Revisiting Triple Bottom Line and Sustainable Construction: A Systematic Review

Abstract

The concepts of Triple Bottom Line (TBL) and sustainable construction were first introduced in the mid and late-90s respectively. However, there is limited research that addresses the integration of TBL principles within the social, environmental and economic dimensions of sustainable construction. This paper intends to (a) revisit and review the concept of TBL within the context of sustainable construction, thereby establishing the current research position, and (b) develop an integrated framework for TBL to help support improved sustainability practices within the sector. A systematic review of outputs published between 1980 and 2018 was carried out by examining three major research databases. Subsequent to filtering, eighty-six journal papers were selected for this review. Results show a growing research interest in, and awareness of, TBL. The challenges and drivers for both TBL and sustainable construction have been analysed and discussed based on current developments. The proposed framework integrates the principles of TBL, and enables new theoretical and practical solutions to help improve the integration of sustainability within the construction industry.

Keywords: Triple bottom line, sustainable construction, review, methodology, integrated framework

1. Introduction

The pace of rapid urbanisation has elevated societal awareness of the consumption of natural resources across all industries. In particular, the construction sector is responsible

for the significant consumption of raw materials, such as, 3 billion tonnes of steel or a half of the world's steel production (Grierson, 2009). Following the emergence of the need for sustainability within the construction industry, the first formal definition of sustainable construction was proposed by Charles Kibert in 1994 as part of an attempt to find a solution to support broader sustainable development (Du Plessis, 2007). However, this approach is still not popular nor well-implemented in the sector due to a culture of "reluctance to change" (World Economic Forum, 2016).

The concept of Triple Bottom Line (TBL) evolved to support the delivery of sustainable development. TBL originally served as an accounting framework that included environmental and social dimensions within the conventional finance-centric business performance model (Elkington, 1994). Its aim was to measure the performance of corporations by emphasising on extensive investment outcomes (Slaper and Hall, 2011). Although literature on TBL seems to have been well-received across a broader range of sectors, the situation is very different from the perspective of the construction industry (Abidin, 2009). Here, the implementation of TBL is rather vague; in particular, the industry is widely recognised for being slow to implement technological development in comparison to many other industries due to its decentralised nature, insufficient collaboration across suppliers and contractors, difficulties in hiring a skilled workforce, and inadequate knowledge transfer between projects (World Economic Forum, 2016). Furthermore, despite literature showing TBL and sustainable construction have been gradually adopted, albeit slowly, they have not been investigated in depth from the perspective of environmental, economic, and social sustainability as a whole. Related publications mainly focus on construction materials (Akadiri et el., 2013; Govindan et al., 2016; Hossain et al., 2018; Khoshnava et al., 2018), society/stakeholders (Almahmoud and Doloi, 2015; Bal et al., 2013; Mostafa and El-Gohary, 2014) or economic benefits (Abidin,

2009; Illankoon et al., 2016; UNEP/SETAC, 2011) individually. Although some publications briefly highlight TBL and sustainable construction in the same article, no prior research has integrated both concepts and discussed them together in detail from a holistic perspective.

This paper therefore aims to (a) revisit and review TBL within the context of sustainable construction, establishing the current research position, and (b) develop an integrated framework for TBL to help support improved sustainability practices within the construction industry. Using a systematic review method, this paper also identifies current research gaps and sustainability needs in the construction industry. It also provides new insights into future developments, and potential future research in the field. The remaining parts of this paper are structured as follows: the second section highlights the theoretical background of TBL. The third and fourth sections describe the review approach and its results respectively, while the fifth section describes the integrated framework. The last section establishes conclusions and the research contribution.

2. The Theoretical Background of TBL and Sustainable Construction

The TBL terminology was famously coined by John Elkington in the mid-90s, and started as an accounting framework that endeavoured to include environmental and social dimensions into the traditional finance-centric measurement of business performance (Elkington, 1994). The framework is sometimes also known as the 3Ps: people, planet, and profits, and has changed views on how to holistically measure sustainability performance (Slaper and Hall, 2011). TBL, however, has no standardised reporting method to holistically measure the social, environmental, and economic dimensions of sustainability (Slaper and Hall, 2011). For example, instead of viewing economic performance in terms

of monetary improvement only, TBL's approach to economy takes into account the economic impacts on related stakeholders, such as employees, government agencies and the general community (Jennifer and Taylor, 2007). In addition, it is a recognised challenge to accurately quantify and evaluate all three dimensions of TBL, particularly the environmental and social dimensions (Schulz and Flanigan, 2016). An absence of standards in evaluating the three pillars of sustainability prompts the proliferation of inventive solutions (Hill and Bown, 1997).

On the other hand, the three pillars of sustainable development seem to have gained increasing attention from stakeholders engaged in the sector. Kibert (1994b) introduced the term "sustainable construction" at the First International Conference on Sustainable Construction in Tampa, Florida, United States of America, defining this as "*the creation and responsible management of a healthy built environment based on resource efficient and ecological principles*" (Kibert, 1994a). In its earliest use, the concept of sustainable construction tended to focus more on environmental issues. This later evolved to include the non-technical issues of economic and social sustainability (Abidin, 2009). These three dimensions have since been adopted for the reporting of organisational sustainability and they are taken into account in numerous building assessment tools for providing clear and structured information on environmental, economic and social interventions (du Plessis, 2007).

Sustainable construction must ensure the delivery of environmental, social and economic sustainability in a balanced and optimal manner, without one pillar dominating any others. In construction, environmental sustainability aims to restore and maintain the harmony between the natural and the built environment for the whole life of a structure (Sjöström and Bakens 1999). It emphasises an efficient use of natural resources to minimise the impacts of the built environment on the earth and enhance the quality of surrounding

environment (Grierson 2009). Social sustainability examines community development, public engagement, user comfort, health and safety, access to services, equality and diversity (Goh, 2017). Although people-centred solutions are often encouraged in sustainable construction, social sustainability is typically found to be given less attention. Economic sustainability in construction refers to financial gains from individual projects for the benefit of project stakeholders (Abidin, 2010).

TBL offers clear and better-developed strategies and action plans to the construction industry, and is hence able to make a meaningful contribution to a sustainable future. The principles of TBL are practical and align well with the common aims of sustainability within the construction sector. However, the relationships between TBL and sustainable construction have not yet been investigated in detail. This paper argues that TBL therefore needs to be re visited as it offers significant potential for integration and improvement in sustainable construction practice.

3. Methodology

A systematic review method was employed to achieve the research findings reported herein. This method of scientific investigation originated with medical practitioners whereby a comprehensive, unbiased method to synthesize research literature was employed (Cook et al., 1997; Chong et al., 2017) Fig. 1 illustrates the overall process of the review.

"Insert Figure 1 here"

To ensure sufficient coverage, the following research databases were utilised: EBSCOhost, Scopus, and Web of Science. Web of Science covers most of the quality journal papers, while Scopus has a larger database. EBSCOhost has other sources of articles that may be useful for this review, namely, magazines. Full-text articles were investigated for the years 1980 to 2018 to provide a full account of the growth, progress and development of this sustainability paradigm. The study period selection was also based on a preliminary search of articles published prior to 1980 that were found to be scattered and isolated in terms of their scope and relevance. A historical review shows that the concept of sustainable development was popularised and became more widely used in the 1980s, especially following the publication of the Brundtland Report in 1987 (Du Pisani, 2006). It brought a new consensus on the adoption of sustainable development, linking to improved economic efficiency, protecting and restoring ecological systems and enhancing the well-being of people (Du Pisani, 2006).

The first key objective of the review was to analyse current research trends and establish the status of TBL within the context of construction sustainability. All searches therefore included the key terms "triple bottom line", "sustainab*", and "construction" in publication titles and/or keywords. These key terms were also considered alongside other common terms including "green", "sustainable development" and "green building". A total of 1261 relevant articles were acquired from the initial search and filtering. These were then filtered again by checking the content of each to determine overall relevance. Articles were removed from the database if they: 1) were not directly relevant to the study topic, 2) were limited to construction materials, 3) considered substitutes for sustainable construction materials/new technologies, 4) examined construction education, or 5) investigated construction safety and risk. This approach to filtering excluded a total of 1143 articles, leaving 120 for further consideration. Subsequently,

duplicate articles were removed, leaving 86 articles for review. Table 1 below summarises the details of the search.

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4. Results

4.1. Research Trends and Current Status of TBL

A wide range of journals were examined, and it was found that most articles were published in *Building Research and Information* (12), *Journal of Cleaner Production* (6), *Habitat International* (6), *Sustainability* (6), *Procedia Engineering* (5), and *Sustainable Development* (4). Overall, it can be deduced that the studies are relatively evenly distributed (6 to 7%) across these journals with the exception of the journal of *Building Research and Information*, which contributed to a higher percentage (13.6%). These journals have international coverage, being based in the UK, Singapore, Chile, Ghana, Malaysia, Lebanon, etc.

Regarding research trends, it was found that the number of articles increased from 1-3 articles per year in 1996-2005 to 5-10 articles per year in 2009-2017, as illustrated in Fig. 2. Most of these articles focused on the adoption and implementation of TBL in the construction industry. Generally, the articles focused on the barriers of implemention in specific countries (Ametepey et al., 2015; Opoku and Ahmed, 2014; van Bueren and Priemus, 2002), multi-level frameworks for implemention (du Plessis, 2007; Hill and Bowen, 1997; Karunasena et al., 2016; Presley and Meade, 2010, Sjostrom and Bakens,

1999), and the assessment or measurement methodologies used to support integration (Kucukvar and Tatari, 2013; Wu, 2017; Yu, 2018; Zhang et al., 2014).

"Insert Figure 2 here"

A few articles focused on the awareness of sustainable construction (Abidin, 2010; AlSanad, 2015; Pitt et al., 2009; Serpell et al., 2013; Yin et al., 2018). Here, the majority were found to be related to the awareness of the TBL concept, barriers in TBL implementation, initiatives for TBL implementation, and non-holistic applications.

Generally, the implementation of sustainable construction practices was fund to be low in developing countries (Abidin, 2010; AlSanad, 2015; Ametepey et al., 2015; Athapaththu and Karunasena, 2018; Saleh and Alalouch, 2015; Sepell et al., 2013; Yilmaz and Bakış, 2015). However some developing countries such as Malaysia, Turkey and Uganda have shown promising signs of awareness of sustainability concepts being embedded within construction (Kibwami and Tutesigensi, 2016; Yılmaz and Bakış, 2015). A study conducted by Kibwami and Tutesigensi (2016) found that construction professionals in Uganda are generally aware of sustainability, although sustainable construction was mostly perceived as synonymous as environmental sustainability. In Malaysia, developers considered themselves to have moderate to good knowledge of sustainable construction but perceived the general knowledge of developers towards sustainability as below average. Interestingly, these two studies (Abidin, 2010; Kibwami and Tutasigensi, 2016) suggested that the high level of awareness of sustainable construction did not reflect the extent of actual implementation of sustainability in a construction context. They argued that awareness does not necessarily equate to the prevalence of sustainable practice but is rather more of an indicator of appreciation. Meanwhile, the adoption of sustainability practices is greater in Europe from the perspective of contractors (Afzal et al., 2017). Consequently, it

was concluded by Bourdeau (1999) that the adoption and implementation of sustainability in the construction sector are significantly affected by the mature, transitional and developing economies.

4.2 Challenges and Drivers for TBL and Sustainable Construction

Many challenges have been found in implementing the concept of sustainability in construction. A number of studies (Alwan et al., 2017; Hall and Purchase, 2006; Moore and Rydin, 2008; Pearce, 2006) confirmed that there is still a knowledge deficit when it comes to defining sustainability, which in turn, causes confusion and impedes implementation. One key issue identified was the difficulty in integrating an environmental perspective into national policy in poverty-prone regions (Gomes and da Silva, 2005). The poor assimilation of urban planning policies was also recognised as impeding progress (Moore ad Rydin, 2008). It was found that an improvement in the construction industry's legal framework by local government was confirmed as one of the biggest drivers in achieving sustainability (Ametepey et al., 2015; Chang et al., 2016; Lorenz et al., 2005; Manoliadis et al., 2006; Serpell et al., 2013). Governments can clearly assist in embedding TBL as a governing principle within the construction sector (Chong et al., 2009). However, it was argued by Majdalani, Ajam and Mezher (2006) that in addition to governments' role, all stakeholders must also play a part in assisting in industry-wide implementation. In addition, other drivers recognised by the majority of building-related firms in the USA is that any effort associated with sustainability can readily complement strategic positioning even though the profit gained from sustainable projects is generally lower than that for conventional projects (de Paula et al., 2017).

4.3 Approaches/ Strategies for Improving Sustainable Construction Practice

In view of the many challenges identified in earlier studies, some researchers have proposed new approaches or strategies to help facilitate the implementation of sustainable construction. Their research focuses mainly on conceptual frameworks and strategies through assessment indicators and tools. One of the earliest approaches was proposed by Hill and Bowen (1997); this included technical criteria as the fourth pillar of sustainability. They proposed a multi-stage framework that considers the life-cycle of construction projects from the planning and design stage to the operation and demolition phase (Hill and Bowen, 1997). Similarly, Miyatake (1996) suggested the adoption of a life-cycle process within the built environment that includes the environmental considerations of restoring contaminated environments, and developing hot and arid areas to fight against the devastation of desertification. The incorporation of a life cycle perspective is also supported by Sev (2009) in which his framework included not only life-cycle considerations, but also efficient resource utilisation and integrated design practice to provide an overview of the various elements of a sustainable system.

Within a broader context, to achieve sustainable construction, developing countries are often tasked with providing a capable local construction sector and ensuring that this can keep pace with the demands for sustainable development (du Plessis, 2007). Huang and Hsu (2011) proposed using a nation's statistical databank to help facilitate the implementation of sustainable construction at a national level. Meanwhile, Wong, Ng and Chan (2010) formulated four key strategic directions to support the concept of sustainable construction: (i) formulating an industry-specific long-term vision and policy; (ii) developing favourable factor conditions and resources; (iii) fostering a best practice culture; and (iv) enhancing technical competency.

Within the context of an overall construction project, Lam et al. (2011) provide a "green" specification that is universal in that it applies to both the public and private sector. It focuses on the procurement, pricing, and administering of works to provide a clear pathway for stakeholders. On the one hand, Presley and Meade (2010) modified the conventional finance-centric performance measurement by integrating strategic and activity-based criteria to create a sustainability benchmarking framework that can be generally applied by any construction project to benchmark project-specific indicators. On the other hand, Glass and Dainty (2011) synthesised the categories for a sustainable construction business to help stakeholders identify discrepancies between sustainable products and the goals or direction set in, or for, their business. Meanwhile, Idris, Ismail and Hashim (2015) proposed a framework that highlights the importance of awareness in promoting sustainability for construction projects in Malaysia's public and private construction sectors. Value planning was also given priority by Karunasena, Rathnayake and Senarathne (2016) in their framework that summarised an integration with sustainability ideas in the initial stage of a construction project to minimise unnecessary costs.

In terms of stakeholder engagement, Tan et al. (2011) proposed a two-dimensional strategy that relates the contractor's competitiveness and their performance in sustainability. It correlates with the study undertaken by Holloway and Parrish (2015) on the crucial role of contractors in the success of sustainable construction. Additionally, a study by Bal et al. (2013) found that when it comes to ensuring stakeholder engagement, the project team is required to adhere to six key steps: (i) identify all key stakeholders, (ii) connect stakeholders to specific sustainability targets, (iii) prioritise stakeholders, (iv) manage stakeholders, (v) measure performance, and (vi) configure these objectives into actions. Because various definitions and methodologies of sustainable construction are

adopted from different viewpoints of stakeholders, du Plessis (2001) highlighted the need for a distinctive approach that universally considers varying values and priorities from different parts of the world.

In addition to the approaches and strategies discussed above, a total of 15 reviewed articles proposed new indicators and tools to assist in assessing sustainability performance holistically. Hakkinen (2007), for example, synthesised the indicators of the 'Trends and Indicators for Monitoring the European Union (EU) Thematic Strategy on Sustainable Development of Urban Environment' (TISSUE) project to evaluate their applicability in addressing urban construction-related problems. Berardi (2012) appraised various building assessment tools and proposed a multi-dimensional approach since he found most tools do not consider economic and social assessment. In line with this, Li et al. (2018) also contended that performance indicators such as green building rating tools are more buildings-focused rather than facilities-focused. They also proposed an integrated measurement tool that is able to numerically record sustainability performance in Australia's university campuses (Li et al., 2018). The essential criteria to measure and compare sustainability performance specifically for modular and conventional construction methods were identified by Kamali and Hewage (2017).

Lastly, some articles also presented specific solutions to address sustainability in onsite construction practice. Sameh (2014) promoted the application of traditional building materials and architectural techniques, such as using mud brick and compressed earth blocks that meet the environmental, economic, social, and technical interests of sustainability. Additionally, Bae and Kim (2008) discussed the benefits of practising lean construction in contributing to sustainability since it promotes more efficient project implementation. It was also found that the suitability in applying a sustainable and lean construction concept depends significantly on the size of the construction project and on

the awareness of the workers (Koranda et al., 2012). Nevertheless, this research found that there is an imbalanced approach to sustainable construction between contractors, where the principles of TBL are applied selectively and can cause ineffective implementation of sustainable development practices (Whang and Kim, 2015). There has also been a rise in social issues such as crime within urban areas and the overall resource available to the construction industry is still inadequately managed (Wang, 2014). Moreover, there has been more focus on economic factors rather than on social and environmental gains (Shen et al., 2010). This imbalanced approach has been exacerbated by use of an outdated system where a project's success is measured by its quality and economic gains (Sha et al., 2000).

"Insert Table 2 here"

5. Integrated Framework of TBL and Sustainable Construction: The Way Forward

An integrated framework has been proposed to highlight potential gaps and requirements to support sustainable construction practices in the future. This framework aims to maximise the three core principles of TBL, i.e., planet, people, and profit with the environmental, social, and economic dimensions from a holistic perspective.

Life cycle thinking is embedded in the proposed integrated framework because a life cycle oriented application will improve the delivery of sustainable development goals in a more holistic manner (Goh, 2017; Ingrao et al., 2018). The adoption of this life cycle approach supports a better integration of sustainable practices because systems thinking, as inherent multidimensional and interdisciplinary characteristics of life cycle thinking, assists stakeholders in considering the long term environmental, social and economic impacts (Goh, 2017; Zheng et al., 2019).

"Insert Figure 3 here"

Regarding the integrated environmental dimension, the principle of environmental protection is often the main focus of green assessment and policy-making in sustainable construction as led by Government. Construction projects consume a significant amount of resources throughout the project lifecycle, particularly in the operational and maintenance phases. There is a need for Government policy and regulation during these phases to help improve the efficient use of natural resources. Life cycle assessment gives a systematic and robust decision support tool for estimating environmental criticalities associated with construction projects or with complex building systems. This integrated dimension should

also work alongside ISO 14001, the international standard for environmental management systems, or with green building rating tools used in both developed and developing countries (e.g., BREEAM from the UK, CASBEE from Japan, LEED from the USA, Green Star from Australia, ITACA from Italy, or Green Building Index from Malaysia). By coupling with ISO standards and green building rating tools, life cycle assessment evaluates the environmental impacts by considering both upstream and downstream activities across the project life. This creates sustainable interactions between society and its environment in an integrated holistic way (Ingrao et al., 2018), thus supporting effective decision making. Future research should focus on designing more robust and dynamic assessment or policies to suit different environmental needs for new buildings, refurbished and existing buildings in developed and developing countries so as to improve environmental protection and energy conservation.

The social dimension is often regarded as the most challenging principle of sustainable construction since project stakeholders typically have different objectives and priorities. Social sustainability by nature involves multiple stakeholders and there are a wide range of social needs and values to be taken into account. Current practices highlight the need for stakeholder engagement at a national or state level (Huang and Hsu, 2011) or from the occupants' perspective (Stubbs, 2015). The proposed framework argues that a collaborative platform at the project level is critical. This platform must embrace the current surge of Building Information Modelling and digitalized practices, and all project stakeholders should be engaged at an early stage. These stakeholders can then clarify their priorities and perhaps even develop the final model of the project together to help improve social dimensions. Social life cycle assessment can hence serve as a basis to assess the potential positive and negative impacts of processes and services in a more consistent and integrated manner. Future research should focus on designing harmonious and more

engaging contracting approaches for engaging all stakeholders across the project, and covering both state and national levels.

The construction industry is already known for its significant contribution to the economy. The integrated economic dimension hereby refers to the whole project lifecycle costing and balanced needs of other sustainability dimensions from the perspective of construction practices. Examining the economic value of construction projects must consider the balance between the three pillars of sustainability to determine the long-term cost effectiveness (AbouHamad and Abu-Hamd, 2019). When this integrated dimension has been applied and balanced , monetary profit from the completion of construction projects will not cease upon reaching the handover stage, but will transfer to society and to those people who use and benefit from it. As a result, the economic performance of a construction project should not be measured by the initial direct and indirect costs, but instead should measure the benefits of engaging societal stakeholders. The whole life cycle cost must also take into consideration: initial cost, maintenance and operational cost, replacement cost, and end of life costs such as disposal, resale and salvage value (AbouHamad and Abu-Hamd, 2019). Future research should capture and analysis all economic data from a project lifecycle perspective, so as to enable better informed decisions for balancing other sustainability needs whilst maximising the economic benefit from the project.

6. **Discussion and Conclusion**

This paper has revisited and review the concept of TBL within the context of sustainable construction, establishing the current research position. In line with a growing awareness of sustainable development, it can be seen that research on TBL has been

steadily increasing over the past two decades in both developed and developing countries. It has also been established that the underlying principles of TBL and sustainable construction remain fundamentally unchanged. However, implementation of sustainable practice within the sector has gradually moved towards a more consolidated approach by considering broader scope of sustainability needs. The awareness and uptake of TBL is expected to continue to increase. For the implementation of the TBL principle to be successful however, it is necessary to balance all sustainability dimensions throughout the project lifecycle. This research has also provided insightful references into the contemporary challenges and drivers for applying TBL.

The second contribution of the paper lies in its proposed integrated framework for TBL. This framework identifies a way forward to support and improve the implementation of sustainability in the construction industry. Future research directions have also been articulated to address and promote new theoretical and practical ideas for each sustainability dimension. This could help to bridge the gap between academia and industry in delivering more sustainable approaches, especially when embracing new digitalised practices.

Certain limitations need to be considered in this paper. First, although the review has covered a considerable search period, ie 1980 to 2018, the search has only captured specific keywords from across five databases. Secondly, the concepts of TBL and sustainable construction are very closely related to the three pillars of a more general definition of sustainability, thus some articles may have interpreted and used terms differently. Thirdly, the proposed framework requires a periodic check against the latest research and developments so as to ensure its relevancy.

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