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SINGAPORE CONTRACTORS' ATTITUDES TOWARDS ENVIRONMENTAL SUSTAINABILITY

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ABSTRACT: Noting the changes within the Singapore construction industry, fuelled by the government's 'green' initiatives in tandem with the prolonged effect of the 1997-2005 recession, this paper investigates Singapore contractors' attitudes towards environmental sustainability. Data were collected from 34 interviews with senior management of large and medium-sized general building contractors and the firms' archival records. The results show that the majority of th e contractors embrace positive attitudes towards environmental sustainability. The respective contractors explicitly e xpress their environmental drives by incorporating keywords such as 'quality', 'sustainability' and 'environmental and social benefits' into their firms' mission statements. The results also show that three environmental-related meas ures implemented by all contractors are: (i) stricter housekeeping procedures in construction sites; (ii) stricter wastage ra tes for construction materials; and (iii) greater focus on Just-In-Time delivery to minimise materials deterioration due to inappropriate site storage.

Keywords: Attitudes, Environment, Sustainability, Singapore

1. INTRODUCTION

Many studies on sustainable construction have recognized the importance of the construction industry in contributing to everyone' quality life as well as conserving and protecting the environmental quality (e.g. [1-3]). However, in an attempt to fulfil the corresponding human needs and activities for shelters and facilities, construction firms were unaware of the detrimental impacts of their construction activities on the environment [4,5]. Some identified environmental impacts include: (i) environmental pollution; (ii) resource depletion; (iii) waste generate; and (iv) biodiversity loss [4,6].

Recognizing the environmental and social impacts triggered by construction activities on the environment, Myers [3] highlighted that construction firms should modernize and adopt sustainable approaches such as: (i) reducing the number of accidents on project sites; (ii) minimising construction waste; (iii) putting an end to its appealing record of pollution incidents; (iv) integration supply chain; and (v) creating a far more ethical and enhanced sustainability profile. Myers [3] and Bourdeau [7] shared the view that the future challenge for construction firms is to find and identify new visions and innovative practices in achieving mutual benefits for both social and environmental aspects of the built environment. To improve public image of the construction industry, which is being described by Fairclough [8:30] as "dirty, dangerous and old fashioned", Myers [3] suggested that responsible contractors should trumpet their new visions or achievements towards environmental sustainability.

There are a few studies on the sustainability agenda of individual contractors operating within different industry settings, for example, in Singapore [2,5], China [9]; UK [3]; Hong Kong [10]; and Australia [11]. These studies found that individual contractors' environmental management systems (EMS) play an important role in driving towards the attainment of sustainable construction. It appears, however, that the majority of these studies found that contractors' are reluctant to implement EMS, and generally there is a lack of respect for the environment. These observations may be attributed to the identified difficulties and obstacles in implementing EMS (see [2,9]). The aim of this paper is to investigate attitudes of Singapore contractors towards environmental sustainability, which have been characterized as negative leading to poor environmental performance such as inefficiency in resource utilization and health and safety problems [2,5,12]. The specific objectives are: (i) to assess Singapore contractors' attitudes towards environmental sustainability based on organizational attributes (i.e. organizational mission, vision, and value), and (ii) to identify environmental-related practices adopted by Singapore contractors in construction activities.

2. CONSTRUCTION ACTIVITIES AND THE ENVIRONMENT

There has of course been plenty written on sustainable construction, which include various implications of sustainability in the construction industry of various national and regional contexts (e.g. [7,13,14]). Several authors, such as Ofori [4,12], Hill and Bowen [1] and Tan et al. [5], provided comprehensive reviews on the effect of construction activities on the environment. In another study, Shen et al. [15] adopted a life-cycle approach in developing a framework for assessing sustainability performance of construction projects. They identified different sets of evaluation items corresponding to inception, design, construction, operation and subsequent deconstruction stage of a project.

A major environmental impact of construction stems from its consumption of energy and raw materials; in which some materials are non-renewable (5,16]. For example, in the UK construction industry, the Department of the Environment, Transport and Region (DETR) [6] reported that: (i) average raw materials consumption of each person was approximately six tonnes per year; (ii) only 10 to 15% of the 300 million tonnes of quarried aggregates used per year was recycled; (iii) more than 70 million tonnes of construction waste was created per year, representing 17% of the total UK waste; and (iv) around 70% of energy consumption could be directly or indirectly attributed to buildings and infrastructure facilities. Other environmental impacts of construction activities include: (i) spillage of silt or substances into the watercourses; (ii) smoke emissions of construction machineries; and (iii) wastage of raw materials during production, transportation and construction processes [4,16].

Recognizing the adverse environment impact of construction activities, Ofori [4] suggested that there is a need for the construction industry to develop a culture of environmental protection and clients should adopt 'the environment' as the fourth project objectives in addition to time, cost and quality. In developing the principles of sustainable construction, Hill and Bowen [1] proposed a multi-stage framework for sustainable construction stems from project planning and designing to decommissioning. Four critical elements were identified: (i) project environmental assessment; (ii) environmental policy; (iii) organizational structure; and (iv) environmental management program. Hill and Bowen [1] added that all identified elements and requirements should be specified in contract specifications and bills of quantities to reinforce the implementation of EMS in a construction project.

Bourdeau [7] summarized the International CIB W82 Project's findings on the relationship between sustainable development and construction across 14 countries. To reach a clear vision of the future of construction within a sustainable development assumption, the study involved extracting data from 14 national reports in an attempt to: (i) identify the main concerns on sustainable construction (e.g. constraint, policies and foreseen changes); (ii) analyse the consequences of sustainable development on different phases of construction process; (iii) identify the main strategic recommendations given by various countries; and (iv) gather the best practice case studies on sustainable construction. It concluded with the statement that:

> The challenge of the industry is to identify new and innovative practices, technologies…satisfy the need for a modern, competitive…and socially responsible industry. This is an enormous challenge; however, the achievement of sustainable construction will depend on the construction industry's willingness and ability to drive much of this change.

Myers [3] reviewed the attitudes of UK construction companies towards sustainability on the basis of public-disclosure of companies listed in the Financial Times 'building and construction sector'. He found that very few large-sized companies positively responded to the urge for sustainable construction in the UK construction industry, and deduced that this finding could possibly due to the fragmented and diverse nature of the industry. Considering the fragmented nature of the Singapore construction industry, Ofori [12] studied the possibility of using supply chain management (SCM) to improve the environmental performance of Singapore construction firms. He claimed that SCM could help to green the construction supply chain, and suggested some recommendations of green procurement initiatives in the Singapore construction industry (e.g. presenting best practices award and educating construction practitioner).

Tan et al. [5] studied the perception of Singapore contractors on ISO 14000, including ISO 14001 EMS, via questionnaire survey, and discussed the benefits and drawbacks in implementing ISO 14001 EMS. They found the all respondents were aware of the ISO 14001 standards, but the majority of them would only adopt the EMS if it becomes mandatory. Following this, Ofori et al. [2] surveyed 53 Singapore construction firms, comprising contractors, consultants and clients, on the impact of the implementation of ISO 14000 series on their operation. They found that: (i) the respondents adopted a wait-and-see attitude towards implementation of ISO 14000; (ii) there is a lack of knowledge of ISO 14001 standards within the industry; and (iii) the shortage of qualified personnel is one main hurdle faced by construction companies in implementing EMS.

In an attempt to explore the relationship between the implementation of ISO 9000 and ISO 14001 standards, another questionnaire survey was conducted by Ofori et al. [17] focusing on the perceptions, attitudes and expectations of Singapore construction firms on both standards. They found that contractors had derived benefits from ISO 9000 certification, and also an ISO 9000 certified contractor can well implement ISO 14001 EMS since the majority of materials prepared for ISO 9000 certification can be subsequently used for ISO 14001 certification. Exploring further into environmental awareness of Singapore firms, Ofori and Ho [18] surveyed 38 architectural firms, and found that the respondents were aware of the environmental impacts of building materials and the possible measures to overcome

the identified problems. However, they were not adopting green design approaches owing to some factors such as the lack of government's key directions and unwillingness of clients.

3. RECENT SUSTAINABLE DEVELOPMENTS IN SINGAPORE

3.1 General Development

The Singapore's Green Plan 2012 (SGP2012), launched in 2002 and currently undergoing its second three-yearly review, is Singapore's blueprint towards environmental sustainability [19]. This plan is based on the following principles: (i) to satisfy economic needs; (ii) to minimise and prevent pollution; (iii) to conduct environmental impact assessment for all development projects; (iv) to educate the public; (v) to legislate and enforce; and (vi) to monitor and review.

In the SGP2012, six environmental areas are highlighted: (i) clean air management; (ii) water management; (iii) waste management; (iv) nature conservation; (v) public health; and (vi) international environmental relations management [19]. Of these, some are related to the construction industry. These include the water quality management, highlighting the need for greater emphasis to educate construction workers on proper practices for discharging of waste water into the drainage system. In addressing the problem of silt pollution in watercourse due to the stormwater run-off from construction sites, the Brown to Clear (B2C) programme is implemented to raise construction firms' awareness and induce the adoption of Earth Control Measures (ECM) at worksite. Similarly, much emphasis is placed on: personal health of construction workers on issues such as Dengue and rat breeding in construction sites, and smoke emissions of construction machineries. In January 2007, a more stringent Chassis Dynamometer Smoke Test was imposed for mandatory periodic inspections of diesel vehicles. In alignment with the environmental campaign, various incentive schemes (e.g. Energy Efficiency Improvement Assistance Scheme and Green Vehicle Rebate) were initiated by the government to: promote conservation of energy and water; and encourage clean vehicle technologies. These recent development programmes reinforce the established statutes and regulations in the Ministry of Environment's (MOE) [20] environmental protection handbook.

MOE [19,21] observed that the Singapore construction industry has increasingly become aware and committed towards environmental sustainability. This phenomenon is supported by the relative high recycling rate of 94% and 98% achieved in 2005 and 2006, respectively. Also, it is reported that 13 agencies (e.g. Land Transport Authority, Housing Department of Board and Singapore Land Authority) have incorporated the ECM requirement in their contracts [19]. Similarly, there is an increase in the number of associations (e.g. Institution of Engineers and Singapore Contractors Association Limited) offering training courses and seminars for construction practitioner.

3.2 ISO 14000

Spring Singapore (previously known Productivity and Standards Board, PSB) adopted both the ISO 14001 and 14004 as Singapore Environmental standards. According to National Environment Agency (NEA) of Singapore [22], these standards are voluntary environmental management standards for organizations to develop, implement and improve their environmental policies and objectives in striving towards sustainability although; these standards do not specify any environmental performance criteria.

ISO 14001 is often seen as the basis standard of the ISO 14000 series, and it is the only standard in ISO 14000 series which is currently possible to be certified by an external certified authority [22]. To complement the ISO 14001 standard, ISO 14004 was established to provide guideline and clarifications on the development and implementation of the EMS and principles as well as the integration of other management systems. However, the ISO 14004 standard could only be used as an internal management tool which is no applicable for ISO certification. Based on NEA's [22] latest update, there are 747 Singapore companies certified under the ISO 14001 environmental standard scheme.

3.3 Green Mark Scheme

In January 2005, the Singapore Building and Construction Authority (BCA) launched the Green Mark Scheme (GMS) in an attempt to promote environmental awareness in the construction and real estate sectors. According to BCA [23], the GMS aims to: (i) provide a yardstick to rate a building's environmental friendliness, and (ii) encourage developers and building owners to adopt green building technologies in achieving a sustainable built environment via improving resource efficiencies.

To further encourage the adoption of green building practices and technologies, the Singapore government launched the Green Mark Incentive Scheme (GMIS) in late 2006. It proposed a $20 million cash incentive for developers and building owners, who achieve the targeted benchmark in the design and construction of new buildings or the retrofitting of existing buildings during the periods 2006 to 2008 [23]. According to BCA's [24] latest update, a total of 61 building projects, comprising a good mix of private and public projects, have been awarded the Green Mark Certificate.

Also, in the Ministry of National Development's (MND) [25] publication on 'Planning for Growth, Investing for our Future', the following vision is highlighted:

> Moving forward, we will go beyond estates upgrading to place greater emphasis on the rejuvenation of our housing estates… to comprehensively redesign these estates...the concept of "Housing in a Park", which will complement our vision of Singapore to be a City in a Garden (p.5).

In complementing the MND's vision, in March 2007,

the Singapore Housing Development Board (HDB) launched its first eco-precinct comprising 712 premium apartments which will be completed in 2011. HDB [26: 9] reported that the precinct would feature:

> A range of green technology and innovations for effective and efficient energy, water, and waste management. It would also promote an environmental sustainable lifestyle with close involvement of the residents.

The foregoing discussion clearly demonstrates the Singapore government and its industry efforts and progresses in addressing environmental issues. In particular, various schemes and regulations have been implemented by the Singapore government from the periods 2002 to 2008. Lim et al. [27] noted that the Singapore contractors have adopted various strategies in surviving the prolonged 1997-2005 recession in the construction industry. They found that the majority of the large-and-medium sized contractors in their study have placed greater emphasis on Research and Development (R&D) activities to effectively manage the business opportunities which emerge from the sustainability agenda. Noting these changes in the construction industry, fuelled by the Singapore government's 'green' initiatives in tandem to the prolonged effect of the 1997-2005 recession, it appears necessary to revisit Singapore contractors' attitudes towards environmental sustainability.

4. RESEARCH DESIGN AND METHOD

Survey design was chosen in this study due its ability to provide a relative quick and efficient method of obtaining information concerning contractors' attitudes and adaptive responses toward environmental sustainability issues. Data were collected from 34 semi-structured interviews and firms' archival records. A semi-structured interview was adopted with the aim to foster a greater deal of freedom to explore various areas and raise particular queries regarding their responses. In this case, a postal questionnaire survey, despite its ability to have wider coverage, was not used for data collection because of the anticipated low response rate (generally below 20%) for studies involving construction practitioners in Singapore [28]. Archival records such as firms' records, statistical and financial reports, on the other hand, provide a comprehensive source of information regarding an organization structure and its mission statement, vision and value.

The target groups of large and medium-sized general building contractors (i.e. Group A1, A2 and B1) were selected from the contractors' registry of the Singapore BCA. A total of 34 interviews were conducted with personnel of the targeted construction firms, consisting 28 local and six foreign firms with their firm age ranging from 17 to 81 years old (based on 2008). Of these, 17 were from Group A1, nine were from Group A2 and the remaining were from Group B1 contractors. This represents a response rate of 37% which appears both representative and reasonable. All the interviewees are from senior management levels including managing directors, directors, general managers and senior contract managers who are key decision makers in their organizations. Textual analysis was conducted on 34 sets of transcribed interview data and the firms' archival records, using the QDA Miner Version 3.03.

5. RESULTS AND DISCUSSION

The classification of firms' mission, visions and values show that 68% (23 out of 34) of the companies interviewed have placed emphasis on corporate quality, environmental and resource management in their business operations (Table 1). This is attested by the keywords: 'quality', 'sustainability' and 'environmental and social benefits' incorporated into their vision, core values and mission statements. Some examples of the firms' mission statements are given below:

> To become a responsible corporate citizen that contributes to economical, social and environmental values and benefits.

> To deliver high quality materials and products, and keep environmental responsibility and sustainability our top priorities across all our business operations.

> To provide quality service to meet customer requirements through the timely delivery of projects, quality workmanship, good safety standard and minimal impact to the environment.

This observation is in contrast to Ofori et al.'s [17] finding in 1999 where the majority of mission statements provided by their respondents emphasized on corporate quality management. In terms of environmental-related publications, 12 out of the 23 firms have uploaded their firms' quality, environmental health and safety policy on the companies' websites. While 32% (11 out of 32) of the companies interviewed have placed sole emphasis on corporate quality in their vision, core values and mission statements, it is noted that four contractors in this classification have uploaded their quality, environmental health and safety policy on the companies' websites. It therefore seems that this group of contractors' have embraced positive attitude towards environmental sustainability although, the keywords such as 'sustainability' and 'environmental' have not been incorporated into their mission statements. The evidence is thus suggestive that the majority of firms interviewed are beginning to acknowledge environmental sustainability.

Further evidence of the Singapore contractors' positive attitudes towards environmental sustainability can be found by examining the environmental-related measures taken by the companies interviewed (Table 2). A total of eleven measures have been identified based on the interview data. All companies interviewed have adopted the following three measures: (i) M1 – stricter

housekeeping to prevent breeding of mosquitoes and pests; (ii) M2 – stricter wastage rates for construction materials on site; and (iii) M3 – greater focus on Just-In-Time delivery concept to minimise materials deterioration due to inappropriate site storage. The interviewees pointed out that stricter waste management is of paramount importance because it has direct impact on companies' cost reduction and control initiatives; particularly during the 1997-2005 recession. The other two common measures identified are: (i) M4 - segregating construction wastes into bins to facilitate recycling process, and (ii) M5 - using silt water treatment system to recycle 'dirty' water for washing and cleaning purposes. The former has been widely identified as good practice in site management practice in implementing waste management on construction sites [29].

In addressing air pollution problems, it can be seen that there are specific measures targeting this issue including: the use of windproof nets (M6), the installation of air filtration devices (M7), and the use of bio-fuels for construction machineries (M8). Although less than half of the companies interviewed have adopted these measures, it is likely that these measures will gain popularity among the contractors in meeting the needs of society and enhancing the quality of life. According to Petrovic-Lazarevic [11], an image of an organization that cares for its environment will contribute to the organization being better positioned among its clients and users compared to organizations that do not assume high social responsibility. This is clearly reflected in the interview findings of this study. For example, one interviewee, who claimed his firm was the first in Singapore to use bio-fuels, noted that this environmental-friendly measure had contributed to the firm's ability to win job.

In assessing environmental performance of construction firms, Tam et al. [30] suggested that environmental-related measures can be categorized into two main categories, namely: operational and management performance indicators. Based on similar rationale, the majority of the identified measures (M1 to M9) can be classified as operational performance indicators, while the two management performance indicators on the list are: (i) M10 – exploring into different construction techniques that lead to efficiency in resource utilization, and (ii) M11 – implementing profit-sharing scheme by rewarding employees for the amount of materials saved. These two measures taken by the respective firms have demonstrated the top management commitment in environmental management. This includes investment into R&D in exploring into different construction technologies and allocation of resources (incentives) in implementing related management structures. There are long-term benefits associated with these measures such as reduction in cost on waste treatment, fines, and insurance premium, etc.

Table 1 Classification of firms' mission, visions and core values

Mission, visions and core values	No. of firms		Total (% of total)
	With Quality, Environmental Health & Safety Policy	Without Quality, Environmental Health & Safety Policy	
Sole emphasis on corporate quality management	4	7	11 (32%)
Emphasis on corporate quality, environmental and resource management	12	11	23 (68%)

Table 2 Environmental-related measures taken by contractors

	Measures	No. of firms (%)
M1	Undertaking proper housekeeping to prevent breeding of mosquitoes and pests via regular inspection by safety managers/officers	34 (100)
M2	Imposing stricter wastage rates for construction materials on site	34 (100)
M3	Implementing Just-In-Time delivery concept to minimise materials deterioration due to inappropriate site storage	34 (100)
M4	Segregating construction wastes into bins to facilitate recycling process	29 (85)
M5	Using silt water treatment system to recycle 'dirty' water for washing and cleaning purpose	27 (79)
M6	Using windproof nets on site to minimise air pollution	15 (44)
M7	Incorporating air filtration devices onto construction machineries to minimise smoke emission	12 (35)
M8	Using less pollutive bio-fuels for construction machineries	7 (21)
M9	Using plastic formwork instead of timber formwork	7 (21)
M10	Exploring into different construction techniques which are more efficient and less-resource intensive	6 (18)

M11	Implementing profit-sharing scheme by rewarding employees for the amount of materials saved	5 (15)

Although only eleven environmental-related measures have been identified in this study, the findings are still encouraging given the lack of respect for environment within the Singapore construction industry as revealed in the literature. As revealed in the interviews, the large contractors (i.e. Group A1 with unlimited tendering limit) that made up half of the sample size can be broadly classified into two groups based on their attitudes towards environmental sustainability. On one hand, the majority of the large contractors are beginning to acknowledge environmental sustainability and examples of practices to minimize negative impacts on the environment were noted in the discussions. On the other hand, there is a small group of large contractors who are genuinely committed to the idea of environmental sustainability and use it to grow their business, they strive to innovate and think beyond the current paradigm. As for the medium-sized contractors (i.e. Groups A2 and B1), the analysis suggests that they do implement some of the identified measures. This represents a typical picture in the industry that smaller firms are slower in implementing sustainability measures [3].

6. CONCLUSION

In the last decade, the Singapore contractors' attitudes towards environmental sustainability have been characterized as negative that lead to poor environmental performance. On the basis on interview findings and firms' archival records, this paper investigates Singapore contractors' current attitudes towards environmental sustainability, fuelled by the government's 'green' initiatives in tandem with the prolonged effect of the 1997-2005 recession in the industry. The results show that the majority of the large and medium-sized contractors embrace positive attitudes towards environmental sustainability. The respective contractors explicitly expressed their environmental drives by incorporating keywords such as 'quality', 'sustainability' and 'environmental and social benefits' into their mission statements.

Further evidence of the Singapore contractors' positive attitudes towards environmental sustainability was demonstrated by the eleven environmental-related measures taken by the companies interviewed. The three environmental-related measures implemented by all contractors are: (i) stricter housekeeping procedures in construction sites; (ii) stricter wastage rates for construction materials; and (iii) greater focus on Just-In-Time delivery to minimize materials deterioration due to inappropriate site storage. Other measures include air and water pollution control programs, incentive program for waste control on site, and exploring into construction technologies that lead to efficiency in resource utilization. The interview findings also show that the large contractors in the sample involved can be broadly classified into two groups based on their attitudes towards environmental sustainability. The majority of the large contractors are beginning to acknowledge environmental sustainability, while there is a small group of large contractors who are genuinely committed to the idea of environmental sustainability and use it to grow their business.

It is suggested that future studies could focus on different major players in the various stages of construction projects in identifying their adaptive strategies in response to environmental sustainability agenda. In this way, the true nature of the industry responses towards environmental issues will be revealed and also how these responses complement to realize the opportunities that emerge from the sustainability agenda.

REFERENCES

[1] Hill, R.C. and Bowen, P.A. (1997) Sustainable construction: principles and a framework for attainment. *Construction Management and Economics*, 15(3), 223-39.
[2] Ofori, G. Briffett, C. and Gang, G. (2000) Impact of ISO 14000 on construction enterprises in Singapore. *Construction Management and Economics*, 18(8), 935-47.
[3] Myers, D. (2005) A review of construction companies' attitude to sustainability. *Construction Management and Economics*, 23(8), 781-85.
[4] Ofori, G. (1992) The environment: the fourth construction project objective? *Construction Management and Economics*, 10(5), 369-395.
[5] Tan, A.T.K., Ofori, G. and Briffett, C. (1999) ISO 14000: Its relevance to the construction industry of Singapore and its potential as the next industry milestone. *Construction Management and Economics*, 17(4), 448-61.
[6] Department of the Environment, Transport and the Regions (DETR) (1998) *Sustainable Development: Opportunities for Changes - Sustainable Construction.* London: Stationary Office.
[7] Bourdeau, L. (1999) Sustainable development and the future of construction: a comparison of visions from various countries. *Building Research and Information*, 2(6), 355-67.
[8] Fairclough, J. (2002) *Rethinking Construction Innovation and Research: A Review of Government R&D Policies and Practices*, The Government of United Kingdom, downloaded from http://www.berr.gov.uk/files/file14364.pdf <130308>
[9] Zeng, S.X., Tam, C.M., Deng, Z.M. and Tam, V.W.Y. (2003) ISO 14000 and the construction industry: survey

in China. *Journal of Management in Engineering*, 19(3), 107-115.
[10] Tam, V.W.Y., Tam, C.M., Zeng, S.X. and Chan, K.K. (2006) Environmental performance measurement indicators in construction. *Building and Environment*, 41(2), 164-173.
[11] Petrovic-Lazarevic, S. (2008) The development of corporate social responsibility in the Australian construction industry. *Construction Management and Economics*, 26(2), 93-101.
[12] Ofori, G. (2000) Greening the construction supply chain in Singapore. *European Journal of Purchasing and Supply Management*, 6(3-4), 195-206.
[13] Lorenz, D., Lützkendorf, T. and Panek, A. (2005) Sustainable construction in Central/Eastern Europe: implications from SB04 in Warsaw. *Building Research & Information*, 33(5), 416–427.
[14] Gomes, V. and Da Silva, M. (2005) Exploring sustainable construction: implications from Latin America. *Building Research & Information*, 33(5), 428–440.
[15] Shen, L.Y., Hao, J.L., Tam, V.W.Y. and Yao, H. (2007) A checklist for assessing sustainability performance of construction projects. *Journal of Civil Engineering and Management*, 13(4), 273-281.
[16] Brandon, P. S. and Lombardi, P. (2005) *Evaluating Sustainable Development: In the Built Environment*. Oxford: Blackwell Science Ltd.
[17] Ofori, G., Gang, G. and Briffett, C. (2002) Implementing environmental management systems in construction: lessons from quality systems. *Building and Environment*, 37(12), 1397-1407.
[18] Ofori, G. and Ho, L.K. (2004) Translating Singapore architects' environmental awareness into decision making. *Building Research & Information*, 32(1), 27-37.
[19] Ministry of Environment (MOE) (2006) *The Singapore Green Plan*, downloaded from: http://www.mewr.gov.sg/sgp2012/index_2006.htm <130308>
[20] MOE (1993) *Environmental Protection in Singapore*. Singapore: Ministry of the Environment.

[31]

[21] MOE (2007) *Key Environmental Statistics 2007*, downloaded from: http://app.mewr.gov.sg/data/ImgUpd/KESDATA.pdf <130308>
[22] National Environment Agency (NEA) (2008) *ISO 14000 in Singapore*, The Government of Singapore, available at: http://app.nea.gov.sg/cms/htdocs/category_sub.asp?cid=146#Part1
[23] BCA (2007a) *Green Mark Incentive Scheme,* The Building and Construction Authority of Singapore, downloaded from: http://www.bca.gov.sg/GreenMark/GMIS.html <130308>.
[24] BCA (2007b) *Green Mark Project*, The Building and Construction Authority of Singapore, downloaded from: http://www.bca.gov.sg/GreenMark/green_mark_projects.html <130308>.
[25] Ministry of National Development (2007) *Planning For Growth, Investing in our Future*, The Government of Singapore, downloaded from: http://www.mnd.gov.sg/publications/planningforgrowth/Index.htm <130308>.
[26] Housing & Development Board (HDB) (2007) *HDB Annual Report 2006/2007*, The Government of Singapore, downloaded from: http://www.hdb.gov.sg/fi10/fi10296p.nsf/WPDis/About%20UsAnnual %20Reports?OpenDocument <130308>
[27] Lim, B.T.H., Oo, B.L. and Ling, F.Y.Y. (2009) The survival strategies of Singapore contractors in prolonged recession. *Engineering, Construction and Architectural Management* (under review).
[28] Tan, W. (1995) *Research Methods in Real Estate and Construction*. Singapore: National University of Singapore.
[29] Shen, L.Y., Tam, V.W.Y., Tam, C.M. and Drew, D. (2004) Mapping approach for examining waste management on construction sites. *Journal of Construction Engineering and Management*, 130(4), 472-481.
[30] Tam, C.M., Tam, V.W.Y. and Tsui, W.S. (2004) Green construction assessment for environmental management in the construction industry of Hong Kong. *International Journal of Project Management*, 22(7), 563-571.