Key Research Agenda on Sustainable Construction

1. Evolution of Sustainable Development and Sustainable Construction

2. Key Research Agenda on Sustainable Construction

3. Concluding remarks
Early concerns on sustainable and environmental issues

Towards the end of 1950s, people began to recognise that technology and economic growth were not always positive and that they could have tragic side-effects (pollution and a steady reduction of resources)

1968| **Biosphere** The Intergovernmental Conference for Rational Use and Conservation of the Biosphere (UNESCO) raised first time the concept of ecologically sustainable development

1969| **Friends of the Earth** formed as a pleading organization to promote the prevention of environment, the preservation of diversity, and the participation of citizens in decision-making
If present growth trends continued unchanged, a limit to the growth would be reached sometime within the next 100 years.

Five major concerns: accelerating industrialization, rapid population growth, widespread malnutrition, depletion of non-renewable resources, and a deteriorating environment.
Sustainable Development:

“development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

(The Bruntland Report) (by the Prime Minister of Norway, Mrs Gro Harlem Bruntland)
Earth Summit – 1992

Agenda 21 produced at UN Conference Earth Summit, in Rio de Janeiro, June 14, 1992, where 178 governments voted to adopt the programme.

In 1997, the UN held a special session to review five years of progress on the implementation of Agenda 21 (Rio +5).

Rio+5 – 1997

Kyoto Protocol – 2005

An UN Framework Convention on Climate Change: combating global warming, adopted on 11 December 1997 in Kyoto, Japan

Enforced on 16 February 2005

184 states have signed as of October 2009

The most notable non-member of the Protocol is the USA

Pleading for sustainable practice in all activities
Figure 2  Construction management with four dimensions

Shen L Y (1993)
Environmental concerns in construction

• Increase in land consumption by removal of green areas, destruction of forest, reclamation of coastal areas, cutting and/or filling of slopes

• The extraction of non-renewable fossil fuels and minerals for construction and related usage

• The continuing and extending consumption on the generic resources, namely, energy, water, materials and land

• Construction activities produce substantial volume of solid wastes

• Pollution of construction activities on air, land and water
What is Sustainable Construction?

Economic performance

Social contribution

Environmental protection

Triple bottom line approach
*Kibert 1994*
Sustainable construction refers to construction activities whose negative impacts are minimized and positive impacts maximised so as to achieve a balance in terms of environmental, economic and social performance.
Key Research Agenda on Sustainable Construction

1. Sustainable urbanization
2. Project sustainability assessment
3. Comparison on sustainable construction methods
4. Green building
5. Waste management
6. .........
Urbanization: benefits

- Accommodating for population growth
- Improvement of living standard
  - Convenient transportation
  - Educational facilities
  - Health facilities
- Social integration and participation
- Promotion for economic activities
Urbanization: adverse effects

- Pollution
- Unemployment
- Crime
- etc...

Pleading for the balance between economic, social and environmental performance in the process of urbanization – sustainable urbanization
What is sustainable urbanization?

• ... is a dynamic process that combines environmental, social, economic and political-institutional sustainability (UN-HABITAT, 2004)

• How do we know whether it is sustainable urbanization?
  • development of sustainable urbanization indicators for guiding the practice
IUSIL Categories under 4 Pillars

ENVIRONMENTAL
- Geographically balanced settlements
- Freshwater
- Wastewater
- Quality of ambient air and atmosphere
- Noise pollution
- Sustainable land use
- Waste generation and management
- Effective and environmentally sound transportation systems
- Mechanisms to prepare and implement environmental plans
- Biodiversity

ECONOMIC
- Consumption and production patterns
- Economic development
- Finance
- Water
- Strengthen small and microenterprises

SOCIAL
- Energy access
- Water access
- Education
- Health
- Safety
- Fire & emergency response
- Poverty
- Transportation
- Natural hazards
- Adequate housing
- Shelter
- Security of tenure
- Access to credit
- Access to land
- Promote social integration
- Culture
- Recreation
- Availability of public green areas

GOVERNANCE
- Participation and civic engagement
- Transparent, accountable and efficient governance
- Government
- Sustainable management of the authorities
Social

Not Included
Similar
Included
Remarks

• Significant difference exists in practising sustainable urbanization in different cities/regions.

• The attempt proposing a set of indicators and objectives to be applied indistinctly in all cities can be arguable.

• Sharing experiences generated from different practices can lead to the maturity of sustainable urbanization as a common practice – identification of best practice.
Current practice of project assessment

- Economic performance
- Social performance
- Environmental performance

- 87 reports surveyed
  - 29 residential projects
  - 27 public-sector projects
  - 20 industrial projects
  - 11 commercial projects
Factors in the current project assessment

18 Economic performance factors, e.g.,
1. Demand and supply analysis (size, scope and structure)
2. Market forecast (price, sales, population)
3. Project function and capacity

10 Social performance factors, e.g.,
1. Influence to the local development (raising living standards)
2. Provision capacity for employment
3. Provision capacity for public services (shopping, education, ..)

10 Environmental performance factors, e.g.,
1. Ecological impacts of project
2. Air pollution impacts
3. Water pollution impacts
4. Noise assessment
Remarks

• Overall, limited application across all three categories of assessment factors

• More emphasis given to economic assessment for assessing residential, commercial and industrial projects

• Better emphasis given to environmental and social aspects in assessing public and industrial projects

• Lack of methods to integrate the assessments on economic, environmental and social aspects

• Need for a new methodology for project feasibility study – sustainability performance assessment
Key Assessment Indicators (KAIs) for Assessing Sustainability of Infrastructure Projects

• Infrastructure projects play major roles in economic, social and environmental activities particularly in developing countries.

• Their sustainability performance should be properly assessed when considering implementation.

• There is a need for a set of key assessment indicators (KAIs) for assessing sustainability of infrastructure project.
The KAIs for measuring the sustainability of infrastructure project
# Example of application of KAI

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<th>Group</th>
<th>Indicator</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
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</table>
• What are sustainable construction (SC) methods?
• How effective are these SC methods?
• How to measure their effectiveness?
Major sustainable construction methods

$M_1$ Education and training
$M_2$ Standard environmental management system
$M_3$ Green technology
$M_4$ Green design
$M_5$ Green procurement
$M_6$ Green roof
$M_7$ Lean construction
$M_8$ Prefabrication
$M_9$ Waste management
How to understand the effectiveness of SC?
- performance indicators

1. Waste reduction
2. Air pollution control
3. Energy saving
4. Noise pollution control
5. Water pollution control
6. Material recycling
7. Quality and safety
8. Flora and fauna protection
9. Cost saving
10. Time saving
<table>
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<td>2) Air pollution control</td>
<td>2) Cost saving</td>
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<td>3) Energy saving</td>
<td>3) Energy saving</td>
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<td>4) Noise pollution control</td>
<td>4) Time saving</td>
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<td>5) Water pollution control</td>
<td>5) Air pollution control</td>
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<tr>
<td>6) Material recycling</td>
<td>6) Waste reduction</td>
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<td>7) Quality and safety</td>
<td>7) Water pollution control</td>
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<td>8) Flora and fauna protection</td>
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<td>9) Cost saving</td>
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<td>10) Time saving</td>
<td>10) Flora and fauna protection</td>
</tr>
</tbody>
</table>
Remarks

1. Different sustainable construction methods perform differently

2. The differences exist between different counties or regions as the places have different backgrounds
   - In Hong Kong construction industry, waste reduction is a major performance indicator in applying SC methods, followed by air pollution control and energy savings.
   - In Malaysia construction industry, quality and safety is a major performance indicator in applying SC methods, followed by cost and energy saving

3. The preliminary findings provide valuable references when SC methods are to be chosen for specific projects where different procurements are adopted – a current study
**What is a Green or Sustainable Building?**

A high-performance property that considers and reduces its impact on the environment and human health (Yudelson 2008).

Healthy facilities designed and built in a resource-efficient manner, using ecologically based principles (Kibert 2008)

What are the typical green features ?……
Effective measures for promoting green building

• Proper financial assessment

  • Proper “green” standards needs to be established by incorporating the impacts of green design and construction on profitability.

  • This will assure the ability to complete projects on specifications, namely, time, cost, quality, safety, environmental performance

Effective measures for promoting green building

- Complying with standard certifications (e.g. HK-BEAM, BREEAM, LEED)
- Tax exemptions of the gross floor areas for green application
- Collaboration with subcontractors and consultants
- Review on the practice of implementing green building, identify the defects/weaknesses, thus the action for improvement
- Lack of consideration on the issues more than environmental performance during construction, such as quality, cost, safety, time – **sustainable building: A new approach needed for assessing effectiveness of sustainable building – a current study**
Construction & demolition waste - A challenging issue

USA: about 29% of solid waste is from the construction sector;

UK: construction waste contributes more than 50% of the overall landfill volume, 70 million tons of C&D waste is discarded annually;

Australia: the construction activity generated about 20~30% of all wastes entering landfills;

Hong Kong: about 21% of the solid waste comes from the construction;

China: accounting for 29% of the world’s municipal solid waste; in which construction contributes for nearly 40%;
Methods for implementing waste management strategies

- Imposing government legislation
- Design for waste reduction
- Application of low-waste technologies
- Effective waste management procedures on site
- Training and education for C&D waste management
- Promoting C&D waste recycling and reuse
- Effective landfill charging scheme
- How to choose waste management methods?
How to choose waste management methods?

A methodology is needed for diagnosing the effectiveness of waste management practice, thus actions can be identified for improvement.

The diagnosis results can also provide information for choosing effective waste management methods for different types of projects when different procurement systems are adopted.
Concluding Remarks

• Although there are a range of interpretations of sustainable construction, there is a general agreement that the uncontrolled exploitation of natural resources for construction is harmful to the earth and counterproductive to the continuity of humankind.

• There is a need of passion in promoting sustainable construction.

• Solutions must be found to ensure that the development of construction projects particularly those large infrastructure projects can contribute in balance to economic, social and environmental dimensions.

• The promotion of sustainable development presents great challenge to the current practice in construction: such as urbanization, competition practice, procurement systems, project feasibility study methodology. There is a urgent need for reforms in these practices, and strategies for the reforms must be effective.