A Paradigm Shift from Green Buildings to Sustainable Cities: Concept and Future Direction

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Abstract. Green buildings and sustainability have been emerging as a mainstream in the built environment in view of increasing awareness of climate change and environmental impacts arising from construction activities. Literature suggests that most sustainable initiatives focus on greening buildings and spaces. There is a need to review existing green building development to take sustainability goals to the next level. This paper unveils the theoretical concepts and current practice of green buildings and put forward sustainable cities as the future direction of green buildings. With the transformation from green buildings to sustainable cities and communities, social sustainability which has been overlooked in the pursuit of sustainable development can be addressed in a wider context. More concerted effort should be put to advocate a balanced development of the triple bottom line of sustainability to create a more liveable, resilient, inclusive, and sustainable living environment for our future generations. It is envisaged that sustainable cities and communities can reduce the current barriers experienced by green buildings in improving social sustainability and offer more strategic solutions for implementing and realising local and international sustainability goals.

Keywords: Sustainable cities · Sustainable communities · Green buildings · Concept · Future direction

1 Introduction

Climate change and ecological imbalance lead to a more vulnerable position of our planet to a wide range of adverse environmental effects. People have become more concerned about the capacity of our Earth in dealing with harmful impacts brought by greenhouse gas emissions, global warming, pollution, natural resources exploitation, land use, energy use, and waste production. According to United Nations Environment Programme (2016), the building and construction sector accounts for 40% of worldwide energy use, 30% of energy-related greenhouse gas emission, nearly 12% of water

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use, and almost 40% of waste. In addition, the construction industry is also a key sector contributing to approximately 4%–15% of Gross Domestic Products (GDP) of a nation, regardless of developing or developed countries. Such significant contribution of the construction industry has called for more efforts in making the built environment more environmentally responsible and sustainable, thereby promoting and accelerating the achievement of sustainable development goals. Considering the significant economic, environmental and social impacts associated with the construction and property market, the construction industry has a great potential in delivering big cuts of environmental impacts if proper measures are taken (Goh and Rowlinson 2013).

The 17 United Nations Sustainable Development Goals came into force on 1 January 2016. These 17 goals call for actions and efforts by all countries to address the universal need for development and tackle climate change. To be in line with the shift towards the Sustainable Development Goals, the construction industry also needs to examine her agenda and development plans by integrating sustainability into the built environment as well as the urban planning and management system to give more comprehensive solutions for achieving the global sustainability goals.

The advocation of green buildings could give potential reductions of environmental impacts but the transformation of social structure and economic base necessitates a paradigm shift towards a more holistic approach for sustainability. Green buildings have to work and perform collectively, and therefore neighbourhoods, built environment, public transportations, amenities and services are always the keys for improving sustainability performance. Poorly planning and uncontrolled urban development could dampen the progress of green buildings towards sustainability goals with lower resources efficiency, higher ecological impacts and wasteful land use.

Despite a considerable growth of green buildings and upgrading existing buildings with green technologies, there is no widespread implementation of green buildings in developed and developing countries due to challenges such as cost, confusion and low coordination among key agencies, institutional and policy challenges (Balaban and de Oliveira 2017). The achievement of sustainable development goals has necessitated a large urban transformation and a different public management agenda (Balaban and de Oliveira 2017).

To take into consideration a more consistent goal, policy and planning of sustainable development and avoid from reducing sustainability into a mono-faceted concept, this paper put forward sustainable cities and communities as a paradigm shift for green buildings. This paper will examine the context of green buildings by looking into their origin and associated concept, followed by the prevailing green buildings standards and guidelines. The origin and concept of sustainable cities as well as the associated standards and guidelines will be introduced in the next section. The transition from green buildings to sustainable cities will also be discussed with a section explaining the significance of such transition.

2 Green Buildings

Green building appears to be the dominant mechanism in developing the modern construction. Green buildings can be applied in any type and form of building structure, whether they are residential, commercial, educational institution, hospital, hotel buildings and they can be either new construction or retrofitting existing buildings. The concept of green building is often linked to sustainability and some used it interchangeably with "sustainable buildings". Although there are some common elements between green buildings and sustainable buildings, they should not be treated as the same. As advocated by Pan and Ning (2015), green embodies a part of being sustainable in which social issues, economic consideration, cultural perception and adaptability are primarily taken into consideration of sustainability.

2.1 Origin and Concept

The concept of green buildings has been widely promoted in the construction industry. There are a wide array of definitions of green buildings and extensive debates sparked in determining the best definition for green buildings. Different countries and regions tend to shape the meaning and approach to green buildings differently since there are considerations for their unique climate conditions, resource availability, geographical condition, cultural background and broad-scale environmental, social and economic factors. As defined by the United States Environmental Protection Agency (EPA) (2016), green building is "the practice of creating structures and adopting processes that are environmentally responsible and resource-efficient throughout a building life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction". It differs from what the traditional building design and construction method which normally gives more concerns of economy, utility, durability and comfort (EPA 2016).

Green building promotes the principle of construction in harmony with the natural environment and this practice in fact can be traced back to the millennia where constructors in the ancient times made use of local and natural elements such as wind, water, sun and soil in designing and determining the integrity and performance of their building structures (GBCA 2010). This consideration was however neglected and people went the reverse side of the principle in construction over time.

The earliest contemporary green building in U.S. arose out of the need and desire for more energy efficient and environmentally friendly building practice, in view of the oil price increases in 1970s (EPA 2016). It began to be more formal in the 1990s with a few milestones such as the formation of the Committee on the Environment in 1989, Energy Star Programme in 1992, the first local green building programme in Austin in 1992, the formation of U.S. Green Building Council (USGBC) and the Version 1.0 pilot programme of Leadership in Energy and Environmental Design (LEED) in 1998 (EPA 2016).

In the United Kingdom, Association for Environment Conscious Building (AECB) was founded by Keith and Sally in 1989, following their concern about the use of unsustainable tropical timber in the UK construction industry. AECM is a network of individuals, students, educational establishments and companies to increase awareness

within the construction industry of the need to respect the environment and to develop, share and promote best practise in environmentally sustainable built environment (AECB n.d.). Building Research Development (BRE) which was formed in 1921 founded BREEAM standard in 1990 with industry collaboration to provide a model for the benchmarking of development and communities in sustainable construction, property, and infrastructure.

In Australia, the momentum of the green building movement was gained after the Sydney Olympics in 2000 received global recognition as the "Green Games" (GBCA 2010). Green Building Council of Australia was launched in 2002 and its green building rating system – Green Star was established in 2003. Meanwhile, China started her movement towards green in September 2004 with the launch of Green Building Innovation Award and the Evaluation Standard for Green Buildings (GB/R5-378-2006) was officially promulgated in June 2006 (Ding et al. 2018; Li et al. 2014). The other Asian countries also joined the green building movement by establishing their certification systems with considerations of local characteristics such as climate, culture and regional resources.

As green building evolved in response to energy crises, the emphasis of green buildings is often on energy saving and energy efficiency, although considerations are also given to the aspects of water use, indoor environmental quality, material selection and building's effect on site to mitigating the harmful impacts. To ensure buildings are designed, constructed and operated in a manner that reduces negative impacts and enhances positive effects on natural environment and surroundings, green features from using low embodied carbon materials to energy efficient equipment and passive design are recommended to be introduced in the very beginning of the construction process. These green features are incorporated into buildings and structure to provide safer, healthier and more comfortable interior environments to users.

2.2 Standards and Guideline

Considering the rise of green buildings, there is proliferation of green building standards and certification systems in the marketplace to assess and rate the attributes of a green building or structure. Construction stakeholders need a third-party green credential to enable the interested investors as well as general public to easily understand the minimal design, construction and operation requirements of a green building. The green building standards and certification systems set criteria to provide a more reliable, structured and systematic way in measuring the progress and the extent to which a green building meets the green expectations (Goh and Rowlinson 2013). Accredited and licensed assessors will undertake a checking to evaluate the assessed building performance against the standards and its benchmarks. A single score will be given after taking into account their attainment in the designed rating scheme (Goh and Rowlinson 2013).

Building Research Establishment Environmental Assessment Method (BREEAM) which is the first sustainability assessment method for buildings was launched in 1990. Being the first sustainable building assessment scheme, it brings profound impacts on the development of other green building evaluation systems. Hong Kong developed her local green building rating standard - Building Environmental Assessment Method

(BEAM) in 1996 based on the UK BREEAM. Meanwhile, USGBC unveiled LEED in 2000 to provide green guideline for building design, construction, operations and maintenance in United States. There is a growing number of regional and international green building rating tools emerged thereafter to assist the delivery of green buildings in different areas to suit their different local requirements and climate conditions. Table 1 shows some green building certification standards that are widely used in different countries and regions.

Table 1. Green buildings assessment standards commonly used in different countries and regions

Countries/regions	Green buildings assessment standards
United Kingdom	BREEAM
United States	LEED, Energy Star, Green Globes, ASHRAE Green Guide
China	Three Star, Evaluation Standard of Green Building (ESGB), LEED
Canada	Building Owners and Managers Association's Building Environmental Standards (BOMA BESt), R-2000, LEED Canada
Russia	BREEAM, LEED
Germany	DGNB
Australia	Green Star
Hong Kong	BEAM Plus, LEED
Japan	Comprehensive Assessment System for Built Environment Efficiency (CASBEE), DBJ Green Building Certification program
Korea	Korea Green Building Certification, Green Standard for Energy and Environmental Design (G-SEED), LEED
Singapore	Green Mark; Singapore Green Building Product
Malaysia	Green Building Index, GreenRE

Apart from regional green building councils and sustainability professional bodies, International Organisations for Standardisation (ISO) and American National Standards Institute (ANSI) also published related standards for sustainability in buildings and construction such as ISO 21929-1:2011, ISO 21930:2017, ISO 15392:2008 and etc. At the same time, there are also supporting standards and regulatory codes developed by local authorities and government for accomplishing the local and global green buildings goals. These include Green Building Codes and Standards in US, Code for Sustainable Homes in UK and Green Building Action Plan in China.

These green building standards and guideline are quite similar to a large extent, although they differ in the level of details to be addressed. They generally cover six major themes: siting and site selection, energy efficiency, water efficiency, materials and resources, indoor environmental quality, and innovation. Social aspects of green buildings involve urban sprawl, mixed land use, health and comfort of users, access to basic services, barrier-free use for all kinds of users, availability of public transport, green and open spaces, protection of cultural heritage, safety, noise and air quality (Häkkinen 2007).

Green buildings give predominantly focus on the environmental aspect in which other dimensions especially social sustainability is greatly overlooked (Retzlaff 2008; Zuo and Zhao 2014). Although recent development in green buildings reflects some changes by giving more recognition towards social and economic sustainability (Zuo and Zhao 2014), there are still challenges in balancing the sustainability focus in implementing triple bottom line. This could be due to the inherent limitations associated with the building context for shaping sustainability strategies. As held by Häkkinen (2007), socio-economic aspects of buildings are generally more relevant on a community level than on a building level. Due to the complex nature of sustainability, building-centric frameworks cannot adequately support sustainable development and a move towards neighbourhood-scale assessment and a more holistic approach to sustainability is critical (Sullivan et al. 2014).

3 Sustainable Cities and Communities

According to United Nations Development Programme (2018), two third of the world population will live in urban areas by 2050 and transforming the way to build urban spaces is necessitated. Rapid and unplanned urbanization poses tremendous challenges and exerts pressures on resources usage, energy demand, living environment quality, fresh water supplies, sewage, waste and public health. Campbell (1996) held that conflicts among the goals of protecting the green environment, promoting the economic growth and advocating social justice are neither superficial nor conceptual notions but a leitmotif in the contemporary battles in both cities and rural areas that go to the historic core of planning. This view is supported by Shen et al. (2011) who also deemed that rapid urbanisation is often at the expenses of the loss of valuable ecosystems and lands for development demands and serious problems are expected if the same resource consumption process in the current and future urban areas continues.

Sustainable development is a holistic approach focusing on balanced development between three pillars: environment, economy and society. It is related to the delivery of long term development by fulfilling both current and future needs in aspects of ecological conservation, social inclusivity and economic benefits (Goh and Rowlinson 2016). To demonstrate the goals of sustainable development, it is essential for construction stakeholders to work beyond the individual building block by entailing sustainable planning and design principles in the early stage of buildings such as planning and feasibilities study. Therefore, sustainable cities and communities come into play by integrating the sustainability concept at both the building and urban scales for creating a more resilient and liveable place.

3.1 Origin and Concepts

According to United Nations (2013), the idea of sustainable cities has been discussed since early 1990s and the first approximation to sustainable city was reflected in the 1992 Rio de Janiero Conference on Environment and Development and Agenda 21 in the United Nations Conference on Environment and Development, although lack of explicit explanation. The context of sustainability cities was then comprehensively

discussed in 2002 in the United Nations Human Settlements Programme (UN-HABITAT) in Nairobi and the discussion affirmed that addressing economic, social, environmental and governance issues was integral to creating sustainable cities (United Nations 2013).

Sustainable cities encompass the integration of four pillars: social development, economic development, environmental management and urban governance (United Nations 2013). Similarly, Shen et al. (2011) also stated that sustainable city is a desirable state of the principle of sustainable urbanisation which refers equal concern to environmental, governance, social and economic sustainability.

The mission of sustainable cities and communities could be better attained by embracing sustainability principles in the urban design and planning. It is worth noting that the application of urban design covers not only urban areas but also neighbourhood, town, subregion and rural areas (UrbanDesign.org, n.d.). Urban design is a process of giving form, shape, character to groups of buildings, neighbourhoods and city by drawing strands of place-making, environmental stewardship, social equity and economic viability together into the creation of places with their unique beauty and identity (UrbanDesign.org, n.d.). In view of that, sustainable cities and communities should not also be limited to application of cities but also neighbourhood, town, suburb and rural areas where development and human settlement are involved.

3.2 Standards and Guideline

The vision for sustainable cities and communities is greatly stressed by the United Nations by incorporating it as Goal 11 in the 17 Sustainable Development Goals. Figure 1 lists the targets highlighted in the Goal 11 by the United Nations. It is important to note that the targets of Goal 11 are set for all levels of society including those in vulnerable conditions, women, children, people with disabilities and elderly.

Numerous green buildings standards and certification systems have extended their consideration beyond the building level. The green metrics adopted in green building assessments are broadened to the sustainable cities and neighbourhood standards. USGBC developed LEED Neighbourhood Development scheme and LEED Cities and Communities to integrate the principles of smart growth, new urbanism and green buildings. Meanwhile, BRE also includes sustainable design into the master planning of new communities or regeneration projects by providing the standard of BREEAM Communities. The BREEAM Communities Standard is a framework to support master planners, local authorities, developers, investors and communities to embed sustainable development goal from the outset before embarking on procurement, detailed building level design and construction.

The development of sustainable cities standards also brings an evolution to Asian countries and cities such as Japan, Hong Kong and Malaysia. CASBEE developed two schemes, i.e. “CASBEE for Cities” and “CASBEE for Urban Development” for assessing environmental performance of building conglomeration and Built Environment Efficiency of cities. Hong Kong Green Building Council launched BEAM Plus Neighbourhood version 1.0 in 2016 for embracing socio-economic elements and sustainability issues at the early or master planning stage of a project. Malaysia has also introduced Green Building Index Assessment Criteria for Township in June 2017 for

Goal 11 Targets:

- Ensure access to adequate, safe and affordable housing and basic services
- Provide access to safe, affordable, accessible and sustainable transport systems
- Enhance inclusive and sustainable urbanisation and capacity for participatory, integrated and sustainable human settlement planning and management
- Strengthen efforts to protect and safeguard the cultural and natural heritage
- Reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to gross domestic product due to disasters
- Reduce the adverse per capita environmental impact of cities (air quality, municipal and other waste management)
- Provide universal access to safe, inclusive and accessible, green and public spaces
- Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning
- Increase substantially the number of cities and human settlements that adopt and implement integrated policies and plans towards inclusion, resource efficiency, mitigation and adaption to climate change, resilience to disasters and holistic disaster risk management at all levels
- Support least developed countries/regions in constructing sustainable and resilient buildings by utilising local materials

Fig. 1. Targets highlighted in the goal 11 of the 17 sustainable development goals (adopted from United Nations Development Programme 2018)

creating liveable places that meet the diverse needs of the community, both existing and future communities.

In examining those sustainable neighbourhood rating standards, social sustainability is often the key dimension for measuring the sustainable urban performance. For instance, LEED Cities and Communities include aspects of energy, water, waste, transportation, human experience, accessibilities, equitability, prosperity, and health and safety (USGBC, n.d.), while LEED v4 for Neighbourhood Development employs five categories in assessing neighbourhood development projects: 1) smart location and linkage, 2) neighbourhood pattern and design, 3) green infrastructure and building, 4) innovation, and 5) regional priority (USGBC 2018).

4 Transition from Green Buildings to Sustainable Cities

The transition to sustainable cities is an evolving process from green buildings. Sustainability would be fully realized by expanding the scale of applications from the project site or building level to the master planning at metropolitan and regional levels. Climate change increases the exposure and vulnerability of our environment to natural disasters and devastating hazards such as hurricanes, floods, and landslides and it requires more international and regional planners to consider it in the urban design and management patterns. A wide implementation of green buildings may still fail to fulfil the sustainable development goals if there is no infrastructure system supporting its delivery in the surrounding. It is essential to create the synergic interaction between

buildings and buildings, buildings and people, and people and people, by expanding the sustainability implementation from the building level to the neighbourhood, town and city level.

4.1 Why Does the Transition Matter?

Sustainability is an overarching notion that no longer considers only environmental and ecological concerns but also economic and social dimensions. However, little attention has been given to social sustainability in most sustainable and green efforts. Apart from the physical form of the built environment, urban form would bring direct impacts to the attainment of social sustainability. Social equity, accessibility, social inclusion, social cohesion, safety and security are the underlying principles of social sustainability and their manifestation requires wider macro factors in urban and neighbourhood planning. Dempsey et al. (2009) pointed out that urban forms such as density, layout and extent of mixed land uses in street or neighbourhood facilitate social interaction and the level of accessibility may also have influences on social coherence and community participation. The change of green assessment systems at the building-level by including site-level and community-level issues may lead to more significant collaboration between various actors in the building development process, hence promoting communication across disciplinary boundaries and interconnections across scales and issues (Retzlaff 2008). It is clear that the transition to sustainable cities and communities is indispensable in contributing to more comprehensive strategies for sustainability.

As highlighted by Tae and Shin (2009), a transition from existing green building certification systems to assessments that considers eco-friendly building performance at the level of the entire region and city is necessitated. They further asserted that the myriad sustainable efforts should surpass regional and national undertakings by having international alliance of sustainable networking system. This is in line with Retzlaff (2008)'s viewpoint that sustainability cannot be attained solely by comparing buildings to benchmarks in which these assessments should be reframed to focus on outputs that are consistent with planning and community goals, rather than focusing on inputs to buildings. He added that many green building assessment systems take a relatively limited view of sustainability and they focus on physical instead of social or economic measures even if some social and economic aspects are considered. A broader range of concerns of sustainability issues such as equity, regionalism, and economic issues are found missing from many existing green building assessments (Retzlaff 2008). Goh and Rowlinson (2013) also found that relatively few sustainability assessment tools in the market consider the features of triple bottom line, with an overly emphasis on environmental protection.

As a result, the significance of building sustainable cities is increasingly appreciated in order to integrate the concerns on environmental protection, economic equity and social wellbeing into urban development plans (Shen et al. 2011). An increasing number of sustainability initiatives demand for an integrated and synergic urban planning and management in the green movement. The significance of sustainable cities is also acknowledged by various international organisations such as United Nations, World Bank, OECD, WHO and European Commission by including it in their

missions or visions. To building sustainable communities, cities should be designed and planned to be more inclusive, fair, safe, and resilient. Building spaces and structure should be designed to provide accessibility to reach all levels of communities such as elderly, disabled, wheelchair users, and children and encourage more public participation, equity and locality.

5 Conclusion

Sustainability is a holistic concept which examines the "big picture" of the project long-term development. The majority of existing sustainability efforts draw heavily on green buildings that give more environmental concern and lack consideration for social and economic sustainability. The delivery of sustainability goals is necessary to consider development at the macro scale by incorporating the sustainability principles into the urban and city planning, moving it beyond the individual building level.

The transformation to sustainable cities could be assisted by deploying life enhancing information, communication and technology. The development of smart and innovative technologies could create more optimised solutions and modelling for energy use, human comfort level, accessibility, social equity, and etc. The vision of sustainable cities and communities is to make the arrangement of buildings, public realms, transport system, services and amenities more viable, participatory, inclusive and self-sustaining. It is envisaged that sustainable cities and communities could reduce the current development barriers experienced by green buildings and offer more strategic solutions for implementing and realising the local and international sustainability goals.

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