

A PROLOGUE FOR KNOWLEDGE MANAGEMENT: THE CASE OF SUSTAINABLE CONSTRUCTION PRACTICE

Will Venters*, Tony Cornford, Mike Cushman, Nathalie Mitev.

Department of Information Systems
London School of Economics
Houghton Street,
London
WC2 2AE

* For correspondence
w.venters@lse.ac.uk
Tel: 0207 852 3619
Fax: 0207 955 7385

Keywords: Knowledge Management, Construction, Sustainability, SSM.

Appropriate Stream and Topic: Co-Ordination – Knowledge Management.

Abstract

This paper provides a prologue to knowledge management for the UK construction industry as it attempts to deal with issues of the sustainability of its practices. Sustainable construction is seen as a novel and contested concept within the industry, and is perceived as requiring the industry collectively to innovate new practices and deploy new knowledge. The paper explores the foundations for any technological intervention to support these aims, based on knowledge management ideas, and considers the issues of beginning such a task. The paper steps back from the detail of what any particular knowledge management intervention is trying to achieve, or how it might be undertaken, and instead asks broad questions of both knowledge management and of the formative context for any intervention in support of sustainability. Drawing on soft systems methodology, the paper explores various relevant weltanschauungen and asks whether a desirable knowledge management intervention is feasible within this context. Classes of findings are described using evidence from an empirical study.

1 Introduction

This paper concerns the prologue to knowledge management; an exploration of a context before any specific application of knowledge management ideas or associated technology. The paper thus steps back from the detail of what any particular knowledge management intervention might be and rather asks questions of both knowledge management as a form of organisational intervention, and of the organisational and industry context that such an intervention would be located in. The specific concern is the UK construction industry and its concern to improve the sustainability of its construction practices. Our aim is to describe and dissect the issues associated with how this industry may make use of knowledge management theory and knowledge management tools in approaching such concerns. As to whether it is a fad (Davenport and Grover 2001, Galliers and Newell 2001, Swan, et al. 1999), or an authoritative and powerful theory, this paper attempts to suspend any disbelief, and to take seriously the ideas of knowledge management, as the construction industry sees it.

In order to undertake such exploration the paper describes a number of epistemological and ontological positions adopted by the researchers. These positions are not accepted as *a priori* truth, but rather as stepping stones upon which to begin the journey towards intervention. The research reported in this paper is part of a larger research programme that is working to identify how knowledge management and ICT, in various forms, might support the innovation of sustainable construction practice. However, in this paper we still takes an ambivalent stance towards knowledge management and its associated technologies. Many studies have argued directly for the power of such an approach, while a few have argued the contrary position, that technology cannot achieve or embody knowledge management (Davenport and Prusak 1998, Galliers and Newell 2001). In this paper we do not start from an assumption that knowledge technology is the “answer”, but we are interested to explore the extent to which it may be constitutive of any broader initiatives. Technology is thus seen as having a potential capability, and it is this potential that this prologue addresses.

The methodological approach adopted here is chosen to support our desire to appreciate the major elements of a problematic situation within established industry structures and work practices – changing construction practice so as to make it (as process and as product) more sustainable and applying technology to this end. The term appreciation is used here after Vickers (1970), who writes of appreciative systems in terms of human experiences developing within us “*readinesses to notice particular aspects of our situation, to discriminate them in particular ways and to measure them against particular standards of comparison, which have been built up in similar ways*” (Vickers 1970). These readinesses may then be organised into an appreciative system, “*which creates for all of us, individually and socially our appreciated world*” (Checkland 1981). “*The appreciative settings condition new experience, but are modified by the new experience.*” (Checkland 1981). In gaining an understanding of the problématique outlined, this notion of appreciation (and its relevance to the adopted Soft Systems Methodology) resonate with the problem. The paper thus adopts SSM as its problem contextualisation tool.

The structure of the rest of the paper is as follows. The next section introduces the least tangible, yet perhaps most encompassing aspect of this work, the issue of sustainability as presented to the UK construction industry. This is followed by a description of our research methods and a summary of our findings. The discussion section develops the main themes that emerge from this work and provide the prologue. The paper then finishes with a summary conclusions.

2 The Contested Question of Sustainability

The global debate on sustainability is expressed through intense political controversies surrounding the macro implications and policy agendas posed by, for example, urban development, global climate change and biodiversity. These issues are also beginning to be considered in many industrial sectors, in particular those associated with energy, transport, materials and the built environment. Within the UK construction industry (the focus of this paper) interest in sustainability has emerged over the past 5 years from the pressure and influence of various parties; from legislative frameworks and regulations via government; the construction industry’s

attempts to gain competitive advantage, and from external pressure groups shaming of offenders. Yet these pressures are not fully understood and within the industry sustainability is still seen as a novel and contestable concept, with no settled or focused understanding of what it means, the drivers that propel it, the bounds of its operationalization or the locus of its practice (Kibert 1999).

As and when pressure is brought to bear to change existing practice, for example in terms of on-site waste management, energy efficiency standards or recyclability of materials, it is the construction industry itself who must innovate the change. For an industry which is characteristically poor at innovation (less than 5% of revenue is spent on R&D) and rigid in its institutional structures, the challenge of changing their embedded stable practices is problematic. The industry does identify a need to collectively innovate and share new practice, and has instigated such change through industry bodies such as CIRIA (Construction Industry Research and Information association www.ciria.org.uk) BRE (Building Research Establishment www.bre.co.uk) or Movement4Innovation. Within these organisations there is an assertion that sustainability is a knowledge related issue, with initiatives focusing on broadly knowledge related activity (e.g. Best Practice Programmes), on innovating new practices (e.g. Rethinking Construction – www.rethinkingconstruction.org and www.knowledgeexchange.co.uk).

These bodies follow the existent and embedded approaches for engendering innovation within the industry through collaborative bodies with associated research programmes, conferences, focus groups and publications. Still there is a perceived need among some industry leaders to extend and develop the “*practice of innovating practice*”, to embed it within the industry’s own work practices (rather than once removed in research establishments), and which then leads to asking if employing knowledge management and associated ICT is a route to such improvement. Certainly the industry’s own discourse often points to the need for a more knowledge rich practice within newly envisioned work processes, and thereby leading to the diffusion and adoption of new ideas and concepts associated with sustainability throughout the supply chain, and on the basis of both market pull and supply push (Egan 1998, Movement for Innovation 2001).

3 Research Methodology

The key question of this research is then how might individuals and groups within the construction industry can be assisted to make knowledgeable interpretations (envisioning) for sustainability within company, professional and institutional structures, and across multi-firm and multi-professional projects. To address this we have built conceptual models developed through soft systems methodology (SSM) to identify patterns in the knowledge activities undertaken or understood by our respondents (Checkland 1981, Checkland and Scholes 1990). Through interviews with industry participants, and using SSM's rich pictures and root definitions, we have explored the understanding of diverse responsible actors, transformations for which they are responsible and knowledge resources they appropriate.

Our use of SSM has been fairly conventional, developing individual rich pictures and root definitions of relevant (essentially technical) systems based on interview transcripts. For our wider project we still need to translate these contextually rich understandings into the sparse language of modelling tools and the even sparser language of programming. How best to achieve these transformations is the current concern of our ongoing research for which we employ UML (unified modelling language) (Apicella 2000, Scott 2001). However in this particular paper we are not reporting directly or in detail on this work. Rather we are aiming to step back from this route through the detail, the functional requirements and the architectures, and to explore what knowledge management interventions are understood as intended to achieve and through what processes or human activities they might achieve these results. Still, the purpose of the work reported here can in various ways be expressed by drawing on SSM ideas. We are interested here in starting to sketch the broader industry criteria against which any particular technical intervention might be judged, in SSM terms, as "systemically desirable" and "culturally feasible" within a varied set of organisations and professional groupings. In doing this we are taken back to the start of the generic mode one SSM (7 stages and cycles between them), with a need to refine (or distil) a rich picture of the overall environment within which any such technical intervention will occur – a rich picture that necessarily sketches or implies both a particular ontology and epistemology. This then leads to a concern with the

weltanschauungen within which any proposed interventions that target issues of sustainability and links them to knowledge and knowledge practices can be placed.

4 Empirical work and findings

An initial 16 interviews with construction industry professionals have been undertaken, mainly with senior members of organizations representing the main construction interests: developers, clients, architects, design engineers, quantity surveyors and contractors (see table 1). These organizations are from both the public and private sector, and ranged from single partner architectural practices to international consulting firms. The interviews were semi-structured and based around a researchers' *aide-memoire* – a prompt consisting of a list of topics which the researcher intends to explore. In addition the research team have attended six industry workshops on sustainability or knowledge management and examined individual organization's policies on sustainability and knowledge management. In this section we summarise some of our preliminary findings from this work.

Company Type	Job Type
Construction Consultancy	Project Manager
Construction Contractor	Project Manager
Independent architects practice	Architect
Construction Consultancy	Innovation / information manager
Construction Consultancy	Quantity Surveyor
Construction Consultancy	Consultant
Client	Client Purchaser
Client	Client Architect
Construction Consultancy / Quantity surveyor	Senior Management
Architects	Architect
Construction Consultants	Consultant
Client Consultants	Environmental Consultant
Construction Consultancy	Consultant
Construction Contractor	Project Manager
Construction Consultant	Senior Consultant
Construction Consultancy / Quantity surveyor	Quantity Surveyor

Table 1 Interviews undertaken (Note Job Type is shown rather than job titles in order to represent the broad areas of each persons work and to protect their identity)

Rich pictures were drawn for each of the various perspectives provided by these interviewees. These pictures were then collectively analysed by the research team and industry members using the problem structuring technique of oval mapping to provided overall themes, and SSM root definitions to identify potential human activity systems to further explore. Models were then produced which suggested potential improvement in these identified activity systems. It is from this analysis of both overall themes and specific actions that the following issues are derived. This led to the development of a set of Rich Pictures and Root Definitions, an examples of which are shown below, with Figure 1 showing a rich picture, Table 2 showing a derived root definition and Figure 2 showing the root definition and the associated CATWOE in pictorial form.

A system to enable construction SMEs to have access to timely and relevant knowledge and experience about sustainable construction and thus enable their staff to act more knowledgably.

The system should enable construction SMEs to, individually and collectively, tender for larger and more profitable projects.

The system should be available at very low costs to SMEs

Table 2: A root definition of a relevant system

Having developed a set of about twelve such root definitions the research team stood back to explore the underlying issues associated with these human activity systems, attempting to describe a prologue to the knowledge management activity which was to come next.

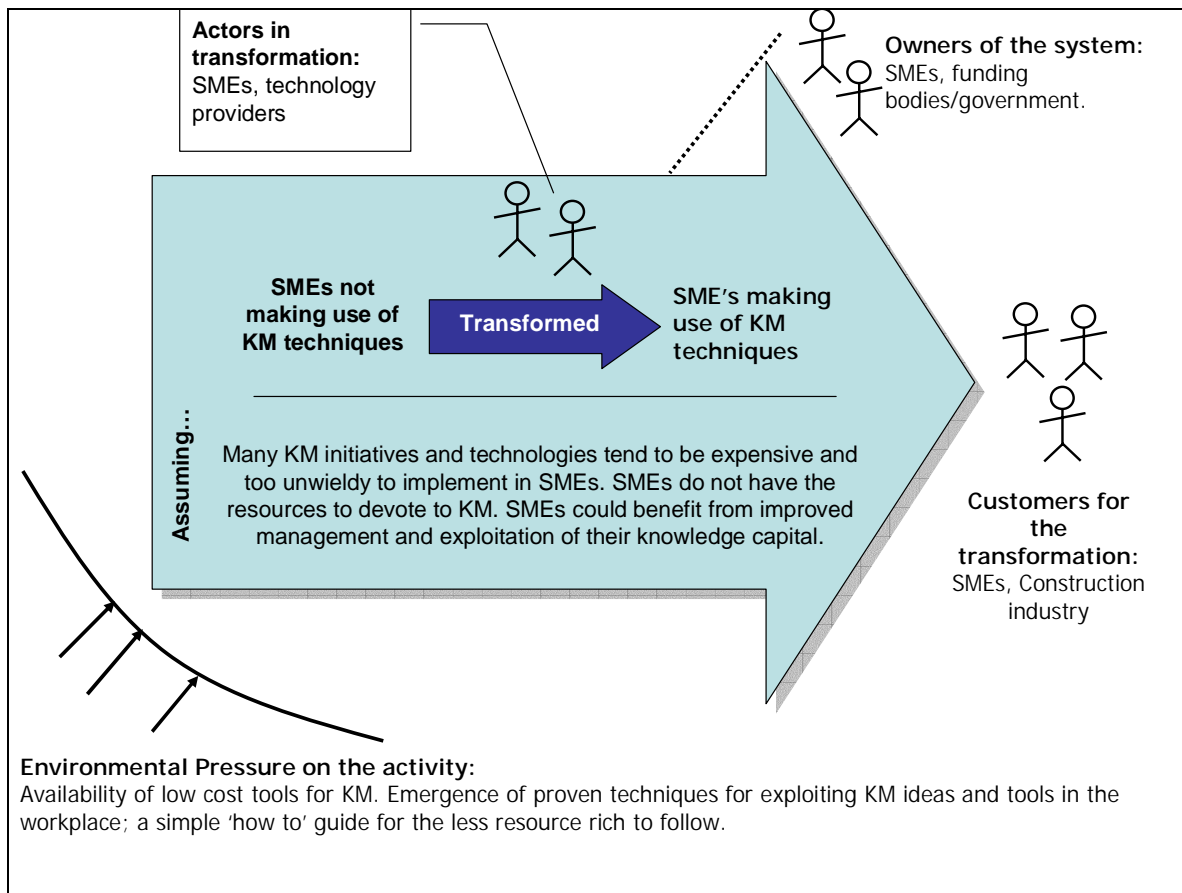


Fig 2: A figurative representation of the CATWOE for the root definition.

5 A Prologue to Knowledge Management

Accepting for the moment that knowledge management potentially offers a route to such an improvement for the UK construction industry's approach to sustainability, we then ask the question of what form such a knowledge management intervention could take? Just as with sustainability, knowledge management is also a contested concept, with little accepted definition (Bhatt 2001, Neef 1999). We are thus led to ask what knowledge management is?

Within the academic literature of knowledge management many varied categorisations may be identified (Alavi and Leidner 2001, Earl 2001, McAdam and McCreedy 1999, Schultze 1998). Schultze (1998) has suggested that knowledge management related theory may be segregated between a subjectivist and objectivist

ontology of knowledge, basing such categorisation on Burrell and Morgan (Burrell and Morgan 1979). An objectivist perspective views knowledge as “object” existent *a priori* and waiting to be discovered (Hedlund 1994). This suggests that technology be employed in the codification and dissemination of such knowledge objects (Hansen, *et al.* 1999). A subjectivist approach in contrast suggests knowledge is inherently indeterminate and linked to human experience and the social practice of knowing - see for example Tenkasi and Boland (1996) and Brown and Duguid (1998). This perspective suggests that technology focuses on supporting such human activity through, for example, personalisation approaches (Hansen, *et al.* 1999).

Here we identify a third stance towards knowledge, taking us beyond both of these approaches and suggesting the general division of approaches into subjectivist and objectivist accounts is too binary (Venters, *et al.* 2002a). This constructionist approach argues that subjectivity and objectivity are interlocked in a reciprocal relationship and should not be considered as binary opposites, but rather as part of a continuum of thought and relative positions in the intersubjective social consciousness (Berger and Luckman 1966, Schultze 2000). In this we accept that society (encompassing Knowledge Management practice) is both a subjective and objective reality. Social reality is to be understood in terms of an ongoing dialectical process composed of individuals simultaneously externalising their being into the social world, and internalising the social world as objective reality; “*to be in society is to participate in this dialectic*” (Berger and Luckman 1966), or in Weick’s (1995) terms, individuals make sense of their world by interacting within it. The constructionist account also see knowledge as essentially dynamic, “*A firm’s knowledge is continually (re)constituted through the activities undertaken within a firm*” (Tsoukas 1996). An argument that can be further extended to suggest that firms knowledge is emergent (Weick and Roberts 1993): “*It is not possessed by a single agent; it partly originates ‘outside’ the firm; and it is never complete at any point*” (Tsoukas 1996).

This constructionist perspective seems to fit well with the problems explored in this paper and the aim of exploring technology as an agent to support emergence of knowledge. In particular a technology resident ‘outside’ (or potentially between) organisational boundaries in the long and complex supply chain of construction. Such a technology aims to act as boundary object (Star and Griesemer 1989), transcending

space and projected through time. This notion of technology spanning boundaries across time and space may appear particularly relevant to an industry which concentrates on a particular time and a particular space (the construction project and the construction site), yet is separated into many disciplines and skills and operates within a very formal set of norms and contracts. As one interviewee expressed it when considering sustainability “*Construction is ultimately a very complex, multi-disciplinary activity and there is a need to integrate the kind of design and management processes in terms of skills and the knowledge that people bring*”. We thus see construction practice as similar to the constructivist process described above, with professionals simultaneously externalising their being into the world through physical objects (the integration of construction components in order to construct), and internalising their interaction with such physicality and its associated social processes. We thus recognise that construction is ultimately concerned with physical objects. The outcome of a typical construction project can be observed and remains for an extended length of time, whether good or bad, sustainable or not. In the words of Frank Lloyd Wright “*The doctor can bury his mistakes but an architect can only advise his client to plant vines.*”

This physicality of objects influences construction practice in many ways, and construction workers focus on the physical as a method of locating discussion and meaning. And yet, the construction site is located outside the offices of the construction firms and requires staff from all participating organisations to co-locate (physically or virtually) at that location with physical construction artefacts acting as boundary objects and the focus and enabler of conversation between communities (Wenger 2000) (Star and Griesemer 1989). Some literature has suggested the relevance of physicality in knowledge work (Davenport and Prusak 1998, Ward and Holtham 2000), and the original literature on communities of practice and knowledge sharing among photocopier repairers emphasised the physical realisation of much knowledge work (Orr 1996, Wenger 1998). But still, where technology is approached within knowledge management discourse this aspect of co-location is often avoided, with the assumption that technology can mediate for a lack of shared context (Davenport and Prusak 1998) even as any abstraction or translation of knowledgeable action removes it from the given context - knowledge being what made action appropriate in *that* situation at *that* time (Introna and Whitley 1997).

We are interested in the bearing such physicality has on the industry's objectivist perception of modelling practices. Our respondents report that their current approaches to knowledge management (as they define it) rely heavily on data creation, storage and dissemination – arguably classic objectivist representations – and within the industry knowledge management discussions usually lead to informational resources of Intranets and document management. Even within the industry's consultancy companies, the sharing of knowledge tends to be grounded in documents, e.g. regulations or drawings, though some research does suggest that engineers can respond positively to situations which challenge such approaches (Cushman, *et al.* 2002).

Drawing on our constructivist stance, and challenging the industry practice sketched above, we are drawn to a knowledge management that is more driven by the agency of the individual than the infrastructure of the organisation. We see Argyris' concept of double-loop learning as relevant here (Argyris 1991, Argyris 1995, Argyris, *et al.* 1985), in which individuals question not simply the practice they are undertaking, but learn from challenging the mental maps' of how to act when faced with a particular situation. Few people are aware of such mental maps influence on their action, but rather believe that they act with the theories they regularly espouse. Knowledge management then involves challenging individual's planning, implementation and review of action. Through a process of double-loop learning pre-given values, plans and operationalised rules are put under critical scrutiny.

Knowledge management is then understood here as potential for new (knowledgeable) practices that are envisioned, pursued and disseminated by people, with others encountering these new practices and learning from them to develop their own reflective capacity. Knowledge creation, in this case, is not simply a codification and dissemination effort, but nor is it driven just by personal explorations, but involves the ability to interact with and convince others (Venters, *et al.* 2002b). We thus see a knowledge management intervention in which individuals are aided to innovate new sustainable practices as part of their ongoing work and through a changed perception of the nature of construction that draws on the insights of others. Rather than engendering individuals to consider sustainability practice in the abstract,

the act of constructing unsustainably leads to them to breakdown, and reflection upon their unsustainable actions. The aim is to hear joiners on construction sites saying “*hang on, if I cut that length of wood like that I am going to waste half of it!*” as opposed to “*I wonder if I could make this construction more sustainable*”. But we also understand that such a process involves a core challenge to the nature of being a construction worker and requires more than the simple provision of database technologies which catalogue information on timber or plan the cutting of wood. Similarly, architects can approach sustainability from the general and macro based on received understandings, or from the specific and situated and thus actively innovate for sustainability. Rather than decisions being made as to whether a building is to be ‘sustainable’, followed by the selection of various design changes to implement such sustainability, the practice we might seek should concern why this or that aspect of the building should not be sustainable.

Of course, our interviews suggest that achieving such a radical change in approach would prove problematic, not least because of the differences between firms in their perceived ability to create and use knowledge, and its relationship to the work they undertake. The large firms we investigated do have an explicit commitment to R&D, regularly participate in academic research projects, and do reflect upon the role of knowledge within their organisation. But still they often see innovation as being led by academia and see themselves as acquiring such knowledge for their own use and as supporting industry ‘best practice’ dissemination programmes. As part of this they do identify the need for ICT based systems for recording and retrieving information about internal and external innovation and knowledge activities – often conceived as intranets based on information storage. Small firms, by contrast, see themselves as knowledge consumers rather than innovators in their own right, using cautiously the research output published in trade magazines and industry reports. They see their knowledge management practices largely in terms of retaining individual staff who have acquired competencies and expertise through practice and they feel isolated from knowledge networks because of their size and the nature of their work - usually with other SMEs and rarely with large knowledge rich partners.

We should also note that, within our interviews, innovation in general, and pursuit of sustainability in particular, are not seen by many as a way of repositioning their firm

for competitive advantage, but rather as a risk to be managed (CIRIA 2002). While individuals may be committed to innovating, they are often frustrated by counter pressure from other stakeholders – particularly clients who ask always the (upfront) cost, and from other construction partners who see only the risk. Where innovation does occur it tends to be associated with particular construction companies who base their reputation on being able to innovate. We are then left wondering if innovative practices are closed to an elite community of clients seeking innovation, and to construction companies specialising in such innovation, rather than permeating throughout the industry. Does such specialisation lead to a polarisation into small “communities of innovation” and larger “communities of standardisation” rather than a shared practice?

6 Conclusions

This prologue has addressed a number of issues associated with applying knowledge management ideas to the UK construction industry as it considers the challenge of sustainability. We have highlighted issues of physicality and location in opposition to the discourse in knowledge management on the virtual and dislocated. Issues of immediacy discussed in knowledge management contrast with the extended lifespan of buildings. The paper has also pointed to the potential risk of innovation, and the tendency for an industry to see it as the domain of external knowledgeable bodies, rather than an individual opportunity for competitive advantage, as argued in the discourse on intellectual capital (Edvinsson and Malone 1997, Stewart 1998). The paper explores issues of communities of practice (Wenger 1998), and, in pursuit on innovation, wonders how such practice might be broken free of these communities?

7 References

- Alavi, M. and D. Leidner (2001) "Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues", *MIS Quarterly*, **25 (1)**, pp. 107-136.
- Apicella, M. (2000) "Uml Simplifies Project Notation", *InfoWorld*, **22 (13)**, pp. 69-70.
- Argyris, C. (1991) "Teaching Smart People How to Learn", *Harvard Business Review*, **69 (3)**, pp. 99-109.
- Argyris, C. (1995) "Action Science and Organizational Learning", *Journal of Managerial Psychology*, **10 (6)**, pp. 20-26.
- Argyris, C., R. Putnam and D. Smith (1985) *Action Science*, Jossey-Bass, San Francisco.
- Berger, P. and T. Luckman (1966) *The Social Construction of Reality*, Penguin Books, London.

- Bhatt, C. (2001) "Knowledge Management in Organisations: Examining the Interaction between Technologies, Techniques, and People." *Journal of Knowledge Management*, **5 (1)**, pp. 68-75.
- Brown, J. and P. Duguid. (1998) "Organizing Knowledge." *California Management Review*, **40 (3)**, pp. 90-112.
- Burrell, G. and G. Morgan (1979) *Sociological Paradigms and Organisational Analysis*, Heineman, London.
- Checkland, P. (1981) *Systems Thinking, Systems Practice*, Wiley,
- Checkland, P. and J. Scholes (1990) *Soft Systems Methodology in Action*, John Wiley & Sons Ltd, Chichester.
- CIRIA. (2002) *Debate: "the Business Case for Sustainable Construction Is Not Convincing" (Personal Communication)* CIRIA AGM Event, London UK.
- Costello, G. (1996) *Knowledge Management in Strategic Alliances: The Role of Information Technology*.
- Cushman, M., W. Venters, T. Cornford and N. Mitev (2002) "Understanding Sustainability as Knowledge Practice". in *British Academy of Management Conference 2002: Knowledge and Learning Track*, London,
- Davenport, T. and V. Grover (2001) "Special Issue: Knowledge Management (Editorial)", *Journal of Management Information Systems*, **18 (1)**, pp. 3-4.
- Davenport, T. and L. Prusak (1998) *Working Knowledge: How Organisations Manage What They Know*, Harvard Business School Press, Boston.
- Earl, M. (2001) "Knowledge Management Strategies: Toward a Taxonomy", *Journal of Management Information Systems*, **18 (1)**, pp. 215-233.
- Edvinsson, L. and M. Malone (1997) *Intellectual Capital*, Judy Piatkus Limited, London.
- Egan, J. (1998) "Re-Thinking Construction: Report of the Construction Industry Task Force" *DETR* London.
- Galliers, B. and S. Newell (2001) "Back to the Future: From Knowledge Management to Data Management". in *The 9th European Conference on Information Systems*, Bled, Slovenia, pp. 609-615, Moderna Obganizacija,.
- Hansen, M. T., N. Nohria and T. Tierney (1999) "What's Your Strategy for Managing Knowledge?" *Harvard Business Review*, pp. 106-116.
- Hedlund, G. (1994) "A Model of Knowledge Management and the N-Form Corporation", *Strategic Management Journal*, **15** pp. 73-90.
- Introna, L. and E. Whitley (1997) "Against Method-Is: Exploring the Limits of Methods", *Information Technology & People*, **10 (1)**, pp. 31-45.
- Kibert, C. (1999) "Introduction" in *Reshaping the Built Environment: Ecology Ethics and Economics*, (Kibert, C. ed.) Island Press, Washington, DC, p. 378.
- McAdam, R. and S. McCreedy (1999) "The Process of Knowledge Management within Organisations: A Critical Assessment of Both Theory and Practice." *Knowledge and Process Management*, **6 (2)**, pp. 101-112.
- Movement for Innovation (2001) "Environmental Performance Indicators for Sustainable Construction" *Movement for Innovation*
- Neef, D. (1999) "Making the Case for Knowledge Management: The Bigger Picture", *Management Decision*, **37 (1)**, pp. 72-78.
- Orr, J. (1996) *Talking About Machines: An Ethnography of a Modern Job*, IRL Press, Ithaca, NY.
- Schultze, U. (1998) "Investigating the Contradictions in Knowledge Management". in *IFIP WG8.2 & WG8.6 Joint Working Conference on Information Systems: Current Issues and Future Changes*, Helsinki, Finland, p. 155, Omnipress, Wisconsin, USA..
- Schultze, U. (2000) "A Confessional Account of an Ethnography About Knowledge Work", *MIS Quarterly*, **24 (1)**, pp. 3-41.
- Scott, K. (2001) *Uml Explained*, Addison-Wesley, Boston.
- Star, S. L. and R. J. Griesemer (1989) "'Institutional Ecology, 'Translations', and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39", *Social Studies of Science*, **19** pp. 384-420.

- Stewart, T. (1998) *Intellectual Capital - the New Wealth of Organisations*, Nicholas Brealey Publishing, London.
- Swan, J., H. Scarbrough and J. Preston (1999) "Knowledge Management: The Next Fad to Forget People?" in *7th European Conference on Information Systems*, Copenhagen, Denmark, 23-25 June, pp. 668-678,
- Tsoukas, H. (1996) "The Firm as a Distributed Knowledge System: A Constructionist Approach." *Strategic Management Journal*, **17 (Winter Special)**, pp. 11-25.
- Venters, W., M. Cushman and T. Cornford (2002a) "Creating Knowledge for Sustainability: Using Ssm for Describing Knowledge Environments and Conceptualising Technological Interventions". in *Third European Conference on Organisational Knowledge, Learning and Capabilities*, Athens, Greece,
- Venters, W., M. Cushman and T. Cornford (2002b) "Inter-Organisational Motility of Construction Knowledge Practices." in *ESmart and CISEMIC*, Salford UK,
- Vickers, G. (1970) *Freedom in a Rocking Boat*, Allen Lane, London.
- Ward, V. and C. Holtham (2000) "The Role of Private and Public Space in Knowledge Management". in *Knowledge Management: Concepts and Controversies*, University Of Warwick,
- Weick, K. (1995) *Sensemaking in Organisations*, Sage Publications, London.
- Weick, K. and K. Roberts (1993) "Collective Mind in Organisations: Heedful Interrelating on Flight Decks", *Administrative Science Quarterly*, pp. 357-381.
- Wenger, E. (1998) *Communities of Practice : Learning, Meaning and Identity*, (1st) Cambridge University Press, Cambridge.
- Wenger, E. (2000) "Communities of Practice and Social Learning Systems", *Organization*, **7 (2)**.