USE OF A DELPHI SURVEY TO SURFACE EMERGING ICT TRENDS IN CONSTRUCTION PROJECT TEAMS: METHODOLOGY DESCRIPTION AND PRELIMINARY FINDINGS.

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ABSTRACT:
This paper describes the design, implementation and preliminary findings of a project funded by the Chartered Institute of Building in Australasia investigating the application of Information and Communication Technology (ICT) in the context of construction projects, seeking to identify and assess avenues by which to extend its use. It describes the context provided by literature relating to ICT-enabled project team performance and proposes an on-line, modified Delphi methodology based on the Blackboard delivery platform to facilitate the asynchronous participation of a national panel of experienced practitioners in the generation of data. It concludes by reporting the preliminary findings arising from the first round of the study.

Keywords: Delphi, ICT, Construction Projects

INTRODUCTION
Observers have described the construction industry as fragmented, information intensive and adversarial (e.g. Cox and Townsend, 1998). Ng et al (2000) explained many of the industry problems by reference to the quantity and complexity of the shared communication. Faraj et al (1999) highlighted a need for common data exchange standards, suggesting that these would address the questions of information and communication technology (ICT) uptake and widespread adoption, leading to shared common business processes (e.g. Williams et al, 2002). Alshawi and Underwood (1999) foresaw project teams using shared electronic workspaces, which would produce multiple benefits. The New South
Wales Government (1998) had previously stressed both the complexity of the problem and the potential benefits arising from its solution. Egan (1998) and Finch (2000) observed that these costly investments had yet to fulfill their potential.

Downward cost pressures, increasing specialisation and technical complexity of projects create a demand for an integrated approach to ICT across the construction sector (Brown et al, 1996). However ‘islands of automation’ first identified by Kartam (1994) are still common, leading to an unacceptably low level of ICT integration across the various industry sectors involved throughout the constructed asset’s life cycle.

A number of factors are identified that explain these disappointing results including:

- Failure to deliver promised returns (Shafagi and Betts, 1997);
- “Backing the wrong technology” (Shafagi and Betts, 1997);
- Lack of standard protocols for inter-organisational communication and transfer of data (e.g. Yu et al, 1998);
- Failure to integrate ICT into the core business processes of the organisation (Sarshar et al, 1999);
- Inability of the organisation to re-engineer business processes to align with those of their trading partners (Shafagi and Betts, 1997).
- Inability to measure the benefits accruing from the use of ICT (Schwegler et al, 2001);
- Difficulty of keeping IT investments up-to-date (Shafagi and Betts, 1997);

Implicit in most of these factors is the recognition that the best intra-organisational ICT deployment will fail to deliver optimal returns if attention to inter-organisational issues is sub-optimal. This in turn links the issue to the individual organisation’s relationship with its trading partners.

Early commentators anticipated the integration of ICT across all sectors of the construction industry triggering revolutionary changes in the ways firms relate to
each other, curing many of the industry's ills as a result. Rivard (2000) sought evidence across a series of surveys of ICT usage (Doherty, 1997; Howard and Samuelson, 1998; Futcher and Rowlinson, 1999, Samuelson, 2002). Nevertheless, the evidence for such a dramatic change is hard to find, with later commentators suggesting that revolutionary change is not possible in the current climate where business leaders remain sceptical about the full range of potential benefits touted by ICT promoters (Bulmer and Brewer, 2000). Key to this scepticism is the difficulty in ascertaining the nature and extent of the benefits gained from ICT investments, fuelled by the prevalent project-centric focus. The diversity of ICT systems and business processes within the industry, the amount of time, effort and resources that must be devoted to realigning an organisation's business processes with those of the rest of the temporary project organisation (TPO) are all seen as impediments to achieving full benefit.

Recent research conducted by the Cooperative Research Centre for Construction Innovation (CRC-CI) investigated the attitudes and behaviour of individuals and firms operating in the construction industry in Australia, with particular regard to the "softer" issues that impacted upon the likelihood of successful deployment of ICT in project team environments (Brewer and Gajendran, 2006). The study found that there were clusters of issues that emerged from collective experience that were widely held to be critical to its successful use. These clusters, or critical success factors (CSFs) were:

- Organisational Commitment
- Organisational Attitude To Communication
- Rights And Duties Of Organisations
- Investment Drive
- Risks Related To ICT Usage (Brewer and Gajendran, 2006).

The CRC-CI "Picturing Success" study (Brewer and Gajendran, 2006) acknowledged the dynamic nature of ICT use in the industry, and since it was completed the patterns of use and behaviour could be expected to have changed. This paper reports on the use of a novel methodology to surface the detail of these
changes using a panel of experienced industry practitioners, representatives of a

group previously investigated using a postal survey, and the preliminary findings.

DELPHI STUDY: UNDERPINNING THEORY
A particular aspect of the research was its use of the online Delphi study to

surface complex emerging relationships between large numbers of concepts,

particularly in relation to matters concerning policy and procedure, be it at the

level of the individual firm, the temporary project organisation, or the industry.

Traditionally Delphi studies have been used for two purposes: exploration or

confirmation of a concept(s). Delphi is particularly suited to exploring complex

problems that require an element of subjective analysis (Kaynak et al., 1994;

Mitchell and McGoldrick, 1994), especially in industries that are undergoing rapid


applications include the following which are appropriate to this study:

- Delineating the advantages and disadvantages associated with potential
  policy options
- Identifying and developing causal relationships in complex economic or
  social phenomena
- Distinguishing and clarifying real and perceived human motivations
- Exposing priorities of personal values, social goals

(Linstone and Turoff, 2002, pg 4)

A Delphi survey is designed to obtain and distill the opinions of experts over a

series of rounds of data collection, which move from the general to the specific,

from diversity to consensus or polarity, requiring justification from those holding

dissenting positions (Delbecq et al., 1986). Each round of data collection is

triggered by a set of provocative statements a copy of which is given to each

participant for comment. The responses are then collated and summarised by the

researcher team, and this is then recirculated to the participants for further

comment. Inter-round feedback should increase participant awareness of issues

and aid both convergence and/or polarity (Rowe et al., 1991). Irrespective of the
details of design, there are three aspects to a Delphi study that separate it from any

other methodology, namely participant anonymity, researcher-mediated feedback,

and statistical group response. These ensure that all individual responses are

reflected in the final outcome (Rowe et al, 1991).
In this deployment Delphi was used to engage "experienced practitioners" -- those charged with implementing the use of ICT in construction project teams (Gajendran et al, 2005) -- in a dialogue to determine the relevance and currency of the concepts developed in the CRC-CI project “Picturing Success” (Brewer and Gajendran, 2006), and to explore issues highlighted by the Delphi panellists in further detail. This was distinct from “experts”, who were defined as being those who, by their works and deeds, had the power to influence the use of ICT in project contexts: their attitudes and beliefs had been explored in an earlier study (Brewer et al, 2005).

CONDUCTING A DELPHI STUDY IN A BLACKBOARD ENVIRONMENT

A key determinant in the design of the study being described in this paper was the geographical dispersal of the invited panellists, these being located in several states and overseas. We decided to use our web-based Blackboard learning management system to service this dispersal because it was able to facilitate both,

- Asynchronous discussion in a number of threaded discussion forums.
- On-line survey data collection.

Access to a dedicated, password-protected area was created for the participants, each of whom was issued with a personal account that included a unique pseudonym and password, thus ensuring their confidentiality. In this study invitations were issued by publicity releases from the Chartered Institute of Building and affiliated professional bodies, and twenty two panellists were recruited.

Participants were presented with four discussion threads and asked to provide written responses to each. The participants then gave their opening statements, and were provided with the opportunity to discuss differences of opinion until polarity or consensus was indicated. At this point a summary was generated by the research team. Each round would be defined by a time limit in order to both expedite the process and to retain the interest of the panellists, the last of which would be defined by the achievement of consensus and participant sign off in
regard to the results. Participants were also asked to complete online a 16 question demographic/attitude questionnaire that was located in another part of the BlackBoard website.

At the time of writing we have retained 15 active panellists, who have contributed 71 discussion items evenly distributed across the four discussion forums: the average size of each contribution is about 100 words. The blackboard website creation process, excluding the intellectual input required to create the initial discussion threads and demographic survey, but including the creation and allocation of pseudonyms and passwords was found to take about 15 hours. There was an ongoing time allocation required for distribution of login details to potential participants in response to their requests to be involved in the study, typically less than 10 minutes per participant. Major plus points for the process have been the absence of any paper communication, postage costs and delays, and the ready-made generation of text data in a format suitable for direct entry into the N-vivo system. Again, at the time of writing we have received no negative feedback regarding the research/data collection mechanisms used in this study from any of the participants.

DATA ANALYSIS AND FINDINGS
The data had originally been entered into BlackBoard as individual postings, and was clearly identifiable as such. However the functionality provided by BlackBoard enabled the researchers to collect the "rolled up" contributions from each forum, and these could be then treated as a focus group when entered into N-Vivo. However it is important to note that each contributor was regarded as the unit of analysis, allowing each of their contributions to a particular focus group to be analysed within the context of the other contributors. Multiple analysis passes of the data were undertaken to extract the fullest understanding. The first pass consisted of note taking/annotation of each piece of data, when read in isolation. This was viewed as a sense-making exercise, and the notes therefore became part of the data generated by the study. The second pass looked at the notes themselves in order to identify possible emergent themes. The third pass reviewed the participants' contributions in terms of the emergent themes identified in the notes: these were then either confirmed or rejected on the basis of
the presence of corroborative evidence in the focus group records. This process generated the following hierarchies of themes, which were then used to code the individual participant contributions:

- Process Integration
  - Current levels of integration
  - Factors affecting levels of integration
    - Procurement
    - Legal framework
- Integrated Communications
  - Opportunities created by integrated communication
  - Threats presented by integrated communication
  - Potential enablers of integrated communication
- Competitive Advantage
  - Business case for ICT in project environment
  - Long-term return on investment
  - Short-term return on investment
  - Competitive disadvantage
  - geographical location and dispersal of firms
  - limited impact of ICT on low level subcontractors
- Leadership
  - Intra-firm
  - Inter-firm
  - Leadership in the industry

Using these hierarchies the data provided by the participants was coded (initial researcher generated notes were thereafter excluded), and a memo relating to each code was concurrently written. This recorded the researchers' observations regarding the development of the code when holistically considering all of the participants' contributions. It is important to note that the researchers' use of the codes breached the boundaries of each focus group, meaning that codes could appear in the analysis of several topics. By this means the data was allowed to surface themes that might not otherwise emerged in their own right e.g. the issue of return on investment, and specifically the period of time over which this should
be planned for, were surfaced in the discussion on competitive advantage, but appeared in the coding of entries in the process integration forum, thereby linking the two concepts. The additional issues thus surfaced were:

- Capability of the individual firm within a project team
- Power position within the project team
- Fee competitions/documentation to fee
- Technology driven change/rapid rate of change
- Responsibility/liability for information re-used by third parties
- Industry fragmentation as a barrier to knowledge transfer
- Ownership/protection of intellectual property
- Cost/risk transference
- ROI linked to technology lifecycle

CONCLUSIONS
This study is ongoing. The processes and protocols used in the data generation, collection and analysis have largely been both efficient and effective, both in terms of cost, and time. At the time of writing the data generated by the process described in this paper is being used to drive the second round of the Delphi study, and it is anticipated that the study will have concluded by the end of May 2007: results from this are expected to be published in the second half of 2007.

Although the results obtained from the first round of the current study in many ways mirrored the findings of the earlier studies referenced in this paper, there are a number of notable points namely:

- The ICT lifecycle as the appropriate period of time over which to gauge ROI.
- The role of fee competitions as an inhibitor to maximal ICT integration across project teams.
- The negative influence of software developers on the stability and viability of ICT investments by individual firms, caused by the rapid (and arguably, unnecessary) rate of obsolescence arising from the development of new systems.
- The contextual issues that generally conspire to limit the scope and influence of innovative change to within the individual firm, usually as a result of that firm's size and power position within the project organisations that it participates in.

It is suggested that these points of difference have arisen for two reasons: firstly, the focus of this study is very clearly on the individual firm rather than an industry "expert"; secondly, the industry and its practices have matured over the intervening time since the first Delphi survey was conducted.

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