THESIS RESEARCH REPORT NOTE

Innovation and attitude: mapping the profile of ICT decision-makers in architectural, engineering and construction firms

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Abstract

Purpose. This paper reports upon a doctoral thesis within the context of temporary project organisations that was driven by the question " what really influences decision-makers when considering whether or not to adopt an innovation ?" This paper describes the philosophy, methodology, and findings of the study, and illustrates the usefulness of the findings for application in construction and other project-driven industries.

Design/methodology/approach. The attitude of decision-makers is discernible in their behaviour, which is an observable phenomenon. It has been observed from outside using a Delphi study of 'experts', providing an etic perspective, and reported upon first-hand through multiple in-depth interviews with 'experienced practitioners', thereby providing an emic counterpoint. Both perspectives have been further abstracted to develop a synthesised model of the attitudinal profile of ICT decision-makers in the construction industry.

Findings. The adoption of innovative ICT-driven business practices by a firm is determined in large part by the attitude of the decision maker, which changes over time, in response to technological push and cultural pull. Moreover, attitudes can be mapped against three exogenous issues: human, business process, and technological. At the heart of these lies a domain of endogenous issues that are personal, and therefore unique to the individual decision maker. All of these issues have an intra-firm, and inter-organisational dimension, and these vary in response to the context within which they are considered.

Practical implications. Successful use of ICT in a temporary project organisation context requires consideration and accommodation of the attitudes of the various project team members. This may entail preparatory auditing of trading partners using an appropriate diagnostic tool.

Originality/value. The attitude of decision-makers has not previously been mapped in relation to ICT innovation adoption. Moreover it is likely that with innovation-specific modification the model will be applicable to other innovations deployed in a similar context.

Keywords. Innovation, attitude, profile, ICT.

Paper type. Research paper.

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Introduction and context of the thesis

Information and communication technology (ICT) advances relating to the architectural, engineering and construction (AEC) sector have been rapid, offering efficiency gains and improved business effectiveness (Construct IT, 1998; Duyshart, Walker, Mohamed, & Hampson, 2003).

Research has highlighted the need to move towards relationship type contracting (Bennett, 2006 ; Chan, Chan, Fan, Lam, & Yeung, 2005), and the adoption of high-level information and communication technology (ICT) in support of efficient and effective project team communications (Duyshart et al., 2003; Gajendran & Brewer, 2007). Yet in spite of the persuasiveness of these arguments, the level of adoption of ICT across the industry has been well below that of other industries (Bulmer & Brewer, 2000; Davis & Songer, 2008) and its integration into the business processes of construction industry participants has been even lower still (Peansupap & Walker, 2005).

Various issues have been advanced to explain the limited adoption of ICT by multi-firm project teams including industry-specific conditions (Miozzo, Betts, Clark, & Grilo, 1998), legal issues, and business issues (Green, Thorpe, & Austin, 2001). Ultimately, the low level of ICT adoption reflects a lack of conviction on the part of decision makers in the industry of the benefits - economic return - arising from its use (Renkema & Berghout, 1997). Classical economic theory clearly indicates that the low adoption rate is a logical consequence of a rational cost benefit analysis undertaken by potential users of the technology, resulting in widespread rejection of its efficacy, and indeed on one level this is irrefutable. However, such business decisions are made by humans, often on the basis of incomplete knowledge of the "facts", influenced by prior experience, and frequently, emotion, in a boundedly rational way (Simon, 1991).

Business decisions made on the basis of bounded rationality are rarely optimal, instead resulting in "satisficing" solutions, outcomes that can be described as being "good enough" (Arthur, 1994). Matters of personal preference and bias, ‘throwing good money after bad’ to justify the correctness of prior decisions, power and politics may all influence decisions (Simon, 1991). These decision-making issues may be powerful influences upon the attitudinal profile of the individual (Aichholzer, 2001; Goel, Kumari, Saldanha, Kaushik, & Gupta, 2000; Krauss, 1995), and will be reflected in their subsequent behaviour (Ajzen, 1991). It is of crucial significance that although attitudes are personal constructs they are also phenomena that are experienced, can be personally reported, and can also be indirectly observed from a distance through the consequent behaviour of the person holding the attitude (Francis et al., 2004).

As a consequence this research reflects the agenda that underpinned the UK’s Engineering and Physical Sciences Research Council-funded ‘Re-thinking Project Management’ research network. In particular Winter, Smith, Morris, & Cicmil (2006, p. 642) highlight Research Direction 1 (Theory about project management practice and the complexity of projects and project management) and Direction 2 (Theory for practice and projects as social processes). This thesis is very much rooted in the lived experience of

project management, in this case those deciding whether to adopt, and thereafter how to implement ICT innovation in a construction industry project context.

Summary of the research.

This research maps attitudinal influences wherein the attitudinal profiles of decision-makers can be located. The topography is observed firstly at a distance by 'experts' whose works and deeds influence the domain through policies (both governmental and industrial), products (related ICT hardware and software), and research (academics investigating ICT use, project management, and supply chains). It is also investigated at close quarters through the narrative of 'experienced practitioners' – those who regularly have the opportunity to utilise ICT in their interaction with project-related supply chains as members of temporary project organisations (Brewer, Gajendran, & Chen, 2006).

By adopting etic and emic perspectives (Pike, 1967), this research reveals independent indication of the extent and features of the phenomenon of attitude formation, and the personal construction of meaning and rules for decision-making. These perspectives are obtained using an asynchronous, online Delphi study of 13 international experts, combined with investigation of the phenomenological experiences of 39 experienced practitioners through in-depth interviews.

The Delphi process has been found to be effective for investigating complex problems (Delbecq, van de Ven, & Gustafson, 1986; Linstone & Turoff, 2002), for exploratory, theory-building research (Akkermans, Yucesan, Bogerd, & van Wassenhove, 2002) on complex, interdisciplinary issues, and for surfacing new issues or predicting future trends (Meredith, Raturi, Amoako-Gyampah, & Kaplan, 1989).

Linstone and Turoff expand the technique's uses to include the retrospective and thus cite a full range of uses for Delphi. The following are of particular relevance to the current study: developing causal relationships in complex economic or social phenomena; distinguishing and clarifying real and perceived human motivations, and; exposing priorities of personal values, social goals (Linstone & Turoff, 2002).

The Delphi survey is a systematic method for surfacing and cataloguing informed opinions on a particular topic, using a set of carefully designed sequential questionnaires. By giving feedback to the respondents between circulation rounds the researcher allows the respondents to review the collective position and modify their subsequent responses accordingly, should they wish to. This process allows the group to arrive at a position of group consensus or polarity, which expresses aggregated expert opinion about specific events (Klassen & Whybark, 1994; Linstone & Turoff, 2002).

Conducting an online Delphi survey has three advantages over other methods. Firstly it allows internationally situated panelists to participate asynchronously without detriment (Brewer & Gajendran, 2006; Grisham, 2006). Secondly it preserves the anonymity of the participant within the group, thereby negating the power position influence that often pervades 'expert panels' (Turoff & Hiltz, 2005). Lastly, it enables freer responses from

the individual by allowing non-linear engagement with other participants' responses (Hiltz and Turoff, cited in Adler & Ziglio, 1996).

The resulting model describes both the boundaries and dimensions of the research problem. However it is not sufficiently detailed to describe the interrelationships between the dimensions or influences. More importantly, given the premise that the object of the investigation is the experience of a phenomenon as contained in the mind of a decision-maker, it could not of itself be any more than a speculation as to the structure of the influences to which decision-makers are subject. A parallel investigation was therefore required.

A phenomenological research method that brackets prior knowledge of the topic (Husserl, 2001) is independently implemented. This captures the individual experiences (Rowlands, 2003) of a sample of 'experienced practitioners', harnessing them to surface and structure the range of influences upon their attitudes to ICT, both at the intra-and inter-firm levels.

Thirty nine in-depth, semi-structured interviews (Daniels, 2001) were conducted with a diverse range of ICT decision-makers, drawn from a broadly representative range of AEC organisations. These include clients (both public and private sector), head contractor organisations, specialist subcontractors, and consultant organisations (architecture, quantity surveying, and engineering). Thereafter, thematic analysis (Miles & Huberman, 1994; Richards & Richards, 1995; Strauss & Corbin, 1990), supported by appropriate Pearson correlation analysis reveals patterns and structure in the data, which is modeled.

The following section summarises the discussion of the results obtained independently by each study, then outlines their synthesis into the final model, before concluding by stating the implications of this research.

Discussion.

Confirmation of literature.

The results obtained from the modeling processes confirm the existence of many issues raised by the literature, albeit with modification dictated by the exigencies of the AEC project context. At their heart is the notion that innovation is undertaken in the expectation of creating competitive advantage, and sustained return-on-investment (ROI) commensurate with the level of risk that ICT adoption entails. The potential for maximal ROI is greatest within one or more project supply chains, as is the potential for risk since it requires boundary-spanning business processes shared with other commercial entities whose objectives may conflict with the innovator firm.

Reported sources of competitive advantage include improves management of supply chains, knowledge, and strategic relationships. Issues to be addressed by the innovator include targeted staff development that supports business change or re-engineering, foster staff commitment to change whilst recognising their legitimate concerns, and recognising/responding to demand-pull.

Perceived impediments to ICT-mediated competitive advantage come from both within the firm and the wider industry, with the former being concerned with issues including the protection of intellectual property, and the effectiveness of conventional contracts for application in an on-line environment. The main concerns relate to compatibility of systems and the lack of technical standardisation at the level of the industry.

Synthesised model.

Thus far this study has generated two models of the phenomenon of ICT decision-making in the AEC sector, one that views it from outside and speculates upon the issues incumbent upon decision-makers, the other being produced by the decision-makers own testimony. Both of these have sprung from a third model built from existing literature, confirmation of the efficacy of which has been provided in the preceding section. These are now synthesised into a unified, multi-dimensional model (Figure 1) using a rigorous process of empirical abstraction (Daniels, 2001), hermeneutics having first been considered and rejected (Ramberg & Gjesdal, 2005).

The model illustrated in Figure 1 reveals that individual attitude is composed of a number of components: exogenous issues include human, technological and business processes; an endogenous component relating to personal considerations; technological push, cultural pull, and a temporal dimension. It posits intra-firm and inter-organisational dimensions, observing variance along a continuum related to the context within which they are being considered. These features are now explained in greater detail, and their significance highlighted.

The overall structure of the model is triangular, acknowledging the three domains identified by the Delphi study, however linking them in interdependence. At their heart is a fourth domain reflecting personal issues related to the individual decision maker. A temporal dimension is included, acknowledging that personal attitudes develop over time. This is crucial since attitudes are revealed to develop both outwardly, in response to exogenous stimuli and inwardly, in response to endogenous stimuli. Whilst exogenous issues reflecting business experiences might not be unexpected, the strong emergence of endogenous issues as significant shapers of attitude have not previously been reported in this context, and the various dimensions exposed during the phenomenological interviews extend both its breadth and depth well beyond the "competing demands/personal ROI" revealed in the "human dimensions" area of the Delphi study.

The temporal dimension of the model is itself subjected to two complimentary forces, namely "technological push" and "cultural pull". The first of these acknowledges the relentless drive of technological innovation and the consequent need to find practical application for new developments. Cultural pull is more complex, and reflects the organic development of fashions/norms/expectations that evolve within a group/organisation/industry sector. It is important to note that these may provide both positive and negative feedback in relation to a particular innovation.

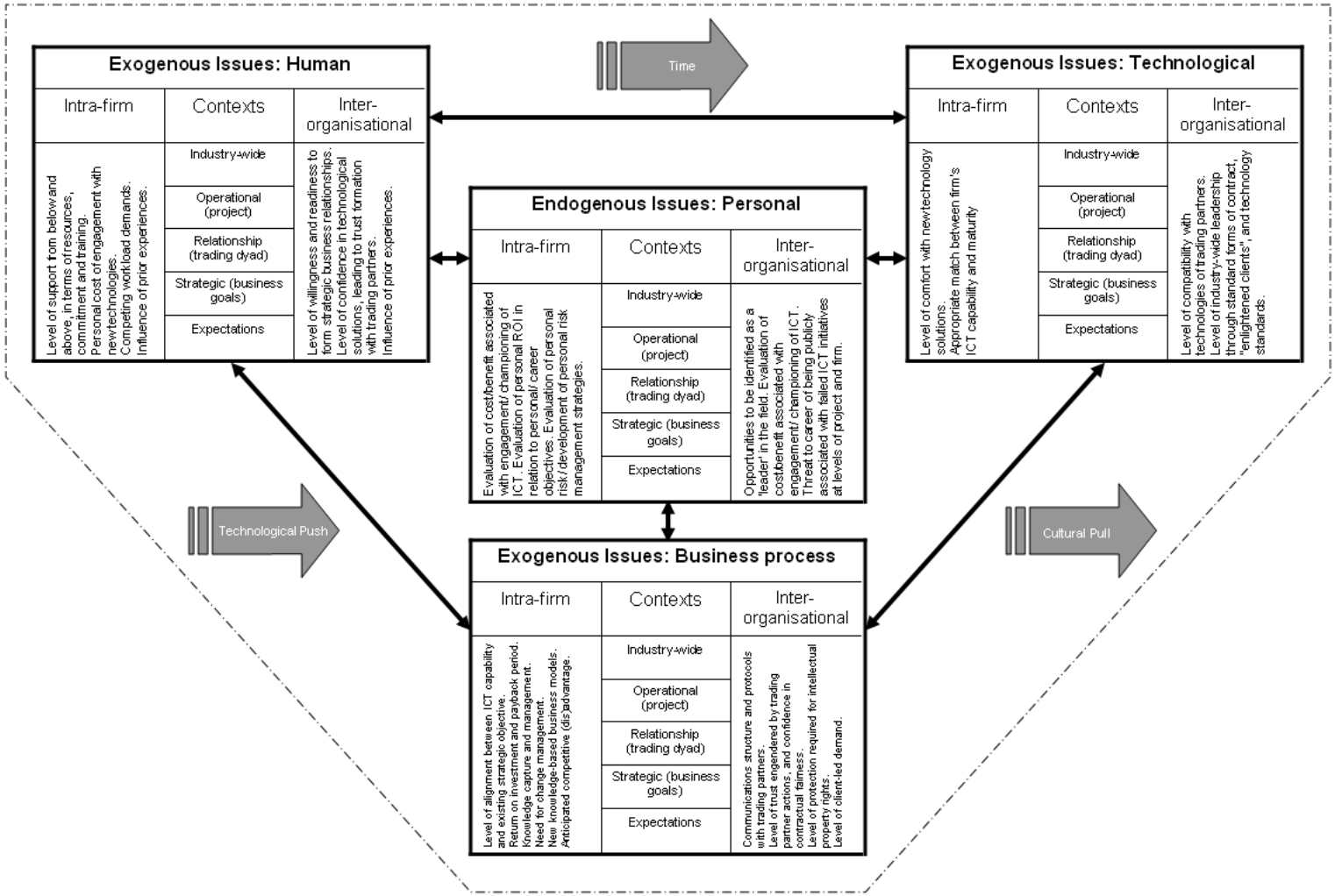

Figure 1. Synthesised model of attitudinal profile of ICT decision-makers in the AEC sector

The domains are now explained in detail:

Human: intra-firm

The level of support from below and above, in terms of resources, commitment and training. This statement indicates that an individual's attitude to ICT will be influenced by the perceived enthusiasm of management and colleagues. Appropriate support and enthusiasm in this group are liable to increase the individual's acceptance of ICT-mediated change.

Personal cost of engagement with new technologies. This statement acknowledges that everyone associated with ICT deployment determines their level of enthusiasm partly in response to a cost/benefit analysis that they conduct in relation to their career/life goals, and that management failure to acknowledge concerns arising from this process will result in suboptimal outcomes.

Competing work load demands. ICT innovations in construction-related firms usually occur within a project context, where profit imperatives tend to override the resources required to achieve optimal ICT experiences.

Influence of prior experiences. An individual's attitude is strongly influenced by previous experiences, which might not necessarily be apparent or have been articulated.

Human: inter-organisational

Level of willingness and readiness to form strategic business relationships. An acknowledgement that successful inter-organisational ICT adoption is partially dependent upon non-technical matters, where the individual decision-makers predisposition to seek strategic alliances will play an important role.

Level of confidence in technological solutions, leading to trust formation with trading partners. In a similar way to the previous statement this reflects the need for a decision maker to have confidence in the technological aspects that facilitate a business relationship with another organisation, so that trust in the mechanisms can develop in step with trust in their motives and actions.

Influence of prior experiences. An individual's attitude is strongly influenced by previous experiences, which might only manifest themselves in less than rational decisions.

Technological: infra-firm

Level of comfort with new technology solutions. Technological decisions can be made on the basis of the decision-maker's comfort with the proposed solution, and this might reflect their personal preferences, previous experiences, or perception of "fit" with the firm's objectives.

Appropriate match between firm's ICT capability and maturity. Decision-makers may choose to match technology investments with the business process employed by their firm, with the intention of developing its capabilities in a stepwise fashion with its organisational maturity as the way to optimise return on investment.

Technological: inter-organisational

The level of compatibility with technologies of trading partners. ICT investment decisions may be influenced by the desire/need to achieve a level of integration with the technology of trading partners, resulting from either a project imperative or a strategic business alignment.

Level of industry-wide leadership through standard forms of contract, "enlightened clients", and technology standards. Wide-ranging influences that extend beyond the single project, and potentially beyond single business relationships, where decisions reflect actual or anticipated changes in the culture (pull) or enablers (push).

Business process: intra-firm

Level of alignment between ICT capability and existing strategic objective. A reflection that strategic review, ICT investment, and organisational capability are interlinked in the mind of the decision maker, and that the nature and rate of ICT-mediated change may be determined by the need to evolve from the existing situation.

Return on investment and payback period. Justification for ICT investments may vary between the short and long-term views, with decisions being made variously on the basis of tactical cost recovery within a single project or as a long-term act of faith, and all points between.

Need for change management. Whether change is to be revolutionary or evolutionary, it must be managed, and decision-makers will rationalise which route to follow knowing that both processes require careful management if they are to succeed.

New knowledge-based business models. ICT has the capacity to harness knowledge developed during single and multiple projects, and the extent to which a decision maker might wish to achieve this outcome for his organisation will partially determine the nature of the decisions he makes.

Anticipated competitive (dis)advantage. ICT has the potential to be viewed by a decision maker as both an opportunity to create competitive advantage or a competitive disadvantage as a result of non-adoption, and the perspective that he takes will affect the nature of the decisions he subsequently makes.

Business process: inter-organisational

Communication structure and protocols with trading partners. These have the capacity to encourage or discourage the extension of a firm's capabilities to include alignment with trading partners, and decisions taken in this regard will also reflect the decision-makers attitude to strategic relationships in general.

Level of trust engendered by trading partner actions, and confidence in contractual fairness. In concert with the previous point this issue reflects the potential that ICT has to expose a firm to increased levels of risk as a result of more open and immediate communication and, given the general inadequacy of current legal mechanisms to deal with online transactions, trust in trading partner fairness.

Level of protection required for intellectual property rights. previous points highlights the extent to which a decision maker must consider the risk associated with loss of control over intellectual property, which is inherent where electronic communications are concerned.

Level of client-led demand. From the level of project upwards, ICT decisions are influenced by demand pull, which has the potential to offset all other considerations, offering the decision maker the stark choice of choosing to engage with inter-organisational ICT-mediated communications or not.

Personal: intra-firm

Evaluation of cost/benefit associated with engagement/championing of ICT. A complex mix of considerations wherein the decision maker assesses the personal profit associated with driving ICT uptake as compared to the personal risks that this brings, in terms of career advancement, personal skills development, visibility within the industry, and so on.

Evaluation of personal ROI in relation to personal career objectives. This set of considerations acknowledge that there is a personal price associated with change, often expressed in terms of opportunity cost, where developing expertise in a particular area requires neglecting something else that was previously considered to be essential to career advancement.

Evaluation of personal risk/development of personal risk management strategies. Having balanced costs, benefits and personal ROI in terms of career and life goals, the decision-makers attention must now turn to the risks associated with being identified with a particular ICT initiative, and develop strategies for avoiding/minimising their effects.

Personal: inter-organisational

Opportunities to be identified as a 'leader' in the field. Identification as a domain leader is a possible consequence of ICT leadership within the decision-makers own firm, or as a result of lobbying in public forums, which could potentially influence his decisions.

Evaluation of cost/benefit associated with engagement/championing of ICT. A complex mix of considerations wherein the decision maker assesses the personal profit associated with driving ICT uptake as compared to the personal risks that this brings, in terms of career advancement, personal skills development, visibility within the industry, and so on, this time within temporary project organisations or at a pan-industry level.

Threat to career of being publicly associated with failed ICT initiatives at the levels of project and firm. With visibility comes the potential for very public failure, something that a decision maker has to carefully consider before making firm commitments.

About The Candidate and University

The candidate came to the University of Newcastle in 1999 as a tenured staff member after many years in industry and training organisations, and is currently the Head of Discipline of Building. The PhD was undertaken in the conventional way for a doctorate by research in Australia, under close supervision and with the absence of coursework. Research training was provided by the supervisor. His thesis was derived from commissioned research for the Cooperative Research Centre for Construction Innovation entitled "Critical success factors for ICT mediated supply chains", the last in a series of related projects that resulted in the publication of six books and the "Picturing Success" series of online self-assessment tools (available from http://www.construction-innovation.info/index.php?id=44). It also spawned four peer-reviewed papers.

Significance of the research.

The significance of this research is twofold: firstly, it maps the domain within which ICT decision-makers in the AEC sector make their decisions; secondly, it provides a reliable basis upon which to base further investigations. These are now briefly discussed in turn.

This research started by recognising that the initial adoption of ICT by an individual firm or larger organisation would be regarded by them as an innovation. This would require a decision to be made, thus requiring the identification, and subsequent empowerment of a decision maker in regard to innovation adoption. On the one hand decision-makers would be concerned with the range of potential outcomes that might eventuate from the innovative use of ICT. On the other hand they would be likely to be evaluating it in a similar way to any other business innovation, in terms of return-on-investment. In the event both aspects were comprehensively addressed during both the Delphi and interview studies, and found to be central concerns of decision-makers.

Both the generic innovation influences such as return on investment or capacity to create competitive advantage, and the ICT specific influences such as technological capability, or appropriate staff development, were found in abundance in both the Delphi and interview studies. However their relationship to each other was modelled somewhat differently in each case. These differences could be explained in terms of the emic and etic stances of each, and these were satisfactorily reconciled during synthesis, resulting in a map within which it is possible to locate the attitudinal profile of the overwhelming majority of ICT decision-makers in the industry.

Moreover, this research provides a reliable basis upon which to base further investigations. Specifically it enables research to establish the extent to which issues influencing attitudinal profiles are: commonly encountered across all sectors in the industry, and; encountered according to the decision-makers position as a leader or follower. This is of particular interest when considering the endogenous issues, which are normally hidden from view, but which have such a profound effect upon the public posture of the organisation.

Conclusions

This research has been conducted on the premise that ICT use in a temporary project organisation context within the AEC sector will be considered as a business innovation by adopter organisations, and as a consequence its adoption can be studied using that particular body of knowledge as a springboard. Given that the attitudinal profile map contains four domains, only one of which is innovation-specific, it could be highly significant to discover the extent to which the principles of the map hold true when applied to a different type of innovation deployed in a similar context.

Lastly, it is significant to understand that whilst attitude is a privately held a set of beliefs and values, it results in publicly visible behaviour, in this case manifesting itself as a business position, and consequent actions in relation to business transactions with trading partners. As business practices in the construction industry develop to embrace the desirability of value generation for clients (as opposed to simple cost-driven protocols) as

an optimised route to competitive advantage, it is becoming increasingly important for firms to trade with other like-minded organisations in order to maximise the likelihood of successful business outcomes. It is therefore desirable to understand the values of trading partner organisations prior to entering into long-term business relationships with them. This necessitates the development of diagnostic tools that focus upon areas of critical importance to the success of the relationship in regard to ICT-mediated business processes. The issues uncovered in this research contributed to the development of the "picturing success" series of diagnostic tools for the Cooperative Research Centre for Construction Innovation in Australia.

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