USE OF ONLINE COMMUNICATION PORTALS IN CONSTRUCTION PROJECTS: ISSUES ASSOCIATED TO ALIGNMENT OF TECHNOLOGY AND PROCESSES

Thayaparan Gajendran, Lecturer , thayaparan.gajendran@newcastle.edu.au
Graham Brewer, Associate Professor, graham.brewer@newcastle.edu.au
School of Architecture and Built Environment, The University of Newcastle, Callaghan, NSW, Australia

ABSTRACT

The online portals have been in use as an information and communication tool for some time in construction projects. Although they have brought significant benefits, the way they are implemented in projects is crucial to deliver the desired outcomes. Appropriates of the technology and processes are two critical aspects that determine the effective use of online portals, as in any other Information and Communication Technology initiatives. Moreover the challenges facing alignment of technology and processes in the online portal implementation is greater in 'intra-organisation' context than in 'inter-organisation'. Online portal implementation in construction projects are typically intra-organisational. In the context of this research supply chain perspective is employed to contextualise the intra-organisational setup of construction projects. This paper identifies the issues impacting technology and process alignment with online portals in sharing information and communication across construction project supply chains. The un-alignment of technology and process will impact on the successful outcomes of the portal, in turn impacting on the project outcomes. A single case study strategy using interview method is employed to collect data. Coding and thematic analysis is used to identify the relevant issues. The findings identify two issues impacting on technological alignment and six issues impacting on process alignment of online portals in the project teams. The issues impacting on technology are (a) the extent of hardware/software systems interoperability and (b) technical capacity/ capability of the supply chain members. The issues impacting on process alignment are (a) designing and resourcing of information management processes, (b) communication of the processes relating to information management to project team, (c) the perceptions on intend and actual purpose of the portal, (d) the level of irrelevant information overburden, (e) level of clarity on accountability and responsibility of project team members, and (f) contractual environment- attitudes of and trust between members.

Keywords: Online portals, technology, process, alignment, supply chain

1. INTRODUCTION

Construction projects are information-intensive, and therefore effective management of information is a key factor in improving quality and cost efficiency and shortening delivery times. Such information-rich environments ought to benefit from the implementation of a coherent Information Communication Technology (ICT) strategy to improve time, cost and quality outputs (Stewart 2007; Titus & Brochner 2005). ICT captures the evolving use and effect of new and emerging technologies, extending beyond the simple hardware and software into the processes to which they are applied, making links to business processes. Despite its suggested potential, the benefits of ICT via integrated operations within a project environment are not widely experienced (Davis & Songer 2008; Fujitsu-Centre 1998). This is often blamed on the poor alignment of ICT in the context of project organisations, (Briscoe & Dainty 2005; Rowlinson 2007; Jacobsson & Linderoth 2010). Among numerous ICT's, online portals have gained wide acceptance in the construction industry as a valuable tool (Alshawi & Ingirige 2003) for project management. However, effective deployment of these portal in an intra organisational context poses greater challenges than deployment in an inter company context. This paper reports the findings of a case study

identifying the issues impacting technology and process alignment in the deployment of online portals in construction projects via supply chain conceptualisation.

2. CONCEPTUALISING DEPLOYMENT OF ICT PROJECT ORGANISATIONS

Lambert and Cooper (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.' Literature suggests that ICT engagement by an organisation can be at one of three progressive levels or stages, namely automation, organisation-wide process improvement, or supply chain-wide process improvement (Fijtsu-Centre, 1998; Shore 2001). Categorisation ICT development in firms by Shore (2001) 'technology' and 'business processes' into account and also looks beyond the organisation, to a supply chain perspective. This view is heavily supported by supply chain literature. Supply chain literature identifies that some form of alignment of people, process and network among the firms as being critical for effective supply chain management. One of the measures of effective supply chain operation is the effective information flows between the supply chain members. When an ICT system is implemented in the context of project organisaitons, the systems are deployed beyond the boundaries of individual firms, challenges of aligning their people, process and technology becomes a challenge. Wainwright and Waring (2004) indicated that (Waring and Wainwright 2000) effective deployment of ICT systems is not only limited to technical considerations, and in a broader sense it incorporates four aspects namely: technical, systems, organisational and strategic integration (Wainwright and Warning, 2004). 'Technical' integration deals with physical, data, and schedules, while 'organisational' deals with schedules, functions, attitudes, principles and purpose.
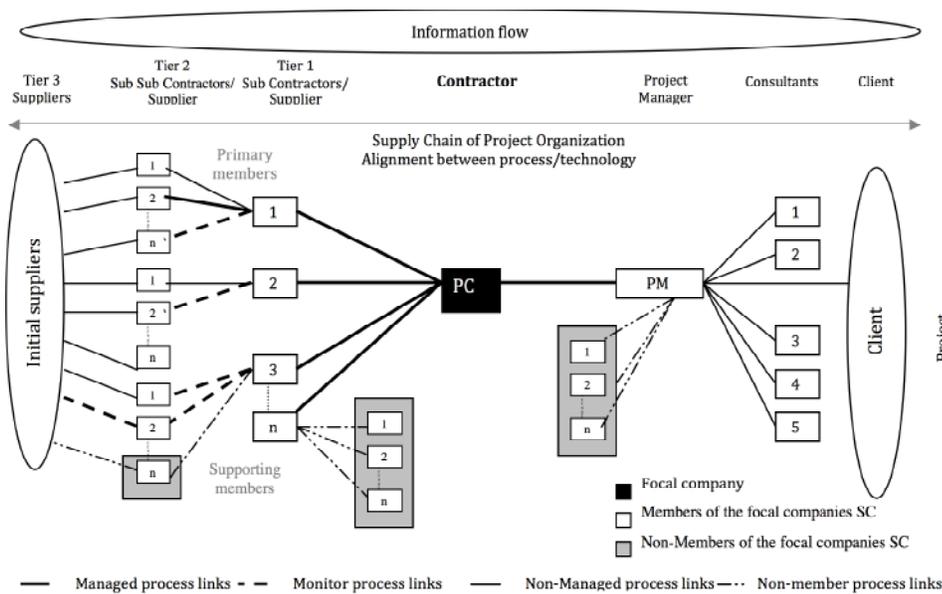

Figure 1: Modified from Lambert and Copper 2000- Typical configuration of a construction supply chain

Visualising ICT integration within a supply chain context enables the information to be mapped and communication followed across the supply chain (Jharkharia & Shanker 2005). Supply chain mapping and conceptualises connections between the components or agents using online portals, assisting conceptualisation of online portal implementation, and provides an alternative but complementary conceptualisation of 'project organisation'The project process, with reference to Figure 1, incorporates the members (architect, contractor, suppliers etc), functions (tendering, design, procurement etc) and process (information flow, material flow, etc.) that come together to construct a make to order construction supply chain. The staged nature of operations and diverse professional functions create boundaries can lead to fragmentation (Baiden, Price & Dainty 2006; Moore & Dainty 2001). The intense nature of fragmentation can pose significant challenges in aligning the required elements for ICT implementation.

3. ALIGNMENT OF PROCESS AND TECHNOLOGY FOR EFFTIVE ICT DEPLOYMENT

As discussed earlier, ICT initiatives in the construction projects are faced with fragmentation issues. Although it is argued that online portals assists in reducing fragmentation in projects via efficient flow of information, the implementation of online portals in itself is impacted by fragmentation. Therefore, it is imperative that appropriate processes needs to be established to deal with such fragmentation, impacting ICT implementation and streamlining of ICT operations within a project (Cutting-Decelle et al. 2007; Vrijhoef and Koskela 2000). In this context the process alignment is focused on (a) establishing appropriate conditions, procedures and practices (within the established boundaries) and (b) developing common and clear understanding of these process among project team members to ensure effective operation of ICT systems across the project supply chain.

Technical compatibility, particularly compatibility between hardware and software systems within a firm and across the project supply chain is crucial for successful online portal implementation (Cox 1999; Kilpatrick and Factor 2000). The literature identifies that extent of engagement with online portals is related to users confidence in the information security offered by the system along with their ability to make access restrictions as required (Angeles et al. 2001; Kilpatrick and Factor 2000: Rowlinson 2007).

Literature also suggest that initiatives beyond individual organisations, such as government regulation and industry-wide ICT standards, may influence streamlining of online portal implementation. (Malmsjo and Ovelius 2003). Project specific processes can also be regulated via legal frameworks (e.g. contract conditions, etc.) to deal with information transactional issues and intellectual property rights (Carter et al. 2001; Stoney and Stoney 2003). Although it has been well established that effective implementation of online systems requires alignment of the technical, systems, strategic and organisaitonal domains, in practice a number of challenges impact on the actual level of alignment- resulting in varying user experiences with the portals (Uden and Naaranoja 2007). The level of alignment in the 'technology' and 'process' are influenced by numerous factors including the way project organisaiton is setup (client, procurement method etc). The political, cultural, economic, legal and technical environments prevailing within and beyond the project boundaries also impact on the level of alignment (Duncombe & Heeks 1999; Wainwright and Waring 2004).

Identifying the issues impacting effective ICT deployment requires conceptualisation of 'effective/successful ICT operations'. Wateridge (1998) identified a number of dimensions that are used to assess the success of IS/IT implementation projects. Some of these dimensions relate to the IT/IS product and the others relate to process of IT/IS project implementation. In the context of the study, the dimensions selected focus on the effectiveness of the online portal as a 'technology product' and 'processes used for implementing/operating the portal' (processes) that support effective information and communication among the project team members. These dimensions include (Wateridge 1998):

- *Meeting user requirements:* Meeting the requirements as perceived by individual firms in a supply chain
- *Achieving the purpose:* Successful completion of a construction project by meeting the project goals
- *Making users happy:* A state of satisfaction among the users within the firms of supply chains

This paper reports finding from two case studies identifying the aspects that impact on the alignment of technology and processes in the deployment of online portals in project organisations. The supply chain perspective illustrated in Figure 1 is used to visualize the project organisation in terms of members, functions and intended communication connectivity in discussing the case studies.

4. RESEARCH METHODOLOGY

The analytical perspective of this research is underpinned by the 'constructivist' paradigm that accommodate multiple realities of the world (Creswell and Clerk 2007). The empirical component of the study used a single case study approach (Yin 2009; Barrett & Sutrisna 2009). Interview method was used to collect data from the case study project supply chain members. Seven individuals in key positions (client, project manager, principal contractor, architect, engineer, quantity surveyor and subcontractor) from firms in the project were interviewed. Following this stage, the interview data underwent a coding and transformation process to abstract ideas or general themes within the data. Initially the interview data of each interviewee is 'open coded' and then they were reviewed to form a set of 'axial codes'. The issues identified through open codes are refined into selective codes.

The constructive paradigm enables to analyse the diverse perspectives and experiences of different members of the project team arising from varying realities or multiple word views held by them. The following section presents the abstracted themes arrived via qualitative analysis process.

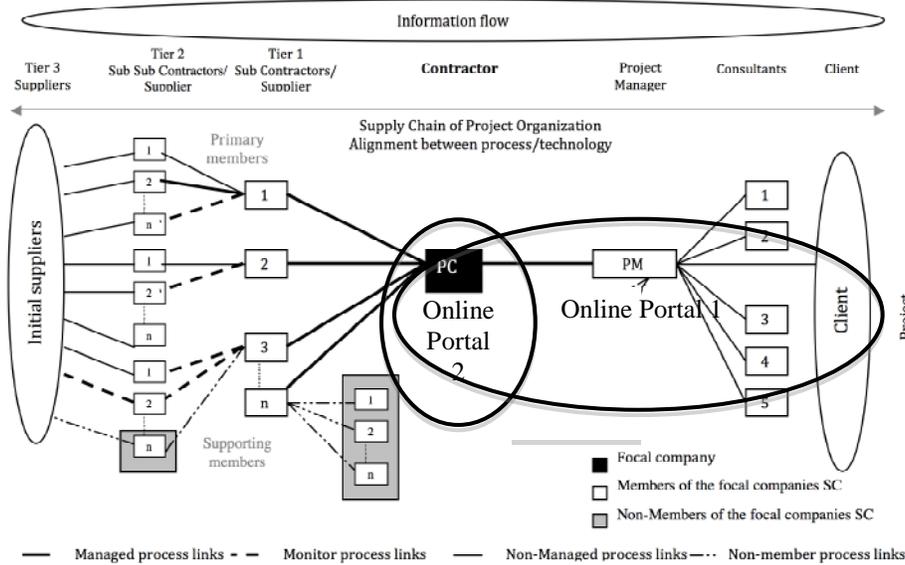# 5. HOSPITAL PROJECT CASE STUDY

Background to the case

The sleeted case study was construction of a hospital building and associated infrastructure. Two online portals were used in the project. The one of the portal was set up by the Project Manager (PM) to manage project documentation and communication. This portal hereinafter is referred as PM portal. The other portal was solely used by the contracting organisation to handle their inter organisaitonal documentation and communication (refer Figure 2 for a visual representation). The project manager had established strict document handling and communication protocols that required all information and communication to be channeled

Figure 2: The extent of the use of online communication portals in Case Study 1

via the PM portal.

- *Intended use of the online portal:* The portal was intend to be use by the client, all consultants, and the principal contractor to share/review project documentation and to encourage formal communication.
- *Proposed communication process:* The communication protocols, within the boundaries of PM portal users, was designed by the PM. PM believed that all members intend to use the platform had the technical capability to engage with the system. The aim was to maintain effective communication with tight controls between the client team and contractor team to manage variations and to control cost/time overruns. PM insisted that all communication to be formal via the portal (e.g. drawing management, RFI process, variation management) and believed this will improve information flow.
- *Actual extent use of the online portal*: During the project operations one of the consultant, the quantity surveyor, did not engage with the portal, while the other members engaged with the portal.

Establishing the success dimensions for the project
The project team perceived the following as the success dimensions of effective communication in a project:
- *Meeting user requirements:* The members of the project team expected the project communication regime to enable fast and cost effective decision making to complete the project in shortest possible time and with least conflicts. They primary aim was to make a profit .
- *Achieving the purpose:* The purpose as to achieve the project goals, that were to complete the project within the budget, time frame and desired quality.

- *Making users happy:* The satisfaction of different project team members is influenced by their perceptions of the combined and related aspects to the above two dimensions. This dimension is will also reflect the deeper cultural assumptions held by the members in terms of use of online portals.

Issues impacting Technological Alignment

T-1: Hardware/software systems interoperability

The respondents indicated that although the online portals generally improve the efficiency of project operations, multiple ICT systems can lead to loss of efficiencies by the way of information double handling. The principal contractor indicated that incompatible technology between the contractor's in house portal and the PM portal consumed a significant amount of time in transferring documents from the PM system to the their system. The contractor had to employ one additional person to deal with the information double handling.

Client: [Technology] is very fragmented, the only thing that everyone has got in common is the [online portal]; even in that . . . [the] contractor has their own system. Because [contractor] use their system for litigation and documentation management they have got to double up, which by default is doubling of cost. So there's a lot of hidden costs in there that are the direct result of not having a common system.

The project manager and architect also believe that all firms should be equipped with the minimum required technology and skills to engage with ICT communication. The conditions of contract for this project stipulated that the 'PM portal' will be the formal communication mechanism and this was a condition of prequalification. Such a condition certainly assists the client or project manager to impose their system within their contractual domain of power/control. However, from a project of view this does not solve the technological fragmentation of the supply chain. It was also suggested that the subcontractor network is the most vulnerable group to be left out of the ICT loop due to technological interoperability.

T-2: Technical capacity/capability of the supply chain members

The quantity surveyor (QS) for this project was appointed by the client, prior to the appointment of the PM. Therefore, QS was not contractually bound to the use of the PM portal. QS indicated that the assumptions made by architects or PM's about the technological capabilities of members in the supply chain may not be accurate and can lead to inefficiencies in the information management process.

Project Quantity Surveyor: [Architects] seem to believe that everyone has the capability to print out a full-size drawing. Now it has always been my belief that an architect gets paid to produce drawings and circulate them . . . The QS has a responsibility to quantify, off drawings that he is sent, on the basis that those drawings are the latest set and they are to scale. Not print his own set of drawings off of a web site [portal] that he is not controlling. He doesn't know they're not the latest set of drawings and then he's got to take the responsibility of printing off a set of drawings either on his own A4 or A3 printer because he doesn't want to invest in ten grand to be able to print A1s or B1s.

Two issues are raised by the QS: first is about technological alignment and the second is about process alignment (discussed in the next section). The technological alignment is not all about getting different systems of hardware and software to connect, but also about the compatibility of peripherals (such as printers, scanners etc) to match the established communication regime to carry out the proposed operations effectively.

Issues impacting Process Alignment

P-1: Design and resourcing of information management processes

This was a public sector project where the client operated as a 'group', constituting various organisations who are accountable for different aspects of the project. The public sector client in this case appointed a few client representatives as the face of the client group to simplify communication channels. However, information bottlenecks and longer response times to queries were experienced by the construction team, due to the entrenched and complex decision making structure of the client organisation. The organisational setup had an impact on the effectiveness of the communication. The principal contractor indicated that identifying key information gatekeepers and establishing an appropriate information streaming process is essential to avoid conflicts and to ensure the timely completion of the project. Analysis indicates two key information/communication gatekeepers in this case study— (a) the project manager, managing communication for the 'client team', and (b) the principal contractor managing communication between the 'construction team'. Figure 3 illustrates the links in the project supply chain that cause information bottlenecks, and the sphere of their

impact on the parties to the project. The clear boundary shows the extent of the client team communication dominance while the shaded part shows the extent of the principal contractor's communication dominance.

All interviewees expect the PM had issues with the way information, specifically the RFI process, was handled via the online portal. Effective handing of RFI process is critical for successful project completion. The principal contractor experienced information/communication bottlenecks from the PM organisation and the contractor and client believed this was due to the high workload of the PM. The RFI and other communication clogged the online collaboration platform and were not attended to in due time. On some occasions it took up to 90 days to resolve some RFIs, way beyond the 27 days stipulated in contracts.
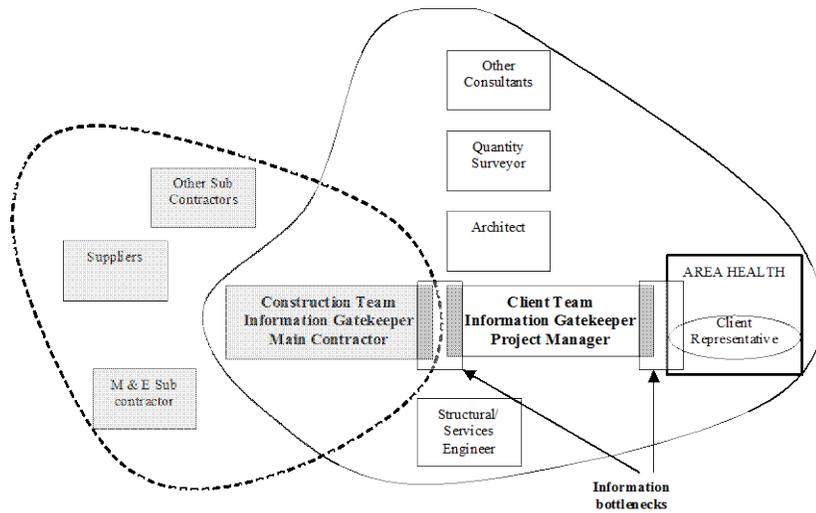

Figure 3: Information/communication key roles and information bottlenecks

The findings suggest that the tightly controlled and poorly resourced information management protocols established by the project manager created information bottlenecks, delays and conflicts (refer Figure 3). Moreover, understaffed project management setup produced less than desirable information and communication flow.

Principal Contractor: We do find ... a bottleneck up at [project manager] side of things. They have one project manager looking after it and he basically has to manage all correspondence and all RFI's and we do find it a little frustrating from time to time that things can get clogged in their system to the point where we've got to ring and say . . . 'It's still sitting on your system, can you please do something with it'.

In essence the information flow was impacted by a restricted flow of information, attributed to poorly established or tightly controlled communication protocols between the construction and design teams. The project manager believed in tight communication control to control variations and associated cost. However, in this case it appeared to be an inefficient approach.

P-2: Communicating the information processes/protocols to project team

The quantity surveyor indicated that conflicts emerge when the expected level of ICT engagement in a project and the associated communication protocols are not communication clearly to the project team. For example, in this case study the conditions of engagement did not explicitly mention that the quantity surveyor would not receive contract documents for the project via the online collaboration platform. The QS was expecting to received a printed set of drawings. However, most consultants did not follow this up, assuming that the QS would access revised drawings through the online platform. The QS strongly believed that delivering a printed set of drawings to the project QS is the architect's responsibility. Therefore, it appears that engaging with ICT assisted communication requires clear communication of processes. These processes should be established during the early stages of the project formation. Any changes to (a) the traditional communication roles/responsibilities of firms, (b) the hard copy documentation trail/protocols, and (c) any cost transfer/implications to the firms arising from the established processes should be communicated to the relevant parties. The effectiveness of any ICT initiative is dependent on the alignment between the organisational policies/procedures and the people.

P-3:The perceived and actual intention that underpin the operation of the online portal

The project management firm mandated that all project-related communications pass through the online portal so that they are traceable. The client indicated that some member's engagement with the online collaboration tools was overshadowed by fears of liability. They engage with online collaboration platforms to create a depository of information to protect from any potential litigation. According to him, this obstructs the collective, collaborative function of information communication. Moreover, when every communication is written with a legal subtext, the

time taken to craft e-mails and online messages could consume significantly more time that otherwise could be spent on collaborative site activities

Client: From a litigious perspective IT is just a lawyers dream because it provides the availability of so much documentation and so much evidence if we printed out every documents that has been sent via [online portal]. . . we need four semi trailers to fill it, so straight away your legal team . . . People are focused on covering their legal positions rather than necessarily getting on with the job . . . this is a major [cultural change] and detrimental . . . now people spend time wording emails, not focused on outcomes of the job but focused on outcome in court if ends up in court.

The process underpinning the operation of a online portal should engender efficient communication to enable project success. Any suspicion or perception of it being a depository for litigation may lead to inefficient communication outcomes.

P-4: Irrelevant information overburden

The client indicated that the online portal sends an email to all firms on every occasion a change or addition of information occurs in the portal, irrespective of the relevance of the matter to the firms. According to him, this creates unnecessary information traffic and sifting through the irrelevant information is unproductive.

P-5: Clarity of accountability and responsibility

The client indicated that firms can use online communication platforms deviously to transfer accountability to other firms. He believes that the principal contractor shied away from their responsibility, allowing information-related delays to occur by not following up electronic queries (including RFI) to consultants using other modes of communication (e.g. phone calls, site meetings). The principal contractor indicated the client and consultants are not upholding to their responsibility and accountability to respond to RFIs with tin the stipulated time. The principal contractor indicated that they followed up on all electronic queries that were not responded to by the project manager within the contractually stipulated timeframe. Consultants indicated that the contractors communication via the portal is not clearly articulated and therefore it takes more time to respond to their queries. It should be noted that the tight information communication protocols /procedures, established by the project manager, discouraged informal communication, and mandated formal communication through the online collaboration platform. This policy channeled all information through the online portal, creating an information bottleneck at the project manager information gate (refer Figure 3). Moreover, the project manager did not seem to be adequately resourced to deal with extensive information traffic, which aggravated the problem. In this situation the principal contractor cannot be accused of transferring accountability, since they are not responsible for the workload of the project manager nor for reminding the project manger of their duties. It is the responsibility of the project managers to honour and resource the communication protocols they establish for the TPO. The lack of consensus on the communication protocols and expected duties created some level of conflict.

P-6: Contractual environment- attitudes of and trust between members

The analysis indicated that the contractual environment had a significant influence the way attitudes of the members developed towards the project and how members trusted other members. This impacted Risk-averse and fee minimisation attitude of client had created frictions between the client and the consultant team, creating an environment lacking in trust and cohesion. The client questioned the credentials of the design team as specialists in health facility design, while consultants were concerned with inadequate time frame and an insufficient fees. The consultants questioned the role of the project manager in the project, and the contractors were dissatisfied with the information clarity and flow in the project. Significant level of dissatisfaction among the project team members, particularly arising from the perceived inappropriate risk allocation/transfer and information communication, was noticed. This resulted in negative attitudes and lack of trust among members. This environment impacted on the online portal in two ways. First was that some members were caution not expose them to litigation with the any from of recorded communication. Some delivery used weakness in the process to exploit the system. The consultants accused of contractors deliberately lodging unclearly worded RFI's to the portal knowing that the Architects will need to request for clarification which will prolong a decision on the RFI- which all adds on to the extension on time claim. This practice undermines the intended aim of the portal- making information and communication effective.

6. DISCUSSION

Members of the project team had mixed feeling about online portals impact on the project. Table 1 cross tabulate the impact of the alignment issues identified in the analysis on the dimensions of portal success. A number of the identified issues, particularly the issues impacting technology have already been discussed in the literature. However some issues impacting the operational alignment of the portal, e.g. specifically the contractual environment and intend-actual use of the portal, are beyond the issues identified in the ICT domain.

Table 1: Summarising the impact of the alignment issues on the dimensions of portal success

Alignment Issues	Dimensions of success		
	Meeting user requirements	Achieving purpose	Satisfaction
Issues impacting Technology Alignment			
T-1: Hardware/ software systems interoperability	PM portal did not technology connect to the contractors system	No evidence to suggest this impacted on the project success. Project team was informed by the PM about the use of this portal platform prior to tendering	Contractor and client were some what dissatisfied
T-2: Technical capacity/ capability of the supply chain members	QS's capability did not meet the portal assisted communication requirements	No evidence to suggested that the incapability contributed to delays. However, miscommunication of the information handling process impacted on the project success measures (Ref P-2 below)	QS was dissatisfied
Issues impacting Process Alignment			
	Meeting user requirements	Achieving purpose	Satisfaction
P-1: Design and resourcing of information management	Did not meet the expectations of most of the project team expect PM	Significant impact on the project success, in terms of time, cost and conflict	All members, expect the PM, were dissatisfied
P-2: Communication of information processes to project team	Not all members of the team were exactly aware of the communication process with the QS firm	Some minor delays in the measurement/costing of the project by the QS	QS was dissatisfied
P-3: The perceptions on intend and actual purpose	Although the intended purpose of the portal was about improving information and communication flow, three were perceptions that the actual purpose was to cover the legal basis for any future litigation.	It was evident the efficient information flow to achieve the project goals were hindered by the legal take on the portal.	Client was dissatisfied with this stage. The other members view on this matter was unclear. (Refer- contractual environment in P-6)
P-4: Irrelevant information overburden	Client and architect were concerned about the time spent on sieving through irrelevant information	Time inefficiently spent - otherwise can be used for productive core activates	Client and architect explicitly raised dissatisfaction.
P-5: Clarity of accountability and responsibility	Each member (expect the PM) indicated that their requirements in with respect to clear accountability/responsibility were not met	Lack of accountability and responsibility in the use of the portal was perceived to contribute to the delays in the project	Each member expressed dissatisfaction with the unclear responsibilities and accountability of other members. However, some members used this to their advantage (Refer- P-6 contractual environment)
P-6: Contractual environment- attitudes of and trust between members	Each member (except the PM) felt the contractual environment did not provide them with the best outcomes.	It was perceived that the contractual environment made some members to exploit the loopholes in the process established for portal use which resulted in impacting the project outcomes	Most of the members were dissatisfied with the bottlenecks in the portal created by the contractual environment.

7. CONCULSIONS

This paper reported on a single case study finding on the issues that impact alignment of technology and process when online portals are used in construction projects. The project manager had clearly dictated to the project team members that all information and communication should be formal and be channeled via the online portal. This was motivated by the belief that strict control of information enables the efficient flow of information. However, the flow of information during the construction stage was impeded by the use of the online collaboration platform in an highly formal way and the flaws in the design of communication protocols. The project team members believed that tightly controlled formal protocols fell short of formulating appropriate processes to support the protocols, creating less than desirable communication flows. The conditions of contract enabled developing an understanding among most firms about the expected ICT capability of each firm to be part of the project. However, not assessing the capability of the quantity surveying firm to print large drawings prior to proceeding with online drawing distribution caused unexpected inefficient in the information flow. Therefore, the ICT communication strategy partly fell short in accounting for the variations in ICT capabilities of different firms. However, a conscious decision made by the principal contractor and the project manager to use online systems that were not technically interoperable caused some expected inefficiencies.

Moreover, inadequate resourcing, in particular, an inadequate number of employees at the project management organisation to manage the proposed online communication process, is believed to have added to the woes of an already inefficient protocol. The project management firm, who were the single point of contact for transferring information between the construction and consultant/client team, faced information overload due to understaffing. The consultants felt that the construction team deliberately worded some RFIs with ambiguous language to buy extensions of time-exploiting the bottled in the online portal system. The client felt that the contractor was passing accountability to consultants. These perceptions led to a partially conflict oriented environment. Moreover, legal considerations believed to underpin the use of online communication portal, rather than information efficacy, undermined the gist of the intended portal use. The procurement approach, communication protocols and perception of the allocation of risks among the firms seem to have created a project environment that was not transparent. This contractual environment contributed to the lack of trust among the firms. This lead to perceptions that some firms were exploiting the portal and associated weakness in the communication process to their advantage. The mapping of the issues impacting the project communication against the dimension of success identified the situations that led to less than desirable communication outcomes.

In summary findings of this study identified two issues impacting technological alignment and six issues impacting process alignment of online portals in project teams. The issues impacting technology are: Hardware/software systems interoperability and Technical capacity/ capability of the supply chain members. The issues impacting process alignment are designing and resourcing of information management processes, communication of the processes relating to information management to project team, the perceptions on intend and actual purpose of the portal, the level of irrelevant information overburden, level of clarity on accountability and responsibility of project team members, and contractual environment-attitudes of and trust between members.

REFERENCES

Alshawi, M. and Ingirige, B. (2003), "Web-enabled project management: an emerging paradigm in construction", Automation in Construction, Vol. 12, pp. 349-364.

Angeles, R. Corritore, C. L. Basu, S. C. and Nath, R. (2001), "Success Factors for domestic and international electronic data interchange IEDI) implementation for US firms", International Journal of Information Management, Vol. 21, No. 5, pp. 329-347.

Baiden, B. K. Price, A. D. F. and Dainty, A. R. J. (2006), "The extend of team integration within construction projects", International Journal of Project Management, Vol. 24, pp. 13-26.

Barrett, P. and Sutrisna, M. (2009), "Methodological strategies to gain insights into informality and emergence in construction project case studies", Construction Management and Economics, Vol. 27, pp. 935-948.

Briscoe, G. and Dainty, A. (2005), "Construction supply chain integration: an elusive goal?", Supply Chain Management, Vol. 10, No. 4, pp. 319-325.

Carter, C. Hassan, T. Merz, M. and White, E. (2001), "The e-legal project: Specifying legal terms of contract in ICT environment", ITcon, Vol. 6, pp. 163-174.

Cox, A. (1999), "Power, value and supply chain management", Supply Chain Management: An international Journal, Vol. 4, No. 4, pp. 167-175.

Creswell, J. W. & Clark, VLP 2007, "Designing and conducting mixed method research", Sage Publications, Thousand Oaks, California.

Cutting-Decelle, A.-F. Young, B. I. Das, B. P. Case, K. Rahimifard, S. Anumba, C. J. and Bouchlaghem, D. M. (2007), "A review of approaches to supply chain communications: from manufacturing to construction", ITcon, Vol. 12, No. 2007, pp. 73-102.

Davis, K. A. and Songer, A. D. (2008), "Resistance to IT changes in the ACE industry: An individual Assessment tool", ITcon, Vol. 13, pp. 56-68.

Duncombe, R. and Heeks, R. (1999), Information, ICTs and Small Enterprise: Findings from Botswana, Institute for Development Policy and Management, Manchester.

Fujitsu-Centre (1998), Information Technology in the Building and Construction Industry: Current status and future directions, Fukitsu Centre & Building and Research Centre UNSW, NSW.

Jacobsson, M. and Linderoth, H. D. J. (2010), "The influence of contextual elements, actors' frames of reference, and technology on the adoption and use of ICT in construction project: a Swedish case study", Construction Management and Economics, Vol. 28, pp. 13-23.

Jharkharia, S. and Shankar, R. (2005), "IT-enablement of supply chains: understanding the barriers", The Journal of Enterprise Information Management, Vol. 18, No. 1, pp. 11-27.

Kilpatrick, J. and Factor, R. (2000), "Logistics in Canada survey: tracking year 2000 supply chain issues and trends", Materials Management and Distribution., Vol. 45, No. 1, pp. 16-20.

Lambert, D. M. and Cooper, M. C. (2000), "Issues in Supply Chain Management", Industrial Marketing Management, Vol. 69, No. 1, pp. 65-83.

Malmsjo, A and Ovelius, K (2003), "Factors that induce chage in information systems. Systems Research and Behavioral Science", Vol. 20 No. 3, pp.243-53.

Moore, D. R. and Dainty, A. R. J. (2001), "Intra-team boundaries as inhibitors of performance improvement in the UK design and build projects", Construction Management and Economics, Vol. 19, pp. 559-562.

Rowlinson, S. (2007), "The temporal nature of forces acting on innovative IT in major construction projects", Construction Management and Economics, Vol. 25, pp. 227-238.

Shore, B. (2001), "Information sharing in global supply chains systems", Journal of Global Information Technology Management, Vol. 4, No. 3, pp. 27-50.

Stewart, R. A. (2007), "IT enhanced project information management in construction: Pathways to improved performance and strategic competitiveness", Automation in Construction, Vol. 16, pp. 511-517.

Stoney, M. A. and Stoney, S. (2003), "The problems of jurisdiction to e-commerce- some suggested strategies", Logistics Information Management, Vol. 16, No. 1, pp. 74-80.

Titus, S. and Brochner, J. (2005), "Managing Information flow in construction supply chains", Construction Innovation, Vol. 5, pp. 71-82.

Uden, L. and Naaranoja, M. (2006), "The development of online trust among construction teams in Finland", ITcon, Vol. 12, pp. 306-323.

Vrijhoef, R. and Koskela, L. (2000), "The four roles of supply chain management in construction", European Journal of Purchasing & Supply Management, Vol. 6, No. 2000, pp. 169-178.

Wainwright, D. and Waring, T. (2004), "Three domains for implementing integrated information systems: redressing the balance between technology, strategic and organisational analysis", International Journal of Information Management, Vol. 24, No. 4, pp. 329-346.

Waring, T. and Wainwright, D. (2000), "Interpreting integration with respect to information systems in organisations-image, theory and reality", Journal of Information Technology, Vol. 15, No. 2, pp. 131-148.

Wateridge, J. (1997), "How can IS/IT project be measured for success", International Journal of Project Management, Vol. 16, No. 1, pp. 59-63.

Yin, R. K. (2009), Case study research : design and methods, Sage Publications, Thousand Oaks, California.