GeoBIM for Asset and Facility Management

GeoBIM Benchmark Workshop

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Benefits of BIM

The initial estimated savings to UK construction and its clients is £2bn pa[4] through the widespread adoption of BIM and is therefore a significant tool for Government to reach its target of 15-20% savings on the costs of capital projects by 2015. An Investor's Report describing the business benefits to the market is available at:
http://bimtaskgroup.org/wpcontent/iploads/2012/InvestorsReport-BIM.pdf

(Cited in : https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/34710/12-1327-building-information-modelling.pdf from a 2008 study)

Overview

- **What is Asset Management**
- GeoBIM for Asset Management - A Practical Example
- GeoBIM Challenges
- Futures and Wider Context

Asset management (AM) definitions

In **finance:** management of client's investment choices, enabling informed decision during the investment, management and disinvestment phase.

equities, bonds, cash equivalents, commodities and **real estate**

In **engineering** is defined as a **coordinated activity** of an organization to to realise **value** from assets.

Balancing **costs**, **risks**, **opportunities** to achieve organisation's objectives

Engineering Asset Management

Asset Management (AM) have been identified since the late 1990's as one of the main functions to be implemented in corporate world.

Operations and resources employed for management of facilities, infrastructure and equipment over their life cycle is called **Engineering Asset Management** (**EAM**)

- Public buildings (U.S. Department of interior, 2008b)(Vanier, 2000),
- Corporate buildings (IFMA, 2008; Ciaramella and Tronconi, 2012),
- Infrastructures (Selman and Schneider, 2004; Halfawy, Ph and Eng, 2008; Sayed, Bcw and Penn, 2016),
- Military facilities and infrastructures (Mills, 2001; NASA, 2003),
- Urban areas goods (Mignard and Nicolle, 2012; Osman, 2012)

Definition of asset

Asset: item, thing or entity that has ***potential*** *or* ***actual value*** *to an organization* (ISO 55000:2014)

The definition has been adopted by:

- BS EN ISO 19650-1:2018
- BS EN ISO 41011:2018

Asset: ***whole building*** *or* ***structure*** *or* ***unit of construction works****, or a* ***system*** *or a* ***component*** *or part thereof* (ISO 15686-5:2017)

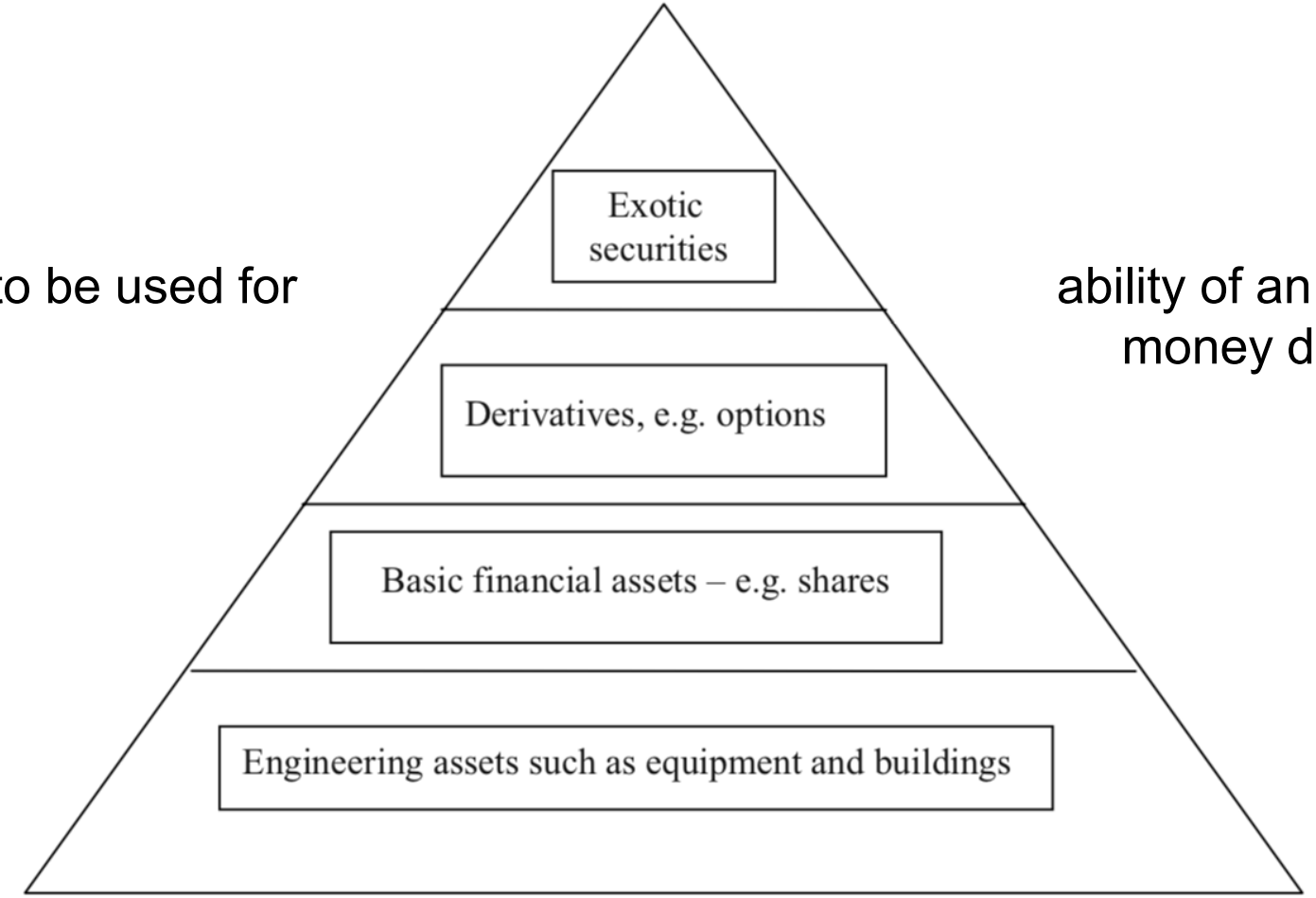
An asset is a uniquely identifiable ***grouping of elements*** *acting as a single entity that has a financial value or that can be operated on as a single unit. An asset is generally the* ***level of granularity at which maintenance operations are undertaken****.* (current IFC release - IFC4 Add2, BuildingSmart, 2018)

The value of the physical assets

Physical assets' value can be approximated with their capability value and financial value

Capacity value:

ability of an asset to be used for a specific function



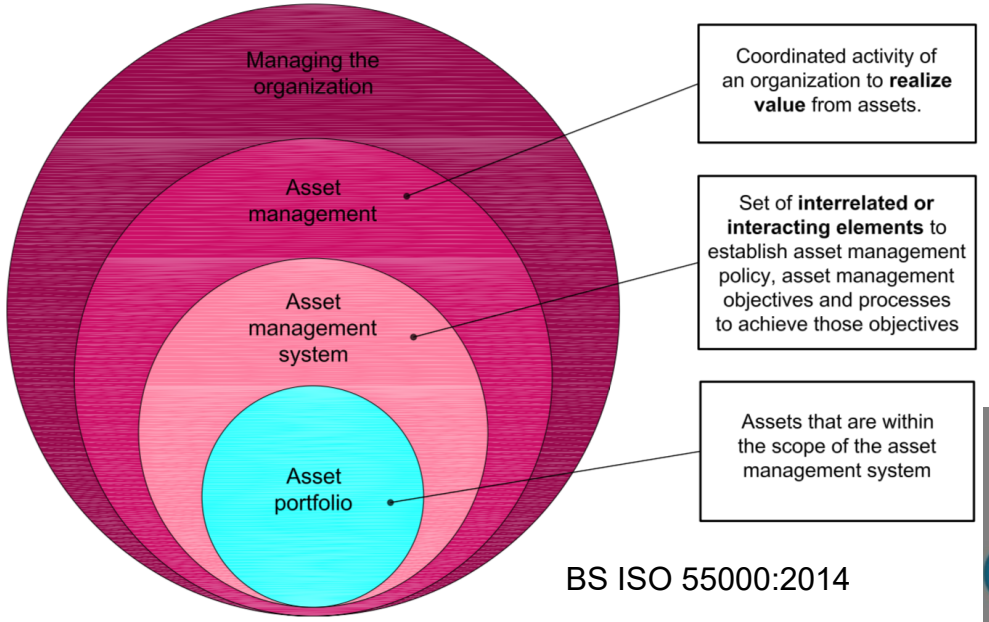
Financial value:

ability of an asset to produce money during its life cycle

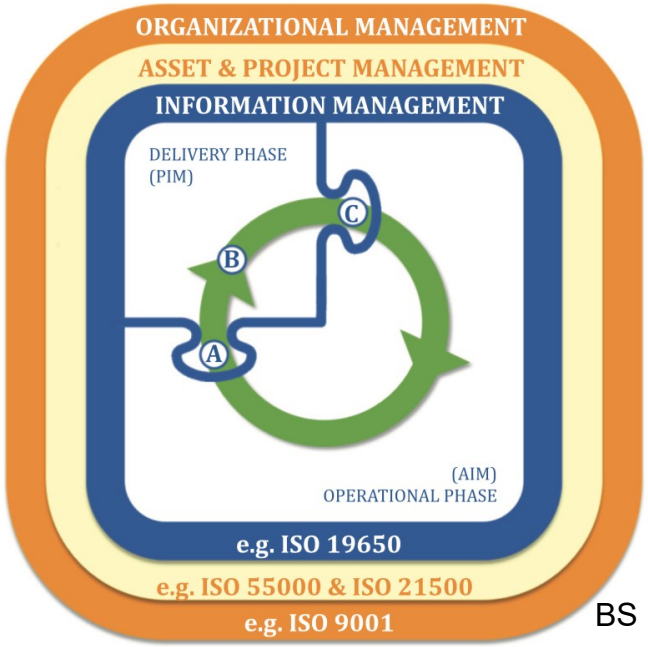
(Amadi-Echendu et al., 2010)

Digital Asset Management drivers

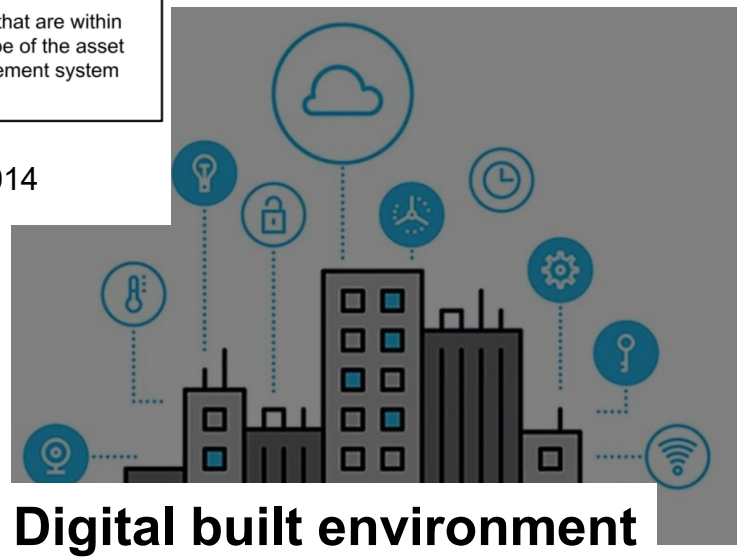
Strategy implementaiton



BS ISO 55000:2014



BS ISO 19650-1:2018



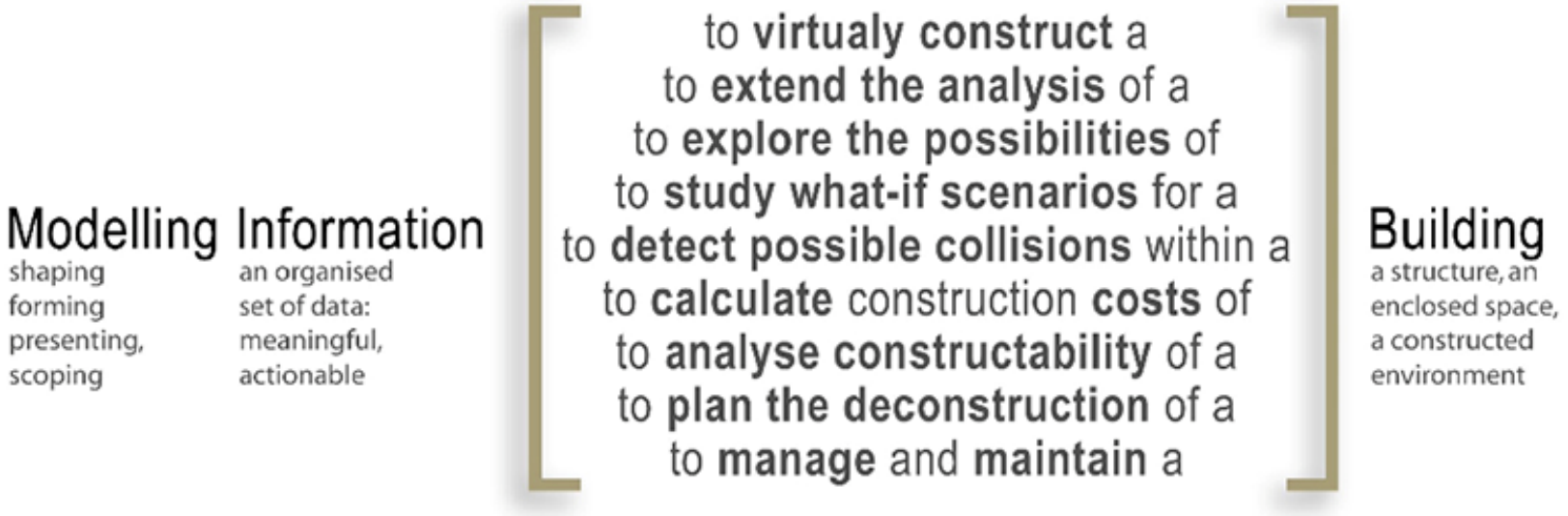
Digital built environment

Managed

Management framework

Digital built Asset Management

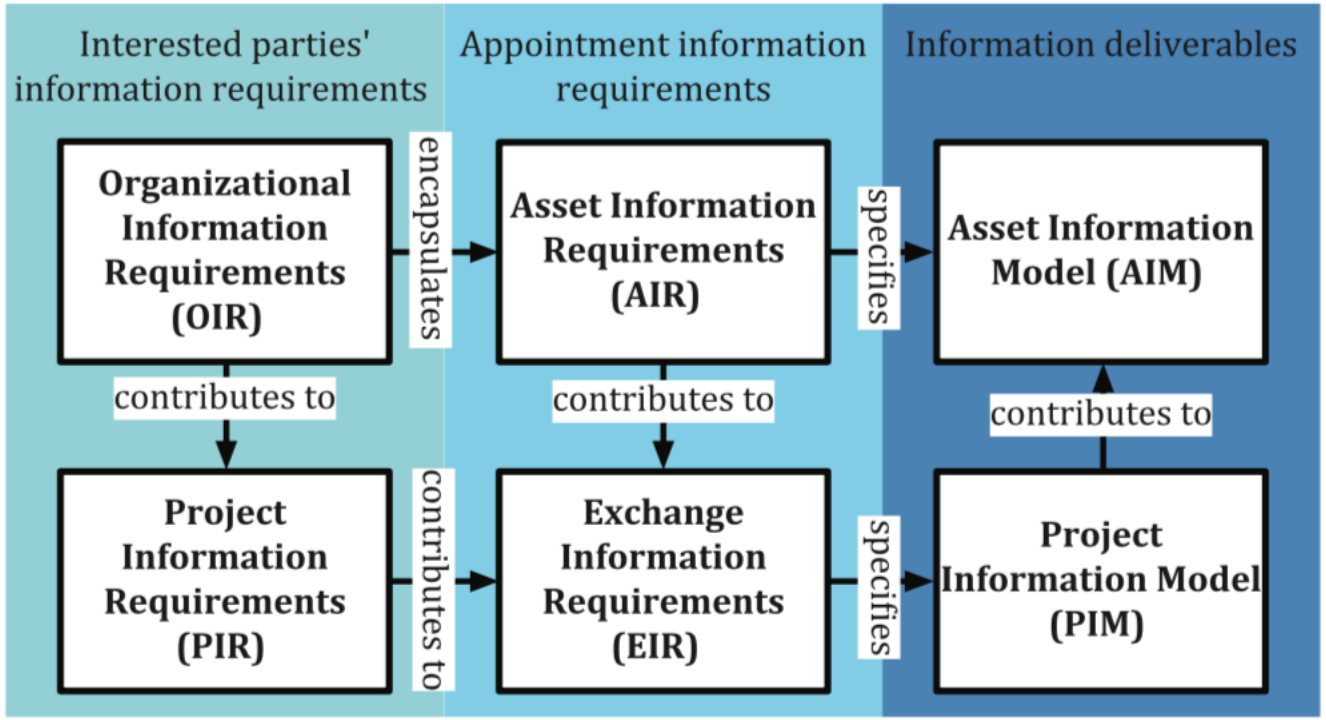
- The physical assets are more and more **integrated in the digital environment**
- They provide a great amount of data and involve a complex stakeholders network



Succar, B. (2008)

Asset Information Requirements & Asset Information Model

An Asset Information Model (**AIM**) is a model that collects data and information needed to **support the asset management process**, i.e. to manage and maintain a building or infrastructure.



EN ISO 19650-1:2018

The **information to be included** in the AIM must be **defined in an AIR** derived from the **OIR**. In the case of a new project, AIRs are used to define the **EIR** included in the project's tender documents.

The cost on information in OM&R

The **costs of operations and maintenance** represent 50–70% of the total annual facility operating costs and **85% of the entire lifecycle costs** are spent on FM. (Wong, Ge & He, 2018)

Table ES-2. Costs of Inadequate Interoperability by Stakeholder Group, by Life-Cycle Phase (in $Millions)

Stakeholder Group	Planning, Design, and Engineering, Phase	Construction Phase	Operations and Maintenance Phase	Total
Architects and Engineers	1,007.2	147.0	15.7	1,169.8
General Contractors	485.9	1,265.3	50.4	1,801.6
Specialty Fabricators and Suppliers	442.4	1,762.2	—	2,204.6
Owners and Operators	722.8	898.0	9,027.2	10,648.0
Total	**2,658.3**	**4,072.4**	**9,093.3**	**15,824.0**

Source: RTI estimates. Sums may not add to totals due to independent rounding.

(NIST, 2004)

Facility Management (FM)

- *Facilities Management (FM): organizational function which integrates people, place and process within the built environment with the purpose of* ***improving the quality*** *of life of people and the productivity of the core business* (BS EN ISO 41011:2018)

- A process within an organisation to **maintain and develop the agreed services** which support and improve the effectiveness of its primary activities.

- Means **management of buildings and their systems**, such as electrical, plumbing, lighting, air conditioning, but also cleaning services, gardening, etc..

Facility Management (FM) main services

The final aim of FM concerns the control of **non-core services** of an organisation to support the **optimisation of the core-business**:

Technical services

maintenance management

reliability

emergency and repair

fire safety

Space

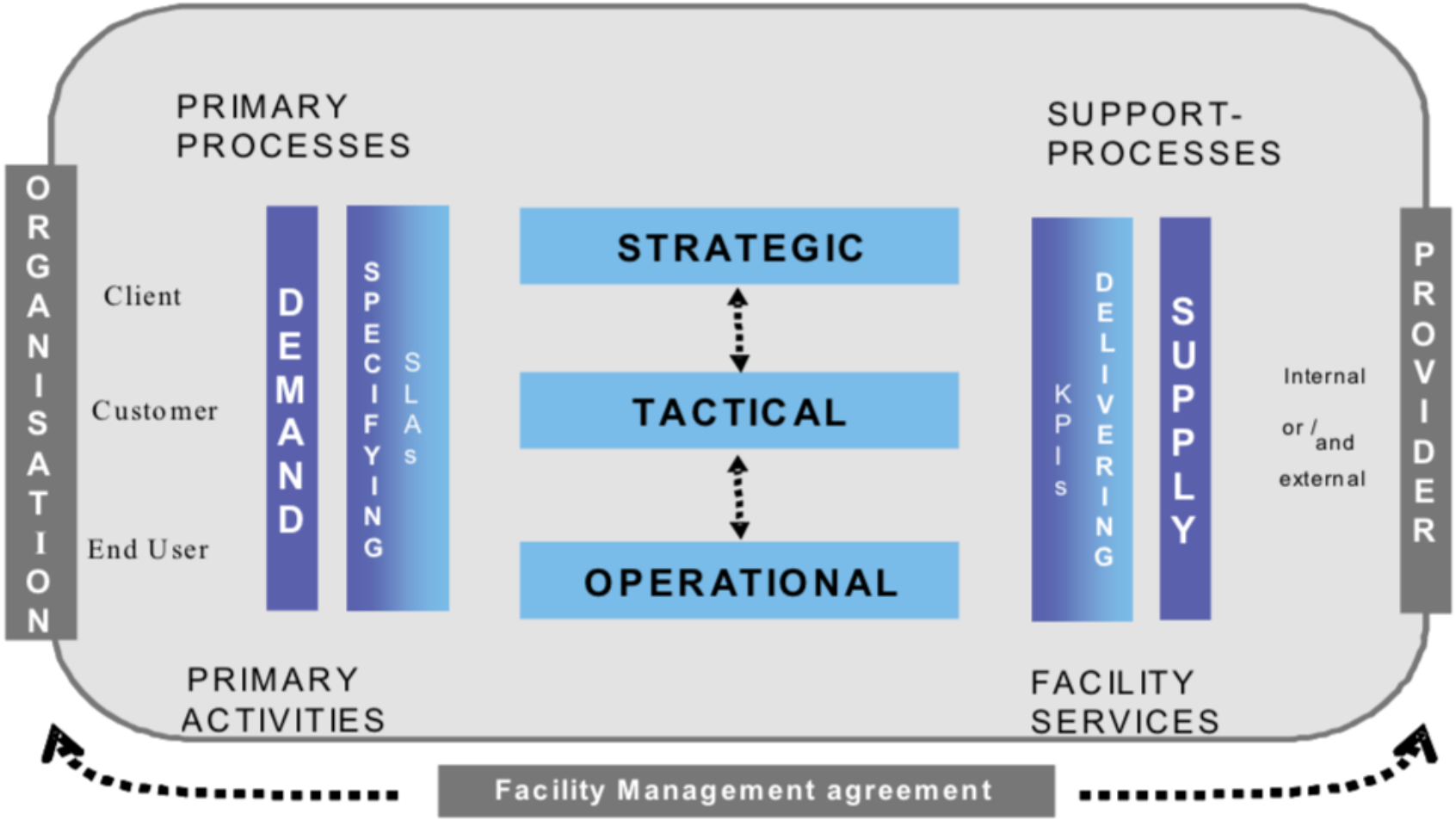
space management,

office layout etc.

People

cleaning, catering, etc.

The Facility Management schema

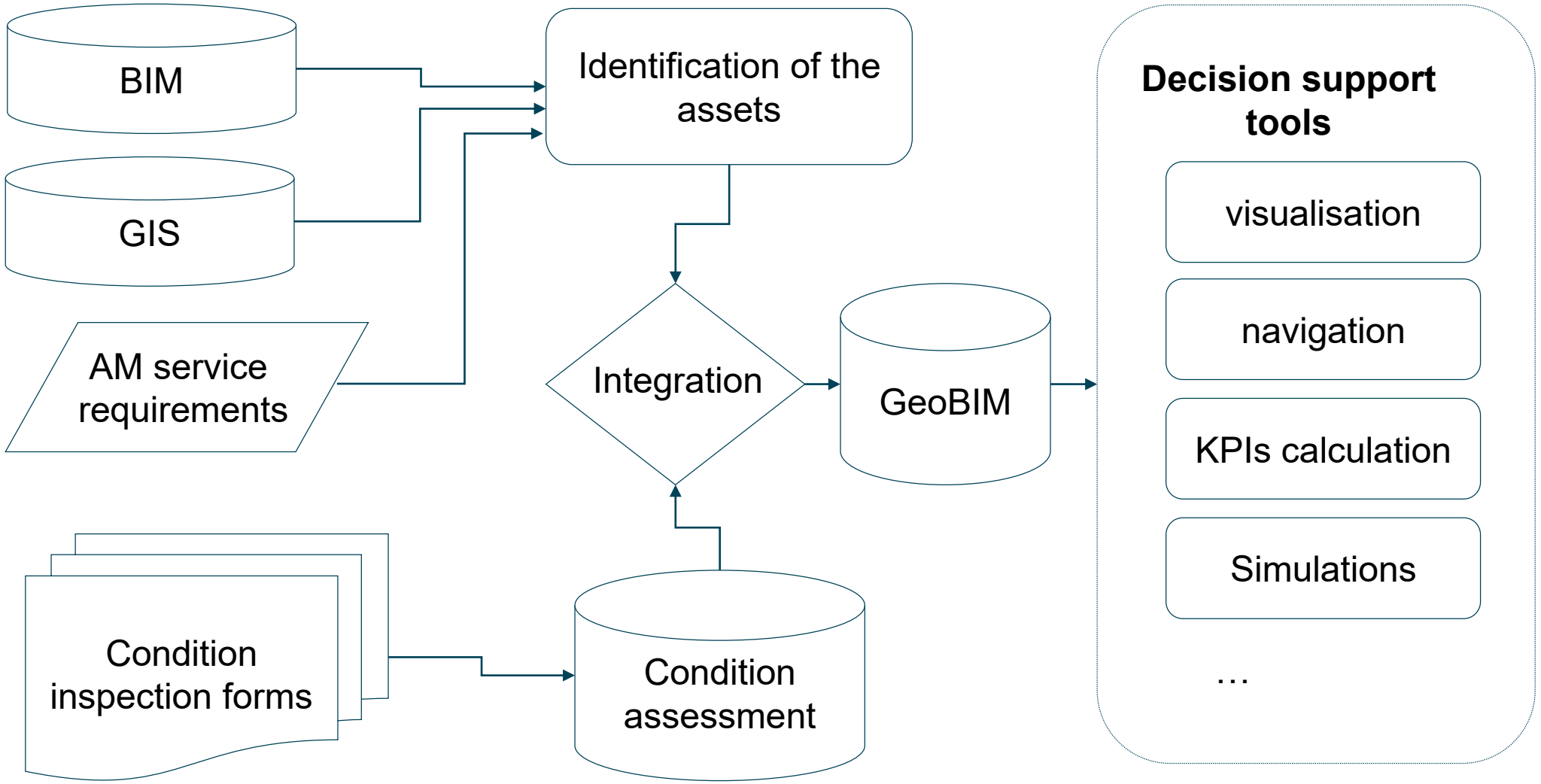


EN 15221-1:2006,

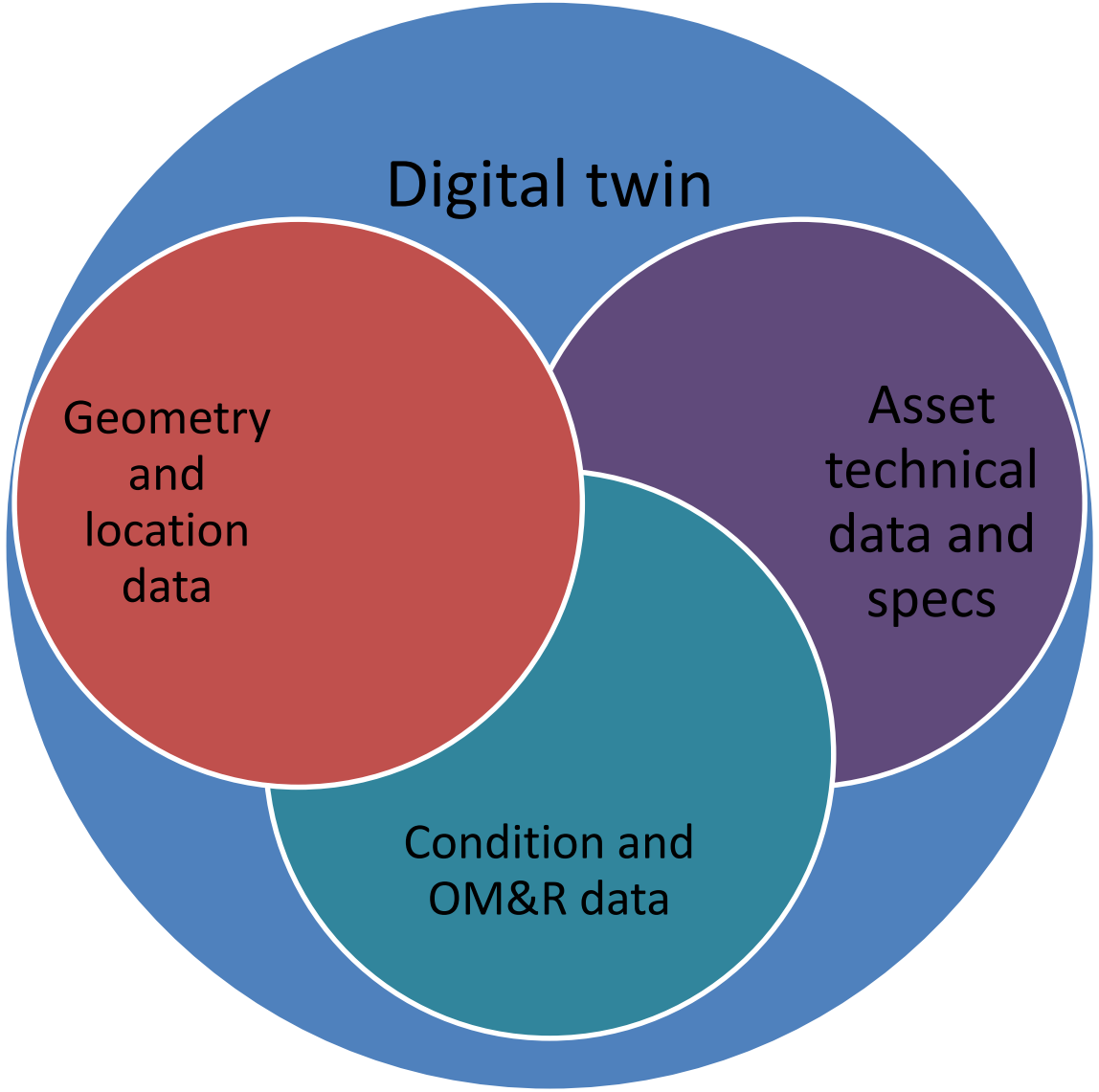
Data to support decisions

- each decision needs specific data:
- strategic: long term, complex decisions made by senior management. These decisions will affect the management of an organization
- tactical: medium term decisions made by middle managers. They follow the strategic decisions and aim to meet their objectives
- operational: day to day decisions made by operative managers that support more detailes and short term tasks

The process schema



GeoBIM model for AM/FM is a digital twin?



- Overcome the separation indoor/outdoor space
- Collect data in a single source of information for decision making
- integrate powerful information management tools

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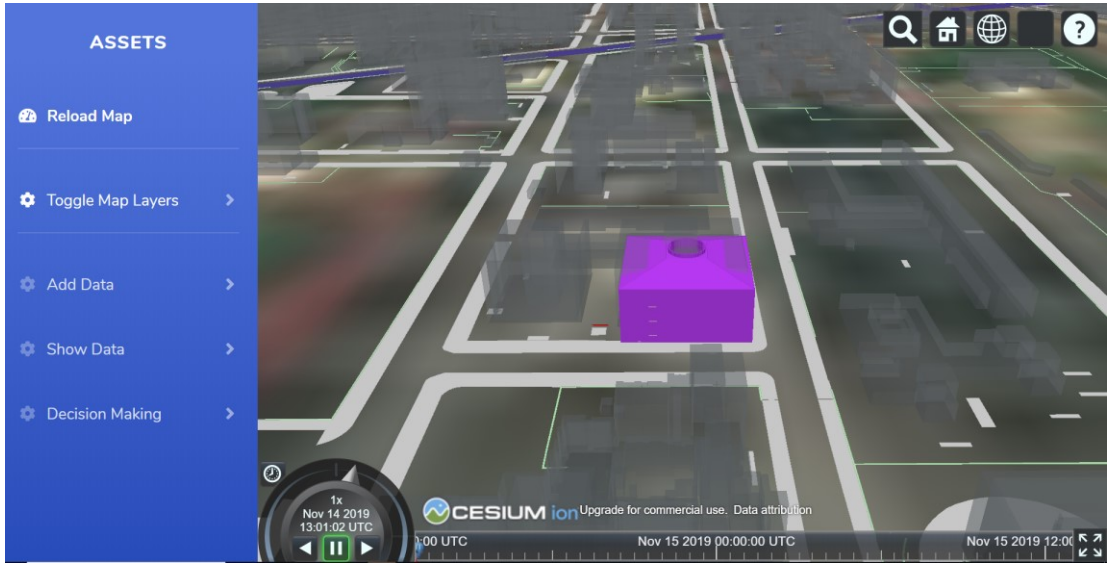
Asset Management

- Practical Example
  - It is common to conduct a rapid condition assessment of an asset (e.g. at handover/acquisition)
    - One for each **room**
    - One for the **building** envelope
    - One for the **building**'s surroundings
  - One feature can have many assessments over time



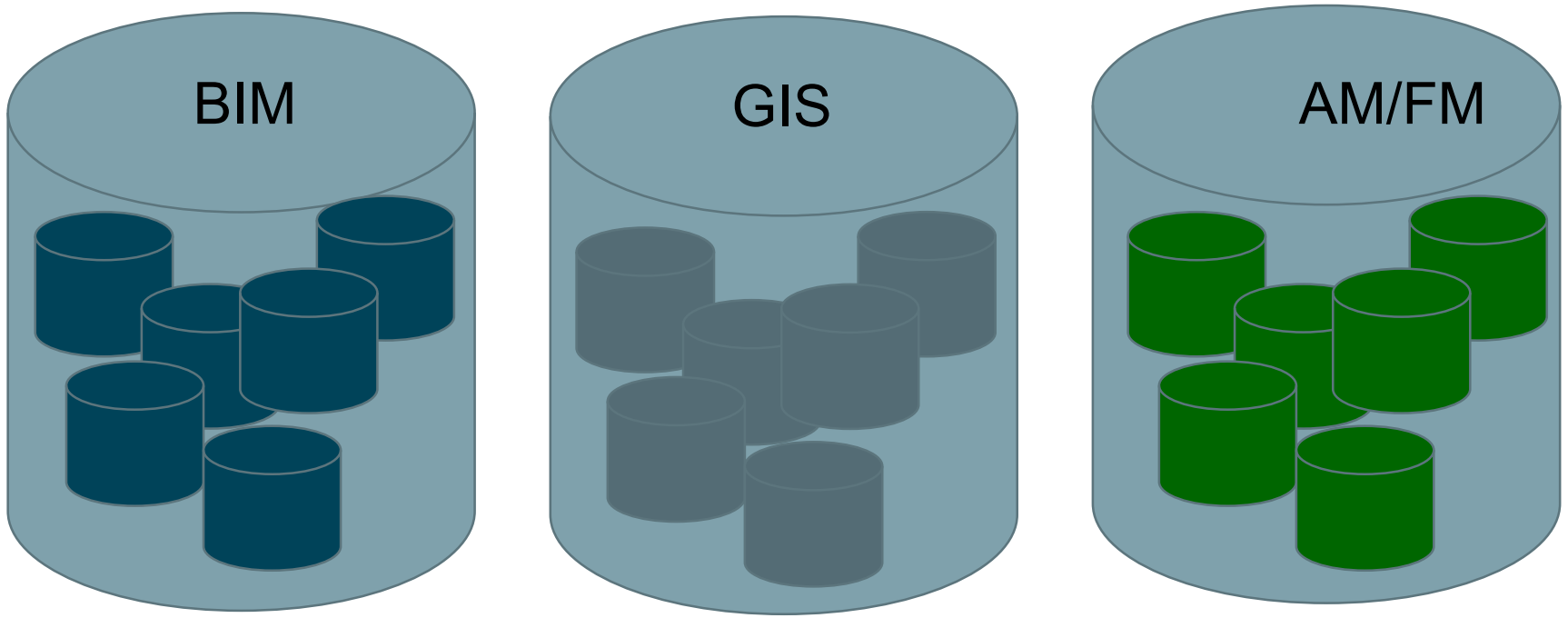
Asset Management

- The is also a need for a detailed assessment where there is one feature in a room that is not the same condition as all the rest

- Time and cost is a factor in deciding which assessment type to use

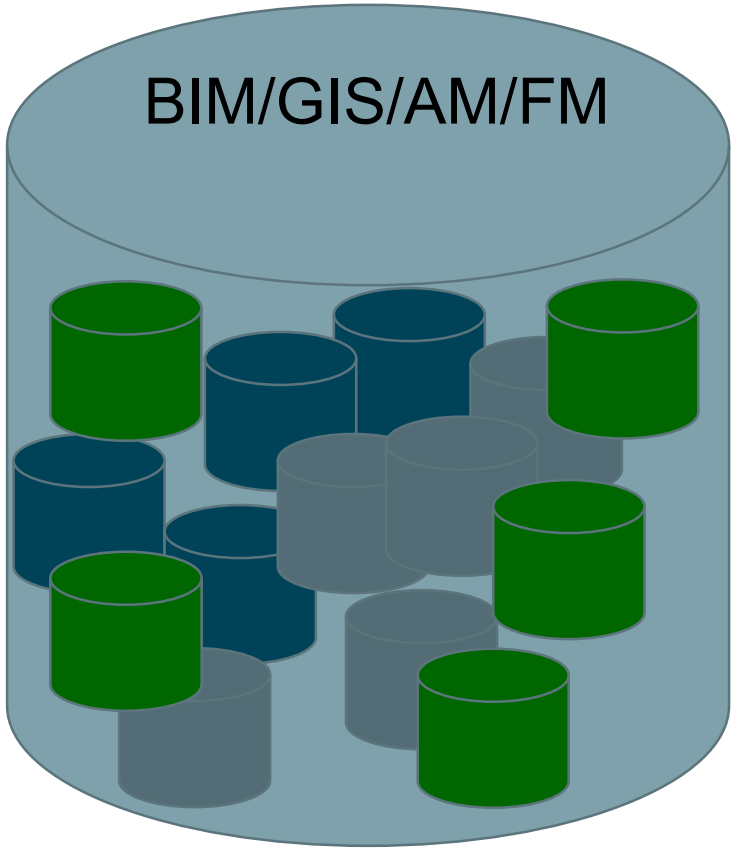
GeoBIM for Asset Management

- 3 main sources of data
- Usually stored in separate data silos

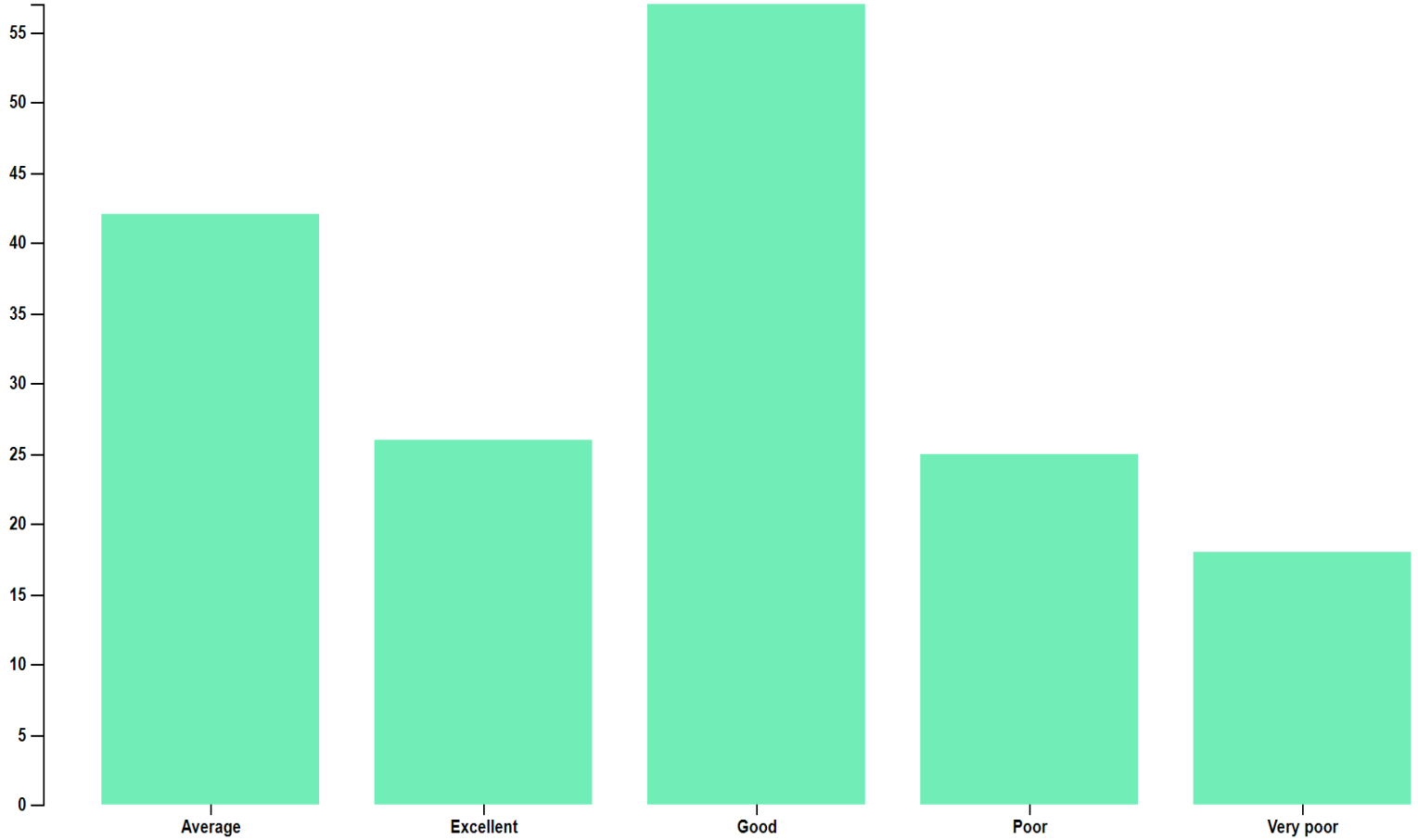


GeoBIM for Asset Management

- A “single source of truth”



GeoBIM and Asset Management



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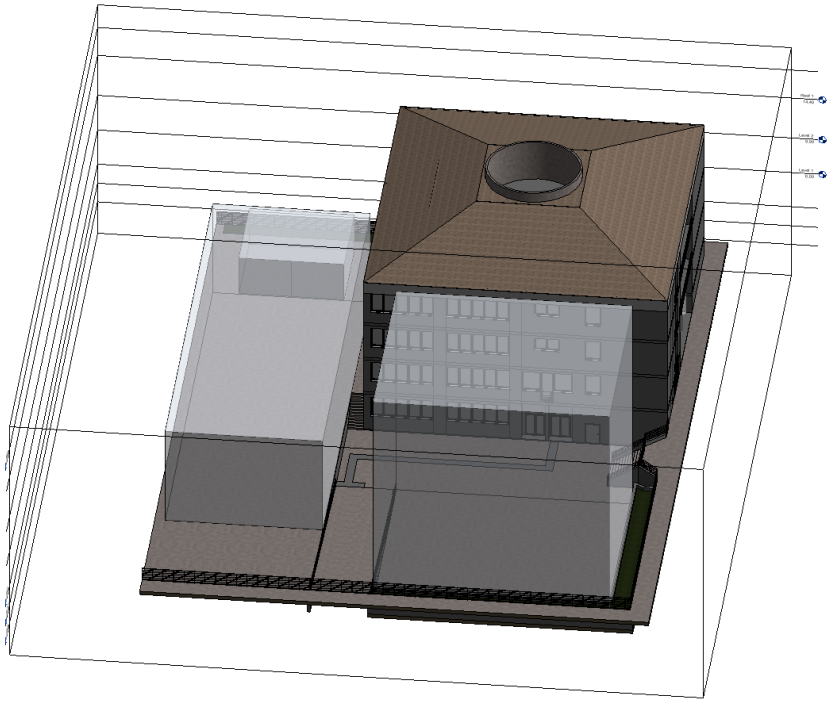
GeoBIM Integration for Asset Management

- Starting Point – Revit 2020 BIM of ‘Building 25’ at the Polimi Campus
  - Created by Hector Ortiz

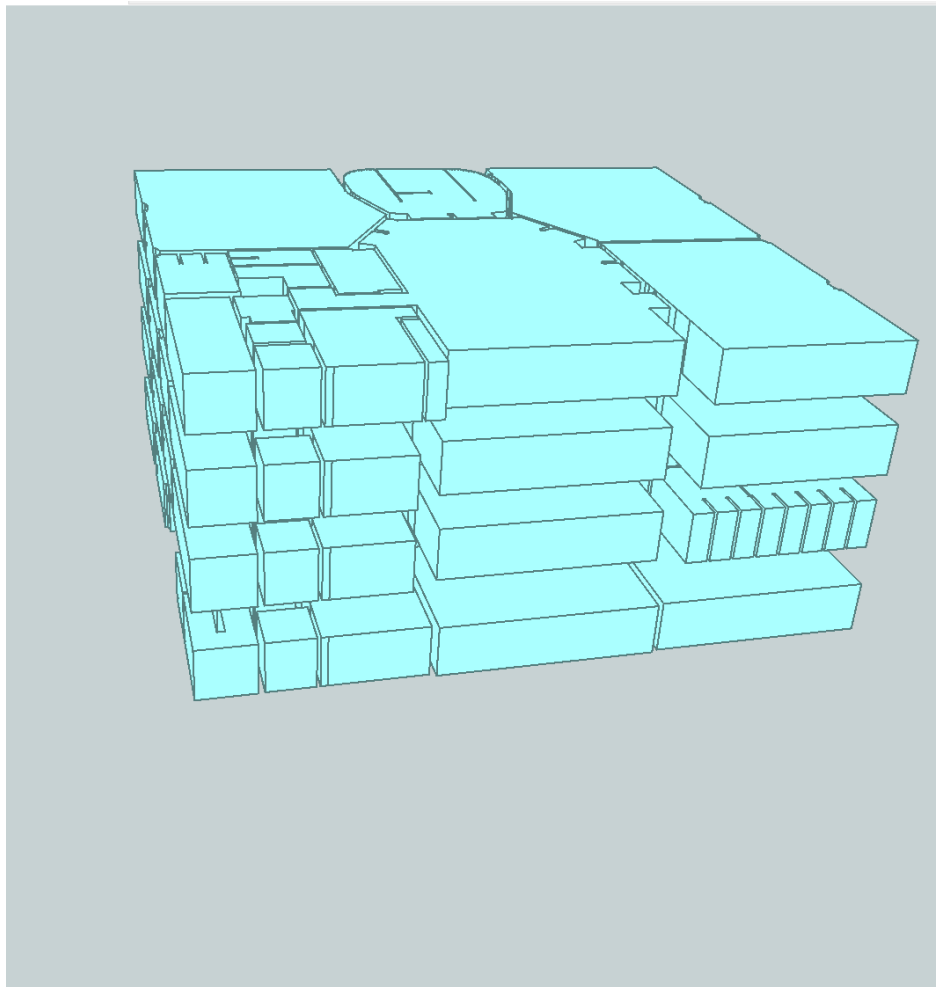


Click View tab Create panel Schedules drop-down Schedule/Quantities.

GeoBIM Integration for Asset Management

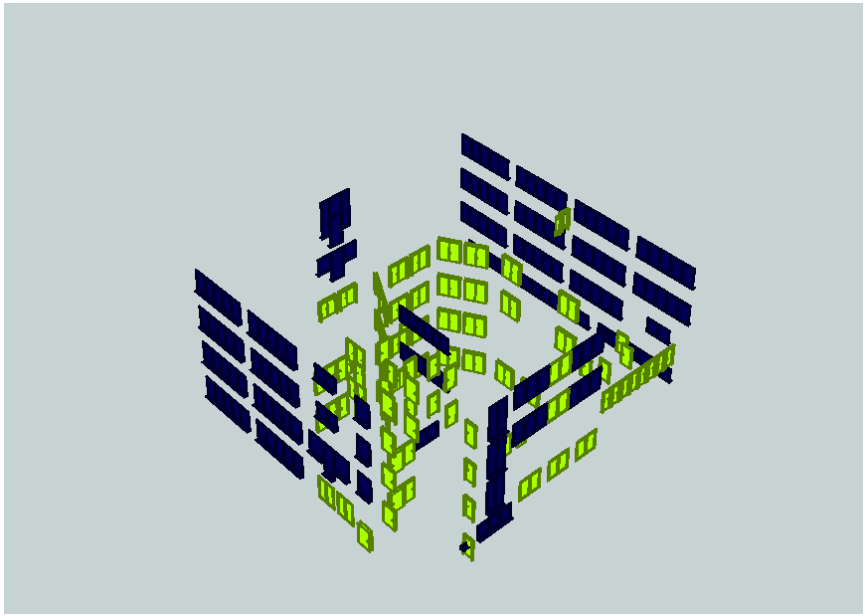
Creating Spaces

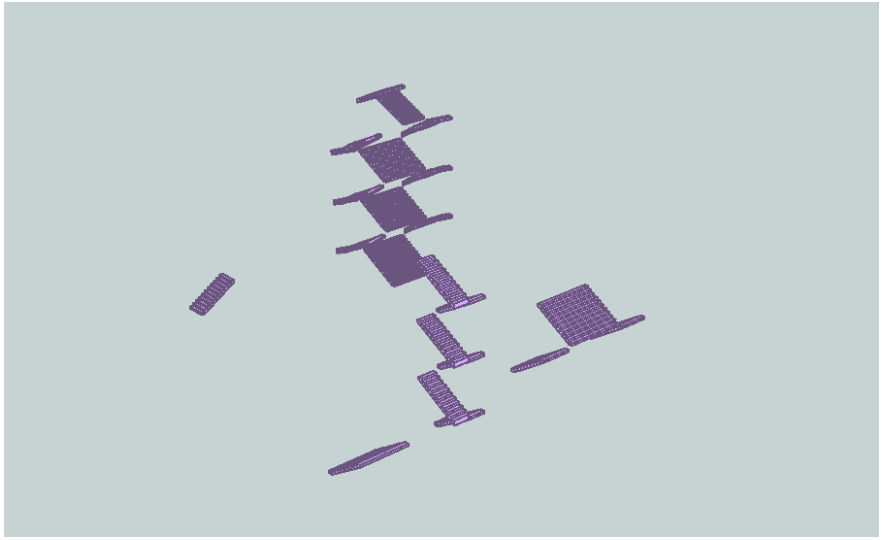
- View a floorplan then ANALYZE > SPACE (can be automated)
- To list the spaces VIEW > CREATE > SCHEDULE > SCHEDULE QUANTITIES



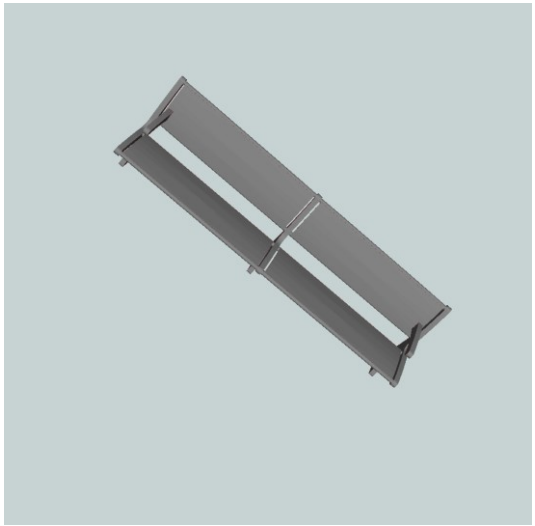
GeoBIM Integration for Asset Management

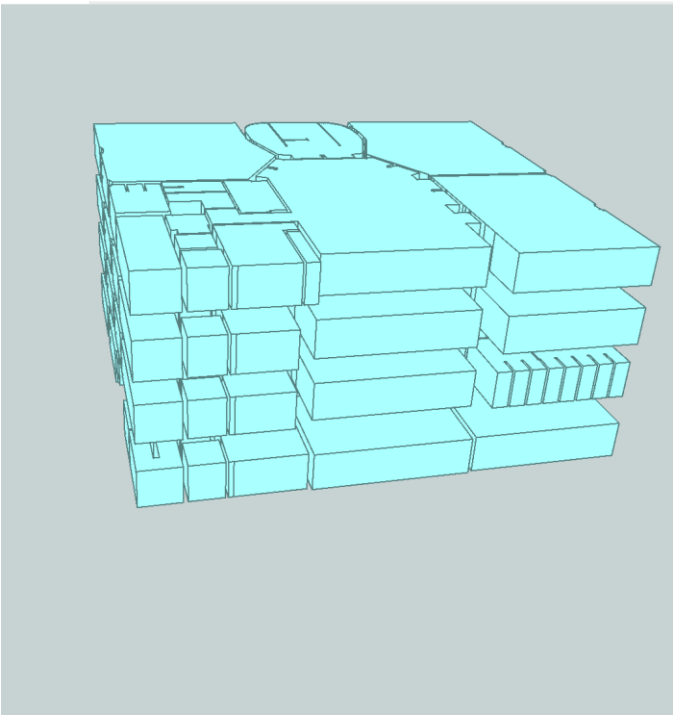
- Feature Geometry
  - In some cases, the feature existed in our data (from GIS or BIM) so we could just report the condition
  - (Doors, windows, staircases)



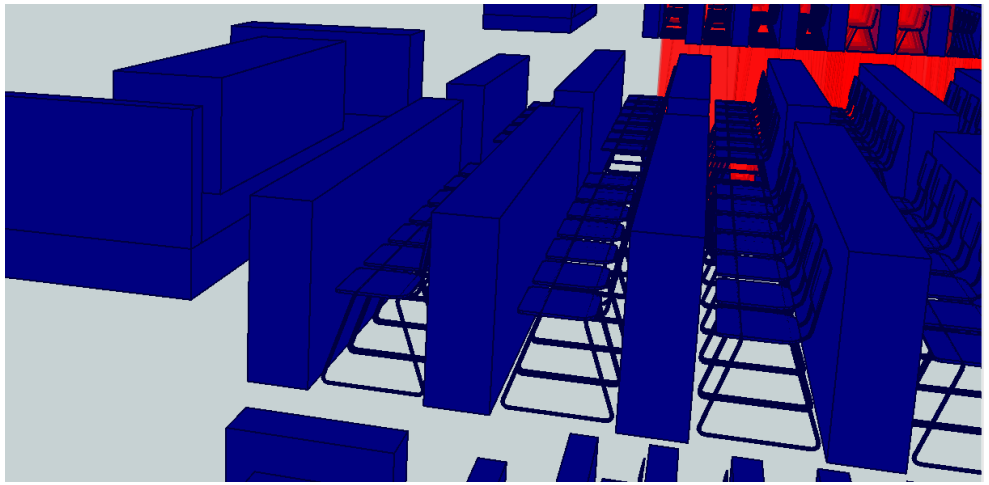


GeoBIM Integration for Asset Management



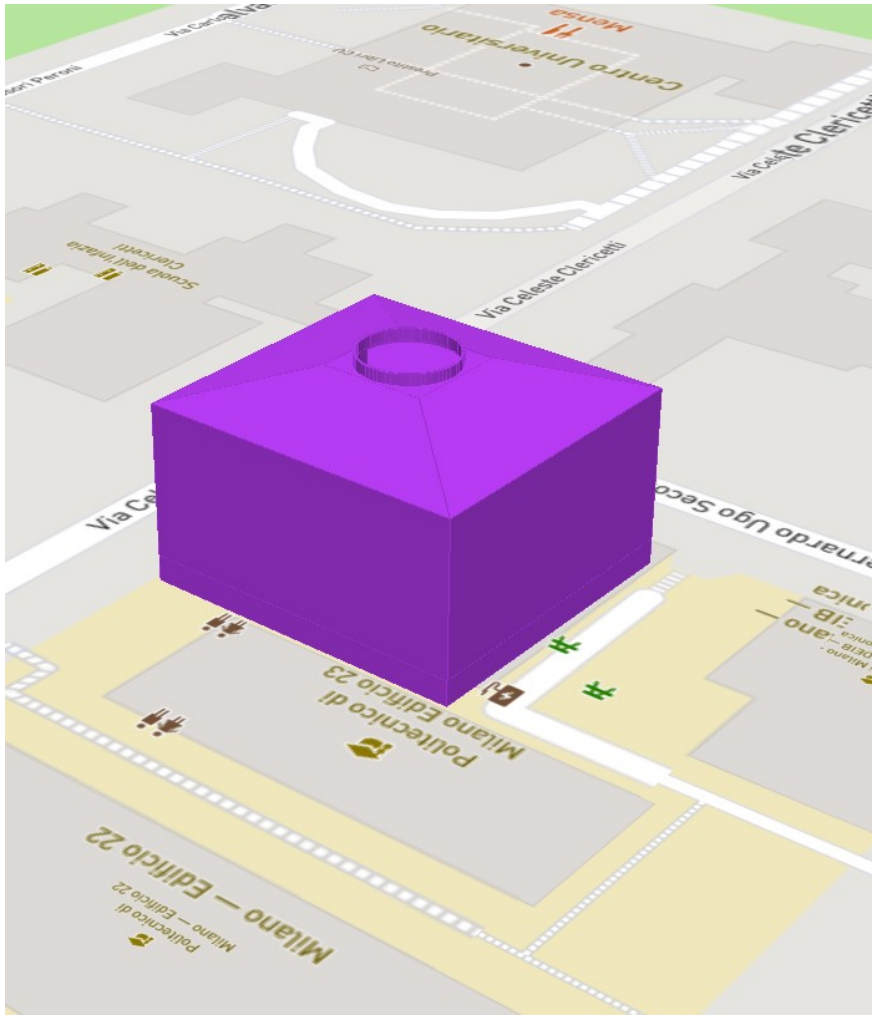


- Feature Geometry
  - In some cases the feature existed but wasn't called something we could recognize …
  - Room = IFCSpace
  - Socket, Light = IFCFlowTerminal
  - Bench = IFCFurnishingElement



GeoBIM Integration for Asset Management

- Feature Geometry
  - In some cases, we needed to create the geometry (the feature) before reporting its condition
  - Building LoD2 = IFCWallStandardCase + IFCSlab + IFCRoof
  - Opaque Façade = IFCDoor + IFCWallStandardCase
  - Transparent Façade = IFCWindow

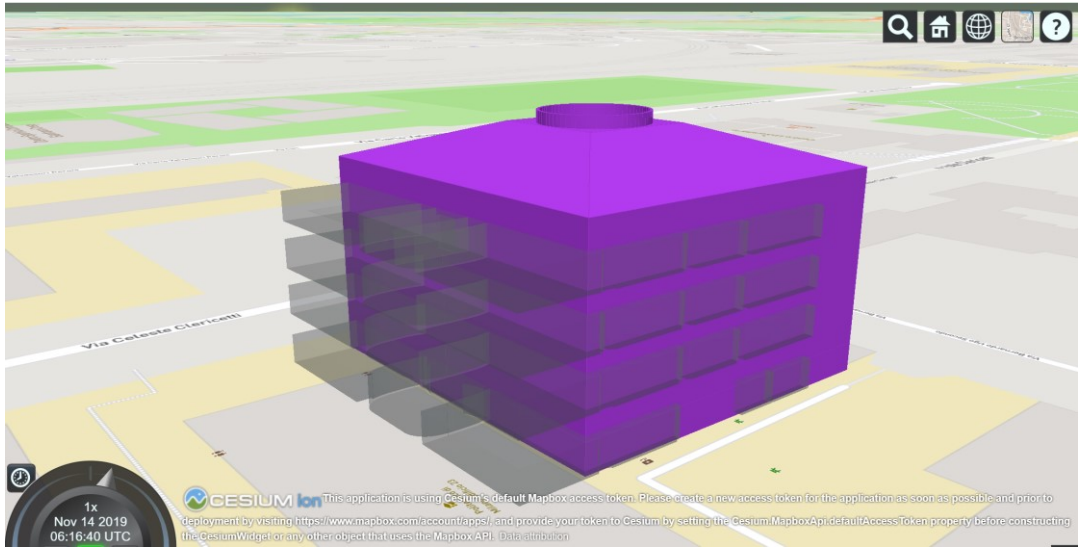


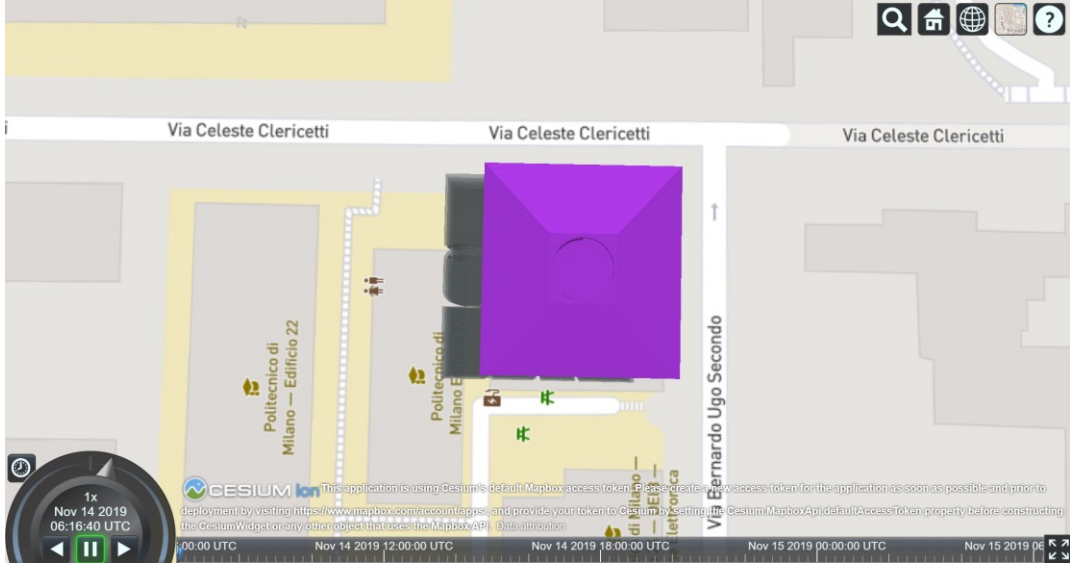
GeoBIM Integration for Asset Management

- Feature Geometry
  - In some cases, we needed to create the geometry (the feature) before reporting its condition
  - This was mostly for outside feature in our case
    - BIM was created specifically for this project by Asset Managers and BIM experts working together
    - 3D editing is tricky

GeoBIM Integration for Asset Management

- Positional Accuracy
  - 3 possible sources of error
    - Georeferencing the BIM
    - IFC Import into PostGIS
    - IFC Conversion to CesiumJS tiles





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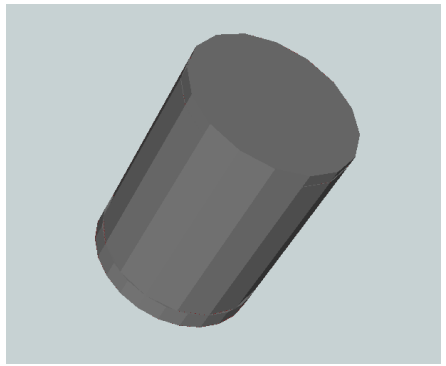
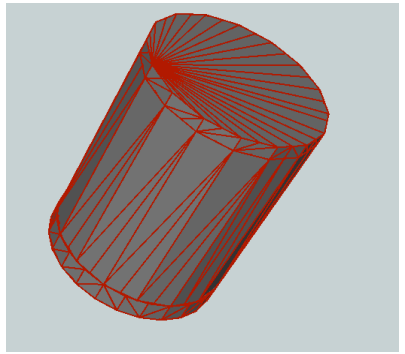
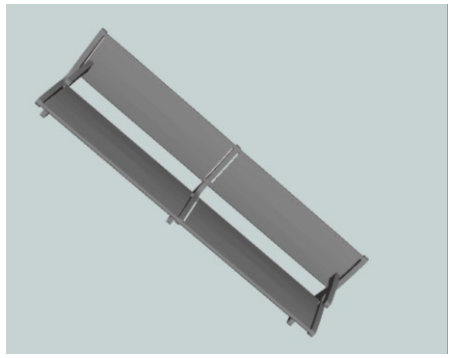
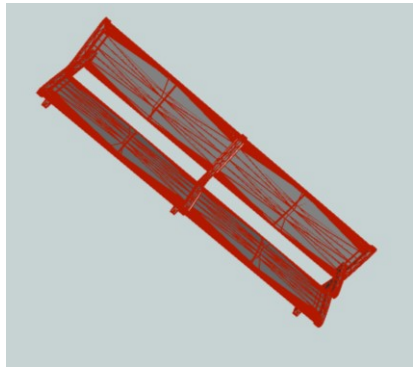




Geometry Conversion

- 1 flow terminal = 1084 nodes
- All flow terminals = 5514216 nodes
- All roads in our map 12300 nodes



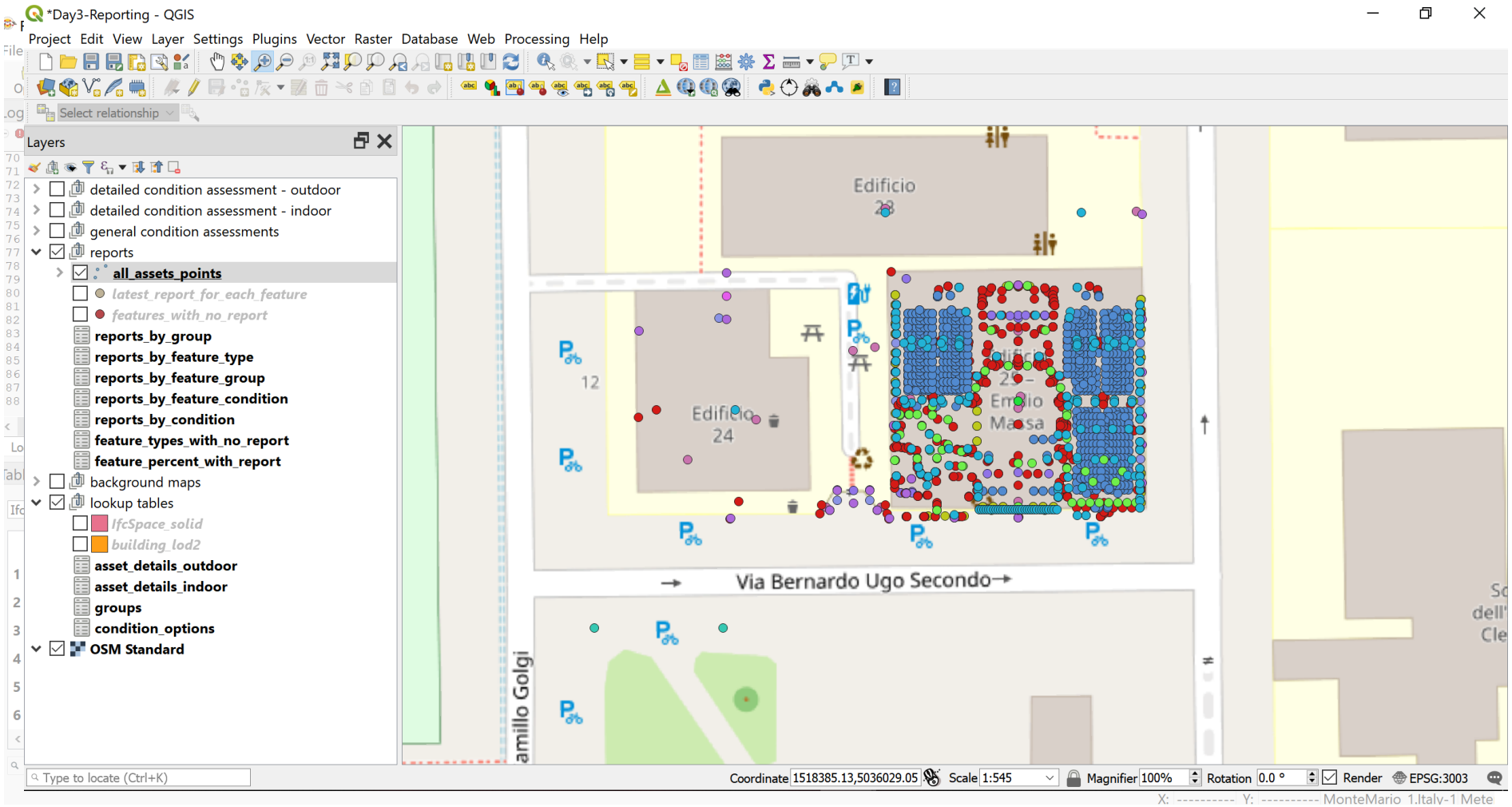


Geometry Conversion

- 1 bench = 62007 nodes
- All furniture = 12255786 nodes
- All buildings in our map 379624 nodes

GeoBIM Integration for Asset Management

- Geometry Complexity – complex features rendered as points in the GIS



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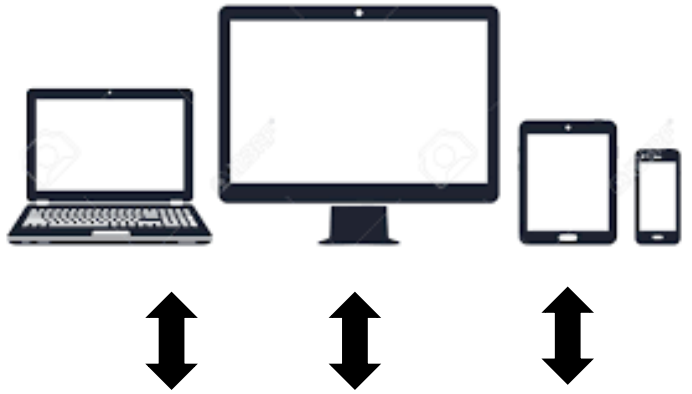
GeoBIM and Asset Management

- The database worked for both BIM and GIS data storage
  - Compromise – reduced geometry quality for enhanced information management
  - Reporting tools easy to create
  - Easy to connect a 3D visualisation and also charts/graphs
- Now we have the data .. we can start to think about higher level aggregation (from FM to AM)

A Digital Twin – Mix and Match



- A “single source of truth” – ambition:

Integration Software – Combine Data As Needed Depending on User Requirements

Data APIs

Employee & CRM

BIM

GIS

FM and costs

Sensors/ Change Detection

Asset Mgmt & finance

Thank You

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