

The use of ICT in the construction industry: critical success factors and strategic relationships in temporary project organisations

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ABSTRACT: This paper describes the application of a previously developed model of critical success factors for ICT-mediated chains to three construction project supply chains. These cases drew on the experiences of key stakeholder organisations within each in order to firstly, identify the extent to which features of a previously developed, generalised model of ICT success factors were present in each case, and secondly to extend the model in respect of those aspects relating to pre-existing relationships, strategic relationship formation, and the expectation of a continuing business relationship into the future. The paper is structured to describe the protocols and analysis used, and to report a summary of the findings across the three cases.

1 PROBLEM CONTEXT

It is axiomatic to suggest that despite early optimism about the use of ICT to improve the productivity and profitability of the construction industry, anything other than localised benefit has yet to accrue. Many industry practitioners and observers have suggested reasons for this, and research has been accordingly conducted. This has been predominantly in the area of technology and technological standards, with somewhat less being conducted in the sociological aspects of the problem. This paper reports on the third and final part of a major research project commissioned and funded by the Co-operative Research Centre for Construction Innovation (CRC CI) in Australia that addresses the problem of ICT adoption and integration at the socio-technological interface. It draws upon the model of critical success factors for organisations in ICT mediated supply chains, that was developed through an international online Delphi study of ICT 'experts', and a nationwide survey of Australian industry participants. In particular it focuses upon the way in which the presence of ICT as a tool for project communication/collaboration affects the structure and operation of a temporary project organisation.

The aim of the research project was to identify those aspects of ICT uptake and integration considered critical to supply chain success in the Australian building industry and to produce a guide for the different participants in the Australian industry. The case studies served three purposes, namely, to verify the success factors uncovered by the nationwide survey, to observe their effects upon real supply chains

associated with project-specific temporary project organisations, and to augment understanding of strategic relationship formation and maintenance.

It was expected that the findings would indicate that in practice there are certain factors that are more important in achieving success and/or reducing the likelihood of failure in the operation of an ICT mediated supply chain, and these were subsequently identified. Armed with this information, it was possible to generate a short series of Best Practice Guides (currently under production by the CRC CI) that would guide industry participants who wished to maximise the benefit from involvement with such supply chains whilst concurrently minimising the risks.

The Guides are based on the patterns of common experience identified by the project and form a stratified list of critical success factors (Table 1) that vary according to the participant type: these were validated by application to three project case studies, described in this paper.

Table 1. Critical Success Factors/participant type matrix

Critical Success Factors (CSFs)	→	Participant type
1. Organisational commitment	Hierarchy and sub-dimension mix determined by participant type	Client
2. Organisational attitude		Head contractor
3. Industry regulation		Consultant
4. Investment drive		Subcontractor
5. Rights and duties		
6. Guarantee/ protection/ assurance		

N.B. Each factor is comprised of sub-dimensions, the mix of which is specific to each participant type: these are not detailed in this paper.



2 CASE STUDY PROTOCOL AND ANALYSIS

A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. Therefore it is neither a data collection tactic, nor merely a design feature alone, rather a comprehensive research strategy (Yin, 1994) that yields deep but narrow findings (Fellows and Lui, 1997). The case study allows an investigation to retain the meaningful and real life characteristics of real-life events, such as business life cycles, organisational and managerial processes, but they provide limited basis for scientific generalisation. Given the confirmatory nature of the case study within this research project it was felt that the previous stages compensated for any perceived limitations of the study findings. Further, given the triangulated research paradigm adopted for the larger part of this study, its findings were not based on the case studies in isolation. A multiple case study design was adopted; however each case was approached from a single case perspective since, within the construction industry few projects, if any, are identical in the way they are procured and completed. Consequently, post-hoc analysis was employed to compare and contrast the individual case study findings to determine if there were similarities between the projects, and between the cases and the CSF model.

The case studies were carried out during the second and third quarters of 2004 using a combination of face-to-face and telephone interviews. Key ICT decision makers in each of the main stakeholder organisations were interviewed in order to reveal the factors that affected their use of ICT, and also to discover the extent to which their previous and current use of ICT influenced both their selection for inclusion in the project team, and the business processes that they employed with their trading partners.

The cases varied considerably in their value, contractual complexity, technical challenges and geographical location. All the stakeholders interviewed were asked to map the project supply chain as viewed from their perspective, indicating the nature of the links with all of their trading partners.

Given that the qualitative themes were already dictated by the CSF themes, the data coding that was undertaken by members of the research team was purely axial in nature, identifying those passages that related to each CSF and then using them to develop it. Only in the case of relationship formation and maintenance were themes identified by open coding, then further developed by axial coding.

The supply chain maps performed three functions: firstly to establish the formal links between the various project supply chain participants; secondly to ascertain the individual participants' attitudes to informal/non-contractual links with the rest

of the project supply chain; and thirdly to further illuminate the interview data, especially when dealing with matters concerning communications and business relationships.

Broadly, consolidation of all case study findings was achieved at research team meetings where anomalies between individual coding exercises was resolved by discussion and further analysis.

3 CASE STUDY FINDINGS

The following sections detail each of the three cases covered by the project. They open with a brief description of the project and its background, the relationships between the participants (both pre-existing and created as a result of the project), and contractual arrangements. They continue with an exploration of the motivations of the various participants to engage with the project supply chain, seeking to find reasons (beyond those directly associated with a desire to win work) for the project supply chain's composition. The third section tries to identify the barriers to ICT adoption as perceived from within the project supply chain, whilst the last section again asks the participants to look to the future and describe the influence that their experiences (both prior, and on the current project) might have on their future business decisions.

3.1 *Case study 1*

3.1.1 *Project background, relationships and contractual arrangements*

This case study describes an iconic city centre development in a state capital, and initiated by a city council decision to leave their current premises. The winning proposal in a design competition, initiated by a developer who then on-sold development rights to a second developer, is now being driven to fruition by them. They also will become co-tenants of the completed building, together with the city council. Along the way, various members of the design and construction teams have been engaged, replaced, or have withdrawn. Further, some of the consultants who had been appointed by the client were novated to the head contractor. The project manager was also novated, but in a different manner to other consultants and was placed in a supervisory role to liaise with the developer, contractor and clients. Concurrently, the procurement mechanism was changed from a fixed maximum price contract to a design and construct contract.

The base building architect was appointed as the outcome of a design competition, but each of the tenants has appointed their own architect for the internal fit-out of their areas of the building. A similar approach has pervaded the issue of specialist sub-



contractors associated with each tenant. However, the head contractor has been engaged to do the fit out as part of the construction management agreement.

Part of the project involves the creation of a large civic square for which the government organisation is contributing capital. It therefore holds the dual role of tenant and financial stakeholder in the final outcome of the building.

The contractual relationships on this project were complex and prone to change. Only one pre-existing strategic relationship was identified, that being between the city council and an in-house design group that has resulted in a contract for the public access areas of the development (library and customer service building). That said, several members of the design team mentioned working in informal alliances with each other in order to maximise their likelihood of being selected for inclusion in the project.

It was often mentioned that with non-contractual relationships, some communication had to be conducted with be caution so that contractual channels were not contradicted, but nevertheless, informally there was communication.

3.1.2 *Motivation to engage with this supply chain*

Most parties involved in the project had worked with some of the other parties on previous projects. However there were few references to pre-existing strategic relationships. In some cases participants did not believe that they would have the authority to decide which other parties would be selected for future projects, but that their opinion, when given informally, was important.

This attitude that was consistent among participants - that maintaining positive relationships with the project participants was good business sense especially for the specialist sub-contractors. In this project, the formation of alliances have not been an intentional strategic move, rather they appear to be the product of positive experiences.

Overall the influence of ICT on the formation of this project teams was not considered to be high, but it was a consideration. Issues of pricing, design and expertise were considered more important, however some basic ICT capabilities were considered relevant. Several organisations stated that they had taken steps to equip themselves with ICT infrastructure that was used by other project partners such as CAD. However, for all contractual purposes, hardcopies for documents were still required and email communications not recognised by any party as a contractually-valid form of information exchange and communication. The head contractor however was insistent that their organisation had taken steps to reduce paper usage and that email was an accepted form of internal communication. Further, in an effort to reduce the paper trail a project platform was established where participants had varying degrees of

access to project information. Costing and accounting had also moved to electronic format within the developer's organisation. These changes appeared to have some reduction on the use of paper in the project.

3.1.3 *Barriers to ICT adoption in the supply chain*

Major issues identified in this case study were the legal ramifications of electronic communications, misunderstanding of security capabilities, ownership of intellectual property, and the capture/management of the knowledge generated during the project; issues of trust and the organisation.

Many participants stated that they did not think (but were not certain) that electronic communications were considered a valid form of formal communications, especially with document exchanges. Copyright issues for design plans were also mentioned as an inhibitor of electronic communications. PDF format documents were exchanged so changes could not be made without contacting the relevant party. This issue of protection of intellectual property and of risk was fundamental to the uptake of electronic communications. Parties were conscious that electronic communications opened the way for changes to be made to plans without their approval or sign off. Thus the issues of trust and control were major factors in the support for retaining paper communications. Knowledge management issues were also raised. With the continuous flow of documentation participants reported that it was difficult to keep up to date with project details, especially if they were working on more than one project concurrently. Storage of electronic files was therefore a priority and a coding system for documents was seen as a necessity if communicating electronically.

Another barrier to ICT uptake was that some participants did not think that electronic communications were not treated with the same urgency - that email communication was equivalent to the "*note under the door*" approach. Interestingly, one participant strongly held the view that email communication could be used subversively in such a way as to deliberately slow down supply chain activity by introducing spurious noise and unnecessary communication traffic, when it suited some parties.

The technological capacity of organisations was another consideration. Although parties were engaged in electronic communications, their bandwidth and server size were not always capable of handling the degree of usage that their employees were capable of achieving. When dealing with other organisations within the project supply chain the problem was accentuated. Across the supply chain the size of drawing/plans files is a considerable issue when aligning technology practices.



3.1.4 *The future*

All participants saw ICT as the way of the future, seeing a completely ICT mediated supply chain as an ultimately realistic and advantageous state for construction projects to reach, especially in the exchange of documentation. The exact nature of the role of ICT was unclear, but those that had been in the industry for over ten years noted the rapid change in the way projects were completed and the speed and efficiency that ICT facilitated. They could only see this situation improving. Investment in ICT was considered highly worthwhile, especially software that could model whole of life attributes. Investment was seen not only as a wise decision, but a necessity to maintain a position in the market.

Most participants had been associated with web-based projects and saw them as an entirely feasible method of communications. Alignment of technologies was considered much more relevant in these situations, but from experience it was not found to be a principal requirement in the tendering process.

3.2 *Case study 2*

3.2.1 *Project background, relationships and contractual arrangements*

Two years ago, the client, an educational institution in regional Australia, initiated a design competition to secure new teaching accommodation. The winning architect (based in the State capital city) proposed the addition of an extra floor constructed on top of a multi-storey car park that had been completed less than two years earlier. The client appointed the regional office of a major quantity surveyor, who had previously assisted in the cost planning and bid evaluation processes to act as Superintendent. The head contractor, also locally based, had also been involved in a similar capacity during construction of the base building. The rest of the design consultants were also based in the state capital. With the exceptions of fire systems and security systems, all of the sub-contractors were domestic, contracted to the head contractor. The nominated sub-contractors had a pre-existing relationship with the client, being responsible for campus-wide provision of services.

3.2.2 *Motivation to engage with this supply chain*

The client had previous experience of working with the quantity surveyor on a number of projects and expressed high regard and confidence in their abilities to forecast costs accurately. They were initially employed to perform feasibility and project cost planning, and evaluate competition entries from a cost perspective, later extending to include their appointment as the superintendent. The head contractor had also previously worked on several projects with the client, the most recent of which had been the

construction of the base building. The client described the contractor as “*good to work with.....and adopted a cooperative approach*”, a fact that was taken into consideration during Tender Evaluation. Fee-bidding was not used during the appointment of the rest of the consultants, however a range of indicators such as design team quality, track record/references as well as fees was used. None of the base building’s design team was involved in the design of the new extension, a fact that led to “*some niggles*” with the structural engineer on the job. In terms of Nominated Suppliers/Subcontractors, the head contractor had a pre-existing relationship with the fire systems specialist and expressed confidence in their abilities. However they had never worked with the security systems specialist before. Both were appointed by the client to ensure that any systems installed would be compatible with those existing campus-wide.

The issue of ICT compatibility was not a consideration in the selection or appointment of any project participant. However, the architect unilaterally distributed all project drawings via a project-specific extranet, located on their company web server. This ensured that all of the drawings thus accessed were the latest revisions and should have ensured that all project participants were working from the most current information. For their part, all of the consultants appeared to be happy to use the extranet, not only for accessing the architectural drawings but also third party data (such as the client’s briefing document and room data sheets) and for the upload and exchange of their own data, a facility that the architect was willing to provide.

3.2.3 *Barriers to ICT adoption in the supply chain*

There were a number of contrasting attitudes and experiences in this regard. Some organisations (mostly concentrated in the design team) were very comfortable with the use of ICT both within their organisations and as the preferred medium for data and information exchange. Others (mostly concentrated in the construction team) were far less capable (though not necessarily unwilling) of interacting in a similar vein.

Amongst those interviewed the use of email for project team communications ranged from 10% up to 70% by volume— the rest would be conducted by phone, fax or hard copy.

The issue of the legality of an email remained a grey area for some. Yet for others, notably the client, this was not an issue, possibly reflecting the embedded culture of the organisation. In this case, email had been used not only for informal, internal communication related to the development of the brief, but as the contractual document to appoint all of the design team, in accordance with the client organisation’s purchasing policy. They also regarded PDF drawing files in a similar vein, though the client’s



representative expressed the desire to obtain signed hardcopies of all “milestone” documents e.g. those that concluded internal consultation processes or represented “as tendered” or “as built” structures.

All of the case study participants expressed the view that email distribution of workshop drawings and revisions sped up the approval process, but several of the construction team still required printouts.

Because of the size of the project there was no permanent on-site presence from the head contractor and their site office did not have a computer or email/internet access.

3.2.4 The future

ICT was not viewed by any participant as a major competitive advantage. Alignment of supply chain practices was welcomed but not regarded as a pre-qualification requirement. The exception to this position was found in the architect who *did* regard ICT-enabled presentations as a *marketing* advantage in design competitions – a view borne out by the client. However most of the interviewees did regard ICT as an increasingly useful tool to facilitate accelerated supply chain responses, for instance, to speed up drawing exchange. It was noted that subcontractors were beginning to match the top supply chain tiers in their ICT capability.

A move towards a paperless office was a common theme, in one way or another, amongst all of the participants in the study. Passing printing costs onto others seemed to be the prime motivation for this. The client questioned whether cost savings actually worked their way down from the architect (who was generally regarded as being the major beneficiary) to the client. To a greater or lesser extent all of the stakeholders used email to replace faxes. But equally, all email recipients tended, to some degree, to want to have hard copies of them.

The head contractor reported that PDF files of workshop assembly drawings were formatted to print out on A4 paper – bigger drawings would be reformatted as TIFF files and plotted out at head office. For subcontractors this continues to be a limiting factor, requiring a third party to print out the files. Several interviews revealed the irritation of users at having to zoom in and out of drawings being viewed on screen, commenting that, in a number of cases, on-site problems were only resolved after a round table discussion over large-scale paper prints of relevant drawings.

However, electronically updated latest versions of the design drawings would be used at the end of the project as indicative of the “as built” state of the building, for inclusion into the building manual.

In regard to remote activity (project interaction at a distance) conflicting views and experiences were expressed, often from the same participants. On the positive side, the exchange of e-photos of site work to augment teleconferences, laptops for site supervi-

sors, bar coding for materials and electronic drawing exchange were all mentioned. On the negative side the difference between sending an email and resolving an issue was described thus; “*I can’t help feeling that it can be a bit like slipping a note under someone’s office door... I’ve delivered the message so now it’s his problem!*”

3.3 Case study 3

3.3.1 Project background, relationships and contractual arrangements

This case study describes a part of the project supply chain that formed around the construction of a landmark art gallery in a major overseas city, centred on the activities of an export award-winning Australian facade engineering company that utilised a highly geographically dispersed supply chain, which would not have been feasible without the use of ICT.

After a design competition the winning architect prepared sketch plans that were approved by the client (city council). The documentation was prepared and cost planning undertaken. The key feature of the project was the technically challenging front facade, known as the ‘Sculpture Wall’. An overseas facade engineer was appointed as consultant to the client and highly detailed documentation developed in order to brief specialist subcontractors. The consultant engineer referred the client to a number of projects in Sydney and arranged an introduction to the firm responsible for their design and construction, who then assisted in the development of the Sculpture Wall. After a round of advisory discussions fully detailed documentation was prepared by the architects, specified by the consultant engineer, and put out to tender ahead of the main contract for the building. The successful head contractor was apprised of the client’s preferred subcontractor and proved happy to employ them as a domestic subcontractor.

3.3.2 Motivation to engage with this supply chain

Clearly the facade supply chain has accreted around the specialist subcontractor, who had pre-existing business links with most of their supply chain partners. These were variously described as “of mutual benefit”, “strategic and valued”, and “important to our company”. Alignment of business interests was the predominant sentiment, with alignment of business processes, including the use of ICT, being of secondary importance. There was vigorous competition for the award of contracts to supply the various components with all supply contracts put up for tender, albeit from within a limited pool of suppliers whose quality and reliability were already established.

The focal company expressed the view that ICT was a pretty-much indispensable tool for modern



businesses on an international stage, noting that the early design processes were exclusively electronically mediated, by email attachment or by CD. Ironically, the only part of the project that was detailed by hand was the Sculpture Wall, where an early CAD wire frame diagram was subsequently developed manually. The geometric complexity and a lack of suitable CAD operators were cited to explain this anomaly. Interestingly, this allowed the designers of both the wall and the building to check the geometry and interface between them by overlaying them by hand, by mathematical calculation and by reference to the CAD wire frame. However, this has left the architect with the headache of scanning a mass of B1 sized drawings for digital inclusion in the building manual.

Outside of the Facade subcontractor's supply chain the motivations to engage became far more conventional, and although the use of ICT was a conspicuous feature of the project communications, the notion of making it a prerequisite for involvement with projects was not considered viable by anyone interviewed.

3.3.3 *Barriers to ICT adoption in the supply chain*

Very few barriers to ICT adoption were evident within this supply chain. All of the consultants used in the facade subcontract and on the main contract had broadly compatible ICT capabilities. There was little apparent tension in regard to the sharing of commercially sensitive information within the facade subcontract, although there was initial reticence from the head contractor when faced with such an open communication structure. This was initially overcome by client/architect persuasion and presumably subsequently, by favourable experience.

Interestingly, during the early stages of the project it was felt that email was the predominant form of communication (together with email attachments). However once the Facade engineer had established an on-site presence this was supplanted by telephone and face-to-face meetings. This transition broadly coincided with an increase in the size and complexity of the drawings associated with the Sculpture Wall, leading to a move away from email attachments for drawing distribution to be replaced firstly by CDs and later on, paper copies.

3.3.4 *The future*

The lack of a project web site for the sharing of documents/concurrent working on a common 3D building model was noted and flagged for future rectification on other projects, as was the use of manual drafting for parts of the sculptural wall. This was attributed to a lack of availability of skilled personnel in the country, the result of a number of downturns in the industry over the last three decades, leading to a brain-drain.

Possibly the most interesting innovation on the project was the use of rudimentary virtual prototyping prior to the construction of a full-size mock up of the cladding. Both the architect and the facade sub contractor undertook aspects of testing prior to finalising the unitary design. This included dimensional control, earthquake and wind load simulations, aspects that were later confirmed during tests conducted on the mock up. Many design defects were picked up during testing – a goal of zero defects was thought to be realistic.

4 DISCUSSION, VALIDATION AND CONCLUSIONS

The specific motives for conducting the case studies were twofold:

- To validate the survey findings represented by the CSFs (see table 1) within project supply chain settings.
- To investigate the role of ICT in the formation and maintenance of strategic business relationships.

Generally the case studies revealed patchy ICT integration into supply chain activities, where small groups of participants worked well together, but often encountered problems when dealing with others at a larger, pan-project level. Furthermore the extent to which many of the participants interviewed understood their own organisations position relative to the rest of the project team was sometimes unclear, hinting at structural ambiguity within the project. It was possible to find examples of best practice, as defined by the CSF model, to identify a group of project stakeholders that displayed interlinked, ICT-mediated strategic business relationships.

4.1 *Validation of CSFs*

Content and thematic analysis of the full transcripts of all the case study interviews was conducted, allowing the frequency and context of excerpts to be established. Examples were found across all three supply chains of the factors previously identified in the national survey. Although it would not be valid to generalise the specifics of these examples up to an industry level it is instructive to note that the most frequent references were to these topics:

- Limited or scarce resources (including time) for ICT investment
- Alignment difficulties when working with trading partners
- Lack of leadership in determining/championing common project communications protocols and mechanisms, which themselves were unavailable.
- The impracticality of a fully paperless project, especially in terms of drawings



- The potential for ICT to improve the flow of information during the design and construction phases
- The potential for ICT to improve the efficiency and accuracy of data captured for post-completion purposes

4.2 Correlation with CSF framework

The salient issues identified with each CSF are presented below in point form.

4.2.1 Organisational commitment

- Widespread commitment to the use of ICT.
- Similar level of satisfaction reported with ICT investments.
- Respondents broadly split into two groups when considering the degree to which ICT was essential to their organisations business activities, with the majority having a strategic vision of where they saw their firms ICT enabled future. A minority regarded ICT as useful but not vital to the effective operation of either their firm or the project.
- Two organisations reported providing pan-project ICT enabled communication for all participants at no cost, viewing this as making good business sense.
- Almost total acceptance of e-enabled project communication, reflecting their acceptance that this was the way of the future.
- Widest variation in attitude to ICT enabled communication found among clients, or more correctly, their representatives. In some cases this reflected the culture of the client organisation, whilst in others it appeared to be at variance with them.
- Commitment to ICT was stronger in design team members than in the construction team.
- Strong commitment to CAD amongst consultants, with architects having a strong expectation of a move towards 3D CAD in the short to medium-term.

4.2.2 Organisational attitudes

- Wide variation in attitudes was found across the cases. The attitudes of individual firms within a particular project seemed to reflect the overall culture of the project.
- One project was widely reported as having “something special about it”. Although no special efforts had been made, or protocols put in place to reduce conflict or facilitate the use of ICT, members of both the design and construction teams reported openness and trust in communication and sharing of intellectual property. Potential risks and actual disadvantage arising from the use of ICT was shared without recourse

to formal dispute resolution processes, seemingly to preserve good working relationships.

- Sensitivity regarding access to, and the sharing of intellectual property stemmed from a number of factors, including potential disadvantage in the future, IP leakage, and potential legal liability in the event that IP was misused by an unauthorised third party. Restricted access to project web sites and extranets, issue of contract documents in PDF format, and a insistence on hardcopy confirmation were all approaches taken to limit the effect of this problem.
- Informal collaboration between various parties at a very early stage in a project, often prior to project team creation, was evident in two of the three projects. ICT compatibility was a secondary issue in this process.
- Established strategic relationships were apparent in one project. ICT compatibility, though not the cause, was a highly significant factor in their existence.

4.2.3 Industry regulation

- Almost every respondent reported the compatibility of technologies and data exchange standards as a serious concern.
- Some respondents reported aligning their ICT with that of their trading partners in an attempt to appear a more attractive proposition by reducing interoperability conflicts for prospective customers.
- Many respondents tempered their enthusiasm for universal standards with the observation that they would not be accepted unless they catered for the needs of all users.
- Issues associated with document identification, and conflicting document numbering systems across a project team raised important concerns for those charged with overseeing quality assurance.
- Version control, whilst aided by the use of ICT, was reported as being problematic at the interface between users and non-users of ICT, commonly at the contractor/subcontractor level. There is no guarantee that the existence of the latest version of drawing on an extranet will mean that it is being used by small subcontractors on-site. Equally it was noted that there was a big difference between posting current information electronically and ensuring that it was read, a matter that could have contractual significance.

4.2.4 Investment drive

- All participants recognised the veracity of their organisations ICT investments as essential to the conduct of their business.
- General agreement that for all firms, generating a return on their ICT investment, and determining the payback period were the overriding concerns.



- Agreement that ICT facilitated business improvement, not revolutionary advance.
- General agreement that the threat of work drying up if firms fail to engage enthusiastically with ICT is a myth.
- Architects alone felt that certain types of ICT were, if not essential, then the highly desirable in order to win work. Specifically the 3D modeling capability of certain CAD systems was believed to be essential in order to win high-end design competitions.
- None of the other respondents reported losing work as a result of the level of their ICT capability.

4.2.5 *Rights and duties*

- Obviously driven by contractual considerations.
- Less obviously driven, but nevertheless influenced by project team culture.
- Clients/client representatives have a strong role to play in determining the effectiveness of ICT use across the project supply chain.
- General recognition that the legal community has been very slow to react to the advent of ICT in construction projects, and that current contractual tools are inadequate for the current environment.
- It was observed that Australia was amongst the most litigious operating environments in the world.
- It was also observed that trust and good faith could, and had overcome project specific problems triggered by ICT, to the detriment of no party.

4.2.6 *Guarantee/protection/assurance*

- Security of communication channels is a major issue, restricting the extent to which many firms are prepared to engage with an ICT mediated supply chain.
- One respondent was concerned that e-mail traffic could be accessed and records manipulated to obtain contract all advantage by sewing seeds of misinformation.

4.3 *Role of ICT in the Formation and Maintenance of Strategic Business Relationships*

Several participants reported strategic relationships with others both within the cases under investigation and in other supply chains. Some were clearly formal whilst others tended toward the expedient and short-lived. This indicated that the term 'strategic relationship' held different meaning for different people. On one project it meant close, informal cooperation between consultants prior to their appointment to the project team, unpaid work that was intended to increase the likelihood of their appointment. Their ICT was known to align and its use would have been intense. Winning the work would have had strategic

implications for both firms. However it was unclear whether their relationship was really strategic in intent, holding long-term implications.

Formally acknowledged strategic business relationships existed in two of the three of the three cases described above and that a potential for informal strategic relationships to form existed in the third. The presence of ICT to facilitate project communications was noted in all three instances but was not recorded as being instrumental in the formation of any of them. To be precise, none of the business relationships identified had come into existence because of either party's ICT capability. In one case, a number of suppliers had formed enduring business relationships with a specialist contractor on the basis that they had proven to be consistently reliable in terms of cost, quality and time certainty. Their ability to add value to the contractor's business was the trigger to relationship formation, but their ability and willingness to align their business processes with those of the contractor enabled relationship maintenance, an attribute made all the more urgent given the geographical dispersal of the suppliers and projects on which they would subsequently work. Central to these business processes was the use of ICT mediated design, communication and quality assurance tools that meshed with those of the contractor. Strategic relationships, in the truest sense, require a two-way commitment indicative of the expectation of mutual benefit. In each of the relationships explicitly described within the case study project supply chain, and others alluded to in the interview (in other project supply chains), the contractor had invested energy in the supply chain alignment process by embedding staff in the partner firms to thus assist in their compliance with the contractor's quality assurance procedures. This had been matched by the partner firms' energy in the form of time and resources. Thus the various ICT tools were the means by which business would subsequently be facilitated.

From this study it may be posited that true strategic relationships must deliver two-way streams of value, commitment and benefit, along an aligned supply chain, and that whilst the mere presence of ICT is unlikely to trigger relationship formation, it is becoming increasingly likely to facilitate relationship maintenance over time, for as long as those streams continue. Further, parallel energy investments in ICT by supply chain participants, whether strategic in intent or not, are increasingly likely to result in strategic outcomes.

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