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Linking Knowledge Management and Innovation

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Abstract- **There has been an explosion of interest in Knowledge Management (KM) theory and practice However, it is argued here that much of this work fails to consider the purpose for which knowledge is'being managed'. In this paper, purpose is considered in terms of encouraging innovationIt is proposed that different approaches toKM are likely to facilitate the management of knowledge during different episodes of the innovation process. Three approaches are outlined and illustrated using empirical material from a case study. The analysis of the case highlights potential tensions and contradictions amongKM practices for different innovation episodes. The paper concludes thatcareful consideration needs to be given to 'fitness for purpose' when introducingKM practices.**

I. INTRODUCTION

Interest in Knowledge Management (herein KM) has seen an exponential growth over the last 2-3 years [1]. Whilst KM could be dismissed as yet another in a long line of management fads, the fundamental problems it seeks to address are, it is argued, more enduring [2]. These centrally concern the difficulties of developing, sharing, co-ordinating and re-cycling knowledge in the context of new structural forms of organization [3]. The current focus on KM recognizes the decline of traditional manual work and the importance of innovation, knowledge work and knowledge workers in an era described variously as the 'information age', the 'knowledge society' and the 'post-industrial era' [4]. Thus knowledge is seen as outstripping traditional resources such as land, labour and financial capital as a, if not *the*, key source of comparative or competitive advantage [5].

The assumptions underpinning the interest in KM are that innovation, not just efficiency or quality, will be the primary source of competitive advantage [6] and that knowledge is central to a firm's capacity to innovate [2]. The reaction to this heralding of KM has (perhaps not surprisingly given the track of other managerial fads) been quests by harbingers and devotees (practitioners, consultants and academics alike) for the superlative solution. The aim is to discover the panacea universal 'best practice' in KM. As Pan & Scarbrough [7, 359] note, "with the development of the field of 'KM' there has been a massive outpouring of articles and books dealing with these issues from a prescriptive standpoint". The problem is that many of these best practice prescriptions assume a direct, functional relationship between knowledge, KM and innovation, despite evidence to suggest that this is over-simplistic[1]. In other words, the more knowledge a firm has and the more able it is to manage it, following the prescribed best way, the more innovative it will be [9]. This paper questions these prescriptive, functionalist approaches to KM for innovation and suggests an alternative view that is both more contingent and more contextualized.

Following the introduction, the second section provides a brief critique of the existing research and practice on KM. The third section outlines the nature of the innovation process. By highlighting the complexity of innovation processes, we conclude that a single best practice approach to KM for innovation is problematic. What is more useful is to think about the particular purpose that the KM practice needs to serve (i.e. what is it good for?). Relating this to innovation, we propose that different aspects of innovation may pose different requirements for KM and present three alternative models. The next sections tests these propositions further through a longitudinal case study that tracks the development of a large scale innovation project involving the introduction of an Enterprise Resource Planning (ERP) system over a period of around two years. This focuses on the KM practices during different episodes in the innovation process and illustrates that different KM strategies can indeed be identified during the different episodes. In the concluding section, the paper highlights potential tensions and contradictions among KM practices for different innovation episodes and concludes that careful consideration needs to be given to 'fitness for purpose'.

II. KM – AN OVERBVIEW AND CRITIQUE

Attempts to define KM mirror and reflect the intangible, fragmented and multifaceted nature of knowledge itself. KM has thus been defined in a whole host of ways that vary in scope and focus. In terms of scope, the term has been used broadly to refer to "the capacity (or processes) within an organization to maintain or improve organizational performance based on experience and knowledge" [7]. More narrowly, it refers to particular processes or practices that involve "acquiring, creating, capturing, storing, sharing and using knowledge to enhance organizational performance" [10]. In terms of focus, definitions emphasize, variously: organizational processes and routines [7]; performance improvement outcomes [10]; processes for networking and collaboration; practices for harnessing, storing and distributing expertise [11]; specific tools and methodologies such as data-mining and storage systems [12]. These definitions suggest a variety of practices and organizational processes - "a skillful blend of people, business processes and IT" [13]. However, research and practice in KM has been dominated by a focus on using Information Technologies (ITs) to store, search and transfer knowledge within and across organizations [1]. The logic behind this technocratic

[1] For example, [8] demonstrate that relative absorptive capacity (which includes the similarity between the knowledge bases of two firms) has greater explanatory power than an absolute measure of absorptive capacity (which would simply include the amount of relevant knowledge) in terms of encouraging inter- organizational learning.

approach to managing knowledge is that by implementing various kinds of IT (e.g. databases, intranets) coupled with relevant search engines, knowledge can be captured and transferred from place to place. The assumption here is that if knowledge is transferred via technology, it can be used for innovation in other parts of the organization and so means that the chances of needlessly reinventing what has already been done elsewhere will be minimized.

The problems with this simple equivalence between ITs for KM and the development of innovative capacity are hinted at by a lack of correlation between investment in IT and firm performance [14, 15]. This may be because the IT tools themselves, or the firm's ability to implement them, are limited. However, leaving aside the limits of the IT per se we can also question the conceptual basis upon which much that is written about KM is built. Behind much of this work lies a cognitive or information processing model of KM. This sees knowledge as an input that is processed, using suitable KM techniques, in order to produce an output in terms of innovation. The view of knowledge, then, is as an entity – a static stock to be leveraged, extracted, codified, and made available more widely. This view of knowledge is clearly reflected in the discourse and languages of KM. Drilling, mining and storing metaphors are often used [1]. Knowledge is talked about in terms of 'stockpiles' and 'reservoirs'.

This cognitive view of knowledge as a stock has been challenged on several grounds [16, 17]. First, the notion that knowledge can be extracted from where it lies (mostly, it is assumed, inside peoples' heads), codified and moved, using ITs, en masse from one place to another has been challenged for failing to adequately address the problems of managing tacit knowledge [17]. Tacit knowledge by definition is, at best, difficult or, at worst, impossible to articulate. It is deeply embedded personal beliefs, attitudes, values and experiences that give tacit knowledge its meaning [18]. Tacit knowledge is thus highly situated - to abstract tacit knowledge from its context of application is to lose much of its intrinsic meaning and value. Moreover, it is precisely because tacit knowledge is tacit that makes it difficult to for other organizations to imitate or import and therefore makes it an important organizational resource for securing competitive advantage [5]. Perhaps more worryingly, the cognitive model of KM adopts a partial view of knowledge, assuming that knowledge lies with individuals and largely ignoring the socially constructed and socially mediated nature of knowledge [19]. To see knowledge as a stock to be transferred treats it is as an entity (the analogy is of a ball to be passed from place to place). This essentially reifies knowledge and de-emphasizes its collective nature as well as social processes of knowing. An alternative is to focus on those fluid, inter-subjective and social processes and activities involved in the creation, interpretation, and validation of knowledge within and across particular social communities. Organizational knowledge is thus both widely distributed (so its source cannot be easily located) and embedded in collective systems of meaning and action (and so it cannot be easily extracted – 20, 21). Thus a more holistic view, and the one echoed here, sees knowledge as "multilayered and multifaceted, comprising cognition, actions and resources. It is socially constructed and embedded in social networks and communities of practice" [7, p. 360]. This means that KM must encompass a number of activities. These may include extracting and transferring information but also include networking and developing social communities of practice [22]. However, these central activities of KM may need to shift depending on the purpose for which the knowledge is required. This suggests a more contingent view of KM, for example linking KM activities with different aspects of innovation. To take this further different aspects of innovation are considered next.

III. The Nature of Innovation and Links to KM

As is the case with KM, innovation is subject to an equally extensive and potentially bewildering array of definitions and approaches [23]. Here we adopt a process-oriented perspective on innovation, seeing innovation as a complex design and decision process involving the diffusion, implementation and utilization of new ideas. According to this approach innovation is defined as: 'the development and implementation of new ideas by people who over time engage in transactions with others in an institutional context' [24]. In keeping with our approach to KM, the social construction of knowledge and the sharing of knowledge across social communities are centre-stage in this definition.

Taking this process perspective, innovation is depicted as a set of recursive and overlapping 'episodes', which move from initial awareness of new ideas, to the selection (or rejection) of particular ideas, through to implementation. If implementation is successful, new ideas are utilized in the form of new products, services, or ways of organizing and become used routinely in the organization (at which point they would no longer be referred to as innovation – [25, 26]). The first episode, *agenda formation*, concerns the initial awareness of new ideas and of the problems that they may help to address. *Selection* then relates to the further processing and promotion of ideas within the organization such that particular ideas are chosen to go forward for further development because they are seen as matching the problems the organization is currently experiencing. *Implementation* describes the process of actually introducing the selected ideas to the organization and applying them to the local context in the forms of new products, services, technologies or processes. The final episode is *routinization* and describes the situation when the understanding of the innovation has developed to a point where it's use has become routine and it is now seen as a standard working practice to be adopted in other parts of the organization where relevant [27]. Although describing the innovation process in this way is a convenient schematic there needs to be a caveat. That is that these episodes do not represent discrete stages - the limitations of stage models of innovation, particularly in relation to the complex information systems, are well known [e.g. 28, 29]. Rather, these different aspects of innovation are iterative, overlapping and ultimately conflated [30] - hence the term 'episodes' as opposed to 'stages'. For example, lessons learned during implementation may further shape and define awareness of problems [30] or may influence the design and further diffusion of new ideas and technologies [31].

Recognizing that innovation episodes inter-relate, it is also important to understand that each involves the development, sharing and application of knowledge.

However, each episode has a somewhat different focus in this respect and suggests the need for a more nuanced approach to KM that takes into account the purpose for which knowledge needs to be managed. Agenda formation, for example, is more concerned with the acquisition of knowledge, whereas selection and implementation are more concerned with its application to specific contexts. Routinization relies on the transfer of ideas that have already been developed within the organization to a point where they are well understood (and therefore able to be codified) while selection and implementation requires explicit knowledge to be reinterpreted, recreated and *appropriated* alongside locally situated, contextually specific, often tacit, knowledge about organizational practices and processes [25]. This suggests a more contingent view of KM is needed in linking it to innovation. In line with this Table 1 presents three different models of KM (the networking, community and cognitive models) which, it is proposed, are each more appropriate for the knowledge management problems specific to one of the three episodes of the innovation process.

The networking model, it is proposed may be more appropriate for agenda formation. This episode primarily concerns knowledge acquisition – i.e. the initial acquisition and sharing of potentially relevant new ideas so that firms can become aware of and choose to adopt new management practices where they are relevant [26]. The primary aim of KM here is to develop awareness of ideas, which exist outside a firms' boundaries and then share them internally. 'Boundary spanning' individuals [32] who are able to tap into external networks and acquire new ideas which they can then share within their own organization will be central here.

In contrast, the community model is more appropriate for the selection and implementation episodes, which require this explicit knowledge to be reinterpreted, recreated and appropriated alongside locally situated, contextually specific, often tacit, knowledge about organizational practices and processes. These episodes require those actors with relevant tacit knowledge and expertise to work together, recreating and applying transferred information in new and appropriate ways at the local level. Critical problems here concern, for example: the engagement of actors with relevant tacit knowledge [33]; the development of social cultures and communities of practice (e.g. through project teams, [34]); the social construction of new meanings and understandings [35]; and the politics of decision-making and change [36]. Selection and implementation occur, then, through combining explicit with tacit knowledge [cf. 17]. Here IT-based tools may play a more limited, possibly even disabling role, and a different approach to KM may be needed.

Finally, the cognitive model may be most applicable during the routinization episode. A new technology has been effectively appropriated within an organization once it is embedded within organizational practices and routines, so that it is an accepted part of the organizational culture [25]. At this stage, the key issue is to ensure the efficient exploitation of the technology and this is achieved by making explicit the rules, procedures and processes surrounding its use. IT-tools may be particularly useful here then for transferring this codified knowledge.

These three models of KM for innovation have been developed on the basis of both the existing literatures and our own empirical fieldwork, which has examined innovation processes in a variety of contexts. What is clear from this fieldwork is that organizations differ in terms of how far they do manage knowledge differently during the different episodes of the innovation process. It is not possible, given the limitations on space, to present a thorough analysis of more than one case so a case is presented next which has been selected because it does illustrate the different kinds of KM activities involved during different episodes of the innovation process. This case represents a relatively successful innovation project and we suggest that the effective management of knowledge, including the use of different KM strategies during the various innovation episodes, was certainly a significant influence on this success. However, the purpose of using the case study is to illustrate the different ways knowledge was managed during the various innovation episodes, rather than to make a link between this and successful innovation. These three very different models of KM illustrate the over-simplicity of much that has been written about KM and, in particular, suggest that the dominant IT-focused approach may actually impede the management of knowledge in some circumstances, while at the same time facilitating this in others. Specifically, IT will impede, according to the framework presented in Table 1, when the focus is on knowledge creation and appropriation [25] as is the case during the selection and implementation episodes.

IV. The Case: BT Industries

A. Method

This case study followed process methodology [c.f. 37] whereby events are tracked over time in an attempt to explain how certain patterns of events may have led to particular outcomes. In this case, an innovation project was tracked longitudinally over a period of around two years. The focal company was visited four times over this period with each visit taking around one week. During each visit, detailed semi-structured interviews were conducted with the Project Leader together with core project team members (with additional people being interviewed as they became involved). Further interviews were conducted with key players located outside of the focal company (e.g. with software suppliers – total N=24). In addition, project documentation was collected on an ongoing basis and field visits allowed for a limited degree of participant observation.

B. Context

BT Industries is the third largest manufacturer and service provider of specialist materials handling (fork-lift trucks and hand trucks) equipment. Its headquarters are in Sweden and divisions are spread across Europe, Asia and the USA. At the outset of the research BT had around 3400 employees, 4.9 billion SEK turnover and was increasing its market share by around 1% per year. Approximately half the business is in manufacturing (BT Products) and half is in sales and after-sales service (BT Sales/Service), the latter including short and long-term truck rental agreements. The organization is structured around geographically dispersed

business units that operate with a high degree of local autonomy. BT Industries overall culture could be thus described as 'responsible autonomy' [cf. 38] and people are keen to see this maintained. The culture at the corporate centre is described as 'typically Swedish' (i.e. relatively non-hierarchical and participative). IT/IS support (comprising systems support; a group support infrastructure, focusing on data resources management; web co-ordination; software applications support; IT strategy) for the BT Businesses across Europe is 'insourced' to BT Industries (i.e. the Corporate Centre in Sweden). Software, hardware and network maintenance is outsourced.

TABLE 1: SUMMARY OF DIFFERENT MODELS OF KM

INNOVATION PROCESS **Model of KM**	**AGENDA FORMATION** **Network Model**	**SELECTION AND IMPLEMENTATION** **Community Model**	**ROUTINIZATION** **Cognitive Model**
Understanding of knowledge	Knowledge is located external to the adopting unit in explicit or implicit forms	Knowledge is constructed socially and based on experience.	Knowledge is objectively defined and codified as concepts and facts.
Primary activity with respect to knowledge	***Knowledge acquisition*** – knowledge is acquired through access to external networks & sources of information. Information communication technologies may play a central role	***Knowledge creation and appropriation***- Knowledge is created and applied through development of social communities including project groups and teams. Information communication technologies play a peripheral role.	***Knowledge capture and storage*** - Knowledge is captured through text-based, searchable archival sources. Information communication technologies play a central role.
Primary aim of KM	To keep abreast of new developments.	To encourage knowledge sharing (including tacit knowledge) amongst and between groups and individuals.	To codify and capture explicit knowledge and information.
Primary gains from KM	Greater awareness of external developments	Greater application of internal and external sources of knowledge to create new management practices.	Better recycling of knowledge and the standardization of systems.
Dominant Metaphors	The network Linking/ joining	The human community. Building/ constructing	The human memory Digging/mining
Critical resources	Social capital	Social and intellectual capital	Intellectual capital
Critical success factor	Boundary spanning	Trust and commitment.	Technology

Traditionally each BT business had gone its own way in terms of systems development. This had led to a range of different systems being implemented to support business applications at different BT companies. The need to provide common services to global customers led BT Industries to launch an innovation project aimed at improving the uniformity of service delivery across its disparate business units through the introduction of common, integrated IT platforms and information systems. The 'Sales Support Project' (SSP) was launched in 1996 with overall responsibility resting with the corporate IT function located in Sweden. The design and implementation of an integrated management information and planning system for all of the European businesses - essentially an Enterprise Resources Planning (ERP) system - was its main focus. The vision of implementing a common and standardized software platform in Service represented a major cultural change for BT in the way people think about, and manage, IT. Nonetheless, owing to millenium problems with existing systems, this was to be completed within a strict 2-year time schedule.

Although he did not specifically use the term, the SSP Project Leader recognized at the outset that KM would be a critical issue. There were three main reasons for this. First, there were very limited resources available in the Corporate IT Group (only 14 people worked there) so they would be unable to support the project single-handedly. Second, it was recognized that, given BT's overall culture, changes seen as imposed by the Swedish Centre would likely meet with local resistance. The SSP Project Leader was therefore keen for local BT companies to 'own' the project themselves by managing their own implementation. The role of the SSP project team was to get the changes started and to then provide support where needed. However, given differences in IT skills and local variation in systems currently in use across BT companies this could prove difficult. A key issue, then, was identifying people locally with relevant expertise and interest to manage each implementation. Third, it was apparent that there was no 'off-the-shelf' ERP package available that was appropriate for BT's operating environment (especially the rentals part of the business). This meant that new software would need to be developed and that the knowledge and skills of end users across far-flung sites in Europe would be required to do this. More broadly, BT is multi-site, multi-national and decentralized. Business skills and expertise are thus widely distributed. KM was therefore critical for this innovation project if BT were to develop more standardized systems that would require collaborative forms of working and yet still retain the advantages of decentralization and local autonomy.

C. Outcomes

Despite the ambitious nature of the SSP, the outcome was relatively successful. Indicators of this were: the project met most of its initial expectations; the overall project was completed within 1 month of the initial target; with minor exceptions the new software delivered the functionality needed; the project team developed a relatively good long-term relationship with their software supplier; there was high

satisfaction and relatively little turnover of project team staff and key users.

V. Case Analysis – KM for Innovation

In the analysis that follows, the ways in which knowledge was managed to achieve this relatively successful outcome are considered across different episodes of the entire innovation process.

A. *Agenda formation*

The SSP project sprang from a study early in 1995 of business processes. This Business Process study comprised a small group of BT senior managers (Process Owners) representing the different parts of the business (e.g. parts, rental, service, finance) working together with external consultants to acquire knowledge about possible ways of managing the business in the future. This took around 4 months and involved intensive, mostly face-to-face meetings (every 2 weeks) with managers from the biggest BT companies to discuss and define current business processes and to identify future 'visions'. Communication during this period was mostly informal. Formal codified output was limited to a short 'report' (actually a power-point presentation). A link forward between the BPR study and the SSP project was established by creating a network of Process Owners and 'Process Owner Support' staff drawn from across different business and areas of expertise. These Process Owner Support staff had responsibility for following through to implementation the issues raised in the Business Process study.

Following the BPR study, a small group of senior managers representing different aspects of the sales/service support business from BT companies in Europe were brought together to review and evaluate currently available systems on the market with a view to purchasing a standard system. This group had some systems expertise alongside considerable business expertise and actively sought information about available products through external sources (e.g. software suppliers, documentation, training events, other firms). They concluded that none of the available software products could handle BT Sales/Services core business portfolio - i.e. multisite *and* multinational *and* with a large proportion of rental service agreements. Two suppliers did offer products that could deliver most of BTs current and future functionality requirements and these were invited to bid for the contract. Ultimately, Intentia (suppliers of Movex) were chosen to partner BT in their innovation project. Interestingly, this was despite recognition that the product sold by the other supplier more closely matched BT's requirements of functionality. Key to this decision was a perception that Intentia (also a Swedish company) would be more likely to work in a close collaborative, network arrangement with BT and therefore there would be better opportunities for knowledge exchange. In turn, Intentia saw themselves as benefiting from this arrangement because, although the BT project would be priced almost at cost, the new version of Movex through their work with BT would be marketable more broadly to other multi-site, multi-national companies and BT would be their reference site. Those interviewed from BT and Intentia generally agreed that BT had managed to sustain a good working relationship with Intentia.

The most central KM practice during agenda formation, then, was the establishment of both intra-organizational networks (i.e. among senior managers from across different parts of the business) and inter-organizational networks (i.e. among BT and their external suppliers and consultants). Through these networks problems and business processes were identified and knowledge was acquired about different software solutions. Knowledge exchange was mostly face-to-face and relatively informal apart from written material describing software products. Those within BT recognized the importance of keeping abreast of new external developments so that, in this instance, they were aware of the potential of ERP systems to solve some of their organizational problems. However, the relatively high level of engagement by BT staff in this external networking meant that the knowledge thus gained was sufficient for them to understand that existing off-the-shelf packages were not entirely appropriate for their particular situation. The chosen solution was then to form a partnership with the selected software company to jointly develop an IT system which would benefit both parties. The case therefore demonstrates the crucial role of networks and boundary spanners (e.g. the software evaluation and Business Process groups) in the agenda formation stage. During this episode, when the organization is deciding how best to solve its particular problems, important knowledge is located externally so inter-organizational networking is crucial. However, in addition, it is also necessary to ensure that there is extensive networking internally so that there can be common agreement about the chosen solution.

B. *Selection and implementation*

Movex software was selected to go forward and work began on unpacking and redesigning the core package to match BTs business portfolio. The Project Leader set about developing a community of people across BT businesses, with both IT and business expertise, who would be able to take ownership for SSP at local level facilitated by the Corporate IT group. Selection, rec ruitment and commitment of the project team were seen as critical and the Human Resources Director was asked to help (albeit informally) in developing project team management procedures. The project team was selected through informal consultation with senior managers from the different European businesses who suggested those people locally who had the most knowledge of the systems they were currently using to manage their particular business. These were often people with detailed knowledge of business procedures (e.g. from finance) and who were well respected in their own businesses rather than those with formal IT responsibility.

The design and development phase was intensive with Intentia consultants working alongside these BT business managers brought together on one site in Sweden for approximately three days a week over a twelve week period. In addition two (later 4) graduates with business and IT backgrounds were employed specifically to work on the SSP project. These were employed by Intentia but had the option

of employment either with Intentia or BT when the project ended. Their work was conducted partly on site at BT and partly at Intentia. This unusual arrangement provided these individuals with a practical knowledge of Intentia and BT businesses. They also played an important role as 'brokers' linking the social communities of Intentia and BT [39](Aldrich and von Glinow, 1992). Knowledge exchange was largely through informal face-to-face meetings and 'hands-on' simulation exercises with the software. There was a great emphasis on 'learning by doing' for the exchange of tacit knowledge and relatively less on formalized kinds of knowledge communication (e.g. minutes, written reports, formal documentation of progress etc).

Implementation across BT's European businesses again emphasized local ownership and commitment through the development of a community of key users facilitated from the centre. Implementation of the ERP system was phased, starting with a pilot in Sweden and then being rolled out to the other European businesses. This phased implementation was managed by three co-ordinated project teams (Sale Support Teams) each of which were responsible for two to four different European sites. Each team comprised consultants from Intentia, corporate IT managers, and business managers who (where possible) were those that had been involved during the design phase. The teams were thus mutliskilled and, importantly, involved representatives from most of the different social communities that would be affected by the system and whose local knowledge was important. They were also selected to comprise different 'personality' types. For example, where it was known informally that a team leader was less 'dynamic' (but suitably senior) they would be complemented by one of the more active IT staff. The SSP Support teams travelled together regularly (on average for two weeks in every three) to their allocated sites to 'kick-off' implementation and to provide training and advice. They recognized that to fully understand implementation problems there was 'a need to see them' for themselves. Beyond this, implementation was handled through local implementation teams involving key users identified at each site. Again these were not necessarily IT experts but were those with business knowledge and power at local level. Knowledge exchange within the teams was through face-to-face 'sharing of experiences' supported by telephone (each team member was provided with a mobile phone) and email. Again the emphasis was on 'learning by doing' - there was relatively little reliance on documented project reports. In addition implementation was scheduled such that, where possible, every third week all the teams would return to the central HQ in Sweden where they could meet and share experiences and lessons learnt through respective implementations. This allowed a strong 'esprit de corps' to develop both within but also across team members and provided a solid base for the sharing of knowledge and ideas.

In the local businesses implementation involved a 'kick off phase' and an initiation phase. During the kick-off, basic training was provided to local 'key users' by the SSP Support teams. End users from different functional areas within the business (e.g. parts, rental, finance) were trained to configure the Movex system for their own use (setting parameters, converting databases etc.) before running a full-scale test. This training was carried out over a period of four weeks with all users being trained together in the same room. This communal training was seen as essential because it allowed individuals to share knowledge about the system as it was discovered through actually working with it. Movex needs to operate in an integrated way. This was visible during training because when key users set up parameters on their own modules (e.g. for finance or parts) they were able to see immediately the impact of this on the modules in other functional areas. This training also facilitated the development of a community of end-users from different functional areas who had not previously worked closely together and generated commitment to the implementation of Movex. Following this the system went live.

The BT case therefore demonstrates very clearly the importance of establishing knowledge communities for the selection and implementation episodes. The emphasis was on creating inter-locking project teams, which brought together individuals from across the organization who had the necessary knowledge and expertise. This was achieved at various levels, for example with the original design team, with the implementation teams and with the end user teams. In each case, the team was co-located, for a significant proportion of the time, so that the individuals could develop a shared understanding of the new system and its various social and technical implications. Moreover, there was significant effort put in to ensuring that there was interaction between these different teams, either by having individuals who were members of different teams or by periodically bringing teams together to share experiences. While ICTs were used during these episodes in BT they clearly had a peripheral role during these knowledge sharing and knowledge creation episodes. Evidence from another of our case companies, discussed in a previous paper, demonstrates the problems of over-relying on ICT during these selection and implementation episodes [40].

C. Routinization

Given that implementation has happened only recently, the new system at BT could not yet be described as routinized. However, there is some evidence of an increasing reliance on IT to support more codified forms of knowledge communication. For example, it became apparent that similar problems and queries were emerging across sites. Gradually, then, routines were introduced to document these so that when a user encountered a problem they could see if this had been logged before and, if so, how it had been resolved. For example, an email site was developed, initially informally among the community of end users, for 'frequently asked questions'. Following implementation, this provided an important vehicle for users at local sites to exchange knowledge about usage of the system at other sites. Similarly, to maintain system integration, where changes to any particular module were likely to affect the operation of other parts of the system, a strict procedure was developed to assess, control and approve all requests for change. This was done primarily through having a physical error log, and a precise reporting and responsibility structure.

The cognitive model of KM is therefore clearly appropriate for describing the way knowledge was managed

during this routinization episode at BT. ICTs played a significant role in facilitating the codification, storing and transferring of explicit knowledge in order to recycle existing knowledge that had resulted from the previous innovation episodes. An important point here though is that this documented information was only really useful because users had already developed a good understanding of the system through being involved in applying it. This gave them the tacit knowledge necessary to add to and/or interpret the documentation in a meaningful way.

VI. Conclusion

The main conclusion then is that those knowledge management practices and processes that will be helpful are likely to vary across different episodes of the innovation process because these episodes have different requirements in terms of their treatment of knowledge. For agenda formation the key issue is to be involved in external networks where new ideas are being diffused since ***acquisition*** of knowledge from external sources is focal and the network model of KM becomes most appropriate. Here then boundary spanning and external networking and the development of social capital are crucial aspects of a KM strategy [41] and practices and technologies that encourage organizational members to access information and to engage in networking may be helpful. Communication technologies may be useful to help organizational members tap these external sources of knowledge (e.g. internets for general information and ITs that support customer or supplier information exchange more specifically). However, there will also be many non-IT -based practices that will facilitate the acquisition of knowledge. For example, encouraging employees to actively participate in professional associations, to take educational courses or to network with consultants may be useful since these are forums where new ideas are disseminated [42].

For selection and implementation , the ***creation and appropriation*** of knowledge is more central and a community model of KM becomes more appropriate. The community model highlights the importance of relationships, shared understandings and attitudes to knowledge formation and sharing. It is consistent with what Glynn [43] describes as the distributed model of organizational intelligence that centres on the creation of meaning and the social construction of reality [44, 45, 46]. The community model recognizes that, whilst it might be relatively easy to share knowledge where groups are homogenous, it is extremely difficult where the groups are heterogeneous. Yet, it is precisely the sharing of knowledge across functional or organizational boundaries, through using cross-functional and inter-organizational teams, that is seen as the key to the effective use of knowledge for innovation [47]. Pre-existing organizational structures, norms and cultural values lead different groups to have divergent, possibly even irreconcilable, interpretations of what needs to be done and how best to do it. In these situations knowledge has to be continuously negotiated. Here then the emphasis of a KM strategy will be on developing social communities (e.g. through multi-functional project team development) so that shared values, trust and understanding, essential for the creation and application of knowledge, in ways that are locally meaningful and relevant, can be established [48]. This is not to say that ICTs plays no role here, but rather that this role is secondary rather than primary. For example, various types of groupware, including intranets, may support the development and functioning of social communities but this technology is unlikely, on its own, to encourage effective knowledge sharing especially where the membership cuts across organizational, disciplinary or geographical boundaries. Indeed, relying solely on this kind of technology may actually reinforce existing boundaries (with 'electronic fences' – [40]) and fuel 'turf-wars' across social groups [49] rather than encourage knowledge sharing. In other words, where social communities are composed of heterogeneous members, as is likely to be the case in innovation project teams, then organizational practices that encourage face-to-face interaction and dialogue are likely to be as, if not more, important than introducing ICTs.

Finally, once the innovation has been implemented the goal will be to ***capture and store*** the newly created knowledge and establish it as routine. The knowledge embedded in the newly implemented technology (in the case the ERP system), which as seen is a blend of external, generic and explicit knowledge with local, situated and tacit knowledge, needs to be fully exploited. In this episode then the emphasis will be on making this newly created knowledge explicit so that standard procedures and practices can be followed. ICTs are clearly central to the exploitation of the innovation. For example, data warehouses can be used to store information and data mining tools used to facilitate access to this information. Here then the cognitive view is quite appropriate to ensure the efficient utilization of established and accepted knowledge.

The three models of KM outlined in Table 1 are presented as 'ideal types' which, although consciously schematic, help to locate different knowledge management strategies, and related ICT use, in the context of the entire innovation process. Any given organization will need to activate each of the identified KM strategies but at any particular moment one of the approaches may be more focal. For example, an organization may be focusing on strategies that support the cognitive model of KM because it is trying to establish and embed an implemented technology as routine. However, given the iterative nature of the innovation episodes, as discussed above, and the almost continuous need to look for new opportunities to innovate, an organization must be constantly 'ready' to activate one of the other KM strategies. Perhaps a useful analogy here is with Windows applications. Thus, while a user may be working on a text document in Word, they may also have running in the background a data file in Excel and a presentation file in Powerpoint, either of which can become the active window should this be appropriate. However, while this analogy is useful to demonstrate the principle of multiple approaches being accessible at all times, it perhaps fails to highlight the tensions between the different approaches to KM that have been identified. Thus focusing on the cognitive model of KM, with its emphasis on standardization and recycling of knowledge, may actually impede attempts to develop the trust-based social communities. These tensions need therefore to be actively managed at the same time as practices and

techniques are put in place to activate each of the KM strategies per se.

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