SBS5322 Basics of Building Information Modelling

http://ibse.hk/SBS5322/

Introduction

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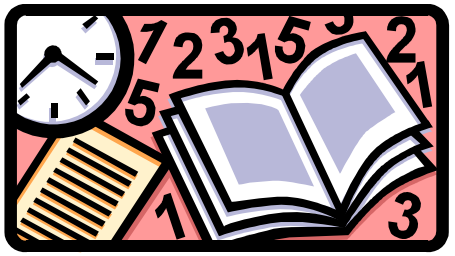
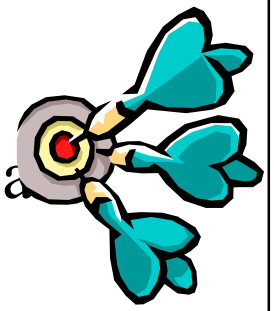
Contents

- Background
- Drawing skills and BIM
- Basic concepts of BIM
- Why BIM?
- Exercise
  - Drawing your doodles

Background

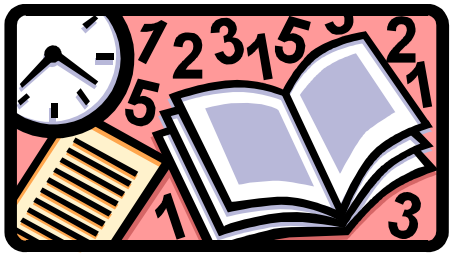


- Module Aim(s):
  - This module introduces the basic concepts and essential background of building information modelling (BIM) to students of building services engineering and other related professional disciplines. It extends the knowledge in engineering drawing and computer-aided design (CAD) in construction projects, and develop skills necessary for understanding virtual design and construction (VDC). Students will learn the conceptual background of BIM a apply the principles for the various aspects of BIM.



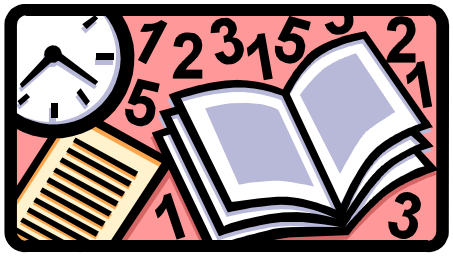
- Related module:
  - SBS5411 Building Information Modelling for BSE

Background

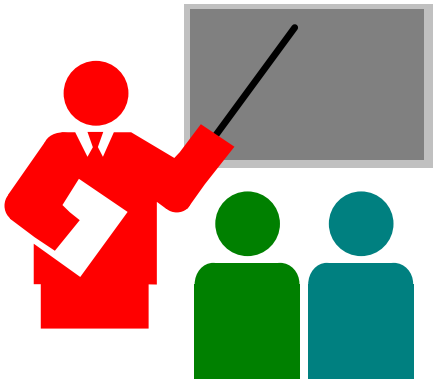


- Learning Outcomes:
  - 1. explain the basic concepts of BIM for construction and building projects;
  - 2. identify the various aspects of BIM and evaluate their potential benefits for different building professionals and stakeholders; and
  - 3. apply the fundamental techniques of BIM to CAD applications and automated construction solutions.

Background

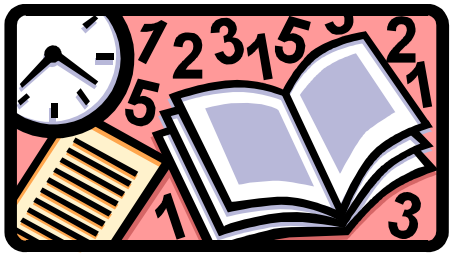


- Lecturers:
  - Ir Dr. Sam C. M. Hui (cmhui@vtc.edu.hk)
  - Dr. PAN Yan, Penny (pennypan@vtc.edu.hk)
- Course Website: (with links and resources)
  - http://ibse.hk/SBS5322/
- Moodle system
  - http://moodle.vtc.edu.hk/



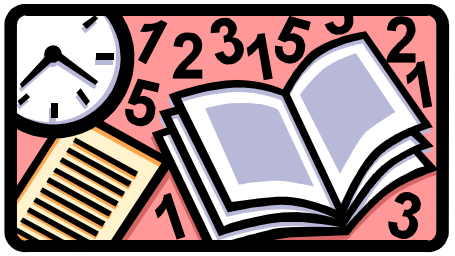
- Your previous learning forms a basis:
  - Engineering Drawing and Construction CAD

Background



- Assessment Components:
- Assignments (50%)
  - Assignment by Dr. Hui (25%)
  - Assignment by Dr. Pan (25%)
- Examination (50%) (3 hours)
  - Section A by Dr. Hui (5 out of 6 questions @ 10 marks)
  - Section B by Dr. Pan (5 out of 6 questions @ 10 marks)

Background



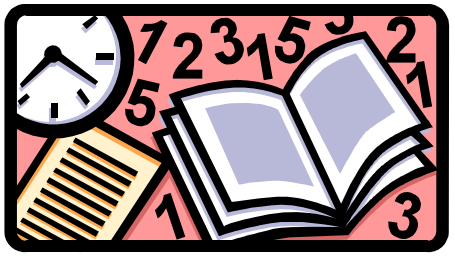
- Study topics:
  - 1. Introduction
  - 2. What is BIM?
  - 3. Computer modelling and BIM software
  - 4. Computer visualization
  - 5. BIM collaborations
  - 6. Teamwork solutions

Dr. Hui

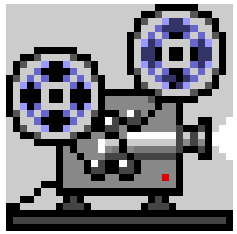
  - 7. Construction coordination
  - 8. BIM 5D model
  - 9. BIM and sustainable design
  - 10. Building energy analysis
  - 11. BIM documentation
  - 12. Latest BIM trends

Dr. Pan

Background



- Learning Methods:
  - Lectures + Further Reading
  - Individual Assignments
  - Discussions
    - During lectures/tutorials
  - Guest lectures
- Resources:
  - Video presentations
  - Web links + References



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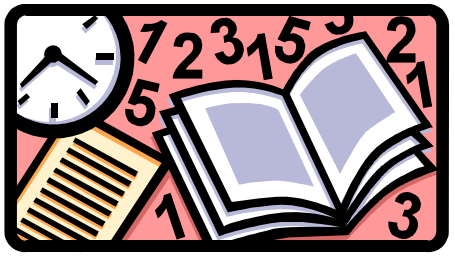
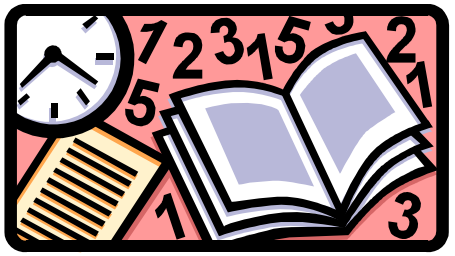


- Useful referencs:
  - Denis, F., 2015. *Building Information Modelling – Belgian Guide for the Construction Industry*, ADEB-VBA, Brussel. (http://adeb-vba.be/the-guide-to-bim.pdf)
  - Garber, R., 2014. *BIM Design: Realising the Creative Potential of Building Information Modelling*, Wiley, Chichester, England. (ebook: http://webpac.vtc.edu.hk/record=b11337834)
  - Holzer, D., 2016. *The BIM Manager's Handbook: Guidance for Professionals in Architecture, Engineering, and Construction*, John Wiley & Sons, Ltd., Chichester, West Sussex, UK. (ebook: http://webpac.vtc.edu.hk/record=b11468140)
  - Lévy, F., 2012. *BIM in Small-scale Sustainable Design*, Wiley, Hoboken, NJ. (ebook: http://webpac.vtc.edu.hk/record=b11305579)

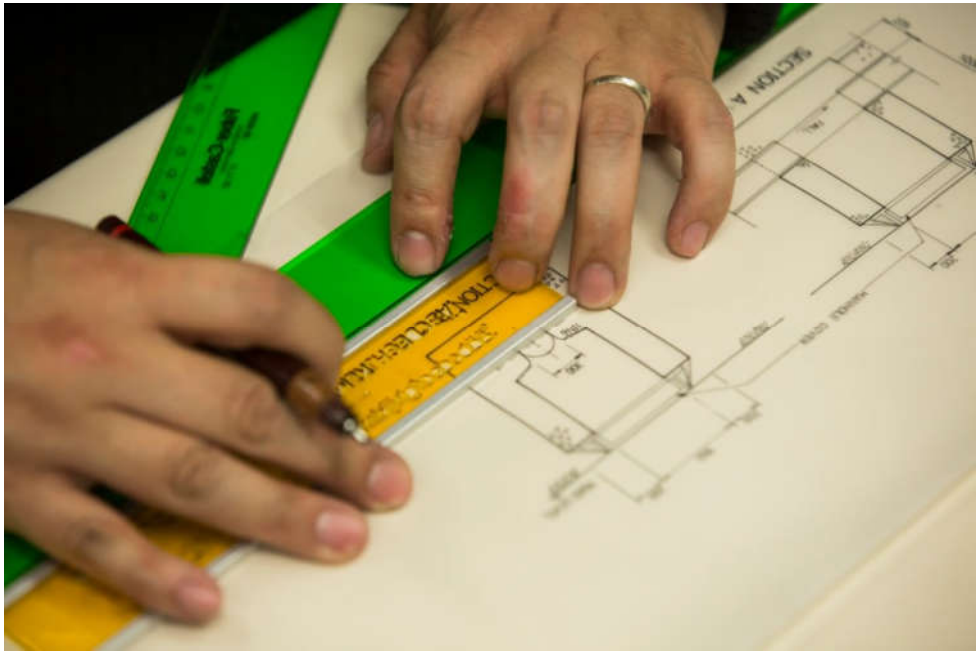
Background

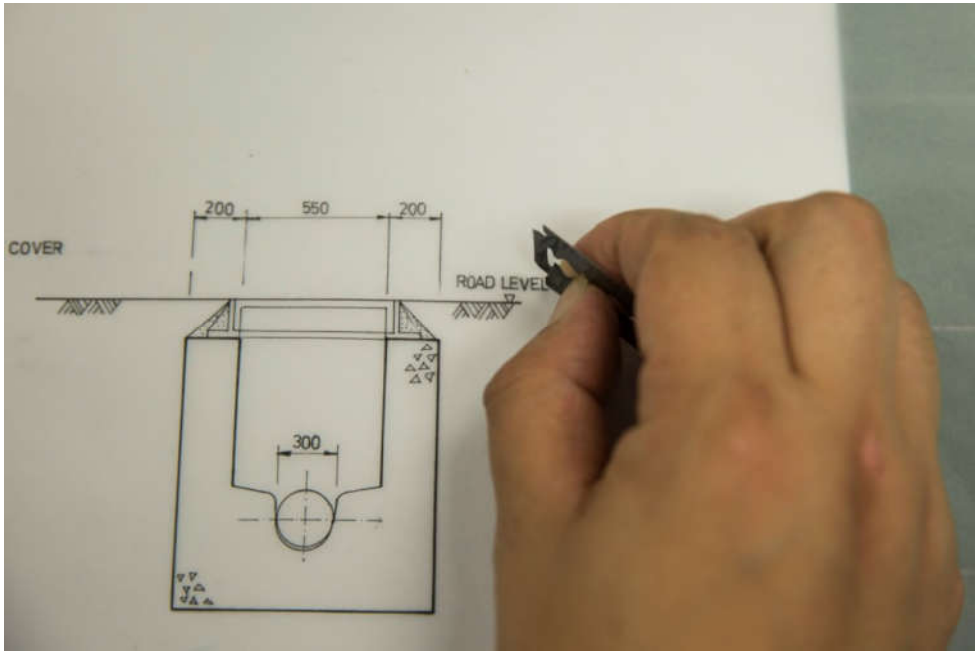


- Useful Websites:
  - Autodesk Design Academy
    - http://academy.autodesk.com
  - BIM Basics [BIM+]
    - http://www.bimplus.co.uk/bim-basics/
  - BIM For Beginners [theb1m.com]
    - http://www.theb1m.com/BIM-For-Beginners
  - Graphisoft BIM Curriculum
    - http://www.graphisoft.com/learning/bim-curriculum/

Drawing skills and BIM

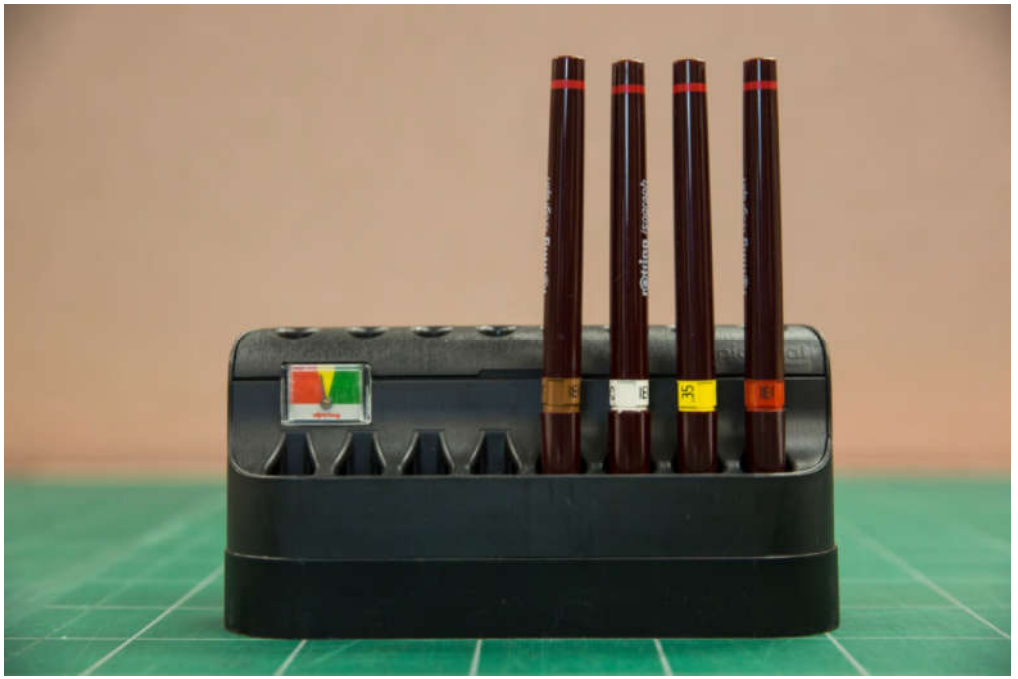
Hand drafting of technical and engineering drawings becomes a history

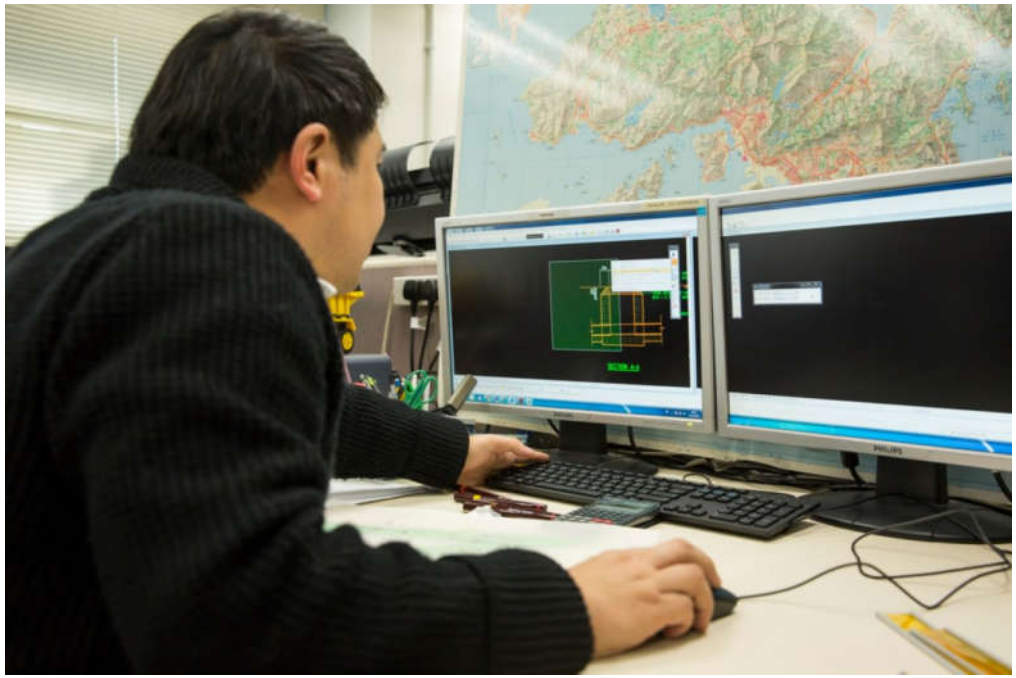




(Source: 一筆一劃勾勒工程靈魂　渠署繪圖師：圖則是將意念實踐 (HK01 News))

Hand drafting tools and computer-aided drafting





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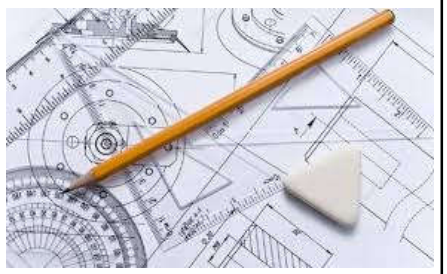
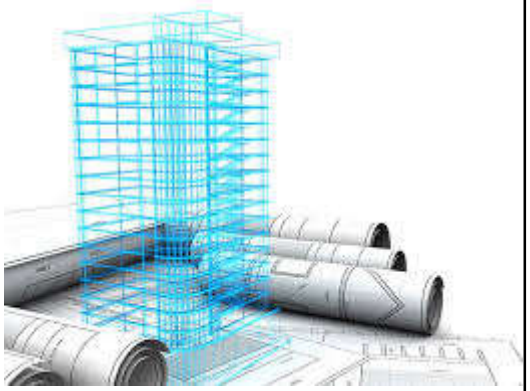
Drawing skills and BIM



- How are your drawing skills?
  - Hand drafting with ink pens and pencils
  - Computer-aided drafting/drawing (CAD) with software e.g. AutoCAD and Microstation
  - 3D models with BIM software



- Year 1 and 2 modules:
  - SBS4122 Engineering Drawing
  - SBS4212 Construction CAD by AutoCAD

Drawing skills and BIM

- Architectural documentation
  - Drawings
    - Floor plans, sections, elevations
    - Interior elevations
    - Details, 3D views
  - Documents
    - Descriptions, calculations
    - Schedules
    - Quantity Take-offs (QTOs)
    - Cost Estimations

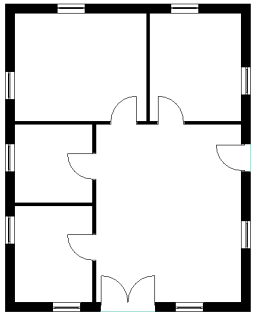
(Source: Graphifsoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Graphical Projections

Ortographic Projections

Planar Views:

- Plan
- Sections
- Elevations

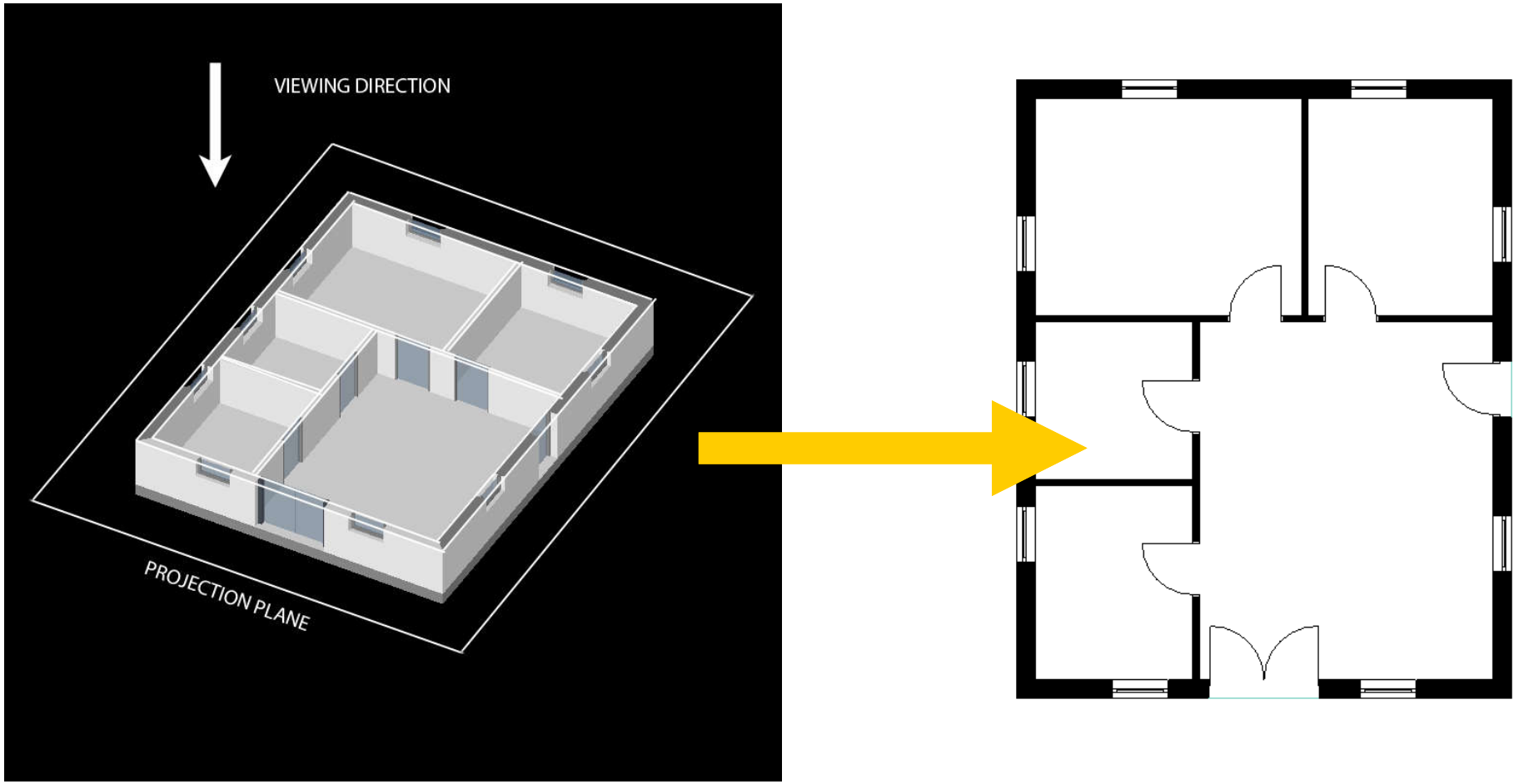


Axonometric Views

Perspective Projections

(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Planar Views: Floor Plans



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

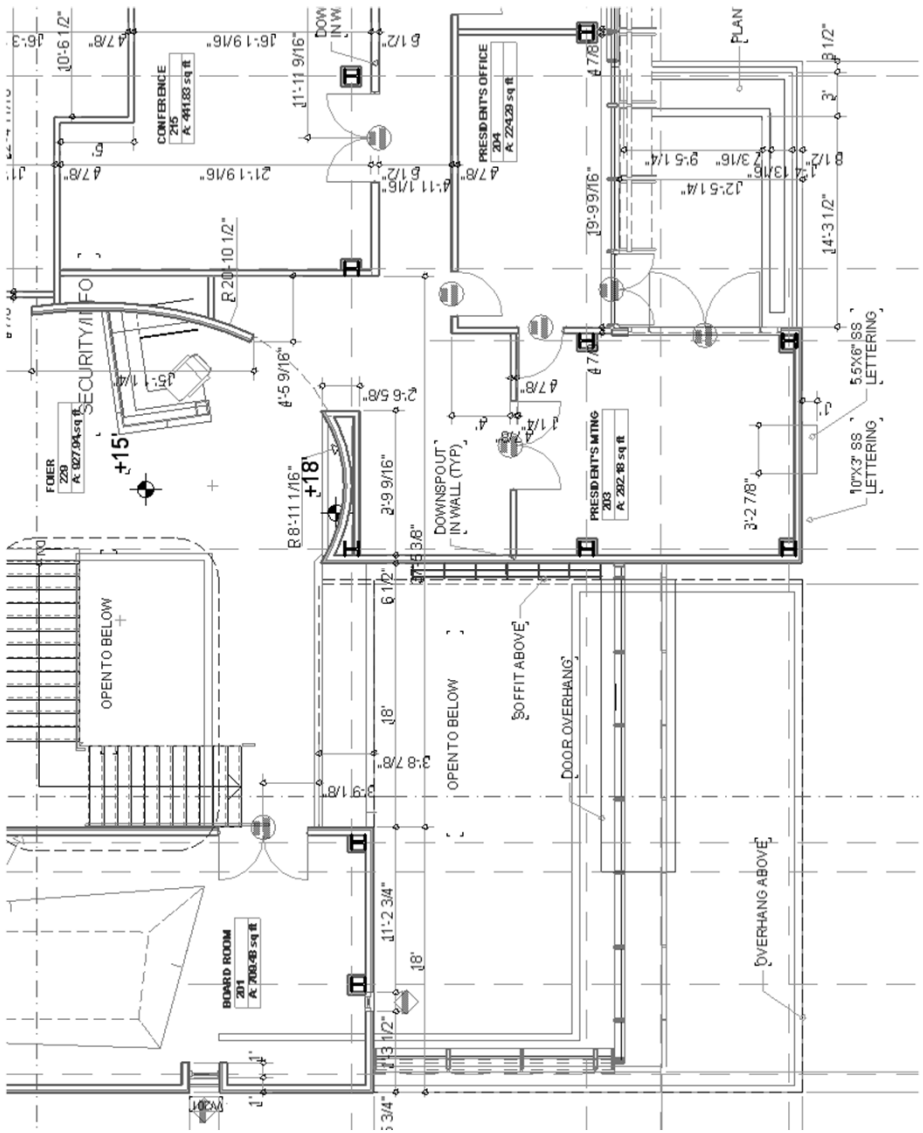
Floor Plans

Drawing Content

- Structural
- Elements
- Mobile & Fix furniture
- Dimensions
- Annotations
- Flooring
- Area info

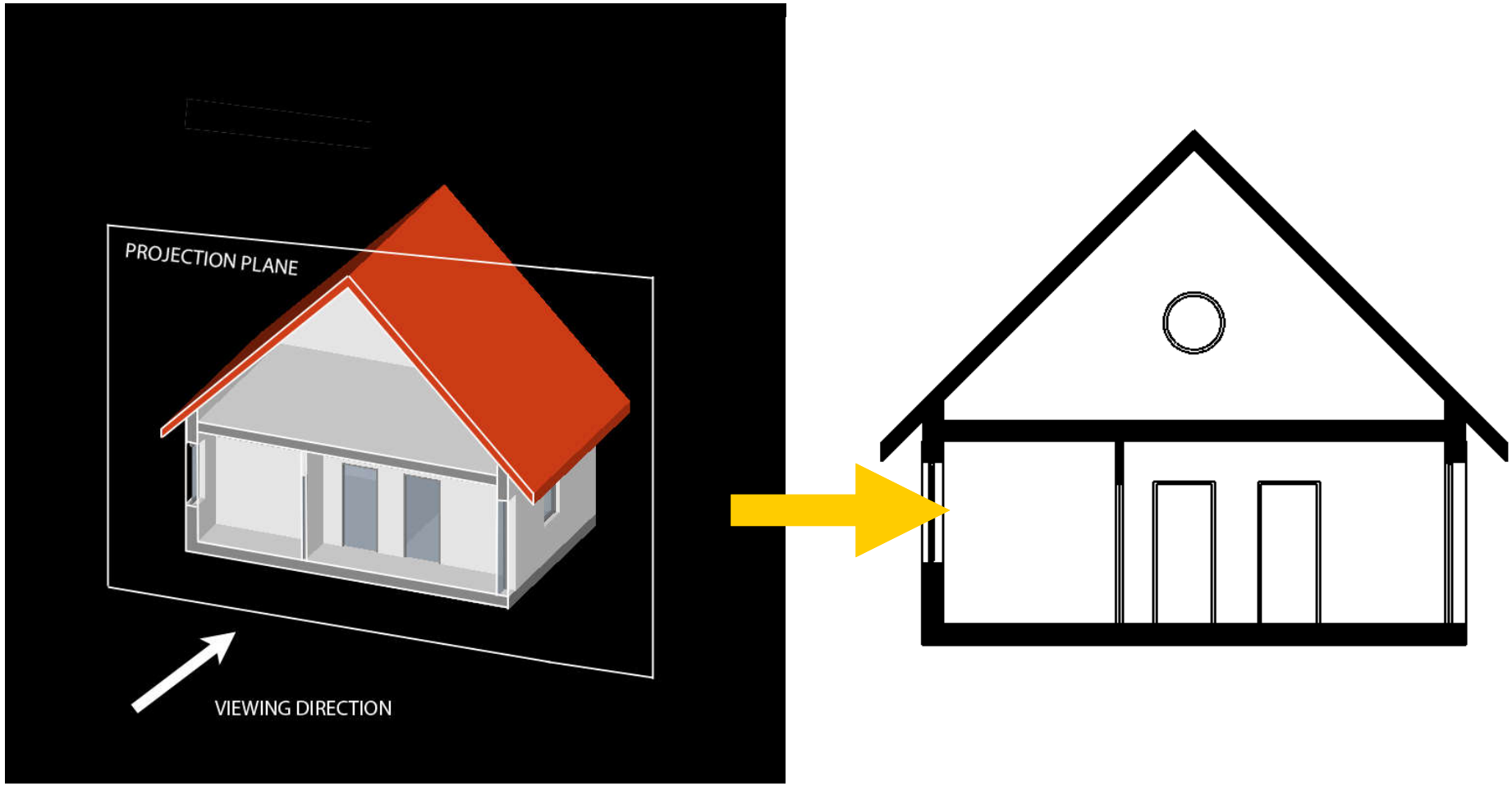
Types

- Architectural
- Structural
- Electrical & Plumbing
- Furnishing
- Reflected Ceiling Plan
- Etc.



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Planar Views: Sections



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

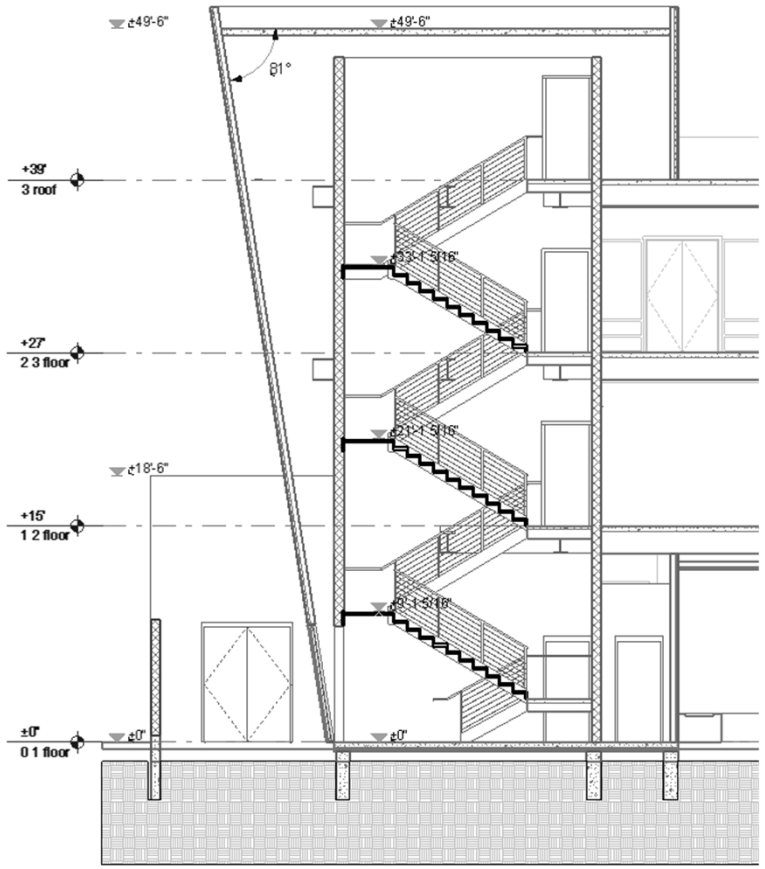
Sections

Drawing Content

- Structural Elements
- Fix Furniture
- Dimensions
- Level Dimensions
- Annotations

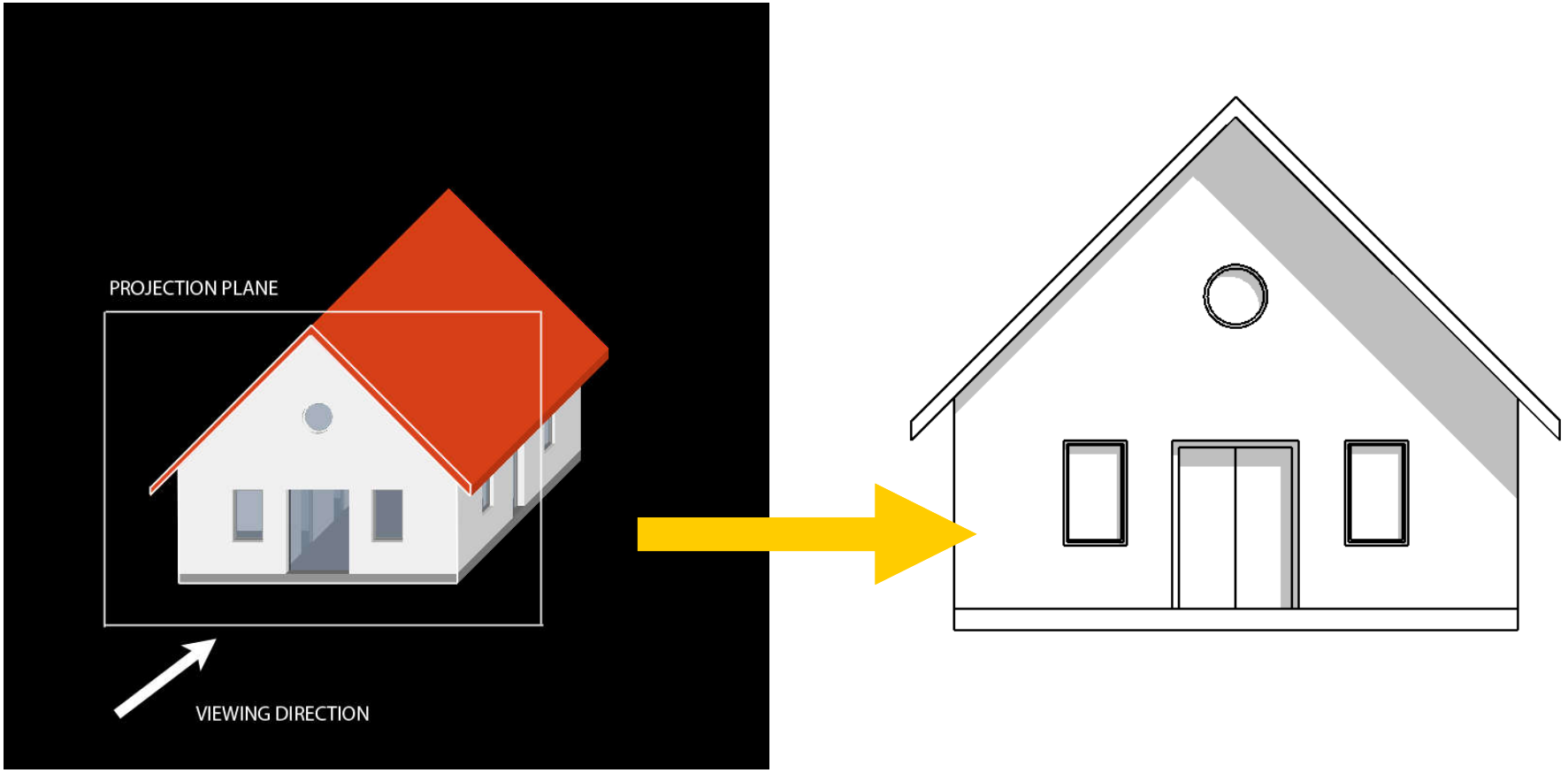
Types

- Architectural
- Structural
- Electrical & Plumbing
- Etc.



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

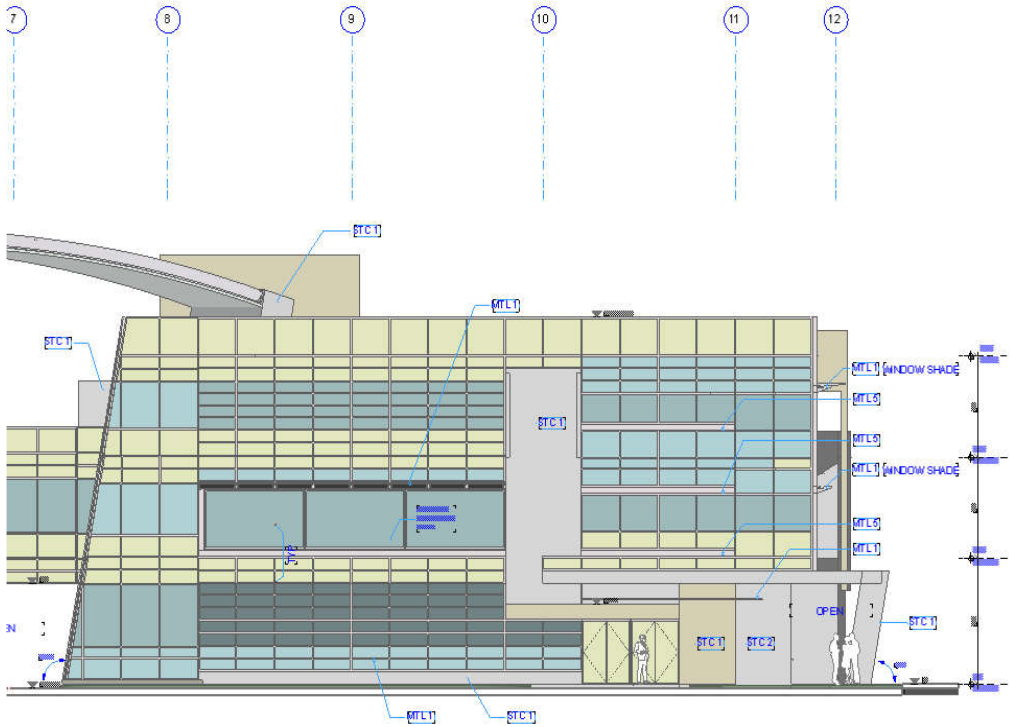
Planar Views: Elevations



(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Elevations
Drawing Content

- Exterior Building Elements
- Dimensions
- Level Dimensions
- Annotations
- Material Information
- Colors, Shadows



Types

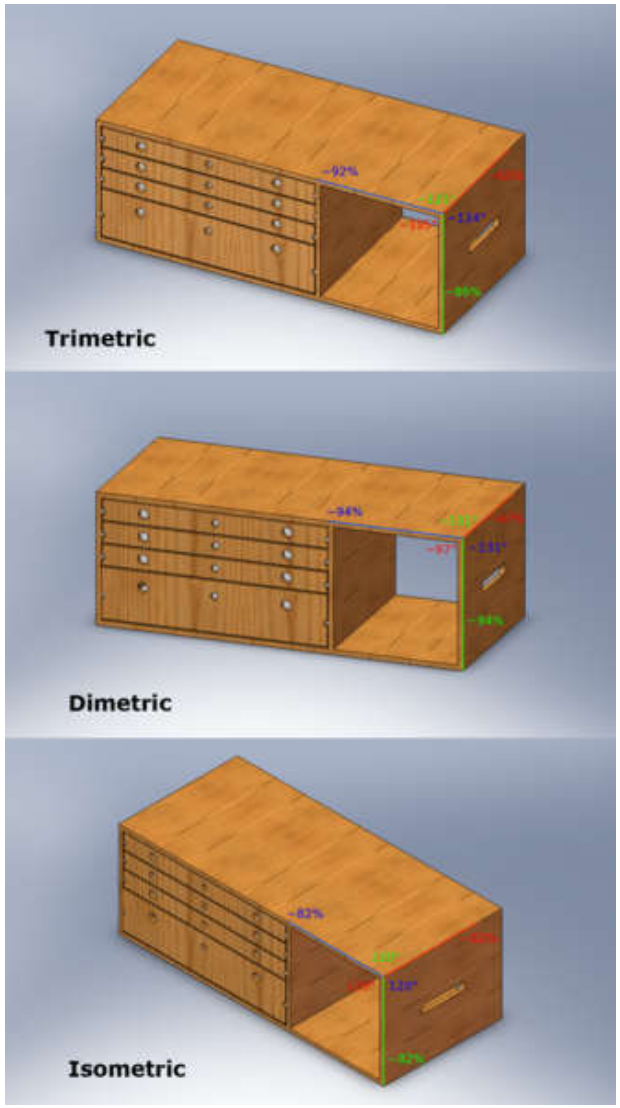
- Architectural
- Structural
- Interior Elevations
- Etc.

(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Axonometric Views

Axonometry:
”Image of an object as viewed from a skew direction in order to reveal more than one side in the same picture”

- Basic View Types
  - Trimetric
  - Dimetric
  - Isometric

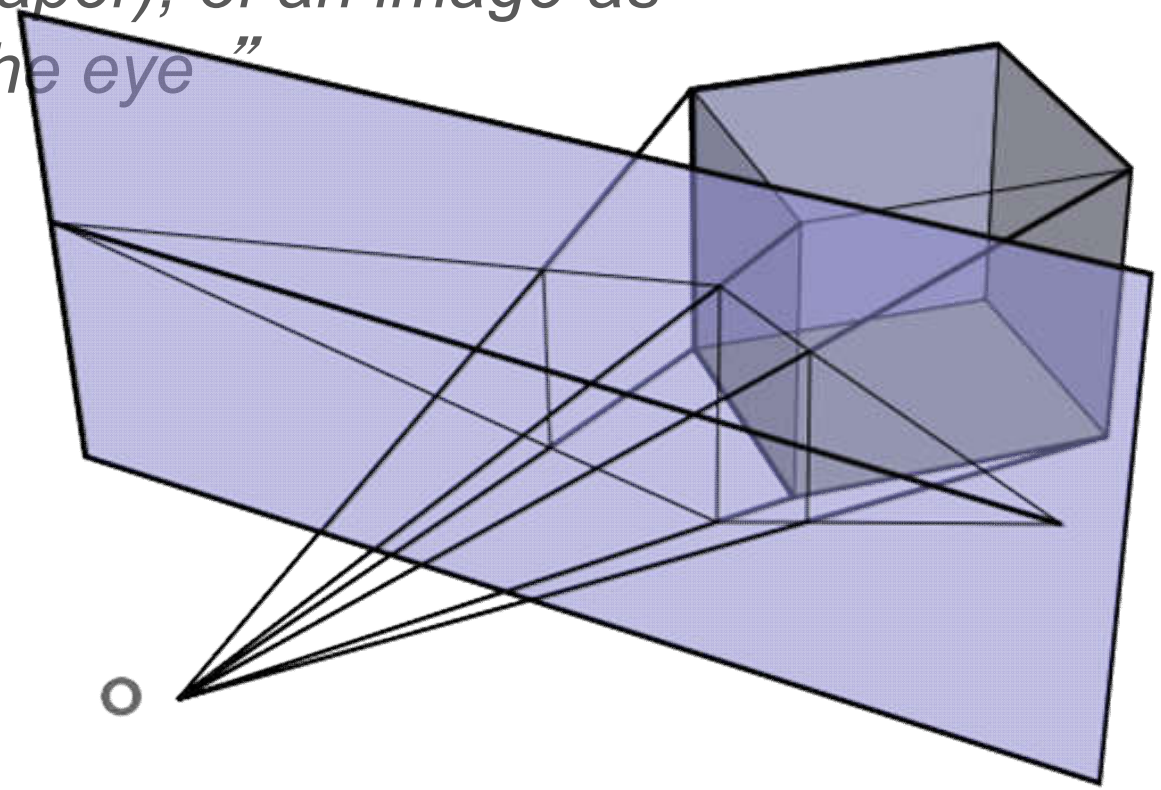


(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Perspective Views

Perspective:

”approximate representation, on a flat surface (such as paper), of an image as it is perceived by the eye”

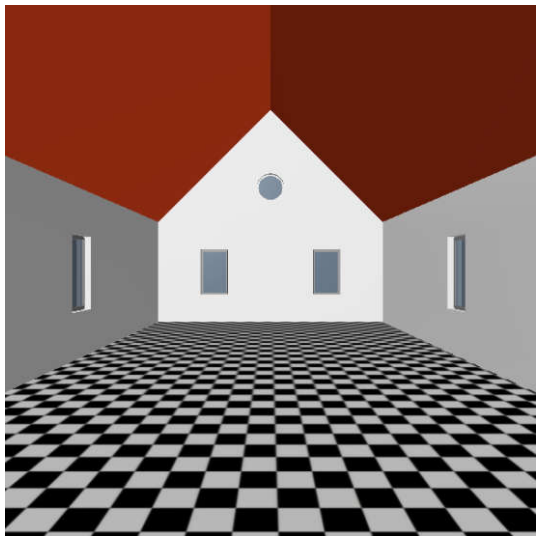


- Main Concepts
  - Foreshortening
  - Horizon Line
  - Vanishing Point

(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Perspective Views

- Basic Types



One-point Perspective

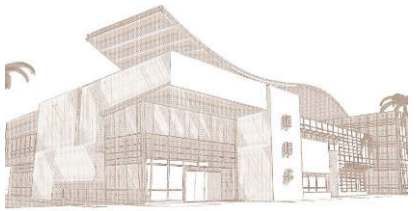
Two-point Perspective

Three-point Perspective

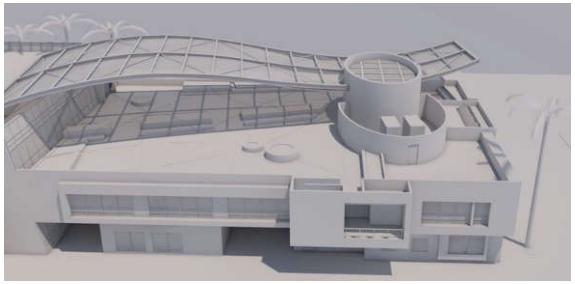
(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

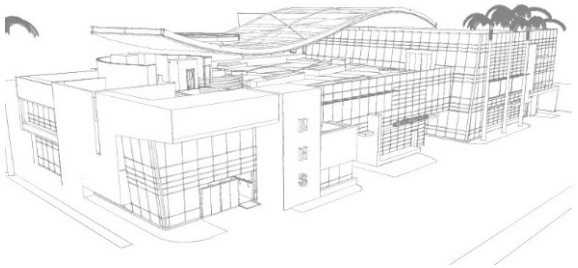
Computer Visualization

- Photorealistic images (rendering)



Artistic images





Interactive virtual models

Fly through animations

Sun studies

(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Non-graphic Documentation

- Descriptions
- Instructions
- Calculations
- Lists
- Schedules
- Quantity Take-offs
- Cost Estimations

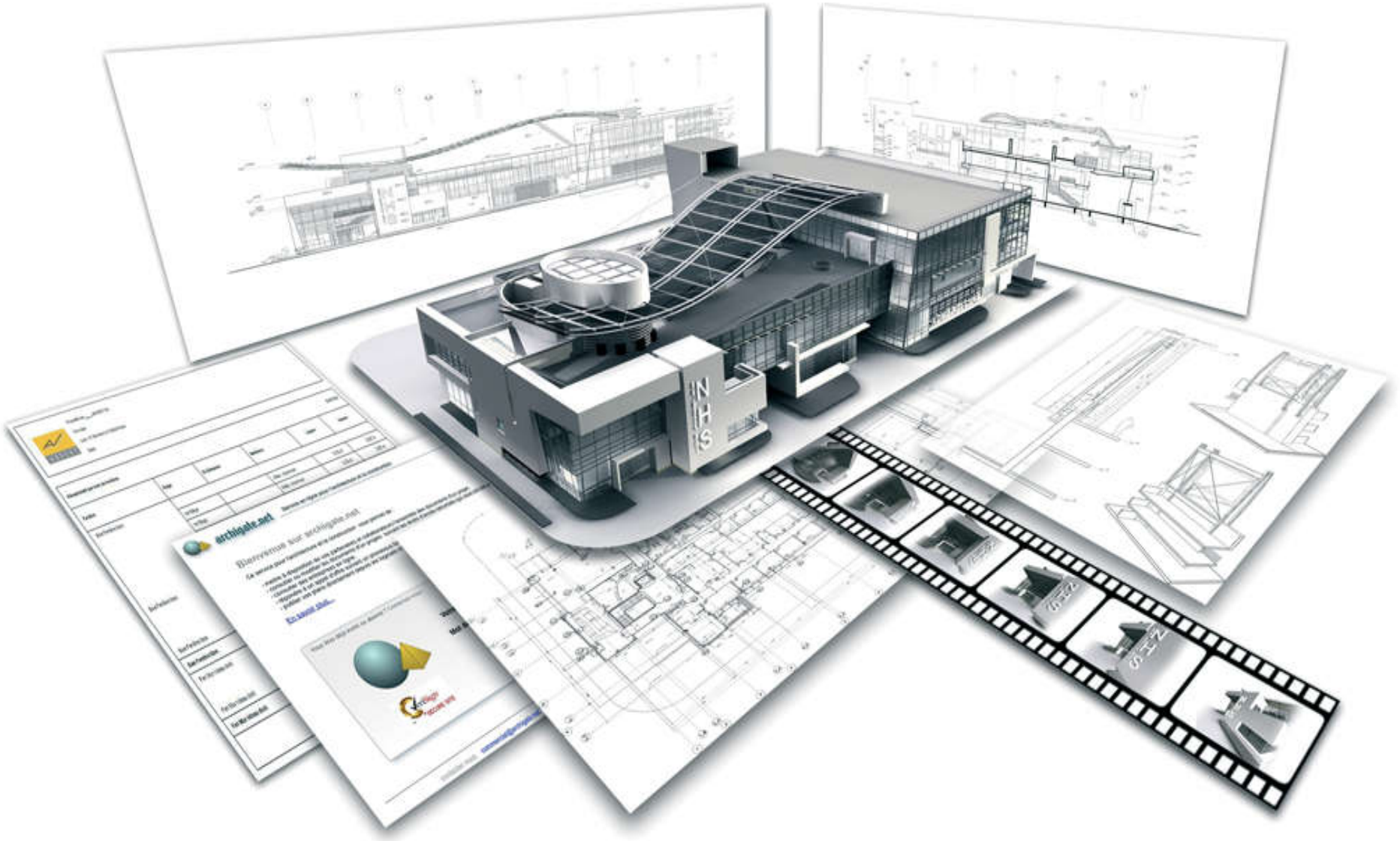
TEXTFIELD 1
TEXTFIELD 2
TEXTFIELD 3
TEXTFIELD 4

Window Schedule 2006. 03. 06.

W1 Casement	Width:	0,90 m	1 piece(s)
	Height:	1,50 m	
	User ID		W01
	Opening orientation		0
	Material		Wood-Pine

(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

The BIM Concept

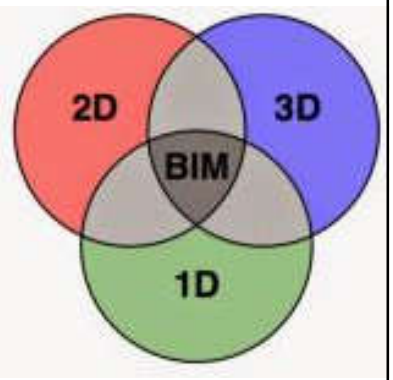


(Source: Graphisoft BIM Curriculum http://www.graphisoft.com/learning/bim-curriculum/)

Basic concepts of BIM

Basic concepts of BIM

- BIM:
  - Building Information Modelling
    - 建築資訊模擬 / 建築資訊模型
  - Building Information Management
- Information and Model
  - 1D: Data/Text information (non-graphical)
  - 2D: Drawings/Diagrams (graphical)
  - 3D: Modelling (geometric information, objects)
  - Object based (with attributes, parametric)

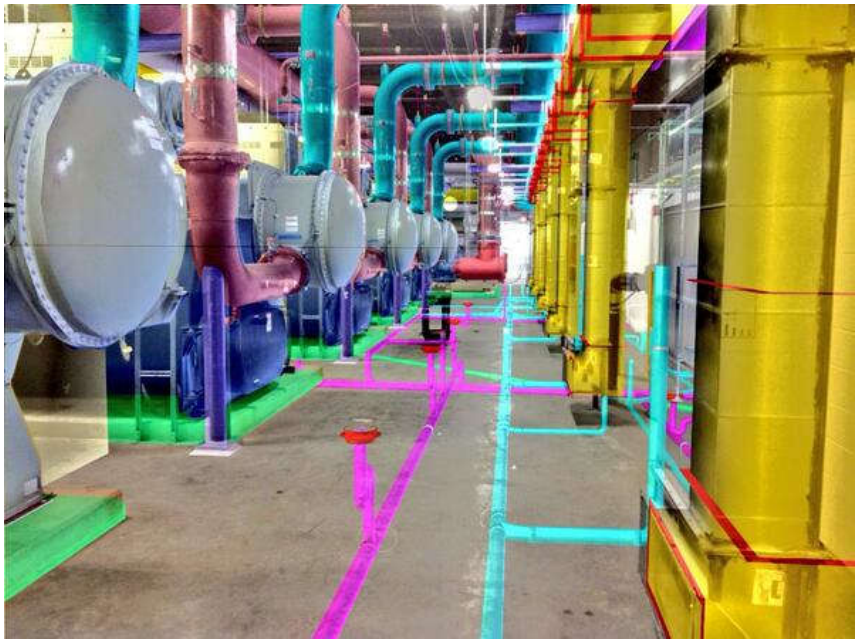


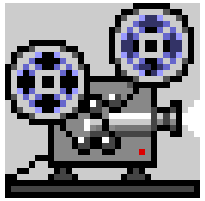
Basic concepts of BIM

- Definition of BIM (from Autodesk)
  - BIM (Building Information Modeling) is an intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure
- BIM is not about the B and the M it is about the I = Information is the key

(Source: What is BIM? (Autodesk) https://www.autodesk.com/solutions/bim)

BIM is an intelligent 3D model-based process





Videos: Examples of BIM applications in AEC and building services engineering
- What is BIM (Building Information Modeling)? (3:00) https://youtu.be/suNadRnHy-U
- Introduction: What is BIM? (2:20) https://youtu.be/rAAGRUXNeNQ

Basic concepts of BIM

- National BIM Standard (US): Definition of BIM
  - A Building Information Model (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 life-cycle from inception onward.
  - A basic premise of BIM is collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information in the BIM process to support and reflect the roles of that stakeholder. The BIM is a shared digital representation founded on open standards for interoperability.

(Source: National BIM Standard https://www.nationalbimstandard.org/)

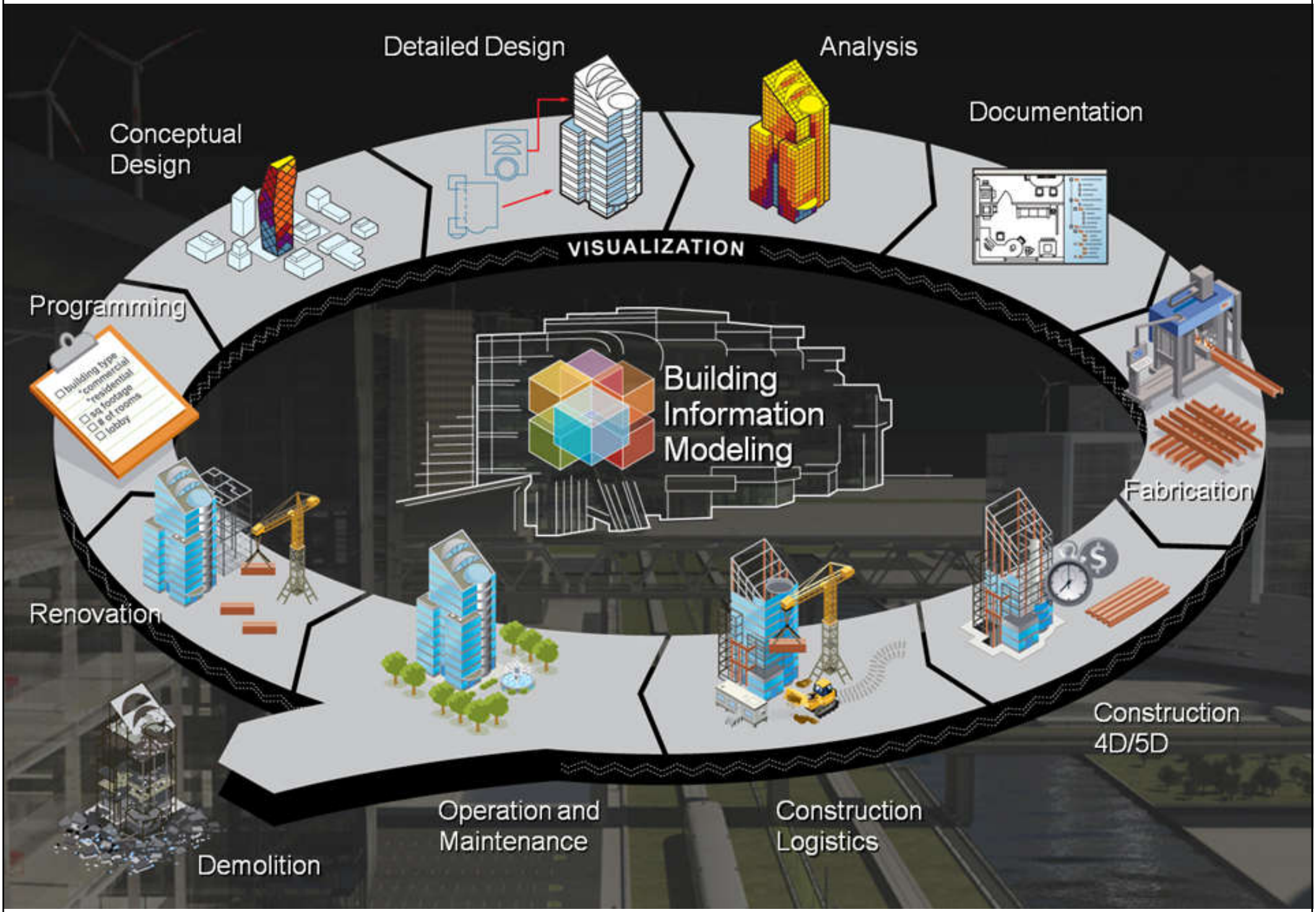
Basic concepts of BIM

- Key concepts of BIM

  - It is a database – not just 3D drawings/images
  - It is all about sharing info through a model with all disciplines (requires all parties to collaborate)
  - Refers to a "model" but it is a "process" not a product (it is a way of working)
  - Working in a BIM environment (a common data environment)
  - Information model => collection of data
  - Connects formerly disconnected silos of info

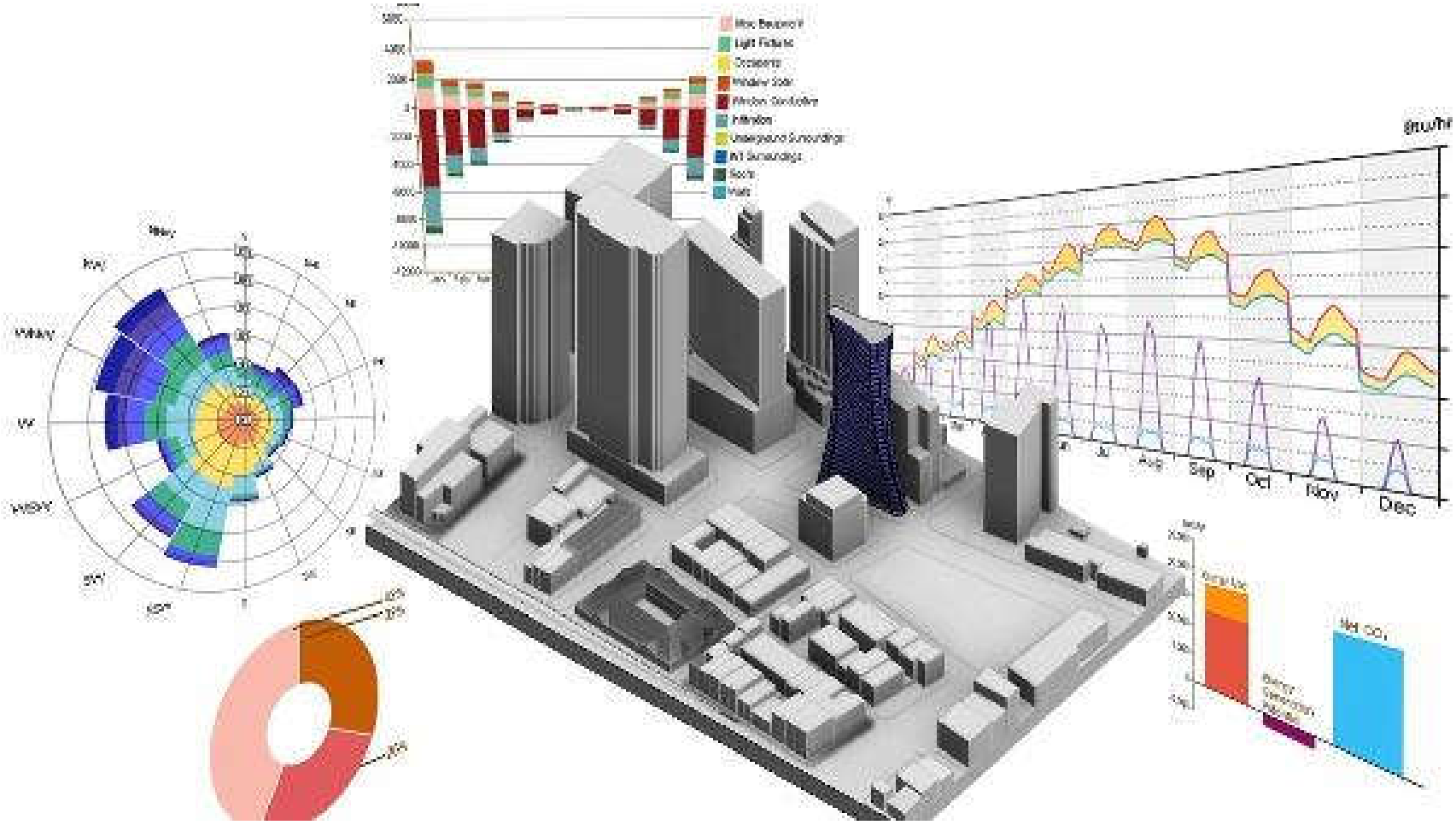
Basic concepts of BIM

- Key concepts of BIM (cont'd)
  - Information models can be used to inform all stages of a built asset's life cycle
  - Ultimate communication tool because it's visual
  - Collaboration to the Nth degree
  - Process + Tools = Power of BIM
  - Enabler for lean construction – can rely on model to help facilitate prefabrication
  - Virtual Design & Construction (VDC) + Analysis + Facility Information = BIM



(Source: Autodesk https://www.autodesk.com/)

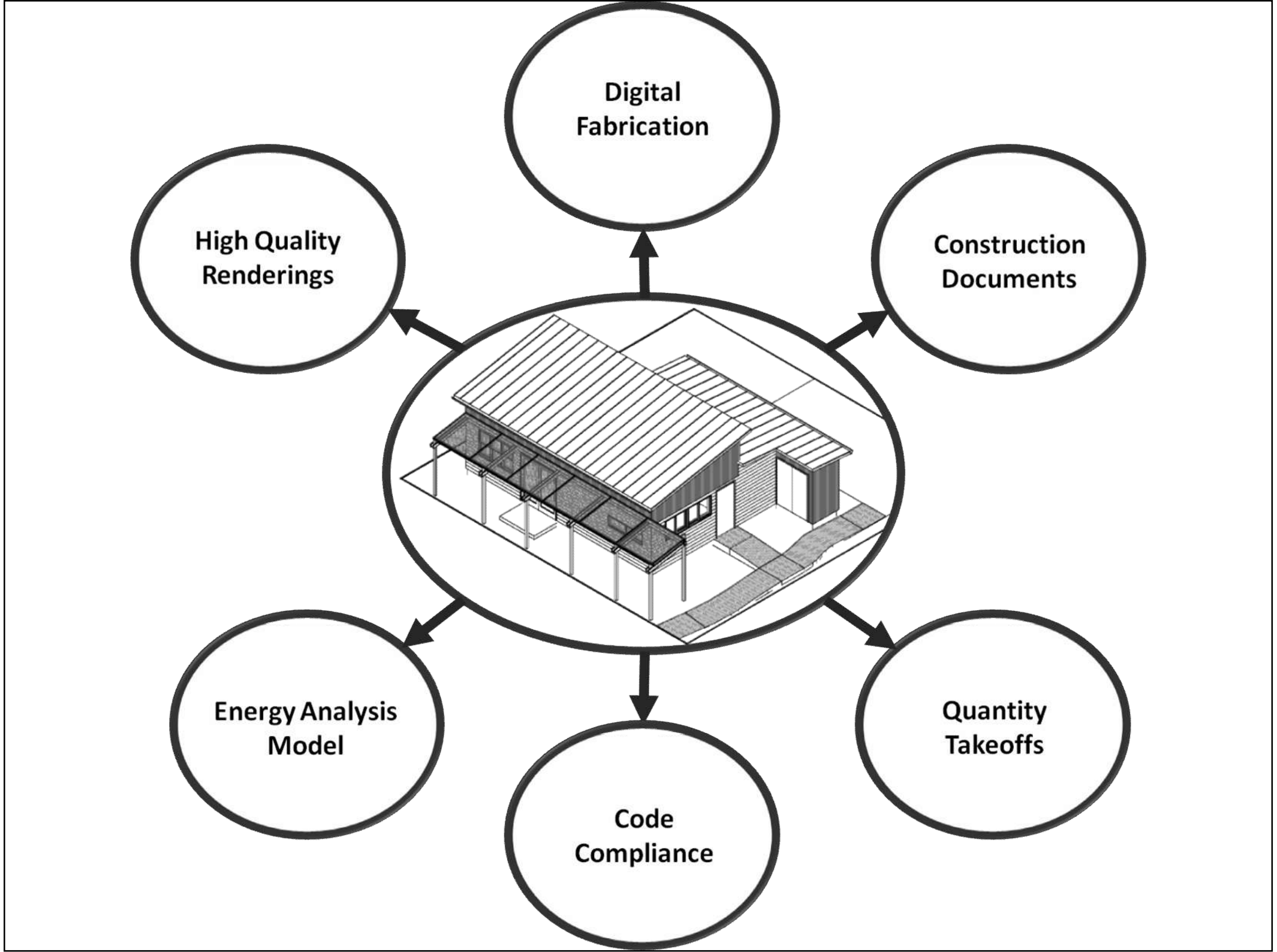
BIM Process + Analysis Tools = Power of BIM



Energy, green building and structural analyses

3D Scanning

Unmanned Aircraft System (UAS) / Drone


Digital Fabrication
High Quality Renderings
Construction Documents
Energy Analysis Model
Code Compliance
Quantity Takeoffs

Basic concepts of BIM

- The BIM information model contains
  - Graphical model: Specific 3-D geometric information such as sizes, areas and volumes
  - Non-graphical data: Cost data, material and component quantities
  - Documentation: Schedule, zoning analysis, environmental performance, instructions for fabrication and construction, reports, manuals
- BIM is a digital design environment

Basic concepts of BIM

- The BIM information model can enable
  - Collaboration among project team members
  - Efficient sketch design
  - Simulation for sustainability, energy and environmental issues, or construction purposes
  - 2D drawing output and numeric export to spreadsheets or other hardware for scheduling or digital fabrication
  - Effective building operation, maintenance & facility management

Basic concepts of BIM

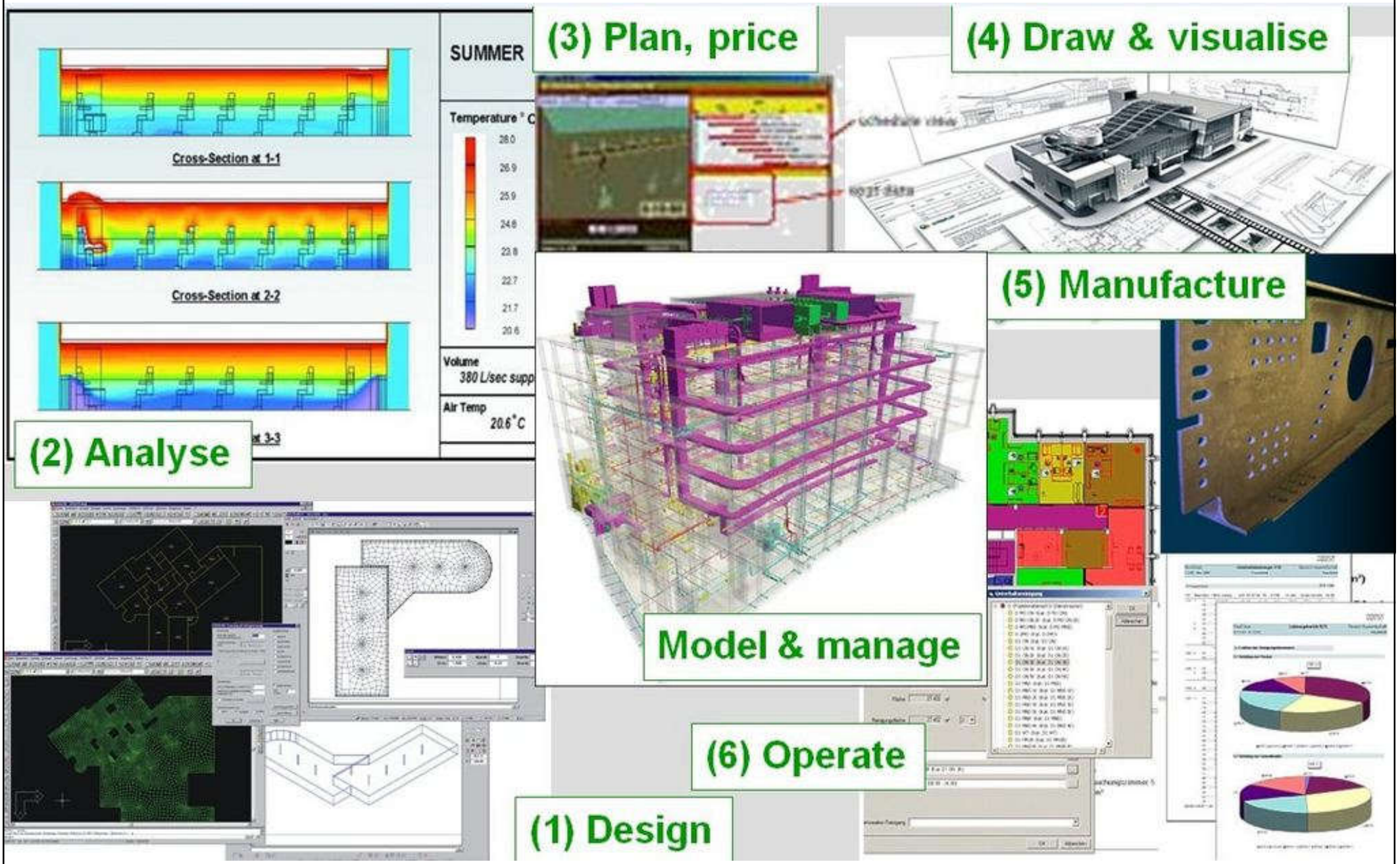
- Based on the use of the information, the BIM information model can be broken down into:
  - 1. Design intent model (by the designer for the designer)
  - 2. Build intent model (by the contractor for the contractor)
  - 3. Fabrication intent model (by the subcontractor for the subcontractor)
  - 4. Facility management model (by the owner for the owner)

Basic concepts of BIM

- Applications for BIM:
  - Architecture
  - Structures
  - Building Services (or MEP)
  - Construction Management, Scheduling
  - Sustainability
  - Utilities
  - Road Construction
  - Property Management

(Source: An Introduction to Building Information Modeling (BIM) https://www.thebalance.com/introduction-to-building-information-modeling-bim-845046)

Practical uses of BIM model and information



Examples of BIM use in building, construction and infrastructure

• Existing conditions modeling • Site analysis • Architectural programming • Quantities Take Off (QTO) • Cost analysis • LCC analysis • Specification production • Design authoring and briefing • Sustainability evaluation • Engineering analysis • Energy analysis • Structural analysis • Lighting analysis • Mechanical analysis • Other engineering analysis	• Building system analysis • 3D coordination • 3D control and planning • Site utilization planning • Product library • Product selection • Perform procurement • Manufacturers information (incl. LCA) • Code compliance checking • Design reviews • Consistency control • Construction system design • Digital fabrication • Phase planning (4D modeling) • Commissioning	• Record modeling • Asset management • Space management and tracking • Disaster planning / emergency preparedness • Building (preventative) maintenance • Scheduling • Security & key management • Telephone move/add/change management • Way finding • Facility management (FM) documentation • Maintenance & repair information

(Source: buildingSMART alliance)

Why BIM?

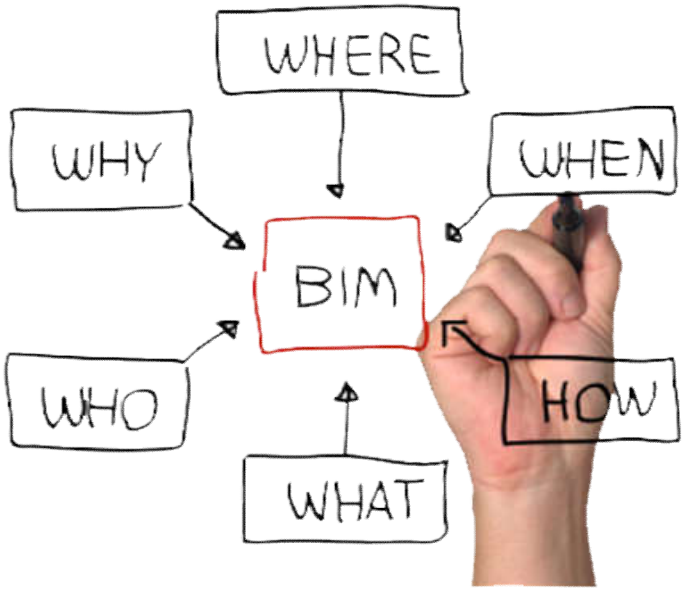
Why BIM?

- Examine problems of construction projects
  - Owner has “clouded” vision of final deliverable
  - Inaccurate/Incomplete plans/specs
  - Trades are picked by lowest price (in most cases no “value added” assigned to competence)
  - Nobody will share info because of liability
  - Everyone wants to shove risk to someone else
  - Because the job is awarded on low price, subs need to make up money on change orders

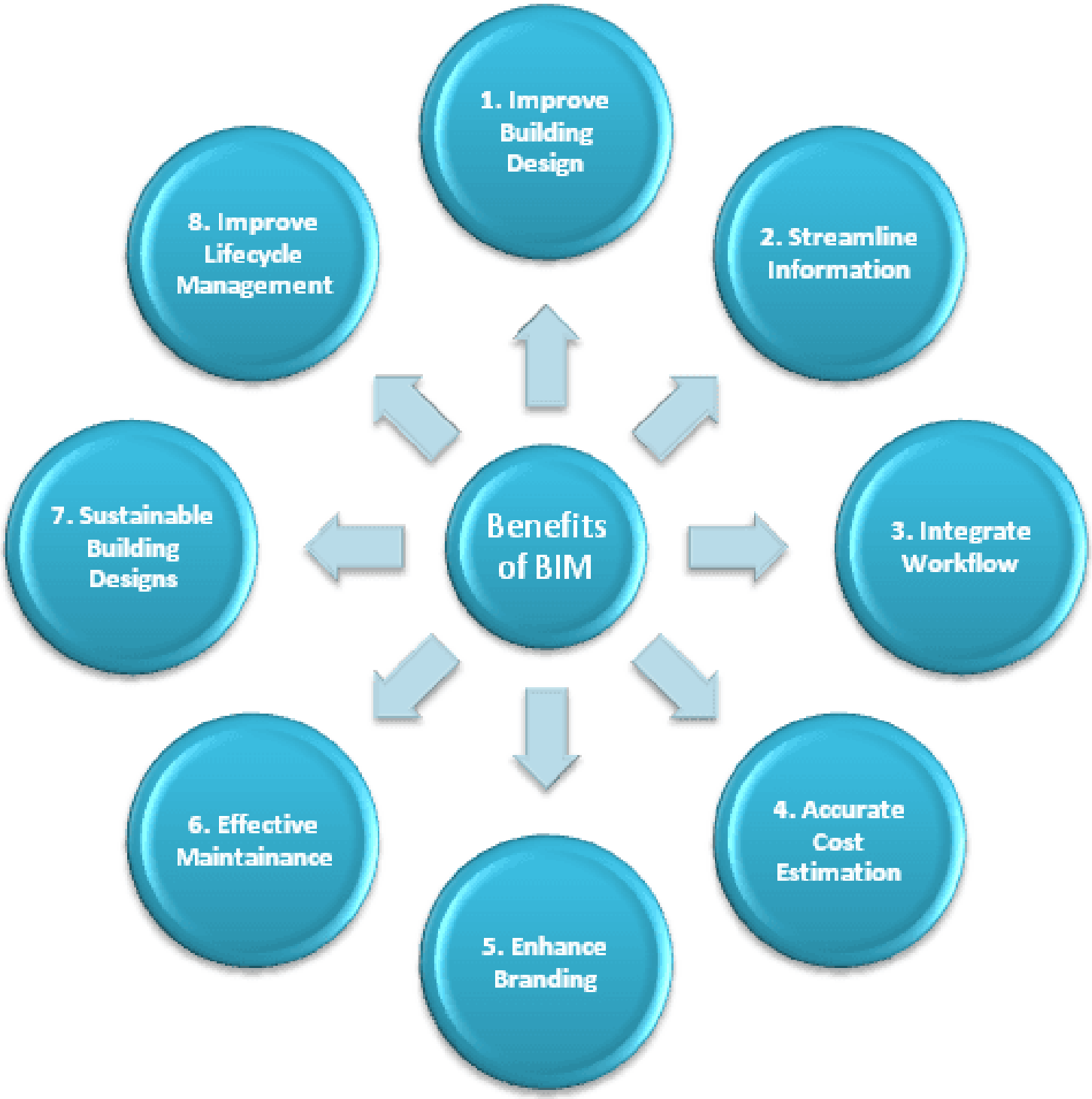
(See also: What is BIM? (4:54) https://youtu.be/PLoUVZjW21g)

Why BIM?

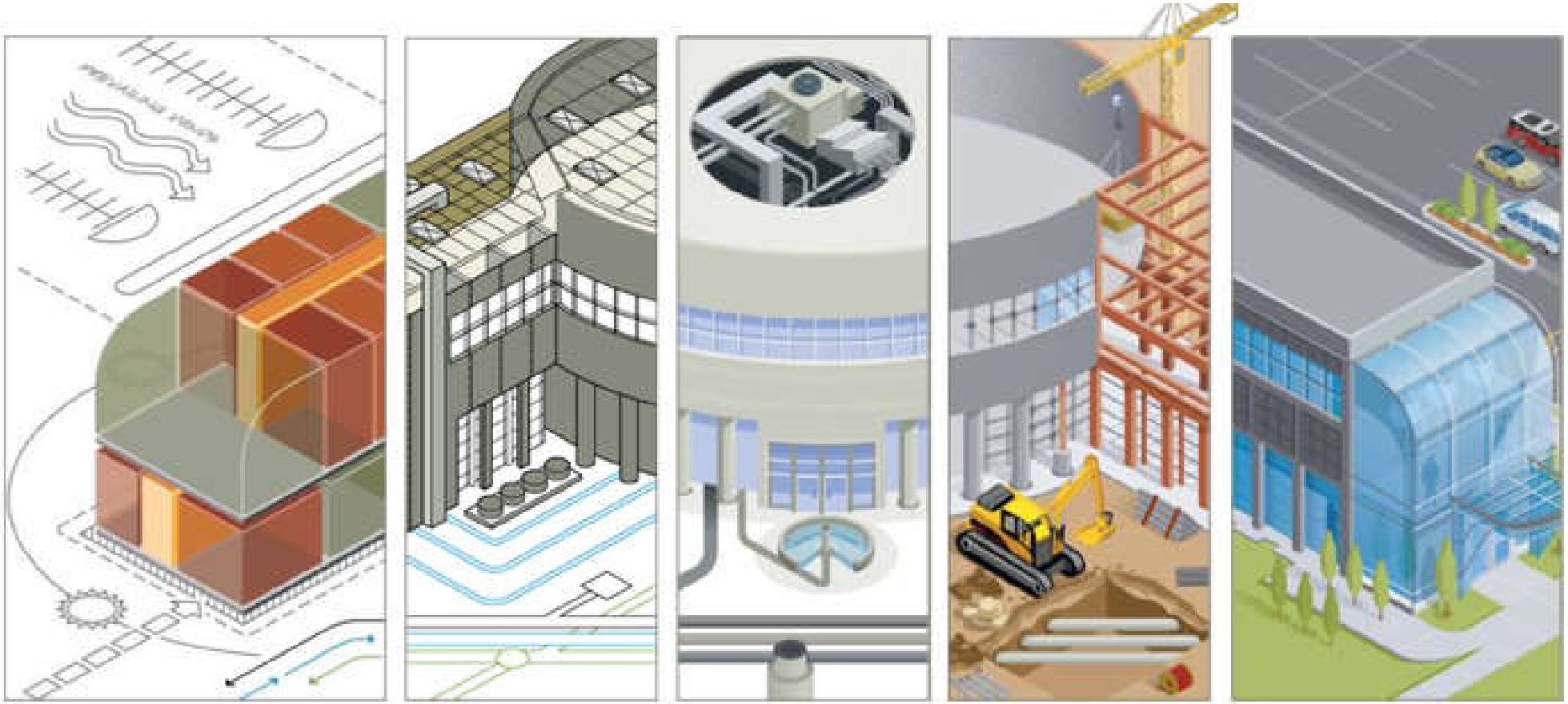
- Biggest BIM adoption hurdles:
  - Lack of BIM expertise
  - Lack of industry standards
- Greatest BIM benefits:
  - Improved communication
  - Improved collaboration
  - Higher quality project decision making
  - More comprehensive planning and scheduling



Benefits of BIM



Use of BIM throughout building project development cycle



Conceptualization **Design** **Implementation** **Construction** **Own/Operate**

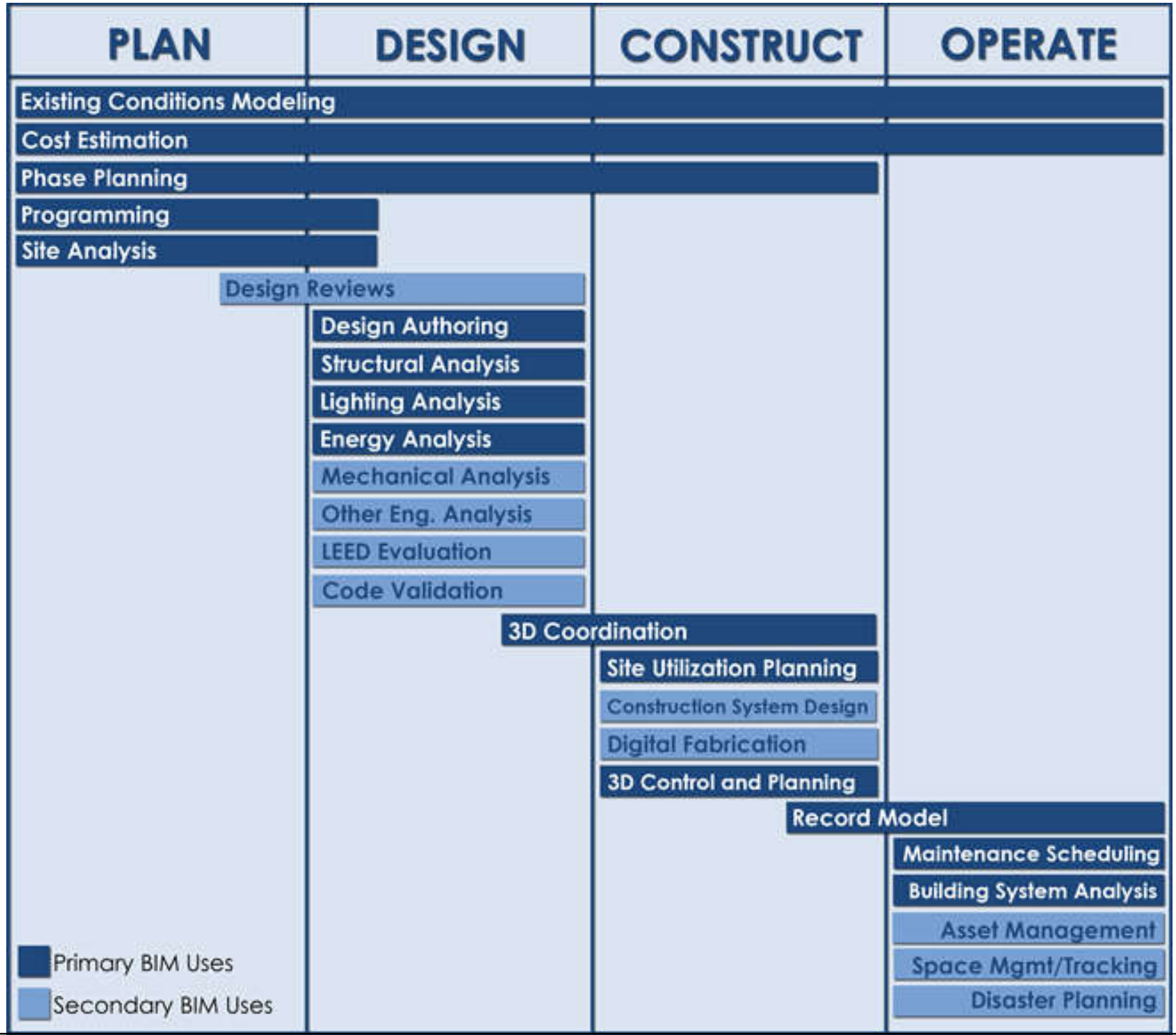
Docs

- Collaborative processes
- Key stakeholders contribute expertise
- Improved decision-making and quality

- Controlled by precise design model
- Improved coordination and documentation

- Early planning = efficient material use, less waste
- Change orders are minimized
- Construction: on schedule/budget

Primary and secondary BIM uses in building process



Why BIM?

- BIM creates efficiency and business benefits
  - Reduce rework
  - Improve productivity
  - Reduce conflicts and changes during construction
  - Clash detection and avoiding rework
  - Promote new BIM-related services
  - Reduce errors and omissions in construction documents

(Source: Building Information Modeling (BIM) Benefits Per Profession https://www.thebalance.com/building-information-modeling-bim-benefits-845045)

Why BIM?

- BIM provides a single, intelligent model to coordinate the following information:
  - Construction documentation
  - Visualisation (design and construction)
  - Material and equipment quantities
  - Cost estimates
  - 4-D construction sequencing and reporting
  - Scheduling
  - Fabrication data and toolpaths

(Source: Garber, R., 2014. *BIM Design: Realising the Creative Potential of Building Information Modelling*)

Why BIM?

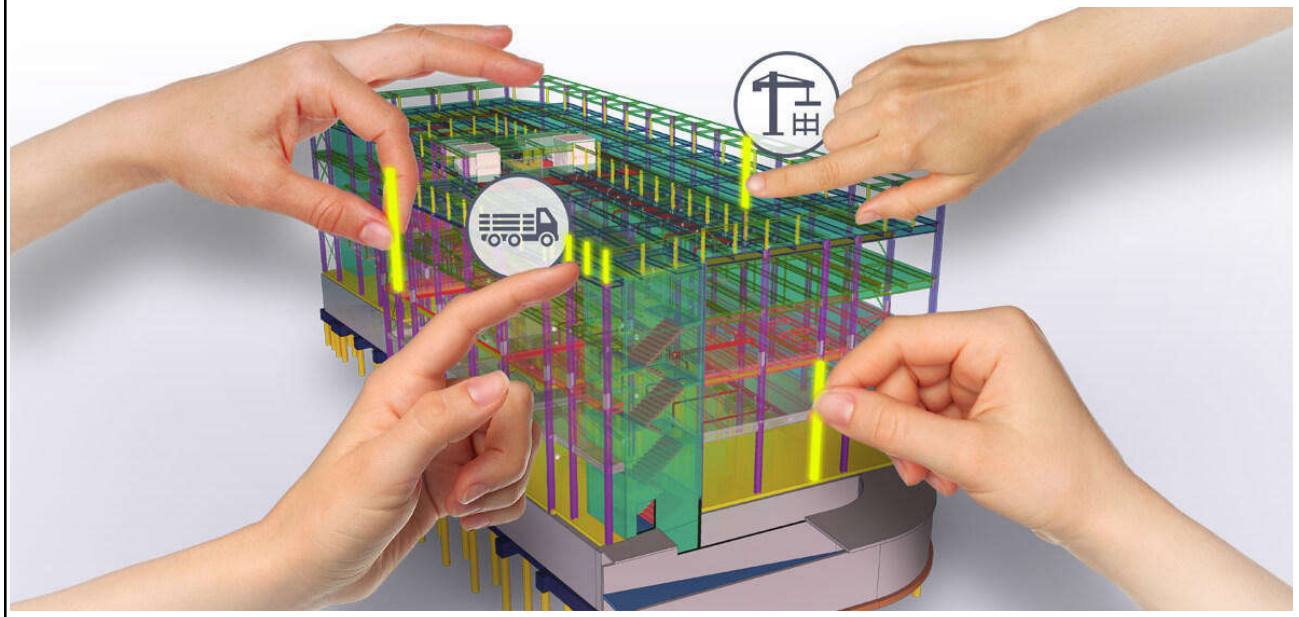
- By adopting an information-modelling platform, building designers can:
  - Visualise multiple design organisations
  - Simulate alternatives
  - Identify clashes between building equipment
  - Communicate design intent three-dimensionally
  - Improve productivity
- BIM will ultimately replace the CAD tools with an integrated, parametric database

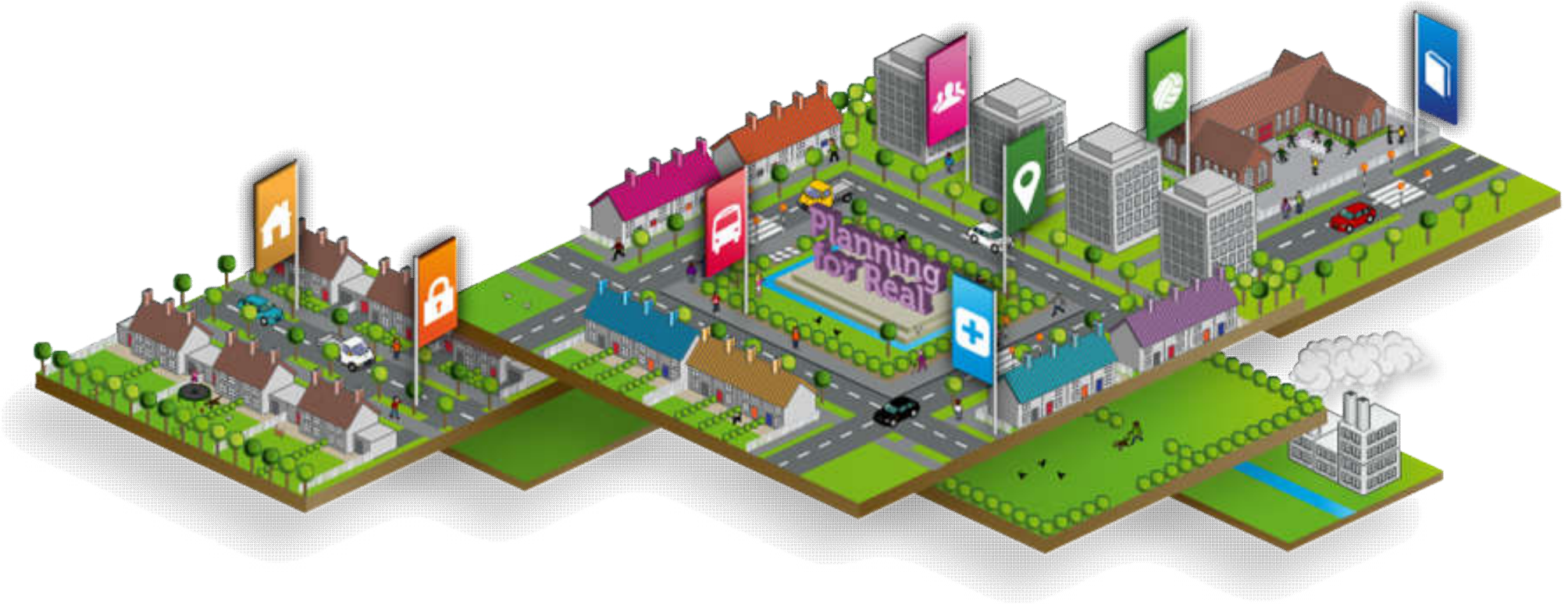
(Source: Garber, R., 2014. *BIM Design: Realising the Creative Potential of Building Information Modelling*)

Why BIM?

- Digital design environment/tools
  - Bring about process change & paradigm shift
  - Simulate the design virtually (like a "*rehearsal*")
  - Attributes such as cost data and construction sequence can be input
- BIM & virtual design and construction (VDC)
  - Management of integrated multi-disciplinary performance models of design-construction projects

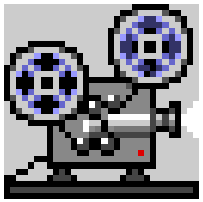
Virtual design and construction (like playing computer games)





Why BIM?

- Virtual design and construction (VDC)
  - An overall framework for conceiving and designing projects using multidisciplinary computer-generated models that illustrate and analyze the entire life cycle of the project, including the design and construction processes, schedule, logistics and cost
    - Virtual Design and Construction (VDC) at Parsons Brinckerhoff (2:21) https://youtu.be/KmRu1rRPRis
    - Virtual Design and Construction (VDC) overview (2:40) https://youtu.be/Y6qJ_KG6Jwo

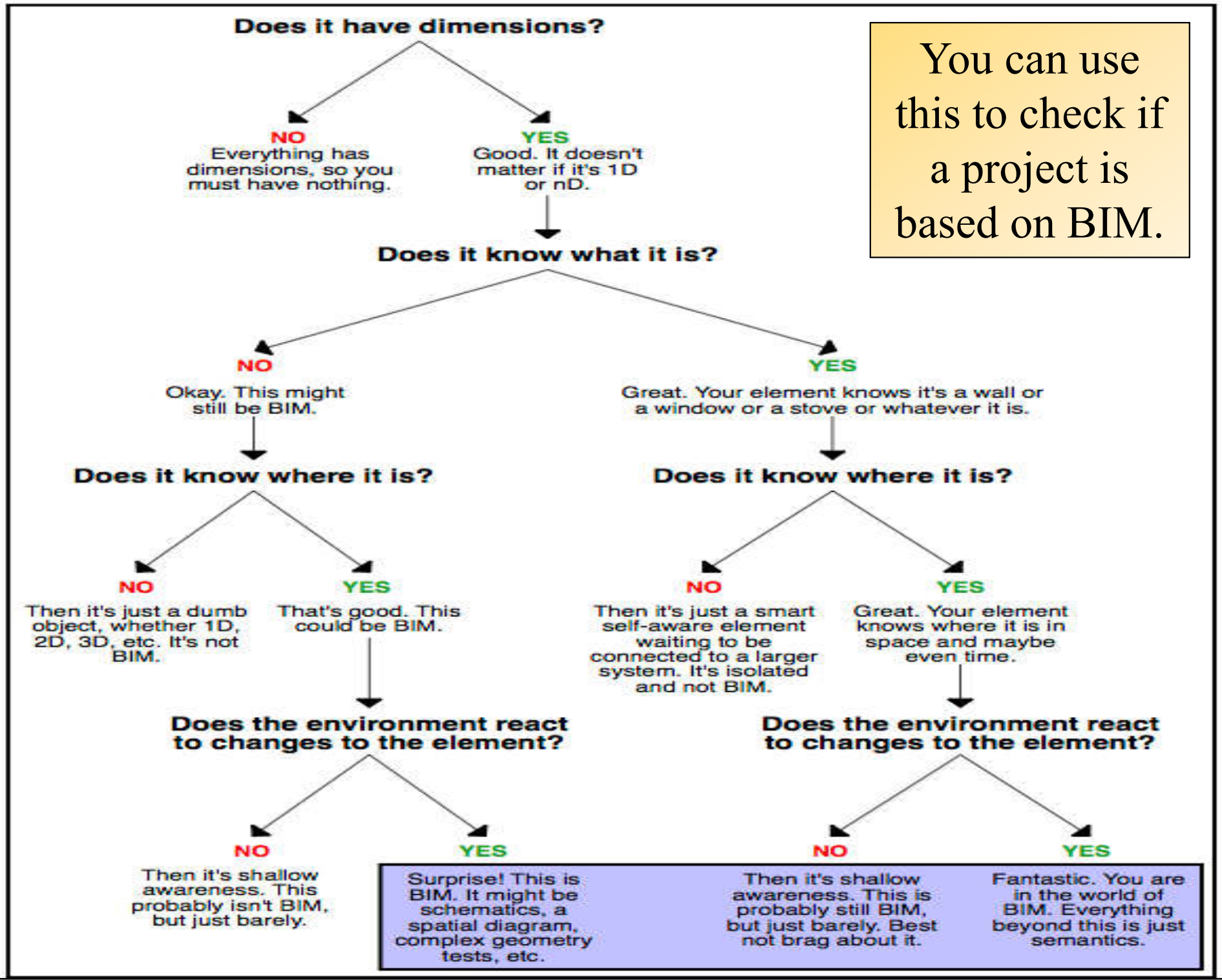


Why BIM?

- Elements of virtual design and construction (VDC)
  - 1. Engineering modelling methods
    - Product, organization, process
  - 2. Analysis methods (model-based design)
    - Including quantities, schedule, cost, 4D interactions and process risks (i.e. BIM tools)
  - 3. Visualization methods (graphics, movies, virtual reality)
  - 4. Business metrics - within business analytics - and a focus on strategic management
  - 5. Economic impact analysis, i.e., models of both the cost and value of capital investments

(Source: Virtual design and construction - Wikipedia https://en.wikipedia.org/wiki/Virtual_design_and_construction)

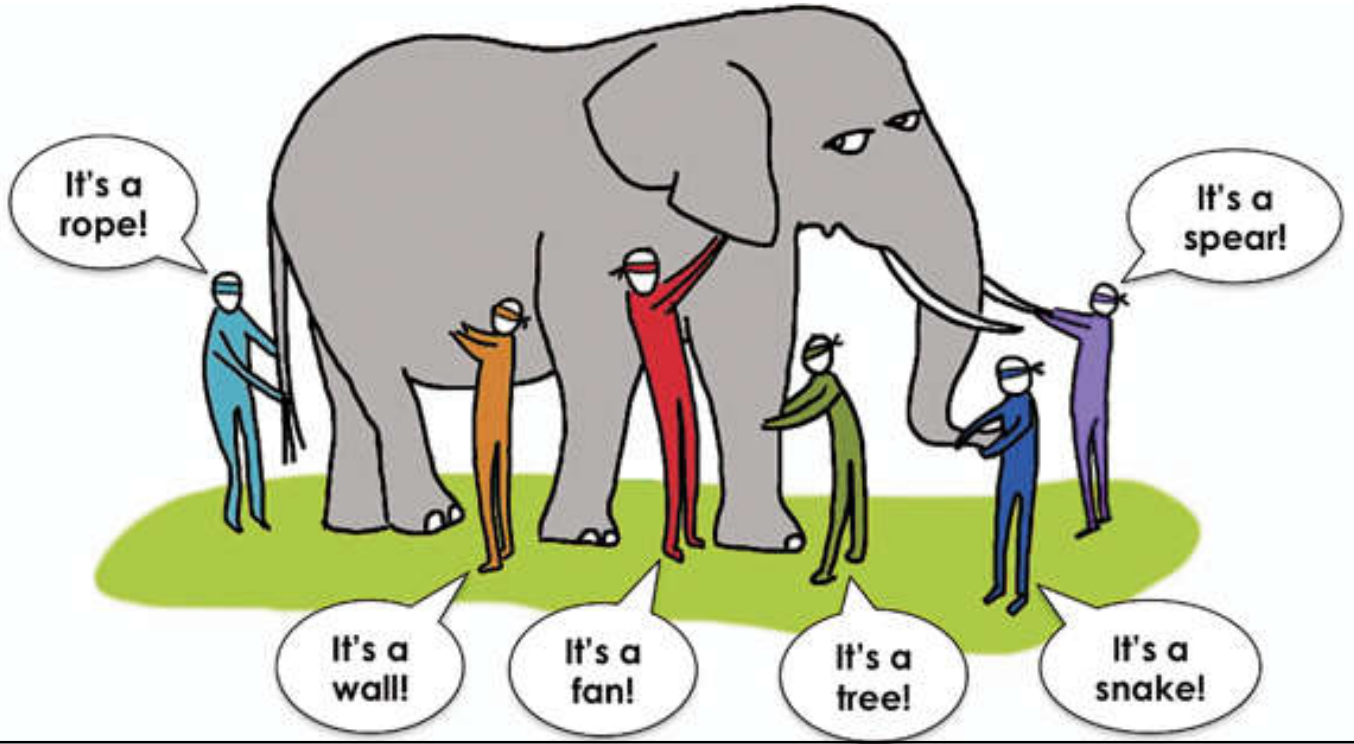
HOW TO TELL IF IT'S BIM



You can use this to check if a project is based on BIM.

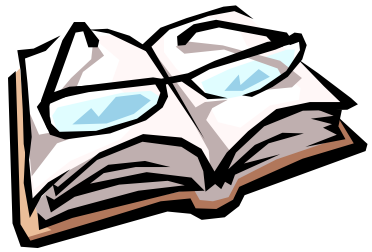
Exercise

- Hand drawing: your doodles
  - Drawing as a way of understanding
- Topic: What is BIM?



Express your thinking about BIM.

Further reading



- 一筆一劃勾勒工程靈魂　渠署繪圖師：圖則是將意念實踐 (HK01 News)
- Videos:
  - What is BIM: All you need to know (10:36)
    https://youtu.be/B3Zwm8DNU1c
  - BIM vs. VDC: Is there a difference? (2:40)
    https://youtu.be/Fcf3hF7bAkI
- Virtual design and construction - Wikipedia
  - https://en.wikipedia.org/wiki/Virtual_design_and_construction