

An Assessment Methodology for e-Business and e-Commerce in the AEC sector

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ABSTRACT: Recent studies have illustrated that the AEC sector has embraced e-Commerce and e-Business. Indeed, case studies demonstrate that the use of electronic collaborative and commerce platforms by the different players in the AEC sector can be as sophisticated as the best practices found in Automotive, Aeronautics or Retailing sectors. However, the same studies do also recognize that though the best practices are at the same level, they are much less frequently deployed. This paper presents a methodology based on business factors to assess the readiness and likeliness of the development of e-Business and e-Commerce between the disparate players in AEC projects.

1 INTRODUCTION

The AEC sector has embraced e-Commerce and e-Business, as demonstrated by recent case studies that illustrate the use of electronic collaborative and commerce platforms by the different AEC players. These applications can be as sophisticated as the best practices found in Automotive, Aeronautics or Retailing sectors, though they are much less frequently deployed. In order to create the enabling conditions for the deployment of the electronic collaborative and commerce platforms it is fundamental to understand the variables that may influence its development, and how they determine the configuration of the e-platform.

2 E-COMMERCE AND E-BUSINESS FUNCTIONS

2.1 *Informational*

The initial use of the Internet technology for business purposes had mainly an informational function. Web pages describing companies' services and products were, and still are, the simplest and most common usage of an e-platform. The informational function has evolved and currently, more than just simple Web pages with descriptions, some companies make available databases with sophisticated data about products, services and the interaction (through business intelligence tools), including 3D CAD components to be embedded in 3D CAD applications. Architects, builders' merchants, contrac-

tors, consultants, suppliers, etc, widely use this function.

2.2 *Transactional*

The electronic exchange of commercial data relates to the transaction life-cycle, from the request for quotation, order, etc. until invoice. Before the availability of the Internet as a communication network, companies used X.25 based technology for Virtual Areas Networks (VAN) to exchange Electronic Data Interchange (EDI) messages. There was scarce use of this transactional function in the AEC sector ten years ago (see Baldwin et al, 1995 or Akintoye and McKellar, 1997), and its use was mainly restricted between builders' merchants and their suppliers.

This reality has changed in the last years. The emergence of the virtual marketplaces has dramatically changed the use of transactional function, with contractors, suppliers, builder merchants, consultants and clients exchanging request for quotations, orders, invoice, etc. through these platforms (Flood et al, 2002; PRODAEC, 2004).

Often denominated as e-procurement, this functions is rarely exploited at its full. The reason lies in the lack of integration of the companies' internal ERP systems with the marketplaces. Thus, most of the companies type the transactional information in a Web browser and receive data in a file that print before re-introducing data manually in their ERP system.

2.3 Collaboration

The oldest and simplest way of the collaboration function is the exchange of files through e-mail. This is a pervasive way of companies using an e-platform for collaboration. However, very sophisticated tools have emerged in the last years. Initially, the deployment of private Extranets allowed disparate parties in construction projects to share information by uploading and downloading files in a central server. More recently several commercial collaborative tools have appeared in the market, with very complex and complete functions like on-line CAD redlining and markup, forums, logs registration, workflow, etc. Examples are Buzzsaw (see Autodesk, 2004) of Autodesk and ProjectNet of Citadon (see Citadon, 2004). These sophisticated tools are mainly used in large-scale construction projects (see PRODAEC, 2004).

2.4 Configuration of the e-platform

These three functions can occur simultaneously between two companies. The degree of sophistication can vary, from the simple usage of e-mail usage or having a Web page with basic information, to intense marketplace transaction and use of a complex collaborative tool with workflow and on-line CAD redlining.

The technology is available, it is reasonably inexpensive, *de jure* and *de facto* exist to facilitate exchange of files and data. Security issues, once a concern for users, are hardly an excuse as most professionals age below 40 years use home-banking, a much more data sensitive world. Case studies have demonstrated that the AEC sector can deploy and use sophisticated configuration of e-platforms (PRODAEC 2004). The main issue is, Why is it not more widely used? – The answer is on the business side of the problem.

3 BUSINESS FACTORS

3.1 Companies' Individual Features

A determinant factor for the likeliness and readiness of a company to engage in any IT development (Venkatraman, 1991) and particularly in e-business or e-commerce is its internal features, namely:

- *Business Strategy, Organizational Infrastructure and Processes.* Companies prone to innovation in all sides of the business, aligned with a strong, centralized organization and leadership are positive factors. Streamlined processes are fundamental to be able to take advantage of collaborative and transaction functions. Teams IT proficient

are also crucial, particularly for collaborative functions.

- *IT Strategy, Infrastructure and Resources.* Companies with low level of IT automation and integration between application, with significant legacy systems, and non-Web based applications may experience major difficulties. Availability of IT resources, either internal or contract out is important, though cost of implementing these tools are significantly low nowadays.

3.2 Relationship

The relationship between firms is very important for the deployment of an e-platform between two firms. There are two main dimensions that should be analyzed (Hakansson and Snehota, 1995):

- *Exchange Episodes.* The more intense, frequent and regular are the exchanges of information between firms the more likely they to use e-platforms, and the increased sophistication of the system. This is reinforced when also occurs strong product/service and financial exchanges. If the transactional type of information is the more intensely exchanged it is likely that an e-platform with more transactional function be developed. Conversely, if the nature of the relationship is mainly regarding the exchange of information needing collaborative interaction then collaborative type of e-platforms are likely to emerge.
- *Atmosphere.* It is not only *what is* exchanged but also *how it is* that is important. Thus, close relationships, with strong bonds, institutionalized co-operation, and mutual expectations – that develop and evolve over time – is a very important driver for deployment of sophisticated e-platforms. The power dependency may also contribute, though if not on a conflict basis.

3.3 Production Network

Firms are not isolated in the market, firms tend to organize in production networks (Harrison, 1994), being the AEC sector networks very dynamic. The characteristics of the network influence in two major ways:

- *Governance Structure.* Networks with a strong core, where the leading firms are prone to innovation and e-business technology is a very important driver. Examples can be found on construction projects with innovation and

leadership commitment clients, or when project / construction managers with e-business focus are contracted. Ideally, the augmented core of the network, composed by Client, leading Architect/Designer and Main Contractor should have a good degree of e-business readiness and commitment.

- *Input-Output Structure.* A small number of production units and firms in a network, and these with reasonably homogeneous size, IT capabilities, and streamlined processes are clear facilitator for e-business deployment, particularly for collaboration function. However, often e-platforms require a critical mass of users for the return of investments.

3.4 Interplay of Business Factors

The deployment of e-platforms and their degree of sophistication is influenced not by just one business factor but from the interplay of factors. The larger the alignment between current conditions of firms' internal features, relationships and the characteristics of the production network, with what was identified as the e-business/e-commerce facilitating conditions of the factors, the more likely the deployment of e-platforms and the more sophisticated the systems can aim to be.

4 E-BUSINESS / E-COMMERCE ASSESSMENT METHODOLOGY

The proposed assessment methodology is based on the previous described factors and grounded on empirical work by Grilo (1998).

The assessment methodology consists on a Gap Analysis regarding the previously defined factors and the situation of potential deployment of e-platform. To visualize this Gap Analysis, it is used a radar graphic, as depict on the Fig. 1:

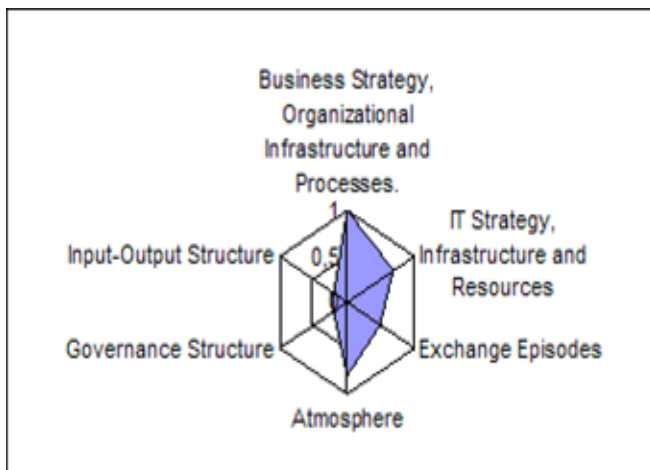


Figure 1. Example of the assessment graphic

The widest the cover of the factors the higher the degree of readiness for deployment of e-platforms but also more likely sophisticated systems can emerge.

The function typology can be analyzed through the Exchange Episodes, particularly the informational and product exchanges. If two companies exchange essentially technical and managerial information (Atkin, 1995) then it is likely that applications with collaborative functions are developed. Conversely, if companies exchange mainly commercial information, than the transactional function occurs.

5 ECONSTROI AND MOTA-ENGIL

In order to illustrate the analytical function of the methodology, a case study is described, based on PRODAEC research.

The *econstroi.com* is a construction-oriented initiative that targets the entire sector in Portugal. It represents an ambitious attempt to integrate a value chain that potentially involves 80.000 companies.

The *econstroi.com* project was launched in 2000. It started considering the use of the Internet to improve the business processes as well as some functions that exist in the fragmented construction industry where the buying process is particularly detailed and demanding in terms of information flow.

Initially, *econstroi.com .com .com* provided only informational functions and by October 2001, it has started to operate in its core business: an instrument to support the electronic commerce for the construction sector. Nowadays, *econstroi.com .com .com* has combined the three functions: informational, transactional (the most used), and also some collaboration features.

- Ask for information and share documents or project models among the participants in the same project;
- Request and answer to proposals;
- Compare budgets and choose among them the best proposal and carry out the respective orders and selection process;
- Coordinate the logistic process;
- Contract financing services and perform financial transactions.

Construction companies can join the *econstroi.com* market for free. However, they are re-

quired to go through a registration process, which includes authentication and pre-qualification procedures. All goods, services and information are provided in a safe and confidential environment based on encrypted and closed communication channels.



Figure 2. EConstroi.com

The *econstroi.com* has introduced innovations on the critical processes of the construction value chain, namely **e-procurement** and **e-project management**. Regarding the **e-procurement**, the *econstroi.com* way of working match buyers and sellers, comparing who is looking for the best offer/price and quality conditions against who is selling their products and services. Econstroi.com .com acts as a facilitator for this matching to happen in the same way that it takes place in the physical market.

The **e-project management** manages all information (technical, financing contractual specifications) that is necessary to perform construction projects. This is a process that demands the involvement of a large number of entities (promoters, regulators, contractors, project managers, suppliers, etc) and demands a very intense and continuous exchange of documents mainly CAD drawings.

Mota-Engil is a Portuguese general contractor, and is the company with the highest number of transactions in the portal, and with 90% of procurement through *econstroi.com*. Despite using the e-platform mainly for transacting exchanges, uses it to its full extent. The degree of sophistication in terms of the transaction function is very high, having Mota-Engil integrated their internal ERP SAP application with the portal, in order to reduce re-typing, or manual upload and download of files. It does not cover digital invoicing, since legally in Portugal it is not accepted.

- *Business Strategy, Organizational Infrastructure and Processes.* Company has very streamlined processes, with centralized supporting departments. It has been in the forefront of innovation regarding construction methods, management, IT, quality assurance and recently in environment and health and safety.
- *IT Strategy, Infrastructure and Resources.* Mota-Engil has most of the documents in digital format, with workflow implemented. All sites are connected to central ERP system. High degree of automatized processes.
- *Exchange Episodes.* Mota-Engil exchanges mainly request for quotations, tenders and supporting technical documents with their suppliers. Despite the use of the portal has opened the market for the contractor, in generic terms, previous relationships with higher number of transactions are still the most frequent users of the system.
- *Atmosphere.* Despite *econstroi.com* enables market to work, with new suppliers coming in, most of Mota-Engil suppliers adhering to the e-platform, worked previously for many years with the contractor, with strong institutional and personal bonds. The market conditions (price, quality, delivery) are crucial, but still, new comers have to pass a confidence threshold in the procurement process for buys above certain budget.
- *Governance Structure.* Clearly Mota-Engil is a core leader in the network of its suppliers. Traditional suppliers were warned that they have to trade through *econstroi.com* – despite being given a period to adapt themselves, or are out of business with the contractor. Most of suppliers are complying with the request, showing the leadership governance capability of Mota-Engil. Curiously, the least adherent are the companies that are on the loose end of the network ring, some of them well known and large companies but that do not dependent much of Mota-Engil for their overall business.
- *Input-Output Structure.* The number of companies on Mota-Engil suppliers' network is high, and their characteristics very heterogeneous. This has clearly been a problem due the need to convince them all to adhere to the system, training, etc. Particularly for small supplier, to whom connecting to the Internet is far from trifle.

Fig. 3 presents the assessment made. It is easily concluded that in this case Mota-Engil had a reasonably high degree of readiness for the deployment of an e-platform.

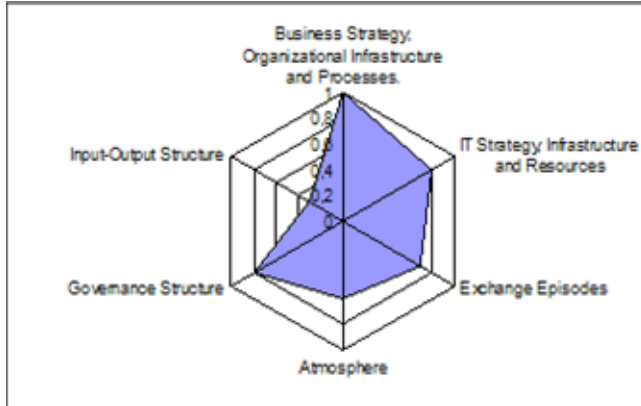


Figure 3. Assessment of *econstroi.com* / Mota-Engil readiness of development of an e-platform

The assessment graphic does also show that the Input-Output structure of the network is the main hindrance to developments and sophistication of the system. Indeed, it was this area of concern that has deserved the biggest efforts by Mota-Engil managers in the last year for the full scale implementation of the digital procurement process.

6 CONCLUSIONS

This paper focused on describing a methodology in order to systematize the analysis of development of e-business / e-commerce platforms and their degree of sophistication. It was argued that technology in itself is hardly an important factor as business factors are: *Individual Features* of companies, like their business strategy and organisational infrastructure and processes, IT strategy, infrastructure and resources; the characteristics of the *Relationship* between companies, addressing issues like the type of informational and product exchanges as well as the atmosphere between the parties; and the *Production Network* where companies are embedded, with variables like their governance structure and input-output structure. A case study was described, and it is possible to conclude that based on this methodology, managers can act accordingly in order to create the enabling conditions for the deployment of the electronic collaborative and commerce platforms.

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