TOWARDS DEVELOPING A MONETARY MEASURE FOR SUSTAINABLE BUILDING PROJECTS: AN INITIAL CONCEPT

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ABSTRACT: *There are growing concerns about considering the long-term benefits of public projects amidst the often dominant short-term returns. Increased value of development to the society at large will mean taking into account the holistic benefits that can be accrued over the entire life of an asset. For the government however, investing the limited available resources in a sustainable manner continues to make the headlines. Sustainable development is now considered a way for the construction industry to contribute to this national agenda. This study therefore takes a brief look at the concept of sustainability and investigates the costs related to producing sustainable buildings through the review of relevant literature. According to the study, to ensure effective use of limited resources and enhance short- and long-terms benefits amidst tight budgets, the industry must respond accordingly and focus its attention on developing projects which are economically viable, socially acceptable and environmentally friendly. The monetary measures that could be used to quantify economic, social and environmental criteria which are the three fundamental pillars of a sustainable development were revealed. They include the initial construction cost (IC) for measuring economic factors, and cost-in-use (CIU) and initial carbon cost (ICC) for measuring social and environmental aspects. The next stage of this research work will be the development of an optimum balance index (OBI), a tool that serves as a single sustainability indicator and which can be used to improve project delivery for the benefits of the society at large. Design options selected based on this multicriteria index will enhance an increased value and reduced waste in a sustainable manner by optimising financial return, maximising social benefits and minimising environmental impact.*

KEYWORDS: *cost-in-use, initial carbon cost, initial construction cost, optimum balance index, project delivery, sustainability, value.*

1. INTRODUCTION

The construction industry as a major contributor to a country's GDP is constantly looking for ways to improve its products and service delivery process which has a multiplier effect on the economy. Coupled with the looming global recession further exacerbated by the UK Government spending cut, there is no such time when new and more efficient methods of delivering construction project is more important. The need for accountability and efficiency savings in public expenditure means that the limited available resources in circulation have to be spent in a sustainable manner that guarantees short- and long term benefits to the society at large (Yu *et al.*, 2009; Jones *et al.*, 2010).

In lieu of the above, Myers (2008) opined that sustainability is another concept that has come to stay in the UK construction industry whilst developing more sustainable buildings continues to be one of the top government priorities (DECC *et al.*, 2008). The private sector is also not left out in the process as they strive to incorporate sustainability into their services and products not only because it is the right thing to do but because of the mounting pressure from the government which appears to be acting in the best interest of the general public. It is

clear why the construction industry must respond accordingly and focus its attention on delivering sustainable projects which are economically viable, socially acceptable and environmentally friendly.

This research takes a brief look at the concept of sustainability as it relates to construction and investigates the costs related to producing sustainable buildings. Taking into consideration sustainability during the cost estimating process is vital for the successful integration of sustainable features within a construction project (Essa & Fortune, 2008). Hence the paper examines the various monetary measures of sustainability and the relationship that exists between these costs. Future research work in this area is expected to lead to the development of an optimum balance index, a tool that will enhance and promote the government sustainability agenda.

2. LITERATURE REVIEW

2.1 The concept of sustainability

Sustainability is broad and has been used in different context, but the economic, social and environmental aspects, which are inextricably linked, remain the three fundamental pillars as shown in Figure 1 below (Kunszt, 1998; Ding, 2005; Matar *et al.*, 2008; Jones *et al.*, 2010). Traditionally, the construction industry has often explored the single state sustainability (1st order) within the economic dimension which explains why most times projects are awarded to the contractor with the lowest tender (Edum-Fotwe & Price, 2009) which is not best value for money. Tenders have often been based on economic issues which measure short-term returns at the detriment of social and environmental factors that can offer increased value for the society at large as they consider long-term benefits of an asset (OGC, 2007). Thus the need to develop an index which achieves 3rd order sustainability, that is, strikes a balance in the three key variables of economic, social and environmental criteria as shown in Figure 1 below. Using this approach to select the best option among alternatives at an early stage of a development is vital in achieving increased value for money and in eliminating waste both in the short and long run for public building projects (Lippiatt, 1999; BERR, 2008; Essa & Fortune, 2008; Zavrl *et al.*, 2009). However, achieving this will mean looking for a way of measuring the three pillars of sustainability in monetary terms when proposing a new development or retrofitting the overly huge building stock.

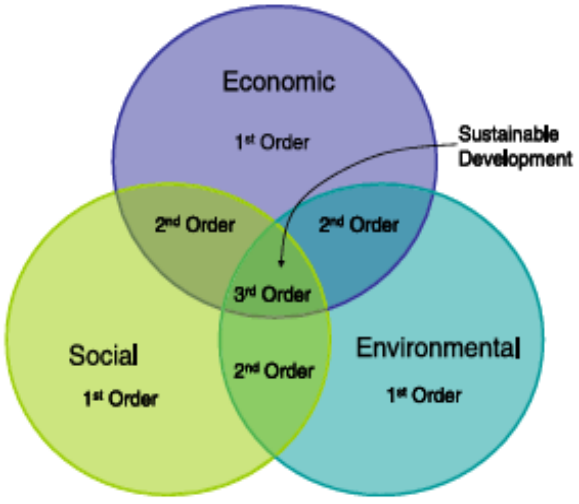
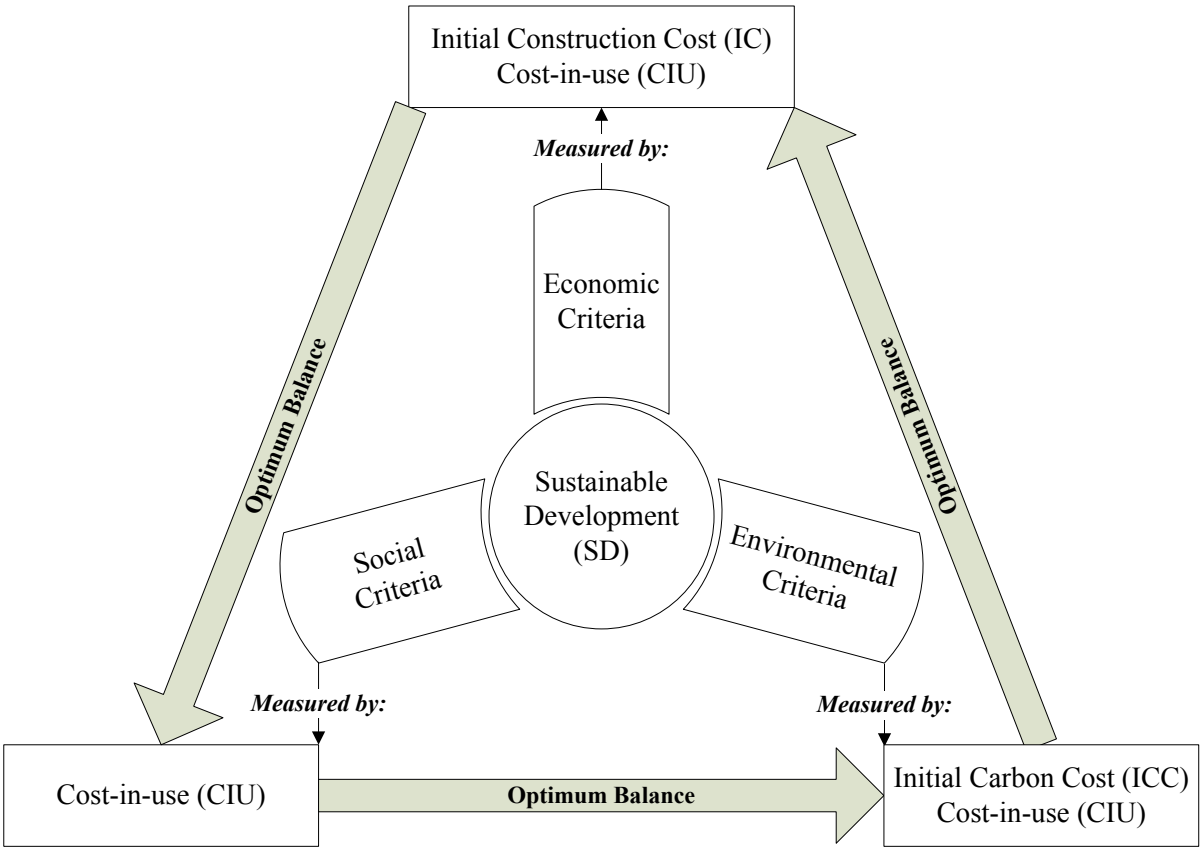


Figure 1: The Three Fundamental Principles of Sustainability (Source: Edum-Fotwe & Price, 2009)

2.2 Monetary measures of sustainability

The economic sustainability of a project which looks at the short-term benefits and the effective use of limited resources has long being measured using initial cost of construction (IC) and in more recent times with cost-in-use (CIU) as value for money, that is, cost-benefit analysis of an asset over its entire life, is gradually becoming more important (Myers, 2008; Barsuk, 2009). Also, CIU is gaining popularity as a monetary means of considering the social and environmental issues at an early stage of development as it takes into account the whole-life appraisal of a building over its useful or anticipated life (Cole & Sterner, 2000; Davis Langdon, 2007; Essa & Fortune, 2008; Dixon, 2009). It is an effective tool now used to measure sustainable building performance and total development value as it considers the long-term benefits that can be accrued (Flanagan *et al.*, 2005). Whilst it could still be difficult to fully measure the social sustainability of a development in monetary terms due to its greater proportion of human and subjective factors, Design Quality Indicator (DQI) is one of the contemporary tools that can be used alongside any monetary measure to ensure that this requirement is duly met (Gann *et al.*, 2003; Edum-Fotwe & Price, 2009).



SD = Optimum balance of IC, CIU and ICC

Figure 2: Optimising the Monetary Measures of Sustainability to achieve Increased Value

Furthermore, carbon equivalent (CO_2e) which now has cost implications known as carbon cost has been greatly developed as a more specific measure of environmental criteria (DTI, 2007; DECC, 2009). Sustainability revolves around minimising the detrimental effects of

development on the built and natural environments through the reduction of greenhouse gas and the transition to a low or zero-carbon economy (Price *et al.*, 2007). Given that 86% of the greenhouse emission is carbon related, CO2e has been developed for the remaining 14% composed of methane (CH4), nitrous oxide (N2O) and refrigerant gases to enhance uniformity of measurement (DECC *et al.*, 2008). Although CIU can be used to measure a building's environmental performance during operation as it takes into account energy usage (Davis Langdon, 2007), it does not measure the environmental impact of construction, hence the importance of the initial carbon cost (ICC) measure. As the UK construction industry consumes a vast amount of resources, assessing the ICC of producing a building can make the difference between choosing a sustainable design that minimises environmental impact and an unsustainable one that wastes the limited available resources and as well degrade the environment. The importance of ICC measure which has been neglected in the past cannot be over-emphasised in achieving sustainability as it is now a legal obligation for the UK Government to reduce carbon footprint by whatever means possible (Lohnes, 2008; BIS, 2010; Jones *et al.*, 2010).

2.3 Relationship between the costs of sustainability

Taking into consideration sustainability during the cost estimating process is vital for the successful integration of sustainable features within a construction project and in achieving increased value (Essa & Fortune, 2008). Hence the importance of the monetary measures of sustainability in producing buildings in a sustainable manner for the best interest of the general public. They include the IC for measuring economic factors, and CIU and ICC for measuring social and environmental aspects (Lowe & Zhou, 2003; Edum-Fotwe & Price, 2009; Zavrl *et al.*, 2009). Considering these costs and seeking the optimum balance in the relationship that exists between them during the early stage of a development will promote the 3rd order level of sustainability, as opposed to the 1st order still prevalent in the industry (Sorrell, 2003). Research has revealed that a reduced IC will in many cases have to offset an increased CIU such as increased cost of operation and maintenance perhaps due to poor quality design (OGC, 2007). On the other hand, using renewable materials in a building could also imply higher IC due to the costs associated with new technology and invention, but lower CIU due to less energy consumption and carbon footprint for instance (Matar *et al.*, 2008; Nalewaik & Venters, 2008; BIS, 2010). However, no known research has been found to date explaining the movement and/or behaviour of ICC in relation to IC and CIU components despite its importance in achieving 3rd order sustainability and increased value.

In summary, it is logical to believe that in practice, achieving a direct relationship between IC, CIU and ICC may not always be achievable as any construction investor would want it. Whilst reducing the CIU and ICC is greatly desired, sustainability which is the increased value comes with a price often reflected in the IC in terms of high up-front expenditure (Davis Langdon, 2007). The different research work examined above have shown that optimising the CIU component which is far greater than the smaller amount IC will often lead to better overall savings and/or increased value over the building life. This implies that a trade-off in constituent costs is absolutely necessary for a sustainably-designed building, but at what point is it best value for money to the society at large is a point for future research work. The movement of ICC in relation to IC and CIU is another indecisive area to be explored. The next stage of the research work will therefore develop a 3rd order sustainability cost index that achieves optimum balance between these three costs. This index when combined with other non-monetary tools such as Design Quality Indicator (DQI) for assessing social requirements of projects for instance will assist construction stakeholders achieve increased value and reduced waste in its entirety both in the short and long run through the optimum balance of sustainability criteria in a project.

3. CONCLUSION

Improved project delivery is no longer an option but a necessity in the current gloomy economic climate as the unavoidable government spending cut continues to affect the construction industry like any other sectors of the economy. The review of the relevant literature have shown that sustainability is one of the strategic means of achieving increased value and reduced waste in the industry that has to improve its delivery process and products for the benefits of the society at large. Increased value and reduced waste in a sustainable manner to the general public means producing a building that is economically viable, socially acceptable and environmentally friendly otherwise known as 3rd order level of sustainability instead of focusing on the 1st order still prevalent in the industry.

This can be achieved through optimum balance of the costs that measures sustainability criteria which are the initial construction cost (IC), cost-in-use (CIU) and initial carbon cost (ICC). The study revealed that IC and CIU are monetary measures of the economic value of a building whilst CIU measures the social value as it considers the impacts of an asset over its useful or anticipated life. CIU and ICC are also argued to quantify the environmental impacts of a building. In summary, developing a system that achieves an optimum balance in the three fundamental pillars of sustainability will increase the overall value of a building to the society whilst eliminating waste both in the short and long run such as reduced cost-in-use, for instance. Considering the short term economic benefits will mean selecting projects that are viable and financially competitive whilst considering the long term social and environmental impacts will eliminate waste in the use of the limited available resources.

The next phase of this research project will be the development of an optimum balance index (OBI), a tool that can promote the government sustainability agenda. In effect the index will be capable of being used alongside any non-monetary measure to ensure that the three fundamental pillars of sustainability are considered at the early stage of a development process. To develop this multicriteria tool, initially the relationship that exists between the monetary measures will have to be established. According to the review conducted above, there is often a direct relationship between IC and CIU which implies that an increased upfront expenditure as a result of a better quality design or the use of renewable materials in construction will most times lead to lesser operational and maintenance costs over the entire life of the building and vice versa. However, no known research has been found to date explaining the movement of the equally important ICC in relation to IC and CIU. Establishing the relationship that exists between initial construction cost, cost-in-use and initial carbon cost is therefore another key area where future research work will be providing more insight and making further contribution to the limited existing knowledge.

The new index to be consequently developed will have several other applications due to its versatile component costs. Firstly, it will be useful when assessing bids for building projects where life-cycle assessment is vital such as PFI projects. Secondly, design options selected based on the model would optimise financial return, maximise social benefits and minimise carbon footprint on the environment. Thirdly, the index will make sustainability accounts in every bid when it is adopted, shifting the attention away from the current unsustainable construction practices. The index when used in tender assessment to select the lowest bid will ensure delivering a sustainable development that is financially competitive, yet best value for money. Finally, the optimum balance index will serve as a more holistic approach or system to producing buildings in a sustainable manner. This will in effect contribute to the larger government and/or industry effort of delivering increased value and reduced waste to the society at large both in the immediate future and in the long run.

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