E-tendering -an emerging design – construction IT-bridge

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Abstract

E-tendering is gaining terrain these years, mostly as stand-alone solutions. This occurs in parallel to the received attention to Building Information Models (BIM) with its ambitions of integration and scope in the building processes. E-tendering is a much more direct practical type of IT solution use. E-tendering can be viewed as an island of IT as it often is implemented as stand-alone systems without much integration to processes before or after the tendering. Equally however E-tendering can be seen as a bridge especially between clients and contractors. The paper adopts a sociotechnical approach to IT systems and their use. It develops a tentative typology of e-tendering systems. The method is a desk study. The exploratory status made of E-tendering in several countries, especially UK, Germany and Denmark is presented. The status indicates an increasing use of E-tendering and with varying integration up and downstream. The paper discusses the increasing use of simple stand-alone systems and identifies four different concepts of E-tendering. The possible integration to BIM is understood as a long term goal that should be reached stepwise.

Keywords: E-tendering, IT, Denmark, public procurement, private procurement

1. Introduction

A Danish popular insight can be phrased ‘don’t let the best be the killer of the good’. IT in construction has often faced exactly that, conceptualizing grand programs of IT systems and IT-architecture that has little bearing in practice and which therefore tend to block more practical and modest steps forward. This paper sets out examining e-tendering in a context where BIM in various versions is all dominating the IT change agenda for construction (Bernstein 2010, 2012). Moreover in a Danish context a major development program is attempting to develop a classification system capable of solving the interoperability issues of the national building sector (cuneco 2013).

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The aim of this paper is to develop an analytical frame for analysing e-tendering systems and their use. And to carry out an exploratory investigation of found national sociotechnical E-tendering systems.

This paper adopts a sociotechnical approach to IT use in construction. When identifying concepts of E-tendering it is argued that technical organizational, economic and other social issues cannot be viewed as separate but has to be understood as a whole.

2. Method

The theoretical perspective of this paper is a sociotechnical approach to information systems and their use, viewing the software hardware, architecture and their business context, the economic and social aspects as inseparable (Linderoth 2010, Koch 2007).

The paper builds on a small study made in Denmark for the Danish Ministry of Climate, Energy and Building on digital tendering.

A selective literature study of journal articles and conference papers has been used to gather both practical experience from various countries, concepts addressing the tendering processes, and their placement in broader business processes. The texts have been found first by a search in the database 'Business Source Complete', second via Google obtaining the practice oriented material. In both searches using the search words 'E-tendering', 'e-bidding', 'e-business', 'procurement', 'construction procurement', 'purchasing' and 'construction procurement'. An element of iterative search has been used. Finally also material known by the project group was used. Only a small body of articles and papers was found and used.

To understand the emergence on BIM, three survey studies of diffusion of BIM was used (Bernstein 2010, Bernstein 2012, Samuelson 2011). It should be noted that these studies only partly cover the same countries as the desk literature study did.

It should be noted that it has been chosen not to reference primary material in Danish as the audience for this material would be limited in an international context.

It is a limitation of the country and concept comparison carried out below, that studies and materials used operates with different understandings of the involved business processes, differences going beyond simple country differences. Moreover the evaluation of advantages and disadvantages depends of the point of departure. This includes for example the present quality of tendering material. Another limitation stems from the resources granted to the study which excluded the study from systematically to assemble practical material and software supplier material of the many E-tendering portals avaible. The resource limitation has increased the study's dependency of scientific sources.

3. E-Tendering Conceptual Framework

Jung Lee (2010), drawing on Williams & Hardy (2007) and OECD (1999), proposes to understand E-tendering systems as being on different maturity levels. The three main dimensions of maturity are readiness, intensity and impact. According to Jung Lee (2010) and Williams & Hardy (2007) readiness describes the current use of e-procurement by organizations. This concept and 'intensity' is used to characterize the types of activities, products, and technologies that are part of e-procurement. Finally 'impact' characterise outcomes from the use of e-procurement; major benefits obtained; costs involved, challenges to further progress; and transformations arising from e-procurement initiatives. Below these concepts are adapted to characterize E-tendering. Using scope (of tasks) to cover the dimension of readiness and intensity, and diffusion (of the concept) as characterisation of impact. And finally these are complemented with social embedding (the organizational, financial, societal side) to emphasize and characterise the sociotechnical character of the E-tendering concepts.

3.1 Scope, coverage of building process steps

Jung Lee (2010: 417) proposes that maturity is measured across the following process:

Tendering, proposal making, evaluating, contracting, delivery, follow-up service

This conceptualization is however too narrow if more comprehensive BIM based models has to be considered. It is therefore proposed to evaluate the concepts across this understanding of the process

Briefing Design Tendering Contracting Planning Execution Operation

With a focus on tendering as the core interest, a tendering system can integrate upstream and/or downstream. Subcategories of tasks are used below when needed in the characterization of concepts, and the related costs and benefits. And for example "announcing" is understood as part of tendering and/or "sharing material with subcontractors".

3.2 Diffusion

The strength of the concepts in an industrial perspective relates a lot to its practical use. In a business with short profitability horizon, concepts should preferably be able to deliver on a 2-4 year basis. At the same time however concepts that are ready at the far end of such a horizon would be an option for innovation within the strategic reach of building companies. The concepts investigated thus reach from

Experimental, first implementation, many implementations, sector, national sector market, regional markets, globally

Linderoth (2010) for example view the diffusion process as an actor network development and gives examples of a number of barriers that BIM has experienced so far. The fragmented structure of the business and interoperability are two examples. Here the framework differs from Jong Lee (2010)'s as most of his dimension assumes that the domains has passed first time implementations.

3.3 Social Embedding

E-tendering and systems with a wider scope in the building process can be embedded several places. Systems might rest with the client, where a typical example would be the public sector clients. Or they might rest with the individual building companies, contractors, architects or consulting engineers. They could also be operated by various types of individual players such as associations or knowledge institutions. Especially when it comes to the business model of E-tendering, one could expect outspoken differences between social embeddings. The Business model could build on gratuity reaching to substantial long term investment by the buyer of the E-tendering service (and more services). The latter business model would be common by private suppliers of software, such as Autodesk or Bentley.

Summarising, the developed typology aims at with simple means to provide a characterisation of the sociotechnical E-tendering concepts, using scope, diffusion and social embedding as main characterisations. These concepts represent a modification of those of Jong Lee (2010), which are too oriented towards already implemented E-tendering on the one hand, and on the other fail to address E-tendering as part of comprehensive software packages covering substantial parts of the building life cycle processes.

4. International Concepts of E-Tendering

Our search for articles and materials found concepts from

- Australia (Gu & London 2010, Kajewski & Weippert 2004, Love et al 2001)
- Denmark (own material)
- Finland (Henttinen 2010)
- France (Prete 2010)
- Germany (Bauinfoconsult 2011, Scheig 2006)
- Korea (Jung Lee 2010),
- New Zealand (NZ Construction Industry Council 2006)
- Nigeria (Oyediran and Akintola 2011),

- Tyrkey (Isikdag et al 2011),
- United Kingdom (Lavelle & Barton 2009, Martin 2007,2008, BICS 2009)
- United States (Jung Lee 2010).

The Danish case build on the project material from the project mentioned above.

4.1 Found Concepts

Across the country experiences one can identify three characteristic concepts. The found concepts differ on technology, scope in the building process, the balance between electronic interaction and other interaction and business model. Each country usually encompasses several of the concepts.

4.2 Web Platforms

In a Danish context there would usually be a split between first briefing, design tools on the one hand and an E-tendering platform on the other hand, and second between the E-tendering platform and calculation systems used by the contractor. The tendering portal is not used in tandem with the calculation systems as most of the latter do no integrate. It's even so that seven E-tendering systems on the Danish market are entirely confined to the announcement of tenders, whereof the "Tenders Electronic Daily" (TED) is covering EU-tenders. Two systems provide higher scope in the E-tendering process "EU-supply" and "byggeweb". These are nevertheless thin portals with limited scope, but enjoy wide diffusion. They cover activities from announcement, distribution of tendering material and carrying out of the tender itself.

The Danish status of the building industry is use of a mixed form of paper and IT-tools in the tendering. A recent status made among contractors showed that roughly half of them had experienced using project web as tool in tendering and half of them had received bill of materials and volumes of materials electronically. Another survey showed that 39% of the building industry has downloaded tendering material of public tenders and 26% had delivered an electronic bid for a public tender. The tendering portals are primarily supporting the clients tendering process, the need to comply with EU- and Danish E-tendering rules. The portals do not support the contractors/bidders efforts in structuring the material and its further preparation through price and calculation systems. A well exercised example of a thin E-tendering portal is the system launched by Royal Institute of Chartered Surveyors (RICS) in United Kingdom in 2007. This E-tendering platform is operated by Building Centre for Information Services (BCIS), and is well documented (Martin 2007, Martin 2008, BICS 2009). The RICS concept builds on a relatively simple portal and does not integrate with other systems. RICS offers four types of digital tenders. The client/tenderer can distribute all documents via the portal to bidders (contractors). And a messaging system can be used to administer additions and changes. Building Centre for Information Services (BCIS) published a series of supportive and complementary material, such as price databases. According to Lavelle & Barton (2009) RICS found already in 2004 that 82% of the quantity surveyors in

United Kingdom used e-tendering to a certain extent and on a series of different portals. This result compares too that 54% indicated that the only accepted tenders on paper. In Australia, Williams & Hardy (2007) found that 43% of the member of a procurement association had used e-tendering. This result cuts across sectors. Similar to the Danish and UK market the Australian marked operate thin portals for e-tendering. The largest web-based tendering network in Australia is probably “Tenderlink” (Tenderlink 2012). It covers from initial advertising to bid response evaluation. Tenderlink has public and private clients. It uses a “pay as you go” business model. Another system is the public GEM system in Western Australia. This system covers tendering, purchasing and contracting in a loosely coupled set of software packages (Australian Government 2005).

4.3 Software integration of Tendering-contracting-invoicing

In Germany there is a combination of public and private systems. Scheig (2006) covers public German tendering portals at land level (as opposed to federal state level), while Bauinfoconsult (2011) covers a series of private software firms offering tendering management systems which are diffused among half of the German architects (Bauinfoconsult 2011). It appears that a German de facto standard has developed which integrates tendering, contracting and invoicing (”Ausschreibung-Vertrag -Abrechnung” AVA software, Bauinfoconsult 2011), where invoicing would occur after finalising the contracted work. Clients/ Tenderers in construction can thus acquire software packages which ties tendering, contract and invoicing in one digital process with the contractors/bidders. There is (even) a competition between private firms developing and maintaining these software packages. In a similar vein, but with a larger scope Jung Lee (2010) and Gallaher et al (2004) covers both concepts that integrates digital tender with previous and subsequent systems. Jung Lee (2010) compares public tendering systems in Korea, United States, Australia and New Zealand and shows that the centralised purchasing method used in US and Korea has led to more developed systems than in Australia and New Zealand, which uses more decentralised purchasing.

4.4 The Fully integrated BIM concept, private players

Many places in the world one can find a quickly raising number of building projects where a highly integrated BIM concept has been operated (Bernstein 2010, 2012). Henttinen (2010) reports a recent large Finnish project where BIM models are part of all phases even tendering, calculation and execution. It is therefore a more comprehensive system than the more widespread and well known design oriented BIM systems (Jarod 2011). It is however unclear how quantities and bill of materials are generated and calculated upon, and Bernstein (2012) notes low use of BIM in these activities. Prete et al (2011) investigates an experimental project in France where a BIM-model is used as basis for the digital tender for a large and complex project, Canopé des Halles. The software Rhinoceros was modified and extended so that it was able to deliver at IFC-compatible 3D-model with the necessary information for tendering. The model was delivered on a single DVD. A similar experimental project is Grilo and Jardim-Goncalves (2011). They conclude on their experiments with e-tendering integrated with BIM that the main challenge is

“the level of aggregation, as BIM objects tend to be very elementary and tenders focus on aggregate levels of products and services. Quantities for tendering are easy to obtain, directly from the BIM model, but how to organize the elements to be tendered is a rather complex issue, and the existing models do not reflect this need” Grilo & Jardim-Goncalves (2011:114) .

Experimental projects like Grillo et al (2011) and Prete (2011) often obtain partial public funding, but the diffusion of BIM-models are by now carried by market developments and private investments (Bernstein 2010, 2012). Bernstein (2012) finds 39 % “heavy” users a and 29% light users the latter having implemented BIM recently. Gu & London (2010) finds a large number of BIM applications at the Australian market, but only a few that supports IFC. Zhilang et al (2011) similarly finds that IFC can be used for tendering in China in the future. Reported new projects are surfacing fast in this area, such as Arayici et al 2011, Sanguinetti et al (2012) and Song et al (2012).

4.5 The Fully integrated BIM concept, private, association and public players

There has for long been exercised both national and international efforts to complement the market driven development of IT in construction. Standards and norms for interoperability and rules for measurement of materials etc. (volumes, weight, length) has been attempted for long. The Industry Foundation Classes (IFC) and ISO standards are internationally proliferated (Laakso & Kiiviniiti 2012), whereas a series of national interoperability standards also are in place. The development of BIM makes it possible to take such joint initiatives a step further. This is currently occurring in a series of countries. In a Danish context a development centre financed by EU has been set up (called Cuneco, Esperanto for common). This centre is currently developing a new building classification for the Danish building market prepared for BIM-modelling. The Cuneco vision is a strengthened interoperability and profitability through joint classification and measurement rules as a complement to the market drivers of standardization. It will be possible to follow up new classifications by public law or public building purchasing policies supporting the classification. The centre is scheduled to deliver by end of 2014.

4.6 Juxtaposition of Concepts

The four identified concepts can be juxtaposed as shown in figure 1. This shows their sociotechnical character as their technical characteristic (scope) *and* their social embedding that distinguishes them.

Table 1: E-tendering concepts

E-tendering concepts	**Social embedding**	**Scope**	**Diffusion**
Web-Platform	Sector association	Tendering alone	Several countries (UK)

Softwarepackage	Private firms and software suppliers	Tendering-contracting-invoicing	Germany
Fully Integrated BIM Market	Private firms, software suppliers	Building process all cycle Market based standards	Several countries but large trail blazer projects
Fully Integrated BIM Communal	Private firms, software suppliers *and* sector association or public body	Building process all cycle Joint classification and measurement rules	Several countries Experimental, Quick Development and large public attention

4.7 Impact of E-tendering

The impact is clearly highly dependent of the level the E-tendering is on referring to the four concepts discussed above. For each concept different impact are prevalent. Especially the RICS concept (a thin model) seems to be particularly evaluated on the impact. Martin (2008) thus finds the following cost types: Mobilization cost, monthly subscription costs, costs related to requirements for increased technology capability (such as upgrades of browser software) and costs related to proprietary systems. Martin (2008) also points at barriers for implementing a thin E-tendering system: lack of common standard, no non partial counselling and juridical and technical “traps”. In a similar vein Lavelle & Bardon (2009) finds that users of E-tendering sees the following main disadvantages; legal issues, difficulties in sharing information, security concerns and poor systems.

BCIS (2009) find that regular user strongly or somewhat agree to that they obtain reduced timescale of tendering. They also strongly agree or somewhat agree on a reduced effort in analyzing tenders, having lower administration costs, having better contact to subcontractors and having a reduced effort in clarifications. Interoperability with previous and subsequent systems is however not covered in this thin systems evaluation. Similar results are found by Kajewski and Weippert (2004) and Lavelle & Barton 2009). Early adoption is enabled by low fee –pay as you go- approaches (Martin 2007), which help overcome initial barriers, which apply less and less as the integration is furthered and investment increase.

The larger the scope the more complicated the impact gets. Gallaher et al (2004) provides estimation for cost of interoperability for the entire value chain for the US building industry, asking the players how much they could gain in interoperability was smooth. Gallaher et al (2004) operate with the following types of costs avoidance costs, mitigation costs and costs of delays. Gallaher et al (2008) finds that two thirds of the interoperability costs are carried by the building owners and operators. There is not a special focus on the interface between architecture, engineering and contracting, but these three types of firms carry each the same level of costs of poor interoperability.

Cretty (2011) points at transformation at several levels i. e. the project and the sector. The social embedding becomes more and more crucial the higher investment and advanced technology employed.

5. Discussion

The four concepts identified above can roughly be claimed to cover the broader sample of systems and concepts looked at. Several systems (such as the GEM in Australia) are placed in between the thin systems and the full circle BIM based and can therefore be labelled medium range systems. The scope is therefore more than a continuum of support to business processes.

When it comes to diffusion all four concepts experience growth. In one end – the most practical - it is common for the national studies to note that around half of the tendering is carried out on paper. Usually this builds on samples of bigger enterprises creating a possible bias for an even larger share if one in-calculated SMEs. In a sense the four concepts all represent the status of the bigger enterprises. In the other end – the more advanced- several contributions note the barriers for fully integrated BIM (Aryici et al 2011, Bernstein 2010, Gu & London 2010, Linderoth 2010). At the same time examples of integrated use of BIM proliferates (Bernstein 2012, Henttinen 2010).

It seems clear that the social embedding is primarily single enterprises. Constellations of software developers/suppliers with building clients around the thin clients, and AEC companies for the BIM oriented solutions. The dominance of market drive is probably also explanatory when it comes to the weak standardization and bridge building across the design construction divide. It is upstream players and not the contractors that dominate the field.

The software package concept represents a series of middle range systems, whereas the web platform is the thin –small scope version. Even the “fully” integrated BIM represents a number of variants. As the constitutive difference between the two BIM concepts lies with social embedding and the scope, we have chosen to label the fourth the communal BIM as shared classification operated by an independent body is central, counter to other BIM model where market forces are central.

6. Conclusion

The international markets of E-tendering and the experiences they represent appear quite diffuse. Four different concepts have been identified. It seems to be common features across the countries that there is a growing use of all four concepts, even if in different tempi and digital tendering is implemented piecemeal. The thin “low scope” solutions appear to be growing as quick as the large scope concepts. Possibly the medium range systems are the most important the coming years as they might address the most important interoperability issues. There is room in time and market for simple practical models, limited in scope, to tendering, whereas the big integrated models seem to have several years in front of them before they are broadly usable in practice. Here social embedding counts more than

technical functionality. A future Danish concept has been mentioned, which emphasizes joint classification and rules of measurement as a means to improve interoperability. But also elsewhere, internationally, there are voices requesting standardisation as an enabler for digital tendering.

Internationally the studies found points at qualitative and quantitative advantages and costs, barriers. The conditions for the evaluation of these costs and benefits are differentiated, but some general patterns can be found, as it is thoroughgoing to point out, that once initial investment cost has been employed, the benefits are reduced time consumption at developing bids, reduced work load during the analysis of tenders, lower administration costs and – work load, better contractor access to information for subcontractors and better security in the digital interaction. Even if two variants of BIM is included it should be underlined that these large scope, integrated system still appear to be quite far from mainstream tendering and E-tendering as around half of the players in the industry still tender with documents. The possible integration from E-tendering platforms to BIM is therefore to be understood as a long term goal that should be reached stepwise.

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