BIM – Building Information Modelling/Management
Outline

- What is Building Information Modelling (BIM)?
  - What is a Smart Building and what is its relation to BIM?
- What are the drivers in BIM?
What is a Smart Building?

• Intelligent? Context-aware? Automated?
  • Intelligent – many definitions since the 80s

• Context-aware – also many definitions

• Smart-building – also many definitions
  • Context-aware buildings? Fit for purpose? Self actualised buildings! ;)
What is a Smart Building?

- Smart Buildings are buildings which integrate and account for intelligence, enterprise, control, and materials and construction as an entire building system, with adaptability, not reactivity, at the core, in order to meet the drivers for building progression: energy and efficiency, longevity, and comfort and satisfaction.

- The increased amount of information available from this wider range of sources will allow these systems to become adaptable, and enable a Smart Building to prepare itself for context and change over all timescales.

  ‘What is a Smart Building?’ Buckman, A.H., Mayfield, M., B.M. Beck, Stephen Smart and Sustainable Built Environment 2014 3:2, 92-109
What is a Smart Building?

- Basically, they are buildings that connect (integrate)
  - building systems
  - people and technology
  - environment (internal and external)
  - smart power grid
  - building data
What is a Smart Building?

- In groups of two, you have five minutes to write down all the information that you could gather from within a building (and how)?
  - Think
    - Sensors and IoT
    - Smart meters and smart grids
    - Building Information Modelling
What data are we interested in?

- Occupants (location, number, comfort, activities)
- Indoor Environment (temperature, humidity, CO2, etc.)
- Security/Access Control
- Building Structure, Spaces
- Weather Data
- HVAC
- Lighting
- Devices (and appliances)
- Power consumption
- Energy (generation, grid)

How to monitor and all of this data!?
What is BIM?

- A BIM is a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward.
  - National Institute of Building Sciences, National Building Information Modeling Standard™ (NBIMS), 2008

- Building Information Modeling (BIM) is a new approach to design, construction, and facility management in which a digital representation of the building process is used to facilitate the exchange and interoperability of information in digital format. BIM is beginning to change the way buildings look, the way they function, and the ways in which they are designed and built.
Building Information Modelling

- BIM is –
  - Building Information Modelling
  - Building Information Model
  - Building Information Management

- Simply put –
  - it is a business process for generating and leveraging building data to **design, construct and operate** the building during its **life cycle**.
What is a Buildings Lifecycle?

- A building’s life cycle covers the entire life of the building, from inception to demolition.

Life Cycle Stages
Background: BIM - Traditional Approaches

- Analogue (paper-based)
- Outdated practices
- Multiple Documents
- Manually Produced
- Manually Coordinated
- Duplication of Work
- Excessive Checking
- Prone to Human Error
- Labour Intensive
- Costly & Time Consuming

● PROBLEMATIC!!!
Background: BIM - Traditional Stakeholders

- What materials are certain design elements made of?
- What are material characteristics of specific construction elements?
- How much are the building costs?
- What are the known advantages/disadvantages of using specific construction elements in certain contexts?
- How are elements altered by design decisions?
- What are the motivations behind specific design decisions?
- How are specific design requirements addressed in the design?

- Which elements are central in bearing specific user-loads? How do elements behave in their specific location? What are recommended construction techniques for specific building configurations?
BIM Today (well kind of)

- Building Information Modelling/Management (BIM) is about INFORMATION – Information is an Asset!
- Reliable information is required for
  - Building Analysis (performance improvements)
  - Daily operational tasks
  - Business Decision Making
  - Preventative, Reactive & Emergency Response
  - Transactions (lease/sale & service charge)
- Quality of Information Affects Performance and Outcomes
Benefits of BIM

- Modelling not Drawing or Drafting
  - Increasing accuracy and efficiency in the design, construction, and operation processes

- Object-based Modelling
  - Database of semantically-rich building objects and properties
  - Computability: cost estimation, energy consumption, etc.
Benefits of BIM

- **3D Modelling**
  - Design visualization
  - Generating 2D construction documents

- **Parametric modelling**
  - Design intent
  - Design change and options: quick, interactive, early and late design phases
    - Example: A floor is attached to the enclosing walls. When a wall moves, the floor updates to remain connected to the walls.
BIM – Bidirectional Associativity

- **Definition**: Changes to any part of the design are immediately reflected in all associated parts. Bidirectional associativity is applied automatically to every component, view, and annotation.

- **Example**: A change in the dimensions of a wall is reflected in all elements such as windows, doors, ceilings, and electrical outlets.

- **Parametric Relationship**: Relationships among the elements in a building model.
BIM – Managing Change

- BIM solutions manage iterative changes in a building model throughout the design process all the way through to the design, construction, and operational phases.
- A change to any part of the data model should be replicated in all other associated parts.
- Advantages of using a database for a real design project:
  - Improves drawing coordination
  - Reduces drawing errors
  - Saves time spent manually checking and coordinating documents
  - Reduced costs
Information Exchange in BIM

- Arrows represent points where information is interpreted from one information structure to another:
  - Computer-computer Interface
  - Human-computer
Information Exchange in BIM

- Information flow between two CAD systems using one file format – Fig. a, (e.g. Autodesks DWG)
  - Each file format has unique structure, with unique syntax and semantics, making mappings near impossible
  - Additional conversions may be necessary – Fig. b

- Leading to information loss!
  - And additional efforts to remodel correctly
Information Exchange in BIM

- Centralised Information Structure: BIM
  - Shared information space
  - Interfaces of critical importance

- Suggests that a standard or neutral data format can manage all data requirements
  - The one model to rule them all paradigm! ;)

![Diagram showing integrated BIM environment with various tools and platforms connected]
Information Exchange in BIM

- Examples include not only proprietary industry standards, such as
  - Drawing Interchange Format (.DXF), FilmBox (.FBX), or .DWG,
- but also “neutral” formats, such as
  - Standard for the Exchange of Product model data (.STEP), Initial Graphics Exchange Specification (.IGES), .X3D or Industry Foundation Classes (.IFC)

- Risk of turning into ‘yet another file format/ontology’
Information Exchange in BIM

- **Software suite strategy**
  - Preferred information flows between applications of same software suite.

- **Advantages**
  - Information exchanges should be better supported

- **Disadvantages**
  - Vendor lock in
  - Use of tools outside software suite
Information Exchange in BIM

- Linked Data approach
  - Information is linked at data level

- Semantic web technologies rely on a common language for describing information
  - Resource Description Framework (RDF)
Levels of BIM

Web of data