Chapter VIII

Knowledge Management: Facilitating Organizational Learning within the Construction Industry

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Abstract

This chapter describes an action research project, Building a High Value Construction Environment (B-Hive), involving: two major construction clients, a privatised utility company (Thames Water), and a major leisure services provider (Whitbread Hotels); a large construction company (Taylor Woodrow); two leading construction consultancy firms; and Leeds Metropolitan University and London School of Economics. The research method, action research, was particularly appropriate for this project because it promoted learning and understanding through action and reflection, culminating in the production of a workshop-based approach that facilitates externalisation of knowledge and organisational learning. The approach facilitated the sharing of knowledge amongst construction project partners that would traditionally be very protective, and even adversarial, towards each other.

Introduction

The chapter seeks to address the problem of fragmentation within the construction industry through the processes of knowledge management and organisational learning. Background to the construction industry is provided with references to respected industry commentators such as Latham (1994) and Egan (1998). This is followed by a review of appropriate contemporary research literature on knowledge management and organisational learning leading to the introduction of the Cross Organisational Learning Approach (COLA).

The COLA process was developed as the output of a funded research project designed to facilitate the sharing of knowledge by all partners of construction projects. The chapter describes COLA and identifies outputs from the process. A diagrammatic representation of the learning model is given in the Appendix. The chapter ends by identifying future issues and directions for research.

Background

The issue of fragmentation is well documented (Latham, 1994; Egan, 1998) as being a critical barrier to change since it is seen as a major factor in the poor communications between parties working together on construction projects. The construction industry is organisationally complex and highly fragmented with more than 95% of companies being small to medium sized enterprises (CICA, 1997). In addition, the construction industry suffers from supply chains and relationships that are both dynamic and transient as a direct result of the temporary nature of construction projects, resulting in a poor communication structure. In 1994, the Latham Report (Latham, 1994) recorded that in the UK there were 163,000 construction companies listed in the DETR's statistical register, most employing less than eight people.

This fragmentation means that the ownership and control of separate functions and their associated processes in a construction project life cycle resides in the hands of separate organisations with their own distinctive cultures and working practices. There is ubiquitous recognition of the need to restructure the construction industry to overcome this problem by engendering a spirit of compromise and collaboration. Latham (1994) generally recommended a rationalisation of inter-organisation agreements and methods of communication, and clearer definitions of roles and contract stages. Specifically, Paragraph 6.43 of the report recommends that the client and contractor enter into a partnering agreement. Under this arrangement, the parties agree to work together on a project "in a relationship of trust, to achieve specific primary objectives by maximising the effectiveness of each participant's resources and expertise." Latham wished to create a team spirit, where cooperation replaced conflict, in order to reduce costs, although how this could work was not made clear.

The meaning of a pioneering partnership is still being explored and negotiated within the industry; it represents an opportunity to change the *status quo* and bring about a

paradigmatic shift in thinking, but much will depend on the strength of further initiatives if this shift is to be realised.

Associated to this fragmentation at the level of organisational ownership is the associated fragmentation at the level of project team membership which manifests itself in two ways. Firstly, the transient nature of team membership during the course of a particular construction project, in that teams are dynamic in that membership is constantly in a state of flux as individuals move between teams as and when their knowledge and skills are required. Secondly, the fragmentation that exists between projects means that a 'team' is rarely left intact to further build relationships on subsequent projects. Such continuity is essential if learning benefits are to be realised (Barlow & Jashapara, 1998).

Egan (1998) points to the crucial importance of providing this kind of continuity in team composition: "The repeated selection of new teams in our view inhibits learning, innovation, and the development of skilled and experienced teams [and] a team that does not stay together has no learning capability and no chance of making the incremental improvements that improve efficiency over the long term."

It is thus recognised that this fragmentation and instability has led to chronic knowledge loss when compared to other industries.

Similar recommendations to address this problem have come from two different sources. Egan (1998) suggests that an objective, impartial "Knowledge Centre" (Paragraph 85) be set up to provide access to information regarding good practices, innovations, and experiences for any organisation or individual connected with the construction industry.

The identification of a need for concepts such as the Knowledge Centre appears to be a manifestation of the need for better communication: between individuals, between organisations, and between the present and the future. It is recognition of the need to manage the organisations' knowledge or, as it is now routinely referred to, intellectual capital.

The B-Hive project addressed this need by engaging in action research to design and provide a process, with appropriate information systems and technology support, which could be used to create and capture organisational knowledge. The process seeks to promote organisational learning and informed action through a process of analysis and reflection at various stages throughout the construction process.

This process—Cross Organisational Learning Approach (COLA)—is referred to throughout and, after discussion of its academic underpinning, is described in more detail.

Learning Objectives

The chapter will:

1. Review approaches to facilitating organisational learning within the construction industry.

2. Consider how information systems and technology support might be used to create and capture organisational knowledge.
3. Discuss how organisational learning and informed action might be promoted through a process of analysis and reflection throughout the construction process.
4. Describe an action research project (COLA) that pilots knowledge and organisational learning through reflection in a construction context.

Knowledge and the Cola Process

We suggest that two predominant problems afflict the study and utilisation of knowledge today. The first problem, which we seek to address here, is consensus on a workable and embracing definition for knowledge. The second is a suitable method for the manipulation of knowledge.

The prevailing taxonomy of knowledge models depicts a hierarchical prescriptive structure emphasizing categorisation of knowledge into discrete classifications. This facilitates implementation of knowledge management initiatives in situations where a catalogue is beneficial. Such models recognize that knowledge may be implicit, imply that it may be codifiable, but rarely describe how to codify it. There is however no suitable provision for handling the complex interrelationships of tacit and explicit knowledge. Since much of what we do practically relies on knowledge, not information or data, there are practical implications.

Technology today requires that we share our knowledge more openly and using less intrinsic methods than our born senses. Writers of an e-mail for example will use capitals or emoticons such as little smiley faces to communicate their intentions, where previously that meaning would be clarified with body language.

Technology often does not possess a sufficiently compatible interface to biological systems. During externalising and transfer, the storage medium for knowledge is changing and so is the format and substance of knowledge. For example, sales call knowledge moves from neurons to silicon and from an unstructured set of ideas and feelings to tangible and compartmentalised database fields.

While hierarchical views may be valid, one person's knowledge can be another person's information or data. An organization using an intranet as a knowledge transfer and productivity tool would need to consider the context of the knowledge, relevance to the organization, creators or codifiers, and the recipient.

Knowledge management, as the contextualisation and integration of information so that useful activity may be informed and performed, therefore requires more clarity as to what knowledge 'is'.

On one level 'knowledge' is often used as a synonym for 'information', so when people talk about knowledge management, they are sometimes referring to information management in a different guise. In this context the term knowledge management refers to technology used to store softer information which previously did not lend itself to formal structuring and storage in computer-based information systems. The advent of newer

storage and manipulation systems such as document management systems, hypertext, and Web-based technologies has meant that these 'softer' types of information/knowledge can be tackled. There is of course nothing wrong in using the term 'knowledge' in this synonymous sense, but it is important to be aware of wrongly assuming common understanding of meanings when tackling knowledge management issues.

Developing an understanding of knowledge may best be achieved by considering various contemporary models. Polanyi (1967) arranged knowledge on a continuum from tacit to explicit; from tangible and that which could be expressed, to intangible and retained in the mind of the knower. Choo (1998) added cultural knowledge, the basis for what we deem fair and trustworthy. Vasconcelos, Kimble, and Gouveia (2000) classify knowledge by replacing Polanyi's continuum with a dichotomy, and adding another level to further categorize tacit and explicit knowledge.

Considering knowledge practically, Demarest (1997) identifies scientific, commercial, and philosophical knowledge. Sveiby (2000), in his model of knowledge management practitioners, divides knowledge into objects and processes. The transfer of knowledge has also been treated ontologically. Boisot (1997) regarded knowledge as either codified or uncodified in his C-D Theory. Nonaka and Takeuchi (1995) described the flow of knowledge as a transfer process that involves either tacit or implicit knowledge.

Philosopher Karl Popper (1959, 1963), after deliberating on scientific knowledge, developed his theory of falsification whereby knowledge cannot intrinsically be proven true, only false by means of a refutation, knowledge a belief until replaced with a concrete rebuttal. This implies if a belief is knowledge, then knowledge must be able to exist solely in the imagination of the knower and have no prior corporeal relationship.

Medical opinion has considered whether knowing knowledge and brain function are linked. Bateson (1972, 1979) deduced that information is based on perceived difference in biological systems. Greenfield (1997) separated short- and long-term memory, where the latter has an explicit component and an implicit component that doesn't need to actively and consciously remember something.

Perception however is not necessarily just a faithful replica of what we sense. In discussing data analysis in social systems, Dey (1993) said: "The trouble is, of course, that we tend to see what we want to see and hear what we want to hear…We tend to make more of the evidence that confirms our beliefs and pay less attention to any evidence that contradicts them," suggesting that knowledge may be strongly affected by context and past or other knowledge.

Definitions vary. Samuel Johnson succinctly defined knowledge as: "Knowledge is of two kinds: we know a subject ourselves, or we know where we can find information upon it."

A little more detailed is Wiig's (1993) definition: "Knowledge consists of truths, beliefs, perspectives and concerns, judgements and expectations, methodologies, and know-how. Knowledge is accumulated, organized and integrated, and held over longer periods to be available to be applied to handle specific situations and problems."

Although not a formal enough basis on which to design a digital repository, this definition introduces time and process. Davenport and Prusak's (1998) definition includes the concepts of transience, context, frameworks, metaphors, processes, and the

mind of the knower: "…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 the knowers…."

These differences in perception about what constitutes knowledge is an apposite issue within the context of knowledge management. The challenge within knowledge management is to decide when it is appropriate to change knowledge types into forms that can be captured, manipulated, stored, and communicated by a computer. This may involve converting tacit knowledge, which is not formalised and is therefore difficult to communicate to others, into explicit knowledge, which can be fully recorded, communicated, and shared (Willard, 1999), whilst at the same time being aware of that which may be lost in translation. More recently, approaches such as the 3K model (Onions & Orange, 2003) have focussed on better accommodating the dualistic, multi-faceted nature of knowledge, simplifying complexities, and reconciling contradictions between tacit and explicit knowledge.

In order for organisations to learn, it may be necessary to release the tacit knowledge that is stored in organisation 'experts' minds. The passing on of knowledge is an essential part of organisational life and economy. It may be necessary for an organisation to attempt to manage some categories of tacit knowledge, capturing and converting it into an explicit format that supports communication to others. It can then be passed on as information (enhanced by experience) to those who may find it useful, fed back as consequences of others' actions, and used to identify and exploit new opportunities. One objective of knowledge management is to provide a means to externalise and codify appropriate tacit knowledge for exchange and to support the reflection and discussion facilitated by the COLA review process. An information system has been developed to support this process and to record and disseminate appropriate forms of the learning which result from the review.

Individual, Collective and Organizational Learning

The knowledge and experience of an individual shapes the individual's actions through a process known as learning, enabling the individual to change and so deal more efficiently with similar situations and cope with, or invent, different approaches to new situations. Learning occurs when new information is compared to previously received information. The comparison is then reflected upon in order to evaluate a suitable behavioural route to the goals required.

Thus, there are internal and external aspects to learning. The internal aspects address how new information is processed by the individual. External aspects cover the means by which new information is arrived at.

Information can be acquired by an individual using methods that are a combination of the two extreme learning methodologies: taught and discovery. Buckler (1998) finds advantages and disadvantages in both. The taught method is useful for passing on

solutions that may be copied and where conformance to specifications is required. The advantage of teaching is that it is a low-risk method of passing on information in a consistent way. The disadvantage of prescriptive teaching—or rote methods of learning—is the increased potential it has for stifling motivation and reinforcing automatic responses to events that might otherwise have presented opportunities for learning.

In contrast, the Discovery method allows theories to be developed and followed through. It provides an opportunity to develop solutions individually, thus allowing creativity and innovation. The drawbacks of discovering new information are that it can consume vast amounts of resources, is subject to a higher risk of failure, and may allow the learning objectives to stray.

This raises the question of organisational learning. What is it? How can it be promoted? How do these theories relate to organisational learning? In order for an organisation to survive and grow, it must therefore be able to learn, yet as a conceptual entity, as Senge explains, "Organizations [can] learn only through individuals who learn." When an organisation's members consciously learn and change their behaviour accordingly, the organisation itself can not be said to have learned. It is only when the effect of an individual member's behaviour has a permanent effect on the behaviour of others within the organisation that it can be said that there has been a "mutual behavioural change," which therefore indicates "mutual learning." It is then that this organisational learning and the capacity to take organisational action can be seen as an emergent property of that collective individual learning.

Senge identifies five 'disciplines' (Senge, 1990) as ingredients that are essential for a learning organisation. The first four disciplines are based around personal or individual qualities, such as a manner of thinking, a commitment to continuous discovery, a way of perceiving issues, encouragement and motivation, and the use of shared views. The fifth discipline, however, deals with the culture of the organisation to provide the conditions that facilitate the creation of interpretative knowledge. It requires that an environment be established where the previous four disciplines are encouraged and can be practised, where there is a desire to operate collectively and no personal aspirations for gain, nor any need for defensiveness. Senge believes that it is in such an open and learning environment where new and different concepts can be raised and built on that groups, and therefore organisations, can learn. That learning thus becomes part of the organisational memory: This memory consists of sets of shared previous experiences that are important shapers of future action.

Epple, Argote, and Murphy (1996), in their discussion of knowledge acquisition and transfer, talk of this concept of an organisational memory and promote Levitt and March's argument (in Epple, Argote, & Murphy, 1996) that organisations not only learn from their own experience, but from the experiences of other organisations (where individuals can pass on that information). As a result of such transfer of knowledge, the learning organisation is said to benefit by increases in efficiency.

In terms of the learning theories discussed previously, a learning organisation must allow both the Taught and Discovery methodologies to operate simultaneously. There must be opportunity for research, innovation, and divergence from the 'normal' course and a provision for an amount of resources to be expended in this way. There must be an acceptance that there is no 'right' answer and an attitude that improvement is always

possible and achievable. Nevertheless, there must also be a facility whereby information regarding the best current practice (which might be decades old or have been updated earlier the same day) can be accessed and copied or adapted. A mix of the two methodologies is therefore necessary, though the formula of that mix will depend on the organisation and its environment.

Stata in Senge (1990) claims that, because of the Tayloristic approach of labour division that has been adopted by most industries in the western world, the workers and the managers have become uncommunicative doers and thinkers. Sata believes that an organisation must bring the two together to enable a learning process to develop. This confirms both Egan's recognition that those engaged in the organisation's activities are vital to that organisation's (or industry sector's) improvement and Drucker's (1998) view that feedback is the most important learning principle.

A further requirement for learning seems to be the ability to reflect on past experience to modify future thinking and behaviour. The role of reflection in individual and organisational learning has been considered in detail by Argyris (1989) and Argyris and Schon (1976). Argyris in particular has studied the role of reflective practice in organisational learning.

Perhaps one of the most important principles supporting the COLA review process is that of reflective practice. Reflection manifests itself through enquiry (Day, 1993) and evaluation involving problem solving and reconstructing meaning. It is an iterative process, enabling tacit knowledge to become explicit and allowing for the externalisation of interpretative knowledge at each iteration, progressively refining and enhancing the individual's knowledge and expertise through reflection, which takes place by capturing recurrent issues and problems.

Thus, while it is important that individuals actively learn and modify their behaviour accordingly, it is vital for an organisation that the process of collective learning is fostered by the organisation (and its environment). Reflective practice should not be seen just within the context of the individual since it is a social process (Harvey 1998). It is: "….a form of self-reflective enquiry undertaken by participants in social situations in order to improve the rationality and justice of their own practices, their understanding of those practices, and the situations in which those practices are carried out" (Schratz, 1993).

A primary function of COLA is to provide a review process forum for the social construction of knowledge. This kind of knowledge may not already exist since it is concerned with the alignment of norms and values within the group; the group needs to establish what can be reasonably expected from each of its members. This knowledge is socially constructed because it is established through discussion and reflection upon past experience and future expectations. Such knowledge, when it is generated, does not belong to an individual, but can be seen to exist collectively within the group and is subject to constant renegotiation.

Reflective practice can have benefits for the organisation as a whole since it contributes to individual learning, and when seen as a social process, it contributes to organisational learning. Individual learning on its own is not sufficient (Jones & Saad, 1998) for the organisation to maximise the benefits to be gained from reflection. Individuals move around the organisation from team to team. They do not necessarily share their

knowledge and experience with colleagues because the mechanisms do not exist to support sharing, or perhaps they just do not know how, or culture does not facilitate sharing.

Organisations must therefore be aware of the various methods, views, and attitudes, and how they affect collective and organisational learning.

Various views have been put forward on knowledge management strategies, and many of them can be seen as complementary rather than mutually exclusive (Stewart, 1997).

The National Computing Centre Guidelines suggest two approaches to knowledge management (Vowler, 1999): manage the people or manage the knowledge The first approach can be seen as suitable for dealing with interpretative knowledge, whilst the second is more suitable for dealing with soft knowledge.

Managing the people requires social, cultural, and philosophical skills in order to be able to encourage individuals into the mindset of openness and sharing. This approach is primarily concerned with interpretative knowledge, whilst technologists are primarily concerned with explicit knowledge, which requires the use of databases, networks, and so on.

In reality both of these approaches are often undertaken simultaneously, as judgments are made about knowledge which can be beneficially codified and knowledge which is best held within individuals and the social system. Hansen, Noria, and Tiernay (1999) advise against this, recommending a strong application of either codification or personalisation. The forced introduction of a computer system that stores information previously held informally within the social system is an easy way to alienate those who are intended to use it!

Cola and the Cola Environment: Knowledge and Organisational Learning through Reflections

The product of the research is the Cross Organisational Learning Approach (COLA—further details may be found at is.lse.ac.uk/b-hive), which has theoretical perspectives in the arena of organisational learning, underpinned by the principles of reflective practice and knowledge management, and supported by the development of an information system that facilitates the capture and dissemination of organisational knowledge.

The B-Hive project identified the problems confronting the construction industry as complex, with different participants holding both different understandings of the issues and having often competing goals, and where there are no certain and agreed measures of inputs, processes, and outputs. The set of approaches and methodologies constituting *problem structuring methods* (Rosenhead, 1989) were adopted both as tools for the academic/industry team to agree on their approach, and later as part of the interventions themselves. An exercise using Strategic Options Development and Analysis (SODA) (Eden, Jones, & Sims, 1979) led to the identification of the issues of post-completion

review in the leisure company and the Management of Project Changes in the utility company as key aspects of the process, where unexploited opportunities for learning were being created in a partnering and value-sharing environment. B-Hive has run one-day post-completion review workshops with the leisure company. The first two exploratory, post-completion workshops were run on the basis of value engineering techniques (Connaughton & Green, 1996), drawing on the experience that the leisure company's representative had in applying this technique. A major constraint on designing a workshop process for project review is the availability of staff and the length of time that they are willing to spend at a workshop. The experience of the exploratory workshops indicated that attention had to be paid to pre-workshop activities, and some activities that are normally carried out within a workshop had to be moved to the pre-workshop phase.

These considerations led to the development of a process model (a diagram of the COLA process and description of its elements may be found in the Appendix). This was an attempt to identify processes to assist in project review in order to: promote the sharing of knowledge across organisational boundaries, and identify the role that information systems can play in supporting the process. It also played a major role as a communication tool to build consensus amongst the B-Hive project team and to inform other workshop members about the process. The model enabled a dialogue between project members about the status of organisational knowledge and learning and, through debates about the concept of a bank of acquired knowledge, the acceptance of the notion of tacit knowledge (Polanyi, 1967). This also enabled an approach that placed emphasis on managers' understanding and interpretations of the world in which they work as a basis for moving towards action (Introna, 1997).

The COLA review process records and monitors key issues, decisions, and actions surrounding these key issues, ensuring that implicit learning is not lost throughout or on completion of the construction project. The term 'review process' is used which allows a great deal of flexibility in that many different procedures may be performed for review (e.g., workshop, meeting, teleconference, videoconference, or any combination of these). The B-Hive project mainly used workshops.

There are many situations that may necessitate the review process being triggered, for example:

- Programmed Review
- Post Completion, leading to a review where the scope encompasses the construction project as a whole
- Stage Completion, scoped for a particular stage of the construction process
- Time Based (e.g., period end, monthly)
- Non-Programmed Review
- Issue Resolution, necessitating a review to address a particular problem of high priority, for example running late or over budget, or perhaps a technical difficulty
- Innovation, where a team has been innovative either in process or use of materials; this experience should not be lost

However all reviews facilitate critical reflection on past activities, a focus on individual and organisation learning, and allow change to future actions to increase value to all participants.

Information Systems and Technology

Within B-Hive we have developed the information system required to support the COLA workshops. Technology can assist organisations in making effective use of their assets (Solvet Ltd., 1997). Such claims, while implying a more efficient utilisation of the artefacts an organisation has purchased, such as machinery, computers, and so on, can also apply to the concept of intellectual capital (Edvinsson & Malone, 1997; Stewart, 1997), that is, the availability of useful knowledge within an organisation.

This is particularly true with organisational learning, since no single application or technology holds the knowledge from individuals within an organisation. Rather, it requires a collection of people and many application types, for example, databases, spreadsheets, word processors, CAD systems, multimedia, workflow, document management, and e-mail. The challenge therefore is twofold—to convert relevant categories of soft knowledge into information that can be stored, and to make the stored information available to those who require it irrespective of which part of an organisation they work for or their physical location. An intranet is a mechanism that can be used to provide this access. As Peddler, Burgoyne, and Boydell (1997) explain, the networking of computers allows individuals' experiences to be fed back into the 'collective organisation'. Peddler and colleagues claim this makes information available that had previously been passed on informally, for example "by the coffee machine." However, it would also be true to say that this is necessary since computers, re-organisation, and 'progress' in general have reduced the opportunities for such informal communications.

An extension of this combination of technology and philosophy is the extranet, which provides access to information across organisational boundaries. This is especially applicable for organisations that are cooperating within a group. The use of extranet technology can provide a collaborative virtual environment where individuals can access (where permission is granted) any partner organisation's intranet. In this way individuals, organisations, and the partnership can make use of previously gathered information and past experiences, and learn from them more easily, regardless of their location, either physically or within the partnership.

The COLA information system supports pre-review event, review event, and post-review event activities. Pre-review event information is requested (via questionnaire) to identify major problems and issues throughout the life cycle of the construction project. Currently the questionnaire is circulated to the construction project team members representing, where possible, all organisations of the partnership.

As a result of this data-collection exercise, problems and issues, arising from the construction project, are collated, categorised, and prioritised, ensuring that only those perceived to be of major importance by the participants are presented for consideration in the review event. During the review event, actions, decisions, and responsibilities are

assigned and recorded against each problem or issue. The review process is designed such that soft knowledge is elicited, yet interpretative knowledge is simultaneously created and externalised. The information system will monitor the performance and value of decisions made and actions taken. This information is currently held on a Microsoft Access database.

The database holds the descriptive information on the problems and issues. Each will have supporting historical data dispersed throughout the partner organisations held in many formats such as word-processed documents, spreadsheets, databases, and drawings. Where feasible, there will be links between the data held on the COLA project review database and these supporting files, and access will be via an extranet.

The COLA information system is not perceived as consisting solely of the Access database system. The primary function of the database system is to capture and process data centred on the review process, for example the following data may be captured and held:

- Pre-review event
  - Data on construction projects and partnerships enabling project team members to access construction project information required to set the context of issue(s) under review.
  - Data on events that may trigger a reflective review, for example the end of a construction stage or post completion or a significant issue.
  - Issue—this may be as a result of a major problem or perhaps where a course of action has resulted in a positive impact and the partnership does not want to lose the associated knowledge. The system facilitates the classification and prioritisation of the issues prior to the review so that a focus is maintained on key business issues during the review event.
- Review event
  - Major decisions, actions, and responsibilities from both the historical perspectives in terms of the construction project and those defined in the review event are captured online during the review event.
- Post-review event
  - The effectiveness of decisions and actions taken is monitored to assess any value improvements resulting from the review process.

This information is made available to all partner organisations regardless of physical location and may be accessed through an extranet utilising World Wide Web-based technologies.

Research Outcomes

- *Skills and knowledge transfer:* The COLA review process adopted useful, practical techniques that were not dependent on technology. The use of these techniques and the workshop structure made a substantial contribution towards convincing people of the benefits of adopting a knowledge management approach.
- *Awareness of corporate knowledge assets:* The research project raised the awareness of knowledge as a corporate resource. All organisations now understand what their valuable knowledge assets are, and have a mechanism to identify them in future. More importantly, the same mechanism also shows how that knowledge may then be used.
- *Increase utilisation and management of corporate knowledge assets for maximum return:* The research targeted the knowledge chain, identifying and capturing knowledge, facilitating use and reuse. The unambiguous way in which this was done ensured that the knowledge needed for specific tasks can be identified, defined, and located throughout its life cycle.
- *A central knowledge repository showing links with information and data:* The large number of disparate and often tacit sources of knowledge hampered centralised collection of knowledge across the organisations. However, the research clearly demonstrated the links between data, information, and knowledge to the individual and eventually to the work processes. This showed that certain knowledge may be explicitly mapped and codified, and linked to other internal and external sources of knowledge, information, and data.
- *Improve accessibility and information sharing between employees:* The knowledge mapping described by the COLA model allows accuracy in locating and transferring tacit and explicit knowledge, speeding access and simplifying retrieval and transfer.

Conclusions

To date COLA has been successful within the context of the research project in that many of the key issues surrounding organisational learning, as discussed in this chapter, have been addressed. One of those key issues is that during the life of a construction project, problems may arise or events occur that result in a non-standard approach being adopted. Normally this would lead to actions being taken that give rise to the benefit of the project (e.g., cost reductions, shorter construction times, new working practices). This leads to the generation of knowledge of how to deal with future occurrences amongst the project team. However, this knowledge is socially constructed and may lose context and meaning as the project team is split on completion of the building. Thus, in reality this knowledge is very rarely made available to other projects. B-hive and the COLA process have provided the means by which some of this knowledge may be generated, externalised, and stored, readily accessible to all partner organisations.

The COLA approach has most definitely fostered a spirit of trust and cooperation amongst, at the project team level, individuals from the different companies and, at a higher level, between partner organisations, thus addressing one of the major concerns of Latham. This was found to be particularly true when COLA reviews were conducted on Whitbread Hotel construction projects.

However, as with many projects, a number of issues have been raised by the research that could not be addressed at the time.

Practical Tips and Lessons Learned

- Individual learning on its own is not sufficient for an organisation to maximise the benefits from reflection.
- Reflective practice benefits the organisation and, when seen as a social process, contributes to organisational learning.
- Mechanisms for sharing individual knowledge and experience need to be addressed explicitly by organisations.
- Technology can assist organisations in making efficient use of their assets, including "intellectual capital."
- The pilot project (COLA) resulted in improved accessibility and information sharing between employees, enabling knowledge and learning captured to be shared for the benefit of future projects.
- The process fostered a spirit of trust and cooperation amongst project individuals, organisations, and stakeholders.

Future Research

It is intended that the COLA approach will be incorporated into future research initiatives so that the approach can be further refined and that such issues may be addressed. In particular there is work on-going that aims to integrate the 3K model, the Integrated Knowledge Architecture Model—IKAM (Onions 2002; Onions 2003), and the COLA approach. IKAM suggests a holistic and systemic development of a knowledge strategy that focuses on all aspects of an organisation. IKAM is a programmatic investigation and analytic tool and approach that commences with strategic and operational objectives; factors in the organisation, culture and communication, people, and processes; then examines the knowledge itself and how it is known; introduces the technical infrastructure; and concludes with a selection of appropriate tools, technology, and implementation plan. Some preliminary work has already been undertaken as part of a project at the Department for Public Enterprise in South Africa.

Future research will centre on the following major issues:

- What approach and techniques? There are many approaches and techniques that are put forward as solutions to knowledge management and organisational learning issues. 3K and IKAM help organisations to identify what is best for the organisations and help develop an appropriate LM and OL strategy. COLA will facilitate the development and implementation of that strategy.
- Ownership—who owns the captured 'knowledge'? The research project was concerned with the capture, storage, and dissemination of knowledge from different organisations. Whilst organisations operate as separate entities, the concept of ownership of knowledge is relatively simple and becomes a matter of concern only within the individual organisation's boundaries. Sharing of knowledge with other organisations has always occurred, but has tended to be through informal processes. Furthermore the nature and content of that knowledge has been highly selective, that is, only letting others know as much as is needed and no more. The B-Hive project throws away these old conventions and encourages openness and sharing, promoting the creation of a rich repository of knowledge contributed by and accessible to all participating organisations. So who has control over this resource? Where does it reside? How is it communicated and who controls its communication? What happens when one of the organisations leaves the partnership? Do they still have rights of access to the repository of knowledge that they have contributed to?
- What is lost through elicitation and externalisation of knowledge? Whilst COLA has demonstrated that it is effective, it is still a relatively young, and perhaps crude method, and cannot lay claim to being able to fully store and disseminate all appropriate organisational knowledge. Furthermore, when tacit knowledge is externalised, is meaning and context lost? Can explicit knowledge still be classed as knowledge? Once it has been codified, does any loss of meaning and context render it information? If so what is the value to the organisation of that which is lost?
- The technical infrastructure required to support knowledge sharing will need to be defined. This will involve identifying the processing and communications hardware and appropriate software and applications to facilitate access to knowledge by all participating organisations. This architecture will, of course, require effective management to deliver the level and quality of network service required to support such knowledge sharing in a dynamic, evolving environment (Lupu & Sloman, 1999; Puliafilto & Tomarchio, 2000). It is also the case that the technical infrastructure of the early 21st century will involve both static and mobile networked systems (Sahai & Morin, 1998).

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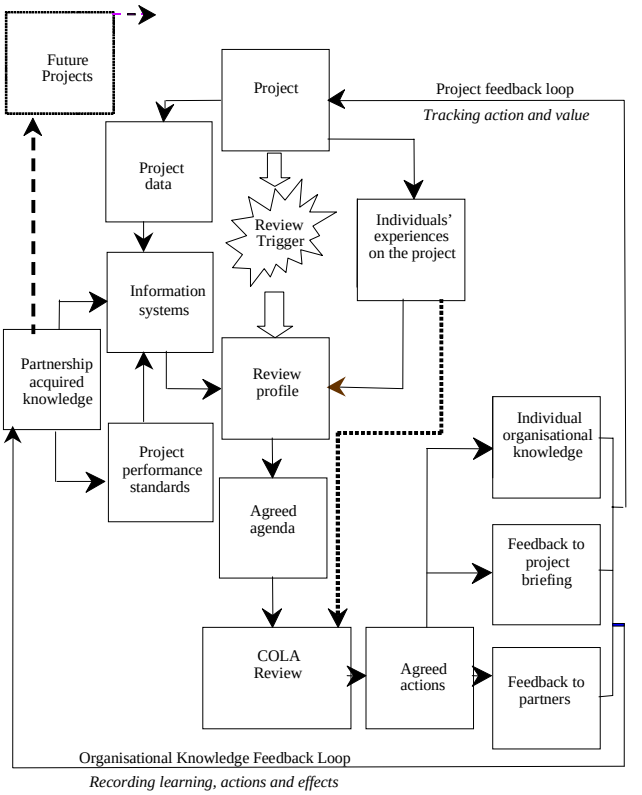
Appendix—The COLA Process



Model Descriptors

- **Partnership Acquired Knowledge** - The knowledge built up within a partnership. This is in part written and formal, and in part the accepted ways of working developed within a partnership.
- **The Project** - The construction project under review.
- **Project Data** - Briefs, plans, meeting records, conditions, incidents, performance information, people and organisations, business results, and so forth.
- **Project Performance Standards** - Criteria by which the project is measured: requirements, benchmarks, model costs, building regulations, and so forth.
- **Information Systems** - These may be paper based or computer based. B-Hive has developed, as part of COLA, a model for a system to collate, analyse, and report on the comparison between the current project and past projects. The specification includes analysing questionnaire returns and prioritising issues, as well as monitoring the effectiveness and value of actions.
- **Review Trigger**. The event that sparks the review—this may be the end of a stage of the project or a critical event in the life of the project.
- **Individuals' Experiences on the Project**. Each individual will have a different view of the project depending on their role and experience. The **COLA** process values and uses this knowledge of the project.
- **Review Profile** - The individual views are collected in the pre-review stage—through questionnaires for more formal reviews. These are set alongside the data and performance standards held in the information systems.
- **Agreed Agenda** - Prior to the review there will be individual discussion on the profile to determine the key areas for discussion and decision to meet the participants' objectives.
- **COLA Review** - The review may take different forms. Depending upon the risk and value attached to the issues to be considered, it may take the form of a day workshop or it may be part of a regular project meeting. A workshop for a high-risk/value review would use an appropriate Problem Structuring Method or problem resolution technique, and require an external facilitator. B-Hive has developed a workshop methodology for such reviews. A COLA review leads to a set of owned and agreed actions.
- **Agreed Actions** - It is crucial to the development of organisations and partnerships that actions are placed upon individuals who have the power and authority to see them through to completion. Commitment to an action also includes agreement of criteria for monitoring its implementation and measuring its effectiveness.
- **Individual Organisational Knowledge** - Each member organisation of the partnership will take the learning gained during the review process, and may use it in other projects and to develop their competitive advantage.
- **Feedback to Project Briefing** - The agreed actions are fed back to be used to improve current and future project briefs.

- **Feedback to Partners** - Within the partnership it is critical that all organisations share the knowledge of the agreed actions. This adds to the Partnership Acquired Knowledge—allowing the benefits of partnering to be realised and shared between all members to keep the partnership ahead of the competition.
- **Feedback Loops** - The **COLA** process is based upon feedback that supports the partnership by tracking the agreed actions, their value impact in the current and future projects, and feedback that records learning and makes it available for future collaborative ventures.