly arbitrary fashion to two skill groupings, either engineering or communication. Consultants then chose which projects they wanted to work on, in an environment that was characterized as highly egalitarian by those interviewed.

In late 1991 however, in response to a worsening financial situation, and in order to provide better accountability, consultants were organized into five divisions, subject to specific expertise e.g. physicists were allocated to Applied Science Innovation Division, biochemists to Life Sciences Division etc. A financial control system was then introduced to monitor the revenue generated by each division and by each consultant. At this time an e-mail system was also implemented to facilitate communication across divisions and to help maintain inter-disciplinary team working.

Within the financial control system all consultants were allocated the same personal revenue target to be achieved each month (indicative of the egalitarian environment), and personal revenue subsequently contributed to divisional revenue targets. Thus, by default, the larger
divisions had the highest divisional revenue targets to achieve. In order to accrue personal revenue it was in consultants' interests to be involved in as many projects as was feasible at any given time. However, involvement in projects would only occur when consultants could demonstrate that they had the required knowledge and expertise to contribute to a particular project. The e-mail system that had been introduced at this time began to be used specifically for this purpose in the following manner.

In the initial stages of negotiation with clients, project leaders used e-mail, primarily as a technology for knowledge acquisition, to conduct a focused search for knowledge that would be relevant to the project proposal. Consultants responded quickly and effectively to requests for information from project leaders, so that inclusion in projects could be secured. It was not necessary, at this proposal stage, to share expert tacit knowledge. Consultants were only required to provide low level explicit information regarding their capabilities and areas of expertise. The e-mail system was considered to be a highly efficient GroupWare technology for managing processes of externalization and generating collective knowledge regarding individuals’ knowledge and expertise within the firm.

This can be explained in part by considering the degree of media richness provided by e-mail. Media richness has two underlying dimensions - the variety of cues that the medium can convey and the rapidity of feedback that the medium can provide [35]. Initially, the project leader required only fundamental information but it was required quickly. The e-mail system provided the necessary degree of media richness for this type of knowledge acquisition; the variety of cues was limited to the written word but the rapidity of feedback was potentially immediate. In this way e-mail articulated and coordinated low level information transfer.

When a project was secured consultants who had demonstrated their potential usefulness and contribution at the project proposal stage negotiated their percentage of the project fee, with the project leader premised on their expected contribution. This then contributed to their personal revenue. In this way a free market for expertise was created at Universal and e-mail became a tendering tool within the financial control system. The information provided via e-mail was explicit and therefore, consultants had on record, their contribution to the successful negotiation of a project. This would not have occurred if project leaders and consultants had relied only on the tacit exchange of this knowledge. By considering the context of application then e-mail could be considered a particularly rich medium within the highly informal tendering system for knowledge and expertise, reflecting the innovative use made of this particular GroupWare. Whilst only low level information regarding consultants particular knowledge and expertise was made explicit using e-mail, project leaders interpreted the information provided (applied their tacit knowledge) and imbued these messages with meaning in order to develop a financial estimate of the potential use that could be made of the knowledge and expertise that was being offered.

Other than project tendering however, the e-mail system was considered to have become a communication medium of hegemonic proportions by the time the research commenced. Since its introduction, the use of e-mail had grown significantly. Any subject matter, regardless of how important, sensitive or trivial, was communicated via e-mail. Whilst it was recognized that e-mail was a useful and efficient tool for communicating to significant numbers of people across divisions, e-mail had become increasingly used within divisions and even between individuals sitting next to one another.

As one consultant stated: "I couldn’t believe it when I saw people sitting next to one another sending e-mails...I think it suits the some of the introvert personality types working here".

Divisional managers received on average between 150 and 200 e-mails each day and other consultants only slightly less. There was no effective classification system used to categorize the type of message sent and this constrained the management of this high level of communication flow. Messages rarely had a header that related to the content of the message and only two classifications were used for messages. The SOC prefix was used to imply a social message and the INNOV prefix was used to imply a message relating to project working. The INNOV category was therefore used not only by project leaders during project tendering but also to promote discussion more generally around new ideas. Thus in principle, e-mail was a potential medium for the articulation and creation of knowledge. However, in reality, the manner in which consultants were free to respond and send emails, meant that this occurred in only a very limited way. For example, some identifiable consultants always responded to requests for information and knowledge, regardless of whether their contribution could be considered useful or relevant. Arbitrary and unconnected responses then allowed other consultants to digress on 'flights of fancy', which subsequently contributed very little information and knowledge to the topic or new idea originally under consideration.

This example of the way in which INNOV mails were treated highlighted the chaotic manner in which the e-mail system was used outside of project tendering. The organizational context at Universal was such that consultants were not subject to any mail protocols and hence were free to introduce bad practice and effectively abuse the system, if they chose to do so.

The majority of e-mails were also sent to everyone and replies also went to everyone. How and when this bad
international boundaries. Lotus Notes discussion that would allow project work to be conducted across on a sub-contract basis), but a technology had to be found work on these projects as 'associates' (experts employed USA and Japan. Scientists in these countries agreed to could only be found outside of the organisation, in the was externalized so that the tacit was made explicit. through a process of socialization, individual knowledge members would spend whole days together, knowledge. For example, at the start of a project, team this had occurred mainly on site at Universal, through time information overload [36] had developed across the whole organisation as a result of the manner in which the e-mail system was used. Attempts to use this GroupWare for processes of knowledge articulation and creation were thus constrained, paradoxically by the culture and work norms that had developed and which were considered to promote individual autonomy and facilitate processes of organizational innovation.

4.3 Lotus Notes

Project team working at Universal was a process of information and knowledge distribution and group interpretation, leading to knowledge creation. Until 1994 this had occurred mainly on site at Universal, through direct verbal communication and the exchange of tacit knowledge. For example, at the start of a project, team members would spend whole days together, ‘brainstorming’ and recording relevant ideas and suggestions put forward. Using Nonaka’s framework, through a process of socialization, individual knowledge was externalized so that the tacit was made explicit.

However, during 1994 two projects were undertaken that required some highly specialized knowledge that could only be found outside of the organisation, in the USA and Japan. Scientists in these countries agreed to work on these projects as 'associates' (experts employed on a sub-contract basis), but a technology had to be found that would allow project work to be conducted across international boundaries. Lotus Notes discussion databases were implemented to facilitate project working and overcome the temporal and spatial obstacles created by the dispersion of project team members. Notes were used successfully to coordinate project work across countries and both projects were successfully completed using this GroupWare. A valuable by-product of using Notes were the databases created, which served as high quality project documentation. These provided a form of organizational memory that could be stored for future use.

Despite the successful use made of Notes by these two projects, by the time the research commenced in 1996, usage of Notes was only limited and partial. By the time the research ended, Notes usage had diminished further and the IT manager was no longer prepared to support the software. It was evident then that teams still preferred and relied primarily upon the verbal exchange of knowledge as the medium for knowledge creation, when team members were all UK based. There had been no concerted effort at Universal to raise consultants’ awareness of Notes as a medium for project working despite its successful use on two major projects. This, we suggest, relates to two of the firm’s structural properties; culture and work norms, and the financial control system.

Orlikowski suggests that individual cognition about technology and work combined with structural properties of the organisation influence the effective utilization of GroupWare. As mentioned previously, consultants at Universal worked within a highly informal, autonomous environment. Whilst they were therefore made aware of Lotus Notes and its successful use on two major projects, divisional managers remained ambivalent regarding its widespread diffusion across the organisation, allowing project leaders completely free choice regarding its adoption, characteristic of the importance attached to maintaining individual autonomy within the firm.

Untypical perhaps within consultancy firms, a competitive, yet strongly co-operative culture existed at Universal, driven by the demands of the financial control system. Individual consultants had always shared their knowledge and expertise with others, both inside and outside of project working. Knowledge sharing freely occurred in order to complete the work required and, perhaps more importantly, to enhance the visibility, or make explicit, individuals’ tacit knowledge within the free market for expertise, created by the financial control system. E-mail was used to communicate low level information regarding the potential use that project leaders could make of particular consultancy expertise or tacit knowledge. However, it was the face-to-face interaction during project team working and more generally, with its significant level of media richness that adequately conveyed the extent and breadth of an individual consultants’ tacit and explicit knowledge base. Face-to-face communication generated collective knowledge from
which new knowledge emerged in the form of new products or processes. Consultants' perceptions of Notes then was that the technology did not provide comparable degrees of media richness in which this particular form of collective knowledge could be developed. This particular GroupWare was not therefore an appropriate technology for knowledge creation within this context. Notes is a suitable medium for the communication of explicit knowledge. However, as Nonaka states, organizational learning derives from combination knowledge and in project working, knowledge creation occurs when the tacit is made explicit through processes of socialization and externalization. Lotus Notes, in many instances lacks the media richness to support these processes. For example, consultants who had worked on projects using Lotus Notes, suggested that whilst the databases provided relevant knowledge in a timely fashion often clarification would be required on particular complex information that was communicated in this way. Clarification would be sought generally via telephone conversations, as consultants attempted to make their tacit knowledge, explicit, in order to provide the necessary clarifications that were sought. As face-to-face communication was impossible, telephone conversations were considered to be the next best (richest) medium for these processes of externalization. This analysis, highlighting the limited and diminishing use made of Notes also supports the research by Straub & Karahanna which suggests that there needs to be a critical mass of users for knowledge workers to invest time and effort in learning and using new forms of communication media.

5. Discussion

The way in which GroupWare technology was used within Universal Consultancy highlights the limited attention of IR theory to context and the context dependency of knowledge creation processes. Thus the analysis of the case highlights the need to consider media richness as a subjective (possibly even an intersubjective) and contextually dependent phenomena rather than as an objective characteristic of the technology. Rogers [37] similarly notes that the characteristics of an innovation that encourages its diffusion and adoption are necessarily perceived characteristics. These then depend on how the innovation is communicated and understood by potential users. One way of explaining the relative success of e-mail within the informal tendering system then is to take into account media richness but in context i.e. in the context of incentive systems. Consultants had to market their expertise in order to meet revenue targets. However a lack of formal structures and processes for recording contribution to projects meant that e-mail was the only mechanism by which consultants could make themselves visible and have their potential contributions to project work recognized. Thus within this particular context e-mail was considered a relatively rich media for the communication of individuals explicit knowledge base and tacit expertise. Over time with extensive use of e-mail for this purpose, collective knowledge was also generated regarding the knowledge and expertise of consultants throughout the firm.

The limited use made of Lotus Notes can also be explained in terms of both the structural characteristics of the organisation (context) and the lack of media richness provided by the GroupWare, which supports many of the arguments made by Orlikowski but within a different organizational context. Whilst Orlikowski’s research was also conducted in a consultancy firm the structural characteristics were very different across the two firms. For example, Universal does not have a partnership structure, which in Orlikowski’s study, was found to inhibit knowledge sharing. Instead, Universal maintains a flat organizational structure of expert consultants of equal standing. It is the personal revenue system, rather than a recognition and promotion system that serves as the major control and incentive mechanism encouraging and motivating consultants to freely exchange information and knowledge. Thus the main source of conflict generated by the partnership system in terms of Lotus Notes diffusion, reported by Orlikowski did not exist at Universal. The structural arrangements at Universal did however encourage experimentation and thus emphasized creation of knowledge at the point of application through face-to-face contact and so the systematic documentation of projects via Lotus Notes became of limited value. It was also the imperative to make visible individuals’ tacit (expert) knowledge, generated by the free market for expertise, which inhibited individuals from using this medium as in terms of IR theory it is particularly difficult to convey tacit knowledge and expertise through such a lean medium.

Thus, whilst e-mail served as an effective tool for the articulation and coordination of low level knowledge, this study suggests that verbal communication, social interaction and hard copy project documentation are more effective mechanisms for knowledge creation - a conclusion also drawn in Kraut & Streeter’s study of knowledge work in software engineering projects [38]. These can provide a level of media richness not found in GroupWare such as Lotus Notes.

6. Conclusion

This discussion has highlighted the importance of considering choice of communication media for processes of knowledge creation not only in terms of IR theory but
also in terms of context. Several commentators on knowledge creation (cf. Nonaka; Spender; Blackler) emphasize the highly contextual nature of the process yet very few empirical accounts of the process have been documented and published. Using both IR theory and research that has focused on the importance of considering the interaction of people, technology and the nature of work processes, this paper has highlighted the highly situated and novel use made of ICTs for processes of knowledge creation.

Considering Universal Consultancy as a case of the diffusion of technological innovations in support of the management of knowledge, the question is how to innovate the innovators? Ciborra [39] argues that because of the highly informal nature of groupwork, organizations must adopt and show hospitality towards GroupWare technology in order for it to succeed. At Universal, the pace of work, extreme low levels of formalization and the relative ephemeral interdependencies among expert consultants constituted a very hostile rather than hospitable environment. The value placed on an individual was constantly being renegotiated among peers and was basically expressed via membership in projects. A consultant was required to constantly market their skills to others in the organisation. Using GroupWare to support work is, therefore, a question of, if not supporting this process, then at least not disrupting it. Basically the adopters were in this case highly motivated, intelligent and technologically proficient people who could not be forced to adopt a particular technology.

As expressed by Browning and Reiss [40] and Blackler it is difficult to manage knowledge workers and the technology they choose to adopt must help them communicate and interact. Technology can not be seen to be a hindrance for project work. Given this user driven technology adoption strategy, if a technology imposes problems for the users, it will not be adopted, and even in the event that it is adopted, there may be heterogeneous diffusion patterns across the organisation. The dilemma here becomes one of the technology as a tool versus becoming an information infrastructure. If both the adoption and the use of a particular GroupWare technology is managed using a laissez-faire approach, the adoption pattern may be heterogeneous across the organisation, and the full potential of the technology may not be achieved [41].

Alternatively, if the technology becomes widely adopted in the organisation this may in turn create other problems. A user group that is technologically proficient and demanding suggests that they will only adopt technologies which serves their goals, and subsequently push the use of these technologies to (and sometimes beyond) the limit.

The chaotic use and abuse of e-mail during project working (as opposed to project tendering) highlights this point, reflecting the considerable personal autonomy that existed within the firm. This final point again reinforces the need to focus on context when studying the use of ICTs for processes of knowledge creation.

**References**


