The potential for the implementation of Electronic tendering in a Professional Quantity Surveying (PQS) practice

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Computer Mediated Construction

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MSC IN CONSTRUCTION INFORMATICS

PROJECT BRIEF

Module Code:	RECE9401	**Mark Allocation:**	100%
Course Title:	Masters in Construction Informatics	**Lecturer:**	Matevž Dolenc
Year:	1	**Semester:**	1
Module:	Computer Mediated Construction	**Project Title:**	Online technologies for Construction SMEs

Module Aim

This module will introduce the field of Construction Informatics and its role in the architecture, engineering and construction (AEC) sector. To provide a broad and sound conceptual framework for construction informatics, its role, classification of its topics, and core knowledge on the three main areas: computation, information representation and interpersonal communication.

Learning Outcomes

On successful completion of the module, the students will be able to:

- Define the role of informatics in society in general and in AEC in particular.
- Describe the strategic importance on the informatisation of the AEC sector.
- Explain the potentials of construction informatics in general and of various specific application areas.
- Discuss critically the specific problems of construction informatics.
- Understending of current and future information-communication technologies in relation to AEC.

Project Requirements

Elementary knowledge on computer science and use of computers, internet access, etc.

Marking Scheme

Project proposal (10 %) **–** Problem/project nature selection, complexity of the proposal and relevancy to module

Presentation (15 %) **–** Coherence, style and presentation content, shown ability to present and communicate issues

Project report (75 %) **–** The use of technical terminology, literature, organization, style

Project Duration/Submission Date Details

Week 0 – Project definition / Discussion
Week 1 – Submission of project proposals for approval / Live online presentation
Week 4 – Live online presentation of the work in progress (presentation + video)
Week 4 + a month – Submission of the final project report (4000-5000 words)

Guidelines for the Submission of Project Work

Students should pick one from the following list of projects:

- Document sharing.
- Collaborative Document editing.
- Sharing news about the progress of the site using RSS or related technologies.
- Collaborative Office solutions, web based calendars and project planning.
- Modelling building using BIM.
- Computing environments: HPC and HTC, using cloud computing technologies.
- …

The result is a presentation (presented as well as handed out) that would convince a boss of a SME company to use this technology. In the role of the audience, the students must play the boss, devil's advocate, co-workers in that company. In addition to this industrial case, the presentation must establish a connection between lecture topics and the technology explored.

Module Leader: Matevž Dolenc
Date: 17/7/2014

1.0 – Abstract

The construction industry is cited by many authors as being behind other industries in the uptake of computer technology and the use of Information Technology (IT) (Laryea & Ibem, 2014, Hore & West 2007). The information age has led to increased use of IT in many industries such as retail, manufacturing and the car industry which allows for increased efficiency and new products and services, while enabling the globalisation of the economy and competition within these industries (Sun & Howard, 2004).

The construction industry is somewhat different in its approach due to the nature of the sector. Construction has a wide range of clients with varying needs, each product is unique and there is a large number of parties involved in each project. The industry is also highly fragmented with a huge quantity of firms of differing sizes.

Both the Latham (1994) and Egan (1998) reports identified the need for improved efficiency and increased productivity within the construction industry.

This project aims to identify an aspect of the construction industry within the author's firm to which IT could be applied to enhance the service provided and also increase efficiency within the business. The author is employed as a Quantity Surveyor and therefore has identified the task of tendering as one to which the application of IT could eliminate the inefficiencies associated with this process.

This study firstly outlines and explains examples of the utilisation of IT applications in the construction industry as a whole. The author then outlines the process and identifies the main inefficiencies of the traditional or 'paper-based' method of tendering. The author proposes the implementation of 'E-tendering' as a solution to tackle these inefficiencies and goes on to describe various E-tendering methods, outlining the benefits and barriers of each method.

From this research and reading, the author draws on three key conclusions. Firstly, Physical media and Document sharing sites do not sufficiently address traditional tendering inefficiencies. Secondly, Email is a suitable means for e-tendering, however it has a number of limitations based on project and firm size. Finally, an e-tendering system is most suited to the e-tendering process, however due to costs of developing such a system it may not be a solution to the smaller to medium firm.

The author recommends the implementation of e-tendering in a small to medium Quantity Surveying firm through the coherent and formal use of email.

2.0 - IT in Construction

IT is seen as an integral part of any industry, and plays a key role in the day-to-day running of a company. It is seen as a catalyst to improve efficiency and reduce costs within a company and has the potential to change the structure of an industry and how information is passed amongst firms (Alshawi, 2007). However, the construction industry has many features which set it apart from other industries such as retail and manufacturing. These features can present a unique set of challenges to the progress and development of the industry, such as the implementation of IT.

2.1 - Features of construction

The construction industry plays a key role in the economy of most countries, with 12% of Gross National Product (GNP) stated as the European benchmark for the optimum level of output for construction in an economy (SCSI, 2014a). However, due to the economic crash in recent years, Ireland's construction sector output has plummeted from a 2006 high of 22% to a forecast of just 7.4% of GNP for 2018 (SCSI, 2014). This reflects the cyclical nature of the industry which leaves it more difficult to predict trends or make long-term forecasts.

The construction industry is 'project orientated', as firms come together to design and construct a project and then dismantle when the project is complete (Alshawi, 2007). In this sense, it is harder for long-term business relationships to grow, unlike in other industries such as manufacturing where firms will work together on the same repeat product or projects for an extended time. Construction is also a highly fragmented industry with a large number of small or medium companies across a wide spectrum of disciplines.

Construction also differs from other industries in that each of its products are unique, produced within a unique set of parameters. No two projects within construction will be identical, as each building will be designed slightly different to suit client requirements, be built in different locations and site conditions, and vary in complexity and value.

These features outlined above present barriers to the construction industry for the successful collaboration and integration of IT into the industry.

2.2 – Overview of IT in Construction

The use of IT systems in the construction industry is perceived as being poor with little adoption or integration of ICT systems in most business processes, especially within SME's (Gatautis & Vitkauskaite, 2008). There are many barriers to increasing the implementation of ICT within construction firms such as poor investment in IT, lack of resources within smaller businesses, insufficient knowledge of systems, their costs and benefits, lack of collaboration, as well as the cultures and traditions which are prevalent within the industry SME's (Gatautis & Vitkauskaite, 2008).

Both the Latham (1994) and Egan (1998) reports identified the need for improved efficiency and increased productivity within the construction industry. The reports highlighted that resources are not being utilised to their full potential. One example of this is computer technology and IT.

Although many reports and papers state that IT implementation in the construction industry is poor, we can identify a number of processes and tasks which are now carried out utilising IT systems.

2.3 - Communication

Communication is important in any business, and plays an important role especially in the construction industry. Any delay or lack of communication on a construction project can be detrimental and lead to increased cost and time requirements on a job which could be restricted in terms of programme and budget.

Email has become the key mode of communication in the world, providing the instant contact which telephone calls provide, with the added traceability which comes with text. There is also the added advantage of remote access and reduced costs, especially when working internationally.

As communication within the construction industry has developed over the years, it has led to the opportunity for firms to work internationally on projects. This has been further facilitated by the availability of high-bandwidth internet connections and the use of Video conferencing or 'virtual meetings'. The use of video and audio technologies allows one boardroom to connect to any other in the world almost effortlessly (Alshawi, 2007), which can reduce costs in travelling and accommodation, save time and improve the efficiency of a project team.

2.4 - Networks

The development of Local and Wide Area Networks (LAN – within one building or small area - and WAN – across a wide geographical area) allows for the transfer and exchange of information between computers within a firm, and the shared use of hardware by employees. Multiple users can access and use documents and information stored on a central server allowing for more efficient working practices. (Alshawi 2007, Sun & Howard, 2004). Members of the same design team can work on similar documents and information. For example, a group of architects working on the same project can access all relevant documents and drawings from a central server allowing for increased efficiency.

Virtual Private Networks (VPN) are set up by firms who wish to extend their network to remote locations or isolated offices. It utilises the internet as a vehicle to establish communication and encryption technology to ensure the information shared across this network is accessed by the intended user and them alone (Sun & Howard, 2004). VPNs are extremely useful within the construction industry, allowing members of a project team to access files and information stored on their firm's network while working remotely at meetings or on a construction site.

2.5 - Document Management / Sharing

John Hollingworth stated in 1990 that "The construction industry is as much a manager of information as it is materials" (Sun & Howard, 2004). The construction industry is an information intensive one, with large amounts of documents shared amongst the many members of a project team. Effective document management is fundamental in achieving a successful business model. The simple networks mentioned above are not capable of effectively handling the increasing volume of electronic documents in the construction industry.

Electronic Document Management (EDM) systems are used to logically catalogue and quickly retrieve the vast amount of documents that a firm are required to handle on a daily basis. The aim of an EDM system is to allow documents to be "linked together in the context of a project or organisation to achieve easy access and control" (Sun & Howard, 2004). EDMs can also facilitate the storage of paper documents via scanning and uploading to the system, helping firms achieve a 'paper-less office' status. Many consulting firms link their EDM to their Enterprise Resource Planning

(ERP) system which allows for tracking of timesheets, expenses and any other information relating to specific projects within the one system.

Collaboration and communication amongst firms in a construction project is vital to its success as highlighted by Latham and Egan, and document collaboration is a key driver in facilitating this. Due to the sensitivity of information, it is difficult to allow other firms to access information which is stored on a firms EDM or ERP system. For this reason the use of a document sharing facility, or a document collaboration system is often employed to facilitate the secure sharing of documents via the internet, or "the cloud". Examples of these collaboration applications include Dropbox, Google Drive or Box which provide users with an online storage facility for documents which can be accessed remotely and by other users as identified by the 'owner'.

Cloud computing or "the cloud" makes use of remote servers to allow for centralised data storage and online access to computer services or resources (Crawford, 2013). This allows for large amounts of server storage to be provided without the cost of server hardware. This use of cloud technology has become increasingly popular in the construction industry, allowing for document collaboration on the projects, and more recently facilitated cost effective collaboration on Building Information Models (BIM).

2.6 – CAD & BIM

Computer-Aided Design (CAD) transformed the design process hugely, moving from traditional hand-drawn 2D drawings, to on-screen digital 2D and 3D drawings using CAD software applications. CAD allows for reduction in time spent on producing drawings, easy editing and changing of drawings, and for drawings to be issued electronically. CAD facilitates the production of 3D models of buildings which can then be rendered to allow for visualisation. Visualisation gives the client and design team a 'real' image of what the proposed building will look like and allows for 'walk-throughs' of the building. (Sun & Howard, 2004)

Building Information Modelling (BIM) has developed from the increasing complexity of 2D and 3D CAD drawings. BIM is defined by the National Building Information Model Standard Project Committee as "*a digital representation of physical and functional characteristics of a facility*". A BIM will contain all the relevant information pertaining to each aspect, object and feature of a building and as such is an 'intelligent model'. BIM has developed to now include 4D (Time), 5D (Cost), 6D (Sustainability) and 7D (Facilities Management). It is viewed as a powerful tool which has the potential to change the construction industry if fully implemented, however there are many challenges and barriers to overcome including lack of collaboration and interoperability (Eastman et. al, 2011).

3.0 - Tendering in Construction

For the purposes of this project the author has chosen to apply IT to the process of tendering in order to improve the efficiency and cost involved. In this section the author will describe the process of tendering, outline the traditional method which is used, and identify the inefficiencies and problems associated with this method.

3.1 - Overview of tendering

Tendering is the process involved in choosing a contractor to carry out an agreed scope of services while informing the client of the price the contractors are willing to carry out this service for. The client will establish their requirements for a building, and together with a team of designers, will fully design and scope the works to be carried out and use this information to tender the work to a number of contractors.

This process is information intensive with many parties involved. Currently the majority of tendering carried out in the UK and Ireland is through the 'traditional' or 'paper-based' method as highlighted in a recent paper by Eadie et al. (2010) which states that less than 20% of construction organisations use e-procurement (electronic procurement) or tendering in the UK.

3.2 – Traditional / Paper-based tendering

The Liason Committee Practice Notes (2006) (LCPN) details the process of tendering in the Irish construction industry. LCPN identifies Stage 1 of tendering as 'Qualification'. At this stage the Quantity surveyor will issue enquiries to establish the contractors' willingness to tender for the work and will request information from the contractor as to their suitability to the project. The Qualification stage allows the client to reduce the number of tendering contractors and compile a concise list for stage 2.

LCPN identifies Stage 2 as Tender Invitation and Submission. During this stage the Quantity Surveyor will formally invite the list of contractors to tender for the works. The Quantity Surveyor will collate and issue a package of tender documentation. In the traditional method of tendering, the relevant designers (e.g Architects, Structural and Services engineers etc.) send paper copies of their drawings, specifications and information for each contractor to the Quantity Surveyors office. The Quantity Surveyor would then include a Bill of Quantities along with other commercial information, and issue this tender package to the relevant contractors. Once the contractor has received all relevant information they will price the works within the given tender period. If there is a change made during this tender period, a tender circular must be issued to each contractor highlighting this change. On completion, the contractor will submit their priced tender documents in hard copy to the Quantity Surveyor.

Stage 3 of the tender process is 'Tender Assessment' (LCPN, 2006). This involves opening the Form of Tender only to rank the contractors from lowest to highest price. Only the lowest priced tenderer's Bill of Quantities can be opened for the Quantity Surveyor to carry out an arithmetical and calculation check. Once the Quantity Surveyor is satisfied the tender has no qualifications or errors, they will recommend the tender to the client for acceptance.

For the purposes of this project, the author will focus on stages 2 and 3 of the tender process.

3.3 – Problems/Inefficiencies in traditional tendering

Hughes (2003) highlighted that tendering can cost a contractor in the region of 1.5-2% of the value of a project. When the rate of successful tendering is considered, Hughes believes the cost of

winning a tender can be up to 6%. This is reiterated by the Canadian Construction Association (CCDC, 2005) who found that tendering can cost up to 5.85% of the total value of a project. A paper by Hore and West (2011) established that traditional tendering for a typical large Professional Quantity Surveying firm can cost €10,350 per project. Identifying the key inefficiencies of the tender procedure will allow the author to establish potential cost savings in the tender procedure.

The traditional tender procedure can be labour intensive and time consuming (Matthews, 2005). The Quantity Surveyor is responsible for collating and making paper copies of all the relevant documentation produced by the Design team to issue to contractors, including producing a full Bill of Quantities. Hore and West (2011) found that this stage of tendering cost the typical PQS firm 80% of the total traditional tender process. Costs to a PQS firm also include the printing and binding of documentation, postage costs and administration costs involved in the issuing of tenders. During the tender period the Quantity Surveyor must also issue tender circulars to each contractor in relation to any changes which has additional costs, paper and administration.

On the return of tenders the Quantity Surveyor will order the tenders from lowest to highest and carry out a computational and arithmetical check on the lowest returned tender. This process will usually involve the keying in or re-entry of rates from the returned tender into a computer system. This process raises the possibility of errors and is also a very laborious and time consuming task.

Based on the above observations regarding the problems and inefficiencies associated with traditional tendering, the author will analyse the potential to apply IT to the tendering process in the form of Electronic tendering, or E-tendering, identifying the key benefits and barriers to its successful implementation.

4.0 - E-tendering

In a recent e-tendering guidance note published by the SCSI (2014b), they define e-tendering as "the electronic issue and receipt of any tender documentation in electronic format as part of the procurement process". This same definition is used by the RICS in the UK in their e-tendering guidance note (2010). However, Gatautis & Vitkauskaite (2008) describe e-tendering as the use of web-based technology to procure construction services and works.

For the purposes of this study, the author will define e-tendering as the issue and receipt of electronic documentation for the tender process using any electronic medium of exchange and will concentrate on tender methods within the PQS practice.

4.1 - Drivers of E-tendering implementation

Solutions for the inefficiencies found within the traditional tender method form the basis of the drivers for e-tendering. Eadie et al (2007) identify a reduction in procurement staff and lower administration costs as drivers of e-tendering. With less documentation to collate, photocopy and issue comes a reduction in labour and subsequently the associated costs.

Egbu et al. (2003) highlight that the use of e-tendering can remove the lost time and errors which result from exchanging paper and re-typing information when using thetraditional method. A reduction in paper and waste, a competitive edge in the industry and overall increased productivity and efficiency are also notable drivers.

4.2 – Barriers to successful E-tendering implementation

There are a number of barriers which hinder the successful implementation of e-tendering in the construction industry. A number of studies report the concern about the level of security which can be provided when sharing documents or working online can cause (Eadie et al, 2007). This barrier can be overcome by implementing the correct level of security while working online, from a reputable IT security provider and explaining the systems to users.

Another barrier is that of the legality of electronic documents. Identified by Price Waterhouse Coopers (2002), the legal validity of an electronic document is important in an industry founded on the tradition of signed paper documentation. Interestingly in Ireland, the Electronic Commerce Act which was introduced in 2000 allows for the "legal recognition of electronic signatures, and electronic contracts and documents" (Construction and Property News, 2003) which the author feels would provide adequate protection in legal proceedings; however this raises the question as to the existence of case-law on this topic.

As with the use of IT and sharing documentation in any scenario, the interoperability of computer software packages can cause problems in e-tendering. This requires the introduction of protocols and rules, and for file formats to be defined prior to the design and tender period (Eadie et al, 2007).

4.3 – Types of E-tendering

Guidance notes published by the SCSI (2014b) and RICS (2010) state that the first step in the e-tendering process should be selecting the type of e-tendering, or medium of data exchange. In other words, what way will the Quantity Surveyor transfer tender documents to the contractors. The author has identified a number of storage mediums including Physical media (CD, DVD or USB

drives), Email, Online Document Sharing and Online E-tendering systems. The author will outline the process involved with each method, as well as the merits and limitations of each.

Physical Media

The use of CDs, and more recently DVDs and USB or 'Memory Sticks', has always been popular for data storage and transfer as they are easy to use, readily available and easily transported.

Within a tender scenario, the use of physical media most closely mirrors the traditional method. Designers will issue tender documentation to the Quantity Surveyor who will in turn collate this information with the Bill of Quantities and other relevant documents and store it on a number of disks or memory sticks requiring a separate one for each contractor. The storage medium will then be couriered or posted to each contractor for tender. The documents should be returned on the same storage device with relevant digital signatures.

Advantages of this medium of transfer include the familiarity and ease of use, software compatibility, ability to stamp and sign disks for legal security, and also 'write once only' disks can be used which means contractors cannot tamper or edit tender documentation. However, the use of disks also presents a number of disadvantages. For example the slow process of postage, possibility for post to be intercepted or lost, if a drawing revision is made then the quantity surveyor must issue further disks incurring further costs and the time taken to collate information onto disks and ensure each contactor receives identical information.

Email

Email is used on a daily basis as a form of communication. It is diverse in use as it can be linked to your calendar, used invite people to meetings or used to transfer electronic documents.

Email can be utilised effectively in the tender process to issue tender documentation. As above, the design team must issue the tender documentation in electronic format, preferably via email which will then be attached to an email, or number of emails to issue to contractors. Advantages with this system include the relative cheapness and ease of use of emails, the process is sped up with documents being issued almost instantly. With the use of Blind Carbon Copy (BCC) facility on the email, a Quantity Surveyor can issue one copy of an email to all contractors therefore saving time and ensuring each contractor receives identical information. However, there are a number of drawbacks to this method.

The SCSI (2014b) highlight the relative informal nature of email which may lessen the importance of tender information being issued in this format. The use of email will raise a number of security issues also. The quantity surveyor must follow up to ensure each contractor has received all relevant information by return of email or confirmation email from contractors. Emails are also limited in size of file which can be transferred, which on a large project will be time consuming to separate and issue numerous emails to contractors ensuring each email is sent and received. Tenders which are returned will be in electronic format but must be password protected to mirror a 'sealed' envelope.

Document Sharing

The development of cloud technology and document sharing websites/software as described in Section 2.5 above, has allowed people to store and share large amounts of data online. This is known as Software as a Service (SaaS). Examples of popular document sharing sites and software include Dropbox, Google Drive, Sky Drive and iCloud.

The tendering process is information and document intensive, requiring large amounts of data to be transferred. Due to storage limitations of both physical media and emails identified above, many individuals and firms make use of the relatively cheap and easy-to-use document sharing and transfer sites. Individuals or firms identified by an email address or unique username can be invited to view documents within a shared folder online.

Advantages to this system include the cheap expandable storage facility available which do not require firms to purchase additional servers, along with the ability for each member of the design team to upload his/her own information to the site or folder, saving time for the Quantity Surveyor. Each contractor will receive the same information and any tender updates can be issued to the shared document folders. However, the key issues with this method is the limitation in control of information. Once a folder is shared, others can edit, rename, move or delete documents which can cause problems in the tender process. Also, many of these sites retain the rights to the information they store which raises the problem of security and legal queries if information is passed or lost.

E-tendering system

The majority of recent papers on the topic of e-tendering discuss various aspects of an Online E-tendering system (Hore & West, 2007, Choen Weng Lou & Alshawi, 2009). The SCSI and RICS refer to these systems as 'web-enabled tendering systems or extranets'; covering a wide range of variants.

E-tendering systems can be provided as Software as a Service (SaaS) or 'on-demand software', where the system or software is hosted in the cloud and accessed online which eliminates the need to install or maintain software on your server. For a subscription fee paid to the software provider, they will maintain the software and also provide essentials such as security which is considered as a barrier to the implementation of e-tendering.

Features of an Online E-tendering System

An Online E-tendering SaaS system would allow for the relevant design team members to log in and upload their respective information and documents to the relevant project. The Quantity Surveyor would have control over designers' access and the day the information is made available to contractors. The QS would then provide log-in access to contractors who would enter the 'Tender area' blindly, unaware of what other tenderers are involved.

The tender system would have a facility to allow the QS to notify the contractors that the tender area is open and also to know who has accessed the tender area and when. This creates a log of access which may become useful should a dispute arise. The e-tendering system would allow contractors to submit queries and requests to the design team allowing for much quicker responses and clarifications. Also, the issue of updated or new information by the design team to the system can be instant with all contractors receiving email notification of the update. Contractors will also receive reminder emails coming towards the end of the tender period to ensure they submit tenders in time.

Many e-tendering systems allow for the pricing schedule to be uploaded with the contractor only able to edit or input into the 'rate' column – thus ensuring the integrity of submitted tender documents which is often a concern with electronic tender documents.

Contractors can submit their tenders via the e-tendering system with their digital signature before the tender period automatically closes, with the system recording a log of submissions. Once tenders have been received, the system will rank tenders lowest to highest immediately informing the QS of the tender positions which can be communicated to the client. The QS can then begin carrying out

checks on the submitted tender documents. If the lowest tender is rejected then the 2nd lowest contractor must be contacted to provide a password for the QS to access their tender information. This ensures the e-tender process adheres to tendering ethics as set out by SCSI and RICS.

Finally, when the winning tender has been selected the QS can issue a successful tender notification to the contractor, and simultaneously notifications to the unsuccessful tenderers, thus completing the tender process.

Examples of E-tendering systems

'Business Callaborator' by Unit 4 software providers is an example of SaaS for the private client in construction known as a Digital Administration Data Management System (DAD) (Unit4 Collaboration Software, 2014). Unit4 used Primark Stores Ltd. as an example of this software in use. Primark as a client are expanding stores across the UK and mainland Europe and as such have numerous tenders and contracts running simultaneously. The implementation of the DAD system is said to have reduced administration costs by 50%, dramatically reduced paper processing and improved efficiency in the office (Unit4 Collaboration Software, 2014).

Union Square are an Australian-based construction industry software specialist. They develop structured databases for document management using Structured Query Language (SQL) and using plug-ins to other common software packages. Union Square's EDM links also with its ERP system and also provides an 'add-on' module for a Sub-contractor & Tendering package (SCT). As can be seen by the title, this add-on is most suited to subcontractor tenders and would be most suited to the Main Contractor who wishes to breakdown a tender into subcontract packages. On review of this software, the author believes the system closely mirrors the typical e-tendering system as outlined above, however further investigation would be required to understand the limitations of this system for a PQS firm.

E-tender.gov.ie is a website set up by the Irish government as part of the strategy to implement e-procurement in the public sector by facilitating the tender of public works online. The website advertises all public works to be carried out and allows Quantity Surveyors to create a tender and contractors to register to tender for these projects. The immediate limitation of this e-tender website is the fact that users can only issue public government tenders. This falls outside the parameters of this study. However, it is worth noting that this website operates free of charge for clients tendering publicly funded projects.

The RICS, in their e-tendering guidance notes in 2010, recommend the use of the RICS e-tendering system which they provide online. A report by Building.co.uk in 2009 reported that the RICS e-tender system had only been used 50 times in the first 15 months of its life. The author would highlight that the RICS has since withdrawn this website facility and has not issued an update on their e-tender guidance note since 2010. This would reflect the lack of confidence that the industry currently has in an e-tendering system.

Within the private works sector in Ireland, the Construction IT Alliance has carried out a number of projects and studies on the potential of e-tendering. The CITAX project from 2006-2008 was aimed at investigating the use of IT in various aspect of the construction industry. Module 3 of this study examined the use of e-tendering over paper-based tendering. The project group reviewed currently available software and tested the use of a File Transfer Protocol (FTP) site for the tender issue and receipt. They concluded that simple technology such as an FTP site can be used for the tender procedure as the users had no problems in using the technology, the PQS reported cost savings in administration, and they found it more secure than the current paper-based system as the tender

and information could be traced back to the contractor. However, there were limitations experienced as all communication was carried through phone calls and emails leaving no auditable trail or proof of receipt, no automatic notification of information uploaded to the FTP and automatic computational checks were not possible as the file had been downloaded from one 'read-only' folder and uploaded to a separate 'read/write' folder.

Advantages and disadvantages of an online e-tendering system

As can be seen above an e-tendering system can take many forms and serve different types of clients or firms. The advantages over and above other forms of e-tendering include files being centrally stored, allowing the various design team members to take charge of administrating their own information, saving time and cost for the quantity surveyor. The central storage also ensure all contractors receive the same information. As the software is provided as a service (SaaS), the information can be accessed remotely and securely online by the design team and contractors alike. A developed e-tendering system would have the ability to issue automatic notifications to contractors when tenders open, or when revisions and updates are uploaded and when the tender period is nearing close. All these benefits eliminate in some form, the inefficiencies related to the traditional, 'paper-based' tendering method.

On the other hand, a number of the disadvantages or barriers to implementing an e-tendering system are highlighted by the RICS and CITA. For example, the rules and ethics on tendering in construction are predominantly relating to paper-based tendering (CITA, 2008). Also, the issue of security arises when firms are issuing sensitive information online and also the legality of an electronic tender. This form of electronic tendering can also be costly in initial development and training, or in subscriptions to use which will deter SME's from using this technology. This means it is more suited to large firms and clients willing to pay for this service. Parties are also relying on the software and software provider as well automated processes with limited control which can put off users.

5.0 - Conclusions and Recommendations

The need for rapid change in the construction industry was highlighted by Latham (1994) and subsequently Egan (1998) in their reports on the construction industry. Some of the key conclusions and recommendations made by both were that there needed to be increased efficiency, improved use of resources and reduced costs within the construction industry.

The utilisation of computers and IT was identified as a catalyst to help achieve these aims within the construction industry. The author identified the process of tendering within the construction industry as one which could be improved with the application of IT due to its inefficiencies outlined above. To address these inefficiencies, the author examined the suitability of implementing E-tendering in a Quantity Surveying firm. Through research carried out on the topic of e-tendering, the author has established the following conclusions:

1. **Physical media and Document sharing sites do not sufficiently address traditional tendering inefficiencies.**

With the use of CDs, DVDs and USB Memory sticks, a Quantity Surveyor must still collate the relevant electronic documents from the design team onto a device for every contractor before issuing them via post. This incurs administration costs and relies on the postal service. Any tender clarifications, updates or revisions must also be communicated through this medium also. The tenders might not be able to be returned on the same device as issued, especially if it is a 'write-once' disk. This process eliminates the use of paper, however can be costly and lengthy due to speed of the postal service.

Document sharing sites likewise eliminate the use of paper and also allow for instant transfer of documents, however the issue of security provided by a site like this, and their copyright policy for documents in their possession raise concern for the design team and tendering parties. Also the access and functionality control of these sites are also limited for users.

2. **Email is a suitable means for e-tendering, however it has a number of limitations.**

Email is used on a daily basis for communication and transfer of information. It is readily available to all users, easily set up, free of charge and can be accessed remotely. It facilitates the issue of tender documentation as an attachment to an email in which all contractors can be BCC'd, removing the need to duplicate information and ensuring contractors all receive the same information. It is quick, easy to use and secure using in-house and 3rd party security. Subsequent tender updates and tender submissions can also be returned via email keeping costs low and eliminating paper use. However, limits on the size of attachments on an email can pose problems, especially on a large project, making it more suited to smaller jobs with less tender information to issue.

3. **An e-tendering system is most suited to the e-tendering process, however due to costs of developing such a system it may not be a solution to smaller firms.**

The SCSI (2014b) state the use of web-enabled e-tendering systems are most suited to any project subject to the availability of the software and required financial outlay (either subscription, or development of in-house system). It is of the author's opinion that a comprehensive e-tendering system which encapsulates all the functionality, features and security as outlined by SCSI in their e-tendering guidance note is the most suitable for e-tendering. An e-tendering system not only addresses the inefficiencies associated with traditional tendering but also overcomes the barriers to successful implementation.

Taking into consideration the research carried out on e-tendering in construction, the author would recommend the development and implementation of a carefully designed and secure e-tendering system for a large quantity surveying firm.

However, within the scope of this project brief with reference to SME's, the author would recommend the use of E-mail as a form of e-tendering in the small to medium Quantity Surveying firm. This form of e-tendering is not recommended by the SCSI (2014b) due to its 'informality' as a means of daily communication, however the author believes that if the correct approach is taken in terms of language used, request of receipt and formal etiquette is adhered to, the use of Email is an effective form of e-tendering for a small to medium Quantity Surveying firm.

Bibliography / References

Alshawi, M (2007) *Rethinking IT in Construction and Engineering*, Taylor & Francis, New York

Betts, M (1999) *Strategic Management of IT in* construction, Blackwell Science Ltd, Oxford

Canadian Construction Documents Committee (CCDC) (2005) *Guideline 23, A guide for calling bids and awarding contracts*, Canadian Construction Association

Choen Weng Lou, E., Alshawi, M. (2009) *Critical success factors for e-tendering implementation in construction collaborative environments: people and process issues*, Journal of Information Technology in Construction

CITA (2012), *Building Information Modelling, Ireland's Opportunity- Presentation To GCCC, Government Construction Contracts Committee* - Wednesday 2nd May 2012

Construction & Property News (2003) *Electronic Tendering – Will it catch on?* Article Author – Kate Kenny, Published July 2003

Crawford, R (2013) *The ICT Teacher's Handbook: Teaching, Learning and Managing ICT in the Secondary School*, Routledge

Eadie, R., Perera, S., Heaney, G., Carlisle, J (2007) *Drivers And Barriers To Public Sector E-Procurement Within Northern Ireland's Construction Industry*, University of Ulster, Belfast

Eadie, R., Perera, S., and Heaney, G. (2010a) *Analysis of the use e-procurement in the public and private sectors of the UK construction industry*, Journal of Information Technology in Construction, 16:668-686

Eastman,C.,Teicholz, P., Sacks, R,. Liston, K. (2011) *BIM Handbook*, Wiley. Available from:<http://www.myilibrary.com?ID=307247>
[Accessed 18 November 2014]

Egan J. (1998). *Re-thinking construction, Construction Task Force report,* Department of the Environment, Transport and other Regions, London UK.

Egbu C., Vines M. and Tookey J. (2003) *The role of knowledge management in e-procurement initiatives for construction organisations*, ARCOM Proceedings Twentieth Annual Conference 2004 (Khosrowshami,F, editor) Vol. 1. 661 – 671.

Vitkauskait, E., Gatautis, R. (2008) *E-Procurement Perspectives in Construction Sector SMEs*, Journal of Civil Engineering and Management

Hore, A.V., O'Connell, L. and West, R., (2007), *Efficiency Gains to be Won Through the Introduction of Electronic Tendering in the Construction Industry*, CIB W102 3rd International Conference, Stuggart, October 16th-18th 2007

Hughes, W., (2003), *Contract Journal, Cost of Tendering*, 321, 4, Further information accessed on www.constructionmarketing.community.com/research.

Latham, M. (1994) *Constructing the team, Joint Government of Industry Review of Procurement and Contractual Arrangements in the U.K. Construction Industry*, HMSO, London.

Liaison Committee Practice Notes (LCPN) (2006) *Code of Practice for Tendering and Contractual Matters*, Liaison Committee Practice Notes, Construction Industry Federation, Dublin.

Laryea, S., O. Ibem, E., (2014) *Patterns Of Technological Innovation In The Use Of eprocurement In Construction*, Journal of Information Technology in Construction, July 2014

Matthews, T (2005) *Realising electronic tendering for the Irish Construction industry*, Dublin Institute of Technology, Dublin

Price Waterhouse Coopers (PWC) (2002). *Electronic business outlook: e-markets realism, not pessimism* Available at http://www.pwc.com/fr/pwc_pdf/pwc_e-markets.pdf

RICS (2010), *E-tendering Guidance Note*, 2nd Edition, RICS, London

Sommerville, J., Craig, N. (2006) *Implementing IT in* Construction, Taylor & Francis, Oxon

SCSI (2014a) – *Construction Sector Outlook*, SCSI, Dublin

SCSI (2014b) – *E-tendering Guidance Notes*, First Edition, SCSI, Dublin

Sun, M., Howard, R. (2004) *Understanding IT in Construction*, Taylor & Francis, Oxon

Unit4 Collaboration Software (2014) *A Case Study - Primark improves efficiencies and slashes costs with BC*, Available Online:
http://www.unit4software.co.uk/resources_global/scripts/file_download.php?inf_file_id=3405
[Accessed 10/11/2014]