

E-READINESS IN IBS COMPONENTS MANAGEMENT FOR CONSTRUCTION PROJECTS

Peniel Ang Soon Ern

*¹Faculty of Technology Management Business and Entrepreneurship
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja - Batu Pahat
peniel.ang@gmail.com*

Dr Narimah Binti Kasim

*²Faculty of Technology Management Business and Entrepreneurship
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja - Batu Pahat
narimah@uthm.edu.my*

Abstract

Construction materials usually constitute a major portion of the total cost in a building construction project, which makes the control of this resource important. Despite the potential benefit of Information and Communication Technology (ICT), convincing construction organisations to embrace its use and implementation has proved a difficult task. This paper aims to present a review of the existing literature on e-readiness (ICT uptake) in Industrialised Building System (IBS) components management in construction projects. Consequently, the analysis is conducted by reviewing and then justifying the findings from the literature. Previous research found that ICT has brought about a competitive advantage to the IBS construction industry from the global perspective. However, the e-readiness in Malaysia is rather low. Thus, there is a great opportunity for the future development of more effective frameworks to encourage e-readiness in the IBS construction field.

Keywords: Construction projects, IBS, E-Readiness, ICT

1 Introduction

IBS Roadmap 2003-2010 in Malaysia has defined IBS as a construction technique in which components are manufactured in a controlled environment (on or off site), transported, positioned and assembled into a structure with minimal additional site works (IBS Roadmap, 2003). The endorsement of IBS Roadmap 2003-2010 in Malaysia by the Malaysian Parliament on 29th October 2003 expressed the importance and urgency of IBS implementation in Malaysia. Nevertheless, the government of Malaysia considers that the usage of IBS is low despite the potential advantages. From the survey conducted by CIDB of Malaysia in 2003, the usage level of IBS in local construction industry stands at only 15% (IBS Survey, 2003). Consequently, rectification step was taken with the government mandate which states that from year 2008, all government infrastructure projects should be at least 70% IBS-based (IBS components usage not less than 70%). However, notwithstanding this progress, a number of barriers were identified as being potential hurdles to the IBS implementation. A study by Hamid *et al.* (2008) observed lack of R&D, low IT adoption and limited technology availability have generally discourage IBS take up in Malaysia.

The terminology of e-readiness can be defined “as a measure of the degree to which a country, nation or economy may be ready, prepared, or willing to obtain benefits which arise from the digital economy”. An alternative question in the context of this paper is “*how ready is my organisation to adopt ICT in the IBS components management?*” (Lou, 2009). This paper aims to present the extent of ICT tools being implemented, the challenges of ICT implementation in IBS applications and what has been done to improve the low e-readiness in IBS management.

Eichert & Kazi (2007) and Hervas & Ruiz (2007) pointed out that IT improve tendering, planning, monitoring, distribution, logistic and cost comparison process by establishing collaborative design integration, accurate data and effective dealing with project documents. Besides that, Lessing *et al.* (2005), Eichert & Kazi (2007), CIDB (2003), Hervas (2007) suggested the utilization of IT in IBS projects to support integration, provide accurate data, help customers in selection process, distribution and logistics, and cost comparison.

However, one of the Critical Success Factors (CSFs) identified for contractors to embrace in IBS construction is the issue of IT reception (E-Readiness). Putting this argument into perspective, the transformation from conventional to IBS required tremendous focus to several critical areas which are important to achieve a transformation goal and at the same time gain benefit and profit from it. It is found that one of major the drawback to IT implementation is higher initial cost. Moreover, the development and implementation of the system required which eventually discouraged some contractors due to the cost issues (Abderrahim *et al.*, 2008)

More sophisticated solutions of ICT based technologies are emerging such as wireless communication, bar-coding and Radio Frequency Identification (RFID) for tagging technologies. Even though many construction firms well notice the importance of effective materials management, today’s practice in materials management decisions still tend to be ad hoc and intuitive not based on the data, resulting in process delays. There is ample evidence that ICT has failed to bring about a competitive advantage to organisations in spite of the large investments over the past decade, and a large percentage of systems have failed to achieve their intended business objectives. Recent studies in the area of ‘IT failure’ have shown that 75% of IT investments did not meet their performance objectives (Alshawi, 2007).

All in all, e-readiness (ICT uptake) at the organisational level is still in its infancy. Hence, there is a need to study on the e-readiness of Malaysian IBS construction players in the management of IBS materials and provide a possible way out to encourage ICT take-up in their projects.

2 E-Readiness In IBS Components Management: Global Perspective

The precast industry is a management-intensive industry. Instant acquisition of management information from the utilization of a mobilized information system could be a critical factor in enhancing industry competitiveness. Thus, ICT tools are essential to the precast management system to address these issues surrounding the policy-makers' instant acquisition of management information, the convenience of allowing frontline employees to enter information, and the set-up of information categories according to a user's job properties are the important concepts for the development of this system.

Since the world is moving towards 4D technology in construction, the adoption of 3D CAD within an IBS design mode is one approach in continuing enhancement of current management processes and methods to encourage adoption of IBS among the design professionals. As compared to traditional method, IT in IBS projects covers wide and extensive range of processes, for example in customer interfacing, design, production, monitoring and integration.

Automation in the European construction industry started years ago. Today, the European prefabrication industry uses platform-based and system-based mass customisation – especially for the provision of wall

and ceiling elements. An almost complete digital chain – using computer integrated manufacturing (CIM) from the very early planning stage through to manufacturing – is state of the art within the timber construction in Switzerland as well. Meanwhile, digital chain such as BIM is developing further. BIM will change the traditional planning process significantly, and perfectly enhances the mass customisation approach to manufacturing individual client solutions. By contrast, the Swiss precast concrete industry is making very little use of the ICT and automation possibilities that are available today (Girmscheid and Rinas, 2010).

Below are some examples of the latest ICT sophisticated tools that are incorporated in the management of IBS components at the global angle.

i. BIM (Building Information Model)

Findings showed that BIM, a 3D modelling software is able to resolve many technical difficulties in the precast construction processes. For instance, with the adoption of BIM in the precast concrete industry, engineering cost are reduced, cost of rework due to errors are tremendously reduced as well (Sacks *et al.*, 2005). In addition, there is a drastic reduction in engineering lead time and support for automation in production.

Reliance on paper-based production practices in the design and construction process causes mis-coordination and inefficiencies inherent to that medium . Thus, Virtual Prototyping helps project teams to better manage risk. All aspects of the project are modelled in the computer first. Coordination issues are identified and addressed there. Fully automated computer-controlled machines working directly from the BIM process results in fabrication efficiency and improved quality (Riese, 2011).

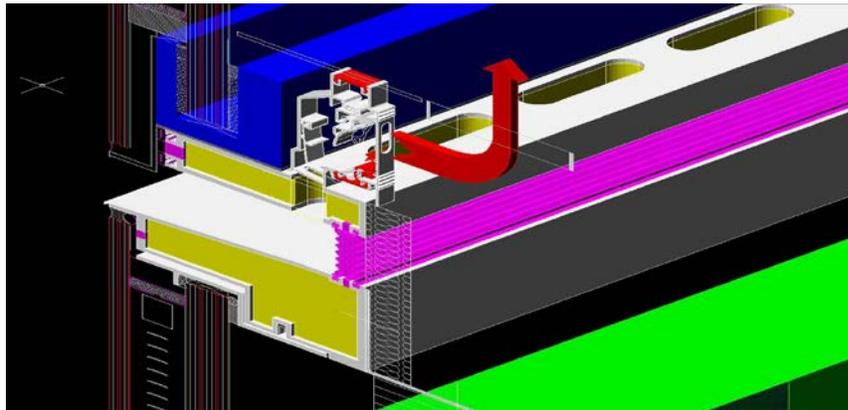


Figure 1: BIM is used throughout the design, delivery and lifecycle of the project to manage coordination down to fabrication level (Riese, 2011)



Figure 2: Building elements of all scales and complexities are fabricated from the BIM process at precast factories in China (Girmscheid, 2011)

ii. RFID (Radio Frequency Identification)

Radio Frequency Identification (RFID) is an advanced Automatic Identification (Auto-ID) system made up of radio tags (transponders) that collect and transmit information through a reader or scanner, by Radio Frequency (RF), to a host computer for processing. RFID can be viewed as a progression from barcode technology, enabling automation to further increase labour productivity (RFID Centre, 2005). This high impact has given RFID systems wide acceptance in various sectors worldwide, especially in the tracking of goods and assets.

The RFID tag and reader is used to collect the information, and then transmit the multifaceted, mobilized information such as the production quantity, the materials quantity, quality control inspection and inventory and transportation management information. Figure 1.0 is an example of RFID application in a precast production management system.

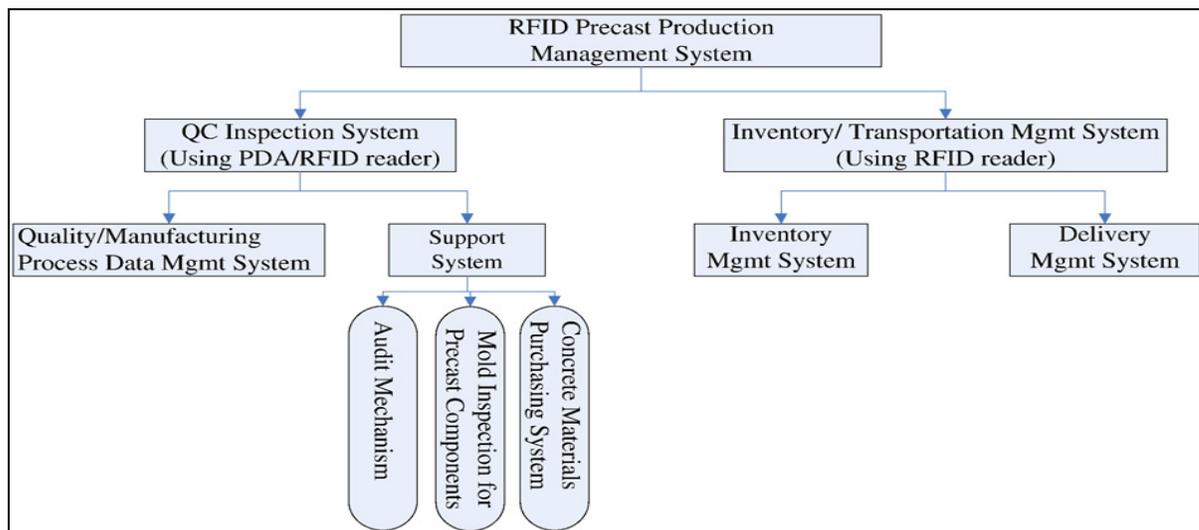


Figure 3: RFID application in a precast production management system (Yin *et al.*, 2009)

iii. RFID and Global Positioning System (GPS)

Ergen, Akinci, and Sacks (2007) investigated the feasibility of utilizing RFID and GPS to track and locate components in a precast storage yard. Song (2005) and Torrent (2006) both proposed a system that combined RFID tags, a mobile RFID reader equipped with GPS and proximity techniques to track the location of construction resources automatically. Though this method is not directly involved with the evaluation of project progress, these systems provide real-time data for the approximate locations of construction materials, proving that proximity techniques can be used efficiently to locate material.

iv. **RFID and 4D CAD**

Chin (2005) proposed integrating RFID technology with 4D CAD to improve progress management. The system is web-based and utilizes a reusable card-type and read-only RFID with a magnet. To monitor each step of the construction progress from “manufactured,” “shipped,” “received,” and “erection” (detached and scanned), the tag is scanned in each phase of the supply chain to identify the precast component, the retrieved relevant information and its progress status and other information (Chin, 2005).

v. **Automation in Prefabrication (Robotic)**

The efficient prefabrication of individual elements in industrialised countries requires higher automation. Therefore, automation is the most important issue concerning cost efficiency and quality in industrialised countries. Automation in construction concerns especially prefabrication in plant since the tools for on-site automation and robotics are still at the beginning of beneficial application (Girmscheid and Rinas, 2010).

Prefabrication’s renaissance:

- Formwork robot for paint coatings
- Automated reinforced cage production
- Automated concrete distributor
- Automated surface smoothing trowels



Figure 4: Reinforcement Cage – Welding & Assembling Robot (Girmscheid, 2011)



Figure 5: Formwork robot – Placing Side Forms (Girmscheid, 2011)

The application of technology in the international construction level is developing rapidly. Nevertheless, there is a rising concern on the uptake of technology use and its area of sophistication in which we should study. Hence, the following section elaborates in the e-readiness for IBS components management in Malaysia.

3 Malaysia's Shortcomings in ICT Implementation (E-Readiness)

Generally, Malaysia's ICT sector faces funding problems especially at the seed or pioneer level. Implementation of ICT could not further take place as local venture capital firms could not afford the high risk. They instead tend to focus on the need to be profitable within 12 months in order to gain back their seed money in a short period.

Result from a recent study in Malaysia called for future initiatives in the implementation of normal and sophisticated ICT tools in materials management despite the fact that there was just an average level of acceptance. It was gathered that the main reasons of resistance towards the increased level of implementing ICT in materials management are due to the high cost involvement whether in the maintenance or overall implementation. In addition, the exceptional high cost of specialist software was also a barrier to the upgrading of ICT implementation (Ang, 2009).

In addition, an interview conducted with Construction Research Institute of Malaysia (CREAM) has emphasised a stagnancy in the progress of ICT adoption throughout the construction industry for the past whole decade (Hamid, 2010). Thus, among the recommendations proposed by the researchers to overcome the barriers is to improve ICT adoption amongst the construction players. In addition, Information Technology is identified as one of the critical success factor (CSFs) to achieve a transformation goal for IBS and at the same time gain benefit and profit from it (Kamar *et al.*, 2009). It is therefore more visible that the government authorities are putting more emphasis to encourage readiness among construction players to adopt ICT.

4 What has been done to overcome the low E-Readiness?

There is a strong argument that the organisations need to adopt a 'measured approach' in order to help them be 'e-ready' – the rubrics of which could be augmented through some form of a practical framework which allows them to measure their e-readiness.

In the framework of the Construction Industry Master Plan (CIMP 2006-2015), there was 7 strategic plans posted by the government to alleviate the condition of the construction industry in Malaysia. ICT is identified as one of the 7 Strategic Thrust to contribute to the betterment of the industry. The increased

leverage of ICT is believed to be able to permeate various industries and is seen as a major drive for improvement in performance and cost efficiency. Among the recommendations are knowledge sharing (information portal) for continuous improvement and to develop a local construction software industry. In order to create a user friendly construction knowledge and information portal for all stakeholders, E-Construction is updated regularly to collate the information effectively. Besides that, a local construction software industry is developed with a few upcoming frameworks such as (CIMP, 2007):

- a) Promoting the use of technology in the construction community
- b) IT Strategy Plan for the construction sector (currently drafted)
- c) Online tendering system (currently being developed)
- d) Leveraging the MSC incentives to develop the software industry

Unfortunately, the latest developed IBS Roadmap 2010-2015 did not emphasise on the issue of ICT. Out of the 36 recommendations, only 2 recommendations showed a slight support in encouraging ICT adoption. They are:

Recommendation 32: Support rapid transformation of IBS manufacturers with potential for innovation by facilitating financial and technical support for IBS manufacturer in innovative and technologically advanced areas, to encourage R&D

Recommendation 35: Enhancing existing CIDB e-portal to include an electronic IBS Marketplace for Matching Demand to Suppliers of IBS components.

Judging from the recommendations above, an obvious gap is discovered which hints that E-readiness framework has only been developed for the general benefit of the construction industry, but not in a great emphasis for the IBS components management as per say. There is a clear lack in the development of framework to tackle the E-Readiness issue in the Malaysia's construction industry. Even though there are some efforts initiated by the latest CIMP 2006-2015, but nothing much has been done to relieve the e-readiness issue in IBS materials management, in specific.

5 The Way Forward

All in all, it is shown that though ICT seems to offer a very good bargain in achieving productivity, many firms are still reserved in fully employing ICT in their projects. E-readiness as a global agenda is not entirely a new proposition, but e-readiness at the organisational level is still in its infancy. The research studied on the e-readiness in IBS materials management. It is evident of a great potential in incorporating ICT in the IBS materials management processes in the construction field. At the same time, a great deal of hindrances inhibiting for the maximum implementation of ICT still surfaces. Thus, the framework output of this research is deemed beneficial to the body of knowledge as well as the industry as a booster to maximise the potential of ICT and to reap the utmost effectiveness in materials management.

6 References

- Abderrahim, M., Diez, R., Boudjabeur, S., Navarro-Suñer, J. M. and Balaguer, M (2005) An IT Infrastructure and safe collaboration in modern construction site, *22nd International Symposium on Automation and Robotics in Construction ISARC 2006*- September 11-14, 2005, Ferrara (Italy)
- Alshawi, A. (2007), *Rethinking IT in Construction and Engineering : Organisational Readiness*, Taylor and Francis, UK.
- Ang, P. (2009) *Implementation of ICT in Materials Management in Construction Projects*. Degree Thesis, Department of Real Estate and Construction. University Tun Hussein Onn Malaysia. "unpublished"

- CIMP (2007) Construction Industry Master Plan 2006 – 2015 (CIMP 2006 – 2015), Construction Industry Development Board Malaysia (CIDB), December 2007, Kuala Lumpur
- CIMP (2007) Construction Industry Master Plan 2006 – 2015 (CIMP 2006 – 2015), Construction Industry Development Board Malaysia (CIDB), December 2007, Kuala Lumpur
- Construction: People and Process Issues”, *Journal of Information Technology in Construction*
- Eichert, J., Kazi, A. S. (2007) Vision and Strategy of Manubuild- Open Building Manufacturing (edited by) Kazi, A. S., Hannus, M., Boudjabeur, S., Malone, A. (2007), Open Building Manufacturing – Core Concept and Industrial Requirement’, Manubuild Consortium and VTT Finland Publication, Finland
- Ergen, E., Akinci, B., and Sacks, R. (2007). “Tracking and locating components in a precast storage yard utilizing radio frequency identification technology and GPS.” *Automation in Construction*. 16(2007), 354-367
- Girmscheid, G. and Rinas, T. (2010) “Cooperation Model for Mass Customised Products in Swiss Construction”, Proceedings of First International Conference on Sustainable Urbanisation, 15-17 December 2010, Hong Kong, China.
- Girmscheid, G. (2011). “New Perspective of Industrialisation In Construction,” presented at the *Malaysia IBS International Exhibition (MIIE)*, sponsored by Construction Industry Development Board (CIDB), Kuala Lumpur, Malaysia.
- Hamid, Z., Kamar, K. A. M., Zain, M., Ghani, K., Rahim, A. H. A. (2008) Industrialized Building System (IBS) in Malaysia: the current state and R&D initiatives, *Malaysia Construction Research Journal*, Vol. 2 (1), pp 1-13
- Hervas, F. C., Ruiz, M. I. V. (2007) Stakeholders Requirement for Open Building manufacturing (edited by) Kazi, A. S., Hannus, M., Boudjabeur, S., Malone, A. (2007), Open Building Manufacturing – Core Concept and Industrial Requirement’, Manubuild Consortium and VTT Finland Publication, Finland
- IBS Roadmap (2003-2010) (2003) Construction Industry Development Board (CIDB), Kuala Lumpur
- IBS Survey 2003 (2003), Construction Industry Development Board Malaysia (CIDB), Kuala Lumpur
- Kamar, K. A. M., Alshawi, M. and Hamid, Z. (2009). Industrialised Building System: The Critical Success Factors. *Paper Proceedings In BuHu 9th International Postgraduate Research Conference (IPGRC)* (Eds, Alshawi, M., Ahmed, V., Egbu, C. and Sutrisna, M.) Salford, United Kingdom, 29-30 January 2009
- Lessing, J., Ekholm, A. and Stehn, L. (2005) Industrialized Housing – Definition and Loughborough: European Construction Institute
- Lou, E.C.W., Goulding, J.S., Alshawi, M., (2008), “Global eReadiness – The alignment of National Policies to Organisational Strategies”, *8th BuHu International Postgraduate Research Conference (IPGRC)*, Prague, Czech Republic, June 2008, 135 – 145.
- RFID Centre, (2005) Introduction to RFID [online] Available from: <http://www.rfidc.com> [Accessed 25 February 2009]
- Riese, M. (2011). “Business Value of Building Information Modelling (BIM) In IBS Construction,” presented at the *Malaysia IBS International Exhibition (MIIE)*, sponsored by Construction Industry Development Board (CIDB), Kuala Lumpur, Malaysia.
- Sacks, R., Eastman, C. M., Lee, G., and Orndorff, D. (2005a). "A Target Benchmark of the Impact of Three-dimensional Parametric Modeling in Precast Construction." *Journal of the Precast/Prestressed Concrete Institute*, 50(4), 126-139.
- Song, J. (2005). “Tracking the location of materials on construction projects.” Ph.D. dissertation, Univ. of Texas at Austin, Austin, Tex.
- Torrent D. G. and Caldas C. H. (2007). "Field experiments of an automated materials identification and localization model," presented at the *ASCE International Conference on Computing in Civil Engineering*, Sponsored By Technical Council on Computing & Information Technology of the American Society of Civil Engineers), Pittsburgh, Pennsylvania, USA.
- Yin, Y.L., Tserng, H. P. , Wang, J.C. , Tsai, S.C. (2009). “Developing a precast production management system using RFID technology.” *Automation in Construction* (18) 677–691