Exploring the Reality of Knowledge Management Systems: A Case Study

Abstract

Researchers in the IS field view IT-enabled knowledge management solutions as novel approaches to the stimulation of creativity and innovation in post-industrial organizations; hence, the focus by researchers on the role of information and communication technologies in enabling and supporting knowledge work. However, despite some success stories, recent research indicates that the majority of knowledge management systems have been unsuccessful. This situation has led some to voice deep-seated concerns about the knowledge management paradigm and its influence on the IS field—particularly the assertion that IT can help capture, store and transfer knowledge. Accordingly, this paper's objective is to deepen the IS field's understanding of the limitations and capabilities of so-called knowledge management systems. A case study of an Irish software vendor's experiences in developing knowledge management systems using case-based reasoning technologies was undertaken to help achieve this objective. The findings of this study illustrate that the knowledge management systems developed did not meet the claims of their creators, as the applications provided a poor approximation of the 'horizons of understanding' of domain experts whose knowledge these systems purported to capture, store and transfer. All this lends weight to the claim that information technology deals with data only, and suggests that knowledge management requires social as opposed to technical support, in that appropriate institutional mechanisms, rather that technological solutions, constitute the memory corporate.

1 Introduction

Knowledge management systems are viewed as novel approaches to the stimulation of creativity and innovation in post-industrial organizations (Davenport and Pruzak, 1998; Kanter, 1999; Laudon and Laudon, 2000). Researchers in the IS field have therefore focussed on the role of information and communication technologies in enabling and supporting knowledge work (see Davenport *et al.,* 1996; Sviokla, 1996). Examples of such technologies include, for example, decision support, groupware and computer-mediated collaboration applications, data warehouses, video conference and other communication technologies, Intranets, the Internet, intelligent agents, AI-based applications, and so on (Davenport and Prusak, 1998; Carlsson *et al.* 2000; Alavi and Leidner, 1999, 2001; Damsgaard and Scheepers, 2001). The application of such technologies underpin a new breed of IS called knowledge management systems: such systems range from directories/databases of domain experts and key knowledge workers in organizations, to systems that purport to capture, store, and transfer the knowledge of organizational actors for access by others within the organization for decision support. Recent research has reported that many knowledge management systems have been unsuccessful (see Schultze and Boland, 2000), with Storey and Barnett (2000) reporting failure rates of over 80%; nevertheless, Davenport *et al.* (1996) report a number of success stories. While there has been much debate, theorising, and writing of a normative nature on the topic, there is a paucity of research of an empirical nature on knowledge management systems. This situation has led some to voice deep-seated concerns about the knowledge management paradigm and its influence on the IS field, particularly the belief that knowledge management systems constitute a new type of IS and that such systems can capture, store, and transfer knowledge within organizational contexts.

This paper's objective is to deepen the IS field's understanding of the limitations and capabilities of so-called knowledge management systems. Given the diversity of enabling technologies and their possible applications for knowledge management, this study focuses on one type of technology—case-based reasoning—for which strong claims are made in regard to its ability to capture knowledge for decision support in organizations. Hence, this study reports on the experiences of an Irish software vendor —Interactive Multimedia Systems (IMS)—and its European partners in developing knowledge management systems for commercial organizations. IMS develops information systems that purportedly capture, transfer, and deliver knowledge in organizational contexts—this paper describes IMS' experiences in developing three knowledge management systems. The findings of this study illustrate that the knowledge management technologies developed at IMS did not meet the claims of their creators, as the case-based reasoning applications described provided a poor approximation of the 'horizons of understanding' of domain experts whose knowledge they purportedly captured and transferred. Accordingly, the use of these applications was restricted to relatively unambiguous and rudimentary situations where problem scenarios and responses tended to be well defined. All this lends weight to the assertion that information technology deals with data only, and suggests that knowledge management requires social as opposed to technical support, in that appropriate institutional mechanisms, rather that technological solutions, constitute the memory corporate.

The remainder of this paper is structured as follows: Section 2 briefly reviews extant thought on knowledge management in the IS field and concludes that there is a need to critically evaluate the empirical evidence for knowledge management systems; Section 3 presents a short overview of the research approach employed; Section 4 describes the case report and study findings; finally, Section 5 provides a discussion of the findings and offers several conclusions.

2 Knowledge Management or Data Processing Systems?

The primary focus of researchers and practitioners in the IS field is the development and implementation of systems whose primary purpose is to informate organizational actors and automate business processes (Checkland and Howell, 1998). However, Boland *et al.* (1994) argue that information technologies have been less successful at supporting the cognition and decision making of organizational actors (i.e. the learning and knowledge accumulation that informs action) than automating business processes. The problem here lies in the prevailing image of organizational actors as decision makers governed by bounded rationality (Introna, 1998). The root cause of this narrow view of organizational reality lies in the predominant influence of economics on the social sciences (Pfeffer, 1994, 1997). This has, in conjunction with the positivist influence of computer science and mathematics, resulted in a chiefly functionalist orientation of IS practitioners toward systems development (Hirschheim and Klein, 1989). Boland (1979) points out that such perspectives have led to the design of systems with decision support models that operate on narrow sets of data. According to Pentland (1995, p. 2), the limitations of this narrow view *"can be attributed, in part, to a lack of attention to the fundamentals of the phenomenon in question: the socially constructed, distributed, and embedded nature of knowledge, and the process by which it changes."* Pentland's paper was one of several which marked a change in emphasis from IS support for organizational learning to organizational knowledge systems. This change in orientation is particularly notable in a paper by Boland and Tenkasi (1995) which focuses on IT-support for *'communities of knowing.'* Hence, in the mid-to-late 1990s, researchers began to focus on how knowledge could be created, organized, stored, retrieved, transferred and applied in organizations (Pentland, 1995; Davenport and Prusak, 1998; Nonaka and Konno, 1998).

While research on organizational learning was certainly influential in the newfound emphasis on knowledge in the IS field[1], another theoretical influence originated in the knowledge-based view of the firm, which emerged from the resource-based view in institutional economics. Also significant here was the focus on knowledge in strategic management and organization theory (Carlsson, 2001). Nevertheless, while strong on theory and normative advice, knowledge management practice has generally failed to deliver, especially when it comes to providing knowledge management systems. Possible reasons for this are offered by Butler (2000) and Broendsted and Elkjaer (2001) who, following Boland *et al.* (1994) and Pentland (1995), recognize the narrow focus of extant perspectives on knowledge and recommend a view of learning that includes social context and processes. These points are echoed by several commentators who have cautioned against an over-reliance on IT solutions at the expense of social and cultural dimensions to knowledge and its management (Davenport and Prusak, 1998; O'Dell and Grayson, 1998; Swan *et al.,* 1999; McDermott, 1999).

The mixed results reported in the studies mentioned indicate a fundamental problem in the IS field's approach to the concept of knowledge. Support for this assertion comes from Galliers and Newell (2001, p. 609), who voice deep-seated concerns about the knowledge management paradigm and its influence on the IS field. Galliers and Newell argue that:

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[1] It must be noted that researchers in computer science and the IS field had previously focused on knowledge, albeit narrowly, in the context of developing expert. decision support, and executive information systems.

> *Knowledge Management [is] the most recent in a long line of fads and fashions embraced by the Information Systems community that have little to offer. Rather, we argue for a refocusing of our attention back on the management of data, since IT processes data - not information and certainly not knowledge.*

This argument reflects views expressed in previous research—see Swan *et al.,* (1999), Butler (2000), and Spiegler (2000). Hence, as indicated, there is a need to critically evaluate the empirical evidence for knowledge management systems. There is also an imperative to examine the 'world views' of developers and those who promote so-called knowledge management technologies. This, then, provides this study's motivation.

3 A Case-based Research Strategy

A constructivist research approach was adopted for the present study (Guba and Lincoln, 1994). Accordingly, a qualitative, interpretive, case-based research strategy was implemented (see Lincoln and Guba, 1985 and Butler 1998). This strategy involved a case study on knowledge management technologies developed at Interactive Multimedia Systems (IMS) of Dublin, Ireland. An article in the Irish Sunday Business Post in early 1998 drew the researcher's attention to a small-to-medium sized Dublin-based software vendor, Interactive Multimedia Systems, and its reported competencies in developing corporate memory and related knowledge management systems. The article claimed that the company had developed a state-of-art knowledge management system for Analog Devices Inc. of Boston in the US. Given the growing interest in knowledge management at this time and the paucity of theoretically-grounded empirical research, IMS presented itself as an interesting case with which to examine the reality of knowledge management systems. Purposeful sampling was employed throughout. Research was conducted in the summer of 1998 at three sites, two in Ireland and one in the US. The US site-visit afforded the researcher an opportunity to evaluate a knowledge management application developed by IMS for a major US multinational. Some 11 social actors participated in the study, and each of the interviews was tape-recorded. A wealth of documentary evidence was also gathered, and a significant amount of data accrued from informal conversations and observations while on-site at the research locations.

4 Applying Knowledge Management Technology at Interactive Multimedia Systems

Interactive Multimedia Systems (IMS) is a small-to-medium sized software vendor operating out of Dublin, Ireland. Since the early 1990s the company's main development focus has been on building a suite of applications aimed at facilitating organisational 'corporate memory.' By the end of the decade, IMS had reinvented itself and was providing systems that captured, transferred and delivered knowledge in organizational contexts. IMS was not alone in this venture, however. The company was and still is part of a consortium of European commercial organizations and academic institutions whose common interest focuses on leveraging case-based reasoning technologies to provide knowledge management solutions for organizations across a range of industries.

In 1992, Interactive Multimedia Systems primary interest was in developing an all-purpose decision support system for the medical profession. Realising that it had neither the capital nor IT competencies to do this alone, it became a participant in the INRECA I program. INRECA stands for INduction and REasoning from CAses and was the brainchild of research and practice in IT. The INRECA consortium was created in 1992 by three European-owned business enterprises and a German university viz.

- AcknoSoft, the prime contractor in the consortium was a French company who specialized in Data Mining,
- Techinno GmbH, a German company who specialized in case-based reasoning (CBR) technologies,
- Interactive Multimedia Systems, whose role was that of software integration,
- And the University of Kaiserslautern in Germany, whose international research center joined the consortium because of its expertise with CBR.

The consortium received funding under the Esprit program (INRECA P6322) for the first and subsequent phases of this project.

The overall objective of the first phase of the INRECA project was to develop innovative technologies to help organizations make business decisions by building on the experiential knowledge recorded in 'case' histories, and to integrate these technologies into a single software platform that would allow wide-spread use of case-based reasoning for knowledge management. The term 'case' here refers to a record of a particular past experience that can be reused in the future. Two key technologies emerged from the first phase: the first was the INRECA Tool or Integrated Case-based Reasoning Tool, which contained the inference engine and component systems; and the second was CASUEL, the interface language between all the INRECA component systems. INRECA's core technologies were based around inductive and case-based reasoning approaches. An inductive approach is said to extract the knowledge that informs individual decision making from cases stored in data repositories by identifying patterns in the data that constitute the cases of interest. Case-based reasoning relates the descriptions of current problems to past experiences of a similar nature. The primary technical advantage of INRECA was that it fully incorporated these techniques on one platform, thereby leveraging the respective advantages of both technologies for case-based decision support (CBDS). Two commercial CBR platforms emerged from the INRECA collaboration—KATE-Tools from AcknoSoft and CBR-Works from Techinno. Both were employed by IMS in technical contexts suited to their individual strengths. While the technical innerworkings of these CBR-platforms are certainly of interest (but outside the scope of this paper), the development 'worldviews' of IT professionals at IMS are important here, because as Hirschheim and Klein (1989) and Schultze (1998) argue, such orientations shape both the process and product of the development endeavour and the subsequent application of such systems. First, an overview of the knowledge management systems developed using KATE-Tools and CBR-Works is presented.

4.1 A Knowledge Management System for the Assessment of Wind Risk Factors at Coillte Teo

In order to provide empirical proof that the CBDS software developed under the INRECA initiative had commercial potential, IMS looked to the Irish market for a suitable application area. Using informal social contacts, IMS' CEO entered into agreement with Coillte Teo, the state-sponsored body charged with overall responsibility for forestry plantations in Ireland, to build an application that would help it manage its tree-planting program. Because state forests were geographically dispersed and under the management of numerous local officials, Coillte had experienced great difficulty in establishing best practice for planting and thinning its forests across its 7 regions and 14 districts.

Senior analysts from IMS conducted an initial feasibility study on the relatively small in-house research-oriented database at Coillte Teo, which contained data on three specific forestry plantations in geographically dispersed locations across Ireland. The feasibility study suggested that a CBR application would be capable of identifying and modelling factors deemed critical to successful planting strategies, so as to enable more flexible and effective forest management policies to be developed. The next step facing developers at IMS was to take the total national database and investigate the possibility of translating it into case-bases dedicated to informing dissimilar decision-processes. The total database contained some 180,000 potential case-records in flat spreadsheet data structures; however, the data was not as comprehensive as the smaller research-database used in the initial feasibility study. Despite its limitations, developers performed a case-analysis on the large national database and the results provided further evidence that the CBDS approach did in fact lend itself to the identification of key factors associated with desirable outcomes in terms of tree yield and quality.

The KATE-Tools subset of the INRECA CBR platform was employed to help domain concepts to be defined and a data typology to be developed so that initial cases could be constructed in the first phase of the project. The outcome of the initial requirements analysis led to case definition according to the following general features: (a) the plot of land used for growing trees; (b) plot planting and subsequent management over time; and (c) the outcome in terms of yield and quality of trees in the forest. These 'features' were processed into an integrated 'measure of value'. The task facing developers was to integrate these features into a model that would provide a structure for the cases. Additional categories of data and associated case features were also identified in the analysis of the larger database. Procedures were put in place to obtain data from forestry workers in a region that was particularly subject to wind-damage. A spreadsheet template was developed to enable workers to input the relevant data and an algorithm written to transfer the spreadsheet data into the CASUEL format. It was also planned to develop a data-entry interface to the CBDS to enable the capture of additional cases from field-based forestry workers once the application was up and running.

The case selection procedure consisted of taking the plots that had been clear-felled due to wind-damage in the previous five years, and performing nearest-neighbour matching with the KATE application on the plot and planting attributes using the available data. The data for this case-base were to be enhanced and completed by field-workers generating the forest management data, which was not present in the main database.

The similarity search procedure was considered to be the workhorse of the system by users in the distributed regional offices. The application also supported problem-solving in relation to decisions about planting a new plot, replanting a clear felled plot, or initiating a thinning procedure on a plot, by providing access to a set of similar plots, at a specified level of maturity, with the matching variables restricted to the information available on the plot under consideration. Thus, forestry workers could take action, based on the past experience of others who had tackled similar problems successfully.

4.1.1 Implementation Failure as an Example of "The Knowledge is Power Syndrome"

Having developed a working prototype that illustrated the utility of the new system, and effectively completed the first phase of systems development, a problem surfaced that influenced the implementation and use of the system—end-user acceptance. Developers at IMS had anticipated this issue to some extent. They recognized that imposing a system on a constituency of end-users who had little experience with computers, and who would associate computer use with de-skilling of their trade, would generate resistance and ill feeling toward the system viz.

> *It is our conviction that user acceptance at the working level is absolutely dependent on the system not being perceived as an alien black box telling the foresters what to do. The use of the decision tree in consultation mode at the distributed regional interfaces is therefore excluded, in the [initial version of the application]. If, in the longer term, it emerges that there are areas of decision-making, based on available local information, that are routine, obvious and rule-driven, and the foresters see it that way, then it will be possible to implement the system in tree-based consultation mode, for that purpose. In the initial application, however, the similarity search must have priority, and the presentation of the information derived from the similarity search, on a single user-friendly screen, with the most significant variables laid*

out prominently, is going to be the key ergonomic factor supporting successful user uptake of the system.[2]

Management at Coillte were made aware of the problem at the time, but never addressed it. Developers' awareness of potential end-user problems with system were flagged early, as this statement taken from the same internal report on the system indicates:

> *There was a perception on the ground that thinning procedures on certain soil types contributed to wind-damage risk, and [this influenced] a reluctance to thin as much as would be desirable for the maximization of the final quality and value. [This had to be balanced against Coillte's] central management [who was] motivated to maximize the overall value of the crop, and to seek a trade-off between wind-damage and thinning, expressible in a thinning policy, based on rational analysis.*

Thus, there appeared to be a conflict between the views of forestry workers on the ground and central management policy, which was informed by best practice in the industry and the need to maximize yield. Hence, it was felt that the system might be a source of industrial unrest in the industry if forestry workers perceived it as a tool of management policy rather than a tool that could help them better manage the resource under their control.

Developers were also sensitive to the issue of ownership of domain specific knowledge and the reluctance of users to enter what they perceived as their most important work-related personal resource—their experiential knowledge and skills as foresters—and enter it into a system for all to see and use—thus possibly making their knowledge, skills and, ultimately, themselves redundant. It would appear that these fears were well founded as Coillte dispensed with the services of IMS—Sean Breen described it thus:

> *The first phase of the project was completed successfully and implemented, however Coillte dispensed with IMS, due to political issues within Coillte, and obtained the services of a masters student, to finish the project, such as it is.*

Thus a combination of factors, associated with change management, saw the application effectively abandoned, to all intents and purposes.

4.2 Developing CBDS for Web-based Customer Support Applications: The Parametric Search and WebSell Experiences

The abandonment of the second phase of the CBDS project at Coillte Teo meant that IMS did not have a working commercial application of its most promising software application. IMS had a solution to a problem; the difficulty was therefore one of identifying and finding the problem to solve. A chance meeting with a friend presented the head of R&D at IMS with a problem domain that the CBDS technology could be applied to. The following subsection describes the development of the Parametric Search application.

[2] Taken from an internal IMS report on the development of the Coillte Teo application.

4.2.1 Mapping The Parametric Search Problem Domain

The genesis of the Parametric Search application is described by the head of research and development at IMS:

> *When we had the CBR application out of INRECA it seemed like a good idea to go to the market and find an application for it. We did, initially, with Coillte but that didn't work out. [However,] during the search process I spoke to an engineer friend of mine on an informal basis, who worked for Analog Devices. Following that discussion, we came up with an initial concept which was related to the analysis of product failure in the field: these [analyses] were on record and would lend themselves to CBDS.*

Identifying and addressing the causes of product failure is a critical activity for design engineers at Analog Devices Inc. of Norwood, MA. IMS' proposal was therefore of interest to product design, marketing and application support engineers at Analog. IMS' CEO, Sean Breen, travelled to Boston to meet with manager of Analog's Central Applications function in order to discuss the possibility of developing an application to identify the causes of product failure in the field. Subsequent to that meeting, IMS decided *"that the structure [of the problem domain] was very complex and [it] couldn't make any impact on it—it was too complex for the system to capture…[But] in a random lateral leap in Analog itself the concept of profile matching in the product catalogue lookup emerged as being a need…This took us in another direction altogether*."

Analog Device's application support engineers were, at that time, grappling with the not insignificant task of supporting thousands of products, the most numerous and widely used of which were integrated circuit-based operational amplifiers. This particular product family was in use by most, if not all, of Analog's thousands of customers in the electronics industry. Supporting the selection and use of these products added a significant overhead in catering for the needs of Analog's key customer, the design engineer. Central Applications were the sole point of contact with the customer at that time, and it offered direct contact with customers via its technical support helpdesk in Wilmington, MA., or indirect support via its product catalogue, which was produced in text and CD-ROM format. The problem confronting application engineers was one of providing customer design engineers with ready access to product specifications so that they could choose the most appropriate product for their design. If this could be achieved with a minimum of difficulty and time spent in the selection of what was a highly complex product family—complex in terms of the range and attributes of the products—then Analog would achieve an advantage over its competitors. Existing paper-based indexing and CD-ROM search facilities were not up to the task. It therefore fell to applications engineers and technicians to apply their experiential knowledge of the product family and individual product attributes and performance to help customers select products.

Application engineers were a scarce and limited resource and their time was an extremely valuable commodity. Conventional database solutions could not perform the sophisticated selection algorithms required to match customer specifications with individual product capabilities. Hence, case-based decision support seemed to offer a promising solution for Analog Devices, to the problem of rapid search and selection of specific products. From IMS' viewpoint, the Parametric Search was an idiosyncratic solution to a domain-specific problem, thus it did have the potential to lend itself to widespread use.

The requirements analysis was a complex undertaking for the systems analyst and application support engineers (domain experts) charged with developing the system. Essentially, the application had to emulate the decision making of an application engineer when responding to queries from design engineers who wished to select a product with particular attributes for use in the design and manufacture of a range of electronic devices. This was a challenging undertaking for the systems analyst/developer as he had to capture the technical understanding of application engineers and relate this to Analog's products and their attributes in order to build cases for the KATE-Tools platform. This activity took several months of analyst/developer/application engineer interaction. Once developed, the application was ported to the CD-ROM format for distribution to Analog's customers.

The parametric search facility was first available on Analog Devices' CD-ROM catalogue; subsequently, the system was available to sales engineers over the Intranet. Significantly, Analog Devices Webmaster rejected the Internet-based version as it was considered to be "too buggy" by the IS function. It is also significant that while the applications engineers held the system in high regard, and while it won general acceptance from Analog's customers and field engineers, the applications engineers who collaborated in its design had a different perspective on system use, as one put it:

> *I never used that system… the one that was developed over in Ireland. I would tend to use paper for something like that, I would use the paper catalogue; I wouldn't spend or waste time type being in data. All you have to do is ask the customer a couple of questions and he you would help you zero in on what he is looking for. And paper is a lot better for that, but a customer would like it, all he would need is punch in a to couple of parameters, and a search engine would return what is looking for.*

A question arises here: could this system be described as a knowledge management system as its vendors claimed? This statement provides an answer in part: that is, application engineers considered their own tacit, experiential knowledge to be superior to the capabilities of the new system. Thus, it could be argued that the system did not capture the experiential knowledge of application engineers. Nevertheless, the application did perform a useful search and selection function for customer design engineers, but it did have limitations here in that the nearest-neighbour matches presented were often inaccurate and did not meet user needs.

The experiential and technical knowledge gained in the development of a case-based decision support system, plus the commercial kudos that would accrue from its successful development, made it an appealing project for IMS. There was also the challenge of taking what was essentially a client/server technology, the CBR-based KATE-Tools platform, and using a subset of it as a standalone runtime application. IMS' CEO commented on the project and its outcomes:

> *The Irish market for such a product did not exist, and the same could be said today. The technology was not considered as a solution to organizational problems. However, the likes of Gateway 2000 and Dell use an Inference product for help desk support. The ADI product was successful, however, the major emphasis is now on WebSell. It was only in the last month that serious work has gone into the development of WebSell applications. These are based on the same technology as used for the web-based version of the ADI product—CBR-Works.*

It can be deduced from this statement that IMS' overall goal was to ultimately develop the Parametric Search application for Internet use, and leverage this to widen the scope of application of its CBDS platform.

4.2.2 WebSell: An Internet-based Knowledge-based System

The Internet-based WebSell initiative was aimed at developing an intelligent agent, based around CBR-Works, that would allow customers search for and select products that closely matched their needs using the World Wide Web. In late 1998, and as a direct result of developing competencies with the Web-based version of the Parametric Search application, IMS launched its suite of WebSell Tools—WebSell CBR-Works and WebSell Pathways—at the 1998 Internet World Show. Essentially, Pathways is used in conjunction with the Access database platform to provide the raw data for CBR-Works to create cases. The cases reflect the object attributes and decision criteria employed by prospective buyers and renters in the selection of properties. The power of WebSell, unlike the Parametric Search or Coillte Teo. applications, lay not in its capabilities to 'capture knowledge' of workers engaged in making sense of complex problem domains and provide a mechanism to 'transfer' that knowledge. Rather, its chief strengths lay in its ability to perform 'fuzzy searches' of a vast range of multi-attribute products.

The first intelligent search agent for the Irish and UK property markets was developed for Hooke and MacDonald, a Dublin-based property sales and letting company. It was envisaged that Hooke and MacDonald would gain a competitive advantage over competitors in the lucrative Irish market by attracting busy young business people looking for high quality rented accommodation on the Internet. The web search agent was also geared to attract corporate customers wishing to find rented accommodation for their new staff. By 2000, the application had evolved to include three key features: the intelligent search agents “Home in on the Net” and “Let on the Net”, in addition to the “Track 'N Tell” facility that automatically contacted customers by email if a closer match was found to their needs when the property listing was updated.

The three system described herein were deemed to be technical successes by the vendors and clients in that they performed the tasks that the developers programmed them to do. However, could they be classified as knowledge management systems? It is clear that the WebSell application was merely a sophisticated decision support tool that had a general application. Hence despite vendor claims to the contrary, it could not be considered a knowledge management system. In regard to the other two systems described—the Wind Risk Factor Assessment system and the Parametric Search system—the brief descriptions offered in this paper indicate that these applications were developed using a highly attenuated subset of the experiential and technical knowledge of domain experts. Furthermore, the ‘cases’ captured by the CBR technologies were not in-depth descriptive narratives, rather they were what could be described as the ‘salient’ points or attributes of particular phenomena in the problem domain and a limited set of rules that act to relate and link them to specific outcomes based on a fixed set of input conditions. This, then, is the ‘knowledge’ that developers at IMS captured in their applications. In order to highlight the limitations of these so-called knowledge management systems and further assess their capabilities to capture, store, and transfer knowledge, a critical analysis of the development-related ‘world views’ of IT professionals at IMS is now undertaken.

4.3 A Development-related Worldview of Knowledge and its Management

Researchers argue that academics and practitioners alike have adopted the naïve ontological and epistemological position of the dominant functionalist paradigm on knowledge and its representation (see, for example, Hirschheim and Klein, 1988 and Schultze, 1998). There is therefore and imperative to capture the ontological and epistemological perspectives of IS developers if the product of their development efforts are to be fully understood.

IMS’ involvement in the INRECA project led to the development of a formal theoretical perspective on individual and organizational knowledge. Briefly, this perspective held that knowledge about real world phenomena is objective in its constitution and it can, therefore, be captured and represented independently of those who possess it: this functionalist, foundational view is clearly at variance with constructivist ant-foundational perspectives on IT as articulated by Butler (2000). The question here is, then, whether practitioners at IMS really believe that they can manage, capture, and transfer individual knowledge, or whether it is part of a product marketing exercise aimed at leveraging the latest management fad? Take, for example, this comment by Sean Breen, IMS’ CEO:

> *We deal with knowledge at two levels within organisations: experiential and formal knowledge. [IMS] is centred on providing tools in both these areas—to manage, capture, deliver and distribute both these forms of knowledge. We view experiential knowledge in the form of cases. For example, experts who have knowledge in a particular area have built up case experience over a period of time, they compile that experience in their minds and it provides them with a source for decision-making…Formal knowledge, we take as knowledge that is written down or documented in procedures. All this we call corporate memory…Most organisations have been recording cases, but don't realise it—they may not detail the outcomes…They tend to have records in a database or a customer problems folder or record etc. None of this data is used as a source of knowledge: it is filed and forgotten.*

In the above statement, two types of knowledge are identified—experiential and formal. According to IT professionals at IMS, social actors are the sole repositories of experiential knowledge; when they attempt to codify experiential knowledge, they formally articulate it. The problem here is, of course, the more complex the phenomenon being delineated the more difficult it will be to concisely describe in a formal manner. The impossibility of this task is underlined by Dreyfus (1998) who cites Husserl's exasperation at trying to give a detailed account of the experience of the everyday lives of social actors. Husserl (1960) termed social actors' representations of their experiential knowledge, the *noema.* However, after devoting his life's work to its delineation he concluded in the face of the *noema*'s "*huge concreteness*" that the "*tremendous complication*" in its representation made it an impossible task (Husserl, 1969, p. 244 and p. 246). To underscore this, Dreyfus (1998, p. 285) turns to Heidegger to argue that *"the everyday context which forms the background of communications is not a belief system or a set of rules or principles…but is rather a set of social skills, a kind of know-how, any aspect of which makes sense only in the rest of the shared social background."* What then of the IS researchers and practitioners who assume that it is possible to describe and codify social contexts as objective facts and who therefore consider unproblematic the transfer of knowledge in organizations? Dreyfus (*ibid.*, p. 283) again draws on Heidegger to reject the notion that *"the shared world presupposed in communication could be represented as an explicit and formalized set of facts."* All this implies that social knowledge cannot be objectified and cannot exist outside the heads of knowers. It also casts doubt on those who speak authoritatively about codifying such knowledge in order to and transfer it within organizations and who ignore the social contexts that give it meaning.

A close interpretation of the above statement by IMS' CEO reveals further inconsistencies in that it contradicts explicit claims for knowledge management using IT. In referring to organizational records lying unused in corporate repositories, the interlocutor here suggests that *"none of this data is used as a source of knowledge"*: what is revealing here is the use of the term 'data' when referring to objectified records or texts, and that such data can be a source of knowledge. This highlights an important issue; that is, conventional IT applications, including those that it is claimed manage knowledge, capture and transfer 'data' in context not knowledge. Empirical evidence of the validity of this assertion is provided in the following statement by another IT professional in relation to IMS' CBDS applications:

We are not delivering 'knowing' to people, they have to assimilate the knowledge using their own skills etc. What we deliver is information in context. People have to make a commitment to using it…to convert it to knowledge.

Here, it is indicated that individuals actively create 'knowledge' out of their commitment to process what this IT professional referred to as 'information in context.' Not objectified knowledge, captured and transferred by IT, simply 'information in context'; however, what is meant by 'information in context'? The following statement by an IT professional at IMS helps answer this question viz.

We express a case as being a mapping of the real domain of knowledge… All we are interested in a case is inputs to the decision, a record of what that decision was, and what were the outcomes. We are not interested in the process of how the decision was arrived at. That gives us a measure of the scenario of the situation, what the expert was looking at in terms of observable facts; what decision/action did he take and what were the outcomes—an economic measure, a time-related measure, a customer service-related view; the measure of the outcome is subjective from the organisation's point of view. What we do in case-based decision support is we assemble a model of the case with the organization and we build a case base…What we are doing [is] decision support rather than text retrieval.

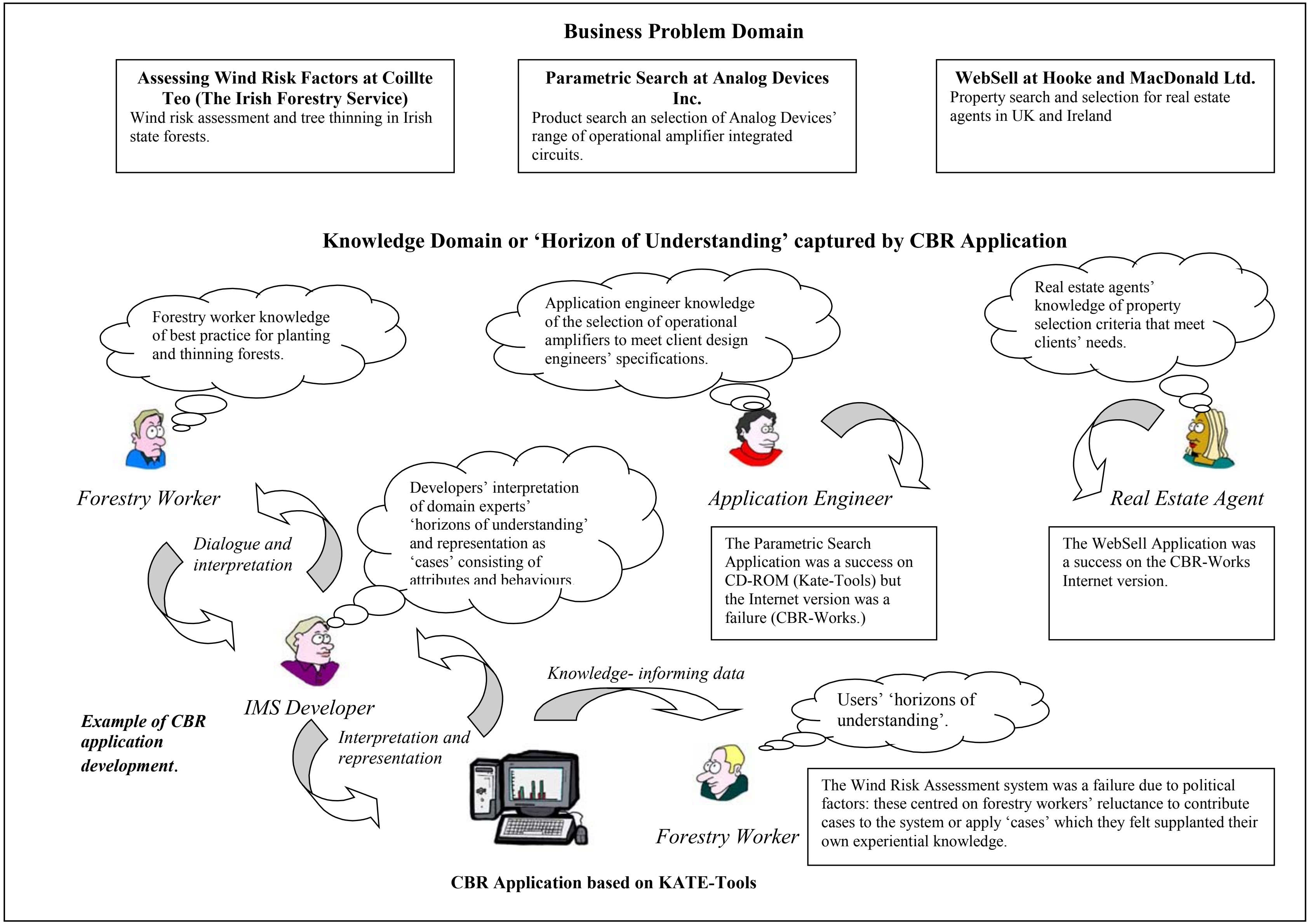
What all this indicates is that, at best, the systems developed by IMS went one step beyond the mere presentation of discrete data, in that they had the potential to deliver data in a structured format which rendered it more accessible to users and therefore lowered the overhead involved in interpreting complex data by reducing ambiguity.

Significantly, the final sentence in the first of the preceding two statements is unequivocal: knowledge is arrived at when individuals make a commitment to interpreting data and converting it to knowledge. This mirrors well a point made by Winograd and Flores (1986; pp. 74-75) viz. *"Knowledge is* ***always*** *the result of interpretation, which depends on the previous experience of the interpreter and on situatedness in a tradition. It is neither 'subjective' (particular to an individual) nor 'objective' (independent of an individual)."* All this indicates that IT provides an occasion for the creation of knowledge, and does not communicate knowledge to the users directly and unambiguously.

4.3.1 A Critical Analysis of the Potential of IT to Capture Knowledge

The previous quotation by an IT professional at IMS describes the application of case-based reasoning technology in terms of its perceived knowledge management capabilities. This statement reveals that far from capturing the text of a case and making it accessible to others in the organization, CBDS applications merely abstract certain salient attributes—'observable facts'—and links them to an outcome or outcomes. The well-defined relationships between attributes and outcomes allow developers to create a model of the original case; however, like all models it is an abstraction from the complex reality of the domain of interest. Figure 1 provides a graphic illustration of the application of CBR knowledge management technologies in three CBDS systems developed at IMS described earlier. The business problem domains and 'horizons of understanding' captured by the systems are indicated in the figure, while the process by which one of the applications was developed is represented. Contrary to initial claims, it was clear that these applications captured, stored and transferred hard data, not knowledge viz. data (case attributes) was input by users (in terms of case descriptions and problem definitions), this was then processed using decision rules (case behaviours) provided by domain experts, and 'output' in the form of data was provided to end-users for interpretation. Hence, support is forthcoming for Bruner's (1990; p. 5) argument to the effect that IT *"cannot deal with anything beyond well-defined and arbitrary entries that can enter into specific relationships that are strictly governed by a program of elementary operations."*

Figure 1 Applying Knowledge Management Technologies at IMS



The applications described herein were not the first ventures into the realm of IT support for knowledge management. Drawing on its parent company's experience and reputation in the healthcare sector, IMS had planned to employ its CBDS technology for decision support purposes in the field of medical diagnosis across a range of areas. However, when IMS approached the medical community to develop such systems it met with a negative response. IMS' CEO described it thus:

> *It was hoped to develop a CBDS for the medical profession—that was the plan. There was little interest, however, and although a product was deliverable within 6 months, the medical market did not want to know. The problem here was that since the initial promise of Expert Systems and Artificial Intelligence, insurance companies were reluctant to provide cover for medical decisions/opinion based on these technologies, of which the CBDS application is one. We also found out that the same problem arises with the application of such technologies to support new product development and trial evaluations in the pharmaceutical industry. FDA approval would not be easy to acquire we were told.*

The implications of this statement is that there is little confidence in IT practitioners' ability to provide systems which purported to capture, manage, transfer and deliver knowledge to support decision making. However, this reluctance appeared to affect the service side of the economy more so than the technology-oriented manufacturing sector. The key issue here seems to be that where people are directly affected by poor decision making, the possibility for litigation increases. If an electronic or mechanical device suffers due to poor decisions based on solutions offered by CBR technologies, then the financial consequences may not be as large as a claim for compensation. One interpretation of this is that economists, risk assessors, and lawyers consider IT-based system more fallible than humans, thereby recognising the limitations of technology.

It is clear also that the benefits of knowledge management technologies may have been oversold. Take, for example, the claim by IMS that significant savings accrued to Analog Devices Inc., when the Parametric Search application was implemented on CD-ROM. While engineers at Analog praised the software, they indicated that there were no tangible financial savings associated with its use, certainly not the millions of dollars cited by IMS. As indicated, applications engineers preferred to use their own experiential knowledge to locate and select products rather than the CBDS Parametric Search application in use at Analog Devices Inc. Nevertheless, end-users—that is, design engineers in Analog's client organizations—found the CD-ROM-based application a useful tool in the complex process of product selection. Likewise, Hooke and MacDonald's web-based system won the praise and confidence of its customers, thereby contributing to its bottom line.

4.3.2 On the Difficulties in 'Capturing Knowledge'

Drawing on their experiences with customers, clients, and end-users, IT professionals at IMS recognized that social actors narrate their life experiences of and in the world, but that certain life experiences remain unarticulated for various reasons. Take this observation by an experienced systems analyst on the ability of domain experts to express their 'tacit knowledge':

> *They very seldom can document the rules behind their cases; you know, 'Well I do this because of this.' They say that they came across this problem or situation in the past, and this is how I solved it. So they talk in terms of cases when expressing their knowledge rather than in any formal sense. Some do, but those at the coalface don't tend to.*

An apparent inability to *'document the rules'* that lead to taking particular courses of action reflects the existence of a 'tacit' component of knowledge, as indicated in the literature. In commenting on this, practitioners at IMS outlined the main reasons why 'tacit' knowledge eludes articulation viz.:

(a) social actors do not possess the educational or cognitive competencies to communicate clearly that knowledge;

(b) individuals are too busy to document what they do and how they do it, and if the activity is infrequent they might simply not remember how they performed a past action;

(c) finally, organizational actors might be unwilling to articulate how they go about their business simply because in so doing they run the risk of making themselves indispensable.

The consequences of this were experienced directly at IMS when it arose as a major issue in the implementation of the CBDS application at Coillte Teo, the Irish Forestry Service. That is, while the application appeared to be successful in supporting the decision-making of foresters, it fell foul of political factors based on the 'knowledge is power' syndrome. The points made here indicate again underline that the problem of 'knowledge management' will not be solved by a retreat to technology unless fundamental issues of communication and commitment are first addressed.

5 Conclusions

At first glance, the empirical evidence cited in this paper appears to provide support for knowledge management systems. The applications described were a technical success, and in two instances—the Parametric Search and WebSell systems—were accepted by end-users. However, the knowledge management technologies developed at IMS clearly did not meet the claims of their creators as the case-based reasoning applications described herein merely provided a poor approximation of the 'horizons of understanding' of domain experts whose knowledge they purportedly captured. As such, the use of these applications was restricted to relatively unambiguous and rudimentary situations where problem scenarios and responses tended to be well defined. In addition, it was evident from this paper's findings that:

- Practitioners formally adopted the functionalist perspective on knowledge, which holds that the human brain functions much like a computer, and that knowledge can be therefore captured, modelled and represented as an objective quantity.
- Consequently, IT professionals attempted to capture and represent "*framed experience, values, contextual information, and expert insight*"[3] using descriptive attributes and computer algorithms.

In reality, however, it was seen that the implementation of this approach to 'knowledge' and its 'management' proved impractical as:

- Practitioners' understanding of the phenomenon of 'knowledge' was seen to be deficient.
- IT professionals admitted that the applications they developed captured and delivered data not knowledge; and that such data informed knowledge only when it was interpreted by an end-user.
- Key players in the legal, insurance and medical industries cast grave doubt the claims made for knowledge management technologies; end-users and co-developers of the aforementioned knowledge management applications also voiced reservations.

Thus, the assertion made by Galliers and Newell (2001) cited at the beginning of this paper is well founded—the systems described herein were clearly data, not knowledge, management systems. That they were technical and organizational successes is due in no small way to the technical proficiency and competencies of IT professionals at IMS. However, there is a danger that these achievements could be overshadowed by overselling the capabilities of the technologies, as happened previously with DSS, EIS, and expert systems, for example.

The dream of the knowledge management paradigm is to capture the knowledge of organizational actors and make it available to all. However, even if it is assumed that this is possible, the findings of the present study illustrate that the following problems arise:

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[3] In their book *Working Knowledge,* Davenport and Prusak (1998; p.3) posit that: *"Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organisations, it often becomes embedded not only in documents and repositories but also in organisational routines, processes, practices and norms."*

1. An absence of educational or cognitive competencies on behalf of social actors hinders their ability to communicate or represent completely their knowledge.
2. If the above problem could be overcome, social actors might just be too busy to document what they know due to the complexity of the task.
3. Finally, there is the likelihood that social actors might be unwilling to articulate their knowledge in order to maintain their status, power or influence within an organization.

The central issues here, then, seem to be communication, commitment and learning—not new topics by any account, but enduring nonetheless.

In conclusion, many challenges confront the IS discipline in the 21st century: chief among these will be to separate fantasy from reality and leverage the practical benefits of IT in order to provide social actors with the ability to communicate and to share knowledge-informing data across space and time. Another will be to have the good sense to avoid being distracted by the siren-call of the latest fad and to maintain credibility as a discipline.

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