A DECISION MAKING FRAMEWORK FOR PLANNING AND IMPLEMENTING COLLABORATIVE WORKING

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ABSTRACT

The new millennium has seen widespread recognition that the construction industry must embrace new ways of working (i.e. collaborative working), if it is to remain competitive and meet the needs of its ever demanding clients. Project collaborations and collaborative working have increasingly become more important in construction projects. However, it has been argued that perhaps they are not being used to their full potential and in the correct context. The industry has shown a need for simple and efficient (shared) processes to help in the planning and implementation of effective collaboration. Much of the recent work on collaborative working has focused on the delivery of technological solutions, through Web-based systems (e.g. extranets), Computer Aided Design/Drafting (modelling and visualisation), and knowledge management technologies and systems. However, recent outputs have displayed a better understanding by many researchers and leading industrialists that effective collaboration does not result from implementing technological solutions alone, but also needs to consider the equally important organisational and people issues. Work currently being undertaken at Loughborough University aims to demonstrate this importance through the development of a decision-making framework and supportive tools to effectively plan and implement collaborative working in construction projects/organisations. This paper reports on the development of a prototype framework.

KEY WORDS

Effective collaboration, construction, decision-making framework, organisation and people.

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INTRODUCTION

"Collaboration is not a natural way-of-working for everybody!" Despite the enormous groundswell of interest in partnering and alliancing in recent years, there has been comparatively little research that has set out to investigate systematically the nature, feasibility, benefits and limitations of forms of project stakeholder collaboration (Bresnen and Marshall, 2000).

Since the 1980s many organizations and individuals have considered electronic collaboration of distributed teams as a means of achieving higher productivity and competitiveness, thereby improving the quality of their work products (COCONET, 2003). Research has observed that the current collaboration tool landscape is improving but at the same time fragmented and lacking comprehensive solutions (COCONET, 2003). Much of the recent work on the developments of collaborative working tools has focused on the delivery of technological solutions (Kvan, 2000; Woo et al. 2001; Faniran et al. 2001) with a focus on the web, i.e. extranets, (Weippert et al. 2003; Nitithamyong and Skibniewski, 2004; Sexton and Barrett, 2004; Wilkinson, 2005), CAD (modelling and visualisation: Kunz, 1999; Schwegler, 1999; Hew et al. 2001; Fulton, 2002; Edenius and Borgerson, 2003; Smoliar, 2003; Waly and Thabet, 2002; Zhu and Issa, 2003; Donath et al. 2004; Hiremath and Skibniewski, 2004;), and knowledge management technologies and systems (Rezgui et al. 1996; Lueg, 2001; Stewart et al. 2002; Stewart and Mohamed, 2003; Asprey, 2004; Egbu, 2004; Kundu, 2004).

Technology by itself is unable to provide a comprehensive answer to working collaboratively (Alvarez, 2001; Vakola and Wilson, 2002; Barthelmess, 2003; Ferneley et al. 2003). This may be because cooperative tasks in teams are increasing, and as a consequence the use of collaborative systems is becoming more pervasive (Dustdar and Gall, 2003). Approaches to collaborative working that purely focus on information technology have been seen to be less than successful, unless the organisational and people issues are considered as part of the implementation process (Grudin, 1994; Koschmann et al. 1996; Loosemore, 1998; Winograd, 1988; Eseryel et al. 2002; Baldwin, 2004).

Another complication in implementing ICT into construction organisations, requires the bridging of many cultural boundaries (Credé, 1997; Proctor and Brown, 1997; Cheng et al. 2001). Managers of ICT implementations have to consider the barriers within the workplace that affect such introductions with a more strategic approach (Norton, 1995; Boddy and Macbeth, 2000; Maguire, 2002). To make matters more difficult, many individuals are apprehensive when confronted with technological, and associated organisational change through the introduction of new systems and technologies (Manthou et al. 2004; Erdogan et al. 2005), a need for a more strategically managed approach is sought, particularly for the construction sector.

This need is currently being considered in research at Loughborough University in the UK. A research project entitled: "Planning and Implementation of Effective Collaboration in Construction (PIECC)" is aiding project managers in construction organisations, throughout the supply chain, to introduce more balanced processes and procedures into their projects. The remainder of this paper will summarise work conducted thus far, concentrating on the

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development of a prototype decision-making tool for the effective planning and implementation of collaborative working in construction projects.

THE PIECC PROJECT

The PIECC project has a focus on supporting strategic decision-making by highlighting areas where collaborative working can be improved incorporating the organisational (business), project and users' needs. When carefully planned, and if based on informed decisions, it is believed that policies and protocols will help organisations improve their collaborative working, achieve better benefits from it, and maximise the use of tools and techniques that are currently commercially available.

AIMS AND OBJECTIVES

The main aim of the PIECC research is to develop a strategic decision making framework that will guide organisations in the planning for effective collaborative working practices and the implementation of suitable tools and techniques. The associated objectives are to:

- Review state of the art collaborative working with a focus on both practices and technologies – (see Erdogan et al. 2005; Koseoglu et al. 2005; and Shelbourn et al. 2005);

- Conduct a requirements capture survey for collaborative working in construction at the organisational and project user levels, and identify key areas for improvement in collaborative working – (see Shelbourn et al. 2005b);

- Develop a framework for the planning and implementation of effective collaborative working taking into account both the organisational business processes and the project lifecycle processes – the main focus of this paper; and

- Test and validate the framework within the construction project context – the final stage of the project.

To realise these objectives the PIECC project has followed a rigorous methodology incorporating many features of recognised requirements and software development lifecycles. The next section summarises the methodology used in the project.

PROJECT METHODOLOGY

In order to achieve the objectives of the PIECC project, a number of different methods have and will continue to be adopted. These are:

- Use of published sources – through an extensive literature review to establish current 'state-of-the-art' practice on collaborative working – and associated areas of interest – both in construction and other industries.

- Field studies – these have been conducted to establish current practice for collaborative working within collaborating organisations. These field studies used a questionnaire, semi-structured interviews (with identified key personnel) and examples of case studies from the collaborating organisations, to elicit requirements

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for collaborative working, and key issues to be considered at the organisational and project user levels.

- Use a 'develop-test-refine' strategy (action research) – to improve the prototypes of the framework for effective collaboration. This aspect is ongoing and is appropriate since the PIECC project wishes to develop real-life solutions for the industry to embrace. Thus, the initial framework has been developed, testing has begun, and will be refined (in iteration cycles) to ensure that it is comprehensive and easy to use.

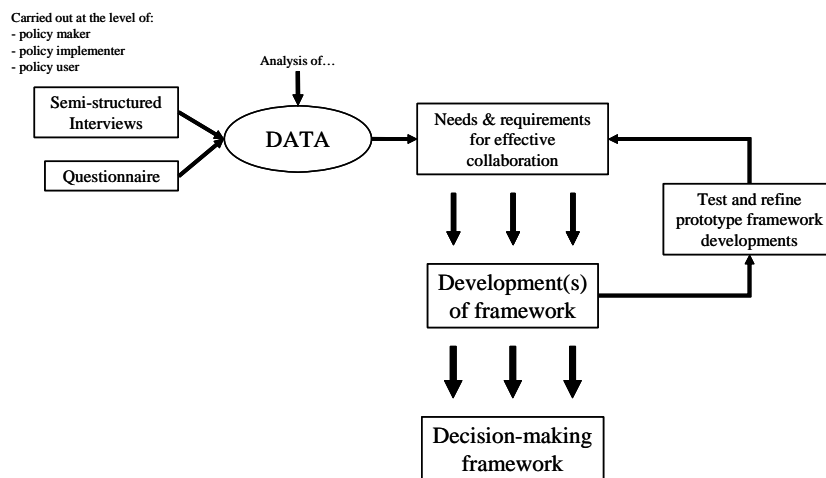A graphical representation of the methodology is provided in Figure 1.

Figure 1: The PIECC projects' requirements capture methodology

Using this methodology the project has been able to determine the current state-of-the-art of collaborative working in the construction and other related sectors. The next section summarises some key findings from the state-of-the-art review.

CURRENT STATE OF THE ART

A comprehensive literature survey was conducted using desktop study techniques to determine the current state-of-the-art of collaborative working in the construction (and other relevant) sectors. Complimenting the collaborative working review, two other specific subjects: collaboration technologies (Koseoglu et al. 2005) – including GRID technologies; and the change management implications of implementing and using new technologies for construction organisations (Erdogan et al. 2005) were also included in the survey.

The survey began with the team aiming to define "collaborative working". Results showed that there are many definitions of collaborative working in the literature. Some incorporated the word "concurrent" in terms of the approach and activity, and "collaborative" in terms of ownership (Moore, 2000). Other notable definitions were provided by (Clemmet, 1997; Kvan, 2000; Robillard and Robillard, 2000). The difficulty in determining a singe definition led the research team to describe the different forms that collaboration may take. Anumba et al. (2002) described four modes of collaboration – 'Face-to-Face', 'Asynchronous', 'Synchronous Distributed', and 'Asynchronous Distributed', and typical

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forms of use in the four areas have been described by Attaran and Attaran, (2002). As the focus of this paper is to describe the framework development process, the full results of the current state-of-the-art review of collaborative working can be found elsewhere (see Shelbourn et al. 2006).

KEY AREAS FOR COLLABORATION

The state-of-the-art survey concluded that for an organisation (or organisational unit) to 'effectively collaborate' there must be a balanced harmonisation of three key strategies: business, people, and technology. Six key areas must be represented in the three strategies. These can be seen in Figure 2, and described as:
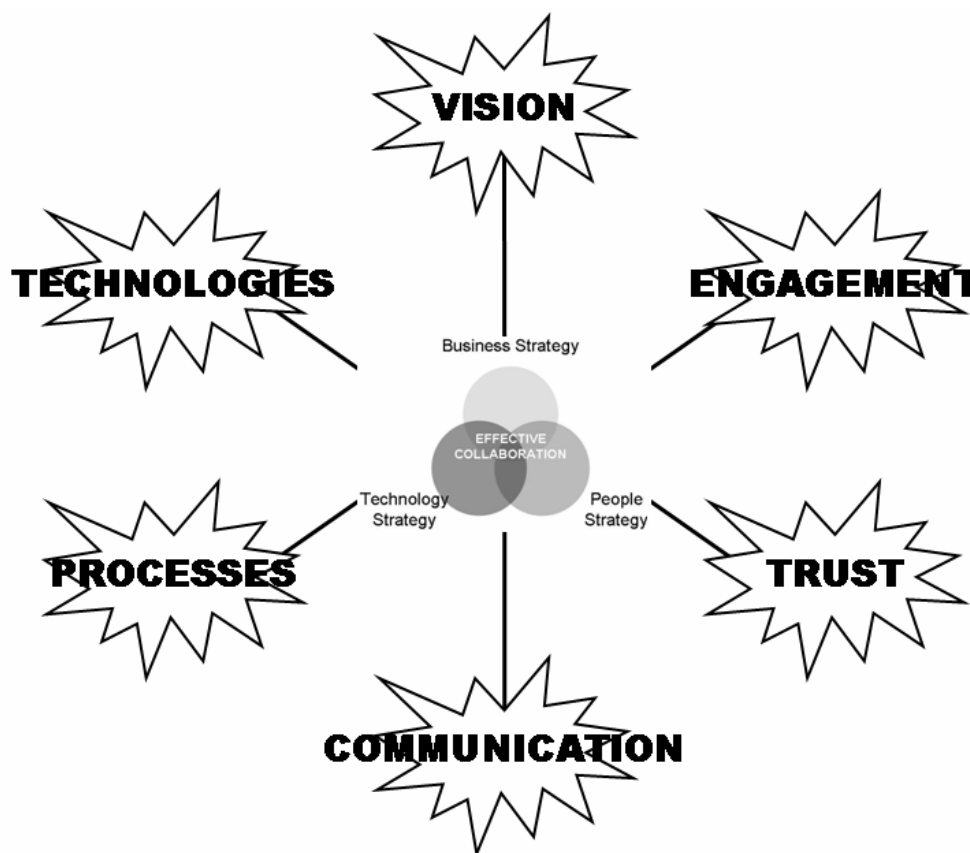
Figure 2: Areas to be addressed in the strategies to enable effective collaboration

- **Vision** – all members of the collaboration agree on the aims and objectives;
- (Stakeholder) **Engagement** – collaboration leaders need to ensure that all key participants are consulted as to the practices to be employed during the collaboration;
- **Trust** – time and resources are needed to enable stakeholders to build trusting relationships;

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- **Communication** – a common means of communication is decided by all key participants in the collaboration;

- **Processes** – both business and project, that describe to all key participants how the collaboration is to work on a day-to-day basis;

- **Technologies** – an agreement on those to be used to ensure the collaboration is easily implemented and maintained.

All 6 areas need to be addressed in the three strategic areas described to have "effective collaboration". However, the strategies may be different depending on the context of the proposed collaboration. Differences exist in effective collaboration at the project and organisational level. Effective collaboration is only achievable through the innovative design and development of a more balanced 'collaboration strategy', that does not rely solely on ICTs. As yet there is little evidence of such a 'strategy' existing that prescribes to project managers effective ways of implementing and managing collaborative projects.

The results of the PIECC project will define processes and procedures to enable the development of such a strategy. This will enable all stakeholders to take advantage of the benefits provided by a more targeted use of ICT, that is better aligned to an organisations people and business processes.

INDUSTRY NEEDS AND REQUIREMENTS

One of the major activities of the PIECC project was the capturing, analysis and classification of the construction industry's needs and requirements for effective collaboration. This section summarises the findings from the conducted interviews and questionnaires conducted in the project. More detailed information on the methods used to elicit the needs and requirements may be found in Shelbourn et al. (2006).

The interviews and questionnaires have enabled a clear set of needs and requirements to be determined. They are categorized into 6 distinct areas listed below. The needs are:…

Model

- "…a recognisable model for collaborative working does not exist at this time – it needs developing to enable a move forward…"

- "…must build upon work being done in other aspects of collaborative working – the AVANTI programme for example…"

Process

- "…processes that enable participants to agree a common vision and priorities for the collaboration – a route map for how the project is going to proceed, and must include suitable time for review of progress against vision and priorities…"

- "…procedures to promote trust in the collaboration – a key person needs to be in charge, they provide leadership, leading (hopefully) to better performance of the team, to build trust within the team…"

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- "…a set of communication procedures that all stakeholders should use in the collaboration…"

Standards

- "…standards that facilitate interoperability between different software and systems – we are fed up with learning a new system for every new project!!…"

- "…suitable (and appropriate) help templates/screens for users to familiarise themselves with the software tools. They are removed when a level of competence is reached..."

Good Practice

- "…examples of good practice/case study material that shows tangible business benefits of collaborative working…"

- "…evidence of good practice of collaborative working to be published to alleviate frustration of the industry…"

Design

- "…intuitive interface design of software to reduce the requirement for training of new members of a collaborative project/environment…"

Legal aspects

- "…clarification of professional liability of information generated. Who is responsible for the information generated and its trustworthiness? A right balance between the technology and professional liability is the issue to building trust…"

Armed with these key needs and requirements the research moved to developing a prototype decision making framework. This work is described in the next section.

PROTOTYPE DEVELOPMENT

Having determined the needs and requirements of the industry for effective collaboration the research team moved to developing a prototype framework. Initial discussions revealed a strong idea that there are essentially four key areas that need addressing. These are illustrated in Figure 3 below.
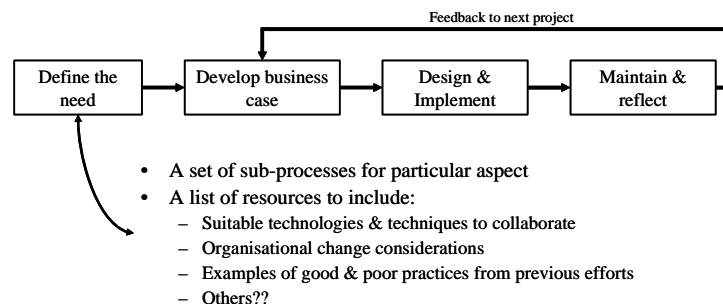

Figure 3: Iteration 1 for a prototype decision making framework.

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Intense discussions with the industrial partners and other prominent members of the industry revealed that this approach suited the needs of the industry. However, there was insufficient detail of the processes and procedures needed to plan and implement for effective collaboration in the industry.

The next stage of development aimed to introduce the 6 key factors for effective collaboration (shown in Figure 2) into the four key areas in Figure 3. This resulted in a framework that had the 4 key factors down the left – 'vision', 'trust', 'engagement', and 'communication' – and three processes/procedures across the top. The collaboration manager would then decide on wanting information regarding the 'people', 'process' or 'technology' aspect of the key area and process. In each of these boxes (an example is shaded on Figure 4) there would be supporting information to aid them understand the associated issues.

	DEVELOP BUSINESS CASE			DESIGN & IMPLEMENT COLLABORATION			MAINTAIN & REFLECT ON COLLABORATION		
	PEOPLE	PROCESS	TECHNOLOGY	PEOPLE	PROCESS	TECHNOLOGY	PEOPLE	PROCESS	TECHNOLOGY
VISION	Issues to consider / Risks to consider / Good practice / Poor practice / Resources	Aims & objectives							
ENGAGEMENT									
COMMUNICATION									
TRUST									

Figure 4: Version 2 of the prototype decision making framework.

This additional information would consist of the 'aim and objective' of that aspect of the framework. This would be supported by other sections on: 'issues to consider', 'risks to consider', 'good practice', 'poor practice', and 'resources'.

This development was presented to the industrial steering group for comment. Although they were encouraged by the development, the group were expecting a more process centric framework. However, the group were complementary in their assessments of using additional information to aid the process of effective collaborative working. They stressed that the additional information pages should be a set of 'sub-processes' that showed the what?, why?, who?, and how? for each sub-process. This information should be supported with relevant tools and techniques that can be used to complete any aspect of the framework.

With these comments and suggestions the research team developed iteration 3 of the prototype framework, shown in Figure 5. This version of the framework describes a set of processes that must be followed to enable the planning and implementation of effective collaboration in projects.

The framework is split into 3 distinct stages. The first aims to bring together the different organisations involved in the collaboration to 'align their business strategies'. In this aspect

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of the framework high level decisions are made on determining the need to work collaboratively. Having determined that collaborative working is the way forward the collaborating organisations (or organisational units) seek approval from senior management and sign a pre-contractual agreement agreeing to work together collaboratively. As part of this agreement a person or team is chosen as a champion for the collaboration. This person or team has the responsibility of managing the future planning, implementation and management of the collaboration. Resources to aid the champion or team are also decided upon and allocated at this stage.
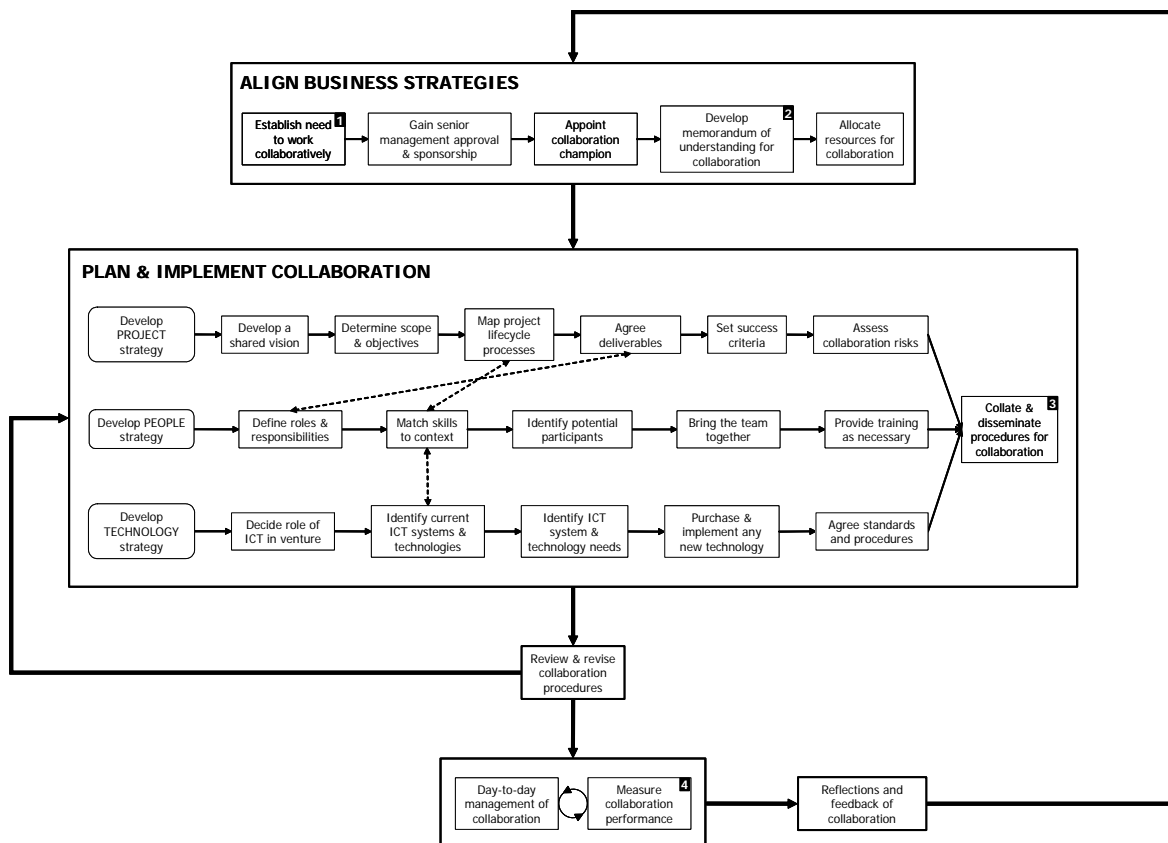
Figure 5: Version 3 of the prototype decision making framework.

The second stage requires the collaboration champion or team to define the three strategies for effective collaboration. This section in the framework provides a number of processes to complete these developments. 'Behind' all of the processes in the framework, sub-processes describing the What?, Why?, Who?, and How?, plus tools and techniques to use for each process are defined. An example of the sub-processes is shown in Figure 6. The information contained in the sub-process information sheets has been developed through the industrial steering group. Many iterations have been conducted. The project has used the "Buzzsaw" extranet system as a repository for information obtained from these iterations, enabling the research team to manage the process of version control and changes to the documents.

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Measure Collaboration Performance PIECC

The aim of the monitoring process is to ensure that the objectives set out in the 'Collaboration Procedures' document remain on track, that the success criteria agreed in the planning and implementing stage are met.

Items that can be chosen and weighted include:
- Safety
- Quality
- Commitment
- Issue resolution
- Dispute avoidance
- Co-operation
- Communication
- Budget control
- Programme control
- Public relations
- Timely reporting

SET SUCCESS CRITERIA

COMPLETE PERIODIC PERFORMANCE EVALUATION — CONTINUOUS IMPROVEMENT

INVESTIGATE SIGNIFICANT VARIANCES — INCENTIVES

CORRECTIVE ACTION

REFLECTIONS & FEEDBACK OF COLLABORATION

Complete periodic performance evaluation
Evaluation reports are to be made monthly by the collaboration champion. A standard method for reporting should be used. A typical example is included over. The reports should be discussed at monthly meetings with representatives from all involved in the collaboration.

Investigate significant variances
Performance evaluation reports may show results that depart significantly from the standard set out in the 'set success criteria' stage. Where this is the case, the results should be examined and discussed and reasons for them sought. The reports may also indicate opportunities for improvement that should be followed up.

Incentives
Incentives should be considered for both organisations and individuals. In respect of individuals, performance reporting and issue identification should involve incentives. These are designed to stimulate a continuous interest and a measure of constructive competition. However, care must be taken to ensure the benefits are fairly shared by all contributors. Benefits may be non-monetary.
Significant savings in cost that result from improvement in performance should be shared in agreed proportions between the collaborating organisations. The arrangement should be included in the 'collaboration contract' documentation. This procedure should be based on calculations that can be audited.

PIECC – Measure Collaboration Performance   1

Corrective action
If the results are unacceptably below the norm, they have to be investigated and corrective action plans drawn up by the management responsible for the operation. These plans should be detailed and allocate specific responsibility.

Evaluation form example

	Score (low) 0 – 100 (high)
Alignment of purpose How well aligned are participants around the business context; overall visions and mission; goals and objectives; and priorities for the venture?	
Ability to perform How effective are participants at getting the job done; contributing their best; focusing on excellence; making a difference; ensuring individual and shared accountability for outcomes	
Attention to process How effective are meeting management; progress monitoring and reporting; decision-making problem solving; conflict resolution; governance; and the internal/external measurement systems for your venture?	
Acuity of communication How well does the group exhibit openness/candor; use discipline and skill to provide and receive information; and ensure timely and accurate feedback in all aspects of the venture?	
Attitude of mutual trust and respect How well does the group share risk and reward; blend autonomy and interdependence; acknowledge and support each other	
Adaptability to learn and change How much attention is paid to continuous learning for all individuals; after action briefings; institutional memory; continuous improvement?	
Total score (0-600)	

PIECC – Measure Collaboration Performance   2

Figure 6: Supporting pages for the processes in the framework.

This has provided valuable experience to the research team in that it has shown how technology is used in collaborative working. This has meant that experiences of actually completing the research activities in the PIECC project have been used in the sub-process information sheets. Once the three strategies have been developed they are collated into a single collaboration strategy document. This document outlines the procedures for the collaboration, and is signed by all parties involved in the collaboration.

The final stage of the framework is concerned with the day-to-day running of the collaboration and its associated review processes. Sub-processes and information sheets have been developed to help the collaboration champion or team to run the collaboration on a daily basis, assess the performance of the collaboration by measuring performance against the criteria laid out in the 'memorandum of understanding' and further detailed in the 'collaboration strategy document'. This particular process is ongoing throughout the life of the collaboration. Once the collaboration has ended a thorough review takes place. This is undertaken to reflect on the processes used to work collaboratively, and reassess business activities to ensure that lessons learned from the collaboration are fed back into the organisational or organisational unit.

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CONCLUSIONS AND FURTHER WORK

The work presented in this paper has shown research and development activities that aimed to assist organisations (or organisational units) to plan and implement collaborative working more effectively. The research to date has determined that there are sporadic examples of balanced approaches to collaboration being implemented in the construction sector. However, these rarely take into consideration the business process or human/organisational issues. A need has clearly been identified through the questionnaire and interviews conducted for the research presented in the paper, for a more balanced approach to planning and implementing collaborative working. Developments in current research (the PIECC project) are aiming to provide the industry with a framework that when followed will make collaborative working a more effective means of managing projects – construction or internal to the organisations. These developments have been discussed in this paper.

The next stage for the project is to assess the developments of the framework in the construction industry. The research team is actively looking for new projects that are in their initial stages where the framework can be tested. This is a challenging stage and will provide further evidence of success to the research.

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