

Infrastructures for construction collaboration: The Cross Organizational Learning Approach¹

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ABSTRACT | The construction industry is recognised as a fragmented collection of service providers, who have, in recent years, benefited from client-driven partnerships focussed on value improvement. Most of the improvement has, quite naturally, been focussed on bringing value to the client, using Value Management tools to derive the project objectives and associated such as factors. It is the mutually beneficial realisation of shared objectives, together with a joint commitment to continuous improvement, that is often seen as the foundation of sustainable business partnerships. However, relatively little work has been done to develop complementary models of cross-organizational learning and feedback improvement within construction teams. Tackling these issues has formed the focus for the work reported here and has resulted in the development and use of a new approach to project reviews known as COLA – Cross-Organizational Learning Approach.

KEYWORDS | project review, post-construction review, feedback, organizational learning, inter-organizational systems, problem structuring methods

1 Introduction

“The Construction Industry has many innovative ideas that get lost because there is little systematic feedback. Lessons should be captured so they are applied on future projects” *Seven Pillars of Partnering* (Bennett and Jayes 1998)

“Alliances offer the co-operation and continuity needed to enable the team to learn and take a stake in improving the product” *Rethinking Construction* (Egan 1998)

During the 1990s the construction industry developed an increased focus on the notion of partnering reflected in such reports as *Trusting the Team*, *Rethinking Construction* and *The Seven Pillar of Partnerings* [1, 2, 3]. The research reported here drew on the context of such ideas in order to establish a particular innovation: cross-organizational learning and feedback improvement *within* construction teams in partnering relationships. The work was undertaken within a multi-partner action-research project with the goal of developing understanding, practices and commitments for improved team working in construction through the joint work of academic researchers and industry participants including client organizations. The project was

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committed from inception to the action-research approach [4, 5, 6] so as to exploit fully the inputs and insights from both the industrial and the academic collaborators [7 2001]. As an action research project, the work developed through intensive interaction and debate within a structure that drew on many contemporary ideas drawn from construction management (value management, partnering, lean construction etc.) [8, 9, 10], as well as from the field of information systems, problem structuring methods and inter-organizational systems [11, 12, 13].

The principal output of the project is a collaboration infrastructure and process model to sustain an enhanced project review approach and to support (multi-)organizational learning within the construction domain in an environment where projects are carried out by temporary multiple organizations [14]. This approach is named the Cross-Organizational Learning Approach or COLA, and was developed, refined and assessed through a sequence of project case studies as described in this paper. This COLA process provides a structure within which multiple participants in a construction project can: reflect on project processes, successes and critical incidents; develop agendas for the discussion of improvement opportunities; prioritise and commit to change; and disseminate and sustain initiatives for change. The process is supported by a prototype software system, ColaBase, which provides an information platform for the COLA process and offers information management functionality to promote take-up of improvements and to track the value of their effects. In developing the COLA process, this research has also extended the range of applications for the use of the Strategic Choice Approach [15] and has demonstrated that Problem Structuring Methods [13] can become part of a continuing business process [16].

2 Establishing Action Research

The aims of the B-Hive project at the outset were stated in the following terms:

1. Analyse the business, technical, human and organizational issues associated with adding value to construction projects through teams.
2. Identify the required and desired changes in work processes and information management in order to deliver value to all investing parties.
3. Demonstrate by application on selected live projects, how emerging information and communication technologies can support re-structured project organizations that are committed to continuous value improvement.
4. Disseminate the performance benefits of these new value added enablers.

The work started out, *inter alia*, by exploring the role and relevance of modern information and communications technologies to foster the use of information within construction projects, between projects and between project partners within the construction domain. It sought to achieve this through a variety of approaches but there was a particular commitment to the use of Problem Structuring Methods (PSMs), both as a research tool and as the foundation of new business processes. The project made use of Strategic Options Development and Analysis (SODA) [17] in the early stages to refine the understanding of the problem area addressed; Soft Systems Methodology (SSM) [18, 19] was used to explore the information requirements for collaboration; while the Strategic Choice Approach (SCA) [15] was used as the basis for the developed COLA process. The Appendix provides a brief overview of each of these PSMs.

Technology, it should be understood, is seen here as expressing not just the potential of the hardware, networks and software of contemporary IT, but also the knowledge and skills implicated in their appropriation and use. In this sense technology is deeply embedded in many innovative schemas for evaluating, reshaping and promoting organizational performance. The project commenced with high hopes to harness such technology, but early in the research, analysis of the technology platforms and resources, and the principal

project focused systems of the industry partners, identified the lack of an 'IT culture', lack of technological resources and fragmented networks [20] as significant inhibitors and the initial intentions of the work were to some degree frustrated by these findings. However, the research was always intended to reflect an approach that was driven by more than boxes and wires, and that was aware of and sensitive to cultures of management, the norms of professional disciplines, and the broader socio-technical and business environment. In many ways these findings confirmed the project's commitment to seeing IT based innovation as necessarily rooted in organizational innovation and processes of change, rather than as a technological 'fix'. This also gave an added emphasis and significance to the creative interaction between academic and industry participants within the chosen action research approach.

Baskerville and Wood-Harper [21] argue that there are a number of models of action research differentiated by the process model used, structure, mode of involvement and the primary goals. Following this classification the model adopted by the B-Hive project fell broadly within the category of canonical action research characterised by an iterative process model; a fairly rigorous structure; a researcher involvement that was primarily collaborative (but with some aspects of facilitation); and with primary goals of both organizational development and scientific knowledge. The action research approach adopted allowed the participants to debate and analyse these problems and to find their own specific and situated points of departure for the substance of the research, as described below.

The essential element of the early stages of the research was then to identify construction projects that would be suitable for action research activities. This was undertaken through a study of major projects being undertaken by the main construction and client partners. In one case this was a joint project, where both the client and the main contractor were B-Hive Project members. As work developed, however, it became impossible to constrain the focus to projects

which involved principally B-Hive partners. We see this as strength, rather than a weakness as an action research study, indicating the research teams ability to follow the real interests and concerns of the partners, rather than adopting some artificial constraint on areas of study. In this way many other construction actors, including other major companies, consultants, sub-contractors and specialists became involved in the research – in excess of 50 by the end of the project and after the final workshops had been held.

3 Identification of Opportunities

Following the initial analysis of ongoing construction projects two workshops were held in late 1997 to build on the common understanding achieved between the partners and to refine a specific focus for action research and suitable live projects to work within. These workshops made use of the Strategic Options Development and Analysis (SODA) approach to identify and prioritise areas of concern within multi-party construction projects. The outputs of the workshops were instructive, but also a little confusing. What was revealed was a broad consensus about the problematic issues of collaboration and communication within the construction domain – lack of communications, shifting requirements, negotiation of professional boundaries, limited views of responsibility, a lack of trust, resistance to change, lost and limited information, short-termism etc. However, less clear was any consensus as to where to start to address these issues once we move beyond blind technological faith or straightforward self-interest. Some saw progress as essentially driven by improved project management structures, some through transparent and consistent information, while others focused on particular problematic relationships or key processes such as briefing. At the end of this debate a more focused approach was developed, driven particularly by the client partners in B-Hive. Their concern, which provided a point of departure for all the subsequent activities, was with the ability to handle in-project (often on-site) problems, and to learn

the lessons from them. In addressing this concern, B-Hive developed an approach consistent with contemporary notions of organizational learning and in particular knowledge creation and knowledge management [22, 23]. Indeed, it is notable that knowledge management was visibly becoming a part of the discourse within the industry as the project found its focus. However, in contrast to the focus of this project, which emphasised the externalisation of tacit management knowledge, the industry discourse (at that time) was far more oriented to the explicit, emphasising effective document handling systems and best practice and project information databases.

Subsequent research was then targeted at issues of review and change management (R&CM): change management here referred to the reactive management of change in the project brief or adaptation to unexpected site or project conditions, rather than the proactive management of organizational change. Observation of approaches used for project review, and change management processes, highlighted a number of important contextual and constitutive issues. For example, when review or change management is seen as an overhead, a process of blame allocation, or a power play, it is not well received. Nor can it prosper if it is just the 'tidying up' of the last details of a project. There was, however, an understanding that this is a potentially important (even vital) activity and one from which all participants have opportunity to benefit. For one client partner, the primary concern that emerged was with the activities involved in the review of discrete construction projects (post-completion review or phase review), but in situations in which similar projects would be commissioned on a regular basis often from the same contractors within a partnering arrangement. For another partner the focus was on the management of changes to the brief occurring *during* construction projects, including the handling of innovations proposed during a project, or the handling of unpredicted site-based problems. Each of these scenarios require an assessment of actions and value associated with the project concerned, their management within and between projects, and should

aim at producing knowledge and organization processes facilitating a continuing partnering process. As Bennett and Jayes [3] identified, and this project confirms, the lack of a process for project reflection and feedback is real a barrier to effective partnering.

Further debate on the aims and practices of R&CM revealed that the aspirations for project review involved a whole process of review, not just isolated review workshops. On this basis the research team were able to sketch and gain commitment to an action research agenda that considered how relevant information is gathered, stored and disseminated, how individual stakeholders can participate in and learn from construction project review activities, and how this learning can feed into future projects and organizational practices. Change management concerns, emphasising the process of handling proposals for changes arising through a project, posed such questions as: how do the various members of the construction team come to appreciate the consequences of individual changes, from their own perspective and those of others; how do they develop some resolution of these differing views and reach consensus or accommodation; and how can 'buy-in' on the resulting actions be achieved? In each case there is a concern with how the (potential) learning arising from engagement with individual problems, assessment of innovation proposals, or perceived successes, could be captured and made available on subsequent occasions. This work revealed an overall and pervasive fear that important information is lost or ill exploited, and in particular that decisions are made without the benefit of substantial frameworks of participation and analysis.

Reflecting on these findings, the research team determined to consider project review as a process of debate, knowledge creation and an opportunity for learning, and not as judgement or even primarily of information extraction, structuring and sharing. The approach developed was one whereby the individuals involved suggested both the topics and criteria for

review and evaluation that they wish to use, as well as the way they found appropriate to assess a project or project activities and processes in relation to these. Out of this grew the particular focus of the later phases of research, a process through which R&CM could offer shared benefits to all partners. This became known as the Cross-Organizational Learning Approach (COLA).

4 COLA in the making

With the refined focus for action research, and with the commitment of B-Hive partners, two interventions were undertaken. First, post-completion review workshops for two refurbishment projects, delivered within a newly agreed partnering arrangement, based on brainstorming and value management techniques were planned and led by a B-Hive industrial partner familiar with these techniques. Second, academic B-Hive members undertook a review of specific in-project problems and the identification of the impact and handling of changes occurring within a large complex civil engineering project working under a risk and value sharing contract. These review activities identified problems encountered in the management of the individual projects, the benefits gained (and potentially available) from partnering and other new contractual forms, and their relation to the creation of value for both the client and the contractors. Among other things these review activities constituted a means for eliciting concerns and suggestions from involved sub-contractors for future project management improvements. It was notable that these meetings were seen as a radical departure by many of the sub-contractors, and they were pleasantly surprised to have their contributions, sought, valued and developed. These reviews confirmed the approach of developing a review process that produced commitment to change through the evaluation of projects involving both site-based managers and professionals, and key representatives of company head offices responsible for project oversight.

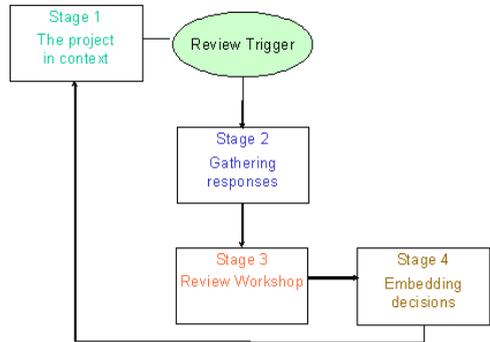


Figure 1. COLA Review Process

The emerging COLA review process that resulted is depicted in Figure 1 as a 4 stage process. A project in its inter-organizational context (stage 1) leads to some review trigger, which in turn leads to a phase of agenda building and information gathering (stage 2) prior to a review workshop (stage 3). Following a workshop a process of communicating and embedding decisions and insights (stage 4) is undertaken to promulgate the workshop findings and to sustain and give impetus to the commitments made.

Six more reviews followed, based on the emerging model of a participative and negotiated evaluation (COLA) with the feedback from each workshop forming the basis of the revision and refinement for subsequent reviews. Three of the six were post-completion reviews for major building and estate renovation projects under the same partnering arrangement as the pilot reviews; one reviewed a civil engineering project that was seriously behind schedule; one reviewed a partnership covering a number of small civil engineering renewal projects; each of these involved the final client. The sixth workshop involved the main contractor on a prestige design and build refurbishment project along with their principal suppliers. Each workshop had between eight and fifteen participants representing varied stakeholders including client property division and the operational management; the main contractor; project management consultants; quantity surveyors; architects/designers; and specialist trade contractors.

Table 1. Experiences of working on a project – critical events

The interface between construction of shell/core and tenant fitout was not really appreciated at the time of 'tender' nor in the project safety plan.
The progress of the roof construction was well below standard and had a significant effect on the overall project
Time required for demolition was disproportionate to the overall construction time (or the time allowed for new construction too short)
Procurement took too long with thus the contractors not on board early enough to permit team building and allow sufficient contractor input to design development.
The client's real objective was not always fully understood (probably impossible)
Client unwilling to accept the 'ideal' programme duration submitted in the contractor proposals. Shorter construction period imposed, compromising the detailed programming and sequence of the base build fitout works
Short construction period compounded when refurb of xxxx fell behind and squeezed fitout further

Apart from the first workshop covering the delayed civil engineering project (which was preceded by highly informative but lengthy and costly interviews), the first stage in the evolving COLA process was the circulation of tailored questionnaires to all participants covering the ranking of aspects of the project including management of time, team relations and profitability (value). The questionnaire also included space for free text comments and asked for details of innovations, critical incidents and lessons to be learned from the project³. Table 1 shows a subset of responses to the question on critical incidents etc. drawn from various workshops. All questionnaires were returned and all contained a number of comments, many a considerable number. However, requests for supporting quantitative data were not met. This lack of quantitative data was addressed specifically in evaluation of the reviews. With almost no exceptions participants believed that provision of the detailed quantitative data would have been unhelpful. They had other opportunities for reviewing data within their company; in this context they recognised that it would have diverted attention from debating the managerial and business processes. The questionnaires took on average about one hour to complete and were judged by participants to be a cost and time effective way of eliciting relevant project information. Analysis of the responses allowed a profile of the project to be developed and candidate decision areas for a workshop to be formulated. This

information was circulated to participants prior to the workshop. The free text comments often were reported as more useful than the rankings, but many participants observed that the process of ranking provoked comments.

5 Issues of workshop format

Issues of workshop format were explored as COLA developed. The model for the workshops themselves was developed from the problem structuring method known as the Strategic Choice Approach (SCA) but, in order to complete a workshop within the limited time that participants were available, typically six hours, the equivalent of the shaping phase of SCA was carried out before the workshops. Equally, the nature of the issues and incidents explored in the workshops did not usually exhibit the high degree of inter-connectivity that SCA was designed to handle. However the SCA focus on moving through problems, and its techniques for reaching consensus on prioritisation, exploration and action, provided a valuable basis for the approach developed.

It was apparent from the earlier research that there were strong norms on how construction industry meetings should be conducted: formal agendas, tight chairing, and progression through issues one by one. Traditional

3. ISA sample questionnaire can be downloaded from http://is.lse.ac.uk/b-hive/COLA_materials.htm

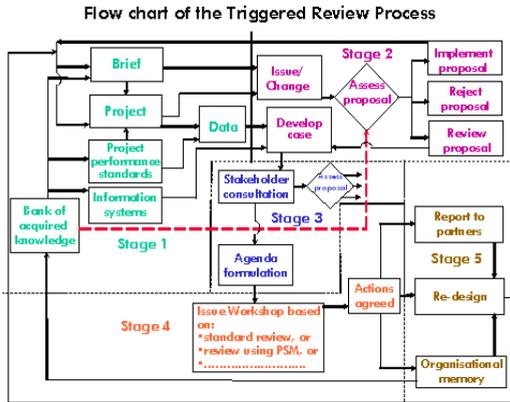


Figure 2. Elaborated Review Process



Figure 3. Example workshop tableau

meetings were characterised by interaction only by the people directly involved in an item, and detachment by others, and attention to dealing with individual issues and assigning responsibilities and liabilities. Such meetings were conducted around tables with large quantities of paper in front of each person. In order to signal that COLA had a different style and purpose, the environment was changed substantially. Workshops were held away from usual site offices and chairs were arranged in a horseshoe shape to allow movement and to attempt to encourage focus on each other rather than on paper. Feedback on this aspect from post workshop interviews was generally positive except in one workshop where the space was too cramped. Nonaka and Takeuchi [24] draw attention to the importance of *ba*, the place where people interact in both its locational and its mode-of-use aspects, in enabling or inhibiting knowledge creation, a view that this research endorses.

In order to build confidence, and to recognise that all projects have elements of successes to be learned from as well as outstanding issues, project successes were considered first. The presentation of the candidate decision areas was on Post-it notes on flip-charts. This presentation allowed for easy modification of concepts by participants, and for patterns, relationships and overlaps to be displayed by positioning and linking. This also allowed the modification, identification and prioritisation of selected decision areas for further consideration

and then led to the exploration of action options under the selected areas. Emphasis was also given to ensuring the inclusion of issues arising since the questionnaires had been completed, following experience in an early workshop. Because of the visual nature of the representation of ideas, the charts were photographed with a digital camera (figure 3) as well as the recording of the sessions on tapes and through observers' notes.

The developed COLA technique placed the responsibility for identifying overlap, conflict and routes to action with the participants rather than the facilitators, who focus on process. Each workshop generated a limited number of actions (generally three to four), with responsible actors and tentative deadlines. By bringing together people involved in the projects, change was mandated on issues long considered to be major obstacles to efficiency and which the regular meetings of the partnership, absorbed with the day-to-day activities of projects and with more rigid and itemised agendas, had not. This suggests that changes in the ways that proposals for change and learning opportunities are generated and formulated has a significant influence on their rhetorical power, and therefore their political and organizational effectiveness.

Unsurprisingly, the formulation of issues and solutions tended to reflect the discourse of the organizations involved. However, similar issues in different work-

shops were addressed in diverse terms using such frames of reference as risk management, lean construction and business excellence. The use of these frames situated the issues in terms of a continuing and contextual management practice, and is an important means of linking knowledge creation to ongoing organizational debates and discourse. The solutions or insights found were thereby both more acceptable, but potentially less critical and focused, and the rôle of the facilitator was crucial in opening the possibility of double loop learning [25] by moving attention on to the organizational barriers to identified beneficial actions. This allowed attention to be focussed on what made current practices meaningful (but perhaps dysfunctional), and what changes in organizational norms, culture and vision would be necessary to make, in Checkland's [18] terms, systemically desirable changes, become culturally feasible.

As a measure of the success of the project we saw ideas and issues developed in COLA reviews taken up and considered at higher management levels. For example, one review led directly to the reassessment of the whole partnering process within a client company in order to consolidate the lessons that had been learned in the first two years and to provide new directions. Another set of reviews identified key issues of how risk is identified and managed and how and when sub-contractors are involved in decision making. Another review identified issues around design management and team relations, and was distinctive in that it was the only one that did not have the client present. While this was not ideal, the review did allow us to explore an assumption that reviews could be conducted across any appropriate layers of the supply chain.

Evaluation of the COLA process continued throughout the project, largely in a formative mode. Rohrbaugh's [26] Competing Values Approach for group processes effectiveness, modified for a multi-organizational setting, was used for the design and analysis of a series of post-workshop questionnaires. Over 85% of participants returned questionnaires which revealed a high

degree of satisfaction with the approach. Post workshop interviews were also held with most participants which provided richer feedback on the processes and possible improvements. These highlighted a wide range of issues most of which were incorporated in later workshops. There was however a range of opinions on when to hold post-completion review workshops. Earlier ones were wanted by some to deal with issues while they were still fresh, others wanted later ones so there was more experience of the facility in use; many suppliers commented on the lack of feedback they conventionally received on this, as opposed to on issues at handover (snagging).

6 Discussion

This research identified and addressed the lack of any existing processes for the routine inter-organizational review of construction projects for the purposes of learning and adding value, as well as the absence of any expectation that such an activity will happen. More generally, while construction professionals in interviews acknowledged their reliance on tacit knowledge, in their communications with other construction project members their tacit judgments were often evidenced through explicit knowledge statements. The COLA review processes developed here shows that discussion and sharing of the tacit understandings and knowledge that underlies people's expertise is possible and can be positively received; even in an environment, like the construction engineering culture, which places a high value on calculation and the explicit management of risk. Thus the use of facilitated workshops enabled agreement on significant improvement actions to be reached across organizations. Going further, the research shows that the outcome from such discussions and the understanding achieved can be incorporated into better ways of working. To achieve this, COLA provides a process by which a programme of commitments to change become shared by actors from a range of organizations through making explicit the links between incidents at site level and (inter)organiza-

tional procedures that support or inhibit value enhancing initiatives. It is important to emphasise that the COLA process does not simply record, but rather actively *creates*, organizational and cross-organizational knowledge. The research also shows that recognition of the role and contribution of clients, particularly knowledgeable clients responsible for a continuing programme of work, is crucial to the successful development of change initiatives. Hence, COLA should be seen as embedded within a partnering approach to construction which allows the sharing of information between the numerous organizations responsible for a construction project. This also supports a greater emphasis on through-life cost and maintainability.

The COLA approach has been endorsed by all the B-Hive project partners and has been formally adopted by one as a key process for delivering business improvement, used as the basis for mandatory post completion reviews. It has been considered in terms of contributing to improvement in internal partnering between departments within the same organization, as well as external partnering with service and product suppliers. More generally the use of facilitated evaluative reviews has extended within the partner companies beyond the group that developed the techniques, and industrial partners have successfully used the methods in other projects including for the Ministry of Defence, Highways Agency and the Isle of Wight Housing Association.

The research is also notable in that it enabled the tailoring of a problem structuring method to a novel situation. PSMs have typically been used under conditions

of uncertainty as to both facts and values, and to assist decision making which is strategic in nature. Its applications have been characterised by urgency, and hence uniqueness. They have rarely been used explicitly for reflective evaluation to develop knowledge and increase managerial competence and capacity and thus lay the basis for future decisions and actions away from the current focus of a study. By developing COLA from the Strategic Choice Approach, B-Hive has demonstrated this use of PSMs and has succeeded in embedding a PSM approach in a continuing business process.

The research has provided some other methodological insights in various fields. We would emphasise two in particular. First is the use of the action research approach within an improvisatory context and in the development of inter-organizational and partnership driven organizational learning processes. The action research took on its own momentum and direction, as was envisaged in the initial proposal and as is required in an action research partnership approach, and in this it turned to issues of organizational (and inter-organizational) learning and knowledge management.

The second methodological insight offered in the research is in the integration of problem structuring methods into evaluation activities. Out of this work come significant findings about the currency of quantitative vs. qualitative data on construction activity, legitimacy in decision making, and factors driving and inhibiting cultural and organizational change. This will provide a very solid basis for further work in these fields and members of this team are actively pursuing and developing these themes.

- REFERENCES | [1] Bennett, J. , Jayes, S.: *Trusting the Team the Best Practice Guide to Partnering in Construction*, Thomas Telford Partnering, London, 1995.
- [2] Egan, J.: *Re-thinking Construction: Report of the Construction Industry Task Force*, DETR, London, 1998.
- [3] Bennett, J. , Jayes, S.: *The Seven Pillars of Partnering: a Guide to Second Generation Partnering*, Thomas Telford Partnering, London, 1998.
- [4] Argyris, C. , Schön, D.A.: 'Participatory Action Research and Action Science Compared: A Commentary,' in William Foote Whyte, ed., *Participatory Action Research*, Sage Publications, Newbury Park, CA, 1991, pp. 85-96.

- [5] Lau, F.: 'A Review of the Use of Action-Research in Information Systems Studies,' in A Lee, J Liebenau, and J DeGross, ed., *Information Systems and Qualitative Research*, Chapman and Hall, London, 1997, pp. 31-68.
- [6] Whyte, W.F., Greenwood, D.J., Lazes, P.: 'Participatory Action Research: Through Practice to Science in Social Research,' in William Foote Whyte, ed., *Participatory Action Research*, Sage Publications, Newbury Park, CA, 1991, pp. 19-55.
- [7] Cushman, M.: 'Action research in the UK construction industry - the B-Hive project,' in *Proceedings of IFIP WG 8.2 working conference on Realigning Research and Practice in Information Systems Development: The Social and Organizational Perspective*, Boise, Idaho, USA, 2001.
- [8] Barlow, J., Ohen, M., Jashapara, A., Simpson, Y.: *Towards Positive Partnering: Revealing the Realities of the Construction Industry*, The Policy Press, Bristol, 1997.
- [9] Connaughton, J.N., Green, S.D.: *A Client's Guide to Value Management in Construction*, CIRIA, London, 1996.
- [10] Womack, J.P., Jones, D.T.: *Lean Thinking: Banish Waste and Create Wealth in Your Corporation*, Simon & Schuster, New York, NY, 1996.
- [11] Avgerou, C., Cornford, T.: *Developing information systems: concepts, issues and practice*, 2nd edition. ed., Macmillan, London, 1998.
- [12] Earl, M.J.: ed., *Information Management: the Organizational Dimension*, Oxford University Press, Oxford, 1996.
- [13] Rosenhead, J.: *Rational Analysis for a Problematic World: Problem Structuring Methods for Complexity, Uncertainty and Conflict*, Wiley, Chichester, 1989.
- [14] Cherna, A., Bryant, D.: 'Studying the Client's Role in Construction Management,' *Construction Management Economics*, vol. 2, 1984, pp. 177-184.
- [15] Friend, J., Hickling, A.: *Planning Under Pressure: the Strategic Choice Approach*, second ed., Butterworth-Heinemann, Oxford, 1997.
- [16] Cushman, M., Franco, L.A., Rosenhead, J.: 'Learning from Partners in the Construction Industry: A Feedback Approach to Cross-Organizational Learning,' in *Proceedings of 8th International Conference in Multi-Organizational Partnerships and Co-operative Strategy*, Bristol, 2001.
- [17] Eden, C., Ackermann, F.: *Making Strategy: the Journey of Strategic Management*, Sage, London, 1998.
- [18] Checkland, P.: *Systems Thinking, Systems Practice*, Wiley, Chichester, 1981.
- [19] Checkland, P., Scholes, J.: *Soft Systems Methodology in Action*, Wiley, Chichester, 1990.
- [20] B-Hive Project, *Explorations, Definitions and Directions: Concluding report on phases I and II*, B-Hive Project, 1998.
- [21] Baskerville, R., Wood-Harper, A.T.: 'Diversity in information systems action research methods,' *European Journal of Information Systems*, vol. 7, no. 2, 1998, pp. 90-107.
- [22] Cook, S.D.N., Brown, J.S.: 'Bridging epistemologies: The generative dance between organizational knowledge and organizational knowing,' *Organ Sci.*, vol. 10, no. 4, 1999, pp. 381-400.
- [23] Von Krogh, G., Nonaka, I., Ichijo, K.: *Enabling Knowledge Creation: How to Unlock the Mystery of Tacit Knowledge and Release the Power of Innovation*, Oxford University Press, New York, 2000.
- [24] Nonaka, I., Takeuchi, H.: *The Knowledge-creating Company*, Oxford University Press, New York, 1995.
- [25] Argyris, C., Schon, D.A.: *Organizational Learning: a Theory of Action Perspective*, Addison-Wesley Publishing Company, Reading, MA, 1978.
- [26] Rohrbaugh, J.: 'Assessing the Effectiveness of Expert Teams,' in Mumpower et al, ed., *Expert Judgement and Expert Systems*, NATO ASI Series, Springer-Verlag, Berlin, 1987, pp. 251-267.

APPENDIX

Brief review of relevant problem structuring methods

An overview of Problem Structuring Methods including descriptions and case studies of the methods used here and three others is given in J Rosenhead and J Mingers (eds), “Rational Analysis for a Problematic World Revisited”, Wiley 2001.

Strategic Choice Approach

The Strategic Choice Approach (SCA) is a planning approach centred on managing uncertainty in strategic situations – that is in situations where the benefits of decisions which are taken in one area are affected by what decisions are taken in other areas. The uncertainties which are handled include

- uncertainty about priorities
- uncertainty about how the system will behave
- uncertainties about what other decision-makers will do.

The approach moves through four modes of decision-making, though the group may decide to cycle through these in a flexible sequence. It will normally be guided by a facilitator with experience of the method. Specialised software (STRAD) is available, this can be used to support and record, but not replace, the paper based participative methods of group workshops. In each of the four modes information is elicited from the members of the group, and needs to be agreed by them, often on flip charts. These form a trace of the progress made, and are often photographed and issued as a record to assist group members after the meeting.

The first mode is *shaping*, in which the group establishes key areas for decision. The output of this phase is a ‘problem focus’ which includes urgent, important and interconnected decisions, but which is small enough to be manageable. The second mode is *design-*

ing, in which the group is helped to identify feasible combinations of options for action in these areas. *Comparing* is an activity in which the group evaluates these alternatives against a range of criteria which they see as important – though in the process they commonly also uncover uncertainties which get in the way of finding a straight-forward ‘best’ option. The last mode is *choosing*, in which the method leads the group towards agreement in some areas and setting up exploratory investigations in others. In each of the modes there are decision-aiding tools, many of them graphical in nature, to help the group to make progress. The method is fully described in J. Friend and A. Hickling “Planning Under Pressure”, Butterworth-Heinemann 1997.

In this project Strategic Choice was used as the basis of designing the review workshop tools.

Strategic Options Development and Analysis

Strategic Options Development and Analysis (SODA) is a general problem identification method. It uses ‘cognitive mapping’ (a graphical way of representing the concepts which some one uses to understand a situation, and the connections between them) as a device to elicit, model and store individuals’ views. These maps are then merged to form a framework and agenda for workshop discussions, in which a facilitator guides the group towards commitment to a portfolio of actions. A recent text is C. Eden and F. Ackermann “Making Strategy: the journey of strategic management”, Sage 1998.

In this project SODA was used to identify the key research issues and help formulate an agenda for the research.

Soft Systems Methodology

Soft System Methodology (SSM) is a general method for system design or re-design. It starts with a period in which alternative world views which are held by those with an interest in the system are identified. With the guidance of a facilitator/consultant, participants build ideal-type 'conceptual models' of systems which would make sense from each of these perspectives. These conceptual models are compared with percep-

tions of the existing system and each other in order to generate debate about what changes are culturally feasible and systemically desirable. The most recent text is P. Checkland and J. Scholes "Soft Systems Methodology in Action", Wiley, 1990.

In this project SSM was used to help model the information systems requirements.