Integration of Information & Communication Technology: A cultural perspective
Gajendran T¹ Brewer G² Chen S E³

Abstract: It is axiomatic that fragmentation, poor knowledge management, and a negative culture have all contributed to poor performance in the construction industry. Whilst the widespread deployment of Information and Communication Technology (ICT) was once thought likely to address many of these issues, it is now becoming apparent that, in spite of fairly widespread adoption, the successful use of ICT in a project setting is often hindered by surrounding contextual issues – indeed the effectiveness of the cure is largely negated by the malaise itself. This paper adopts a cultural perspective to investigate the issues inherent in this problem. It identifies a range of issues that are classified as either cultural, in terms of both the individual firm and the temporary project organisation (TPO), or as defining the boundary existing at the interfaces between TPOs. The paper concludes by constructing a theoretical framework that is appropriate for investigating ICT integration in the context of TPOs situated in the construction industry.

Keywords: ICT, Integration, Culture, Temporary Organisation

1 INTRODUCTION

The construction industry is often criticised for its failure to improve practices and productivity. One major criticism is the fragmented nature of the industry (Cox & Ireland, 2002; Latham, 1994; Egan, 1998; DSIT, 1999), which leads to inefficient communication among project team participants. Although construction management literature identifies the project-based nature of the industry it does not adequately recognise the characteristics of projects, especially as temporary organisations, which impact upon the effectiveness of individual projects and the industry as a whole. Among the solutions intended to address the construction industry problems the uptake of Information and Communication Technology (ICT) was widely anticipated to increase the effectiveness of project delivery. While, it has been established that although the uptake of ICT to automate business processes has given productivity gains at an automation level (Finch 2000; Love et al., 2001; Li et al., 2000), the full potential of ICT to integrate operations within a project is not widespread (Bulmer & Brewer, 2000).

It is now held that the unsatisfactory performance of ICT investments should not be blamed on the uptake of ICT, but rather on the poor integration of ICT into the structure of construction industry business processes. The failure to consider the ‘temporary project organisation’ and ‘network relationships’ that characterise the construction industry business environment by the participant organisations during implementation of ICT is a likely cause for unsatisfactory performance (Brewer et al 2003). This paper focuses on the issues related to ICT integration in the construction sector. It uses mainstream organisational theory, project management and ICT literature to review the complex nature of project organisations, and the issues that impact on ICT integration, using them to construct a theoretical framework that describes the contextual attributes that contribute to suboptimal ICT outcomes and limited project success in the construction industry.

2 ICT INTEGRATION: WHAT IS IT? AND WHAT DOES IT MEAN TO CONSTRUCTION INDUSTRY?

Terms such as IT (Information Technology), IS (Information System), MIS (Management Information Systems) are used in different parts of the world synonymously for ICT. Researchers and practitioners have from time to time attempted to classify and group ICT evaluation. Keen (1995) classified ICT into three basic uncomplicated categories namely, Computers, telecommunications and Multimedia data. These categories were predominantly based on hardware and sheds little light into the process. However, Shore (2001) visualised the role of ICT in four stages:

Stage 1 – Telecommunication - Hard copy dominated (mail) data but substantial telecommunication (telephones and fax) usage.

Stage 2 – Electronic Data Interchange (EDI) - Automation of information flow elimination of many labour intensive data entry activities. Electronic exchanges of routine business transactions from computer to computer.

Stage 3 – Integrative strategy (organization) - Rather than infrastructure comprised of independent applications and separate databases to serve specific business process, enterprise wide systems integrate and coordinate their operations in a centralised manner. Early systems looked at organisation wide integrations and now beyond the organisation. ??(rewrite sentence)

Stage 4 – Integrative Strategy (supply chain) - A supply chain is characterized by strategic supplier alliances with extensive two way information flows. This is to integrate all platforms across project supply chains.

Shore’s categorisation not only takes ‘business processes’ into account but also looks beyond the organisation, to a supply chain perspective. This view is heavily supported by supply chain literature. Supply chain literature identifies the people, process and network integration as being critical for effective supply chain management (refer figure 1). Lambert (2000, p 65) indicated that ‘one of the most significant paradigm shifts of modern business management is that individual businesses no longer compete as solely autonomous entities, but rather as supply chains. Supply chain management is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders.’ However, managing supply chain integration is not without challenges. Handsfield et al (1999) pointed to poor alignment of organisation cultures as the factor in adversely affecting supply chain integration. Faniran et al. (2001) recounted the difficulties faced in achieving Design-construction integration in the construction industry.

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Above review indicates widespread use of the term 'Integration' in supply chain and ICT literature. Although, the term 'ICT integration' is widely used and believed to be necessary for optimum level of organisational effectiveness, the meaning of 'integration' is less well understood.

### Existing domains of integration

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**Figure 1:** Supply Chain Management Framework: Elements and Key Decisions (Source: Lambert 2000)

Wainwright & Waring (2000; 2004) have carried out an extensive literature review on integration and indicated that "in a broad sense, the meaning of integration has become synonymous with utilitarian goal of greater efficiency, effectiveness and competitiveness in organisations" (p329). They indicated that 'integration' as 'the ability of computer hardware or software systems to work with previously incompatible systems' (p336) is limited to technical aspects, and classified integration in a broader sense incorporating four aspects namely: technical, systems, organisational and strategic integration (Wainwright & Waring, 2004). Figure 2 describes their integration framework. They argue that most ICT systems fail due to a lack of management attention to complex organisational factors, preferring to concentrate solely on technical and strategic matters.

According to Wainwright & Waring (2004;336), organisational 'integration is articulated by different IS authors at different times as 'structural', 'social and historical', 'power', 'politics', 'culture' spheres of study'. From a system integration perspective Mize (1987) contextualised interrelationships between subsystems and these interrelationships are interfacing (interacting or communicating with another element) and integrating (organizing various traits, relations, attitudes, behaviours, etc., into one harmonious personality). Platts (1995) proposed a strategic framework which encompasses two basic aspects of strategic integration - external integration (matching organisational objectives to the environmental) and internal integration (developing a set of organizational practices which are consistent with the organizational objectives).

**Figure 2:** ICT Integration Framework (Source: Wainwright & Waring, 2004)

Technical integration deals with physical, data, and schedules, while organisational deals with schedules, functions, attitudes, principles and purpose. Integration with the technical and functional areas of the systems is more streamlined and approachable through established analysis tools. Meanwhile, the integration of strategic and organisational domains, which involves functions, attitudes, principles and purpose, represents an unstructured messy domain where people, social, cultural and strategic issues dominate.

From a construction industry perspective, the model in Figure 3 illustrates the 'integration gap' between the business processes and structures at work in the construction industry, and the ICT used to facilitate them, which arises if ICT is not purposefully integrated into construction projects and participant organisations. In addition, it introduces the notion that the level of integration intensifies from simple 'office-wide automation' to 'pan-supply chain process integration'. However, it is necessary to understand how participants in the construction industry react to the factors...
influencing project-wide integration (Punjani et al, 2001). In order to assess the impact ICT has on inter-firm integration in the construction industry, much needs to be understood about the nature of the project as a temporary organisation. Although it follows that high levels of integration between ICT and the business processes employed in an idealised project would lead to major performance improvements (as per figure 3), in reality the complexity involved in achieving integration increases in terms of system-wide, strategic and organisational issues, when progressing along a continuum from intra-firm automation to project-wide integration. This complexity is best understood by the combined use of temporary organisation, cultural, and boundary theories.

3 THE CONSTRUCTION INDUSTRY: A TEMPORARY ORGANISATION PERSPECTIVE

Almost every project conducted in the construction industry is unique and generally delivered in a very uncertain environment. Firms will only thrive if they are able to deliver their services successfully in such an environment. Therefore, at the heart of the construction industry lies the concept of the project. The early definitions and literature on the project (Cleland and King, 1983; Turner, 1993) focused on its characteristics in terms of product uniqueness, time/cost issues and resource management. Moreover, the notion of the relationship of projects with the permanent organisation was not discussed.

Cleland and King (1983) defined project as 'a complex effort to achieve a specific objective within a schedule and budget target, which typically cuts across organisational lines, is unique and is usually not repetitive with the organisation'. This definition describes the character of a project and its interaction with the functional or permanent organisation. Turner (1999) defined project as 'an endevour in which human, material and financial resources are organized in a novel way, to undertake a unique scope of work, of given specification, within constraints of cost and time, so as to achieve beneficial change defined by quantitative and qualitative objectives'. The definition by Turner, included the resources and change perspective to the project. However, Turner (1999) added additional range of features of project in his later contribution, which included the Aim, Features, Pressures, and Processes. Moreover, he added that the features of project mentioned above creates three pressures 1) Projects are subject to uncertainty, 2) They create a need for integration, 3) They are undertaken subject to urgency. These pressures reflect the central issues that are difficult to manage in a construction project (Turner et al, 2003).

Although early definitions indicated temporary nature of the projects, it is only recent literature that began to recognise the added complexity of projects due to their temporary nature (Berggren et al, 2001; Lundin 1995, 2003; Turner and Muller, 2003). Cleland and Kerzner (1985) later defined a project as "a combination of human and non-human resources pulled together into a temporary organisation to achieve a specified purpose". While, definition of a project from PMI (2000) as 'a temporary endeavour undertaken to create a unique product or service' was simpler, it also emphasised the temporary nature of projects. Turner et al. (2003) also extended his project perspective to reflect the 1) production organisation, 2) temporary organisation, 3) agency for change 3) agency for resource utilization and 4) agency for uncertainty management.

Construction firms generally tend to operate within one of two types of organisational modes: a) as a permanent organisation in their own right (which will be their ongoing posture, being themselves structured for ongoing operations), and, b) as part of a temporary organisation (that has specific goals, each with its own time constraints and characteristics, in order to develop special/prototype products) (Berggren et al, 2001). Using selected characteristics described by Turner and Muller (2003) in the context of manufacturing and new technology industries, a number of them have been adapted in order to contextualise the use of ICT in construction projects when considered as temporary organisations, namely boundary definition, cultural issues, and ICT systems.

1. A project is an agency established by a parent organisation (the principal) to achieve a specific objective. Although, clients initiate a project, in construction, it is sometimes difficult to identify the party that operates in a capacity of the principal with different procurement/financial arrangements and the involvement of many third parties at different stages of the project lifecycle. 2. The conflicts of interest between the various stakeholders at times become quite intense and can work counter productive with the possibility of litigation.

3. There is need to put in place ICT systems to monitor delivery of the projects, and to monitor achievement of the parents objectives. In most instances parent organisations do not recognise this need and are not keen to invest for such initiatives.

4. Viewing the project as an agency for change necessitates defining boundaries of a project based on the coherent set of project objectives. A coherent set of objectives may not be explicit in construction project environments. Most parties involve in the temporary organisation on contract basis, which promotes setting boundaries based on their contractual obligation. This may not necessarily reflect the overall project objectives, and therefore boundaries set may not be ideal.

5. From a principal's perspective the boundaries of project are less clear than from an agent. Due to the complex nature of relationships between the numerous parties involved in a project, boundaries become increasing difficult to define and manage.

6. Uncertainty and urgency are greater in projects integration of the temporary organisation as one entity is essential.

Construction literature focuses on the need for greater integration of business processes and communication across the project team, whereas mainstream project literature describes both the need for, and ways to achieve such integration within temporary organisations formed for specific projects. Such integration is not possible within construction projects without a paradigm shift across the industry. Since the Seventies, there has been a steady move away from the general construction company (which was characterised by vertical integration) towards the specialised construction management function (outsourcing all other needs). This means that, unlike other industries, the relationship between the various functional units performing work is almost invariably defined in the first instance by a contract. This makes explicit the duality in the motivation of each participant in the temporary project organisation, namely the commercial objectives of each participant and the project objectives of the client, which will of course include the profitability of the client organisation.

Frequently these motivations come into conflict, leading to disputes, delay and litigation. Reintegration within a project setting is only possible where the needs of the project objectives temporarily supersede the commercial objectives of the individual project participants. Implicit in this statement is both the need for redefinition of the project boundaries, and understanding the many complicated cultural issues this raises. Therefore it is important to understand the role and influence of the temporary organisation in construction project delivery. Furthermore, it can be seen that the coordination and monitoring of the diverse set of participants in a construction temporary project organisation demands that systems be put in place to monitor the delivery of the project, to monitor the progress being made towards the achievement of the client's objectives. The advent of sophisticated ICT tools to perform this task ought to facilitate it. However, in many instances the client
organisation does not recognise this need, nor are they keen to pay for such technologies. Additionally, unlike temporary organisations in other industries, which exist largely within the aegis of a parent organisation (and presumably, its ICT policy), the construction temporary project organisation is comprised of diverse commercial interests that each have their own ICT systems, which are unlikely to readily integrate with each other.

4. CULTURE, AND BOUNDARY ISSUES, FOR ICT INTEGRATION IN TEMPORARY ORGANISATIONS

A common theme, among the definitions for culture indicates the notion that culture is about shared meanings that are interpreted and acted upon, the environment under which a temporary project organisation could be said to fail. Martin (1996) discusses culture under three perspectives: integration, differentiation, and fragmentation, broadly agreeing with Schein (1984), who asserts that most organisations would need to have a profile of external adoption and internal integration for greatest effectiveness. Martin’s (2004) described these three cultural perspectives, as follows:

- The integration perspective of culture is “...characterised by consistency, organisation-wide, consensus, and clarity, and [and] consistency occurs because people at the higher levels of an organisation articulate a set of espoused values, sometimes in the form of a mission statement.” (p.41)
- The differentiation perspective of culture is “... the confusion of overlapping, nested substrates that coexist in relationships of inter-group harmony, conflict, or indifference.” (p.7)
- The fragmentation perspective of culture is “... claims of people-process, consistency, and consensus are shown to be idealised oversimplifications that fail to capture the confusing complexity of contemporary organisations functioning.” (p.10)

Researchers taking a technical perspective, which is viewed as an offensive formulation of culture, tend to regard culture as a variable, and relate it to organisational performance. This perspective support the exchange regulator, "glue" and "co爪se", as sub-metaphors for culture. While the defensive view of the culture-performance, link, views culture as an obstacle for effective organisational operation and is motivated to remove difficulties emerging due to the negative features of culture. This perspective support the exchange regulator and "dysfunctionalist", as metaphors for culture (Alvesson 2002).

5. DISCUSSION ON THE THEORETICAL MODEL

On the other hand, instead of considering culture as something that an organisation has (the variable view), the "root metaphor" view articulates that the organisation is a culture and can be seen as if it is a culture. Culture as a root metaphor promotes organisations to be understood and analysed not only in economic or material items, but in terms of their expressive, ideational, and symbolic aspects (Smircich, 1983; Alvesson, 2002). In the root metaphor view, culture is not outside anything, but it permeates through all aspects of an organisation, including structures, processes and people (Schein, 1984). In the extreme, considering culture as a root metaphor is limited to aspects of symbols and meaning, but one needs to understand that organisations are normally economic entities which operate in an external environment through competition, and for survival, aspects that may not well be captured by a cultural perspective (Alvesson 2002).
temporary project organisations and define boundaries. The "industry Environment negative" outlook represents a functional and fragmented culture (in a less destructive way "differentiation" view). Whilst determining the boundaries of a permanent organisation is considered difficult (Kaufman, 1987), the transient nature of construction projects makes determining their boundaries a considerably more complex issue. At the intra firm level, internal integration becomes problematic due to consensus on group boundaries and criteria for inclusion and exclusion, which determines membership. Further, cultural boundaries will exert influence on issues of language, power, and status, intimacy, and values, which are confounded when the project’s core mission, goals, means, criteria, and remedial strategies are factored in (Schein, 1984). Table 1 summarises the issues associated with ICT integration when set in the context of the construction industry. Table 1 identifies temporary organisation, culture and boundary perspectives. It identifies the construction industry’s current structure and culture as potential influence to industry-wide ICT integration.

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<tr>
<th>Table 1: ICT Integration</th>
<th>Organisational Environment, culture and TPO perspectives</th>
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<tbody>
<tr>
<td>Aspect</td>
<td>Technical</td>
</tr>
<tr>
<td>Integration</td>
<td>Limited level of technical integration has raised productivity at automation level, integration is obstructed due to short-term project, affiliation, legal barriers to relationship formation and multiple procurement method, multiple technology platforms (cost).</td>
</tr>
<tr>
<td>Aspect</td>
<td>Positive</td>
</tr>
<tr>
<td>Industry Environment</td>
<td>Culture has least impact on technical aspects of integration (viewing technology as culture detached). Nevertheless, technology is a significant factor in system selection, from strategic and organisational angles. The basic assumption on ICT of organisation may affect the behaviour. For e.g. data security and transparency (e.g. less faith in ICT) could be problematic where, organisational cultures clash within a project team.</td>
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<tr>
<td>Cultural Perspective</td>
<td>Temporary organisation Boundary Perspective</td>
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6 SUMMARY

This paper has identified the cultural issues associated with ICT integration across the construction industry when considered from a temporary project organisation perspective and constructed a theoretical proposition. It identifies the dimensions of technology, business process systems, strategic outlook and organisational stance as being significant influences on integration, which itself takes place within the temporary project organisation. It proposes that temporary project organisations are themselves subject to boundary and cultural conditions, so that successful integration of ICT across a project requires attention to be paid to the cultural perspective and structure of the industry.


