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THE STATE OF THE ART IN E-BUSINESS: A CASE STUDY FROM THE CHINESE CONSTRUCTION INDUSTRY

Lei Zhou¹, Srinath Perera¹, Chika Udeaja¹, Xudong Ru²
lei.zhou@northumbria.ac.uk; srinath.perera@northumbria.ac.uk;
shika.udeaja@northumbria.ac.uk; luxd@glodon.com

1. School of the Built and Natural Environment, Northumbria University, Newcastle Upon Tyne, UK, NE1 8ST
2. 18-A Zhongguancun Software Park, No.8 Dongbeiwang West Road Haidian District, Beijing, China, 100193

Abstract

In the 21st century, e-business is seen as the new frontier. Currently e-business has been widely used in other industry and to some extent in global construction market, particularly in developed countries, such as UK, EU and USA. Evidence of performance and success stories shows that the implementation of e-business is already delivering high improvement and innovation in construction project planning, design, delivery and management. However, the current performance of e-business in the emerging market, such as India and China is limited. China, as the world's second largest economy after the United States, has the world fastest growing economy, averaging 10% growth of the past 30 years. The domestic construction industry is booming in both infrastructure and building construction sectors. It is predicted that nearly half of the world's new building construction will be in China by 2015. In a similar way to other countries, there is a great potential for China to implement e-business in the construction industry in order to improve its productivity and competitiveness. This paper initially explains the concept of e-Business and its impacts in construction industry and reviews the development of Chinese construction industry over last two decades. A case study of one of the largest Chinese construction IT Companies is carried out to further analyse benefits, challenges and the market potential of e-business in China. This study provides a better and deeper understanding of the different characteristics of the implementation and capability of e-business in Chinese construction industry.

Key Words: China, Construction Industry, e-Business, Informationization, IT

1. INTRODUCTION

E-Business has been widely adopted in global construction market, particularly in developed countries, such as UK, EU and USA (Issa, *et al*, 2003, European Commission, 2006, Anumba & Ruika, 2008, Chen *et al*, 2011). Evidences shows that implementation of e-Business would highly improve the construction project planning,

delivery and management (Aranda-Mena & Stewart, 2005, European Commission, 2006, Zou and Seo, 2006, Anumba & Ruika, 2008, Chen, *et al*, 2011). e-Business can be implemented to every aspect of construction business and through a project life cycle, however, because of the fragmentation and one-off nature of construction industry, the adoption rate of e-business is slower than other sectors. Furthermore, the current performance of e-Business in emerging market such as China and India is poorly reported. China, as the world's second largest economy after the United States, has the world fastest growing economy, averaging 10% growth of the past 30 years. The domestic construction industry is booming in both infrastructure and building construction sectors. China has significant potential to integrate e-Business into the industry practice in order to improve its efficiency and productivity. However, there is lack of information to evaluate the current status of uptake of e-Business in China and identify the key drivers and barriers in the emerging market.

This paper initially reviews the concept of e-Business and its drivers and barriers from a construction organisation perspective. It then explores the development of construction industry in China within last 20 years and examines e-Business impacts and trends in China construction industry, government policies and uses a case study to identify its main benefits and challenges. This paper reports on the initial findings from a case study of a top construction software service company in China. The results demonstrate that China construction industry is in the transition from traditional business model to e-Business model. Both government push and market pull lead the sector into an accelerating development process. However, the major challenges of e-Business implementation are from inside the construction organisations. The key barriers are lack of senior management support, lack of trainings, fear of uncertainty of investment on return and the implementation of e-Business not aligned with the organisation's business vision and business objectives.

2. THE UPTAKE OF E-BUSINESS IN CONSTRUCTION INDUSTRY

2.1 The impacts of e-Business to construction industry

E-Business is the term used to describe the information systems and applications that support and drive business processes by using information technologies. There are various definitions of e-Business. Li (2007) provides a clearer explanation: '*e-business is about developing new ways of working by innovatively exploiting the new capabilities of ICTs in general and the Internet and related technologies in particular*'. In general, e-Business means all types of business activities that are supported by electronic means (Li, 2007, Anumba & Ruikar, 2008, Chaffey, 2009, Xu & Quaddus, 2010). The main e-business approaches are B2B (business to business), B2C (business

to customer) and C2C (Customer to Customer).

The construction activities are a complex process with a number of parties and project teams involved and this makes the information flow complex and intensive. It is believed that IT and e-business activities can improve these processes and even make the organizations more efficient (Sun and Howard, 2004, Morton, 2008). There are a wide range of e-Business approaches in construction industry, for example, e-commerce, e-tendering, e-procurement, e-collaboration, web-based project management and BIM (Building Information Modeling) etc. The main purpose of e-Business approaches is to facilitate organizational activities across industry boundaries to achieve economical advantages. Base on the different functions, a construction organisation could implement e-Business from five dimensions as shown in figure 1.

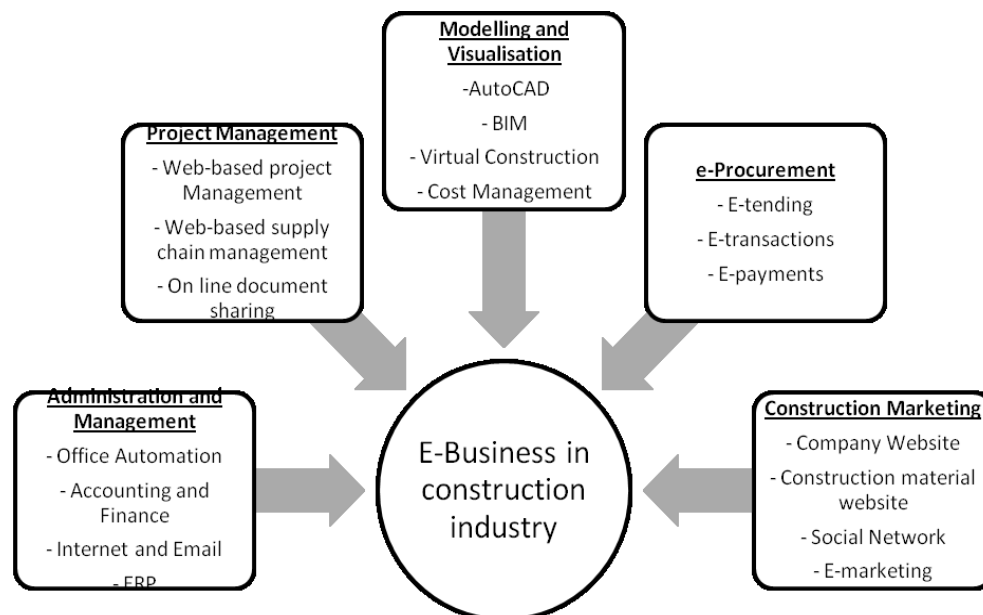


Figure 1: e-Business activities in construction industry

2.2 Drivers and barriers of e-business implementation to construction organisations

The drivers and barriers of e-Business implementation have been well documented and widely discussed by academics, industry and governments for decades (Aranda-Mena & Stewart, 2005, European Commission, 2006, Zou and Seo, 2006, Anumba & Ruika, 2008; Chaffey, 2009; Eadie, *et al*, 2011, Chen, *et al*, 2011). However, most studies are limited to examining benefits and barriers in either in generic level or narrow down to one specific aspect, such as e-commerce or e-procurement, etc. Chaffey (2009) reviewed the potential advantages of e-Business activities in general as both tangible and intangible. Zou and Seo (2006) categorized e-business benefits according to different stakeholder organisations which could be benefits from low transaction costs, reduced staffing requirements, shorter

procurement cycles, decreases inventory levels, higher level of transparency, provision of information on demands. Eadie, *et al* (2011) categories benefits and barriers but more focusing on e-procurement rather than overall e-business activities and Aranda-Mena and Stewart (2005) assessed 23 barriers which have negative impacts to e-business maturity level, but doesn't account the drivers of e-Business. It is necessary to draw a complete list of drivers and barriers regarding the nature of a construction related organisation when implementing e-business. Based on those above studies, Table 1 categories them into five levels: technology, people, project, organisation and industry wide, the benefits of the complete checklist would help organisation who wishing to adopt e-business, to do a self-evaluation and identify specifically their own benefits and challenges at different level. The awareness of competitiveness advantages from e-Business has been reported and demonstrated widely in many countries. The uptake of e-Business has been dramatically improved in developed countries (European Commission, 2006, Anumba & Ruikar, 2008, Chen, *et al*, 2011). In the UK, 'Construction I.T. for Business' (Chen, *et al*, 2011) conducted an updated survey to identify the current status of uptake of e-Business in the UK construction industry. The survey result identifies that most communication among the construction organisations are carried out electronically and over 50% documents are produced and exchange electronically, e-Business activities such as product and service promotion and project collaboration are used more than e-tending and e-procurement. The survey results stated above have identified the benefits of using e-Business in construction industry, however, it shows a slower adoption rate than other service and product industries (retail, tourism and manufacturing). None of study investigates the implementation of e-Business in China construction industry; its typical drivers and barriers are not yet identified. The overall aim of the study is examine the uptake of e-business in China at construction industry level and identify its opportunities and challenges.

3. RESEARCH DESIGN

In order to answer the e-Business implementation process and performance in China construction industry, identify and highlight the main drivers and barriers, this study is divided into two parts. The first part deal with a secondary search of literature relating to central government policies, construction professional association guidelines and relevant web sites are undertaken, this secondary approach is useful because China is a centralized country, construction industry development is mainly driven and controlled by the governments. The second part of the research will involve conducting a case study research of one of the largest Chinese construction IT in companies to further analyse benefits, challenges and the market potential of e-business in China. This involves the collection of the most recent information from multiple interviews of the company's directors and web based secondary data analysis.

Table 1: Drivers and Barriers of e-Business in Construction Industry

Level	Drivers	Barriers
Technology	Office automation Innovation Internet	Interface with other systems Technological updates Lack of software Connection Speed
People	Staff Training Improve staff's competency career enhancement Improve productivity	Lack of staff training Lack of awareness of the benefits Lack of in-house IT technical expertise/skills Resistance to change Lack of Trust
Project	Reduce construction cost, chance of errors, and the need of rework Shortened overall procurement cycle time increased quality through increased accuracy Improve project team communication Better information exchange and data management	No extra money for IT investment from the project Lack of client demand reluctance/inability to adopt ICT among subcontractors and suppliers One-off project Confidentiality of information No upper management support/lack of leadership
Organisation	Strategic cost savings Process, transaction and administration cost savings Increase profit margin Gaining competitive advantage Product and Service Promoting Growth of Revenue Efficiency of Business process Improve the quality of customer service	Cost of initial investment Uncertainty of financial return (Return-On-Investment (ROI)) Lack of clear vision and business objectives Lack of Strategic management Goods/service unsuitable for e-sale
Industry Wide	Energy Saving Reduce paper use Improve industry standard	Legal problems Lack of industry standard Lack of national IT policy to construction industry

4. E- impacts and trends in China Construction Industry

4.1 The growth of China construction industry (CCI)

China is one of the largest countries in the world with a population of 1.3 billion people. China economic growth has remained very strong and its GDP remain in a relatively high level, from 9% - 12% per annum over last 30 years. The average annual housing production was at 800-900 million square meters. The construction industry in China accounts for approx 7 per cent of gross domestic produce since middle 1990s (Zou, *et al*, 2007). At the end of year 2010, there were totally 100,000 registered firms employing around 60 million people working in the construction industry, creating a total output value of 9520.6 billion Yuan (CCIA, 2011) respectively, which is about 1360 billion US \$. According to China Construction Industry Association (CCIA)'s statistics, the gross product value of China construction industry increases 140 times and the productivity ratio increases 20 times within 25 years (1985 - 2010). Chinese construction growth is at its peak; however, this growth has been identified to be fragile and unsustainable. It has also been known that the high growth rate in China relies on the size of fixed assets investment. Inappropriately, construction companies' management systems are considered old, not efficient and the capability of adopting new technologies is relatively low.

4.2 e-business impacts in China Construction Industry

In China, e-Business is known as 'Informationization', in the early stage it mainly describes how the construction related organisation implement ICT and infrastructure, more recently it has expanded to cover all relevant e-business activities. The real exploitation of e-business only started early 2000s; most large construction organisations used advanced IT in many projects and Building Information Modelling (BIM). However, its usage was limited to mega projects such as the Beijing Olympics Games and Shanghai World Expo. In China, the central government policy is the main driver of e-Business. In 2001, the Ministry of Construction (now MOHURD) circulated the basic guidelines for construction sector's informationization and demonstrated about 70 best practice projects. This is the first government document urges the importance of e-business in the construction industry. However, the influence of this policy is limited due to the market condition at that time, most construction organisations just started up and they were not affordable for IT investment. In 2007, Ministry of Construction published *Special grade construction enterprise qualification standard*. The new standard requests all special grade enterprise (top 264 of China construction firms) must be informationization.

An industry-wide survey conducted in 2008 to 2009 by China Construction Industry Association (CCIA, 2009) attempted to identify the adoption rate of ICT and

e-business within China construction industry. This survey examined the implementation of e-Business within 3000 large construction organisations. The results found that 45.83% has started up the e-Business implementation, but the successful implementation rate is only 4.62%. Most organisations are still struggling to set up a leading management team to organise and support e-Business. The survey also found that the usage of internet and intranet to improve communication is relatively high. 83% organisations have internet and 57.01% have intranet. However, the IT investment rate is very low, between 0.05% - 0.5% of annual revenue, most are prefer to invest hardware rather than software and training. Based on the survey, MOHURD (2011) launched '*An outline of 2011-2015 Construction industry IT development*'. The outline set up overarching targets: within next five year the construction industry need to widespread information technology system in the construction industry and speed up the adoption of BIM, improve the usage of web-based collaborative work and the industrialized software development which has proprietary intellectual property right. Moreover, a new evaluation criterion standard of construction enterprise informationization was launched in May, 2012 by MOHURD.

5. CASE STUDY

Above section describes the e-business implementation in China construction industry and the central government's policies. It shows China has a large construction industry, but the adoption rate of e-Business is relative low. On the other hand, it is also necessary to review construction relevant IT development progress in China from the market perspective.

The IT Company used for the case study is one of the best construction related software service companies in China. The company established in 1998, it has developed from single budget software to more than 30 products of four main businesses areas: quantity and cost management software; web based project management network; e-tendering network platform and education training & consultancy. Its products have been extensively applied through the whole life cycle of construction process from design, construction, audit, consultancy, supervision and real estate development. Their software has been employed in some famous projects include Beijing Olympics Stadium: Bird Nest, China's National Grand Theatre, etc. Currently, the company has established over 30 branches, 3 agents and 4 affiliated companies with over 1000 employees, it has over 60,000 company customers and about 280,000 end users and occupies 54% of total market share. Its pricing software is the industrial norm and gradually becomes the standard. The revenue in 2009 is 308 million Yuan (about 44 million US \$) and the net profit is 105 million Yuan in 2010 (about 15 million US \$). The company has been successfully listed in the stock market and has become the first construction IT Company in the stock market. Furthermore,

the company has launched its quantity surveying software English version in Singapore in 2011 and entered the international construction IT market.

Table 2 listed all products and examines their maturity level. This table shows variety of IT products and services and covered most of all type of e-business activities which are shown in figure 1. Moreover, some advanced e-business activities such as e-tendering and BIM are all have similar products in China, which demonstrates China is on the similar development progress of e-Business as other countries. Through the interviews the company directors demonstrates a strong belief in the e-Business market in China Construction Industry and it will have rapid growth in next ten year, as the interviewee states:

“We are the largest construction related IT service company (in China), last year our net profit is over 100 million Yuan and it is almost double this year (2011). Our technologies are actually advanced in the world; we applied BIM to our quantity pricing software 5 years ago.”

“China construction industry is a massive market for IT, it has a big potential, and it is estimated to expand 20-30 times of current market within 10 years.”

The cost of IT investment in China is lower than other developed countries such as UK or USA, etc., but even so the investment in IT is still extremely low, and this approved the China e-business survey results discussed above. Another key barrier is highlighted by the interviewee is that the attitude of staff, they are less educated or in middle age, are not willing to change or learn new technology and knowledge.

“The cost of our software is actually very low, comparing to western countries, only 10% of their price, even lower, however, in China, companies don’t want to pay money for IT”. “The benefits is vital and very clear, use of our software could help companies save lots of money and time, our business are good very quick in last 3 years, because the government policies supports; The main problem is IT training, most of staff in construction companies are now over 30s and they are less educated and not willing to learn new technologies.”

Table 2: the products in the IT Company

Business	Description	Product/Service	Maturity Level
Quantification	Graphic Calculation	Software	Mature
	Building Quantity	Software	Mature
	Reinforcing Bar Calculation	Software	Mature
	Quantity Surveying (English Version)	Software	Test Stage
	Building Installation	Software	Mature
	Petrochemical industry	Software	Early stage
	Piling Engineering	Software	Early stage

	Steelworks	Software	Early stage
Cost and Financial Management	Bill of Quantity Pricing	Software	Mature
	Cost Management	Software	Mature
	Financial Audit	Software	Mature
Project Management	Cost based project management	Software	Mature
	Project Management Information Solution	Online Service	Test Stage
	Web-based project collaboration	Online Service	Mature
Design	CAD	Software	Mature
	BIM	Software	Early Stage
Tendering	Material Price Information Platform	website	Mature
	Construction Work Bidding Network	Online Service	Early Stage
	SAAS	Online Service	Early Stage
Administration and Management	ERP	software	Mature

(Maturity level: 1) Early stage: product is under research and development; 2) Test stage: products are under market test or bespoke for client; 3) Mature: the produce is on the market or on the upgrading stage.)

6. DISCUSSION AND CONCLUSION

The emergence of e-business has revolutionized the way in which companies conduct business. There are numerous benefits to construction sector, for example, use of website to promote service and product, online project management collaboration or e-procurement/tendering through search engines and web directories, these benefits will not only help improve construction processes and performance but also the organizational performance. Construction organisations are motivated that e-Business could improve their business revenue growth and improve the business process efficiency; however, they fear that the return on investment (ROI) is not directly proportional to the initial cost of investment. This has severely caused the slower uptake of e-Business business in many countries. The advent of e-Business development in Chinese Construction Industry is very recent; hence the adoption rate is still relatively low compared to developed countries. One of main barrier is the nature of low-profit sector which limit the construction firms to put extra investment in IT facilities and equipments. Other barriers include: lack of senior management support, the fear of return on investment and resistance of change. Moreover, the IT training is also lacking in the current market. This study identified that training is critical for the future implementation and the readiness in construction organisations. Currently China construction industry is facing a transition stage, the high speed

growth of the industry provides a massive potential for e-Business. The central government is pushing hard to implement the use of e-Business in organisation by using clear guidance and standards for the construction industry. On the technical side, the IT services are rapidly growing and exploiting international market. Many IT products and services are already used for a number of years and the research and development of new e-business activities such as BIM and e-tendering platform are undertaking. The government pushes and the market pull stimulate the uptake of e-Business in China construction industry. However, to avoid the barriers, China construction industry need more focus on the challenges from the inside of construction organisation. Construction organisation need align the implementation of e-Business with their strategic business objectives and balance the investment and return rate.

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