Applied Research Areas in Construction Innovations:
Sustainable Construction Initiatives Leading to Long Term Overall Life Cycle Cost Benefits

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Scope of Presentation

- Project Life Cycle
- The role of information in FM
- Sustainable Construction Initiatives Leading to Long Term Overall Life Cycle Cost Benefits: A Research Focus on IBS and Green Technology
THE PROJECT LIFE CYCLE APPROACH

CONSTRUCT IT MODEL (2000)

FM related activities 78%
Benchmark on PFI Project in UK

Boussabaine (2004)
Asset Life Cycle Behaviours

• Two key parameters:
  – Functionality
  – Utilization

  Function $\rightarrow$ Obsolescence $\rightarrow$ Upgrade

  Use $\rightarrow$ Deterioration $\rightarrow$ Maintenance

  $\rightarrow$ Demolition
MAINTENANCE
Classification of maintenance regimes (Boussabaine, Kirkham, 2004)
Maintenance whole Life-cycle cost

- Building Maintenance whole Life-cycle cost
- Engineering Maintenance whole Life-cycle cost
- External works maintenance whole Life-cycle cost

Maintenance provisions in buildings (Boussabaine, Kirkham, 2004)
• Concept of Facilities Management
• FM within construction industry
FM ACTIVITIES

Handover (Design and Build from AEC)

Facilities Management

Maintenance Management

- Maintenance (defect liability period)
- Maintenance (after defect liability period)

Property Management

Business support services

(Hamid, 2004)
Contribution to GDP

In Malaysia the construction sector growth at 5.3% in 2007 and contributed 2.1% total Gross Domestic Product (GDP) of Malaysia (CIDB, 2008).

The contribution to GDP would be much higher if one considers input from the whole supply chain activities of construction from design to Facilities Management.
• The role of information in FM
• FM concept in information sharing
• Significance of FM information
APPROACH OF FM

Facilities Management

Design, build and construction of project

Handover of construction project from Contractor (Design and Build from AEC)

Design and construction related activities

Maintenance Management

Property Management

Business primary support objectives to organisation

Construction related information

Useful Information passed to organisation to perform its function within two aspects of FM

Bridging the gap

Aspect FM 1

Aspect FM 2

(Hamid, 2004)
CURRENT DATA EXCHANGE

Building owner

Developer

Users

Facility manager

Quantity surveyor

Contractors

Architect

Product manufacturers

Information providers

Government agencies

Engineer

Building certifier

(Mitchell, 1999)
Construction and FM Paradigms (CFM, 2004)
Key Tasks/Activities:
- Develop tender specifications
- Ascertain bills of quantity
- Put up invitation to tender
- Submission of tender
- Evaluation of proposals
- Award of tender
- Drawing up contracts and liabilities

Obtain various permits (e.g., factory permits, work permits etc.)
- Mobilisation of resources
- Construction
- Project management

Maintain 1-year defect liability and structural defect liability
- Carry out remedial work
- Maintenance management
- Property management
- Services operation

**Improve Communication Through Procurement**
Imperative

- Need accurate, timely, data
- Lots of it!
FM in the Malaysian Perspective

• Although FM is prominent in Western Europe, US and Japan, it is still a relatively new concept in Malaysia (Omar, 2004; Hamid, 2004; CIDB, 2001).

• Like other countries in South East Asia, Malaysia shares a similar approach to FM. There is limited understanding and practice of FM benchmarking in the South East Asian (Moore et al., 2004) region.

• Whilst the Asian region in general continues to suffer from a property overhang in most sectors, the cost of occupying, servicing and maintaining space continues to generally represent a high cost in business terms for both owners and occupiers, and hence demands a level of understanding, operation and management (Moore et al., 2004).
Sustainability and Green Construction through Industrialised Building System (IBS) in the Malaysian Construction Industry: A Research Initiative

Zuhairi Abd. Hamid, Kamarul Anuar Mohamad Kamar, Charles Egbu, Mohamad Arif, Khairolden Ghani,
What is sustainability and why is it important?
The United Nations Brundtland Commission Report (1987) defined sustainable development and urged the world to take note: “Sustainable development is that which meets the needs of the present without compromising the ability of future generations to meet their own needs.” A growing global population is straining the finite resources available on the planet. Sustainability seeks to balance the economic, social, and environmental impacts, recognizing that population growth will continue. Sustainable development brings this evaluation to the design and construction industries, which have significant potential to reduce the negative impact of human activities on the environment.
Sustainable issues in construction industry:

• Influx of foreign workers (600,000 over 800,000 total workforce, CIDB, 2007). Social and economy impact??
• Environmental sustainability ???
• 30-40 % of natural resources were exploited by building industry
• 50 % energy used for cooling and heating in buildings
• Almost 40% of the world’s consumption of materials converts to the built environment
• 30% of energy use is due to housing
Is precast concrete a green building material?

Precast concrete contributes to green building practices in significant ways. The low water-cement ratios possible with precast concrete -0.36 to 0.38- mean it can be extremely durable. The thermal mass of concrete allows shifting of heating and cooling loads in a structure to help reduce mechanical-system requirements. Because precast concrete is factory-made, there is little waste created in the plant (most plants employ exact-batching technologies) and it reduces construction waste and debris on site, reducing construction IAQ concerns. The load-carrying capacities, optimized cross sections, and long spans possible with precast concrete members help eliminate redundant members, and concrete readily accommodates recycled content.

Source: Midway-Atlantic Precast Association
How does precast concrete contribute to the underlying sustainability concept of “Reduce, Reuse, Recycle”? 

By reducing the amount of materials and the toxicity of waste materials. Precast concrete can be designed to optimize (lessen) the amount of concrete used in a structure or element.

As one example, the use of carbon-fiber reinforcement or insulation can reduce:

- Amount of concrete needed in a precast concrete panel
- Weight of a precast concrete panel
- Transportation cost of precast concrete panel
- Amount of energy used to erect a precast concrete panel

Precast concrete generates low amounts of waste with low toxicity.

- 2% of the concrete at a precast plant is waste
- 95% of the waste is used to manufacture new panels
- By reusing products and containers and repairing what can be reused
- Precast concrete panels can be reused when buildings are expanded or dismantled
- Concrete pieces from demolished structures can be reused to protect shorelines
- Wood or fiberglass formwork used to make precast concrete products is generally reused 40 or more times
- Concrete and steel have practically unlimited service lives
- By recycling as much as possible, including buying products with recycled content
- Industrial wastes (fly ash, slag, and silica fume) can be used as partial replacements for cement
- Wood and steel forms are recycled when they become worn or obsolete
- Virtually all reinforcing steel is made from recycled steel
- Insulation contains partially recycled material
- Concrete in most urban areas is recycled as fill or road base

Source: Midway-Atlantic Precast Association
Potential Role of IBS in Green Construction & Sustainability

- Sustainability from Controlled Production Environment
- IBS & Waste Reduction
- IBS & Building Materials
- IBS & Logistics
- IBS & Economic Sustainability
What is Green Technology

Green Technology & Opportunities

Energy & Technology
- Solar power
- Wind power
- Energy Storage & Transportation

Building
- Design
- Construction
- Building Materials

Public Sector & Utilities
- Planning
- Energy
- Water
GBI

• Developed by Association of Consulting Engineers Malaysia (ACEM) and Pertubuhan Arkitek Malaysia (PAM) to promote sustainability in Built Environment

• Six (6) key criteria including energy efficiency, indoor environment quality, sustainable site planning, material and resources, water efficiency and innovation
GBI Incentives

- Stamp duty exemption for buyers of buildings with Green Building Index Certificates

- Tax exemption equivalent to the additional capital expenditure to obtain Green Building index certificates from October 24 this year to 31st December 2014
Sustainability and Control Production in IBS

- IBS offers a controlled manufacturing environment with the ability to reach difficult nooks and corners, which are often inaccessible in regular in-situ construction.

- With the availability of production tools, and permanent jigs and fixtures, it is easier to control the workmanship of construction, ensuring a tighter construction resulting in lot lesser energy losses due to leakages (thermal leakage)
• IBS traditionally has been known to minimize waste, with the ability to reuse material from one module or product into another, the sustainability agenda is supported through its use.

• However, several aspects of planning both in terms of materials management and production management have to be monitored in order to achieve the waste minimization benefits promised by IBS.
Sustainability and Control Production in IBS continued

• Several pre-fabricated technologies such as Structural Insulated Panels (SIPS) etc offer great potential in terms of fabrication of more energy efficient buildings.

• However, if appropriate process control and planning are not implemented these potential benefits could be lost due to expensive on-site assembly processes.

• Therefore, it is important that the advent of new technologies should be accompanied by proper process design for on-site assembly.
• Some estimates recently have put the amount of environmental impact from material transportation activities to be one-third of total environmental impact on the entire construction process.

• IBS offers another benefit, and that is the ability to order in large quantities thus reducing the number of trips to be taken. Despite this potential benefit, it is important that a detailed material transportation and logistics plan be put in place.
Way Forward

• A budget for green construction and sustainability
• A portion of the budget will be used to study the link between IBS and issue of sustainability and green construction
• Local collaborators (Universities, Research Institute local and international) to work collaboratively
• Collaboration from industry players is sought for information and data collection
• Support from association/organisation related construction is needed (ACEM, IEM, PAM)
Research Agenda for Sustainability and Green

1. To investigate the main issues in green construction and sustainability
2. To ascertain and document the roles and contributions of IBS
3. To document the major drivers and challenges associated with implementing green construction and sustainability
4. To explore cases where green construction and sustainability issues are integral to IBS
5. To determine and document the main factors (Critical Success Factors)
6. To develop and validate a framework for better understanding
7. To disseminate findings widely through industry and academic communication
Research Deliveries

- A Document that signify the role and contributions of IBS to green construction

- A framework which indicates IBS contribution to green construction and sustainable development

- A training material (or continuing professional development purposes) with the purpose of improving awareness and understanding to all stakeholders
Conclusion

• Malaysian Construction move towards Sustainable and Green Procurement Initiatives