CLIENT PERSPECTIVE TOWARDS APPLICATION OF INDUSTRIALISED BUILDING SYSTEM IN PRIVATE CONSTRUCTION PROJECTS

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Specially dedicated to all precious people around me, especially:

The greatest parents in the world, Abah, Suraji bin Adnan, and Mak, Zuntihana binti Haji Dawam, and both my parents-in-law. And most of all I devote this to my beloved husband, Mohd. Fairuz bin Abu Kaslan, my future kids, and to all my family members and friends.

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ABSTRACT

Industrialised Building System (IBS) is well known in many developed countries due to the benefits that can be derived from its applications in construction projects. However, the low percentage of IBS usage may be due to lack of awareness and knowledge about IBS among many professionals, also there may be factors that contribute to lack of interest from the client towards IBS. The aim of this study is to improve the application of IBS, particularly in private construction projects in Malaysia by determining the current application of IBS in private construction projects, client perspective towards IBS application, and to propose the framework of success criteria for IBS adoption in private projects. In order to achieve these objectives, questionnaire survey and interview have been conducted. The developers were selected from Real Estate and Housing Developers Association (REHDA) website as the sample of respondents. The result indicates that, out of 35 responses, only 16 respondents (46 percent) stated their company has applied IBS in their construction projects, and only 12 respondents (34 percent) have been involved in IBS projects. Out of those 12 respondents, 9 respondents (75 percent) revealed they were satisfied with the performance of IBS projects based on their own experience. In general, respondents indicated high agreement on the identified IBS benefits, the factors of low application of IBS in private construction projects, and the success criteria to improve the IBS application. In the final part of the study, a framework of success criteria relationship for IBS adoption in private projects has been developed.

ABSTRAK

Sistem Pembinaan Berindustri (IBS) terkenal di banyak negara-negara membangun kerana manfaat yang boleh diperolehi daripada pengaplikasiannya di dalam projek-projek pembinaan. Walau bagaimanapun, peratusan penggunaan IBS yang rendah mungkin disebabkan oleh kurangnya kesedaran dan pengetahuan mengenai IBS di kalangan ramai profesional, juga mungkin ada faktor-faktor yang menyebabkan klien kurang berminat terhadap IBS. Matlamat kajian ini adalah untuk meningkatkan penggunaan IBS terutamanya dalam projek-projek pembinaan swasta di Malaysia dengan menentukan pengaplikasian semasa IBS dalam projek-projek pembinaan swasta, menentukan perspektif klien terhadap pengaplikasian IBS, dan untuk mencadangkan rangka kerja kriteria kejayaan penggunaan IBS dalam projek-projek swasta. Dalam usaha untuk mencapai objektif-objektif ini, kaji selidik dan temu bual telah dijalankan. Pemaju telah dipilih daripada laman web *Real Estate and Housing Developers Association* (REHDA) sebagai sampel responden. Hasil kajian menunjukkan bahawa, daripada 35 maklum balas, hanya 16 responden (46 peratus) menyatakan syarikat mereka telah menggunakan IBS dalam projek pembinaan mereka, dan hanya 12 responden (34 peratus) pernah terlibat dalam projek-projek IBS. Daripada 12 responden tersebut, 9 responden (75 peratus) menyatakan bahawa mereka berpuas hati dengan prestasi projek-projek IBS berdasarkan pengalaman mereka sendiri. Secara amnya, responden menyatakan persetujuan yang tinggi terhadap manfaat IBS yang telah dikenalpasti, faktor-faktor pengaplikasian IBS yang rendah di dalam projek pembinaan swasta, dan kriteria kejayaan untuk meningkatkan pengaplikasian IBS. Dalam bahagian akhir kajian ini, sebuah rangka kerja hubungan kriteria kejayaan bagi penggunaan IBS dalam projek-projek swasta telah dibangunkan.

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LIST OF ABBREVIATIONS

BAM	-	Board of Architects Malaysia
BEM	-	Board of Engineers Malaysia
BEST	-	Behavioural-Environment Strategy -Technology
CIDB	-	Construction Industry Development Board
CIMP	-	Construction Industry Master Plan
CREAM	-	Construction Research Institute of Malaysia
CSFs	-	Critical Success Factors
IBS	-	Industrialised Building System
ICT	-	Information and Communication Technology
ICU	-	Implementation Coordination Unit
IT	-	Information Technology
JKR	-	Jabatan Kerja Raya
KPI	-	Key Performance Indicators
MC	-	Modular Coordination
MMC	-	Modern Method of Construction
OSM	-	Off-Site Manufacturing
PDM	-	Psychology Decision Making
R&D	-	Research and Development
REHDA	-	Real Estate and Housing Developers Association
SPSS	-	Statistical Package for Social Science

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CHAPTER 1

INTRODUCTION

1.1 Background

Industrialised Building System (IBS) has been well-known in many developed countries as it produces high-quality construction, lower total construction cost, shorten the construction period, reduces dependence on foreign labour, reduces on-site construction works, reduces waste building materials, maintains the cleanliness and improves safety on construction sites, easier to control, reduces rectification work, as well as leads to the construction of a sustainable environment. As a developing country, practicing IBS in Malaysian construction industry should be an opportunity and one of our initiatives to put the construction industry at a better level. It is because by applying IBS, it can minimise the problems in the construction industry that always arise when using a conventional method as well as improve the overall performance of the project.

Malaysia had long been aware of this opportunity and has started to apply IBS since the year of 1964. Nawi and Nifa (2007) revealed that the application of IBS in Malaysia began with two government pilot projects. The first construction project using IBS involved the construction of seven blocks of 17 storey flats, and four blocks of 4-storey shop lots that executed at Jalan Pekeliling, Kuala Lumpur (Thanoon, *et al.*, 2003). The second pilot project was executed in Pulau Pinang, which encompassed the construction of six blocks of 17 storey flats and 33 blocks of

18 storey flats along Jalan Rifle Range. The project used French Estiot System (Din, 1984).

In fact, Malaysia nowadays is successfully applied IBS in the construction of national landmark buildings such as the Bukit Jalil Sports Complex, Kuala Lumpur Light Rail Transit Station, Kuala Lumpur Central, Kuala Lumpur International Airport (KLIA), the PETRONAS Twin Towers and Kuala Lumpur Tower. Construction Industry Development Board (CIDB) has also played very important roles in the efforts to promote the use of IBS in construction projects in Malaysia to carry out various several on IBS, develop standards and conduct various training, workshops and promotional programs.

Although the history of the application and use of IBS in Malaysia has started over 40 years ago, until now, there are still numerous issues that have yet to be overcome. In fact, IBS still not been well accepted by all stakeholders in the Malaysian construction industry when its application seems still low. Based on the CIDB IBS Survey in 2003, only 15% of construction projects in Malaysia apply IBS. In addition, the IBS Mid Term Review in 2007 indicated that approximately only 10% of the completed projects used IBS in the year 2006 as compared the forecasting of IBS usage by 50% in 2006 and 70% in the year 2008 as projected in the IBS roadmap conducted by CIDB (Hamid *et al.*, 2008).

Based on many previous studies that have been conducted, it is believed the percentage of low usage of IBS is due to lack of awareness and knowledge about IBS among many professionals in the construction industry in Malaysia, as well as resistance, barriers and other negative issues that have limited the development of the use of IBS in Malaysia. According to Hassim *et al.* (2009), IBS in Malaysia is not well accepted by the construction stakeholders due to failure to address the risks in the IBS projects adequately. It probably contributes to the doubt of professionals to implement IBS in construction projects in Malaysia, especially when there is no policy or even insistence to implement it.

Recognising this, the government has taken another step to try to encourage the growth of IBS application by urging the use of IBS in all government construction projects. Through the policy issued in 2008, the government invited and insists the new project to apply IBS by using an open system and demand the content of IBS components until 70% (IBS score) in all government projects. Further, according to Kamar *et al.* (2010), from 2006 to 2010, in approximate of 320 government's projects worth RM9.43 billion has recognised were carried out by applying IBS. It shows that IBS usage has evolved, but still at an unsatisfactory level.

Further, with the government enforcement on the application of IBS, it is hoped that construction stakeholders begin to plan strategies to ensure they contribute to increase the use of the IBS in construction projects as well as the successful implementation, thus able to experience the benefits of IBS in advancing the technology, productivity and performance of Malaysian construction industry.

1.2 Problem Statement

The role of government in developing the policy to achieve the satisfactory level of IBS implementation has contributed significant impact on the IBS issues (Abdullah and Egbu, 2010a). In general, since government enforced the policy that encourages all the stakeholders of Malaysian construction industry to improve the implementation until 70% of IBS components in all government projects, it seems yielded the positive result.

The critical success factors (CSFs) for the application of IBS,, especially in government construction projects are studied, and its implementation is being improved from time to time. The related problems in construction projects which adopt IBS also evaluated and attempted to be resolved to enhance the value of IBS projects. This is to ensure that the projects achieve the targeted objectives, especially increase the productivity and improving the performance of the project itself. However, the implementation of IBS in private projects seems still far behind. In

general, the current studies indicate that the applications of IBS in private construction projects are still at a low level.

Based on the pre-interview conducted with Ir. Dr. Kamarul Anuar Mohamad Kamar, Manager at Construction Research Institute of Malaysia (CREAM), which a research arm of CIDB, he stated that "*Based on observation and workshops conducted by CIDB, the implementation of IBS in private construction projects is still quite low. However, there are no specific data to confirm this information; it is still in the observation and evaluation in our study."*

Kamar *et al.* (2009) revealed that one of the barriers to IBS implementation in Malaysia is awareness and knowledge among professionals about IBS. According to IBS Roadmap Review (2007) report, the adoption of IBS in Malaysia is a client driven. However, lack of the awareness program to understand the client needs and giving correct information on IBS has been contributing to a lack of interest from the client and decision makers (Rahman and Omar, 2006).

Therefore, knowledge of IBS should actually overrun by all the stakeholders involved in a construction project. Not only contractors who will certainly run the project, but widespread and deep knowledge by other stakeholders and professionals, including the client, the architects and engineers are also very important to ensure the implementation of IBS in a construction project is successful in achieving its objectives. In fact, the client can play vital roles when they really understand the concept, method, technique as well as the critical success factors of this system. They can influence the percentage of IBS usage in construction projects in Malaysia. However, many of the professionals, particularly client, they still lack of knowledge about the concept and method of IBS, and how they can contribute to the success of the project. Consequently, the clients are reluctant to adopt IBS, particularly in private construction projects.

1.3 Aims and Objectives of the Study

The aim of this research is to improve the application of Industrialised Building System (IBS) particularly in private construction projects in Malaysia. In order to achieve the aim of the study, the objectives of this study are as follows:

a) To determine the current application of IBS in private construction projects.

b) To determine the client perspective towards the application of IBS in private construction projects.

c) To propose the framework for success criteria in improving the application of IBS in private construction projects.

1.4 Scope of the Study and Limitations

In order to achieve the objectives of the study, the research only focusing on the perspective towards application of IBS in private construction projects in Malaysia. This is because it is believed that government construction projects have advanced a step further when they have a fairly strong support from the enforcement of government policy on the application of IBS in each government construction project. Therefore, this study intended to focus on private construction projects only.

In addition, data collection for this study is from the respondents to the questionnaire which they are among the housing developers only. This is intended to get a holistic view of the client where they are the key drivers for the development of a construction project in Malaysia.

The analysis and conclusion are based on respondent's overview from the questionnaire that designed for this study only. The analysis results probably do not represent the whole overview of Malaysian construction industry. Nevertheless, it is

expected can help provide insight and views as well as knowledge about the current application of IBS in private construction projects, thus helping to formulate appropriate strategies for the successful implementation of IBS, especially in private construction projects.

1.5 Significance of the Study

This study is important to find out the percentage and study the current application of IBS in private construction projects in Malaysia. According to Azman *et al.* (2010), this is a challenge which construction players need a 'step change' in construction method and process to overcome the poor-quality construction and low productivity, at the same time need to meet the growth in demand. This is to enable us to enhance strategies on how to better promote the implementation of IBS in private construction projects other than the government enforcement, research, and standards development has so far been implemented.

In addition, this study is to determine the client's perspective on the use and implementation of IBS in private construction projects to determine the extent of their awareness and knowledge of the IBS. Their thoughts and knowledge contribution is very important for the more encouraging, supporting and driving the implementation of IBS in Malaysian construction projects and not just rely on the roles and obligation undertaken by other professionals only. This is important for planning strategies so that clients can also play important roles in promoting the use of IBS in private construction projects apart of contribute in ensuring the successful implementation of IBS.

REFERENCES

A. Idrus, N.F.K. Hui and C. Utomo (2008). *Perception of Industrialised Building System (IBS) within the Malaysian Market.* International Conference of Construction and Building Technology (ICCBT) 2008-B-(07)-pp75-92.

Abdullah, M.R. and Egbu, C.O. (2009). *Industrialised Building System in Malaysia: Issues for Research in a Changing Financial and Property Market.* Proceeding of 9th International Postgraduate Research Conference (IPGRC), 29-30th January 2009, Salford Quays, Greater Manchester, UK. 15-25.

Abdullah, M.R. and Egbu, C.O. (2010a). *The Role of Knowledge Management in Improving the Adoption and Implementation Practices of Industrialised Building System (IBS) in Malaysia.* CIB World Congress 2010, 10-13 May 2010, The Lowry, Salford Quays, United Kingdom.

Abdullah, M.R. and Egbu, C.O. (2010b). *Selection Criteria Framework for Choosing Industrialised Building Systems for Housing Projects.* Procs 26th Annual ARCOM Conference, 6-8 September 2010, Leeds, UK, Association of Researchers in Construction Management, 1131-1139.

Badir, Y.F., Kadir, M.R.A. and Hasim, S. (2002). *Industrialised Building System Construction in Malaysia.* Journal of Architechtural Engineering, Vol. 8, No. 1.

Bernama.com (2006). *Local Construction Industry Urged to Use IBS Business.* Bernama.com, Malaysian National News Agency, *http://www.bernama.com/bernama/v3/printable.php?id=185301*.

Bing, L., Kwong, Y.W., and Hao, K.J. (2001). *Seismic Behaviour of Connection between Precast Concrete Beams.* CSE Research Bulletin, No. 14.

Blismass, N., Christine Pasquire and Alistair Gibb (2006). *Benefits evaluation for Off-Site Production in Construction,* Construction Management and Economics (February 2006), 24, 121-30.

Blismas, N. (2007). *Off-site Manufacture in Australia: Current States and Future Directions*. Cooperative Research Centre for Construction Innovation, Brisbane, Australia, pp. 1-37.

BSRIA (1998). *Prefabrication and Preassembly – Applying the Technique to Building Engineering Services in Advance Construction Technique* ACT 1/99 (Ed. Wilson, D.G. Smith, M.H. and Deal, J.) Department of Environment Transport Region (DETR) and the Building Services Research and Information Association (BSRIA).

CIDB (2003). *Industrialised Building Systems (IBS): Roadmap 2003-2010*. Construction Industry Development Board Publication, pp. 1-21, *www.cidb.gov.my/content.php*

CIDB (2004). *Dirty, Difficult and Dangerous? Simplify it Use IBS.* Construction Industry Development Board Publication, pp. 1-8, *www.cidb.gov.my/content.php*

Din, H. (1984). *Industrialised Building and its Application in Malaysia.* Seminar on Prefabrication of Building Construction.

Din M.I., Bahri, N., Dzulkifly, M.A., Norman, M.R., Kamar. K.A.M. and Hamid, Z.A. (2012). *The Adoption of Industrialised Building System (IBS) Construction in Malaysia: The History, Policies, Experiences and Lesson Learned*. Construction Industry Development Board (CIDB) Malaysia.

Eichert, J. and Kazi, A.S. (2007). *Vision and Strategy of Manubuild – Open Building Manufacturing in Open Building Manufacturing – Core Concept and Industrial Requirement* (Ed. Kazi, A.S., Hannus, M., Boudjabeur, S. and Malone, A.) VTT Finland and Manubuild Consortium, pp. 3.

Elliot, K.S. (2003). Off Site Prefabrication of Concrete Structures. Conference Proceeding on Industrialised Building Systems, KL, 10-11 September, 2003, CIDB, pp. 7-19.

Esa, H., and Nurudin, M. M. (1998*). Policy on Industrilased Building System* in Collocoqium, R.O. (Ed.) Kuala Lumpur, CIDB.

Eziyaku, N.O. and Bakar, A.H.A (2011). *The Utilisation of Industrialised Building System in Design Innovation in Construction Industry.* World Applied Science Journal 15(2): 205-213, 2011.

Gardiner and Theobald (2006). *International Construction Cost Survey.* Gardiner and Theobald, London.

Gibb, A.G.F. (1999). *Off-Site Fabrication – Prefabrication and Preassembly.* Whittles Publisher, Glasgow, United Kingdom.

Gibb, A.G.F. and Isack, F. (2003). *Re-Engineering Through Pre-Assembly; Client Expectations and Drivers.* Building Research and Information, 31 (2), 146-60.

Haas, C.T. and Fangerlund, W.R. (2002). *Preliminary Research on Prefabrication, Preassembly, Modularization and Off-site Fabrication in Construction.* Report to the Construction Industry Institute, The University of Texas at Austin, Under the Guidance of the PPMOF Research Team PT 171. The Department of Civil Engineering, University of Texas at Austin, Austin, Texas.

Hamid, Z.A., Kamar, K.A.M., Zain, M.Z.M., Ghani, M.K. and Rahim, A.H.A. (2007). *Industrialised Building System (IBS) in Malaysia: The Current State and R&D Initiatives.* Construction Research Institute of Malaysia (CREAM), Kuala Lumpur, 2007.

Haron, N.A., Hassim, S., Kadir, M.R.A. and Jaafar, M.S. (2005). *Building Cost Comparison Between Conventional and Formwork System.* Jurnal Teknologi, 43(B): 1-11.

Haron, N.A., Rahman, H.A. and Hanid, M. (2009). *A Literature Review of the Advantages and Barriers to the Implementation of Industrialised Building System (IBS) in Construction Industry*. Malaysian Construction research Journal; Vol. 4, No. 1.

Hassim, S., Jaafar, M.S., and Sazali, S.A.A.H., (2009). *The Contractor Perception Towers Industrialised Building System Risk in Construction Projects in Malaysia.* American Journal of Applied Sciences 6 (5): 937-942.

Hong, O.C. (2006). *Analysis of IBS for School Complex.* Universiti Teknologi Malaysia, Master Thesis, 2006.

Housing Forum (2002). *Homing in on Excellence – A Commentary on the Use of Offsite Fabrication (OSF) Methods for the UK Housebuilding Industry.* The Housing Forum, London, 1-79.

Kamar, K.A.M., Alshawi, M. and Hamid, Z. (2009). *Barriers to Industrialised Building System (IBS): The Case of Malaysia.* Paper Proceedings in BuHu, 9th International Postgraduate Research Conference (IPGRC 2009), The University of Salford, 29th -30th January, 2009, Salford, United Kingdom.

Kamar, K.A.M., Hamid, Z.A., and Alshawi, M., (2010). *The Critical Success Factors (CSFs) to the Implementation of Industrialised Building System (IBS) in Malaysia.* Paper proceedings, CIB World Congress, Salford.

Kamar, K.A.M., Hamid, Z.A., Zain, M.Z.M., Rahim, A.H.A., Ghani, K., Azman, M.N.A., Majid, T.A., Ahamas, M.S.S., (2012). *Drivers and Barriers of Industrialised Building System (IBS) Roadmaps in Malaysia.* Malaysian Construction Research Journal, ISSN 1985-3807, Vol. 9 (1).

Lessing, J., Elkholm, A. and Stehn, L. (2005) *Industrialised Housing – Definition and Categorization of the Concept.* 13th International Group for Lean Construction, Australia, Sydney.

M.N.A. Azman, M.S.S. Ahamad, T.A. Majid and M.H. Hanafi (2010). *Perspective of Malaysian Industrialised Building System on the Modern Method of Construction.* The 11th Asia Pacific Industrial Engineering and Management

Systems Conference, The 14th Asia Pacific Regional Meeting of International Foundation for Production Research.

Majid, T.A., Azman, M.N.A., Zakaria, S.A.S., Zaini, S.S., Yahya, A.S., Ahamad, M.S.S. and Hanafi, M.H. (2010). *The Industrialised Building System (IBS) Survey Report 2008 – Educating the Malaysian Construction Industry, 2010.* The International Conference on Applied Physics and Mathematics, (ICAPM 2010).

Malik, N.A.F. (2006). *Supply Chain Management in IBS Industry.* Malaysian International IBS Exhibition (MIIE) 2006 Construction Industry Development Board (CIDB) Malaysia, Kuala Lumpur.

Meiling, J. and Johnson, H. (2008). Feedback in Industrialsed Housing: Wy Does it Not Happen?. Proceeding of 24th Annual ARCOM Conference, 1-3 September, Cardiff, UK, Association of Researchers in Construction Management, 145-154.

Mohamad, M.I., Zawawi, M. and M.A. Nekooie (2009). *Implementing Industrialised Building System (IBS) in Malaysia: Acceptance and Awareness Level, Problems and Strategies.* Malaysian Journal of Civil Engineering 21(2):219-234(2009)

Mole, T. (2001). *Prefabrication in UK Housing: 'Innovation or Déjà vu'*. CEEC/AEEBC Conference Dublin, Ireland 4th-6th October 2001.

Na, L. and Liska, R., W. (2008). *Designers and General Contractors Perception of Offsite Construction Techniques in the United States Construction Industry.* International Journal of Construction Education and Research, 4(3), 177-188.

Nadim, W. and Goulding, J.S. (2009). *Offsite Production in the UK: The Way Forward? A UK Construction Industry Perspective.* Eemerald, Construction Innovation, 10, pp. 181-202.

National Audit Office Report (2005). *Using Modern Method of Construction to Build Homes more Quickly and Efficiently*. National Audit Office (NAO), London, November, 2005.

Nawi, M.N.M. and Nifa, F.A.A. (2007). *A Preliminary Survey of the Application of Industrialised Building System (IBS) in Kedah and Perlis Malaysian Construction Industry.* Conference of Sustainable Building South East Asia, 5-7 November 2007, Malaysia.

Nawi, M.N.M., Lee, A. and Nor, K.M. (2011). *Barriers to Implementation of the Industrialised Building System (IBS) in Malaysia.* The Built and Human Environment Review, Volume 4, 2011.

Neala, R., Price, A. and Suer, W. (1993). *Prefabricated Modules in Construction.* Bourne Press Limited, Bournemouth.

Pan, W., Alistair, G.F. and Andrew, R.J., Dainty (2007). *Perspectives of UK Housebuilders on the Use of Off-Site Modern Method of Construction.* Construction Mangement and Economics (February 2007), 25, 183-194

Pan, W., Gibb, F.A.G. and Dainty, A.R.J (2008). *Leading UK Housebuilders' Utilization of Offsite Construction Methods.* Building Research and Information, 36(1), 56-67.

Pan, W., Gibb, A., Danty, A. R. J. (2008). *Perspectives of UK Housebuilders on the Use of Off-Site Modern Method of Construction.* Construction Management and Economic, 25, 2. 183-194.

Qays, M., Mustapha, K.N., Hashim, A.M. and Mohamed, B.S. (2010). *The Constraints of Industrialised Building System from Stakeholders' Point* of View. ICSE2010 Proceedings 2010, Melaka. Malaysia.

Rahman, A.B., and Omar, W. (2006). *Issues and Challenge in the Implementation of IBS in Malaysia.* 6th Asia Pacific Structural Engineering and Construction Conference (ASPEC 2006), Kuala Lumpur, Malaysia.

Rashid (2009). *Industrialised Building Systems: The JKR Perspectives*. Malaysian Construction Research Journal;Vol 4, No. 1.

Sanderson, G. (2003). *A Strategic Review of the Use of Modern Method of Construction in New-Build and Refurbishment Housing Projects.* Rechard Hodkinson Consultancy Report, October 2003.

Sarja, A. (1996). *Towards Practical Durability Design of Concrete Structures.* Proceedings of 7DBMC, 7th International Conference on Durability of Building Materials and Components, Stockholm, Sweden, E&FN SPON, London, 1238-1247.

Soetanto, R., Dainty, A.R.J., Glass, J., and Price, A.D.F., (2006). *A Framework for Objective Structural Frame Selection.* Structures and Buildings, 159 (SB 1), 45-52.

Thanoon, W.A., Lee, W.P., Kadir, M.R.A., Jaafar, M.S. and Salit. M.S. (2003). *The Experiences of Malaysia and Other Countries in Industrialised Building System.* International Conference on Industrialised Building Systems, Kuala Lumpur, Malaysia, 10-11 September, 2003.

Trikha, D. N. (1999). *Industriaised Building System: Prospects in Malaysia.* Paper presented at the World Engineering Congress, Malaysia.

Vrijhoef, R., Cuperus, Y. and Voordijk, H. (2002). Exploring the Connection between Open Building and Lean Construction: Defining a Postponement Strategy for Supply Chain Management in Proceedings IGLC-10 Gramado, Brazil, August 2002.

Waleed, A.M.T., Lee Wah Peng, M.R.A. Kadir, Jaafar, M.S., and Salit, M.S. (2003). *The Essential Characteristics of Industrialised Building System.* International Conference of Industrialsed Building Systems, Kuala Lumpur, Malaysia, pp. 283-295.

Warszawski, A. (1999). *Industrialised and Automated Building Systems.* E and F N Spoon.

Zaini, O. (2000). *Malaysian Construction Industry, Challenges and Demand.* Malaysian Structural Steel Association Convention Report, Kuala Lumpur, Malaysia.

Zakaria, S.A.S, Brewer, G., Gajendran, T., (2010). *Conceptual Framework of Psychology Decision Making on Industrialised Building Systems (IBS) Technology.* Proceedings of the 2010 International Conference on Engineering, Project, and Production Management.

Zakaria, S.A.S, Brewer, G., Gajendran, T., (2012). *Understanding Decision Making: Future Direction for Industrialised Building System Adoption in the Malaysian Construction Industry.* School of Architecture and Built Environment, Faculty of Engineering and Built Environment, University of Newcastle, Australia.