**CRC** Construction Innovation
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# P*ICT*URING SUCCESS:

## Critical success factors for ICT integration in the Australian construction industry

Project Partners

**WOODS BAGOT**™

**Queensland** Government
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*The* UNIVERSITY *of* NEWCASTLE
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September 2006

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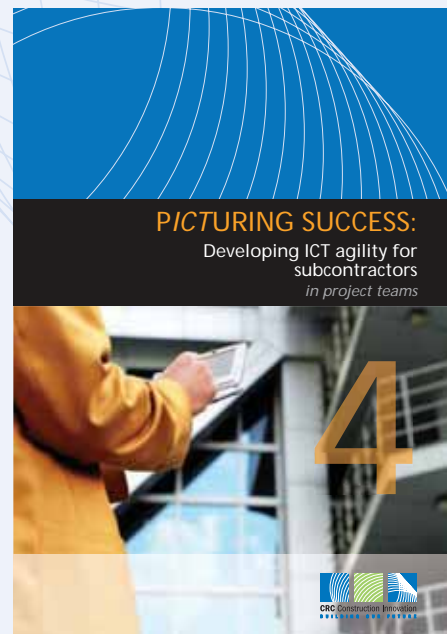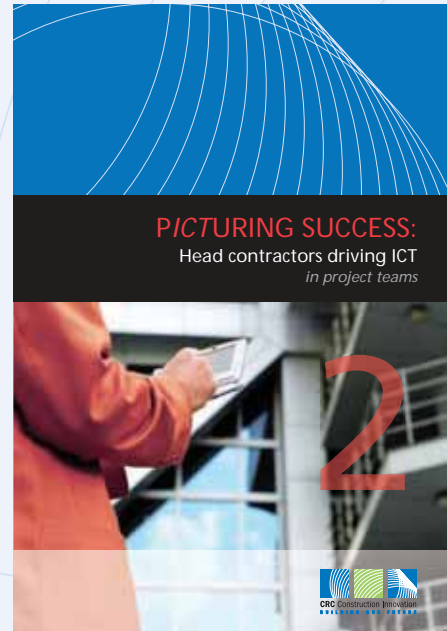
# P*ICT*URING SUCCESS:

## Critical success factors for ICT integration in the Australian construction industry

An introductory overview of
the P*ICT*uring Success series

Graham Brewer and Thayaparan Gajendran

**CRC** Construction Innovation
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# FOREWORD

**CRC** Construction Innovation
BUILDING OUR FUTURE

This publication "P*ICT*URING SUCCESS: Critical success factors for ICT integration in the Australian construction industry" results from a Cooperative Research Centre (CRC) for *Construction Innovation* project led by Graham Brewer (The University of Newcastle) with a project team comprising David Marchant (Woods Bagot), Geoff Caldwell, Raju Chamala (Queensland Department of Public Works), Robin Drogemuller (CSIRO), Kathryn McCabe, Thayaparan Gajendran, Swee-Eng Chen (The University of Newcastle).

The CRC for *Construction Innovation* is committed to leading the Australian property, design, construction and facility management industry in collaboration and innovation. We are dedicated to disseminating practical research outcomes to our industry – to improve business practice and enhance the competitiveness of our industry. Developing applied technology and management solutions, and delivering education and relevant industry information is what our CRC is all about.

This book draws on the major findings from a Cooperative Research Centre for *Construction Innovation* two-year project investigating *Critical success factors for information and communication technology (ICT) – mediated supply chains.* It identifies a range of critical influences on the successful deployment of new technologies across temporary project organisations assembled to complete construction projects. It identifies those factors that *must go well,* and *must be attended to*, to maximise a firm's likelihood of successful engagement with an ICT-mediated supply chain.

The project used a rigorous methodology with three independent data sources. It identified success factors and revealed practical examples of best practice engagement with ICT-mediated supply chains, which are detailed in a series of publications including this one:

• Critical success factors for ICT integration in the Australian construction industry

1. P*ICT*URING SUCCESS: Client leadership of ICT integration in project teams

2. P*ICT*URING SUCCESS: Head contractors driving ICT in project teams

3. P*ICT*URING SUCCESS: Consultants adding value through ICT in project teams

4. P*ICT*URING SUCCESS: Developing ICT agility for subcontractors in project teams.

This book describes the five industry-wide critical success factors:

• organisational commitment

• organisational attitude to communication

• rights and duties of organisations

• investment drive

• key risks related to ICT usage.

These factors are integrated by drawing on industry-wide best practice to develop the key findings. In particular, ICT leadership and champion profiles" across a temporary project organisation are described, together with a set of action plans. The range of ICT-enabled value creation is described in terms of competitive advantage and linked to ICT-mediated business process integration across the project supply chain as the ultimate expression of value creation. The book concludes with a summary of the key findings from the research.

## A p*ICT*ure of success

The critical success factors revealed in this book apply to all construction firms engaging with ICT-mediated project supply chains. However, they must be set in the context of a construction project — itself part of the industry and wider economy — before the multiple dimensions of the challenge facing these firms becomes apparent.
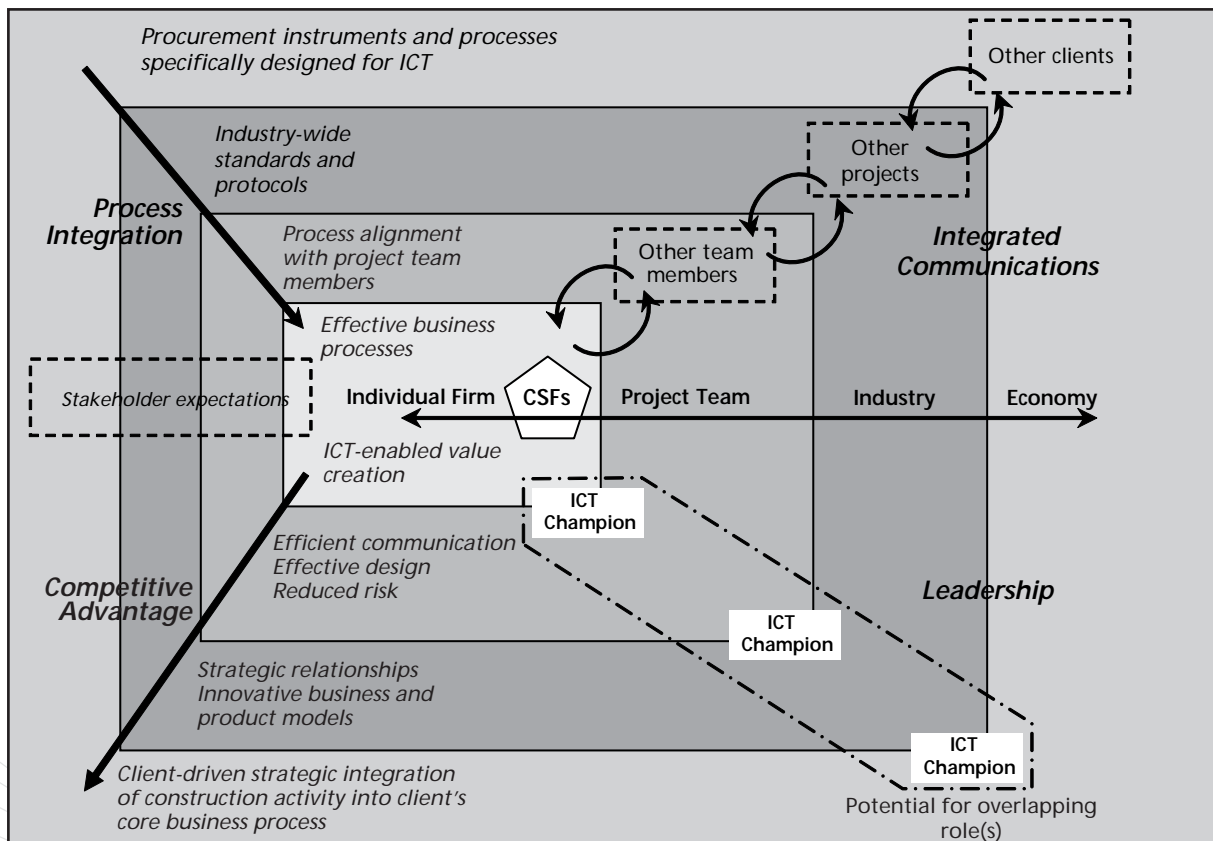
Integrated model of critical success factors in an industry context

This image, then, is the "logo" for the book. Each component of the image is dismantled, explained with the benefit of industry-wide research, and then put back together as a coherent template for the successful deployment of integrated ICT across project supply chains.

## Overview of the research project

The project has sought to identify, verify and test those issues that are, to a greater or lesser extent, responsible for influencing the success or otherwise of ICT investments made by individual firms, for use in conjunction with trading partners. It has harnessed the expertise provided by:

- previous research
- a panel of international experts
- a national postal survey of experienced practitioners from across the industry
- detailed case studies of projects using ICT.

The figure (below) illustrates the research process used to develop the models of best practice.



ICT and SCM issues as they relate to temporary project organisations

Literature Review of Qualitative CSF Methodologies

Literature Review of Qualitative CSF Methodologies

Literature Review of Candidate ICT-related CSFs

Triangulated research procedure

Delphi Study of international panel of ICT, SCM and CM experts

Quantitative Survey of industry-based ICT practitioners

CSF model creation and validation

Case Study of participants in Supply Chain A

Case Study of participants in Supply Chain B

Case Study of participants in Supply Chain C

Industry-wide Best Practice Guide

Best Practice Guide For Clients

Best Practice Guide For Main Contractors

Best Practice Guide For Architects/ Consultants

Best Practice Guide For Sub-contractors/ Suppliers

Project research methodology

The four companion guides to this book have been produced with objectives:

- to identify the perceived effects and benefits experienced by firms that have employed ICT
- to identify the level of ICT use
- to describe the operational environment within which ICT is typically deployed, and describe what form that ICT takes
- to describe the "critical success factors" (CSFs) identified by industry peers
- to examine their implementation through case study exemplars
- to identify the barriers to ICT adoption experienced by industry peers
- to provide a self-assessment tool.

In the context of the project, CSFs were defined as:

"*Those things that absolutely, positively must be attended to in order to maximise the likelihood of a successful outcome for the stakeholder, in the stakeholder's terms.*"

This definition was developed for a number of reasons:

- Success is a notoriously difficult concept to define and yet it is the goal of all businesses. If a business is questioned about factors that contribute to their success it is assumed that they will have a clear understanding of what they expect from their ICT.

- A set of generic CSFs cannot be developed from single cases or a small survey. Instead, they must emerge from a large and appropriate dataset, distilled to produce the essence of collective experience.

- Since the expectation is that closer alignment of business processes should result from wider use of ICT across the construction and property sector, it is reasonable to expect more efficient and effective implementation to arise out of an understanding of what competitors and supply chain partners are doing.

Ultimately, the guides' readers will make business decisions about ICT investments and "business process re-engineering" (BPR) on the basis of:

- prior experience

- persuasion by diverse evidence

- alignment with strategic business goals

- potential to increase profitability.

It therefore follows that these guides adopt a persuasive, advisory stance, rather than suggest a panacea.

Each of these guides is primarily based upon the findings of the national survey, augmented by evidence from both the Delphi survey of experts and the case studies of specific project supply chains. They contain interactive diagnostic tools contained on an accompanying spreadsheet. Specific instances of best practice that were discovered during the case studies are included. These are conveniently arranged in accordance with the critical success factors.

For more than a decade the construction industry has seen the introduction of a wide range of information and communication technologies (ICT) across all sectors. From the trade subcontractor upwards, the use of mobile communications and computer-based tools has become increasingly commonplace, to the extent that it is difficult to imagine working without cell phones and personal computers.

No one would deny that the adoption of these technologies has resulted in greater efficiencies for the overwhelming majority of the industry, but the reality is that the benefits of ICT are largely confined within the boundaries of the individual firm. In terms of inter-firm ICT use, many firms recognise the potential benefits that they would experience if everyone else used the same tools as they, and worked in the same way; but for the majority, the thought of integrating their business practices with those of their trading partners is seen as being more trouble than it is worth.

The problem is not simply having to work cooperatively with another firm or group of firms. This kind of trading relationship is quite common in other industries and, after an initial bedding-down period, usually works well. In fact, industries such as car manufacture, information technology development, aerospace and travel, have all integrated ICT into their supply chains to such an extent that it would be impossible for them to function at their current levels of
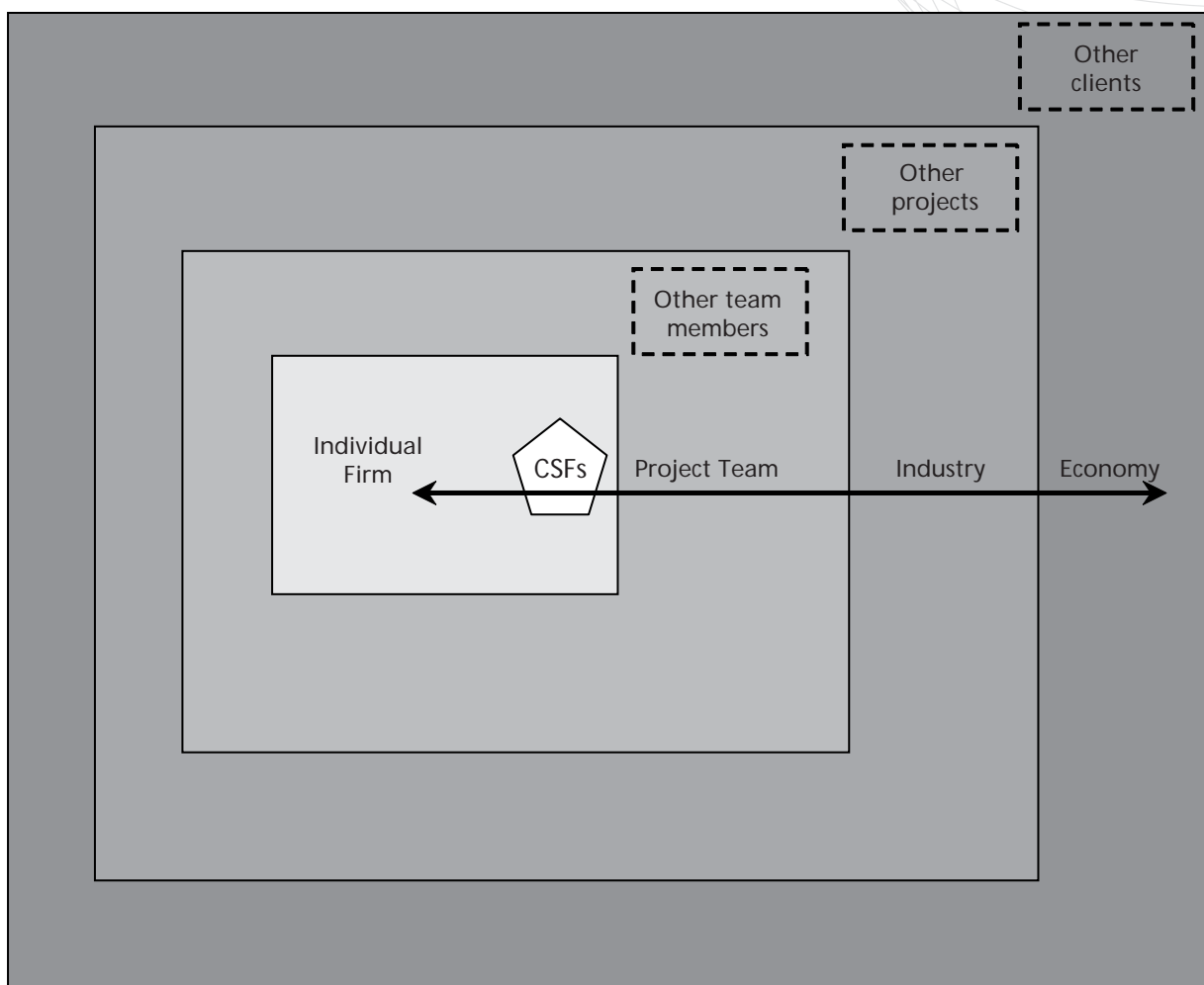


Figure 1. Context and reach for critical success factors

performance without it. While various characteristics from these industries can be found in construction, the one thing they have, which is overwhelmingly lacking in construction, is a pattern of relatively stable trading relationships. Although several of these industries can have project-based elements, no other industry has the wholly project-driven focus that is characteristic of the construction industry.

One of the trademarks of the construction industry is the way in which it comprises an ever-changing network of temporary project teams, the members of which come together to construct a single prototype structure, only to break up upon its completion, unlikely ever to work together in the same configuration again. Some of these teams exist only for months, while a few might remain together for years. In most cases the effort required to integrate business processes across the team is considerable, so much so that for most projects it is seen as prohibitive. Consequently electronically mediated communication and information sharing is rarely seriously considered. In point of fact most business relationship characteristics in the industry can be attributed to its project-driven, predominantly short-term focus. These traits have consistently been blamed for shaping the industry's culture and its low margins, and are now cited to explain its slow ICT adoption rate.

In spite of these impediments, an increasing number of temporary project organisations are adopting and integrating ICT into the heart of their activities. Their motivation is the perceived benefits and competitive advantage that such a move offers them. They recognise that the benefits of ICT integration can extend far beyond simple efficiency gains, offering them a genuine, strategic competitive advantage. Many equally recognise, however, that the benefits of such a move may take a long while to become fully developed, and that full benefits are unlikely to materialise in a short-term project. Their experiences have revealed that there are a number of factors that need to be addressed in order to achieve successful ICT adoption and integration. Figure 1 shows the context within which they occur.

Fundamentally, there are two vital prerequisites for the successful adoption of ICT across an entire project supply chain. The first is to ensure that the initiative is championed vigorously by a project team member who has both sufficient motivation and positional power to ensure widespread ICT adoption across the project team. Secondly, this commitment needs to be mirrored by the presence of a champion *within* each of the other temporary project teams.

However, project-wide championing can really only be successful if the project ICT champion recognises a clear and present benefit to its own interests. This is most likely to be found in those organisations whose interests extend well beyond the practical completion of the project. Experienced client organisations and major contracting firms are ideally suited to this role.

It is a key feature of these champions, and the partners they successfully engage with, that they understand the importance of their business relationships with their trading partners. This leads them to manage the relationships with enough care to ensure continued effective ICT engagement, even when it is evident that this might entail considerable up-front investment in terms of resources, particularly time and people.

These factors have multiple facets that have been revealed by a major survey of the Australian construction industry. These are described in the next section.

# 2. CRITICAL SUCCESS FACTORS FOR THE AUSTRALIAN CONSTRUCTION INDUSTRY

A comprehensive survey across all major sectors of the Australian construction industry has revealed five critical success factors that *must go well*, and *must be attended to*, to maximise a firm's likelihood of successful engagement with an ICT-mediated supply chain. The five critical success factors are:

- organisational commitment
- organisational attitude to communication
- rights and duties of organisations
- investment drive
- risks related to ICT usage.

These have been found to contain sub-dimensions and these are described in the following sections.

## 2.1 Organisational commitment

The wholehearted commitment of an organisation is the crucial prerequisite for the successful adoption of ICT and particularly its subsequent integration into its business practices. This importance of commitment is most sharply felt when integration is attempted across the organisation's boundaries with the project supply chains that it does business with.

Senior management commitment is important for successful management of both internal and external factors. Of these, its commitment to adequate human resource development through training demonstrates to its workforce that it is serious about this. Clearly, a reciprocal commitment from the organisation's employees is essential for the success of new technology initiatives.

Externally, it is desirable to foster continuing relationships with trading partners, noting that ICT-driven project communications require a culture of transparency and trust during information transactions with them.

## 2.2 Organisational attitude to communication

It is widely recognised that the culture of the construction industry adversely affects an organisation's attitude to its communications with trading partners, driven by concerns about risk, liability and loss of negotiating position in the event of contractual dispute. Additionally, the fragmented structure of most construction projects is seen as inhibiting the free flow of information.

In a symbiotic way, collaborative procurement approaches foster the development of more open communication channels — and open communication increases trust. Therefore, a move from the purely competitive towards the collaborative and long term is desirable , with an emphasis on providing the client with real, long-term value rather than short-term lowest price, which often turns out to be anything but an economic reality.

Collaborative engagement must be supported with genuine agreements, tailored to an ICT-enabled environment. Moreover, communications need to be based on a single, compatible structure rather than on multiple online systems led by different participants, which tend to work negatively in the project environment.

## 2.3   Rights and duties of organisations

Organisations should recognise that they have both formal and informal rights and duties when using ICT in their dealings with project supply chain partners — and this needs to be acknowledged.

Clear identification of ownership of the intellectual property of project information is important. Consequently some (commercially sensitive) information generated by an organisation or its trading partners should not necessarily be equally available across the entire project team.

If an organisation intends forming sustainable and enduring supply chain relationships it must be prepared to champion ICT adoption across the project supply chain. Specifically, it must be prepared to support weaker and less technologically able organisations. This posture should not be regarded as an act of altruism but should be recognised as an investment to maximise its own long-term benefit from the technology.

## 2.4   Investment drive

An organisation must have a clear understanding of the real motives for making an ICT investment *and* the consequences of its decision before making the commitment. This will result in one of two stances:

- A short-term, project-based, tactical decision, such as to invest in a particular type of new technology, limited to a single project, to win a large contract that calls for its use. The return on investment would need to be recovered by the end of the project for it to be considered successful

- A strategic decision to integrate ICT into business processes across the firm, and particularly into adjacent trading partners. Although benefits might be apparent over a short period, the true return on investment (ROI) (which could include non-financial benefits such as effectiveness and performance gains) would require a longer-term perspective, possibly extending over several projects and strategic engagement with multiple project team partners.

Failure to recognise the implications of the chosen path will result in profound disappointment, and may cloud the objectivity employed in future ICT decisions.

## 2.5   Risks related to ICT usage

The introduction of new technology and protocols into project supply chains concurrently raises the real and perceived risks to which various project team members are exposed. Their deployment should be "championed" by a supply chain participant whose position and contractual power is such that they can moderate its use. While the specific concerns of individual team members may vary considerably, they can mostly be categorised as:

- guarantee of information security during transmission and storage — of particular importance during the tendering process if on-line tendering/storage of tender documentation is used

- protection of the intellectual property rights for the creators of information that is subsequently shared electronically across the project team

- prevention of unauthorised use of information by those who have nevertheless been granted access to it for legitimate purposes — this could result in issues of liability for the originator of the information if, for example, design information was used improperly.

Overcoming these concerns is crucial for the success of ICT in a project supply chain. Implicit in this is the recognition that leadership in terms of ICT protocols for project communication/ management is best undertaken by the *most appropriate* organisation in the supply chain in terms of skills, motivation and position.

## 2.6    Conclusions

This section has identified the five critical success factors that influence the likelihood of successful ICT-mediated engagement with trading partners in a project supply chain. It has also described the various facets associated with each factor. Further examination reveals cross-factor issues that underpin all ICT deployment in a construction project context, namely leaders and followers, ICT champions' profiles, and value creation. The following sections describe them in detail.

# 3. LEADERS AND FOLLOWERS

In industries other than ours, the rollout of an innovation or new technology would normally be expected to be driven by a highly motivated stakeholder who had a keen interest in its success. This might take the form of a client in a supply chain, or a client division within a large company. Resources and leadership would be identified and deployed in support of its introduction. A similar situation in the construction industry proves to be more problematic.

The fragmentation of the construction industry combined with the transient nature of temporary project organisations conspire to cloud leadership issues. In a project, leadership is predominantly based on the power distribution conferred by contractual relationships, which themselves are driven by the delivery of a constructed asset for a client. This is normally further complicated by the delegation of authority by the client to their superintendent — their project manager, head contractor, or some other function — whose interest in the project is focused on the delivery of a built asset irrespective of the process used.

While it is recognised that ICT can deliver added value to the building's owners and occupiers throughout the life of the building, the extent to which this is practically achieved depends on the attitudes and commitment of the key members of the temporary project organisation. These are also modified by their individual commercial objectives, which may be quite different from the project objectives. In any event, the realisation of potential benefits for the client is dependent on the existence of informed leadership, in whatever form that may take.

When the overall industry was scanned for attitudinal traits, there was an obvious distinction between clients and head contractors on the one hand, and consultants and subcontractors on the other. A detailed cross-sectoral survey of the Australian construction industry has revealed the existence of a clear divide between those in the industry who provide, or are perceived to provide, ICT leadership, and those who expect to be led. Clients and head contractors are usually found in the first category, which can be labelled *leaders*, while consultants and subcontractors tend to populate the second group of *followers*. This is principally explained in terms of the relative power of various parties to the project, and their ability to influence or even dictate the nature of the ICT employed on the project and the way it is used.

The picture, however, is more complicated. Examination of the surrounding issues showed that the followers have often worked with a number of different ICT systems and protocols, and display a high degree of agility and adaptability. Furthermore, while the majority of followers are driven simply by a desire to win work — and adopt new ICT as a consequence of this — there are more and more highly motivated and forward-thinking consultants and specialist subcontractors who are altering their business models in response to new business opportunities that they feel ICT offers them.

Additionally, when individual projects were put under the microscope, it became apparent that regardless of attitudinal traits and expectations, real leadership in project team ICT adoption and integration could be found in any sector. It is possible, though less likely, for a highly motivated consultant or subcontractor to have a significant impact on the way ICT is deployed within a project team. In doing so, they buck the industry norms and confound industry expectations.

Their motives for doing so are rooted in their expectation that by positively influencing ICT adoption and integration they will make further progress towards their own individual business goals. It is apparent that they have a strategic commitment to ICT and consequently regard the expenditure of effort worthwhile. But it is equally apparent that theirs is an uphill struggle, and the extent of their influence may not always include the entire project team, being confined to that part of the supply chain they are actively engaged with.

It is apparent that temporary project organisations can find ICT leadership and drive from many different types of participants. Nevertheless, the ideal situation is one where the client or their delegate dictates *the type of ICT* to be used across the project supply chain and *the way in which it is used* to deliver *best value for the client over the long term.*

## 4.1 Dimensions of value creation

The decision to invest in ICT or to engage with other project team members using ICT will only be made on the basis that it presents the individual firm with the likelihood of increased profit through the creation of competitive advantage, or by cost benefit through improvement in some internal facet of business performance. In either case successful deployment will be accompanied by organisational commitment to the initiative, as indicated by senior management "championing" and "buy-in". Management literature is full of descriptions of the need for managers to recognise the need to integrate ICT roll-out with other strategic business objectives, and to accept that business process re-engineering should be an inevitable consequence of broad technology change. It is within this process that competitive advantage and value creation should be sought.

It is evident from a comprehensive cross-sectoral examination of the construction industry that the potential for value creation occurs at three distinct phases during the life of a construction project: the design phase, the construction phase, and the operational phase of the built asset, with instances of the following ICT uses being reported:

- Design phase
  - 3D modelling
  - 4D modelling
  - automated bill of quantities
  - lifecycle modelling of the building
  - computer-assisted cost engineering.
- Construction phase
  - automated program of works generation
  - intranet access for distribution of design drawings
  - project web-based database for all communication/information transfer
  - on-line materials procurement.
- Operational phase
  - support for the facility management function including computer-assisted maintenance management
  - space management
  - resource management
  - asset management
  - energy management.

## 4.2  Benefits

There are several important issues that need to be understood regarding value creation:

- identifying the beneficiaries
- the changing nature of value creation at different stages in project lifecycle
- the impact of value creation initiatives on the eventual project outcomes.
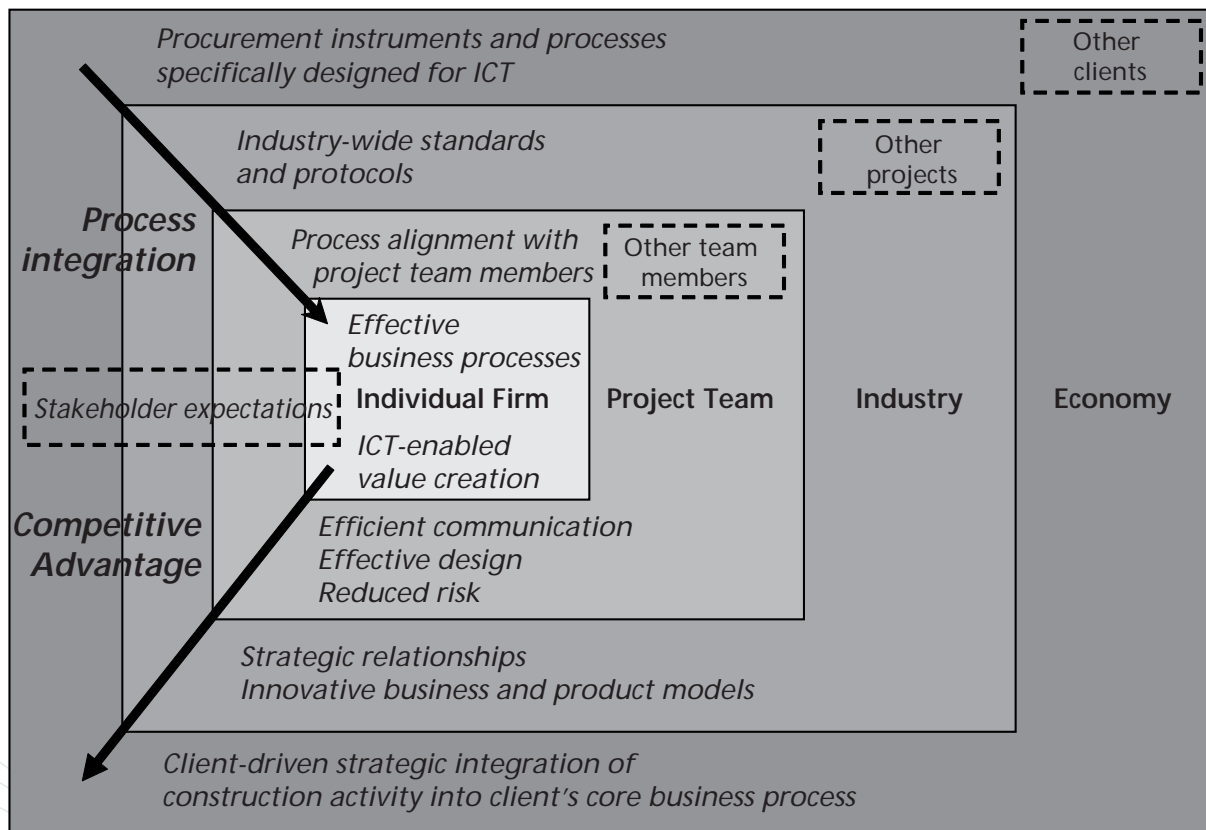
Figure 2. Value creation: competitive advantage and process integration

Value can be created by any member of a project supply chain. As previously noted they will be motivated by the prospect of creating competitive advantage and/or business process effectiveness. It has also been noted, however, that the nature of ICT-mediated engagement changes according to the temporary project organisation's team members' ability to influence supply chain operations, especially in regards to the ICT itself and the consequent benefits it might bring. Those value creators whose position enables them to take a holistic view of the construction process and the role of ICT as a value-creating agent are more likely to see this as a long-term process that extends well into the operational phase of the project.

The extent to which a given temporary project team member regards innovation and value creation as being either an intra- or an inter-organisational issue will also be related to their perceived position within the project supply chain.

As a "follower" of supply chain ICT protocols, an organisation will necessarily focus on ways in which imposed work practices can be accommodated with the least disruption, and used to the most intra-organisational benefit. Value creation for trading partners will be seen as beneficial only where there is a likelihood that this will result in repeat work.

For the "leaders" of supply chain ICT protocols, the focus will be on ways in which to impose work practices that create efficiency savings, increased effectiveness of supply chain activities, and ultimately (though elusively) competitive advantage through new business and product models. ICT-enabled value creation will be viewed as a product of the entire supply chain, even when generated by various trading partners working better in an ICT-mediated supply chain.

The ultimate beneficiary of any such improvements ought to be the client. It is the client who creates the original order for the project and who pays for it. Furthermore, the client has to live with the consequences of the design and construction phase of the project. Any ICT-facilitated efficiency and effectiveness gains should ultimately accrue to those who foot the bill. It is notable that the consequences of (sometimes minor) decisions made early in the design process can have huge economic consequences later on during the operational phase. The same can be said of

expedient decisions made during the construction phase that alter the intent of the original design. The Pareto Principle is well known, and is inherent in complex systems and processes, of which construction projects are classic examples. If ICT-mediated project teams and supply chains are to deliver increased value to the client, they must be designed with that intention, rather than be allowed to evolve ad hoc. Integration is the logical consequence of such a view.

## 4.3    Integrated communications rather than automation

While the construction industry lags behind other industries in adopting and integrating ICT, it is true to say that, at the level of both the firm and project team, there are indications that an increasing number of construction industry participants are moving beyond the mere automation of manual tasks. If construction projects are to be more effective, this will come as a consequence of greater integration of communications across the temporary project organisation. While the industry is still a long way from sector-wide performance improvements, there are enough ICT-mediated projects to make it possible to describe the attributes that a project and its participants require to create value at multiple levels across a project supply chain into which ICT has been integrated.

Best practice value creation by members of a temporary project organisation requires the involvement of the entire project supply chain (Figure 3). From the suppliers of raw materials upwards, inter-organisational business processes should be designed to facilitate the free exchange of information necessary for optimal flow of goods and services.

Members of the supply chain who positively contribute to this process should expect to be rewarded as a consequence, through a combination of increased/repeat business and increased margins. Though the precise nature of the reward will vary from user to user and at different levels within the project supply chain, the concept should remain true throughout the project team. Such an integrated approach is built on the incremental capability improvements of individual project team members, who close the communication gap with other team members.

## 4.4    Conclusions

This section has outlined the dimensions of value creation that ICT brings across a temporary project organisation. It has built upon the preceding section, which indicated the importance of leadership in securing the likelihood of beneficial outcomes from using ICT integration across a project supply chain, hinting at the optimal position of the client to fill this role, but equally recognising the legitimacy of leadership coming from other quarters. The following section looks at the ideal profile of ICT champions from within the "leaders" group, "followers" group and from "within" an individual firm.
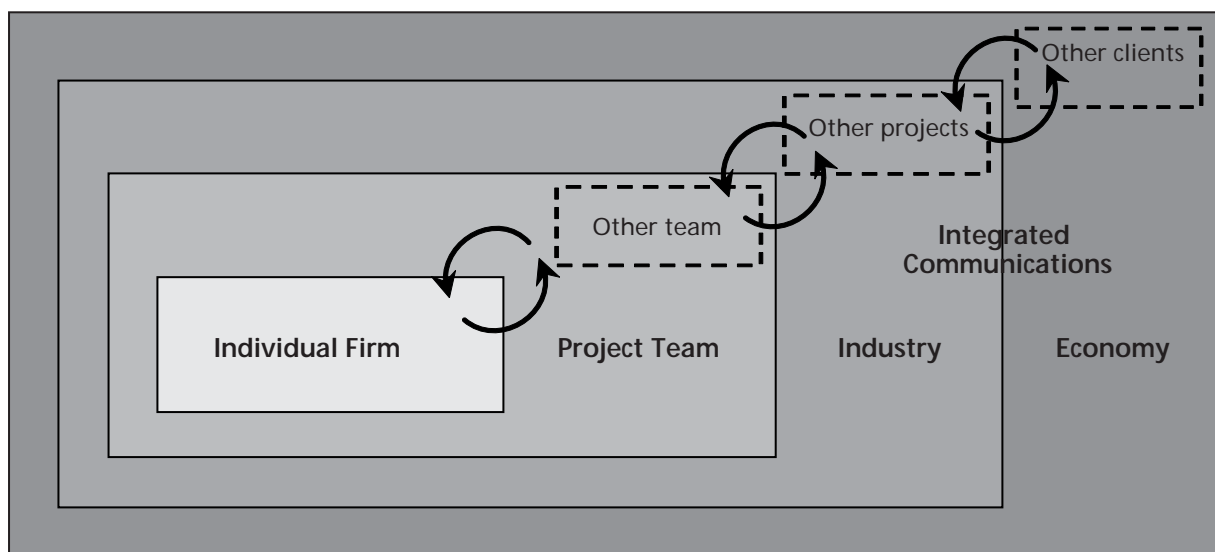


Figure 3. Integrated communications across the project supply chain

# 5. THE ICT CHAMPION: BEST PRACTICE PROFILES

## 5.1  Introduction

The previous sections have identified the range of critical factors that influence the successful roll-out of ICT across a project supply chain, highlighted the importance of leadership in this process, and explained the nature of the benefits that can accrue at all levels in the project if ICT is fully adopted *and* integrated. This section describes various profiles of the ICT "champions" who are required to drive these processes, both at the level of the individual firm *and* across the temporary project team.

Each profile is divided into two sections, the first of which describes the issues, both contextual and ICT-specific, which are likely to be central to the thinking of a person cast in that role. The second section describes a plan of actions that will support the person in their role, specifically in regard to ICT integration. The nature and scope of that integration will vary according to the person's role.

ICT championing can occur at three different levels:

*   supply chain leader
*   supply chain follower
*   internal (firm).

It is important to note that while leadership and "championing" may occur in any one of these contexts, that role must necessarily span formal boundaries. This means that the firm's ICT champion must act as the interface between it and the rest of the temporary project organisation, whose champion may in turn interface with others in the industry or with the wider economy, typically as a result of interaction with clients from other industries. Figure 4 illustrates these relationships.

Conceptually, it is important to note that while there are three levels of champion shown in relation to a single project these might not be present in *all* projects. More importantly, given that the project team will consist of a number of individual firms, a firm's champion could also be the project's champion, who could in turn be championing ICT across sectors of the industry, or in other industries from which construction clients are found. So occasionally an empowered representative of a powerful organisation could champion ICT across an entire project supply chain. A client organisation would be in the best position to fulfil this role.
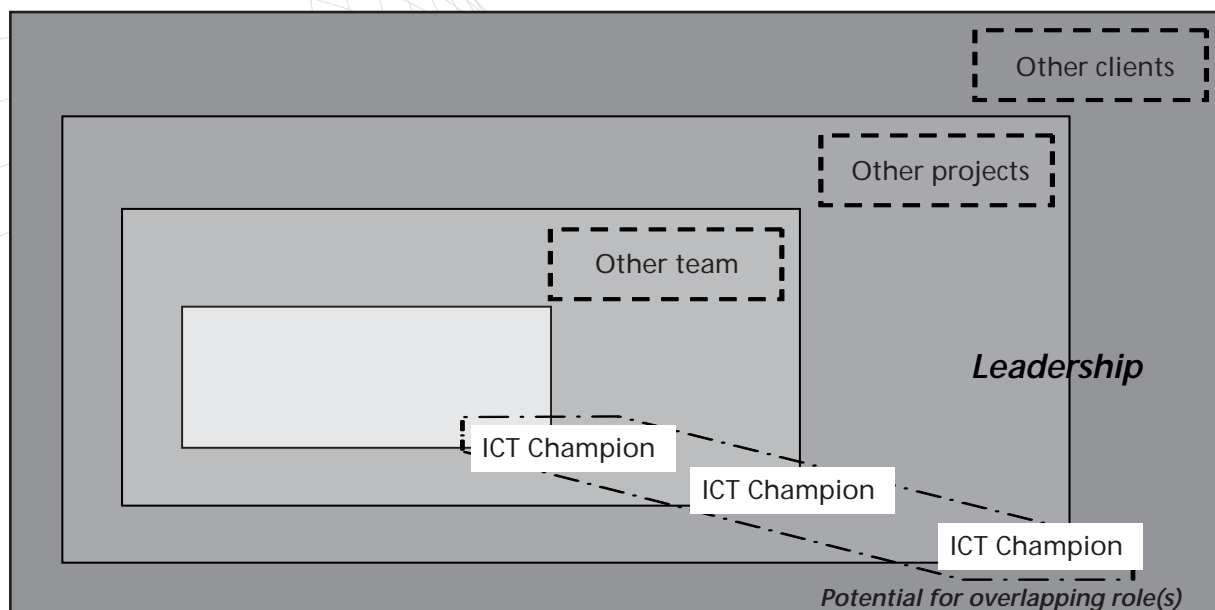


Figure 4. Leadership and "championing"

## 5.2 ICT champion profiles

### Supply chain leader: best practice profile

The ability of a supply chain leader to influence the technology choices and protocols within a project team is clear and obvious. It is the responsibility of the ICT champion within the supply chain to ensure that adjacent project team partners in the supply chain are able to engage with the project protocols by using their ICT capabilities. They should, therefore, be prepared to support those further down the supply chain who may not have the technology or the skills to fully engage with the leader's work practices. If their efforts are successful, the leader should consider forming strategic relationships with them to stabilise that part of the supply chain on successive projects. The larger the leader's investment in the ICT, the greater the pressure on them to make it work!

There is a growing body of evidence to suggest that, with the right technology selection, efficiency savings alone will now provide more than adequate ROI.

### Action plan

- Identify the extent to which it is possible to influence the design of project supply chain communications protocols.
  - If this is possible, be prepared to support the engagement of others across the project in project-specific relationships.
  - If it is not possible to cover the entire chain it may be concluded that commercial/ competitive goals are best achieved by the formation of strategic relationships with the champion's own supply chains over a number of projects.
- In either case, communicate requirements very clearly to trading partners, taking care to ascertain their current capabilities and critical shortfalls. Assess the costs and benefits of the chosen ICT strategy and be prepared to modify before implementation.
- Implementing support for trading partners can take a number of forms: using third parties, vendor help desk, vendor on-site assistance, embedding your own staff within their organisations during the initial stages of implementation.
- Monitor feedback from partners to determine the extent of technical progress and skills acquisition — modify support accordingly.

### Supply chain follower: best practice profile

A supply chain follower's ability to influence the technology choices and protocols within a project team may well be limited, with the ultimate decisions on these matters being taken further up the project supply chain by the client or head contractor. Nevertheless, ensuring that project team partners adjacent in the supply chain are aware of the follower's ICT capabilities may well enable them to ensure these are used to the full and could determine choices for others within the project. The follower should be prepared to support those further down the supply chain who might not have the technology or the skills capability to fully engage with your work practices. The follower should consider forming strategic relationships with them to stabilise that part of their supply chain on successive projects.

The challenge for the supply chain follower's firm will be one of unfamiliarity with a new work practice. The follower will already have developed the agility to adapt to other ICT-enabled work practices and the expectation that they embrace another shouldn't present too much of an obstacle. They should benefit from the initiative sponsor's enthusiasm by engaging with it and demonstrating willingness while at the same time requesting as much assistance as possible. It is important to remember that the larger the sponsor's investment in the ICT, the greater the pressure on them to make it work.

### Action plan

- Identify the extent to which it is possible to influence the design of project supply chain communications protocols.

    - In the event that it is possible to dictate them be prepared to support the engagement of others across the project in project-specific relationships.

    - If it is not possible to cover the entire chain it may be concluded that commercial/competitive goals are best achieved by the formation of strategic relationships with the champion's own supply chains over a number of projects.

- In either case, communicate requirements very clearly to trading partners, taking care to ascertain their current capabilities and critical shortfalls. Assess the costs and benefits of the chosen ICT strategy and be prepared to modify before implementation.

- Implementing support for trading partners can take a number of forms: using third parties, vendor help desk, vendor on-site assistance, embedding your own staff within their organisations during the initial stages of implementation.

- Monitor feedback from partners to determine the extent of technical progress and skills acquisition — modify support accordingly.

### Internal ICT champion: best practice profile

Just as the use of ICT must be championed by a strong firm within the project team, so it is for ICT initiatives *within* the individual firm. An initiative that doesn't have senior management commitment will be unlikely to succeed. But this must be clearly identified with an individual who has both the belief in the initiative and the authority within the organisational structure to ensure that what needs to happen actually does. The identification of this champion is both a visible confirmation of the seriousness with which senior management regards the initiative and a rallying point for those who have to translate the vision into operational reality.

There is no significant difference in the issues facing a champion in a smaller firm except possibly in terms of the amount of investment riding on its success — high-level technologies tend to cost more! Conversely, lower-level initiatives may well permeate further through the firm and could involve diffusion to a wider user group. In addition, the selection of the champion and their visibility will be more obvious in a smaller organisation.

### Action plan

- Identify a willing, competent individual who has sufficient enthusiasm for the task. They should possess a well-rounded grasp of all aspects of the firm, not focus purely on technical issues — remember that ICT is an enabler, not a driver, of business processes.

- Empower this individual publicly with decision-making capacity and access to resources.

- Ensure that regular reports are forthcoming from the ICT team and that the direction they indicate is sufficiently aligned with the rest of the firm's strategic goals.

- Conversely, ensure that messages of encouragement and/or caution are clearly communicated from senior management, especially where an ICT initiative is taking the firm into genuinely new territory.

- Constantly monitor and review the actions of the "champion" and their team so that board-level support can be publicly seen to be unconditional.

## 5.3    Conclusions

This section has explained the need for strong leadership, both at the level of the individual firm and, more importantly, across an entire project supply chain in order to maximise the likelihood of successful engagement for all temporary project organisation members. It has stressed the

importance of realising that ICT success for the individual firm is only likely when it operates as an integral part of an *integrated supply chain, driven by a strong champion.* Conversely, it has also pointed out the reciprocal requirement for *each firm in the project to have a clearly identified champion,* whose role is both to drive internal integration of ICT into its business processes and, at the same time, ensure their best possible alignment with trading partners.

Identifying and developing three distinct profiles for champions at the level of the firm, as a supply chain follower, or as the supply chain leader, has shown that while each role has a different focus there are common attributes that are essential to them all. Furthermore, while leadership and championing ICT across a project supply chain is arguably best achieved by an experienced and motivated client, head contractors are equally able to fulfil the function. Additionally, project supply chain leadership has been supplied by organisations traditionally thought of as supply chain followers.

Finally, some firms (typically but not exclusively supply chain leaders) may only need to look for a champion from within their own ranks, who will then go on to lead the rest of the supply chain by example. Those in this position will have the opportunity to influence the broader operating environment, for instance through client representative groups, professional bodies, government and quasi-governmental organisations, and so on. Clearly this situation will not arise for every firm but it is a highly desirable position to occupy once an ICT-driven competitive advantage has been identified.

# 6. CONCLUSIONS

This book describes the major findings from a multi-faceted research project investigating the use of ICT in construction projects across the Australian construction industry. A central theme of the findings is the need for integration of ICT into the business processes used across an entire project supply chain to maximise the likelihood of successful outcomes when viewed from the various stakeholders' perspectives. A diagram has been developed (refer Figure 5) that illustrates the various interlinked dimensions of successful ICT use in such a setting, which has then been deconstructed, with each component being analysed and explained in the light of the research findings.

The initial commitment to ICT must be made with a full understanding of the context within which any ICT investment decision is made. It has been said that no person is an island, and it is certainly true that no firm operating in the construction industry can consider itself an island, especially when dealing with its use of ICT. Individual firms invariably operate as part of a project team, which is temporary by its nature. It operates in an industry that overwhelmingly consists of temporary project organisations. The products that are generated as a result of these projects are ordered by, and delivered to, clients who operate in the wider economy. Successful integration of ICT requires technological and business systems that can span these multiple boundaries.

There are certain issues in the Australian construction industry, viewed as a whole, that individual firms must attend to, that they must get right, to maximise the likelihood of a successful outcome from their ICT investments. Aspects of these issues are introspective at the level of the individual firm, while others look towards the firm's interaction with its trading partners and beyond, towards the society and the economy as a whole. From the firm's perspective, they deal with factors such as their commitment to ICT, attitude to communicating with other firms, establishing/protecting their rights and duties, understanding what their expectations are from their ICT investment strategy, and lastly, seeking risk-limiting guarantees, protection and assurances relating to their use of ICT.

Further analysis of the data has revealed that two groups exist across the entire industry — one that is empowered to lead project supply chains in terms of their ICT/business process integration, with the other group looking to the first for leadership. The most natural source of leadership has been identified as coming from the experienced client since their involvement in the project is most intense and long-lived. However, successful and effective leadership has been found to exist at all levels across the industry, even though leadership from lower levels in a project supply chain has been shown to involve greater levels of effort and persuasion.

The adoption and integration of ICT, both at the level of the individual firm and across an entire project supply chain, will only succeed when stakeholders perceive the opportunity to create an external competitive advantage and/or internal business process efficiency gain. These can be thought of in terms of ICT-enabled value creation and can occur at any stage during the project lifecycle, but principally during the design, construction and operational phases. Once again, the experienced client has been identified as being the largest potential beneficiary in this regard, and once again it has been shown that the drive for competitive advantage through demonstrable value creation is occurring at all levels in the industry. The most obvious way in which value can be created is by the use of integrated communication across the entire project supply chain.

Finally, the industry survey has shown that there is a clear and present need for demonstrable leadership — within the individual firm, for an entire temporary project organisation, and beyond. The profiles of ICT champions have been described for range of situations, and yet again the potential for clients to lead value creation has been identified.

In summary, it is imperative that all organisations assess their own capabilities and those of their trading partners, ensuring alignment with their strategic objectives before making any ICT investment decisions.

Figure 5 reiterates the complex network of issues and considerations that must be addressed and the context within which they operate. It represents the idealised mechanisms at work within an individual project, and it refers to their boundaries-spanning characteristics. It is not reasonable to expect all of these to be of significance in each project that a firm is involved with, nor as we have seen is it possible for every firm to exert meaningful influence over all of them under all circumstances. However, it is possible — in fact imperative — for all firms wishing to engage with ICT-mediated project teams to factor these considerations into their strategic thinking before making any ICT investments or decisions. Only by this expedient can the opportunity for success be clearly pictured.
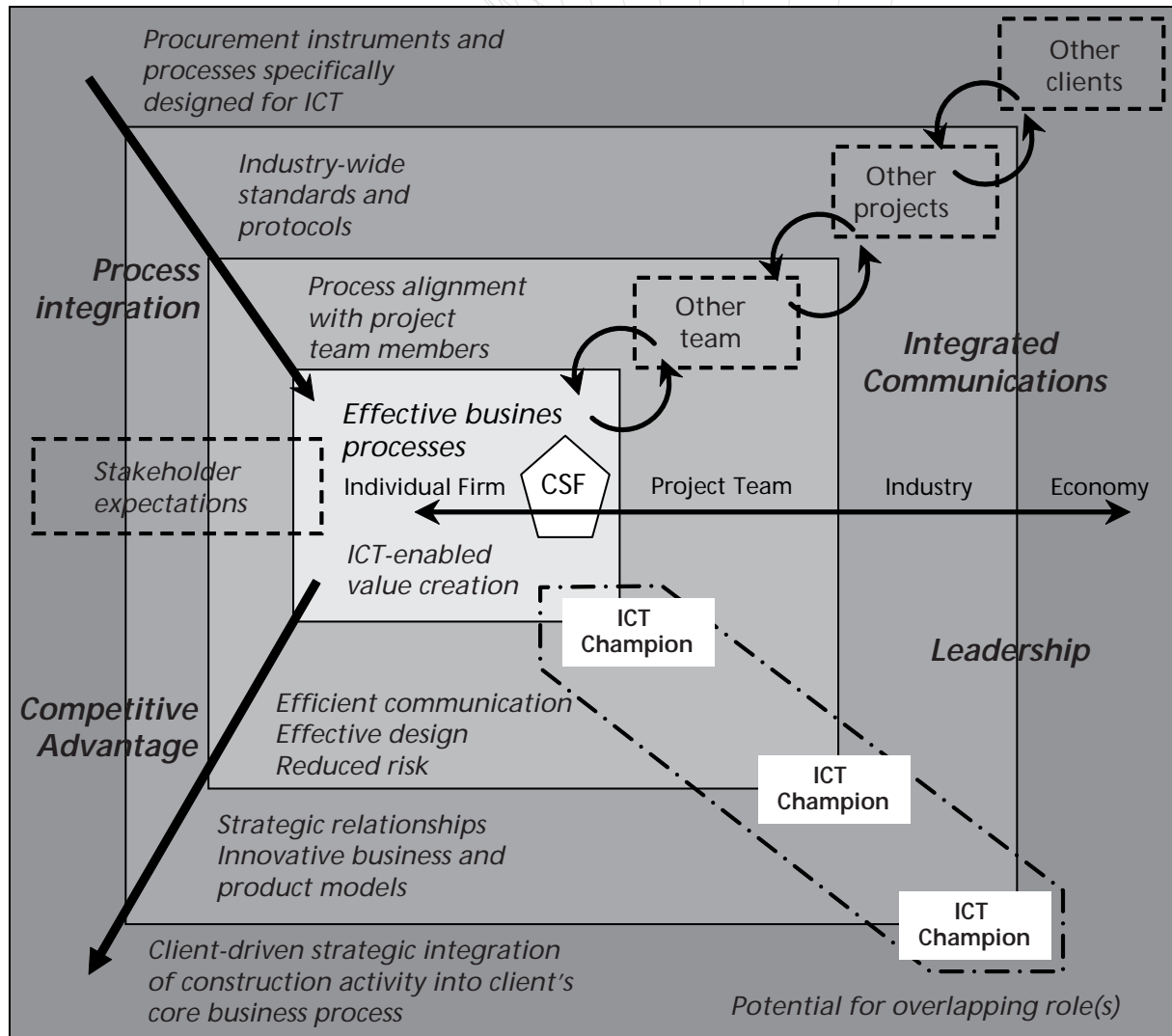
Figure 5. Integrated model of critical success factors in an industry context

*Notes*

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