

- Kabir I. (2006). "The emergence of Web 2.0", The Daily Star, ICT Special, Volume 5, Number 732 (available at <http://www.thedailystar.net/2006/06/19/d606190901122.htm>)
- McAfee, A. (2006a). "Enterprise 2.0: The Dawn of Emergent Collaboration", MIT Sloan Management Review, vol.47, no.3
- McAfee, A. (2006a). "Enterprise 2.0 vs. SOA", published May 20, 2006 - http://blog.hbs.edu/faculty/amcafee/index.php/faculty_amcafee_v3/enterprise_20_vs_soa/ (last access March 27, 2008)
- McAfee, A. (2006b). "Enterprise 2.0, version 2.0", published May 27, 2006 - http://blog.hbs.edu/faculty/amcafee/index.php/faculty_amcafee_v3/enterprise_20_version_20/ (last access March 27, 2008)
- McAfee, A. (2006c). "Enterprise 2.0: The Dawn of Emergent Collaboration", MIT Sloan Management Review, vol.47, no.3
- Nivi, B. (2005). "What is Web 1.0?", published October 16, 2005 - <http://www.nivi.com/blog/article/what-is-web-10> (accessed March 21, 2008)
- Perez, S. (2008). "Technology Populism: Risks & Rewards", ReadWriteWeb - published February 27, 2008
http://www.readwriteweb.com/archives/technology_populism_risks_rewards.php (last access March 28, 2008)
- Stephens, R.T. (2007). "Enterprise 1.0 versus 2.0", published May 24, 2007 - http://www.rtod.com/collaborage/2007/05/enterprise_10_versus_20.html (last access March 26, 2008)
- Iskold, A. (2007a). "Semantic Web: Difficulties with the Classic Approach", ReadWriteWeb – published September 19, 2007
http://www.readwriteweb.com/archives/semantic_web_difficulties_with_classic_approach.php (last access March 26, 2008)
- Iskold, A. (2007b). "Top-Down: A New Approach to the Semantic Web", ReadWriteWeb – published September 20, 2007 - http://www.readwriteweb.com/archives/the_top-down_semantic_web.php (last access March 26, 2008)
- Iskold, A. (2008). "Semantic Web Patterns: A Guide to Semantic Technologies", ReadWriteWeb – published March 25, 2008
http://www.readwriteweb.com/archives/semantic_web_patterns.php (last access March 26, 2008)
- Stewart, R.A. (2008). "IT enhanced project information management in construction: Pathways to improved performance and strategic competitiveness", Automation in Construction, Volume 16, Issue 4, July 2007, Pages 511-517
- O'Reilly T. (2005). "What is Web 2.0 – Design Patterns and Business Models for the Next Generation of Software", O'Reilly - published September 30, 2005
<http://www.oreilly.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html>
- O'Reilly, T. (2006). "Web 2.0 Compact Definition: Trying Again", O'Reilly Radar - published December 10, 2006 - <http://radar.oreilly.com/archives/2006/12/web-20-compact-definition-tryi.html>
- W3C: Semantic Web Frequently Asked Questions (2008), W3C
<http://www.w3.org/2001/sw/SW-FAQ> (accessed March 25, 2008)

ELECTRONIC TENDERING: DELIVERING BUSINESS EFFICIENCIES FOR THE IRISH CONSTRUCTION INDUSTRY

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ABSTRACT

The tendering process predominantly adopted in the Irish construction industry is highly paper-dependent. However, the increase in the availability of Information Communications Technology (ICT) has meant that construction consultants can disseminate information more cost effectively in an electronic format. The aim of this paper is to present the results of an industry-led network project undertaken by the Construction Information Technology Alliance (CITA) in Ireland. This project aimed to demonstrate how greater effectiveness and efficiency can be brought to bear on the tendering process by the application of ICT already used widely in other industries. The paper outlines the inefficiencies of the current tendering procedures, the results of an observation study, industry survey and progress on a simulation project. The project will specifically focus on the exchange of data between network members by quantifying the inefficiencies in current processes and by demonstrating the potential benefits to be won through a live eTendering project.

KEYWORDS

Construction, electronic tendering, information exchange

1. INTRODUCTION

The extent of use of ICT in the Irish construction industry is relatively unsophisticated, being mainly dependent on the traditional telephone, facsimile machines and networked personal computers (Thomas, 1999). At the simplest level, the electronic transmission of business documents offers savings in time, paper and postage (Hore and West, 2005a; Hore and West, 2005b). By going a step further, businesses can make strides in communicating with their partners, at relatively low cost, through direct links between their computers (Hore, 2007).

The Canadian Construction Association (2005) found that tendering costs can account for up to 5.9% of the total value of a project cost to a client on a typical construction project (CCDC, 2005). These costs emerged from an examination of the many hundreds of tender documents produced by consultants. These included standard documents such as tender drawings, project specifications and Bills of Quantities (BOQ). Each of these documents are reproduced in multiple copies and dispatched to tenderers on a regular basis, which results in an expense that is passed on to the client.

ICT tools are used today to support Architecture, Engineering, Construction and Facilities Management (AEC/FM) business processes. The information entering into these ICT tools, however, is almost invariably passed from one ICT system to another by producing paper-based electronic documents, which in turn are re-entered into various other ICT systems along the AEC/FM life cycle (Froese, 2003).

These inefficiencies cannot, of course, be attributed to one specific process or party within the industry, which has also been acknowledged by the Irish government (DETE, 2006). It has been extensively reported by many authorities that collaborative exchange of data between construction project participants is not efficient but that sensible use of ICT enhances productivity (Thomas, 1999 and Gunnigan et al., 2004).

This paper outlines the inefficiencies of the current tendering procedures, the results of an observation study, an industry survey and the research work carried out by an industry group. The project will specifically focus on the exchange of data between network members involved in the tendering process by quantifying the inefficiencies in current processes and by demonstrating the benefits to be won through a live eTendering project.

2. INDUSTRY SURVEY

The Irish-based Construction IT Alliance (CITA) is a limited company comprising over 140 members drawn from the consulting, contracting, suppliers and software vendors sectors. The consulting members include architectural, structural and quantity surveying practices, while the suppliers include a wide variety of firms providing products to the construction industry.

In 2006, CITA carried out a survey examining the perceptions of eTendering in the Irish construction industry (Kenny, 2006). The survey was carried out online and an email, containing a web link to the survey, was sent to 42 CITA members actively involved in the Irish tendering process, requesting them to partake in the survey. This email also included factual background information on the survey. Following further contact, fifteen individuals responded to the request to complete the survey, thereby giving a response rate of 36%.

The survey focused on the industry's level of awareness of eTendering, its knowledge of the potential opportunities it presents to the Irish construction industry, the current levels of adoption of electronic tendering processes and the perceived barriers to its adoption. Some of the more significant results of the survey included:

- Over 70% of individuals had already received tender information in electronic format as part of their daily work.
- 27% had returned the information to the source electronically.
- 93% of respondents would consider using the eTendering solutions in the near future.

The survey found that companies believed that electronic tendering would save manpower in the processing of information, lead to a reduction in errors and would produce better records of the process. Conversely, this was tempered by significant concerns about the use of electronic processes, including their security, legality, the commitment by other firms and the technological capabilities within the Irish construction industry. Respondents perceived that the Irish government was not doing enough to encourage implementation and use of technology in practice.

Bandwidth was not an issue for those surveyed. Undoubtedly the acknowledged shortfalls in bandwidth availability in Ireland may well become a barrier to eTendering when it is more universally accepted for public and private contracts.

3. CITAX PROJECT

In 2005, CITA obtained funding for the CITAX project under an Industry Led Network Scheme (West and Hore, 2007 and EC, 2007). The overall aim of the project was to facilitate more efficient business transactions between companies in the Irish construction sector by the deployment of readily available ICT tools, in particular construction business processes tools and to radically improve the productivity of these business processes. The longer term objective of the network is to develop a platform for the design and development of open standards that would be promoted and implemented within the construction supply chain. The CITAX project focused on five module areas:

- Module 1 - Production and exchange of CAD drawings.
- Module 2 - Production and exchange of trading documentation, such as purchase orders, proof of delivery and invoices.
- Module 3 - The pricing of tender documentation electronically and the recommending of a preferred tender for selection.
- Module 4 - The storage, retrieval and general dissemination of project information on construction projects.
- Module 5 - The use of CAD software in the production of bills of quantities.

The Module 3 team (concerned with eTendering) sought to verify that significant measurable economic benefits can be achieved by collaborating network members through the adoption of a solely electronic tendering process on a live construction project. The project deliverables included:

- Mapping the existing process (see flow chart in Figure 1).
- Re-designing the tender process by removing, where possible, all the identified inefficiencies (see Figure 2).

- Quantifying the potential savings to the various parties in adopting the revised process.
- Simulating the revised process to measure and verify the anticipated efficiencies benefits.

The process shown in Figure 1 starts from the point where the Private Practice Quantity Surveyor (PQS) finalises the BOQ and creates multiple copies of same for distribution to tenderers on a selected tender list. Additional tender documentation is also collated, such as design drawings and schedules which are dispatched with the BOQ. Upon receipt of the tender documents, the contractor will need to examine such and prepare any queries to raise with the design team. On clarification of any of the queries from the design team or PQS, the contractor will prepare trade packages (which are currently heavily paper-based) and dispatch such to sub-contractors for pricing. The sub-contractor will, in turn, prepare their bids and submit same to the contractor. The contractor then collates all price data, often by hand, including any bids from sub-contractors and includes indicative prices into their BOQ and adjudicates their tender sum internally. Following the submission of the documents from the contractor to the PQS, the PQS, normally in the presence of the architect and a client representative, follow the code of practice for opening and checking tenders.

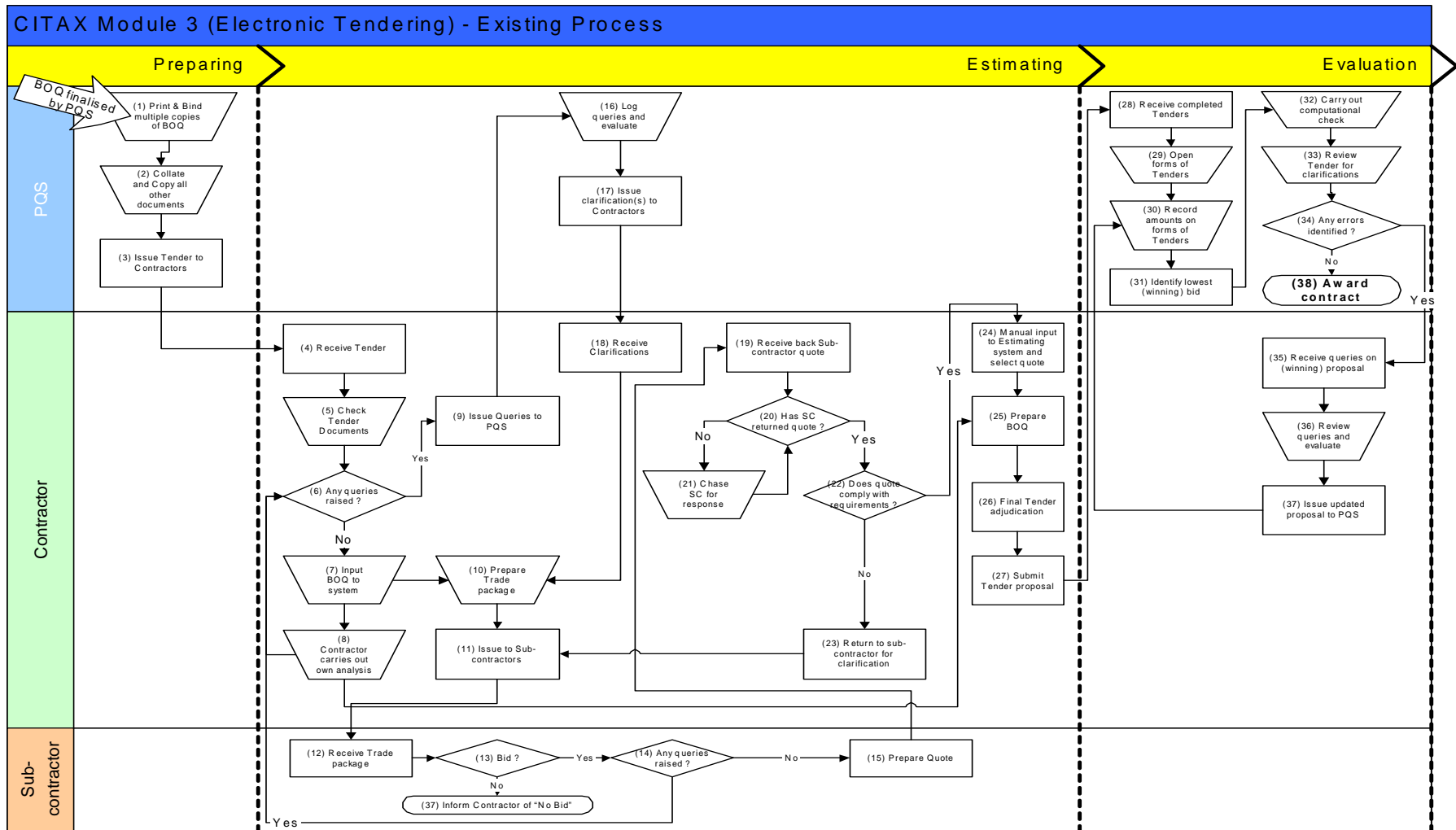


Figure 1: Existing tendering process (O'Connell et al, 2007)

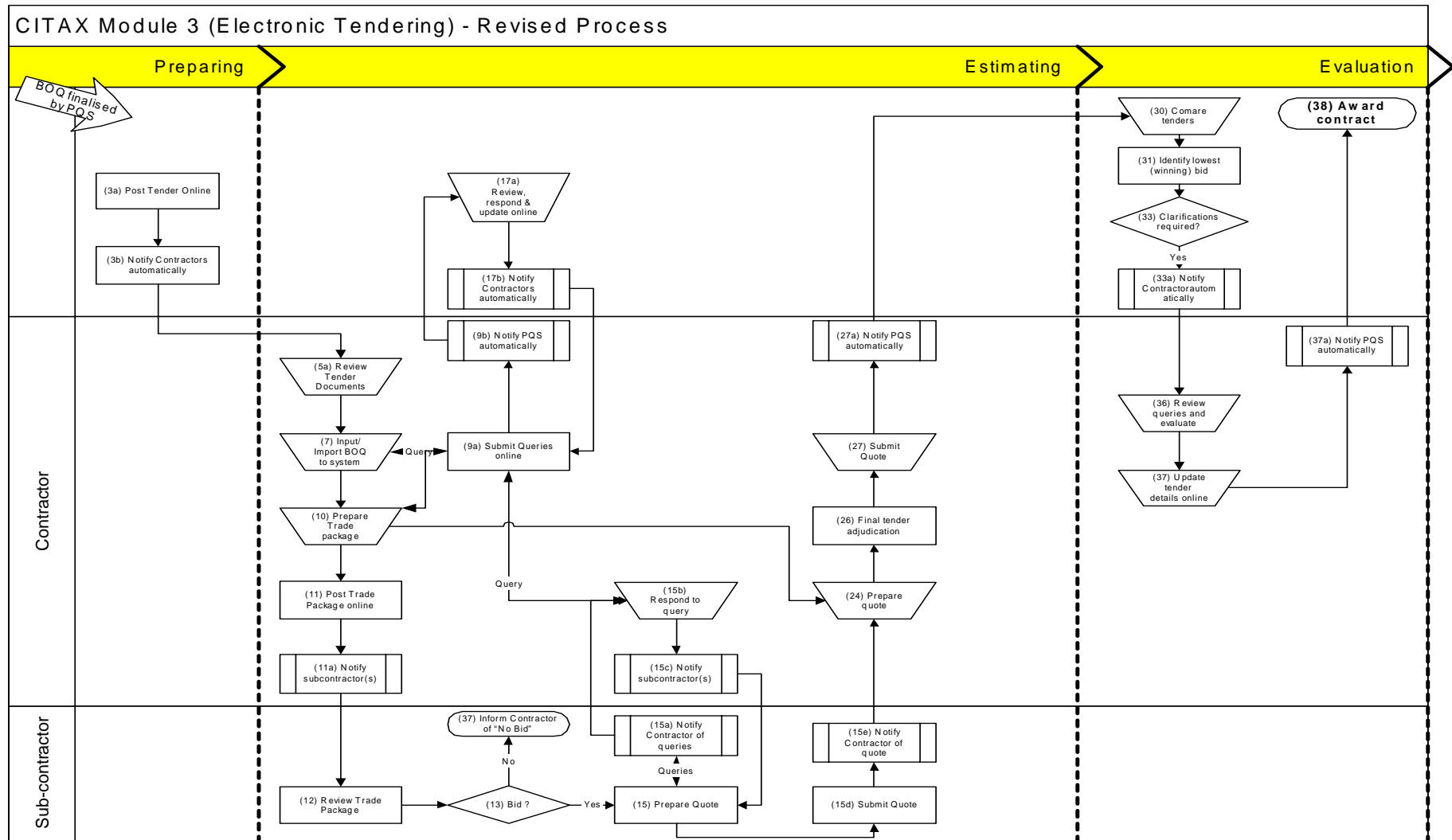


Figure 2: Revised tendering process

Using these procedural guidelines, a contractor is selected and the process of awarding the contract commences.

Of the 37 steps identified in Figure 1, 19 were subsequently removed in the revised process map. The subsequent efficiencies introduced by the module team are summarised in Table 1.

Preparation	Estimation	Evaluation
Paper eliminated as documents no longer have to be printed.	If the tender data can be provided in an electronic format it avoids the need to re-key in data.	No necessity to record tender sums on forms of tenders.
The labour effort involved in preparing the paper copies of tender documents is eliminated.	Savings in terms of paper and the time required to prepare packs for subcontractors.	No necessity to carry out computational checks.
The distribution costs associated with delivering the tenders to bidders is eliminated.	The tender system should provide validation to ensure that all information is supplied. This ensures the completeness of tenders and minimises the number of queries that have to be raised.	Receive and review tender queries in an online environment.
Errors in version numbers, missing paperwork etc. are reduced because a single version of the tender is posted online to which all bidders have access.	The validation of tenders should also provide basic checks on calculations to minimise the risk of errors.	Tenders easily updated with notification to clients and cost consultant.

Table 1 Efficiencies introduced into tendering process

When comparing figures 1 and 2, a number of sub-processes have been removed in the revised map which do not simply relate to the change from postal to electronic file distribution. Examples of these include raising queries; importing BOQ information into the contractors' back office systems; and final tender adjudication.

With this in mind the module team costed all the stages of the tender process. While it is recognised that this practice can be highly subjective, the module team had a number of members with a significant level of experience in the current tendering process. Additionally, the team laid down some criteria to help focus what costs should and could be applicable.

These included but were not limited to:

- 350 page tender document including all Bill, Specification, Preliminaries etc.
- small allowance for queries and adjustments to the BOQ.
- Sub-contractor's allowance set at one day per tender, as there was no member of the module from a sub-contract background. Some contractors may take longer as they are involved in more detailed work while others may only price one standard small item, thus resulting in a small amount of time required in pricing.

The module team then identified software packages capable of reducing / eliminating the inefficient processes in tendering. Many of the vendors of these software were predominantly UK-based and were not in a position to consult with the module participants. However, one Irish-based estimating software developer was consistently interested in partaking and advising the module team. This vendor concurred that the communications process could be significantly boosted simply through the use of File Transfer Protocol (FTP) sites. This was not a method considered in the RICS Practice Notes (2006). Providing a company has a website, it should have the ability to use this technology.

The process map was then consulted to identify how much the process would change. After a short review period, all parties agreed that the process map itself would not change. However, what would change would be the communication of the information within each step over the entire process. This then led the group to estimate a revised cost for the tendering process (see Table 2), leading to a modest saving of about 10% in tendering costs.

Costs of Tendering Process					
Process ID	Process Name	Responsibility	Estimated Existing Cost	Estimated Future Cost	Saving
1-3	All Documents to contractors	PQS	€804	€158	€646
4 - 11	Preparation of tender (1)	Contractor	€3,131	€2,431	€700
12 - 15	Sub tender	Sub-Contractor	€225	€200	€25
16 - 17	Queries	PQS	€1,091	€1,060	€31
18 - 27	Preparation of tender (2)	Contractor	€4,944	€4,681	€263
28 – 34	Receive and assess	PQS	€4,837.50	€4,778	€60
35 - 37	Clarifications; post tender works	Contractor	€1,500	€1,500	€0
Total			€16,533	€14,808	€1,725
	Predicted % saving (A-B)/A		A	B	10.4%

Table 2 – Costings associated with the tendering process

Note: - Each of the figures presented above has a detailed breakdown of the resources expended in carrying out the various activities in the tendering process.

The use of eTendering solutions may result in the reallocation of costs among the process stakeholders. It will inevitably reduce the printing cost of the owner and transfer these costs to the bidders. However, the bidders can pass on a proportion of these costs to specialist sub-contractors, whose prices will be ultimately integrated into the final bid.

Whilst the use of FTP servers, hosting, security and administration costs will add to the overall cost of tendering, all of the simulation participants already have their own FTP sites in place and so issues of an FTP manager and additional hardware did not arise.

To validate the revised process and the assumptions made, the project team has undertaken to partake in a simulation project. As the purpose of the test is to validate that documentation can be distributed more efficiently electronically than by paper, the team decided not to use any specialised eTendering software, but to create a basic test using available technology. A Quantity Surveying practice and two main contractors agreed to participate. It was agreed that the tender documentation would be placed on a shared FTP (File Transfer Protocol) site by the QS firm to which both of the contractors would have access. Each of the contractors was able to download the documentation from that site along with any subsequent updates to the information. The QS firm used email to notify the contractors whenever new information is added to the FTP site. Each main contractor was allocated its own directory on the FTP site for submitting tenders. The QS firm checks each of the FTP directories for the tenders submitted by the main contractors, at the appropriate time.

To minimise overheads on the simulation and to make it more manageable, each of the main contractors agreed to simulate the role of subcontractor to the other main contractor. Therefore, the FTP process implemented by the QS firm for distributing the tender will be replicated by each of the main contractors to simulate their interaction with their subcontractors.

It should be noted that the simulation has not addressed some issues, such as:

- Validating the calculations in each of the tenders submitted.
- Ensuring that all communications between the parties are recorded.

These items will only be addressed through the use of a software package specifically designed for eTendering. The results are expected to show that the estimated savings can be achieved, however, there may be some unforeseen difficulties, which may reduce the saving percentage that has been predicted. The final report on the simulation is due to be completed in the summer of 2008.

5. CONCLUSIONS

The Authors investigated the traditional construction tendering process, as it operates today in Ireland, including the identification of the inefficiencies involved. This was completed, firstly by means of a survey, which was then followed up by completing an observation study. It was surmised that there was significant scope for ICT improvements to the existing processes. Furthermore, it has been established that the Irish construction industry understands that they need to adopt eTendering processes, but this is tempered by significant concerns about these processes, including security, legality, commitment by other firms and the technological capabilities within the Irish construction supply chain.

CITA has acknowledged that there is a general awareness in the Irish construction industry of the business benefit of deploying readily available ICTs in improving tendering processes in construction (Kenny, 2006; O'Connell et al, 2007; Hore et al, 2007).

The construction industry approaches any change in business processes, whether it involves technology or not, with some trepidation (Rankin et al., 2006). The CITAX project has attempted to outline a set of ICT standards for a range of construction processes including tendering, to reduce the level of barriers within the industry. This could help to initiate the investment needed to achieve the wider uptake in ICT usage and, therefore, to realize the savings that have been predicted in a wide range of published articles. In an ideal system, each piece of data would be entered only once and would be available to any ICT system in the tendering supply chain that needs it (West and Hore, 2007). The simulation has worked towards achieving this end but the team went further and reviewed an example of an eTendering software package. This type of package is likely to be used in the future to provide additional levels of functionality and control such as computation analysis of analysis received that were not available in the simple FTP solution.

One of the weaknesses of the FTP solution is the necessity for the QS firm to check the tender figures submitted by the lowest bidder. Notwithstanding use of the FTP solution, the owner who uses it will have a liability if errors in the contractors' bids results from errors in discrete elemental data entry. This will be dealt with in exactly the same way that errors are handled in the existing paper-based tendering system. However with a software package (database solution), these figures could be checked automatically thus reducing the potential for errors and the client's liability.

This paper has set out the methodology within the CITAX project in which the Irish construction industry can move towards the full adoption of eTendering. Its success will inevitably be judged by the extent of its adoption, a problem exacerbated by the diverse nature of the industry's players.

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REFERENCES

- Canadian Construction Documents Committee (CCDC), (2005), Guideline 23, A guide for calling bids and awarding contracts, Canadian Construction Association.
- Department of Enterprise, Trade and Employment (DETE), 2006, Implementing the National eBusiness Strategy of the Department of Enterprise, Trade and Employment, Irish Government Publications, Dublin.
- European Commission, (2007), Sectoral e-Business Policies in Support of SMEs, Innovative Approaches, Good Practices and Lessons to be Learned, eBSN Report.

- Froese, T., 2003, "Future directions for IFC-based interoperability", *Electronic Journal of Information Technology in Construction*, 8, 231-246.
- Gunnigan L., Orr T.L.L. and Hore A.V., (2004), "Rationalising the construction materials purchasing process", *The International Salford Centre for Research and Innovation (SCRI) Research Symposium and International Built and Human Research Week*, Salford University, Manchester, 376-385.
- Hore, A., West, R.P. and O'Connell, L., (2007), "Realising Electronic Tendering in the Irish Construction Industry", *Proceedings of CIB W092 Interdisciplinary in Built Environment procurement*, Newcastle Australia, 289-296.
- Hore, A.V. and West R.P., (2005a), "Attitudes towards electronic purchasing in the Irish construction industry", *2005 CIB W92/T23/W107 International Symposium on Procurement Systems*, Las Vegas, USA.
- Hore, A.V., and West R.P., (2005b), 'A survey of electronic purchasing practice in Ireland: a perspective for the Irish construction industry', *the 2nd International Salford Centre for Research and Innovation (SCRI) Research Symposium and International Built and Human Research Week*, Salford University, Manchester, 98-108.
- Hore, A.V., (2007), "The use of ICT to re-engineer purchasing in the Irish construction industry", PhD thesis, Trinity College, University of Dublin.
- Kenny, K., (2006), *CITA eTendering Survey*, Construction Information Technology Alliance Ireland (unpublished).
- O'Connell, L., Hore, A.V. and West, R., (2007), *Efficiency Gains to be Won Through the Introduction of Electronic Tendering in the Construction Industry*, In: C. P. Lima and M. Bauer (Eds.), *Information and Knowledge Management – Helping the Practitioner in Planning and Building*. Stuttgart, Fraunhofer IRB Verlag, 2008, 264-273.
- Royal Institution of Chartered Surveyors (RICS), 2006, *E-Tendering RICS Guidance Note*, RICS Business Services Ltd, London.
- Thomas K., 1999, "A study of the use of information technology in the Republic of Ireland construction sector", *The International Journal for Construction Information Technology*, 7(1), 21-34.
- West, R.P. and Hore, A.V., 2007, "CITAX: Defining XML standards for data exchange in the construction industry supply chain", *Bringing ICT Knowledge to Work*, 24th W78 CIB conference, Maribor 2007, 5th ITCEDU Workshop and 15th EC-ICE Workshop, Slovenia: Maribor, 26-29th September, 217-224