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REVIEWING GOVERNMENT INITIATIVES ON IMPLEMENTING SUSTAINABLE INFRASTRUCTURE CONSTRUCTION

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Sectoral development activities, lack of standards on eco-systematic approach, prioritizing short-term outcomes, and ignoring the holistic and comprehensive prospects of sustainability have led to environmental degradation. Therefore, the Indonesian government has realized the importance of implementing sustainable development concepts in every phase of infrastructure project life-cycle. This paper reviews the existing government regulations on sustainable construction implementation guidelines, which underlie the execution of infrastructure project throughout five phases of project life-cycle, namely (1) programming, (2) technical planning, (3) construction execution, (4) utilization, and (5) demolition. A relook at existing regulation in form of providing more technical concepts on implementing the sustainable principles throughout the infrastructure project life-cycle is necessary to help both the construction services users and providers in implementing sustainable construction principles in Indonesia. The outcome of this review can serve as a guide to develop a technical concept for the implementation of the sustainable construction in infrastructure projects in order to create sustainable development in Indonesia.

Keywords: Project life cycle, Sustainable development, Indonesia.

1 INTRODUCTION

The concept of sustainable construction is still new to the Indonesian construction industry. The government has realized that all this time, the infrastructure construction projects that have been undertaken merely rely on short-term achievements, less on systemic and ecosystemic approaches, ignoring the prospect of sustainability in a holistic manner, which has caused environmental damage. Sustainable construction concepts will have a positive impact on the global construction industry since the concept aim to improve the environmental objectives (Abdul Jamil and Fathi 2016). Therefore, the implementation of infrastructure projects in the field of public works and housing must fulfill the provisions of environmental management and support sustainable development by taking into account the principles of benefit, safety, balance, and harmony of infrastructure and the environment.

In order to embrace the issue of 'sustainable construction that creates sustainable infrastructure,' the Indonesian government has enacted regulations regarding the implementation of sustainable construction in infrastructure projects owned by the Ministry of Public Works and Housing. The regulations contain guidelines to implement sustainable construction throughout the five phases of the execution of infrastructure project life-cycle, namely (1) programming, (2) technical planning, (3) construction execution, (4) utilization, and (5) demolition. The purpose of

this guideline is to achieve sustainable development in Indonesia through the creation of sustainable infrastructure, which is constructed with a sustainable construction approach. The Brundtland Commission's 1987 report defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). Whilst CIB and UNEP-IETC (2002) states that "sustainable development is not merely development that can be sustained, but rather the kind of development we need to pursue in order to achieve the state of sustainability". By these definitions, every activity related to the implementation of sustainable infrastructure should be more efficient, more effective, more productive, and more environmentally friendly. However, the concept of sustainable development that is supported by sustainable construction has not yet been well explored within Indonesia construction industry. The paper sets out to review the existing regulations from the viewpoints of related literature, to provide more technical concepts on implementing sustainable infrastructure construction.

2 SUSTAINABLE PRINCIPLES OF CONSTRUCTION PROJECTS

Sustainable development departs from a noble goal to achieve a better quality of life for society today and for future generations. This sustainable condition can be created if the development can meet four poles of sustainability at once, namely economic, social, environment, and technology (Agyekum-Mensah *et al.* 2012). By considering these four aspects, the construction industry should involve in an inclusive manner, not having a negative impact on the environment and with more efficient use of construction resources to provide the benefits to all communities.

Regarding sustainable construction implementation that support sustainable development, for those who have roles in the construction project design-based have agreed with the 1987 Brundtland report definition on sustainable development, while those who are working in project site-based emphasis most on material selection, recycling, life cycle analysis and cost analysis (Brahams 2017). Moreover, construction projects that implement sustainable development principles should be proven throughout the project cycle from the planning, design, and construction of buildings and infrastructure, until their final deconstruction, concerning the extraction and beneficiation of raw materials and management of the resultant waste (CIB and UNEP-IETC 2002). Therefore, urgent issues on implementing sustainable principles in construction projects, particularly infrastructure projects that should be taken into account, since the project activities can change the condition and function of the environment, both in and social life, and will consume a lot of resources and have an impact on the surrounding environment.

Research studies on sustainable principles of construction projects have led to several definition of sustainable construction. Abdul Hamid and Kamar (2012) define sustainable construction as "the creation and responsible maintenance of a health built environment, based on ecological principles and by means of an efficient use of resources". In addition, according to Ismail *et al.* (2017), "a sustainable construction practice can be seen as ensuring all the construction activities are being carried out in a sustainable way, from the initial (planning) to the completion stages". The success of sustainable construction indeed depends on the attitude, awareness, and behavior of individuals and related groups of project stakeholders in making decisions based on a value system that encourages the formation of a balance between economic, social and environmental aspects.

Concerning the sustainable construction project life-cycle, according to Agyekum-Mensah *et al.* (2012) the project management principles are needed to successfully manage the phases and resources of sustainable construction while adhering to the sustainability principles. More practical

ways to sustainable construction practices, according to Abdul Jamil and Fathi (2016), can be implemented with regard to the integration of social, economic, and environmental attributes, green design and procurement, technology and innovation to empower sustainability concepts, reorganized organizational structure and process, better education and training, measurement and reporting for improved environmental and social performance. Even, CIB and UNEP-IETC also identified the need for an initial condition or prerequisite that must be met in the implementation of the sustainable construction framework, especially for developing countries, like Indonesia. The prerequisites that must exist in the implementation of a sustainable construction framework consist of technology, institutions and value systems (CIB and UNEP-IETC 2002).

3 GOVERNMENT INITIATIVE ON SUSTAINABLE CONSTRUCTION

A basic regulation of Indonesian Ministry of Public Works and Housing No. 05/PRT/M/2015 relating to general guidelines for the implementation of sustainable construction in the infrastructure project execution was formulated in order to provide direction for the sustainable construction implementation that creates the sustainable infrastructure that eventually contributes to sustainable development. Concerning the practical issues on how the sustainable principles can be successfully implemented in infrastructure project life-cycle, the following sections discuss some technical concepts based on the literature review to help both the construction services users and providers in implementing sustainable construction principles in Indonesia.

3.1 Project Programming

Programming phase is a set of initial planning activities for determining aims, strategies, steps to be taken, schedule, as well as the needs of resources, especially funding to execute sustainable infrastructure. Sustainable infrastructure programming should be applied since the beginning by the technical unit of organization of the Ministry of Public Works and Housing to ensure the availability, continuity, and sustainability of resources fulfillment in achieving the distant targets.

The steps and techniques that should be applied in project programming phase are as follows: (1) determining the infrastructure object to be implemented; (2) determining the sustainable infrastructure implementation achievement; (3) identifying the interested parties and establishing cooperation among these parties since early stages; (4) equating the vision of sustainability for all the interested parties; (5) determining the method of project delivery system, which is appropriate with the sustainable infrastructure complexity and its ability; (6) determining the initial technical conception, choosing the technology and planning the funding for the sustainable infrastructure implementation in all stages by life-cycle cost approach; (7) analyzing the sustainable infrastructure feasibility; (8) selecting the professional service provider needed; (9) programming all stages of sustainable infrastructure implementation with a clear scope, funding and schedule in the form of work packages as well as risk management implementation; and (10) preparing the programming stage final report.

Operationally, the Indonesian government needs to start a holistic approach in the earliest phase of achieving sustainable infrastructure construction. Developing various indicators related to sustainability evaluation or assessment purposes (Abdul Hamid and Kamar 2012), and hiring life-cycle costing (LCC) professionals to evaluate the potential economic, social, and environmental benefits of proposed infrastructure projects (Higham *et al.* 2015), might guide the government to determine the proposed infrastructure projects to meet the sustainability principles and criteria for Indonesian circumstances. Most importantly, the government as the projects owner and leaders need to establish the strategic and transformational leadership styles, which are leading the sustainability agenda (Opoku *et al.* 2015).

3.2 Project Technical Planning

The technical planning phase is defined as a sequence of activities which is a process of thought, creation, and engineering in realizing the expected sustainable infrastructure. Sustainable infrastructure technical planning must be implemented in accordance with the sustainable infrastructure technical requirements to ensure constructability in each phase of construction implementation and infrastructure performance in utilization and demolition phases.

Steps and techniques of management that must be applied in the technical planning stage are as follows: (1) identifying other interested parties in the technical planning phase; (2) selecting the needed professional technical planning service provider; (3) re-communicating the objectives, the scope and the target of sustainable infrastructure implementation to all parties involved in the technical planning; (4) assigning the criteria of sustainable infrastructure design referring to related technical requirement or using technical criteria of other agencies; (5) making technical planning process integrated with all parties involved; (6) analyzing and reviewing the technical planning results to ensure the quality of technical planning results; (7) preparing the final report of the technical planning phase. Given the important role of the technical planning phase in designing the sustainable infrastructure project execution, there is an urgent need for the Indonesian government to apply the project's life-cycle value through green design and the promotion of best construction procurement practice throughout the supply chain (Abdul Jamil and Fathi 2016, Abdul Hamid and Kamar 2012), and to benchmark and technology transfer of best practices from developed countries in implementing sustainable and green construction agenda (Abdul Hamid and Kamar 2012).

3.3 Construction Execution

In construction implementation phase, it is expected that this phase can contribute to the expected sustainable infrastructure accomplishment, sustainable infrastructure construction implementation that should be done using green construction approach and considering social and economic aspects in the location. The steps and techniques of management that should be done in the construction implementation phase are as follows: (1) identifying the interested parties and involve them in the construction implementation activities; (2) selecting professional construction implementation service provider needed; (3) obliging professional construction executor for conducting construction work at the site by applying green construction approach; (4) conducting activities of the sustainable infrastructure construction implementation; (5) ensuring that the results of every stage of construction implementation can be utilized efficiently and effectively by the users; (6) preparing the final report of construction implementation phase.

The roles of contractors organizations as the leading actor in this phase much depend on their knowledge and capabilities to implement sustainable construction principles. Upstill-Goddard *et al.* (2016) have urged that construction organizations must provide resources to their employees for supplementing knowledge, such as training programmes, to introduce sustainability policies and processes on their operations from environmental and social viewpoints. Education and training on the benefits of sustainable construction should reach the construction clients both public and private (Aigbavboa *et al.* 2017). In addition, Opoku and Ahmed (2014) recommend contractors to collaborate with their clients in adopting whole life costing (WLC), so that they do not only consider the initial cost of construction projects but rather considering the WLC of the project asset.

3.4 Utilization

Utilization phase is intended to utilize the sustainable infrastructure in accordance with its function and to maintain the sustainable infrastructure performance based on the possible actual conditions compared to the target and technical planning criteria. The sustainable infrastructure should be utilized optimally and should be maintained in accordance with its age of service for contributing to the goal accomplishment with asset management approach.

The steps and techniques of management to be applied in the utilization phase are as follows: (1) making the utilization plan of the sustainable infrastructure during the age of service; (2) conducting socialization, promotion and education for the users to support the sustainable infrastructure utilization; (3) managing the sequence of activities of utilization; (4) conducting the sustainable infrastructure feasibility test periodically and when approaching the end of the service period; (5) performing function enhancement for the sustainable infrastructure should be done on the request of the users based on the latest results of audit; (6) selecting a professional service provider for the utilization phase; and (7) documenting all processes and results of the sustainable infrastructure. Maintenance programme of infrastructure products is rarely highly considered by the infrastructure owner nor the users; this phase cannot be neglected since this is a part of sustainable principles. Schröpfer *et al.* (2017) have emphasised that improved knowledge transfer on how to build sustainably between all project participants could solve barriers towards delivering sustainable construction; this best practice should allow the Indonesian construction industry to implement sustainable principles in infrastructure projects from programming to project demolition.

3.5 Demolition

The sustainable infrastructure can be demolished at the end of its service period with a deconstruction approach in order to accomplish the sustainable infrastructure implementation goals in full. Deconstruction is the building demolition intended to get the building material or component for reuse and to get new material by recycling. One of the strategies in the infrastructure demolition is choosing the materials that still have values and throw away the unusable. Deconstruction can also be defined as a planned and careful infrastructure demolition intended to maximize the reuse of infrastructure material or components as well as minimizing the amount of material to be thrown away to the environment or nature (waste).

Steps to be taken in demolition stage of a sustainable infrastructure are as follows: (1) obtaining a license from the authorized official based on the feasibility test report of the sustainable infrastructure; (2) making the sustainable infrastructure demolition plans; (3) establishing a demolition service provider; (4) conducting a demolition process in accordance with the demolition plan; and (5) conducting orderly documentation in the demolition phase. It is clear that at the demolition phase, what has been programmed and planned for the infrastructure project execution will have an impact, for example, the use of construction materials. The way Malaysian construction industry addresses the issue of sustainable materials and green construction is by establishing an eco-labeling scheme for construction materials and promoting reduce, reuse and recycle on the various environmental, social, economic and even cultural factors (Abdul Hamid and Kamar 2012).

4 CONCLUSION

The purpose of this paper is to provide more technical concepts on implementing the sustainable principles throughout the infrastructure project life-cycle to help both the construction services

users and providers in implementing sustainable construction principles in Indonesia. Based on the literature review several recommendations are proposed to comply with the Ministry of Public Works and Housing regulation (No. 05/PRT/M/2015). At the programming phase, the Indonesian government has to have strategies to lead the sustainability agenda including providing indicators that can be used to evaluate the proposed project that meets the sustainability criteria. The next phase is project planning, which should be based on green construction procurement and processes. After that, the construction execution should be constructed by well-trained and competent contractors by considering not only the technical aspect but also environmental, social, and economic viewpoints. Finally, knowledge transfer about sustainable principles including the knowledge of sustainable construction materials among all project participants would support the execution of utilization and demolition phases. The results of the review can improve the understanding among the construction service providers to enable them to implement sustainable construction principles, and can prove their commitment on caring about environmental, economic, and social issues as well.

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