Exploring the relationship between knowledge management and organizational learning via fuzzy cognitive mapping

ABSTRACT

The normative literature within the field of Knowledge Management has tended to concentrate on techniques and methodologies for codifying knowledge. Similarly, the literature on organizational learning, focuses on aspects of those knowledge that are pertinent at the macro-organizational level (i.e. the overall business). There remains little published literature on how knowledge management and organizational learning are interrelated within business scenarios. In addressing this relative void, the authors of this paper present a model that highlights the factors for such an inter-relationship, which are extrapolated from a manufacturing organisation using a qualitative case study research strategy, supplanted by a cognitive mapping technique: Fuzzy Cognitive Mapping (FCM). The paper looks at the Information Systems Evaluation (ISE) process within a manufacturing organisation, the authors subsequently presenting a model that not only defines a relationship between KM and OL, but highlights factors that could lead a firm to develop itself towards a learning organisation.

Keywords

Knowledge Management, Organizational Learning, Information Systems Evaluation, Fuzzy Cognitive Mapping, Case Study

INTRODUCTION

It has become clear that information technologies and systems have a significant role in supporting organizational agility and enabling competitive advantage, within the manufacturing industry (Sharp *et al*, 1999). As such, the planning and scheduling of components to be built is therefore an important knowledge-intensive process. Evaluating and assessing the impact and utility of modern technologies, is therefore an important task that must be based upon knowledge of the organisation and its strategic, tactical and operational needs. In doing so, the purpose of any justification process is to identify a relationship between the expected value of an investment and an analysis (often quantitative) of the benefits, costs, and risks. Understanding the manner by which one uses and can learn from the transformation of information into knowledge (Irani *et al.*, 2005) is required. Indeed, King *et al.* (2002) note that the vast majority of practitioners focus their attention on the strategic management of learning, rather than the process of harnessing knowledge. Therefore, there remains a need to not only define the contingent difference between knowledge management and organizational learning, but also to provide an insight into those organizational factors that can support decision-making within a firm, allowing it to become a learning organisation. This paper derives its impetus and motivation through this established void in the literature and supports the need for an integrated model for knowledge management (KM) and its relationship with organizational learning (OL) to be identified, via underlying explicit and tacit knowledge relationships. The authors present the development of a model that highlights the factors for such an inter-relationship, which evolves from a case study research strategy that exploits qualitative research methods. The authors seek to establish such factors through the application of a cognitive mapping technique; Fuzzy Cognitive Mapping (FCM), to visualize aspects of the organization's decision-making approach, which leads to the identification of contingent knowledge factors and dependencies. In doing so, examining the dynamics of knowledge and the role that knowledge plays within the maturity of a learning organisation. Such knowledge flows will allow the exploration of those aspects that may give rise to organisational learning within the context of a manufacturing firm.

IT/IS EVALUATION, KNOWLEDGE MANAGEMENT AND ORGANISATIONAL LEARNING

Information Systems Evaluation (ISE) seeks to provide an understanding of such decision-making tasks through a mapping of core factors to the investment justification process (Irani and Love, 2002), giving rise to the identification of benefits and limitations of information systems adoption across business processes (in terms of tangible as well as intangible assets). Hence, an underlying theme of ISE, is that the influence of organizational culture and learning significantly affects the decision-making approach of individuals. The form and type of knowledge required to make investment decisions has not generally been focused upon in the normative literature. Rather, there has been a tendency to pay attention to the methods and techniques employed via traditional cost accounting and financial methods (Irani and Love, 2002). Thus, the knowledge and

experiential learning that is required within this decision-making process, is crucial to the outcome. It is here where this paper seeks to make a contribution to the extant literature, through providing a deeper understanding of the relationship that exists between KM and OL, through the use of an FCM approach (when contextualized within an ISE process). Advances in implementing information systems within the manufacturing sector, and the evolution and progression of cheaply available computing power, has meant that many manufactured goods and / or services, are now equally dependent upon the input of information and knowledge resources. The concept of knowledge management has been a vibrant growth area within enterprise IT/IS since the mid 1990's (Davenport and Prusack, 1998; McCampbell *et al.*, 1999). Many authors and practitioners have been attempting to realise the nuances of not only semantically structuring knowledge (Belkin, 1980; Sowa, 1994; Wiig, 1997), but also relating knowledge to its abstract, metaphysical state (Huber, 1991; Polanyi, 1967). Indeed, Nonaka and Takeuchi (1995) famously built upon the ideas of Polanyi, differentiating between so-called expressible, explicit knowledge; and inarticulable, tacit knowledge (knowledge which we find difficult to articulate). Whilst these approaches have been somewhat successful, there is still a need to understand the context of how knowledge is used, specifically for human decision-making tasks.

The organizational context of learning is ultimately driven by the dynamics of knowledge transfer and discourse (in a social sense), and the focus of organizational learning as compared to knowledge management, centers on the capability of a firm to adapt to changing knowledge pressures. With this in mind, it is therefore important to recognize that organizational learning and knowledge management are similar in some ways but have different aims. In particular, the latter seeks to provide people, processes and technology to better manage and make use of intellectual assets; whilst the former is the collective organisation-wide realization and usage of knowledge management concepts (Argyris and Schön, 1978; Seely-Brown and Duguid, 1996). Thus, it is within this context that the authors seek to investigate and analyze those aspects of knowledge and organisational learning that drive the evaluation and implementation of an ERP system within the given case company. Via the resulting application of a Fuzzy Cognitive Mapping (FCM) approach, further insights into the inter-relationships that exist within a knowledge intensive decision-making task, is achieved.

RESEARCH METHODOLOGY

Given the specific context thus described, the research question posed within this article is to seek to understand the relationships that exist between KM and OL, through analyzing the ISE decision-making activity. This section describes the methodological stance taken by the authors in approaching this goal,. The authors adopted the approach advocated by Galliers (1995), where the definition of a morphology or 'form of doing' defines the manner in which the research should be undertaken. As such, and defined by Yin (1994), the authors had to consider the form of the research question being posed in terms of the extent to which the authors would have control over behavioral events; and the degree to which there would be a focus on contemporary events.

It was accepted that the organizational context for the research warranted a multidisciplinary approach (underpinned by the research being focused both in social and technical terms). Furthermore, it was acknowledged that to address and craft a model that captured the interplay between KM and OL would require a research strategy with deductive characteristics (based upon empirical observation in an exploratory and descriptive sense). As such, the deep social nature of the given field of observation meant that there was a need to capture 'rich' primary data in the form of human behavioral and psychological traits and characteristics. However, this paper is not seeking to offer detailed conversations with the interviewees following an interpretivist analysis, nor is it a requirement when developing a rich-picture cognitive map to present such qualitative conversations. The systematic approach that the authors used to observe the human and organizational ISE process within the selected case company, were based upon a protocol that involved data collection from primary and secondary sources. In doing so, conforming to accepted procedures as defined in the normative fieldwork literature within information systems and social sciences, involving person-to-person interviews and analysis of company documentation and archival materials (Mayring, 2000; Shaughnessy and Zechmeister, 1994; Yin, 1994). One on one interviews of approximately 1 hour were conducted with the Managing Director (MD), Production Director (PD) and Chief Financial Officer (CFO), as well as numerous shop floor operatives. The interviews with the shop floor workers added further credibility to the data generated as well as confirming issues associated with the environmental setting. Notwithstanding, interviewer bias was addressed by cross checking data between interviewees; at all levels.

The use of reflexive feedback as well as the elimination of leading questions through the use of 'probes' (follow up questions used to get respondents to elaborate on ambiguous or incomplete answers) supported the development of a robust methodology. After every interview, notes were given to each interviewee to check, to resolve any discrepancies that may have arisen and eliminate any interviewer bias. The capture and extrapolation of human and organizational issues form the

genesis of a model that is constructed to identify the KM and OL interrelationship. In seeking to interrogate these relationships, the authors propose to use a cognitive mapping technique in the guise of the Fuzzy Logic (Zadeh, 1965) technique, of Fuzzy Cognitive Mapping (FCM) (Kosko, 1991). The generation of an FCM being an interconnected network of system concepts which support the deduction of meaning from results via narrative description. This then allows for the identification of lessons to be learnt from the case analysis presented.

As such, the authors aim to use this FCM technique to explore the relationship between KM and OL, by principally: elucidating and codifying those key factors involved in the ISE process within the case company; and through the subsequent mapping and analysis, synthesising the case data against this mapping within the context of outlining pertinent explicit and tacit knowledge factors that were identified. Hence, the purpose of the application of an FCM is not necessarily to provide any particular explanation for decision-making behaviour, but to allow the framing of those knowledge constructs which may impinge upon such a process. In this case, the contingent differences between KM and OL (as noted in previous sections), can be explored by assessing the meaning of the FCM from these two viewpoints. This allows for a rich explanation for human behaviour, within an organisatioal information systems context to be carried out, in an exploratory manner.

CASE STUDY DESCRIPTION

The case organization studied in this research, SME-UK, is a manufacturing organization within the UK, which specializes in the manufacture of bespoke aerospace, automotive, and other engineering components. SME-UK is not much different from many other modern organisations, in that the motivations and goals of the business involve key aspects of IT/IS, market involvement, relationships with their customers, new product development and innovation, organizational culture and overall corporate strategy. What differentiates SME-UK from most other companies in its sector and geographic location is a mandated focus on process improvement and IT/IS as the basis for improving competitive advantage and instigating an appropriate environment for organizational learning, being a big believer in the concepts of Total Quality Management and also Kaizen. At the time of conducting the case enquiry, this investment would enable SME-UK to maintain competitive advantage through the innovative use of an ERP system.

Management explained that by approaching investment in ERP in terms of a strategic innovation programme, required business change activities, across the other core processes of Production, Delivery and Support. By enabling and implementing transformational processes which would enable the strategic goals to be achieved, benefits would then be realizable (and hence would ultimately lead to an improvement of organizational learning). SME-UK utilized the Cost Benefit Analysis (CBA) approach in this instance, which attempted to include human as well as costs and benefits. This had been used for appraising previous investments (such as for CNC machinery), and was now to be applied to identify those benefits and costs associated with Production Planning and Control (PPC) and Shop Floor Data Collection (SFDC) modules. However, there was no structure to the analysis of those benefits and costs identified and there was no assignment of financial values to the investment implications identified. SME-UK's prescriptive justification process soon proved itself inappropriate, as it was unable to quantify and qualify the intangible and non-financial benefits, and indirect costs. As a result, an 'act of faith' investment appeared to be the only option available, mainly due to the inexperience of the new management team, who were unaware of how to use non-traditional ISE techniques. SME-UK nonetheless developed bespoke ERP in the same vein (in part, because they were unable to quantify benefits and costs yet again).

Management very much viewed project justification as a hurdle that had to be overcome, and not as a technique for evaluating the project's worth in any sort of rigorous terms. This had significant implications, as during the preparation of the ERP project's proposal, managers spent much time and effort investigating its technical and financial aspects (in a strategic sense), rather than risk and benefit aspects (in a tactical / operational sense). The remaining project team members tried to address implementation and human resource risks, against estimated cost implications. So, whilst there was a desire to invest and implement in technology, there were, in a sense, opposing knowledge-based views of the justification process. There was a lack of representation and involvement by employees from the team that was responsible for selecting and implementing the initial vendor solution, and the management team did not consult, or identify those operational stakeholders responsible for the relevant business processes.. There appeared to be a lack of interest and ownership by the operational workforce in computerizing business processes. The workforce thought that management had a 'hidden agenda' in implementing SFDC, in order to gather planned set-up and run times, therefore implying gathering of performance management data. Therefore, these issues of Employee Commitment associated with implementing PPC were addressed from a purely technical perspective, with SME-UK later realising the consequences of neglecting the 'softer' side of IT/IS implementation.

The organizational culture of the firm was very much driven and was mired in a "them and us" environment, with a skeptical stance taken by most of the workers there, revolving around a union-based view of the worker-management relationship. The "buying-out" of two senior directors, and their removal from SME-UK's board, presented the organisation with a management experience void; although this did evolve the managerial culture within the firm, from a dominating reactive senior management structure, which had a clear hierarchy and was dependent on traditional approaches to manufacturing – to one of a much clearer responsibility-led leadership style. As a result, the firm's mission statement had changed to encompass a partnership between people, technology, customers and suppliers. Also, SME-UK had done little training and education before their implementation of the PPC/SFDC (thought by the management team to have contributed towards the failure of their system). The later implementation of SME-UK's SFDC system, was done in isolation to vendor support, when the system became 'operational', there was much resistance to its use due to a general lack of knowledge about the system, notably commented that people were not informed of the impact of the system and how it would impact their job function. As such, very few people endorsed or understood what the success of this system could bring to the organization. Ultimately, the shop floor workers needed to be educated as opposed to being disciplined in attempting to realize the benefits proposed.

SME-UK then instigated a series of intensive education sessions where all managers were educated on the impact that the investment would make to their job function(s) and shop floor stakeholders were taught how to use the ERP system within cross-functional teams. This also encouraged knowledge and skills transfer associated with ERP, such as throughput production flow, communication, Just in Time (JIT), inventory management and Total Quality Management (TQM). The project was championed by the MD, and when asked why other more directly affected managers were not responsible for leading the project, the MD replied that as he was the main visionary leader, it was up to him to set the standard, and lead the way. However, the MD quickly turned his attention, appearing to have either lost interest, due to implementation problems, or a lack of success, or being 'driven' by other organizational improvement initiatives (which raises the question of whether the MD was the most appropriate person to champion the project). Responsibility of the remaining implementation was then delegated to the well-established Production Director. Interestingly, the Production Director was not a key member of the vendor PPC/SFDC implementation team but operated as an honoree, advising on technical issues when consulted. Although the Production Director acknowledged the contribution the PPC/SFDC system was making/could make towards the streamlining of the production function, he noted that is was never his project and that he did not relish the possibility of being responsible for mounting cost over-runs.

When SME-UK decided to abandon the project and began developing bespoke ERP, many of the problems associated with management commitment were addressed. In doing so, the new project of bespoke system development was this time supported by the MD, with the Production Director now leading the project. The company by and large recognized that change had to occur across all levels of the organisation in terms of people, process and technology. However, this factor was largely at the expense of losing focus and showing a lack of commitment on the details of stakeholder involvement, processes for ISE and communication and system rollout. Originally, it was hoped that the goal of organizational learning would be achieved inter-alia of the implementation. This did occur eventually, though at the expense of the initial failed implementation attempt. Thus, the actual act of learning occurred because of this, when this experience was fed back into the organisation (in terms of people, processes or technologies that are adopted).

ANALYSING CASE STUDY EXPERIENCES VIA AN FCM

The overall approach that the researchers wished to use in this study was to codify the experiences and knowledge of the case data participants, using parameters to represent particular facts and views of the decision-making situation at hand. A graphical representation of these facets, a cognitive map was then created which essentially defined the decision-making environment itself. Hence, the application of the FCM technique is now presented, in order to highlight its use as tool for providing insights into the relationship between KM and OL concepts, based upon the preceding case description.

The technique of FCM is a natural extension to orthodox cognitive maps, which are typically used within the fields of economics, sociology and political science (Axelrod, 1976), and to a limited extent, within Information Systems (Montazemi and Conrath, 1986). An FCM is a method to graphically represent state variables within a dynamical system through links that signify cause and effect relationships; being augmented with fuzzy or multivalent weights that are quantified via numbers, or words (Kosko, 1991). Visually, an FCM is a non-hierarchic flow graph from which changes to each statement (fuzzy concept, i.e. node), are governed by a series of causal increases or decreases in fuzzy weight values (i.e. links between nodes). The advantage of modeling dynamic systems using an FCM is that even if the initial mapping of the problem concepts is incomplete or incorrect, further additions to the map can be included, and the effects of new parameters can be seen (thus, providing a holistic picture of the scenario being modeled). FCMs are highly amenable to enumeration (as

highlighted by Xirogiannis and Glykas, 2004) based upon the underlying mathematical theory as defined by Kosko (1991). The causal interrelationship mappings that are linked, provide the basis for analysis via computational means, and can be used as an AI system which learns from these cognitive inputs. Each corresponding causally linked node within the mapping then reacts and responds to its respective inputs – the state of each, in a cumulative sense, presage any underlying modality or hidden 'pattern of inference', which belies the implicit system dynamic of the FCM.

In terms of this study, data was gathered from the senior management and project implementation team. The nodes of the FCM were formulated as a result of feedback and verbalisation process facilitated by the researchers. In considering such factors, the authors felt that it was possible to encapsulate the ISE approach taken in SME-UK, by evaluating linkages between organisational experiences (as used successfully in the past also – see Irani *et al.* 2001; Sharif and Irani, 2005). In terms of this research, the objective and intent was to not merely map the ISE decision-making process as a series of causal relationships, but to then also place this within the context of the particular explicit and tacit knowledge components of the given process investigated. In the latter cases, this was achieved through active participation between both the researchers and case participants within a workshop setting. The authors originally intended to use feedback from employees directly. However, it was found that in the FCM generated, their responses were heavily skewed towards a negative causality. As the Production Director shared largely the same sentiments as the employees but was aware of other management and organizational factors within with respect to the overall IS evaluation and ERP implementation, it was felt that this represented a more balanced view of the organizational situation.

Hence data was gathered from the senior management and project implementation team, information being arranged into issue groupings. Following this, management were also asked to agree on words that could describe their perception or expectation of a particular part of ISE task (for example, "contributes to", "highly valued") and whether or not this had a positive or negative causal magnitude. Once this data was collected by the authors, it was then coded and categorized into key response types: Employee Commitment, Cultural Issues, Training and Education, Management Commitment, Concept / IS Justification, Project Management, ERP Selection, ERP implementation and Vendor Support.

Based upon these details, the fuzzy cognitive maps are shown in Figure 1 and 2. Within these causal maps the given nodes relate to the elucidated case data factors: EC (Employee Commitment), CI (Cultural Issues), MC (Management Commitment), CJ (Concept Justification), TE (Training and Education), PM (Project Management), ES (ERP Selection), EI (ERP Implementation) and VS (Vendor Support). Also fuzzy quantities are given between each node which relate to a causal definition within a ranked scale: 1.00 denoting maximum positive causality, through to -1.00 denoting negative causality). As can be seen by comparing each FCM against the other, the MD FCM in Figure 1 tends to confirm and uphold the views of management in the sense of wishing to drive the growth of the firm through a commitment to training and education. This is shown in terms of the many causal links from MC to TE. Similarly, there is a concentration of causal links to PM, ES and EI factors – denoting a systems-focused (organisational) view of the ISE task being undertaken.

In contrast the PD FCM in Figure 2, offers a wider set of interconnecting causality links tending to focus on a plethora of issues, not only TE.

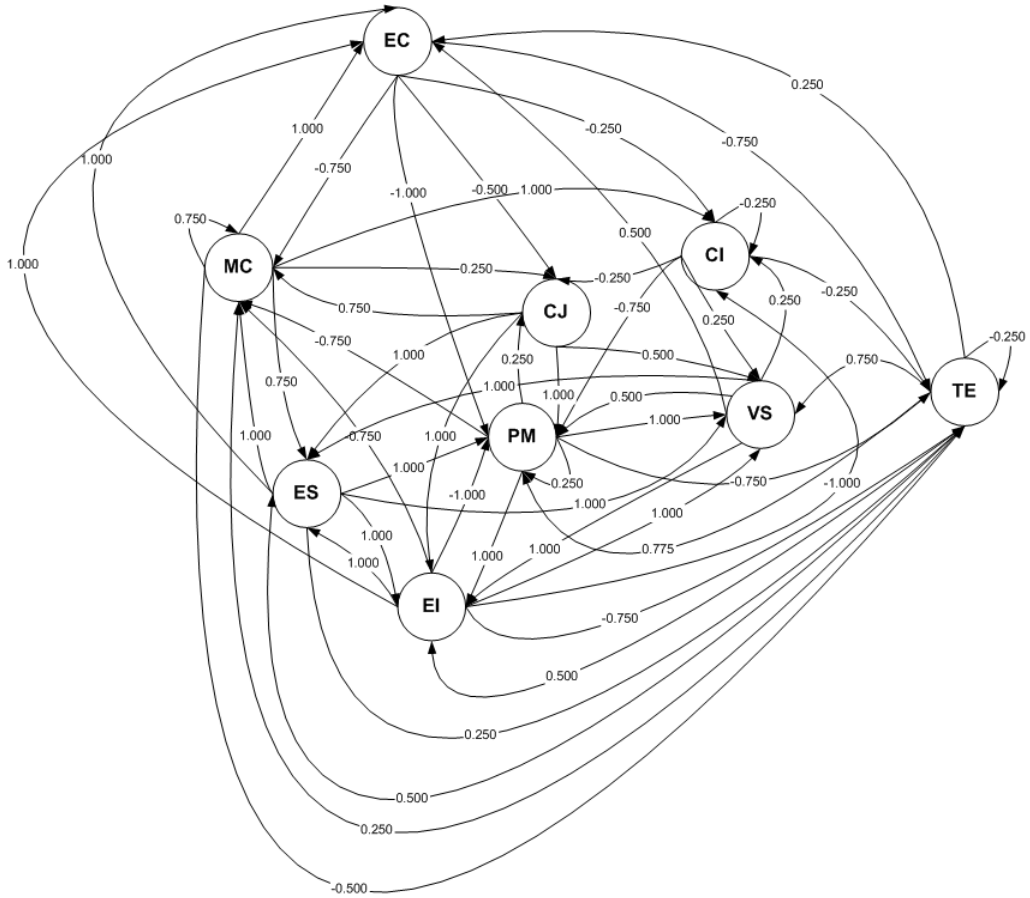

Figure 1. MD FCM

Here, there appears to be an even balance between both organisational-focused factors (for example, ES, EI, VS, PM) and human factors (for example, EC, CI and TE). Table 1 shows how each investment strategy facet can be analyzed in terms of explicit and tacit knowledge. In constructing this table, the authors sought to distill those given expectations of each stakeholder, that were ultimately articulated (i.e. made explicit) or were left unarticulated (were inherently tacit). This table principally attempts to show the synthesis of the case data with the work of King *et al.* (2002) and Holowetzki (2002). The purpose of doing so is to capture any intrinsic meaning that is inherent in the classification and experience of knowledge used within the ISE task. As can be seen, the case data facts of employee commitment, management commitment, training and education, and cultural issues can be related and synthesized with characteristics in the extant literature. Furthermore, as a result of this sublimation of concepts, the authors have also sought to categorize each case data component into explicit and tacit knowledge forms. For example, with regards to Employee Commitment, there was a tacit assumption that any implementation of the SFDC module would imply performance management analysis (and hence potentially, a review of shop floor working practices and workers). This was clearly unfounded but, that this perception existed as noted in the case data. If this tacit knowledge assumption is compared with the explicit Management Commitment factors, it can be seen that it contrasts heavily with the strategic vision of the MD: to bring together people, processes and technology together (as quoted by the MD in the previous section on Cultural Issues).

Also, there was an explicit expectation that a radical, technology-led change would change the culture of SME-UK and make it more competitive. However, the realization of this was found to be based upon tacit knowledge factors that identified a relevant and important skills gap (thereby highlighting a focus on people, rather than technology). It therefore appears that there was an inherent and tacit "gap" between the change that was required and the skills that needed to be identified to reach that goal. Although there was a delayed leadership reaction to this learning requirement, there was little or no motivation given to the employees. In effect, there was no visible reward for being involved in training and knowledge transfer efforts, apart from receiving kudos.

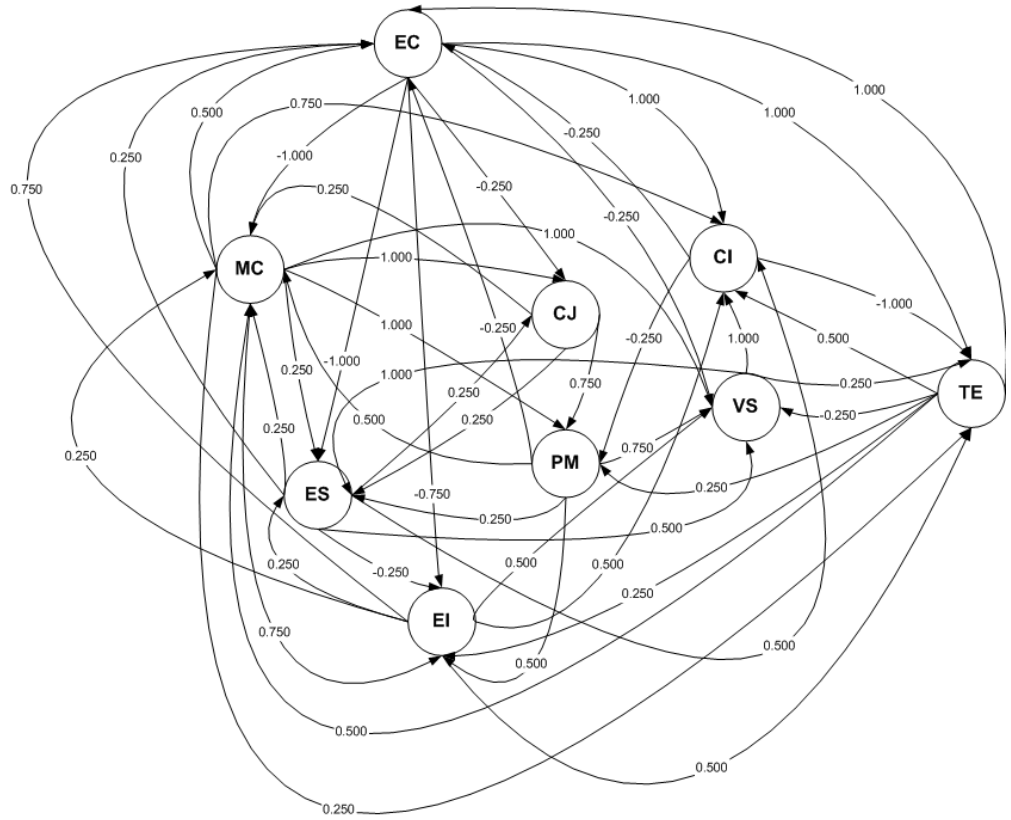

Figure 2. PD FCM

By comparing and contrasting those explicit and tacit factors in terms of their knowledge management and organizational learning constructs the authors now offer a model that describes the interplay between them, in light of the FCM results generated. At a fundamental level, FCMs provide a mapping of knowledge, and is thus a network visualization of domain expertise and factors that drive the utilization of that knowledge.

This subsequently also supports and highlights the view of Croasdell (2001), in that information technology constructs can assist in the structuring and formation of organisational memory. However, the authors note that input and output of data, still requires expert intervention (in the guise of either the researcher or the domain expert). This is to ensure that the FCM is modelling the real-world environment and within an appropriate context. Furthermore, there is a high degree of subjectivity involved in applying causal weightings – which again requires some level of reasoning. Conversely, FCMs are easy to draw and compute and can be formulated and modified by individuals who have little or no prior knowledge of fuzzy concepts. Crucially, the structure of an FCM defines not only input and output states (i.e. content), but also implicitly incorporates knowledge about the system in question (i.e. context).

Thus, it could be said that those factors that appeared to be detrimental were in fact supporting the project. Table 1 therefore describes the interface between KM and OL being constructed by noting that the FCM results belie an underlying behavior of the strategy map of SME-UK. Thereby providing closure to the goal cited in the beginning of this paper, of attempting to relate KM with OL within an organisational setting. By identifying common enablers (the intersecting rows and columns of this table), the authors have been able to identify and segregate the strategic goals of SME-UK, into constituent KM and OL parts (with an overlap between the management of technology and the implementation of strategic goals required). Furthermore, in doing so, the authors have also sought to provide the spectrum of business processes, which underlie KM (in the sense of IT implementation-related knowledge: systems, processes, data); through to organisational culture (employee-management relations, team skills, and other stakeholder issues as identified). This is shown as "Knowledge Basis" and "Business Process" rows at the bottom of the table.

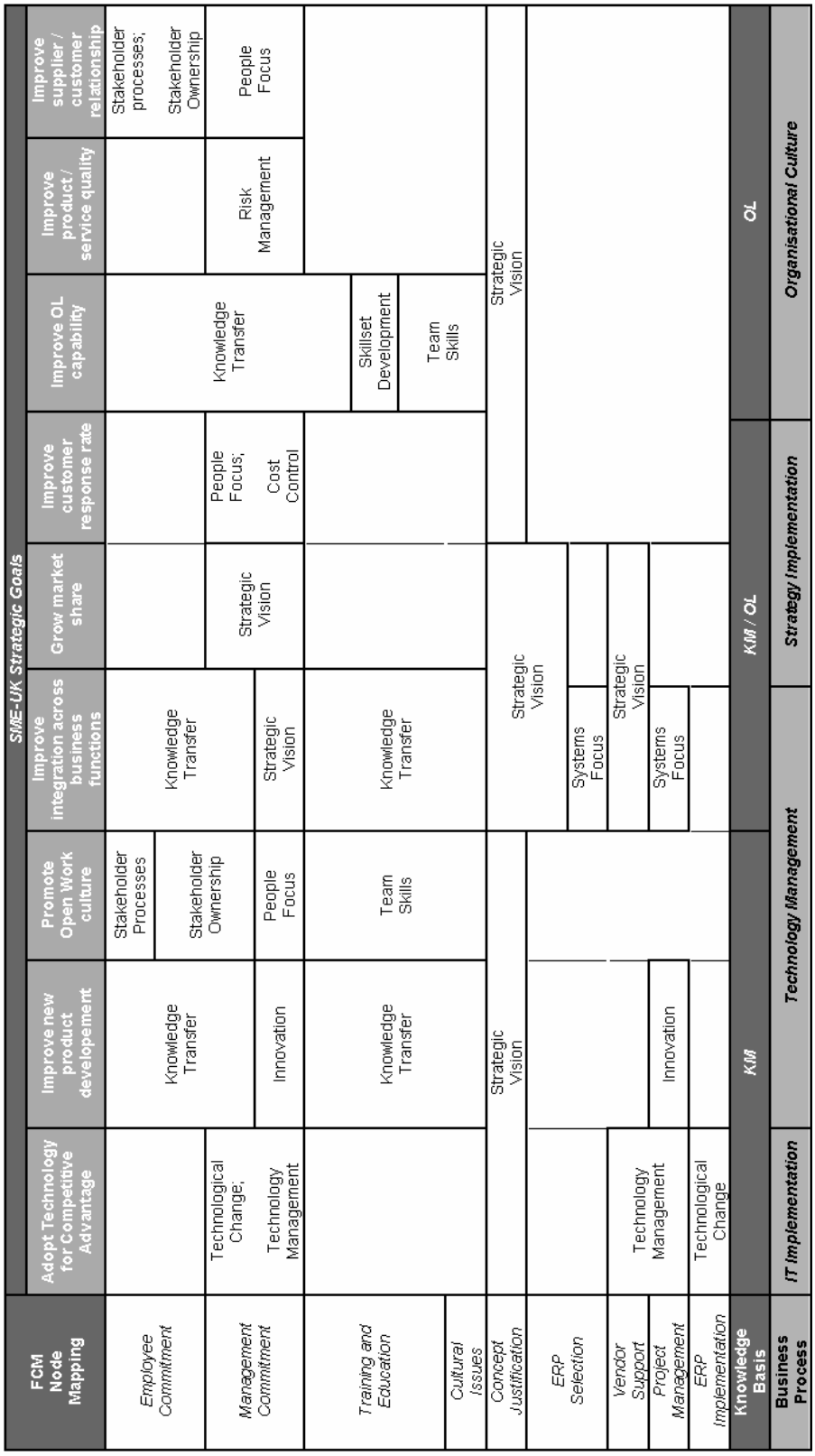

Table 1. Alignment of SME-UK strategic goals against FCM responses

The table contents can be read as follows. For example, to adopt technology for competitive advantage (one of the SME-UK's strategic goals); with respect to Management Commitment, Concept Justification, Vendor Support, Project Management, ERP Implementation; requires Technological Change, Technology Management and Strategic Vision to occur. In other words, strategic goals can be matched against decision-making concepts (i.e. the FCM nodes), in order to elucidate particular knowledge forms (in terms of a KM, a mixture of KM/OL or purely an OL basis). The resultant groupings of drivers though the proceeding levels have been carried out in the same vein. The FCM mappings are categorised along these axes, with the most prominent factors witnessed in each mapping being highlighted (the organisational case as defined by Knowledge management constructs; the human case as defined by organisational learning constructs). Therefore knowledge management in this sense are those actions enacted to realise the transfer of knowledge and its representation; whereas organisational learning in this sense is the ability to learn from such transfers and include those human employee and management factors against a backdrop of organisational culture. Therefore, this shows the overall environment required for organisation learning which in turn could potentially define the basis for a firm to become a learning organisation.

It can be seen that the results presented so far, that in the case of SME-UK, there was little or no reward system or incentive given, which as such did not allow organizational learning to take place immediately. As a result of the training and education, cultural issues and employee commitment needs identified by management, SME-UK therefore recognised the need to address these issues to correct these errors, in order to begin to learn. It is only in this way that a company such as that investigated, could even hope to aim towards becoming a learning organisation (i.e. an organisation that inherently learns and adapts as part of its organizational culture).

CONCLUSIONS

In interpreting the case data, an interplay of sociological, behavioural and ISE knowledge factors have been highlighted – for which the inherent, tacit relationship and pattern of inference resulting from the application of an FCM has presented management commitment and project management as key driving issues. The MD FCM shows project management, vendor support and training and education as being implicit (tacit) knowledge factors for the ISE process. The former underlying factors likewise provided a causal relationship to the training and education, management and employee commitment concepts. The PD FCM shows that project management was an important facet of this case but noted that a combination of consistent management commitment produced a stabilizing effect on the eventual outcome of the ERP implementation. This highlights the importance of management intervention, responsibility, and governance (although at the expense of training and education).

In light of these observations and analyses, the authors were able to formulate a basis of the relationship between those knowledge management and organizational learning concepts within SME-UK (given within Table 1). The model developed showed that a relationship does exist between KM and OL and in this case, each knowledge concept engenders / fosters realization of the other. A consistent involvement and balancing of systematic and behavioural issues can only allow the ideal of organizational learning to be realized. As has been shown however, there may be many tacit as opposed to explicit factors that may achieve this (the FCM being used as a tool to facilitate this discovery). The proposed model not only highlights those factors included in the particular ISE but, also subsequently defines a potential basis for creating a learning organisation. As a result, it appears that SME-UK itself recognised in retrospect, that:

- Training and Education are vital to the continuing success of the company, at both employee level as well as managerial level;
- Tacit issues were not made explicit (employee commitment and cultural issues festered; initial management decision-making, responsibility and commitment was lacking) – the result of which, inhibited project success;
- Organizational culture needs to develop to encompass a diverse and rich communication channel between management and employees;
- Management commitment to any company-wide programmes, needs to be consistent, clear and have the appropriate governance and ownership structures in place in order to avoid conflicts of authority and responsibility (and the avoidance of a 'blame culture').

REFERENCES

1. Axelrod, R. (1976). *Structure of Decision: the cognitive maps of political elites*, Princeton: Princeton University Press.
2. Argyris, C., and Schön, D. (1978). *Organizational learning: A theory of action perspective*, Reading, Mass: Addison Wesley.
3. Belkin, N.J. (1980). Anomalous state of knowledge as a basis for information retrieval. *Canadian Journal of Information Science*, 5 : 133–43.
4. Croasdell, D.T. (2001). IT's role in organizational memory and learning, *Information Systems Management*, Winter, 18 (1) : 8
5. Currie, G., and Kerrin, M. (2004). The limits of a technological fix to knowledge management, *Management Learning*, 35(1) : 9 – 29
6. Davenport, T. H., and Prusak L. (1998). *Working knowledge : How organizations manage what they know*. Boston, MA: Harvard Business School Press : Boston, MA, USA.
7. Galliers R.D. (1995). Choosing information systems research approaches. *Information Systems Research - Issues, Methods and Practice Guidelines*, Edited by Galliers R.D, London, UK: Blackwell Scientific, UK, 1995, p. 144-162.
8. Holowetzki, I. A. (2002). *The relationship between Knowledge Management and Organizational Culture: An examination of factors that support the flow and management of knowledge within an organization*. University of Oregon, Applied Information Management Program, December, 2002.
9. Huber, G.P. (1991). Organizational Learning: The Contributing Processes and the Literatures. *Organization Science*, 2 (1) :88-115.
10. Irani Z and Love P.E.D. (2002). Developing a frame of reference for ex-ante IT/IS investment evaluation. *European Journal of Information Systems*, 11(1): 74-82.
11. Irani, Z., Sharif, A.M., and Love, P.E.D. (2005). Linking Knowledge Transformation to Information Systems Evaluation. *European Journal of Information Systems*, 14 (3) : 213 – 228.
12. Irani , Z., Sharif, A. M., Love, P.E.D., and , Kahraman , C. (2001). Applying Concepts of Fuzzy Cognitive Mapping to model IT/IS Investment Evaluation, *International Journal of Production Economics* , 75(, 1), 199 - 211.
13. King, W.R., Marks, P.V., and McCoy, S. (2002). The most important issues in Knowledge Management. *Communications of the ACM*, 45 (9) : 93 – 97.
14. Kosko, B. (1991). *Neural Networks and Fuzzy Systems*, Saddle River, NJ: Prentice-Hall.
15. Mayring, P. (2000). Qualitative content analysis, *Forum: Qualitative Social Research*, 1(2): 1-80.
16. McCampbell, A.S., Clare, L.M., and, Gitters, S.H. (1999). Knowledge Management : the new challenge for the 21st Century. *Journal of Knowledge Management*, 3 (3) : 172-179.
17. Montazemi, A., and Conrath, D. (1986). The use of cognitive mapping for information requirement analysis, *Manufacturing Information Systems Quarterly*, March, pp.45 –56.
18. Nonaka, I., and Takeuchi, H. (1995). *The Knowledge-creating Company : How Japanese Companies Create the Dynamics of Innovation*, Oxford, UK: Oxford University Press, UK.
19. Polanyi , M. (1967). The Tacit Dimension. New York, NY: Doubleday-Anchor.
20. Seely-Brown, J., and Duguid, P. (1996). Organizational Learning and Communities-of-Practice: Toward a Unified View of Working, Learning, and Innovation. In (M. D. Cohen MD, Sproull LS, editors. and L. S. Sproull, Eds.). *Organizational Learning*. Sage Publications, Thousand Oaks, CA: Sage Publications, pp. 58 - 82.
21. Sharif, A.M., and Irani, Z. (2005a). Knowledge Dependencies in Fuzzy Information Systems Evaluation. In (Ed. N. C. Romano, Jr.). *Proc. 11th Americas Conference on Information Systems (AMCIS) 2005*, August 11th – 14th 2005, Omaha, Nebraska, USA, Association for Information Systems, pp.1574 – 1583.
22. Sharp J.M, Irani Z, and Desai. S. (1999). Working towards agile manufacturing in the UK industry. *International Journal of Production Economics*, 62(5): 155-169.
23. Shaughnessy , J.J. and , Zechmeister, E.B. (1994). Research methods in Psychology. 3rd edition. New York, NY. McGraw Hill.
24. Sowa, J.F. (1994). *Conceptual Structures*. Brooks Cole : Pacific Grove, CA.

25. Wiig, K.M. (1997). Knowledge Management : An Introduction and Perspective. *Journal of Knowledge Management*, 1 (1) : 6- – 14.
26. Xirogiannis, G., and Glykas, M. (2004). Fuzzy Cognitive Maps in Business Analysis and Performance Driven Change, *IEEE Transactions on Engineering Management*, 51 (3) : 334 – 351.
27. Yin, R.K. (1994). *Case study research: Design and Methods – 2nd Ed*. Sage Publications, Thousand Oaks,CA: Sage Publications.
28. Zadeh L.A. (1965). Fuzzy sets, *Information and Control*, 8 : 338 - 353.