

Sustainable Construction in Malaysia – Developers' Awareness

Nazirah Zainul Abidin

Abstract—The creation of a sustainable future depends on the knowledge and involvement of the people, as well as an understanding of the consequences of individual actions. Construction industry has long been associated with the detrimental effects to our mother earth. In Malaysia, the government, professional bodies and private companies are beginning to take heed in the necessity to reduce this environmental problem without restraining the need for development. This paper focuses on the actions undertaken by the Malaysian government, non-government organizations and construction players in promoting sustainability in construction. To ensure that those concerted efforts are not only skin deep in its impact, a survey was conducted to investigate the awareness of the developers regarding this issue and whether those developers has absorb the concept of sustainable construction in their current practices. The survey revealed that although the developers are aware of the rising issues on sustainability, little efforts are generated from them in implementing it. More effort is necessary to boost this application and further stimulate actions and strategies towards a sustainable built environment.

Keywords—Environmental sustainability, Malaysian construction industry, Malaysian developers, Sustainable construction.

I. INTRODUCTION

BUILDINGS and structures enabled mankind to meet their social needs for shelter, to meet economic needs for investment and to satisfy corporate objectives. However, the satisfaction of these needs usually comes with a high price i.e. an irreversible damage to our environment. This lead to a growing realization around the world to alter or improve our conventional way of development into a more responsible approach which can satisfy our needs for development without harming the world we live in. The opportunity for improvement arrived when a new philosophy called 'sustainable development' was introduced in 1987 in Brundtland Report. Since that, many progressive world events had taken place to increase the awareness on environment and sustainability agendas such as Rio Earth Summit 1992, Maastricht Treaty 1992, Kyoto Conference on Global Warming 1997, Johannesburg Earth Summit 2002 and Washington Earth Observation Summit 2003 [1]. The ideas and strategies initiated by these world events have prompted positive actions and plans by many countries to implement

Nazirah Zainul Abidin is with the School of Housing, Building and Planning, Science University of Malaysia (USM), 11800 Penang, Malaysia (e-mail: nazirah_z@usm.my).

and absorb this philosophy within their industries. Subset to this philosophy is sustainable construction, which described the responsibility of the construction industry to attain sustainability. Through sustainable construction concept, the construction industry can contribute in a positive and proactive manner towards environmental protection.

Delivering sustainable construction requires action from all engaged in constructing and maintaining the structure or building including those providing design, consulting and construction services [2]. It requires willingness to explore new territory in construction approach and prepare to adopt new products, ideas and practices [3]. As global interest on sustainability has steadily blooming, Malaysia should not fell short in its attitude on sustainability and sustainable construction. Malaysia needs to demonstrate that it can abide by this new interest and can compete in the global market.

This paper delves into the actions undertaken by the Malaysian government, non-government organizations and construction players in promoting sustainability in construction. Through extensive literature review, this paper will discuss the commitment of the Malaysian government on sustainability agenda and the progress so far in the construction industry. This paper will also discuss the findings from a survey conducted to investigate the awareness of the developers regarding this issue and whether they have absorbed the concept of sustainable construction in their current practices.

II. SUSTAINABILITY IN CONSTRUCTION

Construction industry must inevitably change its historic methods of operating with little regard for environmental impacts to a new mode that makes environmental concerns a centerpiece of its efforts. Previously, the concern on environment is relatively a small part of most of construction development. However, with the growing awareness on environmental protection due to the depletion of non-renewable resources, global warming and extremity of destruction to ecology and biodiversity impact, this issue have gain wider attention by the construction practitioners worldwide. Many efforts are being directed to build sustainably in construction world. The direction of the industry is now shifting from developing with environmental concern as a small part of the process into having the development process being integrated within the wider context of environmental agenda. Thus, the activities of

construction industry must work and comply with the needs to protect and sustain the environment. This shift of ideology is illustrated in Fig. 1.

Sustainable construction, which has been dubbed 'green construction', describes the responsibility of the construction industry in attaining sustainability. The term sustainability has been adopted as a panacea for change and development [4]. Sustainable construction is a process whereby, over time, sustainability is achieved. The concept of sustainability must be applied into construction industry to influence the manner in which a project shall be conducted to strike a balance between conserving the environment and maintaining prosperity in development [5]. Attaining sustainability does not mean the eradication of adverse impact, which is an impossible vision at present, but rather the reduction of it to a certain reasonable level [3].

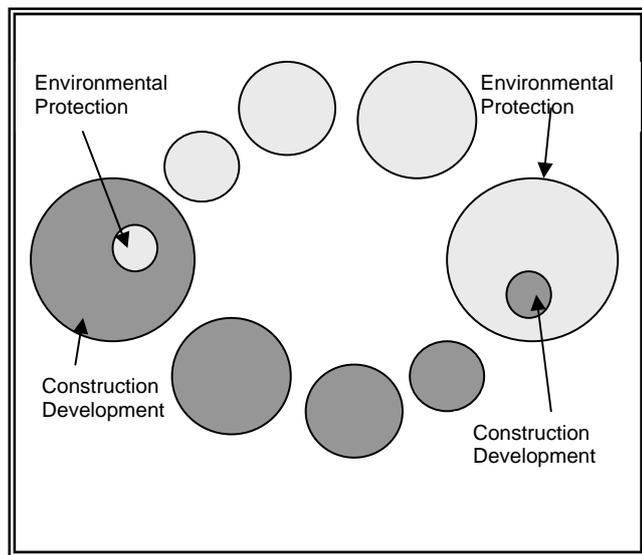


Fig. 1 The movement for 'greener' construction [6]

The concept of sustainability in building and construction has initially focused on issues of limited resources especially energy, and on how to reduce impacts on the natural environment with emphasis on technical issues such as materials, building components, construction technologies and energy related design concepts. The appreciation of the significance of non-technical issues (soft issues) has grown, giving recognition to economic and social sustainability concerns as well as cultural heritage of the built environment as equally important. Presently, the concept of sustainable construction governs three main pillars: environmental protection, social well-being and economic prosperity. Fig. 2 illustrates the tree diagram of these three headings and their areas of concern. Environmental protection concerns on the built environment and the natural environment. The built environment refers to the activities within the construction project itself, which may, if not handled effectively, have a serious adverse impact on the environment. Environmental

sustainability is also concerned with the extraction of natural resources. Although builders have little influence over the extraction of natural resources, they can help discourage this activity by demanding less non-renewable natural resources, more recycled materials, and efficient use of energy and mineral resources [7]. Social well-being concerns with the benefits of the workers and the future users. Basically, this aspect is concerned with human feelings: security, satisfaction, safety and comfort [8] and human contributions: skills, health, knowledge and motivation [9]. Finally, the economic sustainability is concerned with the micro and macro economic benefit. Micro economic focuses on the factors or activities which could lead to monetary gains from the construction while macro economic relates to the advantages gained by the public and government from the project success.

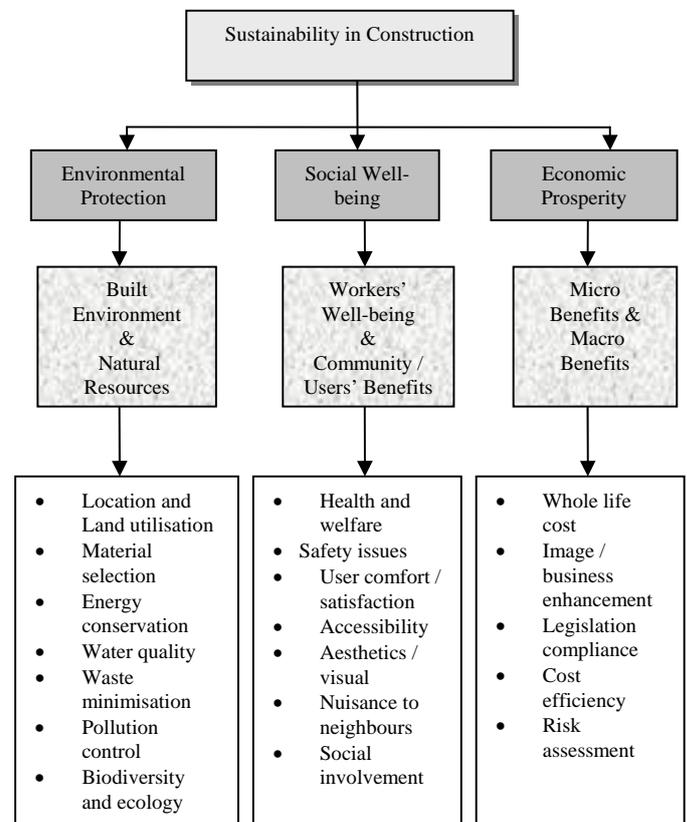


Fig. 2 The diagram of sustainability in construction [1]

Construction practitioners worldwide are beginning to appreciate sustainability and acknowledge the advantages of building sustainable. For example, the concept of green building costs lower than conventional method and saves energy as demonstrated by Hydes and Creech [10]. This was further supported by Heerwagen [11], Bartlett and Howard [12] and Pettifer [13], who added that sustainable buildings will contribute positively to better quality of life, work efficiency and healthy work environment. Yates [14] explored

the business benefits of sustainability and concluded that the benefits are diverse and potentially very significant. The approach of sustainable construction will enable the construction players to be more responsible to the environmental protection needs without neglecting the social and economic needs in striving for better living.

III. MOVING TOWARDS SUSTAINABLE CONSTRUCTION IN MALAYSIA

As a developing country, Malaysia realised that the construction industry plays a significant role in its economic growth. Over the last 20 years, the industry has been consistently contributing between 3% - 5% of the national GDP (Construction Industry Development Board (CIDB) [15]. However, the industry is not without weaknesses. Challenges have been in the areas of productivity, quality, safety, technology and unproductive practices. The government is now striving to upgrade the country, including its construction industry, by committing towards Vision 2020, which calls for a comprehensive quantum leap towards a knowledge based society. The book 'Malaysia's Vision 2020' published in 1993 defined national ambitions and future opportunities for us and to consider long-term strategies to assist the achievement of national goals. One of the basic visions that emerged is for the country to be ecologically sustainable. This basic vision has become an impetus towards sustainability agenda in the country. The issue of sustainable development has emerged as one of the top issues in the Eight Malaysia Plan (2001 – 2005). According to the plan, the government gave high priority to research and development as one of their strategy for sustainable development [16]. Section 19 of the Plan was devoted to integrate environmental consideration into development planning. During that period, concerted efforts were expected to intensify in order to improve energy efficiency, forestry, waste and environmental management.

The Construction Industry Development Board Malaysia (CIDB), which is a corporate established with the main function of developing, improving and expanding the Malaysian construction industry, has identified the environment and other sustainability-related issues as one of the top issues of the construction industry [15]. CIDB calls upon the researchers and construction practitioners to reassess the process of construction to develop good construction planning and management to safeguard the environment. To initiate research in this field, they have formed many focus groups in research and development. One of the focus group focuses on environment and sustainability, which is presently involved in research in waste minimization, environmental management plan, water management and construction hazard identification [17]. Other institutions in Malaysia such as INSPEN (National Institution of Valuation, Malaysia) and MASTIC (Malaysian Science and Technology Information Centre) (Under Ministry of Science, Technology and Innovation) are among the leading institutions for research and development and they have also identified sustainability

and environment as one of the areas for research. The subject of sustainability continues to be one of the important agenda of the government since it has been identified as one of the five key thrusts in the Ninth Malaysia Plan, which was unveiled on the 31st March 2006 [18].

Apart from these government and non-governmental organisation, the local universities such as University Science of Malaysia, University Technology of Mara and University National of Malaysia have also shown interest in this field by offering funding for more research. These universities have also been involved in organising many symposiums and conferences to raise the awareness on sustainable development and to exchange knowledge in this field. Holcim Malaysia has founded a Foundation for Sustainable Construction to promote innovative approaches to sustainable construction and to recognise outstanding achievements through awards competition and international forum [19]. At present, there are several sustainable projects that are being or have been constructed in Malaysia. One of the examples is project Tanarimba at Janda Baik, Pahang. Tanarimba is a sustainable housing project that blends man-made and natural elements in an exciting concept of ecologically-sensitive community development and also introduces the world to eco-tourism opportunities in Malaysian highlands. The project has been dubbed as the forefront of the ecological movement in construction [20]. Another example is the DDC Project (Demonstration and Documentation Centre for Sustainable Urban Household Energy Usage), launched in 2004 by the Centre for Environment, Technology and Development, Malaysia (CETDEM). This project pioneered the construction of urban energy saving house [21]. Malaysia Energy Centre (PTM) has also embarked on energy-efficiency building by constructing a zero energy office building (ZEO) at Bandar Baru Bangi, Selangor [22]. The Planning and National Development Doctrine (DPPS), which stresses development that is balanced and sustainable from the economic, social, spiritual and environmental aspects, served as the foundation for the planning and development of Putrajaya and Cyberjaya. A total of 32 physical planning guidelines were established by the Town and Country Planning Department (TCPD) to ensure sustainable development of area such as coastal areas, islands, open space, housing, retention ponds, solid waste disposal areas, conservation of trees and for environmentally sensitive areas [16].

The initiatives by the government and others have shown positive signs as people are becoming more conscious in their responsibilities towards environment and sustainable projects are being built in Malaysia. However, projects on sustainability in Malaysia are mostly at pioneering stage, indicating that Malaysia construction industry is still at infancy when dealing with sustainability matters. With the promotion from the government and non-governmental institutions on sustainability, it is hope that the awareness on sustainability among the construction practitioners should have improved exponentially in the near future.

IV. THE SURVEY

From the literature review, it is clear that with the encouragement from the government, sustainable concept is beginning to settle in the construction industry. However, referencing to several projects does not representing the wider scenario. To understand how far this concept has penetrated the industry, a survey was conducted among construction developers in Malaysia focusing on their understanding on this subject matter and whether they have incorporate this knowledge within their current and past projects. This survey focused on developers of building construction such as property and commercial building located in the area of Kuala Lumpur (capital city of Malaysia) and Selangor. These areas are selected because many construction developers, which have projects throughout Malaysia, are based there. All construction development companies from these areas will be approached when conducting the postal survey. The list of the companies was obtained from the Real Estate and Housing Developers' Association (REHDA).

A total of 271 respondents were approached and 35 questionnaires were returned for analysis. The data gathered was analyzed qualitatively and quantitatively. Software called Statistical Packages for Social Sciences (SPSS) was used to analyze the data quantitatively. This software enabled the data to be transferred automatically from spreadsheet to graphic to present the data in more attractive manner. The averaging statistical analysis was also used to calculate straightforward totals, percentages and averages. Qualitative technique was applied to make sense of meanings. Contextualizing strategy was used to connect statements, opinion and comments to provide a coherent picture. The results are discussed next.

V. RESULT AND DISCUSSION

A total of 35 construction developers have responded to this survey. These developers have been active in the industry between 4 to 36 years. The majority of them have been involved with more than 20 projects with project cost within the range of 10 to more than 100 millions. Their range of project profiles varies from landed properties to shop houses. The progress in Malaysia is discussed under several subheadings:

- a) the level of knowledge and awareness of construction developers on the concept of sustainability and sustainable construction;
- b) the application of sustainable concept in past and current projects; and
- c) the future outlook of this application in the construction industry.

To articulate the level of knowledge among project developers with regards to sustainability concept, the respondents were asked to rate their knowledge on this subject matter and what they perceived, based on their experience, the general population of project developers' level of understanding on this subject. From Fig. 3, most of the

respondents considered themselves to have moderate or good knowledge on sustainable concept. The mean level is 3.43 (moderate) out of 5 rating system. The respondents also perceived that overall developers' knowledge on sustainable concept is between low and moderate level (mean of 2.80). Although they believe their knowledge is above moderate, they seemed to think that overall, the knowledge is still below average.

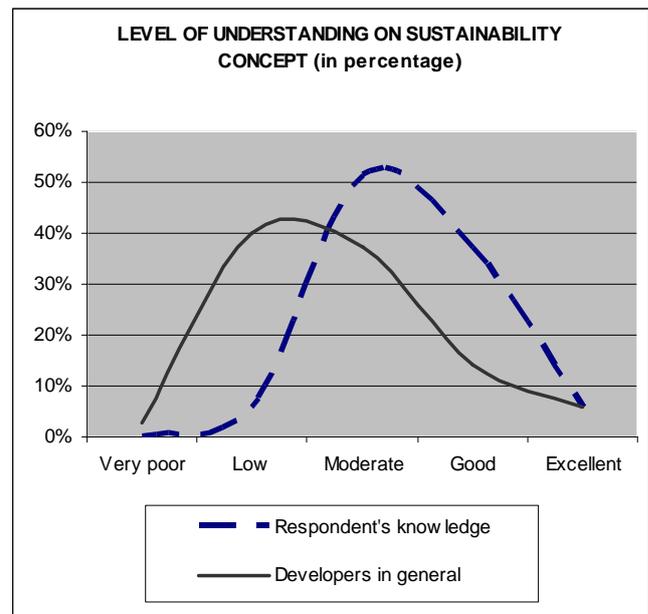


Fig. 3 Level of understanding on sustainability concept

To investigate further what the respondents understand about the concept of sustainable construction, they were asked to select issues that match their understanding about the concept of sustainable construction. Issues that are related to environmental aspect of sustainability received highest percentage: effective protection of the environment (88.6%), effective environmental planning, management and control (80%) and prudent use of natural resources (68.6%). Issues that related to social aspect of sustainability received moderate percentage: enhance the quality of life and customers' satisfaction (71.4%) and social progress which recognize the need of everyone (42.9%). Lastly, the issues the related to economic aspect of sustainability received lowest percentage: generating profit without compromising future needs (42.6%) and maintenance of high and stable level of economic growth (48.6%). From this result, it is deduced that the majority of the respondent understand that sustainability is about protecting the environment but many are still unaware the sustainability is also about balancing social and economy aspects of construction.

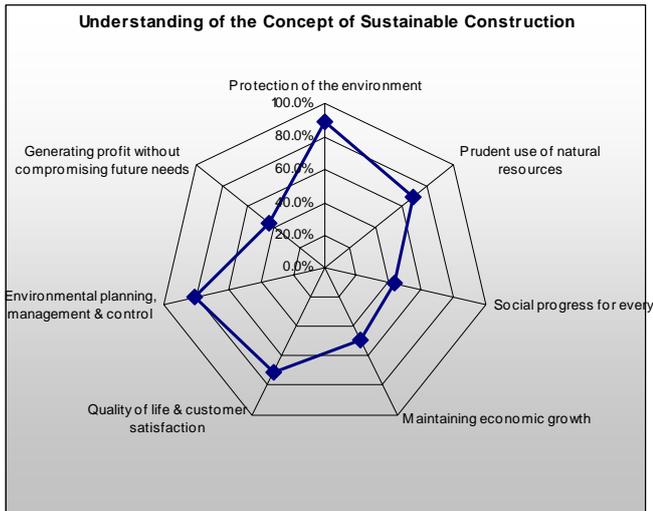


Fig. 4 Understanding on the concept of sustainable construction

The majority of respondents rely on written materials (journals, proceedings, newspapers, websites) to improve their knowledge about sustainable construction. Other sources of knowledge are through education and higher learning; seminars and conferences; and experience with sustainable projects. In-house learning was given a relatively low percentage indicating that most of the companies do not promote this concept within their organizations and project, thus giving small window of opportunity for the employees to learn about this concept internally.

Aligned with the level of knowledge revealed by the respondents, the level of implementation is also at moderate level, as shown in Fig. 5. None of the respondents believed that the implementation of sustainable practices is excellent. Majority believed that the implementation is at low level, followed by moderate level.

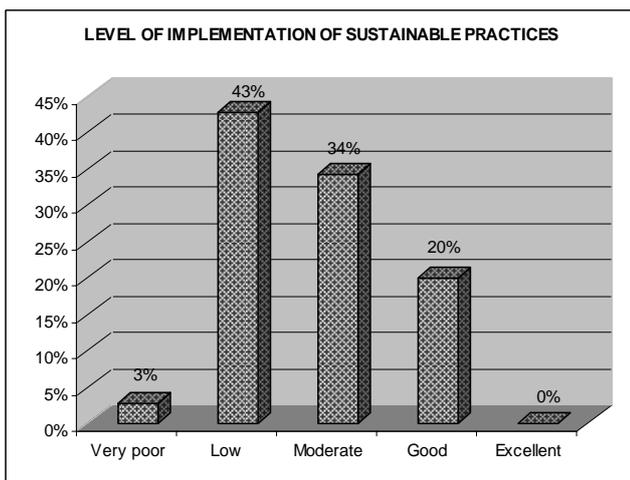


Fig. 5 Level of implementation of sustainability practices

The reasons for the current level of implementation can be clustered under several headings.

- a) *Lack of enforcement* – there are many respondents that stresses the need for enforcement through law and legislation. Although there are several Act which focus on environment, such as Environmental Protection Act, but due to lack of monitoring and enforcement, people just don't really care much about it.
- b) *Government intervention* – Some of the respondents believed that the government should play a bigger role in promoting sustainable construction, through actions such as through strong enforcement of legislation, devising new policy, or giving incentives to developers who want to pursue sustainability in their projects.
- c) *Pointing fingers* – Some of the respondents believed that the role of 'promoting' and 'encouraging' sustainable practices lies on other shoulders too as well such as designers and contractors. The respondents also highlighted that there are too many players in the construction industry and mostly are not professionally qualified. The implementation can be improve if various construction players including engineers, architect and QS play their role in advising the developers on the merits of pursuing sustainable practices. If the consultants can come up with a good design within the project budget that can sustain the environment and give a good business return, then the developers will be inclined to accept the proposal.
- d) *Urgency factor* – Some of the respondents stated that people are indirectly aware on this issue. However, they do not feel the need to incorporate this issue in their projects. This issue is not in their top list. One of the respondents even stated that Malaysia has abundant of natural resources such as water, oil and energy. Thus, there is general lack of urgency on this issue. The respondents also felt that this issue lack of publicity which could speed up people interest on the matter.
- e) *Education vs. experience* – Many of the respondents stated that developers have poor knowledge about sustainability and sustainable construction. A decade ago, environmental issue was not pertinent and was not given a priority in education. Many developers are still trying to balance the three pillars within their means. It is hard to break from their norm in practice. The younger generation, however, have been exposed about sustainable construction in their higher education level but, due to their lack of experience in the real world, they have problem disseminating their theoretical understanding of sustainability knowledge into practice.
- f) *Cost factor* – Many respondents believed that the main factor that impedes implementation of this concept in the Malaysian construction industry is the financial constraint. A few respondents stated that sustainable construction is believed by many to be economically non-viable. Sustainable practices are believed to increase project cost because they need to have higher capital upfront. Higher cost means higher price. If they pursue sustainability in the projects, they need to know

that there is a market for it because technically, the cost will be transferred by the buyers / end users.

- g) *Passive culture* – There are a few respondents who believed that sustainability is an academic pursuit. It is often used in the intellectual circle but seldom known outside leading to non-practice.

The majority of respondents also strongly agreed that sustainability issues should be considered as early as possible in a project to improve the level of implementation. Planning stage has been identified as the most critical stage to incorporate this concept to have the most effect on the overall pursuit of the project. Incorporation after that will be seen as a burden and most likely will add more cost to the budget.

Finally, the respondents were requested to give their opinion on the prospect of sustainable construction application in Malaysia in the next 5 years. From Fig. 6, it is clearly shown that 63% of the respondents believed that in 5 years, not much will change and the level is still moderate. About 17% of respondents believed that it will get better (good) and equally on the opposite site, 17% believed that it will still be low. There are a few people (3%) who think that the future of sustainable construction is very bleak.

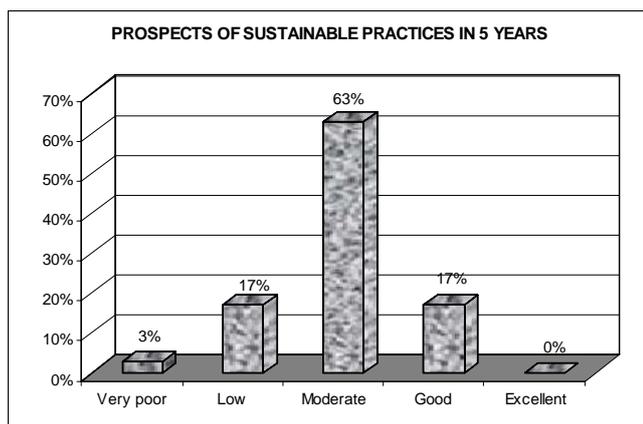


Fig. 6 Prospect of sustainable practices in 5 years

From the comment given, these are the reasons behind the 'low' and 'moderate' opinion:

- a) As long as there is no by-law or new regulation by the government, the players in the industry will not care less. There is also lack of enforcement on existing legislation
- b) Developer must be convinced that sustainability issues will add value to its development and the public is prepared to pay a higher entry cost to enjoy such privilege
- c) Cost is still the main priority of any development. Sustainable construction increases project cost which makes this option less favourable.
- d) Need more construction players to get involve for improvement

- e) Lack of awareness. No political will
- f) Speed is the issue. Our country is moving too fast without building a strong base of culture itself. The success of a sustainable project is very dependable of the soul of the project that is every individual that are involved in the project.
- g) Sustainable construction still lack of understanding by industry

These are the reasons for a brighter prospect in sustainable construction:

- a) The trend is going towards it and eventually, the Malaysian construction players will follow it
- b) There is a gradual improvement by all parties involved in the industry about this concept. Many people are becoming aware of this new concept, even though the application is still weak, the knowledge is improving
- c) Developers and local authorities are improving such sustainable construction including preparation of EIA report, slope protection and river protection. However such evolution do take time to improve
- d) The rise of building material costs would force developers / contractors to seek more sustainable construction application
- e) Various universities with various courses offer student awareness for the above issues. New employee will brought in new attitude
- f) Awareness on sustainable development at the national or global basis is increasing at an encouraging pace which is beneficial
- g) The players in construction will improve their ability and know-how about the sustainable construction application from their experience
- h) Awareness among citizens is increasing. Environmental friendly concept is being planted either at education level or media report

The evidence of several sustainable projects being built in Malaysia from literature review shows positive signs that the concept of sustainable construction has begun to settle within the industry. However, the survey revealed that the concept of sustainability has not been widely applied in many projects. This strengthens the argument that the industry is still at its infancy in this field. The findings indicated that generally, the respondents believed the level of knowledge on sustainability is still below average. Perhaps, this perception derived from the lack of implementation of this concept in the construction industry. Other developers may have good knowledge on sustainable concept, but because they did not put it in practice or incorporating it in their projects, others will tend to believe that knowledge is not apparent. Knowing but not practicing is another major problem in sustainable concept implementation. A lot more efforts are necessary to enhance the level of environmental awareness and civic consciousness among the people to build sustainably in the future. It is recommended to

improve the understanding and awareness on this concept and initiate action to enable this concept be applied efficiently in future construction projects. There are many ways do this such as educating the construction players through conferences, trainings, seminars, workshops. Since this concept is viewed as academic pursuit, perhaps, the academician should play a more active role in reaching to the construction players through collaboration and consultations works. Education should not be limited to the construction players only. As the industry's supply is closely influenced by the demand for it, the education should be expanded to the wider stakeholders, which includes the potential buyers as well. Raising buyers demand for sustainable houses for example, will push the housing developers to improve the specification of their houses which include certain sustainable elements to attract buyers. Government has a major role to play in encouraging sustainable construction. Their support and incentives will prompt interest among construction players. It is also recommended that a full length study on the weakness of present legislation implementation to alleviate the problem of 'lack of enforcement'.

As this subject is a new territory in Malaysia, there are many angles in which research can be extended. Knowledge on present application, weaknesses and potentials can open avenues for further action towards performance improvement. Apart from that, producing guidelines to highlight the aspects of sustainability within construction process would be useful to enable those aspects be managed effectively and efficiently. Last but not least, the challenges to build sustainably need to be critically analyzed and surmounted. Various techniques and tools existed that in the construction industry should be utilized to enhance the appreciation on sustainability in construction processes.

VI. CONCLUSION

The construction, management, use, change and demolition of the built environment can damage the environment to a substantial extent. Urban activities take up space and harm landscapes and ecological values. In the built environment, resources are taken from the environment and returned after use, usually in a degraded state. Fortunately, people are now beginning to realize the pitfalls of building unsustainably and are now moving towards better and more responsible development. The advantages of building sustainably have been revealed through much research and case studies conducted abroad. In Malaysia, the active promotion of sustainable development by the government, non-governmental organizations and education institutions in the past 5 years have shown some encouraging progress in this field. However, from the survey, it seems that the advantages of sustainable practices have not been firmly seized due to the slow permeation of this concept among the construction practitioners. In fact, many construction developers believed that the implementation of this concept is at low level. There are many factors that impede an active implementation such as

lack of knowledge, poor enforcement of legislation, education vs. experience and passive culture. It is believed that with current pace, this situation will only improve slightly (from low to moderate). More strategies and actions should be pursued actively to speed up the process in creating a sustainable-oriented construction industry, which are paramount towards building a sustainable future.

ACKNOWLEDGMENT

The author acknowledges the financial support provided by the Science University of Malaysia (USM) in Penang, Malaysia for this research.

REFERENCES

- [1] N. Zainul Abidin, "Using Value Management to Improve the Consideration of Sustainability within Construction", Ph.D. Thesis, Loughborough University, United Kingdom, 2005.
- [2] WS Atkins Consultants, *Sustainable Construction: Company Indicator*. CIRIA C563. London: CIRIA, 2001.
- [3] G. Ofori, C. Briffett, G. Gang and M. Ranasinghe, "Impact of ISO 14000 on Construction Enterprises in Singapore", *Construction Management and Economics*, vol. 18, pp. 935 – 947, 2000.
- [4] C. Hayles. (2004). "The Role of Value Management in the Construction of Sustainable Communities", *The Value Manager [Online]*, Vol. 10, no. 1, Available: <http://www.hkivm.com.hk/publications/04/TVM2004-1.pdf>
- [5] G. Ofori, "The environment: The Fourth Construction Project Objective?", *Construction Management and Economics*, vol. 10, pp. 369 – 395, 1992.
- [6] N.M. Das Gandhi, V. Selladurai and P. Santhi, "Unsustainable Development to Sustainable Development: A Conceptual Model", *International Journal of Management of Environment Quality*, vol. 17, no. 6, 2006.
- [7] B. Addis and R. Talbot, *Sustainable Construction Procurement: A Guide To Delivering Environmentally Responsible Projects*, CIRIA C571, London: CIRIA, 2001
- [8] P.L. Lombardi, "Responsibilities Towards the Coming Generations: Forming a New Creed", *Urban Design Studies*, vol. 7, pp. 89 – 102, 2001
- [9] S. Parkin, "Sustainable Development: the concept and the practical challenge", *Proceedings of the Institution of Civil Engineers: Civil Engineering*, vol. 138(special issue 2), pp. 3 – 8, 2000.
- [10] K. Hydes and L. Creech, "Reducing Mechanical Equipment Cost: the Economics of Green Design", *Building Research and Information*, vol. 28, no. 5/6, pp. 403 – 407, 2000.
- [11] J. Heerwagen, "Green Building, Organisational Success and Occupant Productivity", *Building Research and Information*, vol. 28, no. 5/6, pp. 353 – 367, 2000.
- [12] E. Bartlett and N. Howard, "Informing the Decision Makers on the Cost and Value of Green Building" *Building Research and Information*, vol. 28, no. 5/6, pp. 315 – 324, 2000.
- [13] G. Pettifer, "Gifford Studios – A Case Study in Commercial Green Construction" *CIBSE National Conference on Delivering Sustainable Construction*, 29 – 30 Sept., London, 2004.
- [14] A. Yates, *Quantifying the Business Benefits of Sustainable Buildings – Summary of existing research finds* (Extract) (Draft for discussion). Centre for Sustainable Construction. London: BRE, 2001
- [15] Construction Industry Development Board (CIDB), *Malaysian Construction Industry: Technology Foresight Report*. CIDB Malaysia and APEC Technology Foresight Center. Bangkok, 2000.
- [16] Eight Malaysia Plan, *Eight Malaysia Plan 2001 – 2005*. Kuala Lumpur: Percetakan Nasional Malaysia, 2001.
- [17] Construction Industry Development Board (CIDB) (2006), *CIDB Focus Groups [Online]*. Available: <http://www.cidb.gov.my>
- [18] Star Special, "9th Malaysia Plan 2006 – 2010", *The Star*, pp. SP 2, 1st April 2006.
- [19] Holcim Foundation for Sustainable Construction (2006), Available: <http://www.holcim.com.my>

- [20] Tanarimba (2006), *Tanarimba Project Development*, Available: <http://tanarimba.com.my>
- [21] Centre for Environment, Technology and Development, Malaysia (CETDEM) (2006), *DDC Project - Demonstration and Documentation Centre for Sustainable Urban Household Energy Usage*. Available: http://www.cetdem.org.my/sustainable_energy/ddc.html
- [22] Malaysia Energy Centre (PTM) (2006), *Zero Energy Office (ZEO) Building*. Available: http://www.ptm.org.my/PTM_Building/Index.htm