Economic Attributes related to Industrialised Building System in Malaysia

Siti Mazzuana Shamsuddin[1], Rozana Zakaria[1], Sarajul Fikri Mohamed[2]

[1] Faculty of Civil Engineering, [2] Faculty of Built Environment
Universiti Teknologi Malaysia, Skudai 81310, Malaysia

mazzuana5962@gmail.com

Abstract

This paper aimed to determine the economic attributes related to the sustainability of Malaysian construction. The method for data collection is questionnaire survey, which collected from 50 respondents. The results showed that there are many momentous economical attributes identified, which are IBS offers long-term monitoring mechanism by using Life Cycle Costing in cost development, the thoughts of environmental-related products are always involved a huge financial burden up-front and more speed on Return-on-Investment of a project. Based on information gained, strategies to strengthen and promotes broader adoption of sustainability in IBS construction, in Malaysia was suggested.

Keywords: Industrialised Building System (IBS); sustainability; attributes

http://dx.doi.org/10.21834/ajbes.v3i11.102

1.0 Introduction

The built environment has such an impact on the national economy. An emphasis toward a more sustainable approach to building design and life cycle performance continues to gain momentum. Construction Industry Development Board of Malaysia (CIDB) defined and interpret IBS as an approach or process used in making construction less labour-oriented and fastest as well as fulfilling quality concern (Shaari S.N. and Ismail, E., 2003).

There are vast potential for Industrialised Building System (IBS) to response to green construction and sustainability. Thanoon et. al (2003) stated that there are several aspects of IBS that has the potential of contributing to different aspects of sustainability and green construction. Kamar et. al. (2010) stated "parallel to the rapid growth of the construction industry, issues regarding the sustainability could have addressed faster and more efficient compared to the other industry". IBS can be a potential solution to achieve greatness in the area of green construction and sustainability.

2.0 Literature Review

This paper will commence by identifying the potential sustainable attributes in IBS, and then continue to discuss the correlation between IBS and sustainability. However, this paper will only focus on the economic attributes of sustainability in IBS. Shen et.al. (2007) stated the main objective of a construction project is to ensure financial affordability to the stakeholders and clients, employment opportunities, competitiveness and maintain the needs of future generations. This certainly can be achieved by incorporating IBS in the project. IBS does not only benefit the environment it also promises profitable returns to the stakeholders and clients. Yunus et. al (2011) explained that IBS offers the possibility for the stakeholders and developers to decrease their expenditures and increase their future profits. Yee (2001) emphasized on the benefit of IBS in reducing the cost of materials. A good collaboration between project participants can be formed while adapting IBS in a project as described further by Richard (2006). The collaboration could be in a form of knowledge sharing as well as experiences, which have a possibility to reducing the cost. In sustainable construction, the economic principle requires equitable distribution in costs and benefits to all parties without neglecting ethics and local economies (Epstein et. al. 2010). IBS offers unique attributes that a tangible cost and intangible cost for the complete building are reduced concurrently along the building life cycle. The economic considerations in sustainable attributes are expanded by flexibility, adaptability and local and domestic situation.

The main advantages of IBS in the economic or monetary perspectives are the quality, speed of construction and cost savings. The high quality characteristics in IBS have reduced maintenance and operation costs. Yunus et. al (2011) stated by adopting IBS implementation, the cost for labour and materials have also reduced significantly. Kamar (2013) stated that many contractors are reluctant to participate in any IBS project because of the cost, specifically the material and labour cost are spike high despite the overall cost saving it offers. By right, IBS offers an overall cost saving rather than individual cost perspective indeed it offers a comfortable profit margin. Jaillon et. al. (2008) proved that a cost saving of 16% in labour requirement on-site are achievable as well as a reduction of

15% of total construction time by using IBS in a construction project. Goodier et. al. (2006) and Ding (2008) further highlighted that a significant time saving is achievable by adopting IBS in a construction due to the standardization process in manufacturing hence it will shorten the lead time, improve quality control and reduce material. IBS will help to promote sustainability in construction, provided that each construction participants realize and has a better understanding on the potential of IBS in enhancing sustainability.

This paper aimed to establish the relationship between economic attributes in basic sustainable principles with the general notion of IBS attributes. Perhaps the outcome from this research can give a better understanding and considerations of both positive and negative aspects of pursuing sustainability in construction.

3.0 Methodology

This paper aimed to establish the relationship between sustainable economic attributes with IBS attributes and to validate all the economic attributes obtained from past researches results. Kamar et. al. (2010) stated that since IBS has the potential to promote sustainability, hence a serious step should be taken into consideration in merging IBS into the issue of sustainable and simultaneously contributes to sustainable development. It is essential to highlight the positive economic attributes which can convince the industry player to participate in IBS project.

Table 2. Respondents frequencies

	Frequency	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
Architect	8	14.5	14.5	14.5
Engineer	10	18.2	18.2	32.7
Executive	2	3.6	3.6	36.4
Manager	6	10.9	10.9	47.3
Others (Site SV & C.O.W)	4	7.3	7.3	54.5
Quantity Surveyor	23	41.8	41.8	96.3
Site Engineer	2	3.6	3.6	100
Total	55	100	100	

The questionnaire is divided into four sections exploring attributes from IBS and sustainability construction. Respondent demography, background and level of experience are identified in part 1. Then in part 2, the IBS attributes are listed according to the economic value, environmental social and institutional attributes to help respondent rate the level of agreement for the attributes. Part 3, all the sustainable construction attributes, are listed according to the same category as part 2. Part 4 investigated the correlation between main

categories in IBS construction and sustainable developments. A five point Likert scales with "5" indicating "very agree" and "1" indicating "very disagreed" is used in the questionnaire

The data collection process is carried out by using questionnaire survey, which distributed to the targeted respondent identified beforehand. The questionnaires, distributed directly to consultant, contractor and manufacturer firms, gathered data from respondents including engineers, architects, quantity surveyors, and technical personnel. The questionnaires were distributed to the respondents all across Malaysia via email, postage and online retrieval. The list of potential respondent was extracted from the official list of professionals (CIDB and IBS Center). The questionnaire was sent to 200 individuals and 55 responded which giving 28 per cent. According to previous researches, the response rate for the construction industry is between 20 to 30 per cent, therefore, that is acceptable. The quantitative analysis is used to investigate the relationship between attributes. All the analysis is performed with the assistance of Statistical Packages for Social Science (SPSS) Statistics 20.0.

4.0 Results and Discussions

The data from received questionnaires are recorded in SPSS 20.0. Descriptive statistic is conducted a check for distribution scores and continuous variables in terms of normality and possible outliers. Pallant (2010) suggest that correlation technique is suitable to explore the association between pairs of variables. Correlation is a statictical technique that an show whether and how strongly pairs of variable are related. The statistic obtained is Pearson's product-moment correlation (r). Pearson's correlation coefficients used for normally distributed data which provides indiction of linear relationship between variables. Pearson's correlation coefficients (r) an range from -1 to +1. The sign in front indicates whether here is a positive correlation (as one variable increases, so does the other) or negative correlation (as one variables increase, the other decreases). The size of the absolute value provides information on the strength of the relationship. To represent the strength of variance of two variables compared, coefficient of determination is calculated.

Economic value of sustainable in this research is defined as equitable distribution of costs and benefits to all parties without neglecting ethics and local economies (Attribute 3) while there are 7 non-economic related IBS attributes. From the table 3, the relationship between economic value of sustainable and IBS attributes was investigated using Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure no violation of assumptions of normality, linearity and homoscedasticity. In determining the strength of the relationship between variables, Cohen (1988) stated "a correlation of 0 indicates no relationship at all, a correlation at 1.0 indicates a perfect positive correlation, and a value of -1.0 indicates a negative correlation."

1) Environmental related products were always involved a huge financial burden up front

For IBS 1 which is a perception of any environmental outcome, it is always expected to involve huge financial burdens up front and costly, there was a small correlation between the two variables, $r = .241$, $n = 55$, $p < .0005$, with low level, about 6 per cent of coefficient

determination. From the interview conducted, the author found out that the small shared variances obtained because there was numerous activities conducted locally to promote IBS in the industry, hence a stronger supply chain in the industry is established. Therefore, there was merely no issue in the perception of investing a huge amount of money in a way to prepare for IBS project. Yunus et. al. (2011) stated that different stakeholders have a different focus. In the other hand, while contractors more concerned on the cost and profits, designers normally put more concern on the aesthetic value and ability of the elements to support structural loads.

2) Ability to execute the project with a minimum amount of waste and expenses

For IBS 2 which is about IBS's ability to execute with a minimum amount of waste and expenses, there was a small correlation between the two variables, $r = .072$, $n = 55$, $p < .0005$, with a particularly low level, 0.50 per cent of coefficient determination. From the interview conducted, these variables shows a merely low r value because the waste can be reduced if the project use more than 70 per cent of IBS components in the whole project where most of the component are manufactured off – site. While smaller project may create abundance amount of waste comes from in situ activities on-site. IBS promotes innovation to the better material management or design solution by incorporating sustainability than the conventional construction system (Tam, 2002). Any reduction on-site leads to waste reduction because of the controlled in the environment in any sustainable development project (Ding, 2008)

3) Maintenance and operations costs are reduced with the high characteristic in IBS

For IBS 3 which is about the maintenance and operations costs are reduced when using IBS, there was a small correlation between two variable, $r = 0.097 \approx .10$, $n = 55$, $p < .0005$, with 1 per cent of shared variance. The merely low correlation, because the maintenance and operations of any buildings are influenced by the frequency of the necessary maintenance undertaken prior to the significant maintenance operation is carried out. If the buildings are maintained well, the operation cost will concurrently low.

4) Cost for material and labour is reduced in IBS implementation

For IBS 4 which is about the cost for material and labour cost is reduced when using IBS, there was a correlation, $r = 0.156$, $n = 55$, $p < .0005$, with 2.4 per cent of shared variance. The small variance recorded mainly influenced by the small number of respondent.

The unique attribute of the construction industry is it depends on its workforce to execute its activities. Labour availability has identified as one of the critical factors in improving sustainability in IBS (Yunus et. al., 2011). Labour consumption is affected in IBS implementation as compared to the other industry. There will be a reduced number of labour needed in IBS implementation by limiting numbers of labours on-site, consequently reducing the cost of hiring the labours for the project (Tam, 2002). Material cost includes all the cost involves before the materials transform into IBS components. The cost includes production,

deliveries and storage of materials. In IBS, the cost of material is reduced by repetition, mass production of the pre cast elements (Yunus et. al., 2011)

Table 2. Relationship between Sustainable Economic Value and IBS Attributes

IBS Attributes	IBS 1	IBS 2	IBS 3	IBS 4	IBS 5	IBS 6	IBS 7	Attribute 3
IBS is the financial burden (IBS 1)	1	-0.111	0.144	-0.068	-0.134	.489**	.405**	0.241
Able to execute in minimal cost (IBS 2)		1	-0.253	-0.257	.711**	.326*	.601**	0.072
Maintenance & operations cost is reduced (IBS 3)			1	-.275*	-0.087	-0.223	-0.259	-0.097
Costs for labour & material is reduced (IBS 4)				1	-.300*	-0.144	-0.23	0.156
Waste reduction contribute saving in the overall cost (IBS 5)					1	0.155	.383**	-0.018
Speed Return on Investment (IBS 6)						1	.737**	0.169
LCC offers long term cost monitoring (IBS 7)							1	0.215

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

5) Waste reduction offers overall cost saving

For IBS 5, waste reductions are expected to contribute overall cost saving in a project. There was a particularly small negative correlation, r = -.018, n = 55, p < .0005. However, the highest correlation, r = .383 recorded between IBS 4 and IBS 7 which is the use of life cycle costing method to help manage the expected cost from planning to demolishing the building.

6) IBS offers speed return on investment

For IBS 6, IBS offers speed Return on Investment (ROI) compared to the conventional system of construction. There was a small correlation, r = .169, p < .0005, with 3 per cent of shared variance. As previously discussed, Chen et. al. (2010) boasting on the return on

investment (ROI) that IBS can offers once the break-even point is attained despite the huge critical investment at the early stage. IBS project offers a shorter lead time, hence the project duration will be shorten simultaneously. Earlier building occupancy is highly possible then the project could meet its break-than normal project.

7) Life Cycle Costing (LCC) offers long term monitoring mechanism

For IBS 7, highlights about the usage of LCC in calculating full cradle to grave development cost. There was a correlation, $r = .215$, $p < .0005$, with 5 per cent of shared variance. LCC is a highly useful tool to monitor the overall cost of any construction project as it offers cradle to grave cost estimation using present value. In other word, LCC can be a highly useful tool to help manage a good investment in IBS, yet the awareness on the usefulness of this method is still lagged behind any other cost estimation method available in the market (Bari, 2011).

In IBS, one of the unique attribute it offers is the ability to reduce not only tangible cost but intangible costs too. Tangible costs in IBS include but not limited to purchasing materials, paying salaries and renting equipment and machines. Intangible cost is difficult to quantify and do not have firm value. Estimations of value are based on experience and assumption (Yang et. al., 2005). To be efficiency and effective in managing a successful project, a good overall planning is mandatory. Ability to execute construction projects with a minimum amount of quantity waste, expenses or unnecessary effort, which is financially measureable, will eliminate financial losses. LCC offers a greater certainty of cost and time estimating by setting targets to achieve a profit in financial perspective in the possible building whole life cycle (Alridge, 2002).

5.0 Conclusion

From the analysis above, it can be concluded that the strongest attribute between sustainable economic value recorded, and IBS are environmental related products were always involved a huge financial burden up front with r=0.241, coefficient determination of 6 per cent, LCC offers long term monitoring mechanism with r=0.215, coefficient determination of 5 per cent and IBS offers speed Return on Investment with r = 0.169 with 3 per cent coefficient determination.

The unique characteristic of IBS will help promotes sustainability in construction. Before wider adoption of this alternative construction method, there must be a better understanding on the potential of IBS in enhancing sustainability. An integrated assessment process and effective collaboration between Designers, Planning Constructors, and Building Authorities on the key attributes and evaluation of sustainability criteria will work towards sustainable IBS delivery.

References

Abdullah, M.R. & Egbu, C. (2009). IBS in Malaysia: Issues for research in a changing financial and property market. *BuHu 9th International Postgraduate Research Conference*. (pp15-25). Salford, United Kingdom

Alridge, G., Pasquire, C., Gibb, A. & Blismas, N. G. (2002). Innovation through standardization nd pre-assembly:issues for benefit measurement. *10th Sysmposium Construction Innovation and Global Competitiveness*. CRC Press.

Bari, N., Yusuff, R., Ismail, N. & Jaapar, A. (2011). Factors influencing the construction cost of industriaied building system projects. *Proceedia of Social and Behavioral* Sciences, 35, 689-696

Blismas, N., Pasquire, C. & Gibb, A. (2006). Benefit evaluation for off-site production in construction. *Journal f Construction Management and Economics*, 24(2), 121-130.

Chen, Y., Okudan, G. E. & Riley, D. R. (2010). Sustainable performance criteria for construction method selection in concrete buildings. *Journal of Automation in Construction*, 19(2), 235-244

Construction Industry Development Board (2003). *Industrialised Building System (IBS) Roadmap 2003-2010* . Kuala Lumpur: CIDB Malaysia.

Ding, D. (2008). Sustainable construction- the role of environmental assessment tools. *Journal of Environmentl Management*, 86(3), 451

Encyclopedia of Earth (2007). Sustainomics and sustainable development. Retrieve from http://eoearth.org.

Goodier, C. & Gibb, A. (2007). Future opportunites for offsite in the UK. *Journal of Construction and Engineering Management*, 25(6), 585-548.

Jaillon, L. & Poon, C.S. (2008). Sustainable construction aspects of using prefabrication in dense urban environment. *Journal of Construction Management and Economics*, 26(9), 953-966.

Kibert, C. J. (2007). The next generation of sustainable construction. *Journal of Building Research & Information*, 35(6), 595-601.

Kamar, K. A., Hamid, Z., Ghani, M.K., Charles, E. & Arif, M. (2010). Collaborative initiative on green construction nd sustainability through industrialised buildings system (IBS) in the Malaysian construction industry. *International Journal of Sustainable Construction Engineering & Technology*, 1(1), 119-126.

Kamar, K. A., Hamid Z., Azman, M. N.A. & Ahamad, M.S. (2011). Industrialised building system (IBS): revisiting issuesof definition and classification. *Journal of Emerging Science* ,192, 120-132

Mohamad, I.M., Zawawi, M. & Nekooie, M.A. (2009). Implementing industrialized building system (IBS) in Malaysia: Acceptance and awareness level, problems and strategies. *Malaysian Journal of Civil Engineering*, 21(2), 219-234.

Nornes, D. (2005). *Life cycle cost analysis (lcc) in the united states green building industry*. Master of Science Thesis Colorado State University, USA.

Pallant, J. (2010). *SPSS survival manual*. (4th ed.). Berkshire:McGraw-Hill, (Chapter 11).

Richard, R.B. (2006). Industrialised, flexible and demountable building system: quality, economy and sustainability. *International Research Symposium on Advancement of Construction Management and Real Estate. Beijing, China.*

Robichaud, L. B. & Anantatmula V. S. (2010). Greening project management practices for sustainable construction. *Journal of Management in Engineering,* 21(7), 48-57.

Shaari, S. N. & Ismail, E. (2003). Promoting the usage of industrialised building system (IBS) an modular coordination (MC). In *The Malaysian Construction Industry*. Bulletin Ingenieur, pp 7-9.

Shen, L.Y., Hao, J.L., Tam, Y. & Hao, Y. (2007). A checklist for assessing sustainability performance of construction projects. *Journal of civil Engineering and Management*, 14(4), 273-281.

Thanoon, W.A.M., Peng, L.W., Kadir, M.R.A., Jaafar, M. S. & Salit, M. S. (2003). The Experiences of Malaysia and Other Countries in Industrialized building system. *Proceeding of International Conference Industrialized building systems*, Kuala Lumpur, Malaysia.

Yang, J.(2010). Critical success factors for stakeholder management: Construction practitioners' perspective. *Journal of Construction Engineering and Management*, 136(7), 778-786.

Yee, A.A. (2001). Social an environment benefits of precast concrete technology. *PCI Journal*, 5-6, 14-20.

Yang, J., Brandon, P.S. & Sidewell, A.C. (2005). *Introduction-Bridging the gaps in smart and sustainable built environment*. Blackwell Publishing Ltd.

Yunus, R. & Yang, J. (2011). Sustainabilifor Industrialised Building System (IBS) in Malaysia. *Procedia Engineering*, 14, 1590-1598.

Tam, C.M. (2002). Impact on structure of labour market resulting from large-scale implementation of prefabrication. *Journal of Advances in Building Technology*, 399-403.