Sustainability **2015**, *7*, 3615-3636; doi:10.3390/su7043615

OPEN ACCESS

sustainability

ISSN 2071-1050

www.mdpi.com/journal/sustainability

Article

Challenges in Delivering Green Building Projects: Unearthing the Transaction Costs (TCs)

Queena K. Qian [1], Edwin H. W. Chan [2,*] and Abd Ghani Khalid [3]

[1] OTB Research Institute for the Built Environment, Delft University of Technology, 2628 BL Delft, The Netherlands; E-Mail: k.qian@tudelft.nl

[2] Building and Real Estate Department, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China

[3] Faculty of Built Environment, Universiti Teknologi Malaysia, 81300 Johor, Malaysia; E-Mail: drdrghani@yahoo.com

* Author to whom correspondence should be addressed; E-Mail: bsedchan@polyu.edu.hk; Tel.: +852-2766-5800; Fax: +852-2362-3979.

Academic Editor: Tan Yigitcanlar

Received: 9 October 2014 / Accepted: 23 March 2015 / Published: 27 March 2015

Abstract: Delivering green building (GB) projects involve some activities that are atypical in comparison with conventional buildings. Such new activities are characterized by uncertainty, and they incur hidden costs that have not been expected nor are they readily appreciated among the stakeholders. This paper develops a typology and chronology to examine the new activities that are associated with transaction costs (TCs) in the real estate development process (REDP) of green building. Through in-depth interviews with representatives from the major developers in Hong Kong who have experiences in GB practice, this study aims to unearth TCs involved at the critical stages of the REDP. Apart from reconfirming the early project planning stage as the most critical in the consideration of TCs, the study results also identified "extra legal liability risk of the GB product" as the major concern for any GB developer in Hong Kong. The key additional activities that bring significant TCs in developing GB are identified and compared to their traditional counterparts. In turn, project managers not only have to pursue overall cost management whilst winning more business, but they also have to pay particular attention to sustainability in order to minimize hidden societal costs. The study also provides a reference for governments and professionals that will aid in forming policy as well as advance the practice of the GB market by optimizing the societal costs.

Keywords: green building (GB); transaction costs (TCs); uncertainty; real estate development process (REDP); government policy

1. Introduction

Greater business efficacy of the building industry could contribute significantly to the sustainability of future development. In Asia generally, energy demand in the building sector is expected to grow fast in parallel with economic and population growth. In Hong Kong for example, buildings consume half of overall energy used, about 89% of electricity; they contribute about 17% of all Hong Kong's greenhouse gas emissions [1,2]. The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) estimates that by using energy efficiency measures and renewable energy, 12% of the overall energy consumption can be reduced [3]. There are ample studies attesting to the overall societal benefits of promoting green building (GB). However, compared to conventional buildings, GB projects are often perceived as having higher initial design and construction costs. Indeed, there are many uncertainties in the process of delivery of GB, which requires a high contingency sum in the project budget. Without a well-informed picture of benefits and costs, the comparably higher initial costs and transaction costs (TCs) with their associated extra risks, still discourage potential stakeholders from entering the GB market voluntarily. Project managers representing the clients play the central coordinating role in integrating sustainability to deliver a sustainable building during the design and construction process whilst meeting the target time and cost requirements of the project [4–6]. The situation calls for in-depth study on due diligence from a project manager in the role of cost management in order to control the TCs of GB, not only for the cost effectiveness of the project, but also for their societal benefits. Research is required to answer questions such as where TCs exist and what risks are associated with GB. To deliver GB, many actual costs, such as extra construction costs and new material expenditure, could be easily appraised. However, the problem comes from the TCs involved, which are specifically costs hidden as "unintended consequence", such as byproducts and unforeseen repercussions. What are these "unintended consequence"? However, the problem comes from the hidden costs in terms of TCs involved, which are specifically costs hidden as "unintended consequence", such as byproducts and unforeseen repercussions. Compared to conventional building, the barrier to the GB market is higher due to uncertainties, such as greater capital costs, new information, new technology, financial risks, risk of delay with government approvals, and so forth [7]. If there is any asymmetric information about quality standards or requirements that are not mandatorily imposed onto the market by legislation, the opportunistic behavior of market players may lead them to continue producing conventional buildings [8].

As the research of this paper spans several disciplines including green building, transaction costs, real estate development process and project management *etc.*, Table 1 provides a reference to introduce the terminologies that appear in this paper.

Table 1. Nomenclature table.

Terminology	Definitions in this paper
Green building (GB) or sustainable building (SB)	Green or sustainable building is the practice of creating and using healthier and more resource-efficient models of construction, renovation, operation, maintenance and demolition [9]. GB brings together a vast array of practices and techniques to reduce the impacts of buildings on energy consumption, environment and human health.
Conventional buildings	Buildings as oppose to green or sustainable buildings
Transaction costs (TCs)	In Coase's work [10], the cost of organizing and marketing costs (costs of using price mechanism) were grouped as TCs. North [11] who stated that TCs are the sources of social, economic, and political institutions, claimed that TCs arise because of the costs of measuring the multiple valuable dimensions involved in exchange (broadly, information costs) and because of the costs of enforcing agreements. Information is not only costly but incomplete, and enforcement is not only costly but imperfect." [12]. Williamson [13] further developed the concept that TC comprised ex ante and ex post, and that the former occurred in drafting and negotiating agreements, while the latter included setup and the costs of running governance structure. Transaction costs are equivalent to friction force in physical systems. In this paper, we specifically refer to those TCs in terms of risk, time delay, uncertainty, and information search, setting up cost as well as learning cost during the REDP of green buildings. Some examples of TCs include resources used for information search, familiarization with new measures and control systems, and establishing new networking, *etc.*
"Hidden costs" in terms of transaction costs	Hidden cost is "unintended consequence", such as byproducts, or repercussions after embarking on a course of action, e.g., investing in green building. In this paper, we consider "hidden costs" in terms of those TCs as referred above.
REDP (REDP)	In this study, the REDP spans from the time the developer decides to invest in a GB project until he delivers the GB products to the market's end-users. With reference to the literature for consistence, this study follows the well-established stages of real estate development in the *RIBA Outline Plan of Work* [14] to establish the transaction's stages and to study the TCs involved.
Critical stages of the REDP	First, we include all the stages mentioned in the *RIBA Outline Plan of Work*. *i.e*., Stage A-M (Inception; Feasibility; Outline proposals; Scheme Design; Detail Design; Production Information; Bills of Quantities; Tender Action; Project Planning; Operations on Site; Completion ; and Feedback) as published in the Outline Plan that has been used in the industry for many decades. The experts interviewed were asked to refer to these stages and to recommend adding or dropping any of the stages that pertain to in-depth considerations of green building. After evaluating their importance, those stages identified as having the potential of causing the most significant TCs are regarded as the "Critical Stages".
Real estate developer	The person or company that organizes finance, people, resources and the processes to deliver a real estate project from Inception to Feedback stages as a business endeavor. In this study, the real estate developer is represented by its professional consultant such as the leading project manager, architect, engineer or surveyor in the company.
Market's end-users	The person who buys or rents a unit or whole block of the green buildings for own use.

New procurement processes and extra tasks are involved in GB that require the support of new rules and institutions, and in turn, cause TCs that are hidden. Cheung [15] defined TCs as any costs that arise due to the existence of institutions. From the new institutional economics perspective, when TCs are too large, they inhibit exchange, production, and economic growth. The functioning of TCs under different institutional arrangements is also crucial to the workings of markets [11,16–18]. The concerns of the critical stage and extra tasks caused by GB should be systematically identified and fully appreciated. The hidden costs, in terms of TCs, due to the extra new activities in delivering GB, should be unearthed so as to explore the potential of reducing them.

Robichaud and Anantatmula [19] recognized the difficulties in hiring an integrated design team early in the green building project. They also suggest using a general project manager with good knowledge of green building to formulate an initial budget and schedule in order to benefit the project. Häkkinen and Belloni [20] pointed out that the cost effects of sustainable buildings are not clearly recognized, and the clients have concerns to the higher investment costs and higher risk of unforeseen costs in GB development process. A better understanding of the nature of GB transactions, the structure of the REDP, and how the TCs incurred in each stage is essential to improve the market mechanisms for GB investment.

Transaction costs, in the form of hidden costs, in comparison with actual construction costs, are relatively obscure, and how they are incurred in each stage of REDP is not well-understood. This study aims to conceptualize and prioritize the extra tasks, in terms of TCs, along the REDP process. This study establishes a framework to understand TCs as addressed by practitioners in a development project in order to envisage the magnitude of "uncertainty." A project manager is said to have ownership of the process in a project development and should be in a position to minimize TCs [21].By borrowing the framework from the RIBA's Plan of Work [22], the study can systematically identify the TCs incurred in each stage of the REDP due to the extra tasks of GB in comparison with its conventional counterpart. This approach is based on the theory that policy interventions and well-designed institutional structures may lower TCs and provide net social benefits [23–25].

This research focuses on the REDP and looks into the TCs incurred by uncertainty. A better understanding of the nature and structure of TCs is necessary to improve the project delivery process for GB. The situation calls for a thorough study focusing on how to smooth transactions for market stakeholders in REDP of GB, with the aim of reducing the TCs involved in the GB development process. From the perspectives of project managers, the research focuses on the stakeholders' concerns in each transaction and different stages of REDP that affect their GB investment; it analyzes the extra new activities, in terms of TCs that cause the concerns to the GB decision-making during the REDP using Hong Kong as the case study.

2. Literature Review

2.1. Green Building (GB)

It is widely acknowledged that buildings account for about 40% of the world's energy consumption. Moreover, buildings have been identified in the Fourth Intergovernmental Panel for Climate Change Assessment Report as having the highest greenhouse gas mitigation potential of all the economic sector

reviewed. Worldwide, governments have been promulgating policy and law to promote and enforce higher energy efficiency in buildings for both new construction and renovation. For example, the European Union (EU) has adopted an EU-wide emission reduction commitment that corresponds to the total reduction commitment of individual member states. Energy Performance of Buildings—(EPBD 2002/91/EC) is the most important EU Directive for energy efficiency in buildings [26]. The main objective of the EPBD is to define a holistic approach to promote cost-effective improvement of the overall energy performance of buildings. In compliance with the EU Directive, an energy pass is required for all new buildings and developers are required to present an energy pass when selling or letting existing non-residential buildings. The pass provides details of the projected energy consumption of a property, which increases transparency on energy use by tenants. In addition, other complementary directives are available to deal with energy aspects in the building context or relevant provisions of buildings. For example, to remove existing market barriers and improve the efficient end use of energy, the Energy End-use Efficiency and Energy Services Directive (2006/32/EC) provides the necessary incentives and institutional, financial and legal frameworks. The Eco-design of Energy-using Products Directives (2005/32/EC) serves similar purpose by setting labeling requirements and minimum energy performance standards for appliances and other energy-using equipment. For construction products, the Construction Products Directive (89/106/EEC) established a single set of European-wide technical specifications to replace existing national standards and technical approvals. From 2012, to ensure meeting the Union's 2020 20% headline target on energy efficiency the Directive 2012/27/EU on Energy Efficiency establishes a common framework of measures for the promotion of energy efficiency within the Union [27]. It also The Directive establishes indicative national energy efficiency targets for 2020 and lays down rules to remove barriers in the energy market and overcome market failures that impede efficiency in the supply and use of energy. By 2019, all new buildings in the European will be required to be Net Zero Energy [28].

Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction [9]. Energy-saving measures such as solar energy cells, sun-shading devices, low-emissivity glass, energy-efficient air-conditioning systems, and building-space planning and orientation are the common design considerations for GB. Sophisticated technologies have been developed ready for GB implementation through good management and policy support. Leadership in Energy and Environmental Design (LEED) certified buildings can lower the operating costs by 8%–9% compared to regular buildings, and these savings pay for higher initial costs in the relative shorter life cycle of GB [28]. Until now, Hong Kong has been relying more on voluntary effort to conserve energy, and there are several green pressure groups, such as the Professional Green Building Council and Business Environment Council (BEC), promoting the voluntary use of GB. The HK-BEAM and other green-label programs are accepted assessment tools promulgated by voluntary bodies in the past decade [29]. In recent years, the Hong Kong government has begun to take an active part in driving GB initiatives. With land and building area in Hong Kong well known to be extremely scarce, the Hong Kong government in April 2011 has introduced an incentive scheme linking the element of bonus floor area of a development project to promote GB design. Developers have to incorporate certain GB features in their development projects and to meet GB certification requirements in order to gain the extra bonus building floor area (known as "granting GFA

concessions") [30,31]. In September 2012, it has promulgated the Buildings Energy Efficiency Ordinance to regulate energy-saving engineering solutions for newly constructed buildings. It has pushed many developers to seriously consider any institutional hurdles and to view the development process more carefully so as to deliver GB in order to enjoy the incentive scheme. However, the TCs and barriers of GB are still to be fully addressed.

2.2. The Role of TCs in GB Market

Neoclassical economics shows that a perfectly functioning market will yield an economically efficient outcome in equilibrium. However, no real-world markets meet all the assumed attributes of perfection. From the new institutional economics perspective, when TCs are huge, they inhibit exchange, production, and economic growth. North [12] concluded: *"TCs arise because of the costs of measuring the multiple valuable dimensions involved in exchange (broadly, information costs) and because of the costs of enforcing agreements. Information is not only costly but incomplete, and enforcement is not only costly but imperfect."* The power of TCs under alternative institutional arrangements is also crucial to the workings of markets [11,16–18]. From a transaction cost economics (TCE) perspective, researchers regard energy efficiency as a co-ordination and incentive problem, rather than one of utility maximization, and they emphasize that policy intervention and different institutional structures may lower TCs and provide net social benefits [23,25]. A better understanding of the nature and structure of barriers is necessary to understand the hidden TCs affecting the decision-making of stakeholders in GB, and help design an incentive scheme that effectively promotes the market mechanisms for GB investment.

In the real estate development process, there are many market stakeholders involved, and each of them is dedicated to their own business interests. Real estate developers intend to do no more than obey the basic requirements of the law and regulatory policies to minimize the potential costs and risks engendered by the extra work entailed by GB or its incentives. In this study, the real estate developer is represented by its professional consultants such as the leading project manager, architect, engineer or surveyor in the company. Contractors also want to avoid these extra tasks, because GB requires special expertise and specialized equipment that they do not typically possess. Manufacturers of GB products want regulations still to be stricter to create greater demand. Building-design practitioners and institutes will not be greatly influenced by the new policies but are apt to succumb to the demands of developers because of the nature of their relationship with them. However, these interests have not yet been fully expressed by the stakeholders themselves, as most of them are still learning about how to participate in policy-making. These conflicting interests are the main source of the risks and barriers to GB development. Government could play an essential role by looking into the barriers and taking them into consideration in policy design. Table 2 shows how TCs directly affect decision-making in the market for GB amongst its stakeholders.

Table 2. TCs directly affecting decision-making in the market for GB (adapted and developed from Koomey [32]).

Stakeholders/Sources of TCs	TCs Code						
Decision-maker	1	2	3	4	5	6	7
Prospective Building Purchasers	×				×		
Prospective Occupants					×		
Developers (represented by their Project Managers)	×	×	×	×	×		
Builders				×			
Architects/Designers	×	×	×	×	×		×
Construction Finance Organizations					×		
Take-Out Lenders					×		
Brokers			×		×		
Appraisers		×	×		×		
Local Government Officials						×	
Utility						×	
Suppliers of Efficient Devices						×	

Legends: Transaction Cost Codes (× = cost directly affects the decision-maker). 1 = cost of collecting information about efficiency measures or the credibility and reliability of new suppliers and subcontractors; 2 = cost of developing expertise; 3 = cost of calculating the costs and benefits of different efficiency levels; 4 = cost of deciding how to alter established design and construction procedures; 5 = cost of demonstrating in a credible way that a new building will reduce prospective tenants' or purchaser's energy costs; 6 = cost of disseminating information about efficiency technologies; 7 = cost of the architect/engineer incorporating new information about efficiency in day to day work.

The main focus of this paper is to study the process of delivering GB by identifying the associated TCs at different stages of the process. We recognize the important contribution of the stakeholders' management to improve the project delivery system, but this paper cannot go deep into stakeholders and multi agent decision making theory. Fair treatment of stakeholders is the key to survival of an organization, and the importance of stakeholder management has been accentuated in various studies [33–35]. The contribution of stakeholder management toward project success is particularly important at the briefing stage [36]. Stakeholders with their own vested interests or short slightness often seem incapable of concerted action in the realization and implementation of sustainability in a development project. These problems are exacerbated in delivering GB, which often concerns new products/practices, and as public goods, causes barriers to GB market [37–39].

2.3. "Transaction" and Transaction Stages in GB Project Development

The unit of analysis in situations that Coase [10,40,41] describes is the transaction—the transaction between the regulatory agency and the private sector. The transaction in this study is the REDP involving the developers and the end-users who take part in the GB market. The purpose of choosing this transaction scenario for investigation is to examine the TCs incurred by the stakeholders who invest in GB, as compared to its conventional counterpart. Some examples of the TCs include resources used for information search, learning costs of the new measures and control systems, and establishing new networking, *etc.* As there is much literature supporting the value of GB [42–47], this

study was not undertaken to find more evidence for the necessity of GB, or to provide further rationales for introducing incentive schemes. Instead, this study intends to determine the concerns of the market stakeholders, whom have been ignored by current policies and research. It also intends to develop a theoretical framework by applying TCE to the study of business rationales and to find ways to improve the GB business by putting more precise and effective policies into place. It compares the extra efforts for GB investments *versus* standard ones (traditional buildings) in terms of TCs and emphasizes how TCs influence decisions about whether to invest in GB and to what extent. Mills [22] in their study on the design manager's role in delivering sustainable building adopted a sustainable building process based on the conventional building process that is presented in Outline Plan of Work 2007 by Royal Institute of British Architects (RIBA). Hence, the transaction, namely REDP, is referred to the well-established stages of real estate development in the *RIBA Outline Plan of Work* [14] to establish the transaction's stages in order to study the TCs involved.

The Plan of Work established by the Royal Institute of British Architects (RIBA) has been used in the UK for over a hundred years as a framework to guide all stakeholders to work in coordinated manner through each stage of the REDP. Hong Kong, as an ex-colony of Britain, has adopted the same plan of work for its building projects. This study, therefore, follows the well-established stages of real estate development in the *RIBA Outline Plan of Work* [14] to establish the transaction's stages with the TCs involved. The adapted *RIBA Outline Plan of Work* is shown in Table 3 with the developers' key concerns regarding GB. The developers' key actions with reference to traditional buildings, as shown in column 1 (Tasks to be done for traditional buildings) of Table 3, are developed from the *Architect's Job Book*, *RIBA Chartered Practice Manual* [47], and *Architects Handbook of Practice Management* [48]. Table 3 adopts the established flow of the developmental process in the *Plan of Work*.

By referring to the tasks that stakeholders are normally involved with in a traditional project, the authors hypothesize in the right hand column the DEVELOPER'S KEY CONCERNS in GB development relating to the extra work with TCs incurred over and above that of a traditional project in each stage of the REDP. According to the *Outline Plan of Work*, GB development projects require the developers to do extra work. Based on the professional practice manuals and the literature on green-building design and construction [27,47,49–53], we propose a list of possible extra work to be conducted by developers of GB projects. The test list of the possible extra work has been subjected to intensive brainstorming sessions among the research team and a pilot discussion with practitioners on the way to its present form. Finally, we propose the new list of extra tasks (not a conclusive list) that were used in interviews. Some tasks have been removed and some are added after interviews. Those shown on the right hand side of the column in Table 3 are the extra tasks that interviews agree on their significance and need of detailed consideration.

Table 3. Outline Plan of Work in REDP with DEVELOPER'S KEY CONCERNS (with reference to traditional buildings and extra works from GB) [47,48] (Adapted from the RIBA Outline Plan of Work).

	Column 1: Stage	**Column 2:Tasks to be done (for traditional projects) in different stages**	**Column 3: DEVELOPER'S KEY CONCERNS Extra work with TCs incurred (in concern of GB)**
Briefing	A: Inception	Set up client organization for briefing. Consider requirements, appoint architect. **Developer's Key Actions:** Identify opportunities (property/need/use/idea); Assemble co-developer; Identify and review information; Identify seed money; Evaluate investment climate.	1. Set up extra organization for briefing in relating with GB, e.g., new offices, new staffs. 2. Consider extra GB related market and policy requirements: market study in GB; policy study in GB. 3. Appoint special architect and involve special stakeholders relating to GB. 4. Need JV or Co-developer for such special project? 5. Carry out extra studies of market requirements and expectation on GB (considering local community need/supply/competitiveness). 6. Extra GB planning, design, and cost, *etc.*, as necessary to reach decisions. 7. Extra effort to identify potential users. 8. Study the extra financial risk. 9. Consideration of extra legal liability risk of the GB product. 10. More careful review of available information on GB. 11. Others.
	B: Feasibility	Carry out studies of user requirements, site conditions, planning, design, and cost, *etc.*, as necessary to reach decisions. **Developer's Key Actions:** Preliminary market analysis (community/supply/competitive); Assemble technical team; Identify potential users; Consider alternative site; Preliminary financial plan; Formal analysis (site/building/market/design/financial/appraisal); Investment threshold; Legal issues; Public participation; Review available information; Review objectives.	
Sketch Plans	C: Outline proposals	Develop the brief further. Carry out studies on user requirements, technical problems, planning, design and costs, as necessary to reach decisions. **Developer's Key Actions:** Obtain control of the land/property; Preliminary plans and specifications; Negotiation with government for approval.	1. Special User Requirement study. 2. Explore special technical solutions. 3. Special concept/design that need negotiation with government for approval. 4. Design leading to non-efficiency use of floor area. 5. Special cost study for using new design features. 6. Others.
	D: Scheme Design	Final development of the brief, full design of the project by architect, preliminary design by engineers, preparation cost plan and full explanatory report. Submission of proposals for all approvals.	

Table 3. *Cont.*

	Column 1: Stage	**Column 2:Tasks to be done (for traditional projects) in different stages**	**Column 3: DEVELOPER'S KEY CONCERNS Extra work with TCs incurred (in concern of GB)**
Working Drawings	E: Detail Design	Full design of every part and component of the building by collaboration of all concerned. Completer cost checking of designs. **Developer's Key Actions:** Finalize plans and specifications; Revise financial projections; Financial negotiations (Mortgage/loan/construction loan); Tax consideration.	1. Financial negotiations for new design feature (consideration of mortgage/Loan/construction loan). 2. Search for a list of contractor with special expertise. 3. Limited no. of contractor available reduces competition. 4. Others.
	F:Production Information	Preparation of final production information *i.e.*, drawings, schedules and specifications.	
	G: Bills of Quantities	Preparation of Bill of Quantities and tender documents.	
	H: Tender Action	*Compile a list of tenders; Issue tender documents; Check and open tenders*	
Site Operation	J: Project Planning	Notify acceptance of tender; Check all contract document are in order; Brief all project personnel of the project requirement and procedure for administer the project ; Check approvals and site condition to ensure the project can be carried out on site **Developer's Key Actions:** Acquire property; Select construction Co; Marketing and leasing; Initial financing; Assemble construction Management team; Tennant involvement.	1. Extra effort to brief all project personnel of the project requirement and procedure for administer the project. 2. Special promotion strategy and materials for Marketing and Leasing. 3. Additional consideration of tenant for GB products. 4. Extra requirement on Testing and Commissioning of service installations to obtain Green Labeling *etc.* 5. Special effort to prepare maintenance manual. 6. Extra fee for certificates involving Green items. 7. Others.
	K: Operations on Site	*Sitting out the building on site; Site meetings; Supervision and site visits; Financial monitoring of each construction stages; Testing and Commissioning of service installations; Prepare maintenance manual.*	
	L: Completion	*Check works ready for completion; Hand-over inspection; Rectify defects; Final inspection and final certificate.* **Developer's Key Actions:** Inspection; Certificate of occupancy; Permission to sell/rent.	

Table 3. *Cont.*

	Column 1: Stage	Column 2:Tasks to be done (for traditional projects) in different stages	Column 3: DEVELOPER'S KEY CONCERNS Extra work with TCs incurred (in concern of GB)
Feedback & Maintenance	M: Feedback	Analysis of job records. Inspections of competed buildings. Studies of building in use. **Developer's Key Actions:** Prepare property management plan; Revise marketing plan; Oversee marketing or Leasing.	1. Special property skill requirement for Property management plan. 2. Special strategy and materials for Overseeing marketing or Leasing. 3. To keep building running effectively and under good repair. 4. Set up and manage ownership entity. 5. More special green items to be taken care of for property improvement. 6. Easy to sell or rent out property. 7. Involve more guarantee certificates. 8. Others.
	N: Maintenance	**Developer's Key Actions:** Set up and Manage ownership entity; Property improvement; Property disposition; Closing ownership entity.	

2.4. Extra Tasks at Different Stages of the REDP of GB

Each of the possible extra tasks may incur extra TCs, which based on the TCE literature, can be categorized as research costs, information costs, analysis costs, decision costs, institutional-arrangement costs, evaluation costs, and so forth. These possible extra tasks and TCs, as suggested by the *Outline Plan of Work*, contribute toward building a framework as presented in Column 3 (Extra work with TCs incurred in the context of GB in Table 3). They are summarized to help develop the research questions and hypotheses later. The proper incentive schemes with reference to the transaction stages could be developed to suit the business rationale of the stakeholders later.

The transaction of concern in this study takes place between the developers and the end users, each of whom has to consider the available incentive scheme and its foreseeable risk, their own resources and capital situation, and their potential competitors, before they decide to carry out the transaction. The regulatory agency's primary purpose is to set up incentive schemes to attract the private sector to invest in GB businesses, whereas the developer's primary purpose is to evaluate its own cost-benefit ratios under different incentive schemes and make an optimal decision for its own sake. As the incentive schemes are mostly on a voluntary basis, the private developers only agree to meet the conditions set forth by the government in exchange for a benefit that more than just covers its loss after an overall evaluation. The developers' private situations vary, so it is not useful to discuss the TCs arising from different situations case by case. However, it is rational and meaningful to study the barriers that cause extra concerns and corresponding TCs that the private sector developers face at various stages of the process during the REDP when they invest in GB. Hence, the study aims to address the following research questions:

Q1: What extra work arises at different stages of the GB development comparing with its counterpart of traditional development in real practice?

Q2: What are the corresponding TCs specific to different stages of GB- development in real practice?

The underlying issues of these questions are incorporated into the interview questions as presented in the following section.

3. Methodology

3.1. Interview with the Real Estate Developers—Case Study in Hong Kong

Real estate developers are the dominant force in the building market. As most incentive schemes for GB promotion are market-based and voluntary, the stakeholders involved are free to accept or reject them [54]. There are two major reasons that real estate developers are not motivated by most of the existing incentive schemes. First, the extra TCs involved are too heavy and the developers would rather give up potential benefits to avoid the attendant difficulties; second, the benefits from the schemes are not enough, which means that the incentive itself is not a sufficient inducement for the potential investors to become involved. Therefore, it is important to understand their priority concerns on their GB transaction so that the policymakers could be able to address incentives more effectively for the healthy, long-term development of the GB market.

We include all the stages mentioned in the *RIBA Outline Plan of Work*, *i.e.*, Stage A-M (Inception; Feasibility; Outline proposals; Scheme Design; Detail Design; Production Information; Bills of Quantities; Tender Action; Project Planning; Operations on Site; Completion; and Feedback) as published in the Outline Plan that has been used in the industry for many decades. A framework (see Table 3) showing the possible extra tasks related TCs to be considered under the *Outline Plan of Work* is established for interview-data collection. The list of extra tasks *is not* pre-defined. The extra tasks listed in column 3 are not an exhaustive list and they were given by the interviewees with reference to their own experience in the REDP for delivering GB. We compile the list based on collection of all extra tasks suggested by the interviewees but still adding OTHERS to allow any further suggestion from interviewees. In Table 4, the importance score for their suggested extra tasks are recorded for each of the interviewees. Hence, some interviewees may not put their scores to some of the extra tasks suggested by others.

The interviewees were asked to identify the additional concerns and work caused by GB, in terms of the TCs, during each stage of the REDP, and to rank them by levels of uncertainty. The purpose was to get first hand opinions of real estate developers to rank the uncertainty of the extra tasks proposed, and for each task, to understand its impact on the GB transaction. This study also provides a better picture of GB market development relating to a specific institution in the case of Hong Kong, and it gives a reference for designing rational policy for GB promotion.

3.2. Considering TCs Caused by GB during Different Stages of REDP

For the data collection process, Table 3 shows the extra work and related TCs in GB. Based on those possible extra tasks involved at different stages of the REDP, key senior professionals, who have served the role of project managers on project basis for real estate development companies and their representatives and as in-house project managers, were interviewed to seek their views on the significance of TC considerations and related uncertainties for each of the extra tasks (Table 4).

In this case study, the real estate developers and their professional representatives who took part in the interviews are all from the top six real estate development companies in Hong Kong, which undertake about 80% of local real estate developments. In-depth interviews were conducted to solicit their views on issues regarding GB investment. The interviewees selected were 15 top managers, directors or their representatives, who actively worked as project managers for major real estate development firms. In addition, we selected those people who have an abundance of practical experience in GB, and who could influence the market in a significant way. Therefore, the interviewees are limited and selected with the above considerations to ensure the sample is representational and the results are significant. The profiles of the interviewees are shown as below. Table 4 summarizes the views of the interviewees.

Profiles of the interviewees:

E1: (Executive Director of Electrical and Mechanical Engineering)
E2: (Executive Director of one of the top developers)
E3: (Sustainable development director for a leading architectural firm)
E4: (Associate Director of a world-class architectural firm)
E5: (Director of one of the top 2 Quantity Surveyors firms)
E6: (Director, Campus Development of a Hong Kong university)
E7: (Senior officer, Environmental Protection Department)
E8: (Director of a medium size QS firm)
E9: (Director, one of the top developers)
E10: (Director of one of the top developers)
E11: (Chairman of a leading property services company)
E12: (Director of an international property investment company)
E13: (Director, Science Park)
E14: (Surveyor, and past president of Professional Green Building Council)
E15: (Architect, and Council Member of Professional Green Building Council)

Table 4. Weighed extra tasks to be done in REDP from interviews in Hong Kong.

	Extra Tasks by GB	Highest frequency	Overall grading and Remarks
Briefing stage	1. Set up extra organization for briefing in relating with GB.	S (61.5%)	S: Standard risk (Consistent views)
	2. Consider extra GB related market and policy requirements.	U (53.8%)	U: High risk (Consistent views)
	3. Appoint special architect and involve special stakeholders in relating to GB.	S (84.6%)	S: Standard risk (Very consistent views)
	4. Need JV or Co-developer for such special project?	X (84.6%)	X: Not applicable (Very consistent views)
	5. Carry out extra studies of market requirements and expectation on GB (considering local community need/supply/competitiveness).	U (61.5%)	U: High risk (Very consistent views)

Table 4. *Cont.*

	Extra Tasks by GB	Highest frequency	Overall grading and Remarks
Briefing stage	6. Extra GB planning, design, and cost, *etc.*, as necessary to reach decisions.	S (61.5%)	S: Standard risk (Consistent views)
	7. Extra effort to identify potential users.	U (61.5%)	U: High risk Standard risk (Consistent views)
	8. Study the extra financial risk.	S (46.1%)	S: Standard risk (but with diverse views)
	9. Consideration of extra legal liability risk of the GB product.	V (30.7%) S (30.7%)	V: Very High risk (with very diverse views)
	10. More careful review of available information on GB products.	U (61.5%)	U: High risk (Consistent views)
Sketch Plans stage	11. Special User Requirement study	S (61.5%)	S: Standard risk (Consistent views)
	12. Explore special technical solutions.	U (53.8%)	U: High risk (Consistent views)
	13. Special concept/design that need negotiation with government for approval.	S (84.6%)	S: Standard risk (Very consistent views)
	14. Design leading to non-efficiency use of floor area.	X (84.6%)	X: Not applicable (Very consistent views)
	15. Special cost study for using new design features.	U (61.5%)	U: High risk (Very consistent views)
Working drawing stage	16. Financial negotiations for new design feature (Mortgage/Loan/construction loan).	S (61.5%)	S: Consistently standard risk
	17. Search for a list of contractors with special expertise.	U (61.5%)	U: Standard risk (Consistent views)
	18. Limited no. of contractors available that reduce competition.	S (46.1%)	S: Standard risk (but diverse views)
Site operation stage	19. Extra effort to brief all project personnel of the project requirement and procedure for administer the project.	S (76.9%)	S: Standard risk (Very consistent views)
	20. Special promotion strategy and materials for Marketing and Leasing.	U (46.1%) V (23%)	U: High risk (but with diverse views).
	21. Additional consideration of tenant for GB products.	S (54.5%) U (38.5%)	S/U: Standard to High risk (but with diverse views).
	22. Extra requirement on Testing and Commissioning of service installations to obtain Green Labeling *etc.*	U (46.1%) S (30.7%)	U: High risk (but diverse views).
	23. Special effort to prepare maintenance manual.	S (53.8%)	S: Standard risk (but diverse views).
	24. Extra fee for certificates involving Green items.	S (69.2%)	S: Standard risk (Very consistent views).
Feedback and Maintenance stage	25. Special property skill requirement for Property management plan.	U (38.5%) S (46.2%)	U/S: Standard to High risk (but with Very diverse opinion.
	26. Special strategy and materials for overall marketing or leasing of the completed green/GB building.	U (31%) V (31%)	U/V: High and Very High risk (but with very diverse opinion.

Table 4. *Cont.*

	Extra Tasks by GB	Highest frequency	Overall grading and Remarks
Feedback and Maintenance stage	27. To keep building running effectively and under good repair.	S (53.8%)	S: Standard risk (but diverse views).
	28. Developer's Key Actions: Set up and manage ownership entity.	X (53.8%) S (38.5%)	X: Not applicable (but some diverse views).
	29. More special green items to be taken care of for Property improvement.	S (76.9%)	S: Standard risk (Very consistent views).
	30. Easy to sell or rent out Property (Involve more guarantee certificates?).	S (38.5%) U (38.5%)	U: High risk (but with very diverse views).

Legends: S: Normal standard levels of risk that developers are not too concerned about and could easily be covered by an extra % expenses/fee (e.g., pay a specialist consultant to do the work); U: Certain uncertainties that developers are concerned about such as time, cost, risk, government requirements, sales, *etc.*; V: High level of uncertainties that developers are very concerned about: time, cost, risk, government requirements, sales, *etc.*); X: Not applicable, or so low that it can be ignored; %: For each item, the ones (S, U, V or X) with the highest frequency, and where there are significant diverse views, the significant second highest frequency of the items being ticked by the interviewees are shown in the table. The rate in terms of % is shown in the bracket (%).

4. Interview Data Analysis

4.1. Briefing Stage

At the briefing stage, interviewees were asked about ten extra tasks, identified from the literature review. Four of them are regarded as representing normal levels of risk (S) at various levels of development and could be covered by lump sum money. Developers are not too concerned about these. These four tasks, listed here from the most to the least acceptable, are listed below:

- No. 3 "Appoint a special architect and involve special stakeholders in relation to GB" (S: 84.6%)";
- No. 1 "Set up extra organizational structures for briefings in relation to GB" (S: 61.5%);
- No. 6 "Extra GB planning, design, and cost, *etc.*, as necessary to reach decisions" (S: 61.5%); and
- No. 8 "Study the extra financial risk" (S: 46.1%).

Four tasks are regarded as involving uncertainty (U), which means there is no readily available standardized practice in the market for the developers to refer to without worrying about too much risk. These tasks are normally not standardized and cannot be predicted. These four tasks, listed from the most to the least acceptable, are put forth below:

- No.5 "Carry out extra studies of market requirements and expectations about GB" (considering local community need/supply/competitiveness)" (U: 61.5%);
- No.7 "Extra effort to identify potential users" (U: 61.5%);
- No. 10 "More careful review of available information on GB products" (U: 61.5%); and
- No.2 "Consider extra GB-related market and policy requirements" (U: 53.8%).
  (Here, the higher rate means that more people agree that the item should be rated as U.)

One task, No.9 "The consideration of extra legal liability risks for the GB product" (V: 30.7%; S: 30.7%) is rated equally as very uncertain and standard. Opinions about this task are diverse. In the authors' judgment through the interview, they appear to be concerned with uncertainty which is considered as very high risk (V). Another task, No. 4 "Need JV or co-developer for a special project?" is consistently considered to be not applicable as a GB special task.

4.2. Sketch-Plan Stage

Five tasks were confirmed as extra works at the sketch-plan stage. Two are considered to be of normal risk levels (S). These are: No. 13 "Special concepts/designs that need negotiation with government for approval" (S: 84.6%), and No.11 "Special User Requirement study" (S: 61.5%). Both of these tasks are generally considered to be of standard risk that will not cause extra concern besides the lump sum money input. No.15 "Special cost study for using new design features" (U: 61.5%), and No.12, "Explore special technical solutions" (U: 53.8%) are the two among the five tasks that are consistently rated to be of high risk to the developers, and which cause high concern in their decision-making about GB investment. No.14 "Design leading to non-efficiency use of floor area" (X: 84.6%) is generally considered not to be an extra task for GB during the sketch-plan stage.

4.3. Working-Drawing Stage

Three tasks are confirmed for this stage. No.16 "Financial negotiations for new design feature" (Mortgage/Loan/Construction loan)" is rated consistently as of standard risk (S: 61.5%). Another S-rated task is No.18 "Limited number of contractors available" reduces competition (S: 46.1%), which shows more diverse opinions about this task with a higher tendency to consider it as standard risk. No.17 "Search for a list of contractors with special expertise" (U: 61.5%) is consistently considered to be of high risk and concern to developers in Hong Kong.

4.4. Site-Operations Stage

Six extra tasks for GB were confirmed by the interviewees. Three of these are rated S (in decreasing order): No.19 "Extra effort to brief all project personnel of the project requirements and procedures for administering the project" (S: 76.9%); No.24 "Extra fees for certificates involving Green items" (S: 69.2%); and No.23 "Special efforts to prepare maintenance manuals" (S: 53.8%). These three are all rated as being of standard risk that lump sum money can cover without too much concern. The two tasks rated U are No.20 "Special promotion strategy and materials for Marketing and Leasing" (U: 46.1%; V: 23%), and No.22 "Extra requirements of testing and commissioning of service installations to obtain green labeling" (U: 46.1%; S: 30.7%), both of which elicit high diverse opinions but are considered high risk. The task No.21 "Additional consideration of tenants for GB products" (S: 54.5%; U: 38.5%) is rated with very diverse opinions between high and standard risk.

4.5. Feedback and Maintenance Stage

There are six GB extra tasks for this stage. Two of them are generally agreed to be of standard risk (S). These are: No.29 "More special green items to be taken care of for property improvement"

(S: 76.9%) and No.27 "To keep buildings running effectively and in good repair" (S: 53.8%). The other two extra tasks elicited diverse opinions. No.25 "Special property skills requirement for Property management plan" (U: 38.5%; S: 46.2%) is deemed to be between high risk and standard risk and No.26 "Special strategy and materials for overall marketing or leasing of the completed GB" (U: 31%; V: 31%; S: 31%) attracted split opinions, but is mainly judged as a high or very high risk. The authors feel from the interview that No.30 "Easy to sell or rent out property (Involving more guarantee certificates?)" (S: 38.5%; U: 38.5%) is of high risk. Finally, task No.28 "Developer's Key Actions: Setting up and managing ownership entity" (X: 53.8%; S: 38.5%) is generally considered by the respondents to be not applicable.

5. Results and Discussion

The objectives of this paper aiming to identify the concerns specific to GB projects have been addressed more explicitly by dividing the transactions of the entire REDP into smaller established stages. This helps the project managers of developers and government agencies to better understand the market and to develop policies with an emphasis on the different stages of transactions, thus promoting GB more efficiently with appropriate policies. Based on the analysis in the previous section, Table 5 summarizes the concluding findings from the interview questions. It helps to address the above-mentioned two research questions for this study (Q1 and Q2 from literature review). Table 5 shows only those extra tasks that concern the project manager of developers that also need to be seriously addressed by government policy design.

The results show that additional tasks are more likely to arise during the early period (briefing stages) of a GB project than at other stages. This reinforces the established scholarship concerning the importance of the design stage of the construction project deliver process. It is particularly true for GB, which calls for an integrated design process as a response to the additional considerations and that various stakeholders work together from the pre-design phase through post-occupancy [55]. This point also echoes other studies emphasizing the importance of stakeholder management at the briefing stage [36]. The area of greatest TCs concern is the possibility of extra legal liability in relation to the GB product due to uncertainties about the market, consumers, and available technical information. This is mainly because the approval process by the government departments for innovative GB design in Hong Kong is uncertain. Once a building plan is disapproved, it will cause project delay, thus incurring enormous expenses for the project manager. To alleviate the problem, government intervention is necessary to promote GB by setting policy that calls upon government department to publish more certain GB design guideline. The other significant risk items mainly relate to extra study and knowledge about the market. At the sketch-plan stage, the task with the highest risk is the cost of study involved in incorporating new design features and exploring special technical solutions for GB projects. These are pointing out the fact that stakeholders want information sharing in industry and fair treatment of all stakeholders. Institutional rules should encourage new culture in government departments to be more "facilitative" problem solving rather than simply exercising "black and white" punitive control. Providing bonus floor area in building approval as an incentive for developers to invest in GB has been proven to be attractive. The GB industry could be further developed through government incentive mechanisms such as green assessment schemes incorporated into the

government's planning and building control system. At the working-drawing stage, the high-risk task is looking for suitable contractors to construct the GB project. Again, this calls for more training for design professionals, project managers and contractors on GB professional development. Government or the industry should promulgate systems that facilitate information sharing of GB construction.

During the site-operation stage, there are fewer concerns and opinions are diverse. "Extra requirements for testing and commissioning," which again deals with new knowledge, is the top risk item. During the feedback and maintenance stage, the risks are general, and views about them diverse. The highest concerns for risk (TCs) mostly relate to marketing and leasing, which is already a major uncertainty concern during the Briefing stage. Generally, the latter half of a GB project development process does not involve too many extra tasks or risk concerns, but the high risk ones are still identified. The findings inform project managers of the developers to direct their efforts to the exact critical stages of REDP to cut down TCs incurred, and provide references to government for policy design to overcome the TCs concerns to better promote GB.

Table 5. Major TCs (risks) caused by GB at different stages of the REDP.

	Extra tasks arising from GB	**Remarks**
Briefing stage	1. Consideration of extra legal liability arising from the GB product.	Very diverse opinions, but tends to be seen as high and very high risk.
	2. Carrying out extra studies of market requirements and expectations for GB (considering local community needs/supply/competitiveness).	Very consistently high risk.
	3. More careful review of the available information on GB products.	Consistently high risk.
	4. Considering extra GB-related market and policy requirements.	Consistently high risk.
	5. Extra effort to identify potential users.	Consistently high risk.
Sketch Plans; Working drawing stage	6. Special cost studies for using new design features.	Very consistently high risk.
	7. Exploring special technical solutions.	Consistently high risk.
	8. Searching for a list of contractors with special expertise.	Consistently high risk.
Site operation stage	9. Extra requirements for testing and commissioning service installations to obtain Green Labeling, *etc.*	Diverse opinions tend toward high risk.
	10. Special promotional strategies and materials for marketing and leasing.	Diverse opinions tend toward high risk
	11. Additional consideration of tenants for GB products.	Very diverse opinions between high and standard risk.
Feedback and Maintenance	12. Special strategies and materials for overall marketing or leasing of the completed GB.	Very diverse opinions, but mostly between high and very high risk.
	13. Ease of selling or renting property (e.g., will it involve more guarantee certificates?).	Very diverse opinions tending toward high risk.
	14. Special property skill requirement for property management plan.	Very diverse opinions, tending to be between high risk and standard risk.

6. Conclusions

In this study, in-depth interviews were conducted with those who assume the role of project manager representing major real estate development firms in Hong Kong. It applies the theory from TCE to study the underlying reasons for reluctance by real estate developers to introduce GB into their portfolio of developments. It analyses the GB transactions into smaller established stages of the REDP by referring to the *RIBA Outline Plan of Work,* and it focuses on how to smooth GB transactions and lessen TCs involved. The analysis and explanation of it applied to the key stages of the *RIBA* Plan provide a framework to understand the extra tasks created by GB in general, and the TCs concerns in particular from the perspective of a project manager. Further, it has evaluated the risks of all TCs, and identified those extra tasks with high-risk concerns at the critical stages of the REDP. It contributes to the argument that TCs are the key factors impeding GB market penetration, and thus provides guiding principles to design a governance structure as well as to design government policy packages to promote GB. It should be noted that TCs may vary considerably in each country. This paper has used Hong Kong as an illustration of the importance to appreciate TCs involved in the GB development process. As TCs are affected significantly by the policy and intervention of government and the local institutional rules, the TCs concerns are specific to different country. Real estate development is also strikingly dynamic in response to local governance and market systems that affect TCs. The result of this study provides a general reference only. A more detailed study should be undertaken to appreciate the TCs for GB development processes in each country.

Acknowledgments

The work described in this paper was supported by a RGC research grant from The Hong Kong Polytechnic University. The authors would like to thank all those who contributed to the interviews and those who contributed in reviewing the manuscript.

Author Contributions

The article was developed from the first author's Ph.D. study, which provided the originality; the second author, as her Ph.D. supervisor, stimulated the research idea and advised on the structure and presentation of the paper; the third author assisted on the outline plan of work from an architect's perspective and provided feedback on the article.

Conflicts of Interest

The authors declare no conflict of interest.

References

1. Civil Exchange (CE). Submission on a proposal on the mandatory implementation of the building energy codes. Available online: http://www.civic-exchange.org/eng/publication.aspx (accessed on 15 September 2014).

2. Environmental Bureau (EB). Policy and consultation papers: a proposal on the mandatory implementation of the building energy codes. Available online: http://www.enb.gov.hk/en/resources_publications/policy_consultation/building_energy_codes.html (accessed on 15 December 2011).
3. Ahmed, A.Z. Integrating Sustainable Energy in Buildings: A Case Study in Malaysia. In Proceedings of the FAU Conference, Copenhagen, Denmark, 14–15 May 2008.
4. Ofori, G.; Toor, S.R. Leadership: A pivotal factor for sustainable development. *Construct. Inform. Q.* **2008**, *10*, 67–72.
5. Delnavaz, M. Project Managers' Role in Sustainable Building Process. Master's Thesis, Department of Civil and Environmental Engineering, Chalmers University of Technology, Göteborg, Sweden, May 2012; p. 50.
6. Toor, S.R.; Ofori, G. Leadership for future construction industry: Agenda for authentic leadership. *Int. J. Proj. Manag*. **2008**, *26*, 620–630.
7. Chan, E.H.W.; Qian, Q.K.; Lam, P.T.I. The market for green building in developed Asian cities—The perspectives of building designers. *Energy Policy* **2009**, *37*, 3061–3070.
8. Akerlof, G. The market for "lemons": Quality uncertainty and the market mechanism. *Q. J. Econ*. **1970**, *84*, 488–500.
9. EPA. Definition of Green Building. Available online: http://www.epa.gov/greenbuilding/pubs/about.htm (accessed on 12 May 2013).
10. Coase, R.H. The nature of the firm. *Economics* **1937**, *4*, 386–405.
11. North, D.C. *Institutions, Institutional Change and Economic Performance*; Cambridge University Press: Cambridge, UK, 1990.
12. North, D.C. Constraints on Institutional Innovation: Transaction Costs, Incentive Compatibility and Historical Consideration. In *Agriculture, Environment, and Health—Sustainable Development in the 21st Century*; Ruttan, V.W., Ed.; University of Minnesota Press: Minneapolis, MN, USA, 1995; pp. 48–70.
13. Williamson, O.E. *The Economic Institutions of Capitalism*; The Free Press: New York, NY, USA, 1985.
14. RIBA. Outline Plan of Work 2007 (revised 2008). Available online: http://www.architecture.com/Files/RIBAProfessionalServices/Practice/Archive/OutlinePlanofWork(revised).pdf (accessed on 18 March 2015).
15. Cheung, S.N.S. On the New Institutional Economics. In *Contract Economics*; Werin, L., Wijkander, H., Eds.; Blackwell: Cambridge, UK, 1992.
16. Cheung, S.N.S. The transaction cost paradigm. *Econ. Inq*. **1998**, *36*, 514–521.
17. Coase, R.H. More about the Institute. Available online: http://www.coase.org/moreabouttheinstitute.htm (accessed on 30 October 2009).
18. North, D.C. Institutions. *J. Econ. Perspect*. **1991**, *5*, 97–112.
19. Robichaud, L.B.; Anantatmula, V. Greening project management practices for sustainable construction. *J. Manag. Eng*. **2011**, *27*, 48–57.
20. Häkkinen, T.; Belloni, K. Barriers and drivers for sustainable building. *Build. Res. Inform.* **2011**, *39*, 239–255.

21. Walker, A.; Chau, K.W. The relationship between construction project management theory and transaction cost economics. *Eng. Construct. Architect. Manag.* **1999**, *6*, 166–176.
22. Mills, F.; Glass, J. The construction design manager's role in delivering sustainable building. *Architect. Eng. Des. Manag.* **2009**, *5*, 75–90.
23. Golove, W.H.; Eto, J.H. *Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency*; LBL-38059; Energy & Environment Division, Lawrence Berkeley National Laboratory, University of California: Oakland, CA, USA, 1996.
24. Koeppel, S.; Urge-Vorsatz, D. *Assessment of Policy Instruments for Reducing Greenhouse Gas Emissions from Buildings*; Report for the UNEP-Sustainable Buildings and Construction Initiative; Central European University: Budapest, Hungary, 2007.
25. Levine, M.D.; Koomey, J.G.; McMahon, J.E.; Sanstad, A.H.; Hirst, E. Energy Efficiency Policy and Market Failures. *Annu. Rev. Energy Environ.* **1995**, *20*, 535–555.
26. EPBD. Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings. Available online: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32002L0091 (accessed on 24 March 2015).
27. Obara, H. Energy Efficiency Drivers in Europe Regulations and other instruments open new horizons for Energy Management in buildings. Available online: http://www2.schneider-electric.com/documents/company/EE_drivers_in_EU_white_paper.pdf (accessed on 24 March 2015).
28. European Commission. *A Lead Market Initiative for Europe*; European Commission: Brussels, Belgium, 2007.
29. Chan, E.H.; Lau, S.S. *Energy Conscious Building Design for the Humid Subtropical Climate of Southern China, Green Buildings Design: Experiences in Hong Kong and Shanghai*; Lau, S.S., Chan, E., Xu, Q., Eds.; Architecture and Technology Publisher: Beijing, China, 2005; pp. 90–113.
30. BD. APP-151 Building Design to Foster a Quality and Sustainable Built Environment. Available online: http://www.bd.gov.hk/english/documents/index_pnotes.html (accessed on 13 April 2013).
31. BD. Sustainable Building Design Guidelines, APP 152. Available online: http://www.bd.gov.hk/english/documents/pnap/APP/APP152.pdf (accessed on 24 March 2015).
32. Koomey, J.G. Energy Efficiency in New Office Buildings: An Investigation of Market Failures and Corrective Policies. Ph.D. Thesis, UC Berkeley, Berkeley, CA, USA, 1990. Available online: http://enduse.lbl.gov/Info/JGKdissert.pdf (accessed on 24 March 2015).
33. Donaldson, T.; Preston, L.E. The stakeholder theory of the corporation: Concepts, evidence, and implications. *Acad. Manag. Rev*. **1995**, *20*, 65–91.
34. Mitchell, R.K.; Agle, B.R.; Wood, D.J. Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts. *Acad. Manag. Rev*. **1997**, *22*, 853–887.
35. Rowley, T.J.; Moldoveanu, M. When will stakeholder groups act? An interest- and identity-based model of stakeholder group mobilization. *Acad. Manag. Rev*. **2003**, *28*, 204–219.
36. Tang, L.Y.; Shen, Q. Factors affecting effectiveness and efficiency of analyzing stakeholders' needs at the briefing stage of public private partnership projects. *Int. J. Proj. Manag*. **2013**, *31*, 513–521.
37. Berardi, U. Stakeholders' influence on the adoption of energy saving technologies in Italian homes. *Energy Policy* **2013**, *60*, 520–530.
38. Cooke, R.; Cripps, A.; Irwin, A.; Kolokotroni, M. Alternative energy technologies in buildings: Stakeholder perceptions. *Renew. Energy* **2007**, *32*, 2320–2333.

39. Pinkse, J.; Dommisse, M. Overcoming barriers to sustainability: An explanation of residential builders' reluctance to adopt clean technologies. *Bus. Strat. Environ*. **2009**, *18*, 515–527.
40. Coase, R.H. The problem of social cost. *J. Law Econ*. **1961**, *3*, 1–44.
41. Coase, R.H. *The Firm, the Market, and the Law*; University of Chicago Press: Chicago, IL, USA, 1988.
42. Fisher, A.F.; Rothkopf, M.H. Market Failure and Energy Policy. *Energy Policy* **1989**, *17*, 397–406.
43. Dennis, K. The Compatibility of Economic Theory and Proactive Energy Efficiency Policy. *Electr. J.* **2006**, *19*, 58–73.
44. Qian, Q.K.; Chan, E.H.W. Government Measures for Promoting Building Energy Efficiency (BEE): A Comparative Study between China and Some Developed Countries. In Proceedings of the CRIOCM2007 International Symposium on "Advancement of Construction Management and Real Estate", Sydney, Australia, 8–11 July 2007.
45. Sutherland, R.J. Market Barriers to Energy-Efficient Investments. *Energy J*. **1991**, *12*, 15–34.
46. Varone, F.; Aebischer, B. Energy efficiency: The challenges of policy design. *Energy Policy* **2000**, *29*, 615–629.
47. RIBA. RIBA Chartered Practice Manual 2010–2011. Available online: http://www.architecture.com/files/ribaprofessionalservices/membershipandmarketing/general/charteredpracticemanual/charteredpracticemanualmay2010.pdf (accessed on 24 March 2015).
48. Ostime, N.; Stanford, D. *Architects Handbook of Practice Management*, 8th ed.; The Royal Institute of Architects: Chichester, UK, 2010.
49. GBRC. Best Overall Sustainable Design. Available online: http://greenbuildings.berkeley.edu/best_practices2010.htm (accessed on 24 March 2015).
50. Kibert, C.J. *Sustainable Construction: Green Building Design and Delivery*; John Wiley and Sons: Hoboken, NJ, USA, 2008; p. 407.
51. Chan, E.H.W.; Lee, G.K.L. Factors affecting urban renewal in high density city—A case study of Hong Kong. *J. Urban Plan. Dev.* **2008**, *134*, 140–148.
52. Wang, W.M.; Zmeureanu, R.; Rivard, H. Applying multi-objective genetic algorithms in green building design optimization. *Build. Environ.* **2005**, *40*, 1512–1525.
53. Wang, Z.; Lau, S.S.Y.; Zhu, Y.H.; Chan, E.H.W.; Tang, G.W.K. *Green Building Design and Technologies: Experiences in Hangzhou and Hong Kong*; China Building and Technology Publisher: Beijing, China, 2008; p. 363.
54. Qian, Q.K. Barriers to Building Energy Efficiency (BEE) Promotion: A Transaction Costs (TCs) Perspective. Ph.D. Thesis, The Hong Kong Polytechnic University, Hong Kong, China, 2012.
55. Kubba, S. *Green Construction Project Management and Cost Oversight*; Architectural Press: Oxford, UK, 2010.

© 2015 by the authors; licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (http://creativecommons.org/licenses/by/4.0/).