May-June 2020
ISSN: 0193-4120 Page No. 3977-3990

The Development of Conceptual Model for Improving Sustainable Building Construction Implementation

Nazirah Mat Russ[*a], Mahanim Hamid[b], Kho Mei Ye[c]

[a]Architecture and Environmental Design Department, Centre for Foundation Studies, International Islamic University Malaysia, Kuala Lumpur, Malaysia
[b,c]Department of Quantity Surveying, Faculty of Built Environment, University of Malaya, Kuala Lumpur, Malaysia

Article Info
Volume 83
Page Number: 3977-3990
Publication Issue:
May - June 2020

Abstract

Ongoing discussion about sustainable building construction problems such as high initial cost caused by "green cost premium" supported by long-term and uncertain of return on investment (ROI) as well as long-term and low profitability, lead to passive involvement of construction practitioners to construct sustainable building even many benefits are well documented. Previous research finding revealed that, most of the construction practitioners are not willing to spend more just to implement sustainability in their project and some of them has no long-term interest in operating or leasing the buildings. Hence, the question arises on "how can this issue be resolved?". Therefore, this study presents a conceptual model aiming at reducing the initial cost of sustainable building construction project with the hope that this will encourage construction practitioners to invest in sustainable building construction project. Based on the analysis of existing literature (e.g.: conference paper, journal article) there are 19 cost reduction methods, that classified into six elements:technical approach, motivation, design management, project team characteristic, practical approach and management innovation. As there are limited studies conducted on methods to reduce sustainable building construction cost, the authors decided to gather an information on methods to reduce initial project cost not limited to sustainable building construction and in various industries. The components of this conceptual model were constructed based on theories and empirical evidence relating to cost reduction at which, the authors combine and conceptualized them into input-process-output (IPO) model to produce the proposed conceptual model of this study. At the end of this stage, the authors found 9constructs with 2 associations.

Keywords**:** *Conceptual model, cost reduction methods, sustainable building construction, sustainable building construction cost.*

Article History
Article Received:*19 November 2019*
Revised: *27 January 2020*
Accepted: *24 February 2020*
Publication: *12 May 2020*

1. Introduction

Sustainable building construction yields a number of benefits, both tangible and intangible. For instance, sustainable building construction may increase land, material and water efficiency (Zhu, 2012), ensure the quality, safety and minimize the negative impacts on the environments (Li, Liu,& Tang, 2011). Additionally, issues such as reduction of natural resources, environmental pollution: noise, air, water and solid waste that may cause hazard and accident at site, project delay and project failures can be mitigated through sustainable construction (Sousa, Almeida, & Dias, 2015; Windapo &

May-June 2020
ISSN: 0193-4120 Page No. 3977-3990

Goulding, 2015).Sustainable construction is the process applied during construction to achieve sustainable development (Kamar & Hamid, 2011), and it involves the integration of three principles: (i) economic sustainability, which is a commitment to a financial mechanism to increase profitability; (ii) environmental sustainability, which is a commitment to carefully use natural resources; and (iii) social sustainability, which is a commitment toward people's needs (Hussin, Rahman, & Memon, 2013).

However, the application of sustainable construction within building construction received inadequate support at which, sustainable building construction commonly mentioned to be more expensive than traditional building construction due to additional cost which is termed as 'green cost premium' (Jin, 2019; Russ, Hanid, & Kho, 2018;Latiffi& Ng, 2017; Hwang, Zhu, Wang, & Cheong, 2017; Zaini, 2016; CREAM, 2016; Mao, Xie, Hou, Wu,Wang, & Wang, 2016; Hwang & Ng, 2013; Jaafar & Radzi, 2013; Oladinrin, Olatunji, & Hamza,2013; Ling & Ali, 2012; Nurul Zahirah & Abidin, 2012).This is parallel with the study conducted by Russ, Hanid, & Kho (2018), where it has been proved that, green cost premium are the problems allied with sustainable building construction implementation worldwide. There are eight elements of green cost premium been identified that contributed to higher initial cost of sustainable building construction which are sustainable materials, sustainable equipment, sustainable technology, sustainable design, tendering, contractor's experience, and insurance (Russ, Hanid, & Kho, 2018). Endless discussion about higher initial cost of sustainable building construction, lead to demands for cost reduction, value improvement, and better quality (Aapaoja & Haapasalo, 2014).

Besides, the existing models: Green Construction Assessment (Tam & Tsui, 2004), Green Construction Implementation (Shi, Zuo, Huang, Huang, & Pullen, 2013), Green Construction Framework (Qi, Shen, Zeng, & Jorge,2010), The path of Achieving Sustainable Construction (Abidin, 2010), and Green Construction Model (Zaini, 2016) relating to sustainable construction are mainly focused on the elements of awareness, readiness, design and environment at which, there is an absence of economic sustainability principle. Furthermore, it is known that, the concept of economic sustainability as applied to the construction industry is planned to apply the utmost cost efficiency and reduce financial cost (Akadiri, Chinyio, & Olomolaiye, 2012) along with commitment to financial mechanism to increase profitability (Hussin, Rahman, & Memon, 2013).As construction companies are profit driven organization, therefore this study presents the conceptual model, aiming at reducing the initial cost of sustainable building construction project with the hope that this will encourage construction practitioners to invest in sustainable building construction project.

2. Methodology

This study reviews the literature in the area of cost reduction methods purposely for a conceptual model development. Therefore, a systematic literature review is conducted and identified 127 studies related to cost reduction methods. This review procedure involved journal articles and conference papers identified from EBSCOhost, Science Direct, and Scopus database searches within the context of Asia, Europe, the United States, Africa, and the Oceania continents between 1999 to 2019. The authors decided to include studies in year 1999 as studies conducted in sustainable building construction cost reduction are scarce (Sarhan, Pasquire, Elnokaly, & Pretlove, 2019; Arif, Jaapar, Bari, & Zawawi, 2013). As for this study, method is referred to specific strategies, tools and techniques, or procedure aimed at reducing sustainable building construction cost. Therefore, out of 127 studies, 77 studies highlighted on tools and techniques, and 50 studies highlighted on strategies. This study included only literature that highlighted on the effectiveness of cost reduction methods in reducing the desired cost, as this study focuses on examining the association between methods and cost reduction areas to develop the conceptual model, and there were 19 studies had been selected.

The conceptual model of this study was design based on Input-Process-Output (IPO) model and the components of this model was established based on theories and empirical evidences relating to cost reduction in various industries. IPO model consist of 3 dimensions: input, process, and output as depicted in Fig. 1. Input is defined as all factors that are independent, can be manipulated and directly impact the output through process (McCuspie, Hyman, Yakymyshy, Srinivasan, Dhau, & Drake, 2014; Cohen & Bailey, 1997). As for this study, input dimension is represented by the element of green cost issues at which, issues contributing to green cost premium can be manipulated and controlled by the authors in order to see what effects they have. Process is defined as a series of activities that influence by different input and affect the output (Herre, 2010; Cohen & Bailey, 1997). As for this study, process dimension is represented by the element of green cost reduction methods where the usage of cost reduction methods is influenced by different elements of green cost issues (input). While, output is defined as the result produced by the process (McCuspie, Hyman, Yakymyshy, Srinivasan, Dhau, & Drake, 2014). In addition, Cohen and Bailey (1997) highlighted that, there are 3 measures of output which are (i) measure of effectiveness (e.g. response time, productivity, efficiency, quality, customer satisfaction, innovation), (ii) measure of member attitude (e.g. employee satisfaction, commitment, and trust and (iii) measure of behavioural (absenteeism, turnover, and safety). As for this study, the output dimension is represented by the element of green cost reduction success at which, measure by the effectiveness of cost reduction.

May-June 2020
ISSN: 0193-4120 Page No. 3977-3990

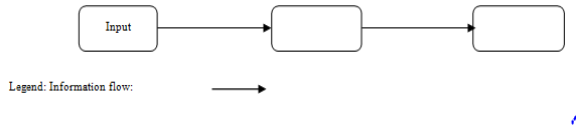

Figure 1: IPO model

3. Literature Review

This section presents the discussion of the existing literature in the area of cost reduction methods in various industries due to limitation of cost reduction studies conducted within sustainable building construction context. It starts by justifying the need of cost reduction within sustainable building construction followed by theoretical review and empirical review of cost reduction and ended with discussion. The result of this review will help in developing the components of the conceptual model of this study where the placement of each component is based on IPO model.

1.1 Cost reduction and sustainable building construction

Previous studies (Hwang, Zhu, Wang, & Cheong, 2017;Dodge Data & Analytics, 2016; Mao, Xie, Hou, Wu,Wang, & Wang, 2016; Dwaikat & Ali, 2016; Whang & Kim, 2015; Shang & Pheng, 2014; Ahn, Pearce, Wang, & Wang, 2013; Qian & Foong, 2013; Hwang & Ng, 2013; Robidchaud & Anantatmula, 2011) claim that high initial cost caused by green cost premium is the crucial barrier prior to sustainable building construction implementation. However, those cost can be recuperated by high turnovers and profit in a long run as a result of low maintenance cost and low operational cost of sustainable building (Whang & Kim, 2015; World GBC, 2013; Akadiri, Chinyio, & Olomolaiye, 2012; Robidchaud & Anantatmula, 2011).

Despite the prevailing circumstances, construction practitioners' primary goals are to make benefits and quick return on investment (Lee, Lee, Kim, & Kim, 2013). It is believed that, investment in sustainable building construction project can be full returned during operational stage where it will take about 7-8 years (IEA, 2006). Parallel to this, Orry (2019) highlighted that, there is still lack of hard evidence to link between capital cost expenditure in sustainable building construction and positive return on investment (ROI) and it may vary according to building type which have different operational requirement. Therefore, many construction practitioners relatively passive to invest in sustainable building construction as they prefer a short-term payback period (Lee, Lee, Kim, & Kim, 2013; USGBC, 2006). Additionally, Akadiri, Chinyio, & Olomolaiye(2012) highlighted that, construction practitioners are under pressure since client are demanding for project cost minimization, at the same time relatively ambitious. For this reason, it is important to look for, find and remove the unwarranted cost during the initial stage of the project.

The term cost reduction, cost control and cost saving are always use interchangeably, despite these term holds different meaning (Akeem, 2017; Barbole, Nalwade, & Parakh, 2013; Yadav, Jain, Kapoor, & Nateriya, 2013). Cost control is a process of maintaining the actual cost of each element with respect to agreed budget (Akeem, 2017). Cost saving is a process of reducing the production cost by all means, without compromising the quality or value for instances, use poor quality of raw materials, or improper logistic management (Yadav, Jain, Kapoor, & Nateriya, 2013). While, cost reduction is a process of achieving profit maximization by removing all types of waste and inessential expense at the same time maintaining the function and quality of the products and assure value for the customer at the lowest life-cycle cost (Barbole, Nalwade, & Parakh, 2013; Yadav, Jain, Kapoor, & Nateriya, 2013).Therefore, this study refers cost reduction as a process of removing the green cost premium of sustainable building construction project during initial stage, to achieve profit maximization, at the same time maintaining the quality of the product in meeting client requirement.

a. 3.2 Theoretical review of cost reduction

Theory is a logical tool use to understand, explain and make prediction about subject of interest (Dokata, 2017). As for this research, two theories: Neo-classical growth theory, and social cognitive theory are well discussed in the following paragraph.

3.2.1 Neo-classical growth theory

The neo-classical growth theory is a theory used in economics, identified and explained the factors that contributes to the growth of economy (Egbide, Adegbola, Bamidele, Sunday, Olufemi, & Ruth, 2019). Otekunrin, Nwanji, Olowookere, Egbide, Fakile, Lawal, Ajayi, Falaye, & Eluyela(2018) stated that, a stable growth of economy can be achieved with the proper amounts of three powerful economic factors: labour, capital: physical capital (eg; factories, equipment, infrastructure), human capital (eg; skills, knowledge, experience) and technology. Due to this, a study conducted by Egbide, Adegbola, Bamidele, Sunday, Olufemi, & Ruth (2019) on cost reduction strategies in manufacturing industry found that there are three major factors that affects its capacity to grow which are labour cost, material cost and overhead expense at which, manufacturing organizations will experience growth if these costs are well allocated, controlled and reduced. Therefore, this paper theorizes that, in construction industry, particularly sustainable building construction, an organization may experience growth if initial costs: preliminary, design (human capital), and construction cost (physical capital, technology) are rightly allocated, controlled and reduced and this will encourage more construction practitioners to invest in sustainable building construction project.

May-June 2020
ISSN: 0193-4120 Page No. 3977-3990

3.2.2 Social cognitive theory

Social cognitive theory is a theory used in psychological field that describes the motivations, expectations, forethought, and predictions that influence individual's action (Joachim, Kamarudin, Aliagha, Mohammed, & Ali, 2017). A study conducted by Afandi & Abidin (2013) highlighted that, social cognitive theory is used to explain the decisions to invest in sustainable building construction where it closely depending on the intention and implication identified through forethought. As regard to this, social cognitive theory theorizes that, tax relief, low interest loan, subsidies, and incentives can motivate contractors to invest in sustainable building construction at which, one of the strategies to reduce the cost of sustainable building construction offered by the government (Joachim, Kamarudin, Aliagha, Mohammed, & Ali, 2017).

b. 3.3 Empirical review of cost reduction

As stated earlier, many construction practitioners relatively passive to invest in sustainable construction as sustainable building represents a long-lasting investment in financial terms (Akadiri, Chinyio, & Olomolaiye, 2012) as well as long-term of ROI and long-term profit (Lee, Lee, Kim, & Kim, 2013). Thus, the construction practitioners are under pressure to reduce project cost and consider how much a building will cost (Akadiri, Chinyio, & Olomolaiye, 2012). The following Table 1, summarize the studies of cost reduction methods application across industries.

Table 1: The application of cost reduction methods in various industries.

Author(s)	Country	Industry	Empirical finding(s)
Zhiran & Mengxiao (2012)	China	Automotive	Just-in-time, Standardization.
Athalye et al. (2013)	India		Kaizen costing, just-in-time, value engineering, total quality management.
Gilotra & Kandoi (2015)	India		Value engineering.
Egbide et al. (2019)	Nigeria	Manufacturing	Kaizen costing, value engineering.
Sharma (2017)	Nepal		Total quality management, supply chain management, kaizen costing, standardization.
Barbole et al. (2013)	India		Value engineering, total quality management, just-in-time, kaizen costing.
Yadav et al. (2013)	India		Supply chain management, reuse practice, tax relief, and subsidies.
Nowotarski et al. (2016)	Poland	Construction	Just-in-time, 5S
Heralova (2016)	Czech Republic		Value engineering
Damnjanovic et al. (2009)	Texas		Value engineering, standardization, bundle/split project, price escalation clause, performance-based contracting, reuse practice.
Mahadik (2015)	India		Value engineering
Ganja et al. (2005)	Brazil		Kaizen costing, value engineering.
Hwang et al. (2017)	Singapore	Sustainable construction	Tax relief, availability of skilled design team and contractor, subsidies, and incentives.
World GBC (2013)	-		Hiring skilled and experienced project team, integrated design process.
Akadiri et al. (2012)	UK		Locally-sourced materials, reuse practice, standardization.
Bae & Kim (2007)	Korea		Integrated project team, performance-based contracting, integrated design process, set-based design, just-in-time, target costing, kaizen costing, 5S.
Robidchaud & Anantatmula (2011)	US		Integrated project team, integrated design process.
Lehman & Reiser (2000)	US		Just-in-time, value engineering, standardization, integrated project team.
Building Green Inc (1999)	US		Value engineering, integrated design process, reuse practice.

c. 3.4 Discussion

Based on the above review, the proposed conceptual model of this study was developed aiming at reducing high initial cost of sustainable building construction projectcaused by green cost premium, to improve sustainable building construction implementation. Belout & Gauvreau (2004) stated that, most of the models were developed based on theories rather than empirical evidence. Considering this, the components of the proposed modelling were developed based on adoption and combination of theories and empirical evidence at which, the authors embedded them into Input-Process-Output (IPO) model.

As stated above, there are 2 theories adopted in this study which are neo-classical growth theory and social cognitive theory. Yadav, Jain, Kapoor, & Nateriya (2013) stated that, businessperson requires growth of the firms and at the same time demand to reduce cost. Therefore, as responds to the growth of a firm and cost reduction, neo-classical growth theory is chosen. Besides, it is highlighted earlier that the commitment and effort among the construction practitioners toward sustainable building construction are relatively low due to higher initial cost which on top of that, uncertain return on investment (ROI). As responds to this, social cognitive theory is chosen as it explains on the factors that will influence individual's action.

Additionally, these 2 theories are combined with another 19 studies highlighted in this study, that represented the empirical evidence of the effectiveness of cost reduction methods applied in various industries: automotive, manufacturing, construction, and sustainable construction industry to reduce the desired cost. There are 19 cost reduction methods being identified which are just-in-time (JIT), value engineering (VE), kaizen costing, standardization, integrated design process, reuse practice, integrated project team, total quality management (TQM), tax relief, 5S, performance-based contracting, supply chain management (SCM), availability of skilled and experienced project team, subsidies, set-based design, locally-sourced material, green financing scheme, price escalation clause, and bundle/split project at which, positively prove can reduced the desired cost.

However, few studies have been conducted on methods to reduce green cost premium, therefore, it is important to fill in this gap through the establishing of conceptual model of this study, which includes (i) INPUT- elements of green cost issues: sustainable materials, sustainable equipment, sustainable technology, sustainable design, tendering, contractor's experience,

May-June 2020
ISSN: 0193-4120 Page No. 3977-3990

and insurance (ii) PROCESS- elements of green cost reduction methods: technical approach, motivation, design management, project team characteristic, practical approach, and management innovation, (iii) OUTPUT- green cost reduction success: effectiveness of cost reduction process.

4. Result and Analysis

This section presents the discussion of conceptual model and hypothesis development of this study. Based on the analysis results of identified theories and empirical evidence of previous studies, the authors combine and conceptualized them into IPO model to produce the proposed conceptual model of this study. At the end of this stage, the authors found 9 constructs with 2 associations. The following Fig.2 shows a proposed conceptual model of this study.

4.1 Conceptual model development

The different elements of the conceptual model of this study are defined and described below, where the placement of each element is based on IPO model.

4.1.1 Element of green cost issues (Input)

Sharma (2017) and Himme (2012) stated that, it is necessary to identify the areas on which, a company is suffering from cost related issues where cost reduction is needed, lead to company growth. Parallel to this, according to the neo-classical growth theory as previously mentioned, it is theorizing that sustainable building construction will experience growth if initial cost: design, and construction cost are rightly allocated, controlled and reduced. However, most of the existing review have identified only the cost issues that influence cost premium but failed to classified them according to building life-cycle cost (Russ, Hanid & Kho, 2018). Additionally, Russ, Hanid & Kho (2018) found that it is critical to classify these cost issues according to building life-cycle cost so that the additional cost incurred during the initial stage are identifiable. Therefore, table 2 summarize the cost premium, at which, proved to be problems in sustainable building construction with respect to initial cost.

Table 2: Identified green cost issues in sustainable building construction with respect to initial cost.

Authors	Green cost issues	Area selected for cost reduction	
		Elements	Initial cost
Mao et al. (2016); Nurul Zahirah & Abidin (2012)	High consulting cost	Sustainable design (E4)	Design cost
Hwang & Ng (2013)	Frequent occurrence of alteration and variation, lead to drawing reproduction		
Arumugam et al. (2015); Mao et al. (2016)	High cost of tender bidding	Tendering (E5)	Construction cost
Jaafar & Radzi (2013); Ling & Ali (2012); Oladirin et al. (2013)	Type of contract use		
Hwang et al. (2017); Malin (2000)	Lack of proficiency with sustainable technology and equipment	Contractor's experience (E6)	
Ashby et al. (2004)	Difficulties in matching the equipment with the sustainable design		
Hwang et al. (2017); Zaini (2016); Damnjanovic et al. (2009)	Less competition among contractors (dominated by grade 7 contractor)		
Hwnag et al. (2017)	High production cost	Sustainable materials (E1)	
Zaini (2016).	The excessive usage of imported materials		
Nurul Zahirah & Abidin (2012)	Extra time allocated for equipment installation	Sustainable equipment (E2)	
Hwang et al. (2017); Malin (2000)	High cost of research and development		
Jin (2019); Hwang et al. (2017); Latiffi & Ng (2017); CREAM (2016)	High cost of BIM implementation	Sustainable technology (E3)	
Latiffi & Ng (2017); CREAM (2016)	Uncertainty of ROI recovery of BIM		
Zuhairi (2016); Mao et al. (2016)	High cost of IBS implementation		
Nurul Zahirah & Abidin (2012)	Additional values of coverage provision	Insurance (E7)	

(Source: Russ, Hanid, & Kho, 2018)

4.1.2 Element of green cost reduction methods (Process)

There are 19 cost reduction methods identified from the review and analysis of previous literature and these 19 methods had been classified into six elements: technical approach, motivation, design management, project team characteristic, practical approach, and management innovation based on their characteristic. Table 3 depicted the cost reduction methods with respect to initial cost. To note, certain methods can be applied to a specific phase of initial cost only, while certain methods can be applied to more than one phase of initial cost. Thus, for the purpose of conceptual model development of this study, the identified methods will be placed to a phase at which, impact would be the most.

May-June 2020
ISSN: 0193-4120 Page No. 3977-3990

Table 3: Identified elements of cost reduction methods with respect to initial cost.

Author(s)	Cost reduction methods	Description	Identified elements	Identified phase of initial cost
Arivazhagan et al. (2017); Heralova (2016); Berawi et al. (2011)	Value engineering (VE)	1. An effective **technique** used to reduce project cost with quality and function consideration.	**Technical approach**	**Design and construction cost**
Heralova (2016); Mahadik (2015); Berawi et al. (2011)		2. A well-known technique during **design stage**, however, several organisation and institution started to apply VE up to **construction stage**		
Emmanuel et al. (2015); Heralova (2016)		3. Design stage -eliminate unnecessary design		
Heralova (2016)		4. Construction stage- encourage contractors to come out with proposal that might improve project performance, value improvement, lower construction cost or shorten the delivery of time.		
Miazi (2014); Athalye et al. (2013)	Kaizen costing	1. Is a lean **tool** that invented by manufacturing industry.	**Technical approach**	**Construction cost**
Miazi (2014); Bae and Kim (2007)		2. Aiming for cost improvement by eliminating non value-added activities, improving **production processes** and productivity.		
Vidhate and Salunkhe (2018); Hanid (2014); Koskela (1992)	Just-In-Time (JIT)	1. Is a lean **tool** originated from manufacturing industry.	**Technical approach**	**Construction cost**
Banton (2019); Athalye et al. (2013); Barbole et al. (2013); Salem et al. (2006); Lehman and Reiser (2000)		2. Designed to reduce **production process** variability by optimizing inventories of materials and equipment according to the construction site real needs or request only.		
Nowotarski et al. (2016), Bae and Kim (2007)	5S	1. Is a **lean management** invented from manufacturing industry.	**Management innovation**	**Construction cost**
Nowotarski et al. (2016)		2. Introduced at the stage of **production**		
Nowotarski et al. (2016); Demirci (2012), Bae and Kim (2007)		3. To reduce waste and at the same time create added value for the end client through creating and maintaining a clean, orderly, and standardize work place.		
Jaochim et al. (2017); Afandi and Nurul Zahirah (2013):	Tax relief, Subsidies, green financing scheme	1. Tax relief, financing scheme (low interest loan), subsidies, and incentives **can motivate** contractors to invest in sustainable building construction.	**Motivation**	**Construction cost**
Hwang et al. (2017)		2. Tax relief is the most powerful and feasible solution to reduce green cost premium		
Hwang et al. (2017)		3. Subsidies for: research and development of sustainable materials and technology and educational courses to flatten the learning curve may help in green cost reduction.		
MGTC (2019); Fan et al. (2018)		4. Green financing scheme is made available to reimburse for additional cost result in, disabling the economic barriers among investors through green bond, green investment fund, green loan, and climate risk insurance.		
Isa e al. (2014); Aziz and Hafez (2013)	Integrated Design Process	1. **Design methodology** that focuses on the integration of project team where communication and information sharing are the key to generate new idea at early **design stage**.	**Design management**	**Design cost**
Aziz and Hafez (2013); Larsson (2009); Bae and Kim (2007)		2. The early integration of various discipline help in: rework and re-design reduction, highly efficient with minimal and sometimes zero incremental capital costs, along with reduced long-term operating and maintenance costs.		
Isa et al. (2014); Bae and Kim (2007); Lehman and Reiser (2000)	Integrated Project Team	1. A **method** use to integrates different disciplines of project team members at early **design** stage to encourage communication among project team members result in, minimization of miscommunication or conflict of interest.	**Technical approach**	**Design cost**
RIBA (2018); Robidchaud and Anantatmula (2011)		2. Project team assembly, roles and responsibilities normally are decided during preparation and brief stage which guarantee **virtuous teamwork**.		
Gorgolewski and Morettin (2009)	Reuse practice	1. There are four types of components available for reuse **practice** during **design process**.	**Practical approach**	**Design cost**
Yadav et al. (2013); Shah and Pitroda (2011); Damnjanovic et al. (2009)		2. Significantly reduce material cost, haul cost, and overall project cost, reduce energy and effort in new material production as well as offer environmental benefits.		
Yasin and Rjoub (2017); Aapaoja and Haapasalo (2014)	Standardization	1. Referring to the **principle** of implementing technical standard to the system: process and procedure as well as components during **design** and **construction** stage	**Practical approach**	**Design and construction cost**
Aapaoja and Haapasalo (2014); Ahuja (2012)		2. Industrialize building system (IBS) is an example of standardization of process during construction stage and is mainly implemented through prefabrication.		
Akadiri et al. (2012); Lehman and Reiser (2000)		3. Modular design is an example of standardization in design that may be achieved through concept of uniformity in designing the components in terms of size and shape that are easily replace or interchange.		
Anwar et al. (2016)	Performance-based contracting	1. Is a **technique** which defines all aspects of project **procurement system** and required performance of facilities, not the construction process.	**Technical approach**	**Construction cost**
Anwar et al. (2016); Public Procurement Practice (2012); Natalya et al. (2005)		2. Help in obtaining overall better value, better performance and lower costs as it allows freedom in decision making on design, construction methods, technology and management.		
Bae and Kim (2007); Natalya et al. (2005)		3. Allow the integration of specialty contractor and supplier at early stage lead to early information of special techniques and materials that required to construct sustainable building, variation order reduction as well as minimum control of the owner once the project is executed.		
Mohd Arif et al. (2019); Shoshan and Celik (2018); Kakkad and Ahuja (2014)	Total quality management (TQM)	1. Management **approach** to achieve qualified product and services as per customer's need and expectation through the participation of all construction players throughout the **construction process**.	**Management innovation**	**Construction cost**
Mohd Arif et al. (2019); Barbole et al. (2013)		2. Help in reducing construction waste such as defects, over-processing, delay, minimizing inspection cost and rejection cost.		
Serpell and Heredia (2014); Vrijhoef and Koskela (1999)	Supply chain management (SCM)	1. SCM is an **approach** that has invented in the manufacturing industry, described on how organization should manage their network to achieve project goal.	**Management innovation**	**Construction cost**
Vrijhoef and Koskela (1999)		2. SCM in construction is applied in the **area of logistic, inventory, site activities,** and **transferring activities from site to upstream stages** purposely for reduction of cost and duration		
Emmanuel et al. (2015); Akadiri et al. (2012)	Locally-sourced materials	1. The **design** should prioritize **the usage** of locally-available material as locally manufactured products are cheaper due to cheaper transportation cost as compared to imported materials.	**Practical approach**	**Design cost**
Nurul Zahirah and Zainul Abidin (2012); Damnjanovic et al. (2009)	Price escalation clause	1. Is one of the **methods** to reduce the high cost of **bidding the tender** that is highly associated with long-term project duration.	**Technical approach**	**Construction cost**
		2. Price escalation clause may mitigate the price variation issues for instances, guarantee fixed price especially raw material price.		
Hwang et al. (2017); World GBC (2013)	Availability of skilled and experienced project team	1. By hiring skilled and experienced **project team**, right green design features and materials can be appropriately adopted, avoid rework and changes throughout **design** and **construction** process.	**Project team characteristic**	**Design and construction cost**
Do (2019)	Set-based design	1. A modern **design methodology** in architecture, engineering and construction (AEC) industry	**Design management**	**Design cost**
Singer et al. (2017)		2. Allows design effort to proceed concurrently and defers detailed specifications until a compromise are aggregable.		
Do (2019); Bae and Kim (2007)		3. Avoid rework and waste		
Damnjanovic et al. (2009)	Bundle/split project	1. Is listed among the top ten most efficient **methods** to reduce **construction cost** as project size affect the construction cost.	**Technical**	**Construction cost**
		2. Bundling small project or splitting large project into medium-size project.		

May-June 2020
ISSN: 0193-4120 Page No. 3977-3990

4.1.3 Element of green cost reduction success (Output)

The effectiveness of cost reduction measures, designates the success of project cost reduction. From the review and analysis of previous literature on the cost reduction methods in various industries: automotive, manufacturing and construction industry, traditional building and highway construction, the application of the selected cost reduction methods have been found effective in reducing the desired cost. Table 4 depicted the summary of studies on the application of cost reduction methods on desired cost across various industries, that lead to project cost reduction success.

Table 4: Summary on cost reduction success across industries.

Author(s)	Country	Industry	Study background	Findings
Zhiran & Mengxiao (2012)	China	Automotive	This paper highlighted on cost reduction in automotive industry in the field of Chinese market	1.The application of cost reduction methods showed positive impact towards the reduction of logistic management cost and production cost 2. Methods: Just-in-time (JIT), Standardization
Athalye et al. (2013)	India		This paper is based on application and analysis of various cost reduction methods particularly in reduction of unwanted cost through elimination of non-value-added activities	1. The sampled of automotive stamping part supplier can save cost of Rs 1,89,115 per annum after cost reduction activities implemented during production phase. 2. Method: Kaizen costing, just-in-time (JIT), value engineering (VE), total quality management (TQM).
Gilotra & Kandoi (2015)	India		This paper presents the cost reduction method of on-road and off-road vehicles	1. The organization has been able to offer 8% - 19% reduction in cost per product to the client. 2. Method: Value engineering (VE)
Egbide et al. (2019)	Nigeria	Manufacturing	This paper discussed on the impact of cost reduction strategies in relation to growth of manufacturing organization	1. Cost reduction methods indicate positive relationship in reducing the material cost and labor cost, lead to growth in manufacturing companies 2.Methods: Kaizen costing, value analysis
Sharma (2017)	Nepal		This paper aims to evaluate the effectiveness of cost reduction method in Nepalese manufacturing organization	1. All sampled manufacturing organization highlighted that the major cost area that need attention is purchasing of raw material, production planning and control 2. Methods: Total quality management (TQM), supply chain management (SCM), kaizen costing
Barbole et al. (2013)	India		This paper study on the impacts of various cost reduction method on manufacturing industry	1. Cost reduction activities are significant in manufacturing industry for manufacturing companies to remain in business, grow and prosper. 2. Methods: Value engineering (VE), total quality management (TQM)
Yadav et al. (2013)	India		This paper presents various methods to reduce cost in the field of food manufacturing.	1. The reduction of cost lead to increase in production which makes out profit maximization. 2. Methods: Supply chain management, reuse practice, tax relief, and subsidies.
Heralova (2016)	Czech Republic	Construction	This paper discussed on the likelihood of using cost reduction method in construction project as project delivery is not within cost and time results in, not in line with budget limits	1. Using right cost reduction methods at the right time, results in project cost reduction and project performance improvement. 2. Method: Value engineering
Nowotarski et al. (2016)	Poland		This paper discussed on the idea of how lean methodologies can influence the total cost of selected construction process.	1. Cost reduction methods showed positive impact (medium to high impact) towards three selected construction process: column concreting, storage area management, and scaffolding ordering. 2. Method: Just-in-time (JIT); 5S
Damnjanovic et al. (2009)	Texas		This paper objectively to identify the factors contributing to the increase in construction cost and methods to reduce them.	1. Cost reduction methods applied on project and program level has a significant relationship in reducing project cost. 2. Methods: Value engineering (VE), Standardization, Bundle/Split project, price escalation clause, performance-based contracting, reuse practice.
Mahadik (2015)	India	Construction (Cont'd)	This paper highlighted on the role of value engineering as cost reduction techniques relating to sustainable construction.	1. Research findings revealed that, the application of cost reduction techniques in sustainable construction project by multidisciplinary team lead to value and economic improvement. 2. Method: Value engineering
Granja et al. (2005)	Brazil		This paper examines the application of kaizen costing in the construction of Brand Retail Unit (BRU)	1. The application of kaizen costing when the first unit start to be built, lead to continuous reduction of estimated cost of the BRU construction. 2. Method: Kaizen costing
Hwang et al. (2017)	Singapore	Sustainable construction	This paper investigates the cost premium and cost performance of green building projects as well as propose solution on how to address them.	1. Research findings revealed that several solutions are found effective for reducing green cost premium and improving cost performance. 2. Methods: Tax relief, availability of skilled design team and contractor, and subsidies/incentives.
World GBC (2013)	-		This article review on the green building cost and benefits for the developers, investors, and occupants.	1. Research findings revealed that building green does not need to cost more if the correct strategies are apply right from the beginning. 2. Methods: Hiring skilled and experienced project team, integrated design process (IDP)
Akadiri et al. (2012)	UK		This paper aims at implementing sustainability principles in the building industry.	1. Economic sustainability -to promote upmost cost efficiency and to reduce financial cost. 2. Methods: Locally-sourced materials, reuse practice, standardization
Robidchaud & Anantatmula (2011)	US		This paper presents a suggestion on specific modifications to traditional building practices to optimize the delivery of cost-efficient green building projects	1. Greening project management practices showed positive impacts in improving the ability of sustainable construction projects to be delivered within acceptable cost constrain. 2. Methods: Integrated project team, integrated design process.
Bae & Kim (2007)	Korea		This paper investigates the impacts of lean construction methods on social, economic, and environmental sustainability.	1. All methods showed positive impacts toward economic sustainability for sustainability facilities. 2. Methods: Integrated project team, performance-based contracting, integrated design process, set-based design, just-in-time (JIT), target costing, kaizen costing, 5S.
Lehman & Reiser (2000)	US		This paper examined on the factors that contribute to cost reduction and at the same time improve value for the customers.	1. Methods: Just-in-time (JIT), value engineering, target costing, standardization, integrated project team.
Building Green Inc (1999)	US		This article discussed on the economic benefits of sustainable construction projects and strategies to reduce initial cost.	1. This document revealed that, the first cost not higher than the original budgeted amount due to the methods applied to reduce them. 2. Methods: Value engineering (VE), integrated design process, reuse practice.

May-June 2020
ISSN: 0193-4120 Page No. 3977-3990

4.2 Hypotheses development

To articulate the association of green cost issues (input), green cost reduction methods (process), and green cost reduction success (output), several propositions can be highlighted through the development of directional hypotheses as stated below. The directional hypotheses are formulated for this study due to identified 19 past studies that shows consistent direction. To articulate the association of green cost issues and green cost reduction methods, empirical evidence is used as depicted in Table 5. To articulate the association of green cost reduction methods and green cost reduction success, qualitative measure based on meta-analysis studies is used as depicted in Table 6. Even all 19 past studies show positive association, the authors decided to test the hypotheses within sustainable building construction context, since the application of identified cost reduction methods are derived from various industries. Therefore, the null hypotheses are developed. The following description highlight the research hypotheses to be tested.

H1: There is a positive association between green cost issues and green cost reduction methods.

$H1_0$: There is no association between green cost issues and green cost reduction methods.

H2: There is a positive association between green cost reduction methods and green cost reduction success.

$H2_0$: There is no association between green cost reduction methods and green cost reduction success.

Table 5: Justification of the association.

Author(s)	Industry	Positive association
Athalye et al. (2013); Zhiran & Mengxiao (2012)	Automotive	Production cost → Just-in-time
Zhiran & Mengxiao (2012)		Production cost → Standardization
Athalye et al. (2013)		Production cost → Kaizen costing
Gilotra & Kandoi (2015); Athalye et al. (2013)		Production cost → Value engineering
Athalye et al. (2013)		Production cost → Total quality management
Egbide et al. (2019); Sharma (2017); Barbole et al. (2013)	Manufacturing	Production cost → Kaizen costing
Egbide et al. (2019); Barbole et al. (2013)		Production cost → Value engineering
Sharma (2017); Barbole et al. (2013)		Production cost → Total quality management
Sharma (2017); Yadav et al. (2013)		Production cost → Supply chain management
Sharma (2017)		Production cost → Standardization
Barbole et al. (2013)		Production cost → Just-in-time
Yadav et al. (2013)		Over whole manufacturing cost → Tax relief
Yadav et al. (2013)		Over whole manufacturing cost → Subsidies
Nowotarski et al. (2016)	Construction	Construction cost → Just-in-time
Nowotarski et al. (2016)		Construction cost → 5S
Heralova (2016); Mahadik (2015); Garnja et al. (2005); Damnjanovic et al. (2009)		Construction cost → Value engineering Design cost → Value engineering
Granja et al. (2005)		Construction cost → Kaizen costing
Damnjanovic et al. (2009)		Design cost → Standardization Construction cost → Bundle/split project Construction cost → price escalation clause Construction cost → Performance-based contracting Design cost → Reuse practice
Hwang et al. (2017)	Sustainable construction	Construction cost → Tax relief Construction cost → Subsidies
Hwang et al. (2017); World GBC (2013)		Construction cost → Skilled and experienced project team Design cost → Skilled and experienced project team
World GBC (2013); Robidchaud & Anantatmula (2011); Bae & Kim (2007); Building Green Inc (1999)		Design cost → Integrated design process
Akadiri et al. (2012)		Design cost → Locally-sourced materials
Akadiri et al. (2012); Building Green Inc (1999)		Design cost → Reuse practice
Akadiri et al. (2012); Lehman & Reiser (2000)		Design cost → Standardization Construction cost → Standardization
Robidchaud & Anantatmula (2011); Bae & Kim (2007); Lehman & Reiser (2000)		Design cost → Integrated project team
Bae & Kim (2007)		Construction cost → Performance-based contracting
Bae & Kim (2007)		Design cost → Set-based design
Bae & Kim (2007); Lehman & Reiser (2000)		Construction cost → Just-in-time
Bae & Kim (2007)		Construction cost → Kaizen costing
Lehman & Reiser (2000); Building Green Inc (1999		Construction cost → Value engineering Design cost → Value engineering

May-June 2020
ISSN: 0193-4120 Page No. 3977-3990

Table 6: Justification of the indicator for qualitative measures of green cost reduction methods effectiveness.

Authors	Construct	Indicator
	Technical approach	
Anwar et al. (2016); Natalya et al. (2005)	Performance-based contracting (PBC)	**The application of PBC influences the success of green cost reduction**
		1. Freedom in decision making on design, construction methods, technology and management
		2. Reduction of variation orders as its integrated contractor and supplier in the early stage of construction
		3. Increase contractors' effectiveness as it allows minimum control of the owner/client once the project is executed
		4. Reduction of unnecessary construction waste as payment is based on performance
Isa et al. (2014); Bae & Kim (2007); Lehman & Reiser (2000)	Integrated project team	**The application of integrated project team influences the success of green cost reduction**
		1. Encourage communication among project team members
		2.Reduction of additional cost due to rework caused by conflicting of interest or miscommunication among stakeholders.
Arivazhagan (2017); Heralova (2016); Oke et al. (2015)	Value engineering (VE)	**The application of VE influences the success of green cost reduction**
		Design stage:
		1. Help to identify and remove unnecessary cost by eliminating unnecessary design
		Construction stage:
		1. VE encourage contractors to come out with proposal that might improve project performance, value improvement, lower construction cost or shorten the delivery of time subject to project team agreement
Hanid (2014); Miazi (2014); Athalye et al. (2013); Bae & Kim (2007)	Kaizen costing	**The application of kaizen costing influences the success of green cost reduction**
		1. Help to eliminate non value-added activities, improving production processes and productivity
		2. Encourage the unity of lower management to top management from different organizational function, together to find the best solution for the problems occurred before any decision is make
		3. Increase profit margin, effectiveness of production process and relationship with suppliers and sub-contractors
Vidhate & Salunkhe (2018); Athalye et al. (2013); Hanid (2014); Barbole et al. (2013); Koskela (1992)	Just-in-time (JIT)	**The application of JIT influences the success of green cost reduction**
		1. Reduction of process variability
		2. Optimize inventories of materials and equipment according to the construction site real needs or request only
	Design management	
Isa et al. (2014); Aziz & Hafez (2013); Larsson (2009); Bae & Kim (2007)	Integrated design process	**The application of integrated design process influences the success of green cost reduction**
		1. Allow the integration of mechanical and electrical engineers, specialized consultants, contractor, and supplier at early design stage, result in, re-design reduction
		2. Allow the integration of mechanical and electrical engineers, specialized consultants, contractor, and supplier at early design stage, results in, production of highly efficient design with minimal, and sometimes zero incremental capital costs, along with reduced long-term operating and maintenance costs
Do (2019); Singer & Doerry (2009); Bae & Kim (2007)	Set-based design	**The application of set-based design influences the success of green cost reduction**
		1. Allows more of the alternative design to proceed concurrently and defers detailed specifications until a compromise are aggregable
		2. Help in seeking various alternatives to avoid rework and wasted effort.
		3. Allow the design team to explore possible solutions concurrently in considering the needs of the clients
	Practical approach	
Yadav et al. (2013); Akadiri et al. (2012); Shah and Pitroda (2011); Damnjanovic et al. (2009); Green Building Inc (1999)	Reuse practice	**The application of reuse practice influences the success of green cost reduction**
		1. Help to reduce material cost, haul cost as well as offer environmental benefits
		2. Help to reduces the energy and effort in production of new materials
		3. Reuse of salvaged and reconditioned components in repairs, and recycle content building products will create better compatibility of materials
Oke et al. (2015); Akadiri et al. (2012)	Locally-sourced material	**The application of locally-sourced material influences the success of green cost reduction**
		1. Prioritizes locally sourced materials in design result in, overall cost reduction as locally manufactured products are cheaper
Aapaoja & Haapasalo (2014); Akadiri et al. (2012); Lehman & Reiser (2000)	Standardization	**The application of standardization influences the success of green cost reduction**
		Design stage:
		1. Allows concept of uniformity in designing the components in terms of size and shape that are easily replace or interchange
		Construction stage:
		1. Improving labour productivity and saving time since components that need to be manufactured and installed are in standard structure and shape
Damnjanovic et al. (2009)	Bundle/Split project	**The application of bundle/split project influences the success of green cost reduction**
		1. Bundle small projects into one larger project. This may offer contractors economy of scale in their operations and attract more contractors to bid on a project.
		2. Split one large project into two or more smaller projects to increase potential competition especially when there are an insufficient number of qualified contractors to bid on a large project.
Nurul Zahirah and Abidin (2012); Damnjanovic et al. (2009)	Price escalation clause	**The application of price escalation clause influences the success of green cost reduction**
		1. For longer contract durations, such clauses have a potential to reduce the contractor's risk premium. This risk premium is added by contractors to bid item prices to account for the expectation of future increase in prices of materials due to inflation.
	Project team characteristic	
Hwang et al. (2017); World Green Building Council (2013)	Skilled and experienced project team	**The application of skilled and experienced project team influences the success of green cost reduction**
		1. Hiring skilled and experienced project team, right green design features and materials can be appropriately adopted, avoid rework and changes that lead to lower cost premium
		2. Reduction of design complexity
	Management innovation	
Ojo et al. (2015); Serpell and Heredia (2014); Damnjanovic et al. (2009)	Supply chain management (SCM)	**The application of SCM influences the success of green cost reduction**
		1. Help the organization in managing their network (comprise of all parties: supplier, manufacturer, distributor and, customer) in different processes and activities to achieve project goal
		2. Help the project team plan ahead and communicate requirements to material suppliers in advance. Early information may help suppliers plan their production better.
Mohd Arif et al. (2019); Shoshan & Celik (2018); Barbole et al. (2013)	Total quality management (TQM)	**The application of TQM influences the success of green cost reduction**
		1. Help to achieve qualified product and services as per customer's need and expectation through the participation of all construction players throughout the construction process
		2. Help in reducing construction waste such as defects, over-processing, delay, minimizing inspection cost and rejection cost
Nowotarski et al. (2016); Demirci (2012); Bae & Kim (2007)	5S: Seiri (sorting), Seiton (improvement), Seiso (cleaning), Seiketsu (standardization), and Shitsuke (discipline)	**The application of 5S influences the success of green cost reduction**
		1.Help to create and maintain a clean, orderly, and standardize work place
		2. Low implementation cost
	Motivation	
Hwang et al. (2017); Aliagha et al. (2013)	Tax relief	**The application of tax relief influences the success of green cost reduction**
		1. Encourage the selling, buying, and using of green technologies
Hwang et al. (2017)	Subsidies	**The application of subsidies influences the success of green cost reduction**
		1. Subsidies for research and development of sustainable materials and technology to achieve material and technology cost reduction
		2. Subsidies for sustainable building educational courses to flatten the learning curve
MGTC (2019); Fan et al., 2018	Green financing scheme	**The application of green financing scheme influences the success of green cost reduction**
		1. Help sustainable producer/ manufacturer in terms of financial support through low interest loan
		2. Help to improve investment priority through compensation
		3. Help to reduce investment cost
		4. Help to reduce financial risk

May-June 2020
ISSN: 0193-4120 Page No. 3977-3990

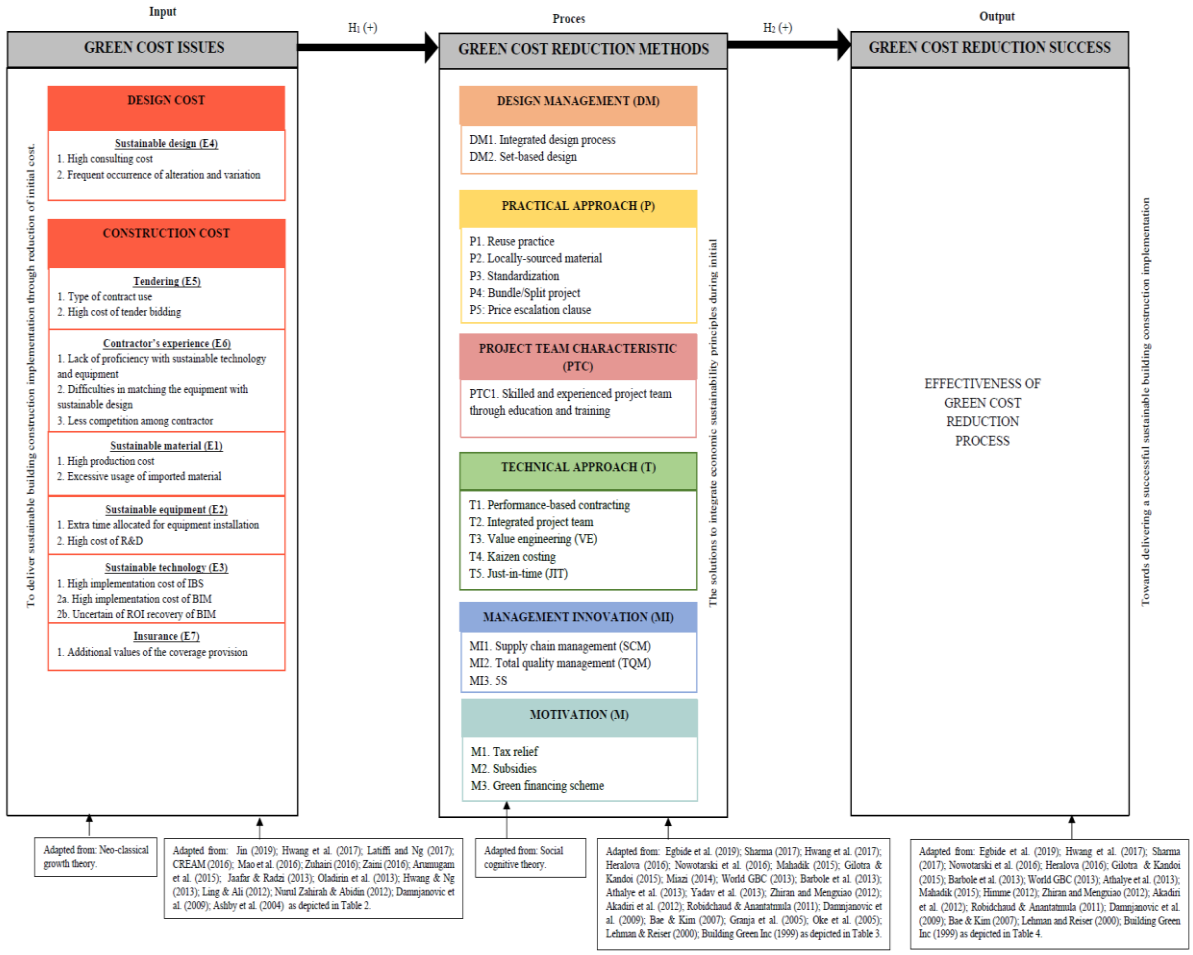

Figure 2: Proposed conceptual model.

5. Conclusion

This study has explored the integration of sustainability concept in the construction industry, which were termed as sustainable construction as responds towards sustainable development. In the context of building construction, sustainable construction aims to improve the existing ways of constructing buildings. Sustainable construction literature documented that, there are many models being developed purposely to enhance sustainable building construction, but none of these models focused on economic sustainability aspect which is to promote the utmost cost efficiency and reduce financial cost. It has been identified that green cost issues are actually hinder the successful of sustainable building construction implementation. Thus, solutions must be provided to reduce the identified issues so that, the construction practitioners be more attentive in the area of sustainable construction. Therefore, the objective of this study was achieved through the development of conceptual model for improving sustainable building construction implementation.

However, the presented conceptual model needs to be further developed. Therefore, the author highlighted several commendations that will be the basis for further study. First, exploratory research, by conducting a semi-structured interview with the experts to explore possible methods to reduce green cost issues as well as to prob finding from literature, looking for similarity and contrasting. Second, explanatory research, purposely to examine the effectiveness of green cost reduction methods in reducing the green cost issues, result in, green cost reduction success, seeking further development of presented conceptual model.

References

[1] Aapaoja, A., & Haapasalo, H. (2014). The challenges of standardization of products and process in construction. In: Proceedings IGLC-22, Oslo, Norway, 983-993.

[2] Afandi, N. D., & Abidin, N. Z. (2013). Motivation and expectation of developers on green construction: a conceptual view. Humanities and Social Sciences, 7(4), 100-104.

[3] Ahn, Y. H., Pearce, A. R., Wang, Y &Wang, G. (2013). Drivers and barriers of sustainable design and construction: the perception of green building experience. International Journal of Sustainable Building Technology and Urban Development, 4 (1),35–45

May-June 2020
ISSN: 0193-4120 Page No. 3977-3990

[4] Akadiri, P. O., Chinyio, E. A., & Olomolaiye, P. O. (2012). Design of a sustainable building: A conceptual framework for implementing sustainability in the building sector. Buildings, 2, 126-152.

[5] Akeem, L. B. (2017). Effect of cost control and cost reduction techniques in organizational performance. International Business and Management, 14(3), 19-26.

[6] Aliagha, G.U., Hashim, M., Sanni, A.O., &Ali, K.N. (2013). Review of green building demand factors for Malaysia.J. Energy Technol. Policy, 3, 471–478.

[7] Anwar, M. F., Shariff, N. D. M., Teoh, C. C., Lim, X. J., Riazi, S. R. M., & Nawi, M. N. M. (2016). Implementation of performance-based contracting in Malaysia. International Review of Management and Marketing, 6(8), 286-293.

[8] Arif, M. M., Jaapar, A., Bari, N. A. A., & Zawawi, M. (2013). Sustainability through lean construction approach: A literature review. In: AMER International Conference on Quality of Life, Langkawi, Malaysia (pp. 90-99).

[9] Arif, M. M., Azmi, A. B. N., &Jaapar, A. (2019). The effectiveness of lean construction tools in the Malaysian construction industry towards contractor's environmental performance. MATEC Web of Conferences, 266.

[10] Arivazhagan, O., Guru, V., partheeban, P., & Rachel, P. P. (2017). Application of value engineering in construction job sites- A case study. International Journal of Engineering Research & Technology, 6(2), 65-69.

[11] Arumugam, S., Sumanarathna, N., & Perera, K.K.S. (2015). Transaction Costs of Green Office Building Construction in Sri Lanka. In: 8th FARU International Conference, Sri Lanka,78–91.

[12] Ashby, M., Brechet, Y., Cebon, D., & Salvo, L. (2004). Selection strategies for materials and process. Materials and Design, 25(1), 51-67.

[13] Athalye, A., Gera, P., & Madan, A. R. (2013). Study and analysis of cost reduction techniquesby scrap utilization of press part production:a case study of stamping unit. International Journal of Science and Research, 4(4), 3247-3252.

[14] Aziz, R. F., & Hafez, S. M. (2013). Applying lean thinking in construction and performance improvement. Alexandria Engineering Journal, 52, 679-695.

[15] Bae, J., & Kim, Y. (2007). Sustainable value on construction project and application of lean construction methods. In: Proceedings IGLC-15, Michigan, USA, 312-321.

[16] Barbole, A. N., Nalwade, Y. D., & Parakh, S. D. (2013). Impact of cost control and cost reduction techniques on manufacturing sector. Indian Streams Research Journal, 3(5).

[17] Berawi, M. A., Priyatno, H., Latief, Y., Sesmiwati., & Rahman, H. Z. (2011). Application of value engineering at design stage in Inddonesia construction industry. In: 12th International Conference on Quality in Research, Bali, Indonesia, 2121-2126.

[18] Building Green Inc. (1999). The economic benefits of sustainable design. Available online at: http://www.buldinggreen.com, Accessed on November 12th 2017.

[19] Belout, A.,& Gauvreau, C. (2004). Factors influencing project success: the impact of human resource management. International Journal of Project Management, 22(1), 1-11.

[20] Cohen, S. G., & Bailey, D. E. (1997). What makes teams work: Group effectiveness research from the shop floor to the executive suite. Journal of Management, 23(3), 239-290.

[21] Construction Research Institute of Malaysia (CREAM). (2014). Issues and Challenges in Implementing BIM for SME's in The Construction Industry. Available Online at https://www.cream.my/main/index.php/publication/seminar-workshop-materials, Accessed on October 31st, 2017.

[22] Damnjanovic, I., Anderson, S., Wimsatt, A., Reinschmidt, K. F., & Pandit, D. (2009). Technical report: Evaluation of ways and procedures to reduce construction cost and increase competition. Retrieved from National Technical Information Service (NTIS). Available online at http://www.ntis.gov, Accessed on September 26th, 2019.

[23] Do, D. (2019). Introduction to set-based design. Lean Construction Journal. Available online at: https://www.leanconstructionjournal.org, Accessed on July 13th 2019.

[24] Dodge Data &Analytics (2016) World green building trends 2016. Available online at: https://www.construction.com,Accessed on November 2nd2017.

[25] Dokata, R. A. (2017). Factors influencing building construction project cost management in commercial real estate in Nairobi County, Kenya. Master Dissertation, University of Nairobi, Kenya.

[26] Dwaikat, L. N & Ali, K. N. (2016). Green buildings cost premium: A review of empirical evidence. Energy and Buildings, 110, 396–403.

[27] Egbide, B. Adegbola, A., Bamidele, R., Sunday, A., Olufemi, O., & Ruth, E. (2019). Cost reduction strategies and the growth of selected manufacturing companies in Nigeria. International Journal of Mechanical Engineering and Technology, 10(3), 196-203.

[28] Fan, K., Chan, E.H.W., & Chau, C. K. (2018). Cost and benefits of implementing green

May-June 2020
ISSN: 0193-4120 Page No. 3977-3990

building economic incentives: case study of a gross floor area concession scheme in Hong Kong. MDPI journal, 10, 2814-2833.

[29] Ghani, A.B.A., Mahat, N.I., Hussain, A., Mokhtar, S.S.M. (2019). Water Sustainability In Campus: A Framework In Optimizing Social Cost. International Journal of Recent Technology and Engineering, 8 (2 Special Issue 2), pp. 183-186.

[30] Granja, A. D., Picchi, F. A., & Robert, G. T. (2005). Target and kaizen costing in construction. In: Proceedings IGLC-13, Sydney, Australia, 227.

[31] Gilotra, A., & Kandoi, D. (2015). Value engineering: Cost reduction of on-road & off-road vehicles. Available online at https://www.technosofteng.com/, Accessed on August 21st, 2019.

[32] Gorgolewski, M., & Morettin, L. (2009). The process of designing with reused building components. Available online at: https://www.irbnet.de/daten/iconda/CIB14291, Accessed on October 15th 2019.

[33] Hanid, M. (2014). Design science research as an approach to develop conceptual solutions for improving cost management in construction. PhD Dissertation. University of Salford, UK.

[34] Heralova, R. S. (2016). Possibility of using value engineering in highway projects. In: Creative Construction Conference, Budapest, Hungary, 362-367.

[35] Herre, C. (2010). Promoting team effectiveness: How leaders and learning processes influence team outcomes. PhD Dissertation, University of Freiburg, Germany.

[36] Himme, A. (2012). Critical success factors of strategic cost reduction. Journal of Management Control, 23(3), 183-210.

[37] Hussain, A., Mkpojiogu, E.O.C., Abubakar, H., Hassan, H.M. (2017). The Usability Evaluation Of Mudah. My On Mobile Device. AIP Conference Proceedings, 1891, art. no. 020058.

[38] Hussin, J. M., Rahman, I.A., & Memon, A.H. (2013). The way forward in sustainable construction: Issues and challenges. International Journal of Advances in Applied Sciences, 2(1), 15-24.

[39] Hussain, A., Mkpojiogu, E.O.C., Jamaludin, N.H., Moh, S.T.L. (2017). A Usability Evaluation Of Lazada Mobile Application. AIP Conference Proceedings, 1891, art. no. 020059.

[40] Hwang, B.G., Zhu, L., Wang, Y., &Cheong, X. (2017). Green Building Construction Projects in Singapore: Cost Premiums and Cost Performance. Project Management Journal, 48(4),67–79.

[41] Hwang, B.G., &Ng, W.J. (2013). Project Management Knowledge and Skills for Green Construction: Overcoming Challenges. International Journal of Project Management, 31(2), 272–284.

[42] International Energy Agency (IEA). (2006). World energy outlook. Available online at: http://www.worldenergyoutlook.org, Accessed on July 4th 2019.

[43] Isa, N. K. M., Alias, A., & Samad, Z. A. (2014). Towards developing a sustainability integration framework for building project. Journal of Building Performance, 5(1), 22-33.

[44] Islam, R., Ghani, A.B.A., Kusuma, B., Theseira, B.B. (2016). Education And Human Capital Effect On Malaysian Economic Growth. International Journal of Economics and Financial Issues, 6 (4), pp. 1722-1728.

[45] Jaafar, M., & Radzi, N. M. (2013). Level of satisfaction and issues with procurement systems used in the Malaysian public sector. Australasian Journal of Construction Economics and Building, 13(1), 50-65.

[46] Jin, J. (2019). Sustainable construction technologies: current management approach. Available online at https://www.researchgate.net/publication/330321046, Accessed on September 16, 2019.

[47] Joachim, O. H., Kamarudin, N., Aliagha, G. U., Mohammed, M. A. H., & Ali, H. M. (2017). Green and sustainable commercial property supply in Malaysia and Nigeria. Geographical Review, 107(3), 496-515.

[48] Kakkad, S., & Ahuja, P. (2014). Implementation of total quality management in construction firm. International Journal of Science, Engineering and Technology Research, 3(10), 2653-2658.

[49] Kamar, K.A.M., & Hamid, Z.A., 2011. Sustainable Construction and Green Building: The Case of Malaysia. WIT Transactions on Ecology and the Environment, Volume 167, pp. 15–22

[50] Koskela, L. (1992). Application of the new production philosophy to construction. Finland: Technical report.

[51] Larsson, N. (2009). The integrated design process: history and analysis. In: International Initiative for a Sustainable Built Environment (iiSBE), 1-16. Available online at http:// www.researchgate.net/publication/ 23597964, Accessed on November 20th, 2019.

[52] Latiffi, A. A., & Ng, H. T. (2017). Exploring developers' understanding on building information modelling (BIM) and its impact of return on investment (ROI).In: 2017 International Conference on Research and Innovation in Information Systems (ICRIIS), Langkawi, Malaysia.

[53] Lehman, T., & Reiser, P. (2000). Maximizing value & minimizing waste: value engineering & lean construction. Lean Construction Institute.

May-June 2020
ISSN: 0193-4120 Page No. 3977-3990

Available online at http://www.leanconstruction.org, Accessed on August 19th, 2019.

[54] Lee, S., Lee, B., Kim, J., & Kim, J. (2013). A financing model to solve financial barriers forimplementing green building projects. The Scientific World Journal, 1-10.

[55] Li, H., Liu, X., & Tang, S. (2011). Green construction bid evaluation system research based on comprehensive evaluation method (pp. 1–4). IEEE.

[56] Ling, S. C., & Ali, A. S. (2012). The effects of procurement systems towards performance of the refurbishment projects. In: ASEAN Postgraduate Seminar, University of Malaya, Kuala Lumpur.

[57] Mahadik, U. A. (2015). Value engineering for cost reduction and sustainability in construction projects. Journal of Mechanical and Civil Engineering, 95-97.

[58] Malaysian Green Technology Corporation (MGTC). (2019). Green technology financing scheme. Available online at https://www.greentechmalaysia.my, Accessed on January 25th, 2020.

[59] Mao, C., Xie, F., Hou, L., Wu, P., Wang, J., &Wang, X. (2016). Cost Analysis for Sustainable Off-site Construction based on a Multiple-case Study in China. Habitat International, 57, 215–222.

[60] McCuspie, R. I., Hyman, H., Yakymyshyn, C., Srinivasan, S. S., Dhau, J., & Drake, C. (2014).A framework for identifying performance targets for sustainable nanomaterials. Sustainable materials and Technologies, 17-25.

[61] Miazi, M. G. U. R. (2014). A study on kaizen costing: continuous cost improvement. Available online at: https://www.academia.edu, Accessed on August 28th 2019.

[62] Natalya, S., Navaid, Q., Cesar, Q. (2005).Transport note: Performance-Based Contracting for Preservation and Improvement of Road Assets. Washington, DC. Available online at http://documents.worldbank.org, Accessed on November 23rd, 2019.

[63] National Institute of Governmental Purchasing (NIGP). (2016). The place of public procurement within the entity. Herndon, Virginia: Public Procurement Practice. Available online at: http://www.nigp.org, Accessed on January 20th, 2019.

[64] Nowotarski, P., Paslawski, J., & Matyja, J. (2016). Improving construction processes using lean management methodologies-cost case study. In: World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium, Prague, Czech Republic, 1037-1042.

[65] Nurul Zahirah, M.A., &Abidin, N.Z., (2012). Main Elements of Soft Cost in Green Buildings. International Journal of Economics and Management Engineering, 6(12), 3601–3606.

[66] Oke, A. E., Aghimien, D. O., & Olatunji, S. O. (2015). Implementation of value management as economic sustainability tool for building construction in Nigeria. International Journal of Managing Value and Supply Chains, 6(4), 55-64.

[67] Oladinrin, O. T., Olatunji, S. O., & Hamza, B. T. (2013). Effect of selected procurement systems on building project performance in Nigeria. International Journal of Sustainable Construction Engineering & Technology, 4(1), 48-63.

[68] Orry, R. B. (2019). Sustainable buildings market study 2019: sustainable buildings: a good return on investment?(Report No.6). Available online at: https://issuu.com/ramboll/docs/ramboll_green_market_study, Accessed on October 15th 2019.

[69] Otekunrin, A. O., Nwanji, T. I., Olowookere, J. K., Egbide, B., Fakile, S. A., Lawal, A. I., Ajayi, S. A., Falaye, A. J., &Eluyela, D. F. (2018). Financial ratio analysis and market price ofshare of selected quoted agriculture and agro-allied firms in Nigeria after adoption of international financial reporting standard. Journal of Social Science Research, 4(12), 736-744.

[70] Qi, G.Y., Shen, L.Y., Zeng, S.X., Jorge, O.J. (2010). The Drivers for Contractors 'Green Innovation: An Industry Perspective. Journal of Cleaner Production, 18(14),1358–1365.

[71] Qian, A.Y., & Foong, W. K. (2013). A cost management approach to sustainable construction: maximizing value via cost engineering techniques. In: Proceedings of the SB 13 –Realizing Sustainability in the Tropics, Singapore

[72] Robidchaud, L. B., & Anantatmula, V. S. (2011). Greening project management practices for sustainable construction. Journal of management in Engineering, 48-57.

[73] Royal Institute of British Architects (RIBA). (2013). RIBA Plan of Work. Available Online at http://www.architecture.com, Accessed on August 23, 2018.

[74] Russ, N.M., Hanid, M., & Kho, M.Y. (2018). Literature review on green cost premium of sustainable building construction. Int. J. Technol.9 (8), 1715–1725.

[75] Salem, O., Solomom, J., Genaidy, A., & Luegring, M. (2005). Site implementation & assessment of lean construction techniques. Lean construction journal, 2(2). Available online at: https://www.leanconstructionjournal.org, Accessed on August 21st 2019.

[76] Sarhan, S., Pasquire, C., Elnokaly, A., Pretlove, S. (2019) Lean and Sustainable Construction: A

May-June 2020
ISSN: 0193-4120 Page No. 3977-3990

Systematic Critical Review of 25 Years of Experience. Lean Construction Journal, 01-20.

[77] Serpell, A., & Heredia, B. (2004). Supply chain management in construction: Diagnosis and application issues. In: CIB W107 & CIB TG23 - International Symposium on Globalisation and Construction, Bangkok, Thailand.

[78] Singer, D. J., & Doerry, N. (2009). What is set-based design. Naval engineers journal, 1-14.

[79] Shah, R. A., & Pitroda, J. (2011). Recycling of construction material for sustainability. In: National conference on recent trends in engineering and technology, India.

[80] Sharma, D. (2017). Application of cost reduction tools in manufacturing organization at Pokhara. Janapriya Journal of Interdisciplinary Studies, 6, 45-59.

[81] Shang, G & Pheng, L. S.(2014). The last planner system in China‘s construction industry — A SWOT analysis on implementation. International Journal of Project Management, 32(7), 1260–1272.

[82] Shi, Q., Zuo, J., Huang, R., Huang, J., &Pullen, S. (2013). Identifying the Critical Factors for Green Construction – An Empirical Study in China. Habitat International, 40, 1–8.

[83] Shoshan, A. A. A., & Celik, G. T. (2018). Application of TQM in the construction industry of developing countries-Case of Turkey. Anadolu University Journal of Science and Technology, 19(1), 177-191.

[84] Sousa, V., Almeida, N.M., & Dias, L.A.(2015). Risk-based management of occupational safety and health in the construction industry – Part 2: Quantitative model. Safety Science, 74, 184–194.

[85] United States Green Building Council (USGBC). (2006). Building the Business Case for Green Commercial Buildings in Australia. Available online at: http://www.gbca.org.au/dollars-sense08, Accessed on November 23rd 2017.

[86] Vidhate, T., & Salunkhe, A. (2018). General overview of lean management in construction industry. International Research Journal of Engineering and Technology, 5(7), 1999-2004.

[87] Vrijhoef, R., & Koskela, L. (1999). Roles of supply chain management in construction. In: Proceedings IGLC-7, University of California, Berkeley, USA.

[88] Whang, S.W., & Kim, S. (2015). Balanced Sustainable Implementation in the Construction Industry: The Perspective of Korean Contractors. Energy and Buildings, 96, 76–85.

[89] Windapo, A. O., & Goulding, J. S. (2015). Understanding the Gap between Green Building Practice and Legislation Requirements in South Africa. Smart and Sustainable Built Environment, 4(1), 67- 96.

[90] World Green Building Council (WorldGBC). (2013). The Business Case for Green Building—A Review of the Costs and Benefits for Developers, Investors and Occupants. Available Online at: http://www.worldgbc.org, Accessed on November 15, 2017.

[91] Yadav, G. H., Jain, R. K., Kapoor, M., & Nateriya, R. (2013). Cost reduction in different disciplines. International Journal of Current Research, 5(10), 2821-2825.

[92] Yasin, B., & Rjoub, A. (2017). Standardization in construction as a tool to reduce cost of housing for the low-income families in Jordan. Journal of Civil Engineering and Architecture, 11, 141-148.

[93] Zaini, A. A. (2016). A Model for Implementation of Green Construction. PhD Dissertation, Universiti Teknologi Mara, Shah Alam, Malaysia.

[94] Zhiran, X., & Mengxiao, Z. (2012). Cost reduction in the automobile industry-case studies of the Chinese market. Master Dissertation, University of Halmstad, Sweden.

[95] Zhu, S.-J. (2012). Comprehensive evaluation of green construction based on AHP and grey theory. In: 2012 International Conference on Information Management, Innovation Management and Industrial Engineering (pp. 30–33).