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# Green building incentive model during design recognition to ensure the reliability of green building operation and maintenance achievement

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**Abstract.** A low number in green building development cause the building construction will have an immense direct and indirect impact on future generations. This paper identified the optimum incentive model driving the building efficiency achievement in green building operation and maintenance. Critical factors that influence building consultant and contractor decision in green building design and construction toward the operation and maintenance achievement planned were analysed using partial least square structural equation modelling (PLS-SEM) methods. Precisely, the study modelled the regional policy affecting building efficiency achievement in the developing country. This research already identified the way of green building stakeholders' operations and maintenance in the capital city of Indonesia. Quantitative method using case study analysis already validated for the questionnaire data. The PLS-SEM indicated that sustainable in green building implementation and sustainability has significant causal effects on the regional policy of building the life cycle. Among these factors, tax exemption, expedited permit, and floor to area ratio were significant. The regional policy indicators in green building implementation have the most significant effect on building efficiency achievement.

**Keywords:** Green Building, Incentive, Building Efficiency.

## 1. Introduction

Green building has become a popular concept in the world of building design, construction, operation, and maintenance [1]. Furthermore, some of the regional building policies already necessitate the building demolition or recondition using the green building method. Some countries already proved that green building achievement looks like energy efficiency more than 50%, water-saving more than 60%, and waste reduction by up to 29% [2, 3]. That's why the world's green building population is



doubling every three years [4]. However, most developing countries are still low in green building growth number with various reasons such as social awareness, high upfront costs, uncertainty in achieving building performance, lack of knowledge, and resistance to change or trying new things [5, 6].

Green building is some efforts to reduce the negative impact of building life cycle to increase the sustainability of environmental and social life [1, 7, 8]. Building planning and construction have a significant impact on building quality achievement. After that, the previous research proved that a key success factor for building operational was integrating green technologies to the building tenants' needs. In these two critical phases, building management and tenant have responsibilities toward the sustainability of building operations and maintenance [9]. Water savings, energy efficiency, using recycled materials to increase resource efficiency were considered in the planning and construction which the building operation and maintenance had an impact on improving the environmental performance and cost savings felt by the owners or users [8, 10, 11].

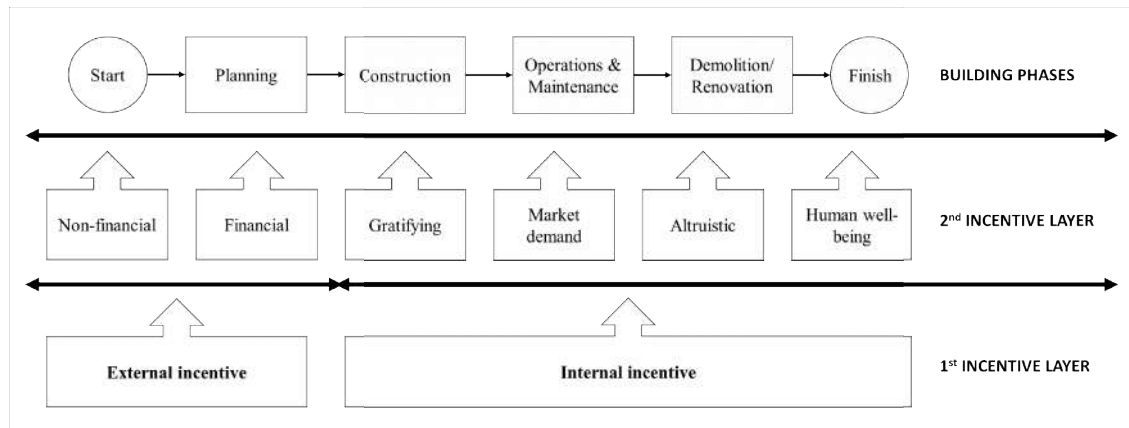
This research identified the factors affecting the green building operation and maintenance. This identification began from planning phases in which the consultant and building owner were fully responsible for this process. After that, the contractor has a role in building construction process to meet the design up to ready to operate. Therefore, the research process was observed using the indicators in which building operations could be affected by design and construction processes.

The purpose of this study is to determine the factors of green building operations and maintenance implementation in the context of uncertainty economic, environment development, knowledge improvement, and regional policy. After that, these critical success factors are tested to investigate the potential relationship between the variables in structuring an incentive model in the construction phase based on building owner and tenants view in developing countries, particularly in Indonesia. Several previous studies have reviewed the constraints of green implementation on the potential incentives partially in each aspect. Therefore, this study develops the integrated aspects of green building operation and maintenance toward buildings life cycle aspects. Uncertainty economic in response to the initial incremental cost of green building maintenance strongly depends on the country's situation [12]. Regional policies as the role of government, affect to the green concept implementation [1]. Besides that environmental development aspect as a process of changing the needs and humans lifestyle could give the effect to the building design such as capacity, design, and technology implementation. Knowledge aspect made the building owner and team improving the awareness green building technology implementation [13].

## **2. Green Building Incentive**

The green building concept is an important concept to realize efforts in improving sustainable resources and environmental sustainability now and in the future [14]. Several countries made a guide to assess the feasibility of buildings under green building criteria such as the UK, USA, Japan, Hong Kong, Australia, Israel, Singapore, Malaysia, Germany, and Indonesia. All developed countries are accelerating to increase the number of green buildings in their respective countries. The provision of the incentive could stimulate the increasing number of green buildings which it reaches a certain level in the green building ranking. The USA, Singapore, Germany, India, and Malaysia have a significantly growing number of the green building. Each country respective to increase about 867, 170, 61, 54 and 48 buildings each year as a result of implementing the green building incentives [8].

Incentives contribute an award both to individuals or a group to motivate based on the expected results of performance achievement. In building construction, incentives would motivate the building stakeholder to reach the building performance achievement. They are not only considered in the planning and construction phase but also the operational phase [15]. Figure 1 introduced various types of incentives scheme in building from several developed countries. Incentives grouped into sources which namely internal incentives and external incentives. There are two types of external incentives, financial and non-financial incentives. On the other hand, internal incentives value got from the building activity in which building owners and users' have a role in these phases [16, 17].

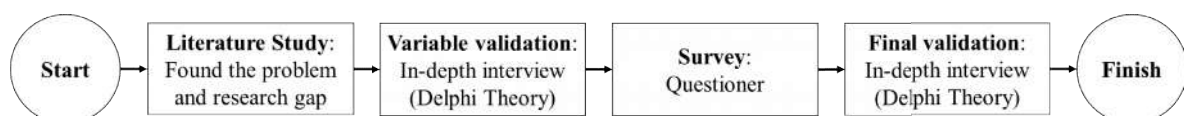


**Figure 1.** Kind of incentive toward building life cycle

Facilitating case study, a review of the types of incentives can shape the building's life cycle flow. In the planning phase, providing expedited permit incentives, technical or marketing assistance, floor to area ratio, and certification are the best potential incentives [10, 18-20]. During the construction period, potential incentives included added value taxes reduction incentives, technical assistance, and green contractor awards for green construction. [21, 22]. In the operational and maintenance phases, it provides incentives for releasing property taxes for a certain period, re-certification, high rental value, high occupant productivity, reducing carbon emissions, high market demand, building comfort, high resource efficiency, and healthy environment [23]. Therefore, the most potential incentive implementation is in the operational and maintenance part. Also, the impact of incentives in that phase requires testing of aspects of green building sustainability, namely regional policy, economic, knowledge, environmental change aspects [24, 25].

**3. Research Methodology**

This study begins by reviewing aspects that influence the low growth of green building in developing countries as this research process in Figure 2. This phenomenon is a background of this research. Some references become a source for mapping problems through literature studies. Initial validation involved five green building experts in the survey area in a developing country research, Indonesia. As a developing country, Indonesia already has green building rating tools. However, Indonesia is lower in the total and growing number of green buildings than its neighboring countries such as Singapore and Malaysia.



**Figure 2.** Research framework

This study starts with a review of aspects that affect the slow growth of green building in developing countries as in Table 1 which is the background of this study. Literature studies show that in four aspects influence building construction with the concept of green building, namely economic, knowledge, policy, and environmental development aspects. In the next stage, these aspects become the input to test the critical factors of buildings in the implementation of green building concepts. The survey results in an identification of the barriers to green building implementation continued with optimization of the incentive model appropriate to the conditions in the survey area.

**Table 1.** Research framework

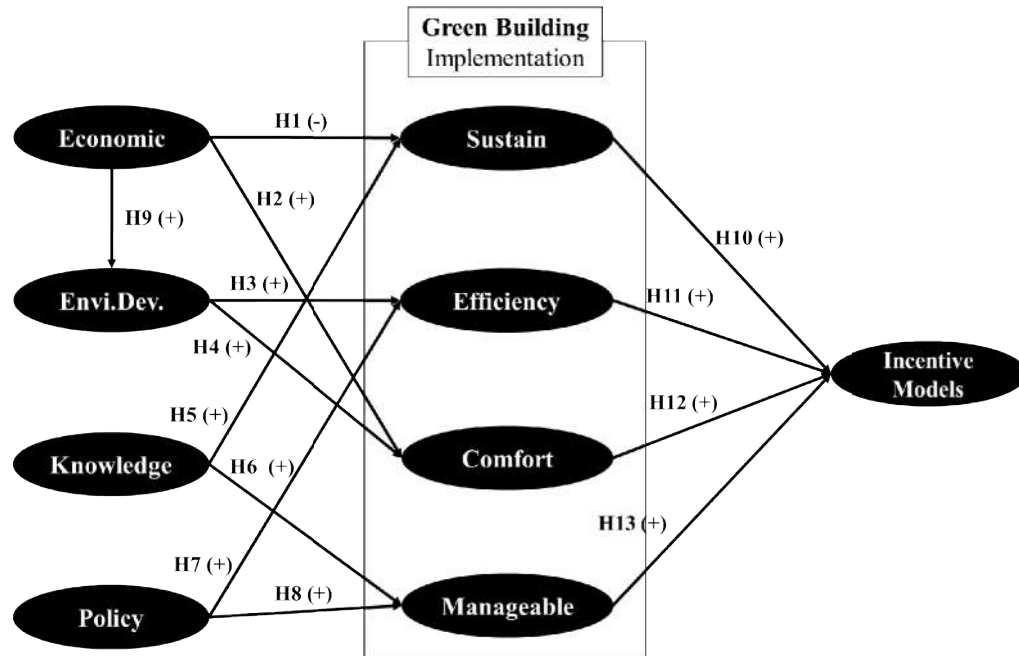
Code	Building aspects	Barriers	References
I2	Economic	No incentive scheme	[14, 26-32]
I6	Economic	High upfront cost with a long payback period	[26-31, 33-35]
I8	Economic	No financial resources for green feature	[27, 30, 36, 37]
I7	Knowledge	Lack of pilot project	[26, 27, 30, 33, 38]
I1	Knowledge	Low stakeholder responsibilities	[14, 31, 32, 34, 38, 39]
I3	Policy	No integrated regulations and codes	[26, 27, 29, 30, 32, 34, 40-42]
I5	Policy	No guidance from the regulatory authority	[14, 26, 27, 29, 30, 33]
I9	Knowledge	Low knowledge of professional	[26, 27, 32, 33, 36]
I4	Environmental development/ knowledge	Lack of building design and construction update training	[33, 43]
I10	Environmental development/ knowledge	Low in building equipment and methods innovation	[30, 44]

Figure 3 shows the conceptual model in this study that reviews incentive models that fit the needs of green building implementation and the building life cycle. The concept of green building and building incentives are relatively common models in green building research. However, in several case studies and review papers, the benefits of incentives to sensitize building stakeholders are relatively considered from partial aspects. Besides that, there is little empirical evidence of an optimal incentive model between internal and external incentives [10]. Determination of the value of incentives determines the attractiveness of using the concept of green building by considering incentives from operational stakeholders and building maintenance. The novelty of this research if it compares to the previous research, there is pay attention to the concept of the life cycle cost of buildings in previous research. Furthermore, this research can show the optimal value of incentives according to the needs of certain regions and the consideration of criteria in the Cost-Benefit Analysis Method in buildings, namely the aggregation of criteria for aspects of economic conditions, development environment, knowledge level, and regional policy.

Based on the explanation in this paper, four aspects were the novelty of this research, namely green building certification by considering four factors that successfully implemented green building for the provision of incentives and building permits. Economic problems in building development such as the price of green features and their construction/installation, availability of capital sources / financial services loans, accuracy of investment capital returns, building operating costs, green building tax values, and maintenance/replacement costs [5]. These indicators are part of the three tested hypotheses (H1, H2, and H9) towards sustainable, comfortable, and environmental development aspects. These indicators are part of the three tested hypotheses (H1, H2, and H9) towards sustainable, comfort, and environmental development aspects [38].

The condition of climate change is a condition of environmental development caused by natural factors [45]. On the other hand, environmental changes can also be caused by human engineering through changes in land use and changes in the composition of buildings [46]. Implementation of a concept in a sustainable building life cycle is an effort to reduce the adverse impact of buildings on the environment [47]. Some things that can affect the sustainability of a building's life cycle are social conditions, climate change conditions, and financial strength. The indicators that test the relationship between environmental development variables with efficiency (H3) and comfort (H4) are climate change, land-use change, and building density changes. The aspect of knowledge level (H5) which will test sustainability and manageable building (H8) has a test indicator on the questionnaire namely

construction work and building management methods, planning of building structure design, the direction of building orientation, building certification targets, and selection of integration of green features.



**Figure 3.** Research hypotheses

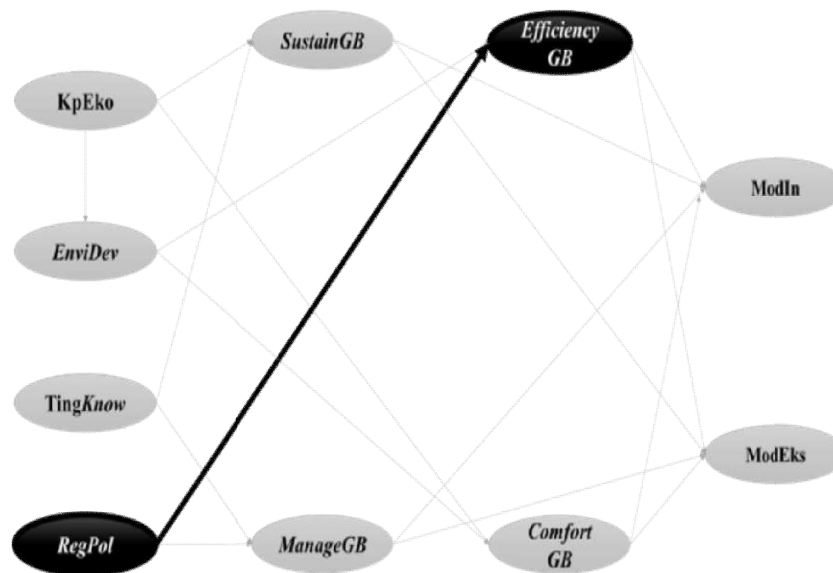
Regional policies are provisions that are made to be mutually agreed upon and are mandatory [48]. The building regulations can be determined in the process of building function and green features properness. Both of the building assessment will be certified appropriateness and green building. Some indicators can measure regional policies towards the achievement of efficiency in building and manageable resources, namely the determination of building zones, determination of the value of tax objects, acceleration of building permits, and determining the type of incentives. In the view of incentive, the model provides a choice of models according to the needs and targets of aspects of building development with sustainable concepts that require increased performance. The internal incentive variable indicators are improving the quality of life of building occupants, improving building performance, increasing the attractiveness of buyers/tenants of the building (marketing), and accelerating return on investment. While indicators that can measure external incentives consist of reducing construction material taxes, reducing land and building taxes, increasing the coefficient of building area, building management technical assistance, and accelerating licensing.

Indonesia is the developing country where the location of this research conducted with a relatively low green building growth or three buildings per year. Besides that, the limitations of green building experts in Indonesia are part of the cause of the slow implementation of green building. This study is limited to reviewing the attractiveness of green building planning and construction of the building's operations. Therefore, this study took a sample of respondents from parties involved in the developer, operation, and use of the building. The snowball technique known as Chain-referral-sampling of a hidden population, is a non-random sampling method from hidden populations [49, 50]. The results of data collection obtained 32 respondents consist of 87% male respondents and 13% female respondents, moreover based on respondents' education who graduated 69% and postgraduate 31%. More than 53% of the respondents have experience in green buildings development and operation or working. It's occurred because the first time green buildings developed in Indonesia was in 2012. On

the other hand, the other respondents are more than five years because they worked in green buildings abroad. Apart from the survey results using a questionnaire instrument, case studies are also input material for final validation through in-depth interviews with experts. The case study provides a technical picture of the results of the survey of respondents. After that, the experts assessed each option of incentive as a recommendation of the questionnaire survey and the case study. So that effectiveness was achieved in increasing the attractiveness of the concept of green building for stakeholder owners and building management. In the in-depth interviews phase, the data analysis was carried out using the Delphi method. The Delphi method is a decision-making process that involves several experts. The experts gave their understanding of research problems through personal interviews.

#### 4. Result and Discussion

The questionnaire compiled was the result of initial validation to green building experts. The reliability test results showed 12 of the 32 indicator variables were invalid because the amount of alpha and Cronbach composite reliability were both less than 0.70 [51]. Means of standardized factor loadings and Average Variance Extracted (AVE) is examined the convergent validity with a bootstrapping analysis of 500 subsamples. Indicators that have low-reliability values include investment value of green features, use of soundproofing tools, emission values, climate change, building function change, the number building occupancy change, building design change, land area function change, period of investment, operational costs, building monitoring, and building surveying. Twenty indicators of variable ( $p < .001$ ) have a high confirmation in validity testing. On the other hand, the convergent validity achieved when the AVE values of each construct in the model were found to be larger than 0.50. There are only two constructs with the highly significant confirmation consisted of regional policy toward building efficiency (Figure 4). There is only one hypothesis proven under the initial assumption which regional policies regarding the mandatory green building have a significant effect on building efficiency achievement in the operational phase.



**Figure 4.** Significance construct in structural measurement

Green building experts are the resource persons to discuss the results of the questionnaire and the results of case studies in the form of a policy of integration and acceleration in the management of green building licensing and certification. Green building experts are the interviewee to discuss the



results of the questionnaire and case studies results in the form of a policy of integration and acceleration in the management of green building licensing and certification. The experts also stated that the still limited number of green buildings allows the existence of indicators and other variables test results in this study. Respondents' limitations are a result of the still limited number of green buildings in Indonesia. The results of this study are limited to a survey of respondents who have activities as developers and managers of new green buildings in Indonesia. The number of respondents represented was eight of the twelve new green buildings in Indonesia.

According to respondents survey results, three indicators of success factors in green building policy implementation are the value of building tax exemption, expedited building permits, certification, and the addition of floor area ratio. The resource efficiency in the green building operations phase, the respondents' survey results includes reducing energy use and conserving clean water in buildings. The experts in this research consisted of academics, governments, and green building practitioners. They stated that the early stages were an attractive incentive in the form of accelerating building permits through simplifying the licensing process and SLF green building (Table 2). There are several risks for other incentives such as floor to area ratio addition control in the operational phase and some regional budgeting dependency to property tax.

The matrix in Table 2 shows the form of the process of simplifying green building licensing and certification. According to developers and building management survey results, attracted building stakeholders to implement green buildings because previously it took more than one year while the simplification results were only three months. This simplification could become true because of the existence of an online system assistance in obtaining licenses. Besides that, the government will provide technical assistance in preliminary an open court in-licensing and green building certification.

## 5. Conclusion

Several developing countries in the world have developed a green building assessment system in the form of rating tools. Many building certification programs with the concept of green buildings relatively are not progressing well included Indonesia. Indonesia is the largest country in Southeast Asia. It has a low growing number of green buildings compared to its neighboring countries. The main constraints to implementing green buildings that are the result of literature studies are economics, environmental change, level of knowledge, and regional policies.

Developers and building managers who have a role in the successful implementation of green building expect the green building to produce significant value efficiency resources. Achieving this efficiency is an attraction for green building stakeholders by having a mandatory regional policy in a region. The formulation of policies that favor all green building stakeholders is property tax exemption, acceleration of green building permits/certification, and the addition of floor to area ratio. There are three incentives according to the expert knowledge about green implementation. They has strength and witness value. They agreed in the early stages of building permit acceleration is the right step to facilitate green building investment. The amount of time efficiency as a result of this research is that three months of licensing integration and new green building certification from before took a year.

Acceleration is feasible if the administration system applies online procedures for building permits. Some of the green building experts are part of monitoring and controlling to the planning and implementation of green building construction process. The benefits are part of the regional government is the reduction in energy use by more than 50%, water conservation by more than 70%. Besides that, the passive impact is increasing the environmental quality such as decreasing carbon emissions which are an indirect impact

**TABLE 2.** Integrated building permit and certification process for new green building

Activity	Stakeholder								Standard quality			Note
	Building designer	Permit service	Expert team	IOR	RSPCB	District head	MIA	RFMA	Document	Duration	Output	
Start												
1 Submit an online building permit application: Green Building & Incentives									Building permit requirement	1 day	Online receipt	
2 Verify submitted documents									Online	1 day	Validation	
3 Assign the Building Expert Team to examine the building Green & Technical documents									Validation document	1 day	LoA	
4 Feasibility study in green building architecture									Architectural design	45 days	Validation	
Feasibility study in green building structure									Structure design	45 days	Validation	
Feasibility study in green building MEP									MEP design	-	Validation	
Reviewing the green building implementation plan									Engineering document	-	Validated document	
5 Approve the technical plan of the green building									Validated document	-	Technical approval	
6 Conduct financial and national evaluations of green buildings that apply for incentives									Engineering & financial report	-	Evaluation report	
Propose validation of green building incentive forms									Evaluation report	-	Incentive validation	
7 Receive results of the validation in the form of green building incentives									Incentive validation	-	Incentive approval	
8 Establish preliminary building permit issuance									Validation report	1 day	Preliminary certificate	
Establish certificates of technical planning for green buildings and incentives together with the issuance of the Final building permit									Overall validation report	-	Final validation	
9 Calculate the number of levies for submitting certification, incentives, and green building permits									Final validation	-	Retribution bill	
10 The green building planning certification plaque, construction permit, and incentive determination letter are issued.									Proof of payment	-	Building certificate	
Finish												
<b>Total processing time for Building Permit – Green Certification – Incentive Letter (New Building)</b>										94 days		

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