

Development of Sustainability Building Index in Hong Kong

Ir Prof. Peter K. W. Mok
Chairman, Hong Kong Quality Assurance Agency

Abstract In 2007, the Intergovernmental Panel on Climate Change (IPCC) identified the building sector as having the highest emissions and also the highest potential for drastic emission reductions. Urban buildings contribute on average to 30% of energy use in society causing similar levels of associated greenhouse gas emissions. There are many proven ways to reduce the energy use in new and existing buildings but experience shows that this will not happen without the support from policy makers.

The Hong Kong Quality Assurance Agency recommends to develop a Sustainable Building Index for Hong Kong with reference to the latest international standards in sustainability in building construction, UNEP SBCI research papers, green building certification and rating system that commonly adopted in the developed countries and cities. The index is aimed at developing a model for rating the sustainability performance along the life cycle of operating the building. The outcome will facilitate players in the building sector and energy policy makers on energy strategies to understand the interest of investors as well as to promote the sustainable building development in Hong Kong.



Why Needs Sustainable Buildings?

UNEP SBCI (United Nations Environment Programme, Sustainable Buildings & Climate Initiative) revealed that the building sector contributes up to 30% of global annual greenhouse gases emissions and consumes up to 40% of all energy (13). Greenhouse gases emissions mainly come from the operations of buildings along its life cycle where energy is used for heating, cooling, ventilation, lighting and electrical appliances.

The buildings and construction industry is one of the key industries that affects the sustainable development of the community. Variety of stakeholders is engaged in the supply chain of the whole life cycle of buildings. The construction, operation and demolition of buildings generate considerable environmental, social and economic impacts to the society. It may introduce serious negative impacts, in particular on the environment when there is lack of suitable management of buildings along the whole life cycle.

This business sector contributes about 8% of the total employment (8) and normally generates more than 7% of the GDP in Hong Kong (15). It plays an important role for achieving sustainable development in the community and provides the context for social interactions as well as economic development in our daily life. The condition of building may also affect the public health and safety.

At the same time, the built environment accounts for a large share of energy use, waste generation or use of natural resources. Other areas of key concern also include the production of construction materials, consumption of hazardous products, integration of buildings with other infrastructure and social systems, use of freshwater and foul water discharge, etc.

Environmental Performance vs Sustainability Performance of Buildings

Stakeholders in the community become more concerned about the green performance of buildings. To respond to the needs in the society, various green building rating or certification schemes were launched in developed countries and cities to promote and recognize the green performance of buildings in the past decade, such as LEED in the United States (7), BREEAM in the United Kingdom (2), CASBEE in Japan (4), and the Building Environmental Assessment Method (BEAM) in Hong Kong (1). Environmental performance of buildings is the core issue of these schemes. Besides, the UNEP-FI/SBCI'S unveiled the importance for incorporating the social and economic performance in measuring the sustainability performance of buildings (12).

This paper proposes to develop a simple, direct and evidence based rating system to support the establishment of Sustainable Building Index for measuring the sustainability performance of buildings in Hong Kong by referring to the applicable international standards and green building rating or certification schemes regarding the sustainable performance of buildings. The aim of this rating system is to enable the common users of buildings, such as the Property Managers and Owners, to evaluate the sustainability performance of their buildings periodically.

Major References

The research is conducted with reference to several important international standards regarding the sustainability of buildings and social responsibility (9)(10)(11). A comprehensive literature review was conducted to study the relevant research papers from various professional bodies (3)(12)(13). In addition, the common international green building

rating or certification schemes were reviewed to identify the common core of aspects and indicators to be used for measuring the sustainable performance of building (1)(2)(4)(5)(6)(7).

Overview of the Rating Framework

ISO/DIS 26000 states that the sustainable development has three dimensions - economic, social and environmental - which are interdependent. It also provides a definition of sustainable development, i.e. the development that meets the needs of the present without comprising the ability of future generations to meet their own needs (11). ISO/TS 21929-1 and ISO 15392 also concur that the sustainability performance of buildings should be closely linked with environmental, social and economic aspects in its life cycle (9)(10).

We, therefore, adopt the economic, social and environmental as the three core aspects of the proposed rating system. There are several critical issues under each aspect. By reviewing the common international green building rating or certification schemes and UNEP SBCI research papers, we are able to identify the suitable indicators of the respective issues.

When developing and selecting indicators, the starting point is the identification of the needs and expectations of stakeholders and concerns of the public regarding the sustainability performance of buildings. The major stakeholders should include investors and owners, occupants and users of the buildings, and the neighbors around the buildings.

The proposed rating system is focused on measuring the evidences that reflect the environmental, social and economic performance of building along its life cycle. It is not intended to be used for certification of the appropriateness of the operational or engineering issues of buildings. By comparing the performance of respective indicators in a defined period, the Building Owner or Property Managers may evaluate the sustainability performance of their buildings. These results would facilitate the necessary modification or enhancement to the building for improving sustainability.

This rating system is a tentative proposal only. Comments are welcome from readers and the industry for further contribution to other performance indicators.

The Environmental Indicators

The environmental aspects are relevant to the impact to the environment and the consumption of natural resource when operating buildings. By reviewing the international green building rating or certification schemes, we can identify that the "Climate Change", "Biodiversity", and "Use of Natural Resource" are the common issues for measuring the environmental performance of buildings.

By measuring the amount of renewable and non-renewable energy consumed by the building, it is feasible to measure the impact contributing to the issue of Climate Change. The use of harmful chemicals will directly affect the sustainable development of ecosystem that should be included as one of the indicator to measure the building's impact toward Biodiversity. Whereas the consumption of freshwater and renewable resource and the amount of building waste are suitable indicators to measure the building performance in terms of Use of Natural Resources.

With reference of specific geographical and climatological characteristic of Hong Kong, the building may expose to the risk of flooding and typhoon damages, therefore they are included in the performance indicators.

The Social Indicators

There are various concerns in identifying social aspects. Based on the research outcomes, the social performance of buildings is primarily related with issues of "Harmonized Community", "Social Infrastructure" and "Health and Comfort of Users". After the collapse of an aged residential building in Hung Hom in January 2010 (14), there witnessed the awareness of the structural soundness of buildings in particular the aged reinforced concrete buildings and thus it is crucial to include the issue of "safety and security of buildings" as an integral part of social aspects.

The operations of buildings have immense influence on achieving harmonized community. By studying the reactions and responses of neighbors, it is conceivable to evaluate how well of buildings in achieving harmonized community.

Social Infrastructure is closely linked with the accessibility for buildings. The mode of transportation to and from the building relates to convenience of users and may have potential impacts to the environment.

In order to achieve health and comfort for building users, it is essential to evaluate the users' feeling about lighting, thermal, ventilation and acoustics comfort. The quality of air and freshwater is closely connected with the health of building users that there should be regular testing in assessing their performance.

It is fundamentally important to assure building safety. The Owners and Property Managers have to engage authorized competent persons to evaluate the structural soundness and fire safety of buildings. By reviewing the statistical of security issue, we are able to assess the security performance of buildings.

The Economic Indicators

The consideration of economic aspects is closely linked to the areas of "Asset Value" and "Resources for Maintain the Building". The Asset Value of building will directly affect the wealth and investment of the building owners. It is essential to evaluate its value in regular interval by professionals.

The ease of maintenance associates with the whole life cost of buildings. The Building Owners and / or Property Managers should consider applying innovative and effective maintenance method to reduce the maintenance costs. By tracking the expenditures in maintenance, we can make use of these figures to gauge the performance of buildings maintenance.

Measurement Approach

Factual based measurement approach is proposed in defining the status of respective performance indicators. The recommended measurement approach is addressed in table 1. Scoring approach is applied in rating the sustainability performance of buildings to facilitate the benchmarking exercise.

Scoring Method for Individual Performance Indicator

The score for individual performance indicator is determined by comparing the performance figure in a defined time period. The criteria of respective scoring level are shown as follows:

Scoring Level	Criteria
1	The performance datum is yet to be determined.
2	The performance is determined and collected for tracking. However, unstable performance is observed.
3	The performance is determined and collected for tracking. Stable performance is observed.
4	The performance is determined and collected for tracking. Improving performance is observed.

Overall Rating for Sustainability Performance of Buildings

The overall rating for the sustainability performance of buildings is concluded based on the performance of indicators in three aspects. The criteria of overall rating are shown as follows:

Overall Rating	Criteria
1- Preliminary Stage	Unstable performances are observed in any one of the three aspects.
2- Progressing Stage	All issues and data are effectively covered but only stable and improving performances are observed in a particular aspect.
3- Sustainable Stage	All issues and data are effectively covered whereas stable and improving performances are observed in all three aspects.

By analyzing the distribution of the rating score of buildings, it is feasible to establish the Sustainable Building Index of Hong Kong.

Table 1 - Overview of Rating Framework of Sustainability Performance of Buildings

Aspects	Categories	Issues	Performance Indicators	Measureme Approach	
Environmental	Climate change	Reduce Greenhouse Gases emissions	Use of non-renewable energy Use of renewable energy	Trend analysis of reported data Trend analysis of reported data	
	Biodiversity	Enhance ecology in building	Use of harmful chemicals	Trend analysis of reported data	
	Resource use	Reduce water consumption	Use of freshwater	Trend analysis of reported data	
		Reduce materials consumption	Use of renewable resource	Trend analysis of reported data	
		Reduce amount of waste from operating the building	Amount of waste	Trend analysis of reported data	
	Geographical risk	Minimizing climatological risk	Number of incident of flooding Typhoon damages	Trend analysis of reported data	
Social	Security and Safety of Building	Assure the building strength and quality	Comply with legal requirement	Trend analysis of review result by authorized competence person	
		Fire prevention	Comply with legal requirement	Trend analysis of review result by authorized competence person	
		Designing out crime	Number of security incident	Trend analysis of reported data	
	Health and Comfort of Users	Enhance building user comfort	lighting comfort		Trend analysis of survey data of users' feedback
			Thermal comfort		Trend analysis of survey data of users' feedback
			Ventilation conditions		Trend analysis of survey data of users' feedback
			Acoustic comfort		Trend analysis of survey data of users' feedback
	Social infrastructure	Maintain good indoor air quality Assure quality of fresh water	Indoor air quality		Trend analysis of testing result
			Quality of fresh water		Trend analysis of testing result
			Accessible to public services and transportation	Users' satisfaction	Trend analysis of survey data of users' feedback
Harmonized community	Promote harmonized neighborhood relationship	Neighbors' satisfaction	Trend analysis of survey data of users' feedback		
Economic	Whole life cost	Ease of Maintenance	Maintenance cost	Trend analysis of reported data	
	Asset value	Maintain the value of building	Monitoring the value of building	Trend analysis of reported data	

Reference

1. BEAM, *Building Environmental Assessment Method*, HKGBC & BEAM Society, Hong Kong (2010)
2. BREEAM, *the BR Environmental Assessment Method*, BRE Global, United Kingdom (2008)
3. CRISP, *European Thematic Network on Construction and City Related Sustainability Indicator*, (2004)
4. CASBEE, *the Comprehensive Assessment System for Building Environmental efficiency*, Japan Sustainable Building Consortium, Japan (2008)
5. *Green Globes Rating / Certification scheme*, Green Building Initiative, United States of America (2010)
6. *Green Star*, Australian Green Building Council, Australia (2008)
7. LEED, *Leadership in Energy and Environmental Design*, US Green Building Council, United State of America. (2008)
8. *Census and Statistics Department, Hong Kong in Figures*, HKSAR Government (2010)
9. *International Standardization Organization, ISO 15392 Sustainability in Building Construction - General Principles*, ISO Geneva (2008)
10. *International Standardization Organization, ISO/TS 21929 -1 Sustainability in Building Construction - Sustainability Indicators - Part 1: Framework for the Development of Indicators for Buildings*, ISO, Geneva (2006)
11. *International Standardization Organization, ISO/DIS 26000 Guidance on Social Responsibility*, ISO, Geneva (2009)
12. *United Nations Environmental Programme, Sustainable Buildings & Climate Initiative, Finance Initiative, UNEP-FI / SBCI, Financial & Sustainability Metrics Report* (2009)
13. *United Nations Environmental Programme, Sustainable Buildings & Climate Initiative UNEP-SBCI, Buildings and Climate Change, Summary for Decision-Makers* (2009)
14. *屋宇署・九龍土瓜灣馬頭圍第 45 號 J・2010 年 1 月 29 日・樓宇倒塌調查報告 (2010)*・香港特別行政區政府
15. *Hong Kong General Chamber of Commerce, Service Sector in Hong Kong, Statistical Card* (2009)