UTM
UNIVERSITI TEKNOLOGI MALAYSIA

SKAB 3412: Building Information Modelling and Data Management

Introduction to Building Information Modelling (BIM)

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Building Information Modelling

DEFINITION

HISTORY

EVOLUTION

LEVELS

Definition

Definition

BIM is not just referring to a category of leading edge software for designing buildings but it goes beyond that to a process view in which the focus lies on the information over the full lifecycle of a building (Watson, 2010).

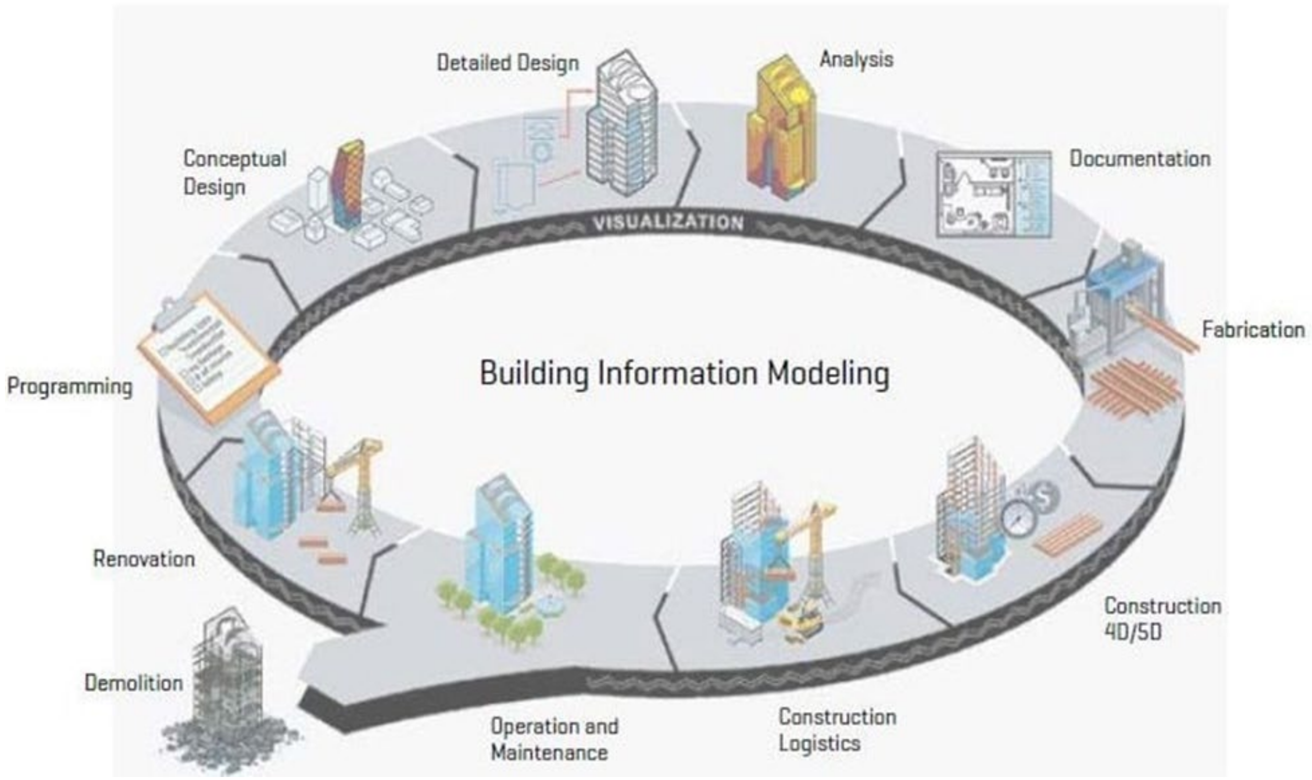
BIM is a set of interacting polices, process and technologies generating a methodology to manage the key building design information in a digital format throughout the building life-cycle. (Succar, 2009)

The National Building Specification (NBS) UK

- Building Information Modelling (BIM) is a process for creating and managing information on a construction project across the project lifecycle.
- One of the key outputs of this process is the Building Information Model, the digital description of every aspect of the built asset. This model draws on information assembled collaboratively and updated at key stages of a project.
- Creating a digital Building Information Model enables those who interact with the building to optimize their actions, resulting in a greater whole life value for the asset.

Definition

- Building Information Modelling is defined as a modelling technology and associated set of processes to produce, communicate and analyse building information models. (Eastman et. al., 2008)



Online resources

- Watch the video on definition of BIM: - https://www.youtube.com/watch?time_continue=5&v=NtYTh14xXNA&feature=emb_logo
- Video: What is BIM? :- https://www.youtube.com/watch?time_continue=1&v=_beeFtrgQJE&feature=emb_logo

History

Sketchpad

- First **computer-aided design (CAD)** with a **graphical user interface** in 1963.
- Pioneered the way for **human-computer interaction** and was a major breakthrough in the **development of computer graphics**.
- Gave way to solid **modelling programs**.

Building Description System (BDS)

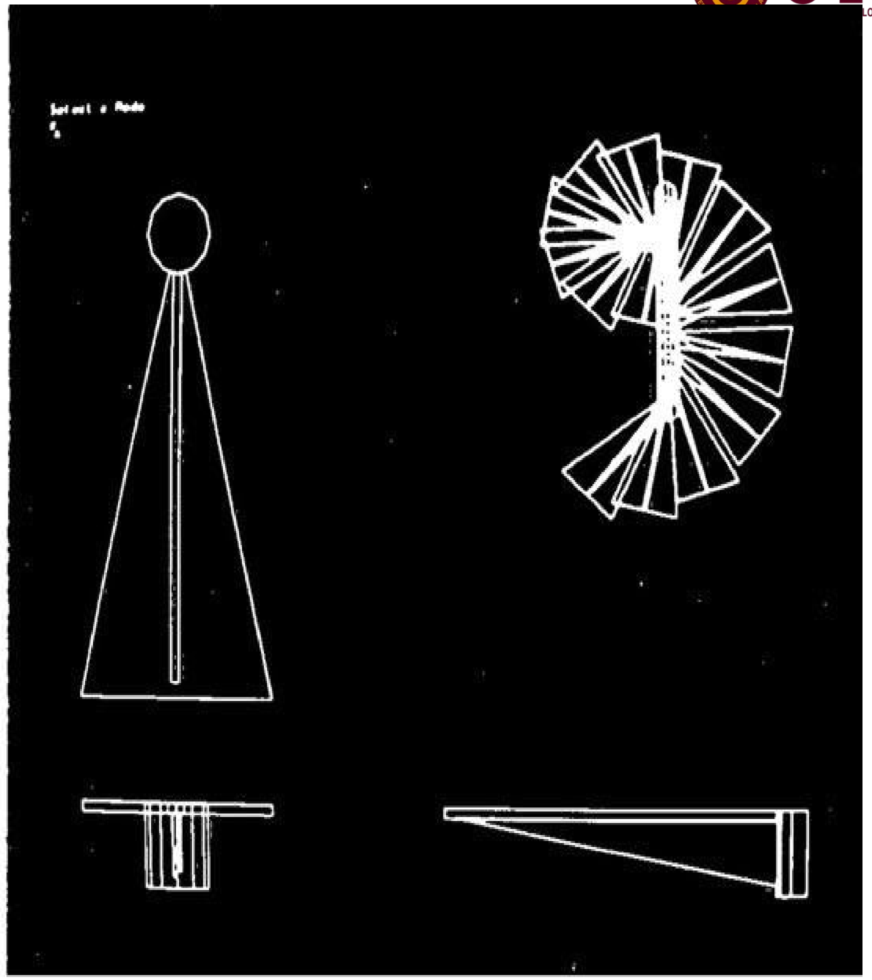
- In 1975, **Charles Eastman** published a paper describing a prototype called **Building Description System (BDS)**.
- It discussed ideas of parametric design, **high quality computable 3D representations**, with a "**single integrated database for visual and quantitative analyses**"
- It is a database capable of **describing buildings at a detail allowing design and construction**.

GLIDE (Graphical Language for Interactive Design)

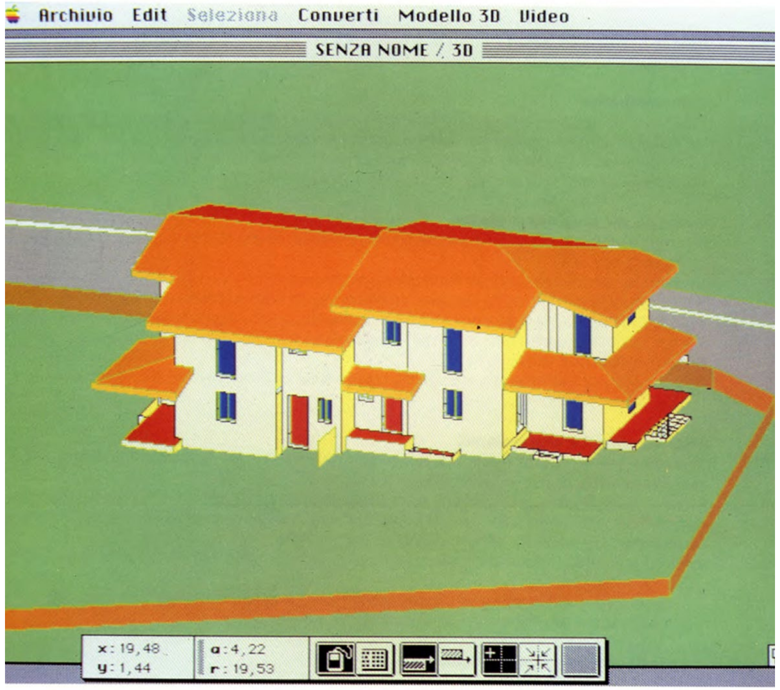
```
POLY PROCEDURE spiral.step(POLY centre;
        REAL riser,radius,r,angle,th)=
    BEGIN
    POLY support =
        triangle(radius*0.95,-riser*0.8,th);
    POLY collar = column(12,riser,r);
    POLY plate = wedge(radius,th,angle);
    ! return the result of shape operations;
    CUT centre FROM  COMBINE collar WITH
            COMBINE support WITH plate
    END;

To make spiral staircase, (dimensions in inches)
  SET PROCEDURE spiral.stair(ht,radius,angle)=
    BSET; INTEGER numsteps; REAL riser;
    numsteps ← ht/8.0;
    riser ← ht/numsteps;
    POLY centre = column(12,ht+32.0,5.0);
    POLY step = spiral.step(centre,
        riser,radius,3.0,angle,0.625);
    FOR i TO numsteps
        DO COPY step=(0,riser*i \0,angle*i)
    ESET;

  SET stair1 = spiral.stair(100.0,46.0,30.0);
```



- In 1977, Charles Eastman created **GLIDE** which exhibited most of the characteristics of the modern BIM platform



ArchiCAD

- Pioneering software such as ArchiCAD take things further towards **virtual 3D design and construction**

Revit

Building information modelling software for **architects, landscape architects, structural engineers, MEP engineers, designers and contractors**

Evolution

4 Generations of BIM

The growth of BIM over the past decade has continued due to the benefits of using 3D virtual models to guide real-world processes.

Progress of BIM over the last 20 years in terms of key shifts and leaps in its capabilities over four major generations that we can call: BM, BM+I, BIM, and BI(m).

BIM has gradually grown from its origins in BM (Building Modelling) into BI (Building Information) with various combinations of model and data in between.

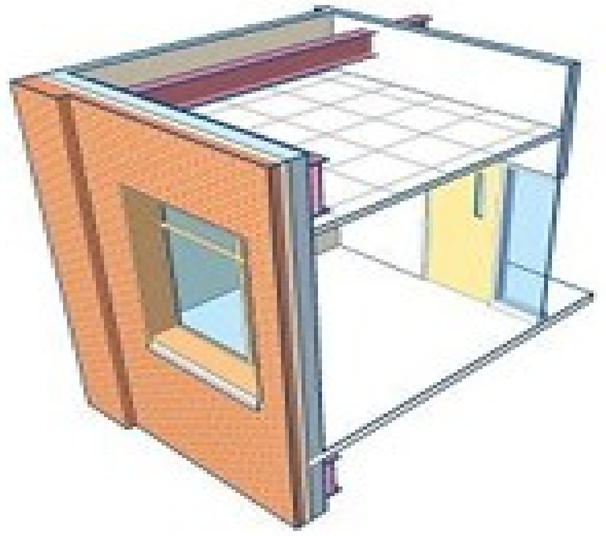
A Building Information model can be viewed as a collection of BIM "atoms" of information in a context of project information.

1st Gen: BM

3D models are a valuable tool for predicting aspects of the design and construction effort.

The technology to create such models started to become a reality in the early-to-mid 1990s

Digitally sophisticated firms began employing 3D modelling for various uses. We call this solely 3D-modeling effort (without data) Building Modelling or BM.



BM
Building Modeling

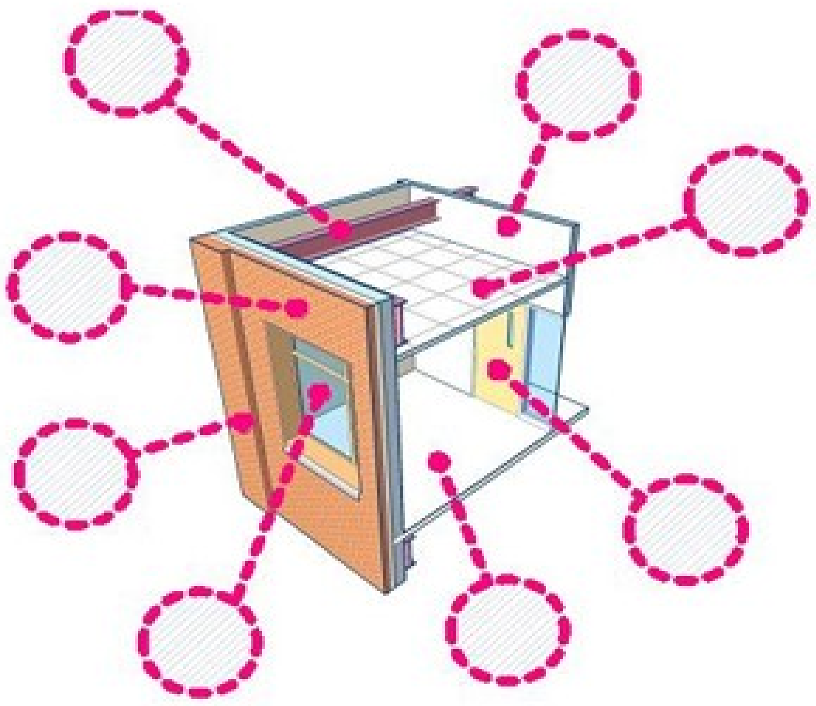
The value proposition of BM alone is to understand the relationships between purely physical, geometric components – beams and ducts or walls and stairs, for example.

The “information” that exists in the BM model is simply spatial – where things start and stop, how they are arranged – which while valuable, is really just graphical information.

In the first pure BM phase, an atom of BIM was simply a 3D object. There was no other data, no opportunity to create schedules of components or arrange them on a timeline or count them for cost estimating.

It was simply geometry. To do any of those other things, we would have to add data tags to the objects. This is largely what happened in the next stage of evolution: BM+I.

2nd Gen: BM+I



BM+I

Modeling w/ Data Attached

In the first advance, data tags were added to 3D objects. The geometry object dataset was simply expanded to contain fields of data that were attached to the geometry.

However, for those computer-savvy users who could pluck the data from the 3D objects, arrange them into a spreadsheet and add the necessary context

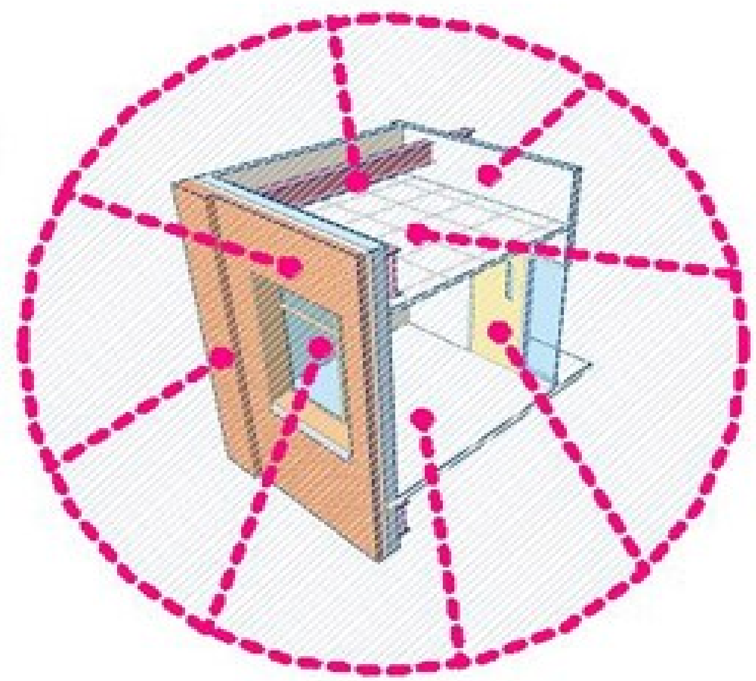
The data transfer was not bi-directional, however. Once a design change was made, the data fields would be exported and manipulated again.

Autodesk's Architectural Desktop, Bentley TriForma, Graphisoft's ArchiCAD and BricsCAD from the late '90s exemplify this approach where often quite comprehensive datasets could be attached to 3D objects like doors, walls, roofs, etc.

BM+I atoms, therefore, were 3D objects with data attached to them in a "pin-cushion" configuration.

The "pins" containing object data were jabbed into the 3D objects but were not automatically related to each other.

3rd Gen: BIM



BIM
Modeling within a Database

The CAD objects, however, were not the centrepiece of this software, but fabrication management and process simulation were.

This bold new direction in digital design soon made its way to the AEC industry where similar software soon emerged.

In this new arrangement, the "information engine" was at the centre of the software, and both graphical representations and schedules were driven by data contained in the engine.

In addition, data objects were clearly situated in an architectural context

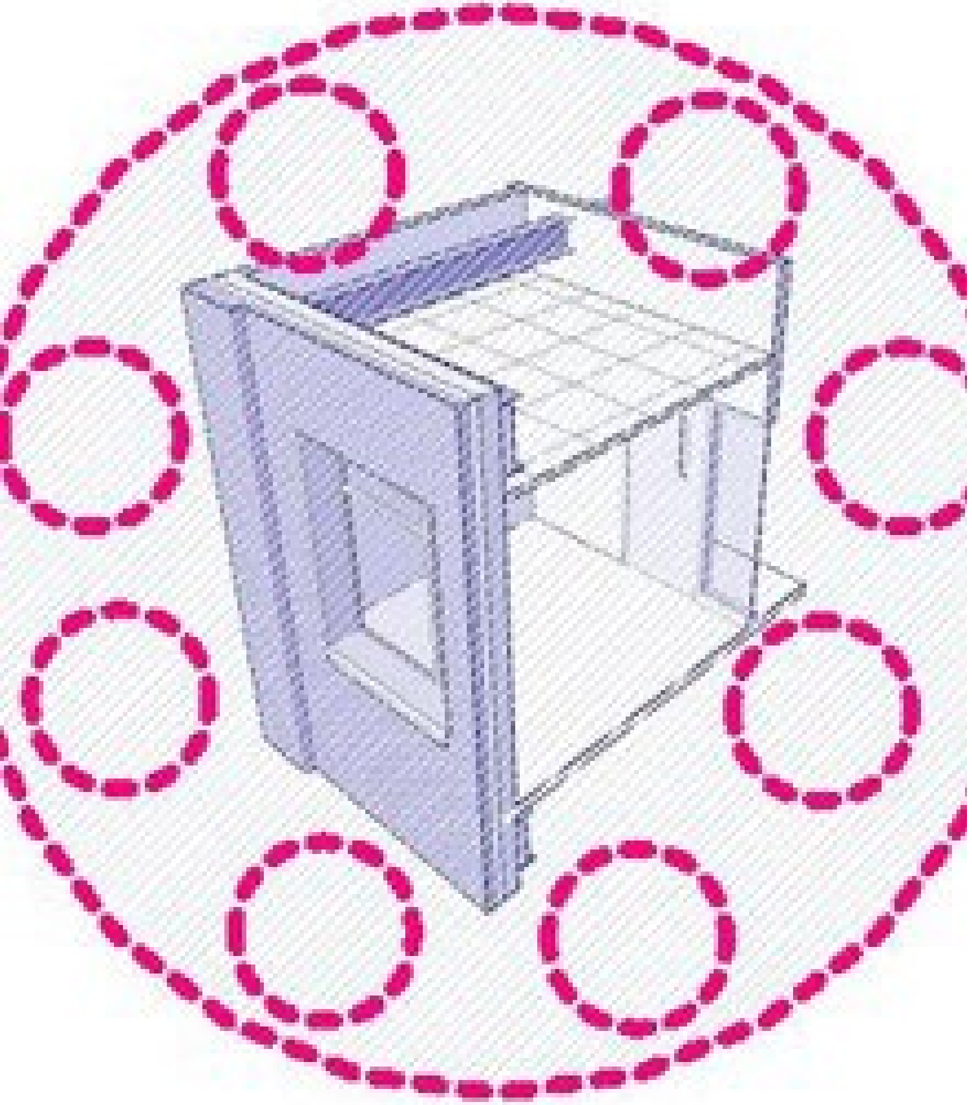
For example, walls were "hardwired" to have certain behaviours, such as hosting doors and windows, gridlines.

Every component "knew" which floor level it belonged to, and all manner of architectural objects were capable of being scheduled.

At this stage, contextualized building-related data was born: atoms of 3D objects with embedded data floated in a further data context.

This heralded the arrival of BIM: BM linked to information management. This is roughly where we find ourselves today, with 3D objects in a context that also creates linkages among object data.

But that is not where the evolution of BIM ends.



BI(m)

Data about model elements

4th Gen: BI(m)

Our current focus is skewed towards the design and construction process – information in the models get transferred downstream to an increasing cast of builders, owners and operations people.

The subset of data from the model is of greater importance than having the whole model, because once a project passes a certain point, the workflow emphasis shifts, and it becomes equally crucial to get that data out as the project enters the Bid, Construction and Operations phases.

An atom of BI(M) is just information about 3D objects without the 3D object itself.

Information about the components rather than the 3D characteristics of the geometry that provides critical information for comprehensive tracking of construction projects.

As the technology continues to evolve, we expect to see more downstream uses and perhaps a fifth generation of BIM.

BIM Visualisation

3D

- Existing Conditions Models
  - Laser scanning
  -Ground Penetration
- Safety & Logistics Models
- Animations, renderings. Walk throughs
- BIM driven prefabrication
- Laser accurate BIM driven field layout

4D

SCHEDULING

- Project Phasing Simulations
- Lean Scheduling
  -Last Planner
  -Just in Time (JIT) Equipment Deliveries
  -Detailed Simulation Installation
- Visual Validation for Payment Approval

5D

ESTIMATING

- Real time conceptual modeling and cost planning (Dprofiler)
- Quantity extraction to support detailed cost estimates
- Trade Verifications from Fabrication Models
  -Structural Steel
  -Rebar
  -Mechanical/Plumbing
  -Electrical
- Value Engineering
  -What-if scenarios
  -Visualisations
  -Quantity Extractions
- Prefabrication Solutions
  -Equipment rooms
  -MEP systems
  -Multi-Trade Prefabrication
  -Unique architectural and structural elements

6D

SUSTAINABILITY

- Conceptual energy analysis via DProfiler
- Detailed energy analysis via EcoTech
- Sustainable element tracking
- LEED tracking

7D

FACILITY MANAGEMENT APPLICAATIONS

- Life Cycle BIM Strategies
- BIM As-Builts
- BIM embedded 0&M manuals
- CODBie data populationand extraction
- BIM Maintenance Plans and Technical Support
- BIM file hosting on Lend Lease's Digital Exchange System

Other references

- National Building Specification - https://www.thenbs.com/knowledge/what-is-building-information-modelling-bim
- MyBIM CIDB Malaysia - https://mybim.cidb.gov.my/
- Autodesk - https://www.autodesk.com/solutions/bim