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CONCEPTUAL DEVELOPMENT OF COST BENEFIT ANALYSIS BASED ON REGIONAL, KNOWLEDGE, AND ECONOMIC ASPECTS OF GREEN BUILDING

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ABSTRACT

Economic, social, and environmental sustainability comprise the general motivations in most green building developments. Deciding to spend additional costs on the optimum benefit results generally applies the cost-benefit analysis (CBA) method to evaluate green building implementation. However, previous studies have not investigated the general aspects affecting green building achievements in CBA. This article proposes the development of a CBA method for evaluating building aspects to define the goals of green building indicators. Disaggregating of the building development attributes and indicators through literature review showed that the CBA in green building implementation measured by several aspects such as regional, knowledge-based, and economic. The research method used a simple flow diagram to classify the building development attributes and indicators. This flow process aggregates attributes and indicators based on the CBA aspects in green building implementation. In-depth interviews with several building development experts are carried out to ensure this conceptual development implemented. This work confirmed that efficiency achievement, financial evaluation, and national economic evaluation measured the feasibility of investment in green building development. Incentive schemes were expected as the financial breakthrough to enhance green building investment feasibility.

Keywords: Cost benefits analysis; Economic; Green buildings; Knowledge; Regional

1. INTRODUCTION

Constructing commercial buildings is a strategic way to support the development of a country and the welfare of its people (Firmawan et al., 2016). The United States (US), one of the "big five" countries in sheer quantity of commercial buildings, built 4,462 commercial buildings, the total value of which reached US $17.418 trillion in the country's gross domestic product (GDP). Furthermore, the European Union (EU) and China built 3,657 and 2,525 commercial buildings; the total value thereof in each country's respective GDP was US $16,242 trillion and US $11,212 trillion (Damassa et al., 2015). Unfortunately, this development has caused these countries to become the world's highest-emission nations, with the EU producing 22.3 percent of the world's total emission amount and the USA and China ranking at 13.4 percent and 9.3 percent (Darko et

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al., 2017a). Moreover, building construction and operation uses 40 percent of global energy, 12 percent of the total clean water supply, and 30 percent of the world's resources (Dwaikat & Ali, 2016; Zhang et al., 2017; Latief et al., 2017a; Nguyen et al., 2017). Now, stakeholders of building construction must not only develop sustainable building concepts based on economic, social, and environmental aspects, but also meet the demands for resource conservation, health, comfort, and safety during the building's life cycle, collectively known as the green building concept (Soleri, 1969; Li et al., 2014). As a result, this commitment has proven successful in increasing buildings' energy efficiency by about 30 to 50 percent, using up to 80 percent recycled materials, decreasing water use by 40 percent, and reducing greenhouse gas emissions by about 30 to 40 percent in some developed countries (He et al., 2018; Onuoha et al., 2018). Finally, many countries issue standards or rating tools for green buildings to make green buildings easy to implement and to create high-performance buildings.

Many green building implementation concepts already provide a wide range of benefits in developed countries, but the implementation is still not largely merit in developing countries, including Indonesia (Qian et al., 2013). Shafii and Othman (2005) stated some of the obstacles to green building implementation in developing countries, especially in Southeast Asia, such as lack of awareness (in people), lack of training in and education about green building concepts, higher costs, special materials and technologies, rules and regulations, and lack of demand. In Indonesia, the growth in the number of buildings reached 116 percent until 2011, but the number of buildings that implemented the green building concept until 2015 was only 23. The Green Building Council Indonesia (GBCI), the founder of the Indonesian chapters of greenship rating tools, was established in 2009. If the number of implementation periods after the year GBCI was established remained steady until 2015, the average growth of green building in Indonesia was three buildings per year. This number is relatively low for the largest country in Southeast Asia when compared to Singapore and Malaysia, which built 170 buildings and 48 buildings per year, respectively.

Wimala et al. (2016) recommended some ways to resolve the problem of the low number of green building implementation concepts in Indonesia, such as comprehensive education programs, incorporating green building practices in school curricula, providing grants or rewards, reducing green building premium costs, and regulation detailing. Therefore, this study continued the previous research by developing a decision-making method to facilitate the solving of these inhibiting factors. At present, there are many studies concerning green building evaluation meant to convince building stakeholders, especially about the costs and benefits of green building features that should be applied in their respective buildings for optimal results (Preciado-Pérez & Fotios, 2017). In brief, the success factors in sustainable building development are the ability in detailing in attributes and indicators of CBA aspect in green building concept implementation (Bakar & Cheen, 2011). Therefore, this research integrates this three aspects such as knowledge-based, economics, and regional conditions (Araújo et al., 2016).

The purposes of this work are to classify the factors that influence a developing country's decisions about green building concept implementation and to create an appropriate decision-making process using the CBA method framework. This process should be accurate in estimating green buildings' cost and benefit components to accelerate building stakeholders' understanding of the concept and its appeal to them. This study limits the development of the CBA framework for making decisions about the implementation of the green building concept as it pertains to aspects of the office building. This priority is a response to the office building's highest potential for resource efficiency not only in the planning but also in the operating stage (Shao et al., 2014). Therefore, the literature study in this research not only proves the magnitude of the potential benefits of the cost of new green building implementation but also that of existing buildings.

Finally, using the CBA framework as the decision-making tool can integrate the feasibility of new green building rating tools and existing green building rating tools.

The lack of comprehensive reviews of aspects that influence the success of green building concept implementation in previous studies results in the decision-making in which the CBA method was not feasible when viewed from investment costs and payback periods (Khoshbakht et al., 2017). Therefore, the development of CBA aspect in green building concept implementation is needed because it can simplify the implementation process and it can also convince building stakeholders that the green building development is possible to do in developing country. This study enriches the CBA framework in evaluating green building implementation by integrated aspects such as regional, knowledge-based, and understanding of the economic climate aspects. In addition, this study will stimulate the potential benefits of building improvement by considering the green building indicator. The result of this work is the development of a conceptual CBA framework for the decision-making process surrounding green building as a roadmap to achieve the optimum benefits of the cost of a building's life cycle. Because this study is only a conceptual development, this study provides an opportunity for further research to test this concept empirically.

2. METHODS

Based on the problem of the low number of green buildings implementation, particularly in developing countries such as Indonesia, the literature study is the first step to tracing the obstacle of this implementation. Furthermore, some of the literature give suggestions for further research as potential problem-solving in a developing country. Table 1 categorizes the top ten issues of green building implementation in several developing countries (Indonesia, Malaysia, Vietnam, Pakistan, and Ghana) with aspects of building development in Southeast Asia. According to previous research (Shafii & Othman, 2005), aspects that affect building development in Southeast Asia are regional, knowledge-based, and economic. Therefore, this study developed a decision-making model to solve the problems of constraints of green building implementation from sustainable aspects (social, economic, and environmental) and building development (regional, knowledge, and economic).

Table 1 Problem mapping in green building development

Barriers of green building implementation	Key references	Building development aspects		
		Regional	Knowledge	Economic
Lack of awareness (people)	1, 2, 3, 4, 5, 6, 7		√	
Lack of training	1, 2, 3, 4, 6, 7		√	
Lack of education	1, 2, 3, 4, 6, 7		√	
Higher investment cost	1, 2, 3, 4, 5, 6, 7			√
Risk of investment	1, 2, 4, 7		√	√
Special materials	1, 2, 6, 7	√	√	√
Special technology	1, 2, 4, 6, 7	√	√	√
Regulation	1, 2, 3, 4, 5, 6, 7	√		
Lack of building codes	2, 4, 6, 7	√	√	
Lack of demand	2, 4, 6, 7	√		√

Sources: Wimala et al. (2016)[1]; Darko et al. (2017b)[2]; Chan et al. (2018)[3]; Samari et al. (2013)[4]; Hopkins (2016)[5]; Azeem et al. (2017)[6]; Nguyen et al. (2017)[7]

The results of grouping the obstacles to green building implementation by the three aspects that influence the development of the building are taken into consideration to create a framework for making decisions with the CBA method approach. After that, this study explored the efforts solving the problems in this implementation, considering the costs and benefits to obtain a framework model for optimal decision-making. Figure 1 shows that the literature review of the green building concept is the first stage in Task 1 that explored the three aspects of building development. Furthermore, this literature review explored the benefits of financing green building according to the rating tools achievement. This study integrated all these aspects to facilitate the decision-making process with the CBA development method. Green building assessment targets are part of the benchmark for achieving green building benefits. Therefore, this research integrated the factors that cause the premium cost of green building implementation through disaggregation of its attributes in the CBA method framework, which is the first finding in this study (Task 2). Then this study examined this existing CBA framework arrangement for green building through in-depth interviews with green building experts in developing countries, which in this case is Indonesia (Task 3).

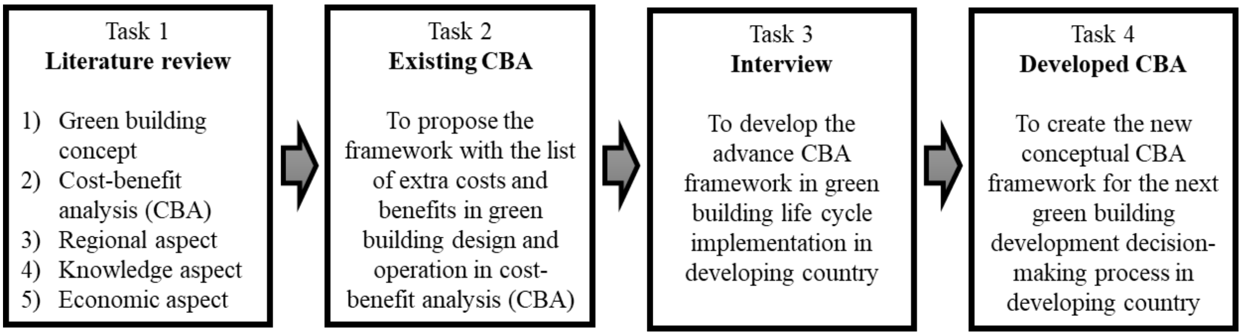

Figure 1 Research design

The results of the in-depth interviews provide feedback and comments on the proposed development of the CBA framework as a decision-making method that integrates aspects of the green building implementation review. The green building experts consist of policymakers, the office building developers, the green building council founders in Indonesia, green building consultants at the International Finance Corporation (World Bank Group in Indonesia), green building consultants' companies, green building management and contractors, academic professors, and building users (Table 2).

Table 2 Profile of interviewees

Profession	Qualification and position	Number of experts
Regional government	Deputy chief of regional service as policymaker and supervision team	5
The office building developer	Project managers who are experts in green office building development	2
Green Building Council Indonesia (GBCI)	Green building rating tools founder in Indonesia	2
International Finance Corporation	Green building consultants who focus on developing policies and funding for sustainable infrastructure in Indonesia	3
Green building consultant company	Consultant company experienced in green building development	2
Green building contractor company	Green construction implementation and maintenance	2
Officer/building user	Building owner and the user who responds to building operational	6
Senior lecturer	Academic focus on sustainable infrastructure	3
	Total	25

The researcher collected data from all 25 interviewees

Researchers interviewed 25 green building experts in Indonesia. This number is relatively small when compared to the number of green building experts in developed countries, especially when looking at the quantity of green buildings constructed. In Indonesia, there were only 23 green buildings as of 2015, while developed countries like Singapore have reached more than 1,000 buildings.

In the proposed CBA framework, the second phase of expert interviews was conducted regarding green building elements aggregation as it pertained to the building attributes and aspects. Based on this process, cost and benefit disaggregation of green features is shown in Table 3 and Table 4, as are the definitions of the attributes. The aim was to validate the identified list of costs and benefits and provide an explanation for each as well as the effectiveness of the CBA framework in green building development evaluation. All interviewees were at least at the management level and active in green building development with a minimum of 10 years' experience in the building industry. In addition, they were all certified greenship professionals (GP) or greenship associates (GA).

The structured interviews were designed to discuss the costs and benefits that arose because of regional, knowledge-based, and economic aspects of building development as they pertained to the green building concept. The structured interview questions were divided into three parts:

- Benefits of green building implementation (Table 3)
- Green feature costs based on regional, knowledge-based, and economic aspects (Table 4)
- CBA framework in green building implementation (Figure 2 and Figure 3).

Table 3 Green building attributes disaggregation in benefit analysis

Building aspects (S)	Indicator (N)	Define	Beneficiary
Regional	National economic evaluation	Decreasing number of emissions (CO_2 reduction)	Government/Public
Economic	Financial evaluation	Feasible in the private and public sector (NPV)	Government/ Developer/User
Knowledge	Efficiency achievement	High-performance building	User/Contractor/ Building Management (BM)

Table 4 Green building attributes disaggregation in cost analysis

Attributes (T)	Element	Define	Responsible for costs
Green implementation	Green features	Envelope structure	Developer/User
		Renewable energy system	Developer/User
		HVAC system	Developer/User
		Intelligent building system	Developer/User
		Water utilization	Developer/User
		Green campaign	Government/Council/IFC/BM
	Air temperature	>25ºC = cooling system	User
		<25ºC = heating system	User
Building life-cycle cost	Discount rate	3-10%	Developer/User
	Loan rate	5-6%	Developer/User
	Annual cost	Energy costs	User
		Water costs	User
		Solid waste treatment	User
		Maintenance	BM/User
		Contingency fund	Developer/User/ Consultant/Contractor
		Annual escalation	Developer/Contractor
Time horizon	Initial cost	Certification grades	Developer/User
	Tax revenue	Consultant = 1%	Developer/Consultant
		Contractor = 28%	Developer/Contractor
	Incentive	Once (before operation)	Government/Authorities
		Monthly (in operation)	Government/Authorities

The interviewees were encouraged to share views beyond this framework, which is believed to be essential to capture any building development factors. The discussion also included the relevant background points of view that were not shown before the general publication. Furthermore, the interviewees shared their opinion about the future perspective of the CBA framework. The comprehensive views of the development of CBA framework that analyzed building aspects helped to evaluate and complement the theoretical method of this paper from empirical perspectives (Task 4).

3. RESULTS AND DISCUSSION

3.1. Knowledge Aspects

The knowledge aspects of green building development could help stakeholders in the optimization process of the buildings' design, construction, operation, and maintenance. Some of the green building stakeholders in Indonesia said that several green buildings would not continue being implemented. They considered the higher cost and lack of capability in green building implementation and maintenance. They found it difficult to abandon old habits such as disposing of organic and non-organic waste, smoking inside the building area, energy consumption, and water conservation. The optimization process in green features implementation (GI) should pay attention to the initial goals of the concept that are sustainable in the building environment and improve the quality of human life (Darko et al., 2017a). Therefore, all building knowledge was discovered to increase building and environment performance at an affordable cost. The attributes of the knowledge aspect were green features, building orientation, and type of building structure (Perini et al., 2011). Some focus areas of green feature development were building envelopes, ventilation systems, air conditioning systems, and renewable energy systems. Furthermore, building orientation would influence the amount of solar radiation that an air conditioning system or other passive design optimization could conduct to reduce initial and operational cost (Pikas et al., 2015). In addition, the green building concept improves the environmental quality in the construction phase by using the prefabrication method. Besides that, the right structural and material planning could reduce the negative environmental impacts of the construction process such as carbon emissions, pollution, and solid waste.

3.2. Regional Aspects

In some developed countries, the goal of green building concept development is to focus on quality improvement to support a better living environment for humans. By contrast, in developing countries, including Indonesia, the economic aspect of the green building concept is the main consideration for building stakeholders who are the investors in the private sector and the policy-makers in the government or public sector. Therefore, green building life-cycle costs have been evaluated for their net present value to obtain the investors' view. However, the original point of high-performance building development was to optimize the building operations, especially in resource efficiency. Regional aspects of green building development affect the implementation of green features and building life-cycle costs (BLC) by drawing attention to the climate zone, humidity, type of building, and resource efficiency. Climate zones and humidity affected the kind of air conditioning and sensor installation system that could be used to optimize indoor comfort and energy (Alexandri & Jones, 2008). Furthermore, two types of building were based on the construction phase: new buildings and existing buildings. The new and existing building life cycles had different financial schemes because the green concept design was already planned from the beginning of the new building's life while the existing building was retrofitted with refurbished building components (Liu et al., 2014).

The implementation of energy simulation is one of the stakeholders' efforts to consider BLC. Therefore, BLC was the major factor in determining how to construct a sustainable building that would meet the most efficient building costs and be effective for human comfort. In addition, other factors in BLC consideration were interest rate and annual building cost. The interest rate depended on the regional economic condition, which may have affected a loan or investment value. At the operational stage, the regional aspects also affected the number of annual building life-cycle costs. For example, building stakeholders had to decide the most effective energy resources because different regional areas have different energy sources, such as coal, national electricity, and some renewable energies. These sources also have different prices. Other annual costs in building operations included water costs, waste management costs, and building maintenance (Tam et al., 2017). The annual escalation of prices also was considered in green building development.

3.3. Economic Aspects

Disaggregated economic aspects consisted of BLC and time horizon (TH) attributes in building infrastructure that were limited by the life cycle time. Premium cost and revenue in green building implementation should be considered based on integrated formulation that recognizes the payback period, which is required not only by the private sector but also by the public sector. Therefore, BLC attributes had to consider factors in green building investments such as interest rate, initial cost, annual cost, residual value, and tax revenues (Zheng et al., 2009; Latief et al., 2017b). GI attributes have an effect on all components of BLC consideration. For example, when green building stakeholders used renewable energy technologies in their buildings, they calculated the overall cost of green technology investment, including the additional tax. After that, the stakeholders compared the cost to the overall benefit gained, including efficiency achievement (EA) and residual costs. At the end of the evaluation process, the BLC aspects would be collaborated with TH and EA to define the NPV, after which stakeholder evaluation could be generated (Berto et al., 2018). Some assumptions could be justified in the cost analysis of a building's life cycle, even though the empirical data could reduce the failure in the financial simulation.

3.4. CBA Framework Benchmark

In green building development problems, the decision-making process is categorized as an ill-structure or mixed problem because this process includes qualitative and quantitative elements. The CBA method was popular as the consistent support for economic decisions in this kind of project (Simon, 1960; Pikas et al., 2014). In addition, CBA is applied in some examples of environmental project areas to choose attractive alternatives when a project's benefits outweigh its costs (Bouyssou et al., 2000). However, unstructured problem elements and unidentified stakeholders' analysis tend to dominate the general task of green building development because problem-solving is supported only in particular aspects of building development (Khoshbakht et al., 2017). Conceptual development of the CBA method was conducted by a literature study to disaggregate the green building aspects from their attributes and indicators. Structuring the decision-making process in green building implementation made it easy for building stakeholders to select and assess their buildings based on the cost and benefit of the building indicator and parameters (Liu et al., 2014; Pikas et al., 2015; Araújo et al., 2016; Preciado-Pérez & Fotios, 2017).

Several cases of green building feasibility studies use the CBA framework to identify the benefits of implementing green features in their costs. Unfortunately, the green building analysis in previous studies still limited the CBA method to a small part of the building (no system integrated all aspects of a building). Therefore, this study describes all aspects and attributes of previous literature that discusses the costs and benefits of the green building concept to obtain a green building evaluation framework that uses the CBA method. The researcher succeeded in identifying and developing an integrated model of the green building aspects and attributes in building construction, as seen in Figure 2. The first layer observed the aggregation criteria for general aspects of building development, which consisted of knowledge-based, regional, and economic development aspects (S). The next layer defined green building attributes (T) through categories and general aspects that affected building development. This framework was conducted to propose a decision-making model according to the specified indicator limit (N).

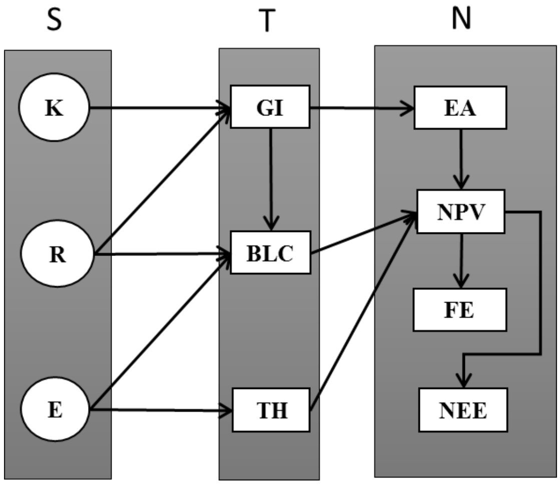

Figure 2 Green building aspects in existing CBA artifacts

The CBA framework in this study is a way to evaluate the implementation of green building based on three aspects of the building observation. GI is a green feature that is influenced by the level of stakeholder knowledge (K) and regional conditions (R) of the building (Alexandri & Jones, 2008). Furthermore, the GI, R, and global economic values (E) influence the BLC. Meanwhile, partially economic conditions affect the calculation of the feasibility of the length of the investment time (Ottelé et al., 2011). EA is a benefit of green building implementation, while the cost of implementation is BLC. This framework suggests a simple way of summarising the components of the vector. All the benefits and costs are calculated using net present value (NPV) analysis (Perini & Rosasco, 2013):

$$\text{NPV} = \sum_{i=0}^{TH} \frac{a(i)}{(1+r)^i} = \sum_{i=0}^{TH} \frac{EA(i) - BLC(i)}{(1+r)^i} \quad (1)$$

Based on Figure 2 and Equation 1, the interviews conducted with green building experts indicate that EA is the result of improving building performance (benefits) with the use of green building concepts. Meanwhile, BLC is an incremental cost in a building's life cycle that improves building performance from the period of beginning (i) to TH by considering the discounting rate (r). The attributes and definitions that affect each EA and BLC coefficient are shown in Table 2 and Table 3. The outputs of the NPV consist of feasibility evaluation (FE) for green building investors and national economic evaluation (NEE) for the regional public environment of the green building. The FE indicator, according to (Pikas et al., 2015; Preciado-Pérez & Fotios, 2017), consists of an internal rate of return (IRR) and a payback period of investment. Interviews with green building experts (developer, GBCI, IFC, consultant, contractor, building owner, and academics) stated that the minimum value of IRR is at least eight percent in Indonesia. In addition, the experts said that the payback period value depended on the implemented green features that spend six to twenty years in the service period.

3.5. Advanced CBA Framework

Building developers and users or owners occupy the highest positions in green building initiatives and operational financing (see Table 3). Therefore, in-depth interviews ask parties' influence on the implementation of green building concepts. Afterward, the interview results compare to those of previous literature. In the in-depth interviews, the developers and building owners mentioned inhibiting factors in green building concept implementation such as the incremental costs, uncertainty of the benefits of green building concepts because of low levels of engineering knowledge in integrating building development aspects, and lack of governmental encouragement, especially in building appreciation or incentives. GBCI is the founder of green building concepts in Indonesia, and IFC is a World Bank Group that handles funding for sustainable infrastructure. These organizations also state that these three issues are the main problems of developing green building concepts in developing countries such as Indonesia. The willingness of consultants and contractors in the development of green building design and construction concepts depends on the initiative and commitment of the building developer or building owner. In addition, the interviewees said that the government plays an important role in green building concept implementation, not only in mandatory policies but also supervision and enforcement. Furthermore, there are several cases in which tenants or building users benefit from green building operations. Therefore, the building owners generally expressed interest in green building concepts, but the technical implementation depended on the knowledge of consultants and contractors or developers.

Based on case study data in previous research, it was clear that green building investment was relatively unattractive to investors because of a high premium cost of green building implementation and uncertainty of the performance of the green building features. These features accelerated the payback period of investment because of lack of knowledge, and the most interesting element was the absence of external incentives in providing encouragement for and guarantee of new technological applications (Liu et al., 2014; Pikas et al., 2015; Azeem et al., 2017; Preciado-Pérez & Fotios, 2017). Therefore, CBA development in this research did not only result from the relationship between integrating green building aspects with the CBA and life cycle costs but also the green building incentive system. Figure 3 shows the latest development of the CBA model, which was the funding of this research by an additional incentive attribute (I) in the decision-making evaluation process.

The existence of an incentive scheme was expected to increase building stakeholders' awareness of green building concept implementation. The awareness of adopting green building practices had the potential advantage of increasing stakeholders' knowledge and decreasing the building's life-cycle cost. However, the incentive policy to push green building concept implementation was adjusted by the local government based on the condition of their regional financial capability. Therefore, an evaluation based on stakeholder needs showed that FE was an evaluation for the private sector and the NEE was an evaluation for the government as an external incentives provider and superintendent. The validation of the CBA framework model development was conducted by an in-depth interview. The experts from GBCI stated that the critical condition of the green building development was not only in new buildings but also in existing buildings. The number of green buildings was less than five percent in the capital city of Indonesia despite the mandatory policy of green building for all building developers. The lack of knowledge, investment uncertainty, market competition, and the absence of control from the government as policy organizers, make the incentive scheme proposed in this study useful in providing the real view of green building benefits to all building stakeholders.

The local government statement, which was the organizer of the green building policy, could not provide the incentives in the currency value derived from local budgeting because the developer was a private sector or profit-oriented party. Therefore, there were other potential incentive models (I) in green building implementation, such as the Floor-to-Area Ratio (FAR), tax reduction, and expediting the permit process. Based on the methodology development in this study, some potential incentive scheme can be facilitated to find the best alternative in decision-making to accelerate an increase in green building (see Figure 3). However, building developers and private-sector parties want incentive schemes in government policy to be formulated clearly. Without certainty or clarity of incentive regulation, green building as a competitive tool in the property market became unattractive to building investors. The incentive schemes offered in this study must have been attractive because the content consisted of a comprehensive analysis (FE and NEE) and was easy to implement by all the building stakeholders.

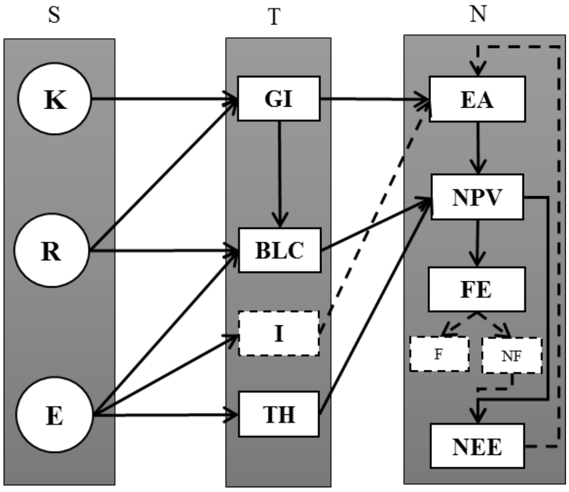

Figure 3 Development of CBA model in green building decision-making analysis

4. CONCLUSION

The sustainability concept in building development is the right step for advancing all regions of the world without neglecting the needs of the future. The concept of sustainability in buildings by way of the green building concept shows economic, social and environmental relationships. Basically, there are other aspects concerning the building development process, such as regional and knowledge aspects. The integration between green building concept needs and the building development concept in developing countries is an effort to increase the attractiveness of this concept.

Decision-making in the implementation of green building concept is not easy, especially in developing countries because of the relatively large number of stakeholders' buildings. This research has succeeded in developing a decision-making process for green building concept implementation through a CBA framework to conduct the evaluation of the feasibility of green building in both the private sector and the public sector. The framework reviews the development of green building through three aspects: regional, knowledge-based, and economic factors. Then, assessing the feasibility of green building investment, this study describes the indicators of building development based on attributes and definitions. This study shows the aggregation process of green building aspects as those aspects pertain to the initiative of green building experts in developing countries, particularly in Indonesia. The development of a CBA method framework shows the integration of building aspects that evaluate the building development needs of both the private sector—namely, financial evaluation—and the public sector—namely, national economic evaluation.

This research validated the framework through in-depth interviews with some green building experts in finalizing the CBA framework for green building concept implementation. They agree with this model because of its comprehensive evaluation of green building life cycles based on building development aspects and attributes. In addition, the government could control the green building achievement with this integrated system on a consistent basis. For future work, the research may enrich other building aspects. Furthermore, some of the combination incentives can be modeled in the real case study to evaluate this formulation.

5. ACKNOWLEDGEMENT

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