Towards an Integrated Approach for Assessing Triple Bottom Line in the Built Environment

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ABSTRACT: Triple bottom-line, i.e. environment, society and economy is widely recognised as the main underlying principles of sustainable development. Nevertheless, they are not treated equally in the pursuit of sustainability goals. In addition to imbalance development, the three dimensions are sometimes found to contradict each other in achieving the sustainability goals. Existing approaches tend to make individual assessments on either environmental footprints, social equity or economic development. Therefore, these approaches fail to offer "a complete picture" in assessing the overall implications of all the three pillars of sustainability. This paper examines prevailing definitions, perceptions, principles of sustainability assessment and proposes a life cycle based model to put forward the integration of the three dimensions of sustainability into assessment. The main principles of developing a life cycle sustainability approach are identified. By considering environmental loads and social issues alongside the economic development, different types of impacts should be consolidated to a single framework. This would give convergence of separate schools of environmental, social and economic assessments and leads to better understanding of potential escalation effects of the sustainability dimensions. More efforts are required to further develop and improve the integrated assessment in both methodological and practical aspects to guarantee a holistic application of sustainability in the built environment.

1 INTRODUCTION

The construction industry is a primary sector for the economy of a nation, both developing and developed countries. It contributes to about 6%-15% of GDP of a nation. It consumed approximately 30% of raw materials and 25% of water in U.S. and also produced about 30% of total landfill content annually (Kucukvar & Tatari, 2012). Extensive construction activities have given rise to environmental issues in both the regional and global contexts.

Considering the growing sense of urgency in addressing environmental issues, the sustainability concept emerges and it leads to a paradigm shift towards sustainable development in all kinds of sectors and industries. On one hand, the World Business Council for Sustainable Development (WBSCD) works together with over 200 leading businesses to accelerate transition to sustainability. On the other hand, Global Reporting Initiative also established a standard on sustainability reporting and disclosure. In addition, United Nations also established Agenda 21 - an action agenda for governments and organisations to address sustainability at the global, regional, national and local levels. It is apparent that sustainability has become a mainstream in any decision context situations, regardless of international policies or business strategies.

2 SUSTAINABILITY AND TRIPLE BOTTOM LINE (TBL)

Sustainability is referred to as the ability to meet the current needs without compromising the need requirements of future generations, as described by WCED in 1987. The notion of sustainability is inherently broad, complex, subjective, indeterminacy, and multiplicity. It embraces the ideas of enduring, continuing, and sustaining long term impacts in the product or project capacity. According to Ravetz (2000), sustainability involves rethinking practices and paradigms:

- Extended time horizons with linkages intra- and intergeneration
- Extended physical horizons with linkages from regional to global context
- Extended causal chain from upstream pressures to downstream impacts
- Extended sectoral boundaries from environment to human activities
- Extended value systems from a multiplicity of social, economic, political and cultural perspectives

Similarly, European Commission (2016) also indicated that sustainability science conciliates the mutually influenced scientific and social reference paradigms and covers multi temporal and spatial scales. The broad coverage of sustainability has resulted in difficulties in finding a common ground for determining which aspects to be included in attaining the sustainability goals.

In 1993, John Elkington coined the concept of triple bottom line (TBL) in the sustainability framework to include environmental and social dimensions into the traditional economic measures. Since then, profit, people and planet have become the interrelated elements in the realm of sustainability. Social sustainability gives recognition to social development, community involvement, user comfort, community safety and health, equal access to services, and consideration for disabled and disadvantaged. Meanwhile, environmental sustainability examines biodiversity, climate change, greenhouse gas emissions, water use, waste management, natural resources consumption, and air pollution. Economic sustainability considers financial gain, productivity, consumption and competition as well as the whole life ownership cost. Apart from the traditional economic measures used in the financial account, other aspects of economic interactions and intangible assets such as research and development should also be encompassed (Krajnc & Glavič, 2005).

The emergence of TBL promotes the ideas of a balanced development and trade-offs in decision making for sustainable development. The establishment of a balance between the three dimensions prompts all three pillars developing in harmony with each other, with no pillar dominating the others. Sustainability should be viewed as an integrative and holistic concept that involves creating synergies between the three pillars (Whang & Kim, 2015).

However, the three key elements are not always treated equally in the pursuit of sustainability, with some remain undervalued in the industry. There has also been a bias towards focusing environmental sustainability only in the sustainability discourses (Lozano & Huisingh, 2011). As explained by Ristimäki et al. (2013), the focus on environmental sustainability in urban development is dominated by climate change and drastic population growth. It is hence vital to move away from imbalanced development and the distorted approach towards a more holistic approach of sustainable development in construction.

2.1 *Measuring Sustainability Performance*

The challenges of pursuing sustainability lie not only on defining sustainability but also measuring the progress towards sustainability goals. Sustainability is dynamic and is continuously evolving over time. Parrish and Chester (2013) argued that the architectural, engineering and construction industry has been focusing nearly exclusively on certification or environmental sustainability. The view is supported by Guo and Xie (2017) and Geng et al. (2017). In Gou and Xie (2017)'s review, most of the existing sustainable building tools focus too much on environmental sustainability and perform poorly in social, economic and institutional perspectives. Environmental management also has a high frequency in the building LCA research (Geng et al., 2017). The regulation through government agencies often provides little practical guides for organisations to attain triple bottom line goals in sustainability, and hence measuring the extent to which sustainability is being practised can be difficult (Slapper & Hall, 2011).

Sustainability performance could not be improved if no measurement tools are in place to manage and navigate the implementation towards higher levels. Sustainability assessment therefore

become a key instrument to measure the degree of success for implementing macro-level policies, plans and programs at organizational and project levels (Slapper and Hall, 2011). Various methods and tools are proposed to measure sustainability performance in their respective dimensions. Pope et al. (2004) however held that sustainability assessment could be attained by evolving the tool from environmental impact assessment and strategic environmental assessment.

In the development of sustainability assessment model, indicators and metrics are often introduced to translate sustainability issues into quantifiable measures for addressing the key sustainability concerns (Krajnc & Glavič, 2005). Some researchers such as Pope et al. (2004) advocate to encompass the goals and objectives of a project or organisation in assessment to evaluate their paths towards sustainable development. The use of goals or indicators in assessment models enables the communication of stakeholder expectations on sustainability decisions, and reaching consensus among stakeholders would only be possible with the identification of key performance indicators at different scales of sustainability concerns.

3 INTEGRATED ASSESSMENT

The term of "integrate" is defined by Cambridge Dictionary (2017) as "to combine two or more things in order to become more effective". It should coordinate with other elements in the system to form a whole for making impacts of "the whole is greater than the sum of its part". Integration can be categorized into horizontal integration (bringing together different themes and scope) and vertical integration (linking elements at different levels and stages) (Hacking & Guthrie, 2008). The paper puts greater emphasis on horizontal integration of sustainability which integrates the environmental, social and economic aspects.

Several assessment frameworks and certification systems have evolved in view of the rising concern of sustainability. Nonetheless, it is still challenging to develop a comprehensive evaluation system for examining sustainability collectively, rather than analyzing them separately in their composites. The need for an integrated assessment of sustainability to decision making is highly acknowledged in the past research (Kloepffer, 2008; Krajnc & Glavič, 2005; Parrish and Chester, 2013; Singh et al, 2009).

The concept of an integrated assessment is however not a new term in the sustainability research in which it has been discussed since 1998. Post et al. (1998) developed a conceptual integrated impact assessment through various sectoral studies and procedural tuning of the studies. Pope et al. (2004) also proposed a principle-based approach that emphasizes interconnections and interdependencies between the three pillars. Krajnc and Glavič (2005) advocated a model for integrating various sustainable development indicators into composite index using normalisation. Kloepffer (2008) also developed a three-pillar model that emphasizes on feasibility, robustness and flexibility for including new scientific and technological development in future.

In the meantime, UNEP (2004) proposed an integrated ex-ante assessment for achieving both substantive and procedural integration of assessment and planning. Five key elements are outlined in the proposed approach: i) initiation; ii) analysis; iii) design of strategy/strategic planning; iv) design of actions/ operational planning; v) implementation and monitoring. The integrated framework is regarded as an interactive process for preventing negative trade-offs and strengthening positive interactions between environment, society and economy in a spatial and time perspective (UNEP, 2004).

In 2012, the Australian Capital Territory Government has also designed a Triple Bottom Line Assessment Framework by identifying and integrating environmental, social and economic factors into the policy development cycle to ensure that the decisions are informed by the sustainability principles. The Australian TBL Assessment Framework is embedded in three steps: i) identification of the problem and the policy goal; ii) preliminary assessment of the matrix of TBL criterion; and iii) analysis of impacts in detail (Australian Capital Government, 2012).

The advocacy of an integrated evaluation framework in the scientific and business applications demonstrates its potential and contribution in facilitating understanding across the jurisdictions of TBL. It allows the process accounting for the temporal, environmental, dynamic contexts of the decision problems (Mukherjee & Muga, 2010). The integrative understanding of TBL through an integrated assessment would show not only the anticipated direct impacts but also the interconnections, secondary effects and multiple feedbacks of sustainability decisions (Gibson, 2006).

3.1 *Challenges towards an Integrated Sustainability Approach in the Built Environment*

Despite the significant role of an integrated assessment, there are several challenges for a wider adoption in the built environment. Diverse understanding and attitudes towards sustainability lead to incompatible practices due to the ambiguity rooted in sustainability discourse (Mukherjee & Muga, 2010). People and organisations often gauge the sustainability goals differently, considering their respective expectation and targets. The indefinite and vague definition of sustainability proves inadequate and this results in stakeholder reliance on the abstract constructs in giving guidance on quantitative indicators as representation of complexities involved in environmental performance and social responsibility (Mukherjee & Muga, 2010).

The absence of integrative expertise, data and authority and an entrenched tendency neglection of the interdependence of three pillars have also exacerbated the already tense advocacy of incorporating TBL (Gibson, 2006). There are also fears of facilitating continued neglect of traditionally under-valued considerations such as ecological protection if an integration is done (Gibson, 2006). The prevailing sustainable building evaluation systems are overwhelmed by environmental protection, technology and certification and the systems fail to consider and incorporate the multiple dimensions of sustainability appropriately (Conte & Monno, 2012). Other researchers such as Berardi (2012), Gou and Xie (2017), and Parrish and Chester (2013) also concur with Conte & Monno (2000)'s view. In Berardi (2012)'s analysis, the weight of environmental sustainability six sustainable rating systems (i.e. BREEAM, LEED, CASBEE, SBTool, SBC-ITACA and Green Globes) is found to be much higher than economic and social sustainability in the assessment criteria.

Additionally, there is also no agreed methodology to aggregate and measure sustainability performance in view of her multidisciplinary and complex characteristics. Lozano and Huisingh (2011) held that most guidelines and standards address sustainability issues through compartmentalization, thus resulting in divisive assessment of environmental, social and economic sustainability. Pope et al. (2004) also found the practical difficulties in developing a consistent and compatible myriad of TBL objectives that truly define sustainability. Sustainability would be at a risk of "the sum of which is less that the whole" when the linkages and interdependencies between TBL are not effectively understood and this reduces the conception of sustainability into three separate pillars (Pope et al., 2004).

From that, it could be enormously challenging to develop a comprehensive assessment method to include all the sustainability indicators into measurement due to the multifaceted and dynamic characteristics of sustainability. TBL does not have a common unit of measurement and finding a universally accepted measurement for TBL could be very cumbersome. Despite the difficulties, one should never treat sustainability as a solution merely for environmental protection or corporate social responsibility.

3.2 *Proposed Integrated Sustainability Approach - Life Cycle Based Approach*

Life cycle thinking goes beyond the traditional approach that emphasizes on production site and construction process by extending the consideration to the entire life cycle, i.e. from cradle to grave of a product. The wider emphasis would facilitate the links and interconnection between economic, social and environmental dimensions through its value chain. It allows analysis and/or quantification of the TBL implications in a systematic way by tracing the entire supply chain.

A life cycle model is regarded as a valuable support tool in integrating sustainability because a life cycle approach is rooted into the sustainability concept for its systems thinking characteristic and interdisciplinary framework (Sala et al., 2013; Zamagni et al., 2013). According to Mukherjee and Muga (2010), the adoption of a life cycle based approach is a step towards greater inclusion of situation and temporal context by taking into account not only the economic viability but also the long term economic and environmental impacts.

Life cycle methodologies have been widely employed, particularly in determining environmental impacts and costing of a project. Environmental life cycle assessment (often known as LCA) is used as an assessment tool of determining ecological impacts throughout the life cycle of a product, service or system, from raw material acquisition, production, transportation, use, maintenance and end-of-life. Life cycle costing is a tool used for considering economic and financial forecasts of a product or service throughout its life cycle by taking into account time value of

money. Social life cycle assessment is however neglected by the scientific community and it is in the infancy stage of the development, as compared to the other two life cycle methods.

To foster a rigorous and consistent sustainability assessment approach, the essential principles of developing the approach need to be clearly identified. The following principles should always be the central components to the establishment of the sustainability assessment approach: 1) defining goal and scope; 2) determining the spatial and temporal scales; 3) developing strong database as supporting information; 4) identifying sustainability indicators.

As demonstrated in ISO 14040 and ISO 14044, goal and scope definition is a key step in life cycle assessment. The setting of goals is essential and it should be built on the principal values of sustainability, i.e. attaining the best balance between three pillars. The goals, scope and functional unit of the studied subjects would form the overarching framework for setting sustainability strategies in future decisions.

Long term impacts of projects or services are the main context of sustainability and it would be very broad and confusing if no boundary is properly set in the beginning. Decision makers should determine the spatial and temporal scales involved in the assessment, by which the analysis level can be conducted at the micro-, meso- and macro-level. For instance, when sustainable buildings are assessed at the macro level, the contributions to urban planning and regional development should be highlighted. It is important to note that the assessment scale should not be reduced to an analysis level where it fails to consider the whole life cycle impacts of a product. Decision makers should be avoided from capturing sustainability performance incurred in a particular stage only, where the assessment is required to be made along the axes of a project lifespan.

Data provision is critical to provide necessary supporting information for making informed decisions for sustainability. The quality of decision making cannot rise above the quality of the information and documents upon which the decision relies on. Superior database is essential to make sound decisions for sustainability in which the source of information should be supported or if possible, corroborated with evidence. Although there may be unavoidable to involve assumptions, scenarios and uncertainties in the assessment, the analysis outcomes could be inconsistent, inaccurate and jeopardised if too many assumptions and estimates are employed in the sustainability assessment practice.

The identification of sustainability indicators is important because these indicators would serve the purpose of tracking and evaluating the performance across the sustainability goals. The identified indicators or criteria would also encourage the thinking across boundaries between the three pillars, thus maximizing the multiple reinforcing net benefits for sustainability (Gibson, 2006). It helps to simplify a complex situation such as sustainability practice into a tangible, useful and understandable manner. In-depth understanding of the interactions of the three pillars and their collective impacts are crucial in developing the sustainability indicators.

The three pillars deal sustainability issues in a complementary manner and no measurement could be made perfect in the first place. The transition to an integrated sustainability assessment could be gradual. Past research demonstrates the urgent need and possibilities of assessing sustainable development in a collective manner for better decision making. Overlooking the importance of a holistic examination of sustainable development would be an ill-considered move and pushes the built environment towards unsustainability. Sustainability methodologies offered are required to be more convertible, quantifiable, and flexible. More efforts should be made in finding the shared values of sustainability for attaining the goals of TBL.

4 CONCLUSION

The paper offers insights to the prevailing definitions, perceptions, principles of sustainability assessment. It also demonstrates the available methods and challenges in implementing an integrated assessment approach for sustainability. Literature shows the critical need for incorporating environmental, economic and social dimensions in a single assessment model. A life-cycle based sustainability approach is proposed to improve sustainability applications in construction. The key principles of the development of a life cycle-based sustainability approach are highlighted to ensure that the transition towards sustainability are properly measured.

Developing an integrated assessment approach for sustainable development should be continuum of organizational, national and global efforts to strengthen the capacities and governance of

an undertaking towards sustainable development. Instead of a mere framework, a life cycle sustainability approach may comprise an array of disciplinary models interlinked for sustainability in the built environment. Further exploration and development should be made through great care and deliberations of the effectiveness in integrating the complex implications of TBL in the sustainability assessment.

The proposed life cycle sustainability approach is still at the preliminary stage. It may be neither a rigid recipe nor a silver bullet for addressing all sustainability issues and detailing measurements of sustainability impacts. There is still room for improvement and a continuous improvement of the proposed life cycle sustainability approach would aid decision makers shaping their approaches for attaining the sustainability goals in a more holistic manner. More research will be conducted to develop the life cycle based sustainability approach to make it more complete, robust, flexible, and dynamic.

5 ACKNOWLEDGEMENT

The author would like to acknowledge the financial support provided by the Ministry of Higher Education Malaysia under Fundamental Research Grant Scheme (project no. FRGS/1/2016/SSI11/HWUM/02/1).

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