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Main Elements of Soft Cost in Green Buildings

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***Abstract*—**Green buildings have been commonly cited to be more expensive than conventional buildings. However, limited research has been conducted to clearly identify elements that contribute to this cost differential. The construction cost of buildings can be typically divided into "hard" costs and "soft" cost elements. Using a review analysis of existing literature, the study identified six main elements in green buildings that contribute to the general cost elements that are "soft" in nature. The six elements found are insurance, developer's experience, design cost, certification, commissioning and energy modeling. Out of the six elements, most literatures have highlighted the increase in design cost for green design as compared to conventional design due to additional architectural and engineering costs, eco-charettes, extra design time, and the further need for a green consultant. The study concluded that these elements of soft cost contribute to the green premium or cost differential of green buildings.

***Keywords*—**Green building, cost differential, soft cost, intangible cost.

I. Introduction

THE concept of green is believed to help minimize the impact of construction on its environmental surrounding and promote a sustainable environment for the future generation. Although green buildings have been commonly cited in studies to be more costly in its first cost than conventional design [12], [18], it is believed that benefits accrued over the building life often offset these initial higher costs with savings that are over 10 times the average initial investment required for green construction [11], [13]. For example, the incorporation of a green roofing system will contribute to lower building temperatures during warm climates, thus reducing the need for any cooling system [20], [29]. The adoption of a Variable Air Volume (VAV) is proven to be more energy efficient compared to the conventional air-conditioning system regularly used in office buildings [1], [2], [7]. Green buildings also prevent pollution, which allows savings in cost, input and energy consumption, and reuses materials through recycling [8], [25].

Many previous studies have cited a marginal difference in cost of green buildings and their conventional counterparts [6], [9], [10], [12], [18], [27], [28]. Most research findings show that the cost premium for green buildings were insignificant and fall in the range of 1 to 4 percent [6], [10], [12], [27], while some even argued that green buildings had no cost difference than conventional buildings [28]. However, a disparity of belief exists between researchers and practitioners.

While researchers repeatedly prove green buildings can be built at little or no additional cost, practitioners often identify high initial cost premiums, and low risky long-term cost savings as barriers to adopting and investing in green practices [9]. The inconsistency between theoretical findings and actual practice proves a research gap in green building cost. This demonstrates a research need to identify the factors affecting cost in green buildings, and how they differ from those in conventional buildings.

Green building design can be categorized into passive design strategy and active design strategy [29]. Passive design strategy refers to the architectural design of the building envelope which does not involve use of mechanical equipment. These include the building orientation that optimizes solar power and use of environmental sources and low carbon emissivity materials which is decided during the planning and design stage of the building project. Active design strategy refers to the adoption of artificial, mechanical or electrical equipment, such as air-conditioning, artificial lighting, elevators, escalators, pumps and fans. Passive design strategies such as walls insulation, low-E window and solar heating appliance incur only a marginal cost addition. However, active design strategies that involve the acquisition of green technology such as ground source heat pumps, radiant flooring and electric radiant heating system incur expensive cost additions and extra time to install [29]. Due to this, cost savings take a longer time to be realized and are unattractive to developers who prioritize fast investment returns. This becomes the main cost barrier to building green.

This theory answers the inconsistency in researchers' belief and practitioners' belief with regards to green building cost [9]. Many times, the decision to become green is made either after the design stage or after project completion; hence green elements are just added to the existing conventional design so that the building function will meet green requirements. This is due to the existing notion that green design is something that gets added to a project [10]. This results to expensive cost additions for the added green elements. Hence, it is generally accepted that most cost premium of green buildings are caused by active design strategies.

II. Definition of Hard Cost and Soft Cost

The construction cost of buildings may be typically divided into "hard" costs and "soft" costs. Hard costs can be defined as things which are structurally fundamental construct a building including excavation, foundation works, concrete

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flatwork, framing materials, windows, insulation, basic plumbing and electrical wiring, roofing materials, exterior finish, drywall and painting. Soft costs, on the other hand, are defined as things that are not necessarily fundamental but are desirable and add value to the construction project. These items include exterior finish, plumbing fixtures, electrical fixtures, cabinetry and flooring [4].

Soft costs are also referred to unseen costs that composed the initial part of developing a construction project [24]. Reference [13] defined hard costs as direct costs and soft costs as costs that are not directly related to the physical construction of the project, including indirect labor, contract supervision, tools and equipment, supplies, inspection, insurance, repairs and maintenance. Similarly, reference [15] and [19] referred to hard costs as the physical items that incur actual construction costs to erect a building, whereas soft costs refer to all architectural, planning, engineering, permitting, financing, and marketing costs. These include site preparation (grading / excavating), concrete, framing, electrical, carpentry, roofing, and landscaping. Soft costs are referred to indirect costs or "offsite" costs that are not directly related to labor or materials for construction. These costs include nonphysical expenses and involve all other fees involved in the completion of the project, such as transfer taxes; origination points; mortgage insurance; appraisal fee; testing; hazard insurance; marketing; construction insurance and etc. Soft costs also include costs for fixtures, furnishings and equipment. Soft costs are generally estimated as a percentage of the total project budget during the planning stages, and can fluctuate as the project progresses.

In other words, hard costs are the fundamental costs for construction, and soft costs are other costs for design and certification services [28]. Another source [21] defined the term soft costs to include those activities associated with LEED that fall outside the range of construction costs. These include design fees by the design team, project commissioning, documenting compliance with various criteria selected, energy modeling for the project, and LEED application fees. These costs fell variously in the range of one percent to five percent of construction costs. Two examples given were Maryland's Green Building Council that had an additional three to five percent to the total construction costs in soft costs; and The Jean Vollum Natural Capital Center in Portland in which soft costs' amounted to $322,000 representing 3.2 percent of construction costs. These major components of soft costs were categorized into four categories i.e. design costs, commissioning, documentation and energy modeling [21].

Table I compares the various definitions of soft cost found in existing literature. For the purpose of this research, the author will refer to hard costs as those costs that are directly related to items needed to construct a building, and soft costs as those costs that are intangible or unseen in a construction project.

III. Main Elements of Soft Cost

A. Insurance

One of the main values of soft cost in any building project is insurance [13], [15]. The adoption of green practices in order to achieve green building standards such as LEED and Green Globes has introduced new risks to developers that are not usually encountered in conventional buildings. As a result, developers need to address these risks in insurance so that their investments in green buildings are fully protected. As the move towards green certification grows, insurance companies are called to respond with products and services that cater for this new market. Due to the unique qualities that green properties possess, standard insurance forms need to be enhanced and values need to be attached in the coverage provisions for green buildings. The insured value is determined when the policy is purchased and premiums are charged on the insured, therefore an accurate valuation of the insured value is important to avoid paying uncollectible premiums [22]. It can be understood here that green properties carry additional risks for developers, and therefore incur higher insurance value compared to the conventional building. As a result, this contributes to a green premium or additional cost for building green.

B. Developer's Experience

In 2007 and 2008, larger LEED Platinum projects were completed by experienced developers or large institutions with sophisticated project management systems for less than 2% construction premium compared to their conventional counterparts. It is noted that green premium may be reduced over time as developers gain more experience and become more familiar with green projects. These costs include such things as innovative storm water management, water conservation measures, green materials, construction waste recycling and other sustainability features. Table II shows the average cost premium identified from hard costs for greening retail projects according to different LEED certification levels [28]. This can be due to the inexperience of first timers who wish to build green are prone to make a number of misguided decisions in strive to achieve green. Certain decisions were probably very costly such as decisions to install expensive technology and expensive materials. The next time the same developers decide to build green, they are more familiar with what green projects entail and are able to make more ideal decisions that optimize their resources. Hence, the cost difference can be reduced.

C. Design Costs

Green design cost is largely dependent on several factors, including building type, project location, local climate, site conditions, and the familiarity of the project team with green design [18]. Other factors include architectural and engineering (A&E) design time, modeling costs and time necessary to integrate sustainable building practices into projects [11]. Hence, the question about the cost of green is highly subjective. Studies have demonstrated that green design can be achieved in a cost-effective way if sustainability goals,

TABLE I
DEFINITION OF HARD COST AND SOFT COST

Source	Hard Cost	Soft Cost
Build My Own Cabin [4]	Things which are structurally fundamental to build a house. These items include excavation, foundation works, concrete flatwork, framing materials, windows, insulation, basic plumbing and electrical wiring, roofing materials, exterior finish, drywall and painting.	Things that are not necessarily fundamental but are desirable and add value to the construction project. These items include exterior finish, plumbing fixtures, electrical fixtures, cabinetry and flooring.
Rodriguez [24]		Unseen costs that composed the initial part of developing a construction project.
Klinger [13]	Direct costs	Costs that are not directly related to the physical construction of the project, including indirect labor, contract supervision, tools and equipment, supplies, inspection, insurance, repairs and maintenance.
Collier [19]	Actual construction costs to erect a building	Architectural, planning, engineering, permitting, financing, and marketing costs
Kubba [15]	Costs for physical items and visible improvements that incur actual construction costs. These include site preparation (grading / excavating), concrete, framing, electrical, carpentry, roofing, and landscaping.	Indirect costs or "offsite" costs that are not directly related to labor or materials for construction. These include nonphysical expenses and all other fees involved in the completion of the project, such as transfer taxes; origination points; mortgage insurance; appraisal fee; testing; hazard insurance; marketing; construction insurance and etc. Also include costs for fixtures, furnishings and equipment.
Yudelson [28]	Costs for construction	Design and certification services
Northbridge Environmental Management Consultants [21]		Activities associated with LEED that fall outside the range of construction costs including design fees by the design team, project commissioning, documenting compliance with various criteria selected, energy modeling for the project, and LEED application fees.

strategies, and budgets are readily established and integrated in the early design process [11], [18]. An efficient design will reduce the size of the heating and/or cooling system required to meet the peak heating and/or cooling loads [14]. This corresponds to another source [29] who named this as passive design strategy. The author concludes that a passive design strategy is highly desirable to reduce the cost premium of green buildings. Hence, the decision to build green should be made during the design stage, as changes issued after the design stage will incur expensive variation orders.

In relation to design costs, green buildings usually require extra time and effort to the design and specification phase of a project due to incremental requirements on architects and engineers as well as the additional LEED consultant. The estimated design cost for a green building would cost 5 percent more than the typical design cost for a conventional building which usually ranges from 8 to 12 percent of construction costs [16]. This corresponds to another source [28] who called this intensive design exercise "eco-charrettes".

Soft costs include requests for additional architectural and engineering fees, holding "eco-charettes" for considering green alternatives and the LEED system documentation and certification activities [28]. Architectural and engineering fees for green design are higher due to longer design time and the need for additional meetings to confirm design decisions. Eco-charettes are held as an intensive design exercise focused typically around issues specified by a particular green building rating system.

D. Certification

Certification fees and documentation costs also add to elements of soft cost [21]. A pre-requisite to achieve LEED certification is the documentation to be submitted to GBC for review and discussion on certification. Hence, the LEED consultant's role is needed here for tracking and reporting all information that otherwise is not standard practice in specifying or sourcing systems and materials. A survey reported that an average of 226 hours is needed in order to complete all the proper LEED documentation. This cost includes fixed documentation costs and the fees required to register and certify a project. An average of 0.5 percent to 0.9 percent extra is assumed for a typical project commissioning [21].

Most pre-design explorations show that achieving the minimum level of certification under LEED can be cost neutral to even cost-reductive compared to standard design and construction methods. Previous projects have shown no

identified premiums and no extra budget. Third party certification does have direct and indirect costs to the project and the design team. In one example, direct costs paid to USGBC were about 20,000 of the soft cost total. This case study revealed a cost premium of $761,500 or 1% of the $80 million total construction budget. It was found that most of the additional costs i.e. $643,000 were soft or administrative costs paid to USGBC and the consultant team whilst the remaining $118,500 is only 0.015% of the total construction cost. Considering the total of both hard and soft costs, the total additional cost for green building amounting to $761,500 is only 0.38% of the total $200 million development costs [28]. This proves the significance of additional soft costs for green buildings as compared to conventional buildings. Thus, a deeper study needs to look into defining these elements of soft costs.

E. Commissioning

Another element of soft cost is commissioning which is a pre-requisite of the LEED process [16]. Commissioning involves a team of independent individuals to ensure the building complies with the "fundamental building elements and systems" according to LEED guidelines. This process costs an approximate of 0.5 percent to 3 percent of construction costs. The Weidt Group (2002) as cited in reference [21] found commissioning costs between the range of 0.75 percent and 1.5 percent of construction costs. The Oregon Office of Energy asserted that the typical range for commissioning costs were between 0.5 percent and 1.5 percent of construction costs. This cost range varies according to size and complexity of the building. It can be concluded that a typical range of commissioning cost is somewhere between 0.5 percent and 1.5 percent of construction costs [21].

F. Energy Modeling

Two of the most expensive elements are modeling the energy use characteristics of the building, and commissioning the HVAC system to make sure it functions according to design intent [28]. According to a database of fifteen certified projects, this adds about 0.1 percent to construction costs. A study [21] concluded a total estimate of 2.3 percent of construction costs for typical projects with a range of 1.5 percent to 3.1 percent. This range varies according to level of certification, experience with process, and scale of project. Table III displays the estimated cost range for green building components according to Northbridge Environmental Management Consultants [21]. Energy efficiency sets one of the fundamental parameters for assessing green buildings. Hence, energy modeling is conducted to simulate the energy use during the design stage in order to ensure that the building is energy efficient.

Table II shows the percentage of construction premium of hard costs for greening retail projects at basic, silver, gold and platinum certification levels. Findings revealed green buildings with basic LEED certification level incur only a marginal construction premium ranging up to 2 percent at most, whereas those with platinum LEED certification level incur the highest construction premium averaging above 5 percent. Table III and IV show the cost estimate and cost range of soft costs for greening building projects in the United States. Findings indicate that design services for green buildings incur up to 10 percent extra costs depending on the developer's experience with green. Other soft costs include energy modeling, building commissioning, LEED consultant and LEED certification fees.

TABLE II
PERCENTAGE OF CONSTRUCTION PREMIUM OF HARD COSTS FOR GREENING RETAIL PROJECTS AT BASIC, SILVER, GOLD AND PLATINUM CERTIFICATION LEVELS

LEED certification level	Construction premium
Certified (basic)	0 – 2%
Silver	1 – 3%
Gold	3 – 5%
Platinum	Above 5%

Source: Yudelson, J. [28]

TABLE III
COST RANGE OF SOFT COSTS FOR GREENING BUILDING PROJECTS IN THE UNITED STATES

Cost category	
Design services	0 – 10% extra (depending on experience with green)
Building energy modeling or prescriptive design analysis	$15,000 - $30,000
Building commissioning	$0.40 – $0.70 per ft^2, $20,000 minimum
LEED consultant / certification effort	$25,000 - $50,000 (varies by project size)
LEED certification fees	$0.035 per ft^2, with certain minimum and maximum fees

Source: Yudelson, J. [28]

TABLE IV
ESTIMATED COST RANGE FOR GREEN BUILDING COMPONENTS

Component	Best estimate	Range
Design costs	0.5%	0.4% - 0.6%
Commissioning	1%	0.5% - 1.5%
Documentation & fees	0.7%	0.5% - 0.9%
Energy modeling	0.1%	0.1%
TOTAL	2.3%	1.5% - 3.1%

Source: Northbridge Environmental Management Consultants [21]

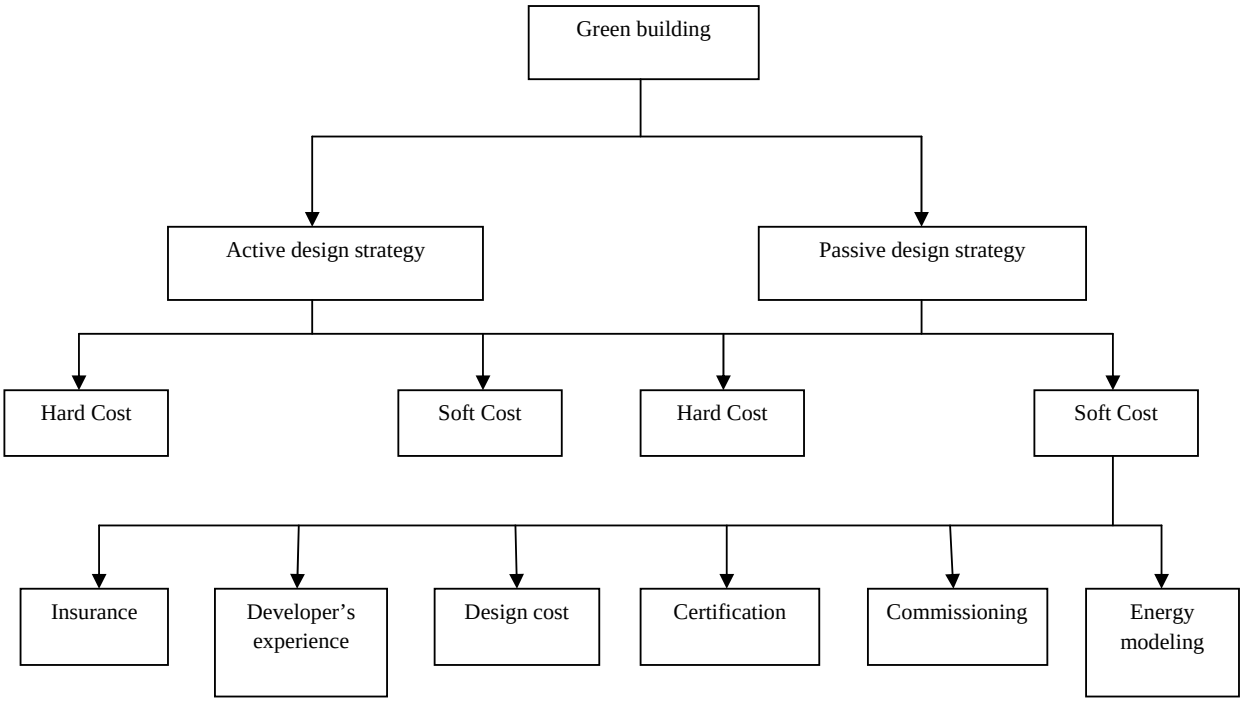

Fig. 1 Distribution of cost elements in green building

IV. Discussion

The study concluded that the green premium or cost differential for green buildings as compared to their conventional counterparts can be attributed to several elements of soft cost in the building. These soft cost elements are derived from intangible costs or unseen costs which involve all non-physical expenses. Many previous studies on green building cost seek to identify factors affecting cost but do not separate elements of soft cost and hard cost. Therefore limited studies had discussed elements of soft cost. From the literature findings, the author categorized these soft costs under six main elements which are insurance, developer's experience, design costs, certification, commissioning and energy modeling.

Insurance for green buildings is relatively higher than conventional buildings due to the additional risks that green properties carry. Hence, in order to protect developers' investments, enhancements need to be made to the insurance provisions to address these risks. As a result, this contributes to a green premium or additional cost for building green.

Developer's experience in green building plays an important role in the general cost implications of green buildings. It was discovered that developers were able to reduce the construction premium to less than 2 percent as they gain more experience and become more familiar with green projects. This can be caused by wiser design decisions made to optimize resources for building green after many learned lesions during earlier experiences.

Another element of soft cost is the design costs which can be sub-divided into factors of additional architectural and engineering fees, eco-charettes, longer design time, and green consultant fee. The fourth element is certification which involves all certification costs to achieve the green building standards.

The fifth element is commissioning which is a pre-requisite in the LEED process for achieving green building standards. Building commissioning is fundamental to ensure that the building complies with the fundamental building elements and systems and incur additional costs up to 1.5 percent of the construction costs.

The last element is energy modeling which is conducted to simulate the energy efficiency of the green building design. These soft cost elements can be represented in Fig. 1.

V. Limitations of Study

The study only identified and explained the elements of soft cost in green buildings but did not rank their importance according to its significance. This requires a survey to be conducted on the research sample so that a hierarchy of elements can be produced accordingly. Most of the literature found focused their study in the United States and applied the LEED rating system to measure their performance. Limited studies were found to be conducted in the Asian continent on cost factors of green buildings. Hence, the reliability of data can be brought to question due to different assessment methods and environmental conditions influencing the building.

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