ASHRAE Hong Kong Chapter Annual General Meeting: Technical Talk
29 Mar 2019 (Fri), Room TU107, PolyU

BIM Development and Trends in Hong Kong

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Mar 2019

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- Key concepts of BIM
- Challenges for BIM
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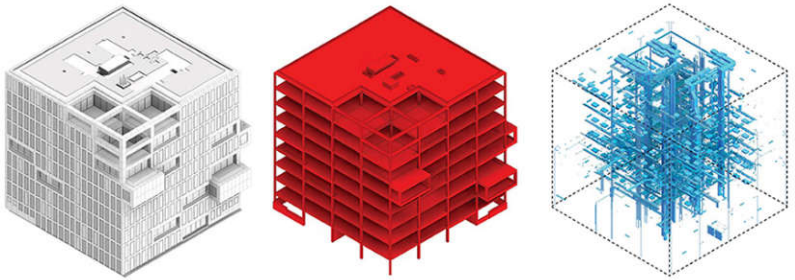
- Conclusion

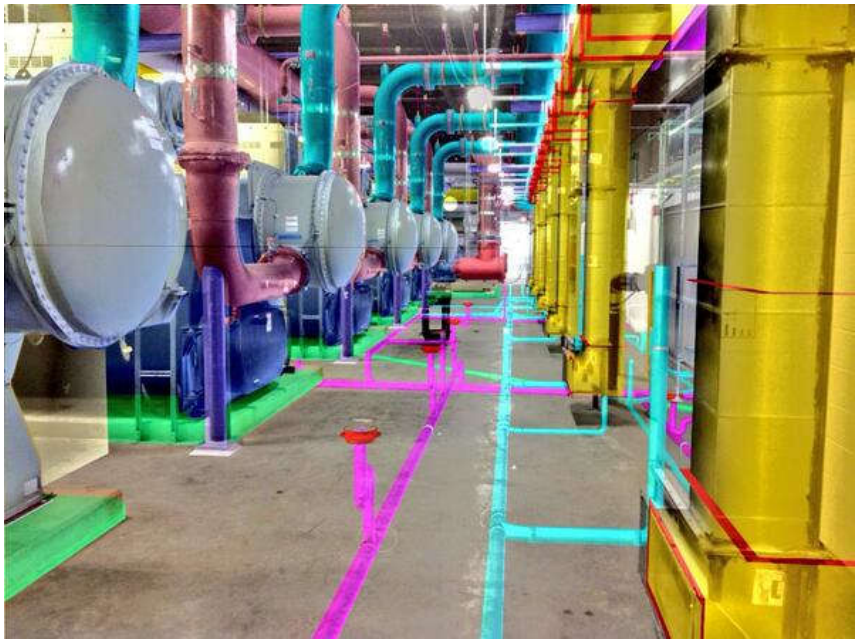
Introduction

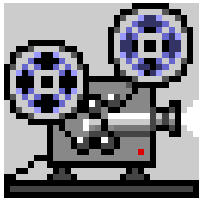
- **Building Information Modelling (BIM)**
  - A collaborative working process
  - 3D design + Information



- BIM definitions:
  - Process of creating & using digital models for design, construction, and/or operations of projects
  - Simulate the construction project in a virtual environment, to identify any potential design, construction, or operational issues

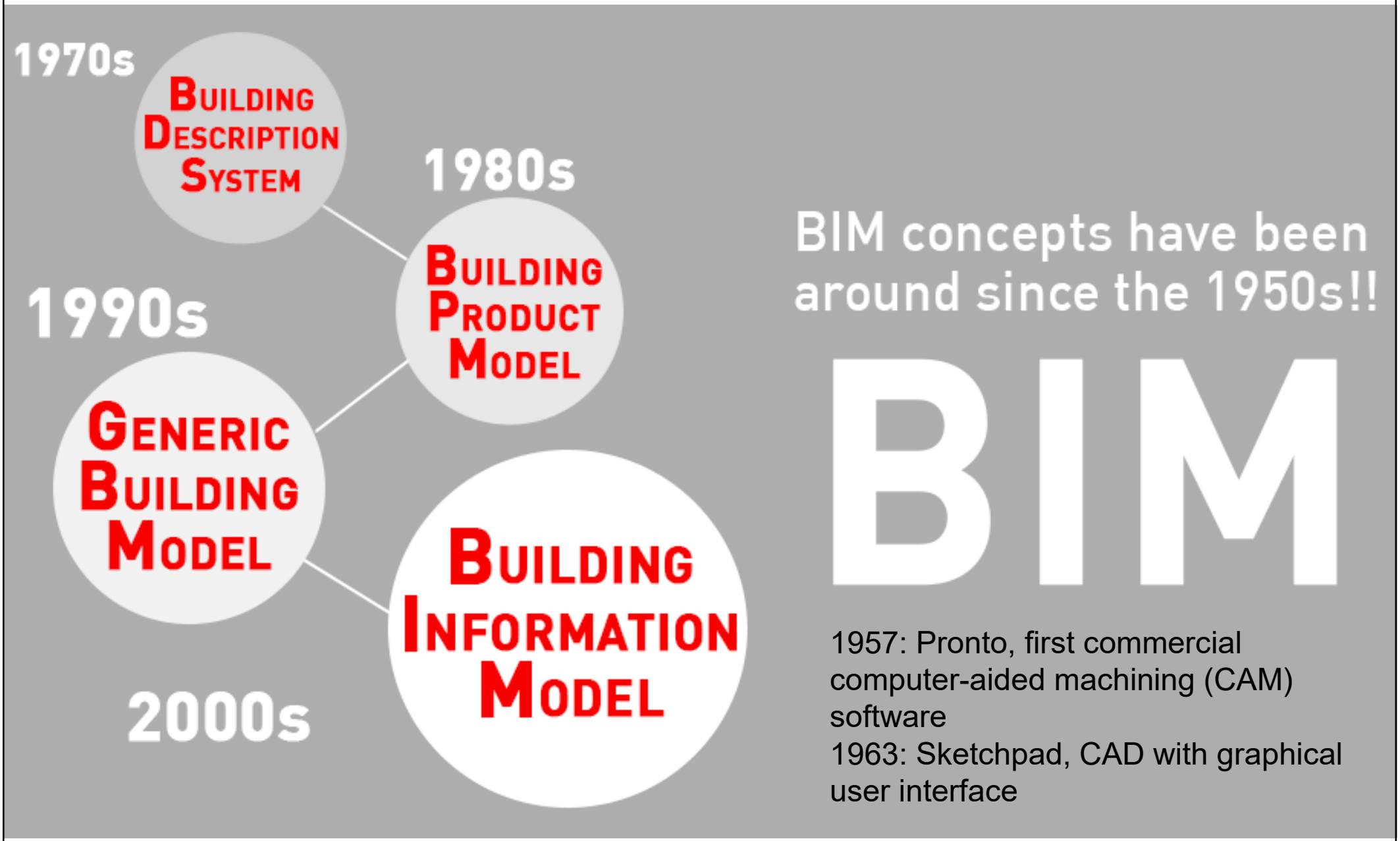
BIM is an intelligent 3D model-based process





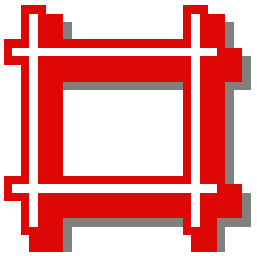
Video:
- What is BIM (Building Information Modeling)? (3:00) https://youtu.be/suNadRnHy-U

BIM history and timeline



(Source: https://www.exactal.com/en/company/blog/if-bims-a-mystery-heres-the-history/)

Introduction



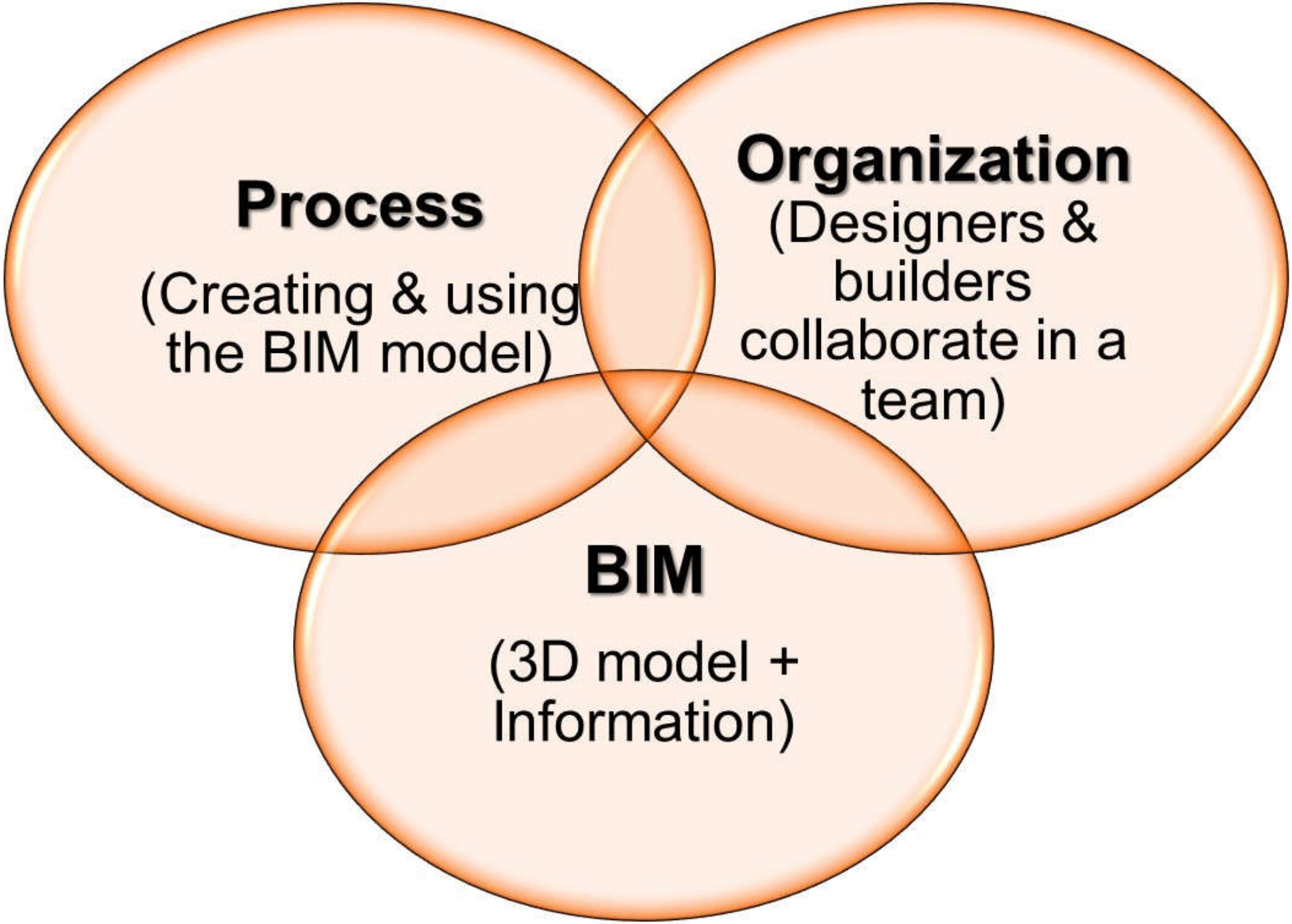
- BIM history in the world
  - Early dates of computer-aided design (CAD) and computer-aided manufacturing (CAM)
  - Dream building the (virtual) model
  - Development of computer graphics
  - High quality computable 3D representations
  - BIM software (ArchiCAD, Vectorworks, Revit)
  - Towards virtual design and construction (VDC)

(See also: A history of BIM https://www.aproplan.com/blog/construction-collaboration/a-history-of-bim)

Introduction

- **V**irtual **D**esign & **C**onstruction (VDC)
  - It is the management of integrated multi-disciplinary performance models of design-construction projects
  - Five elements that enable VDC:
    - 1. BIM model
    - 2. Level of development (LOD)
    - 3. Advanced digital tools
    - 4. Collaboration space
    - 5. Collaborative mindset

Virtual design and construction (VDC) process

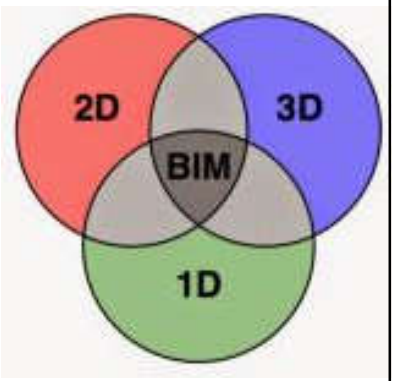


Introduction

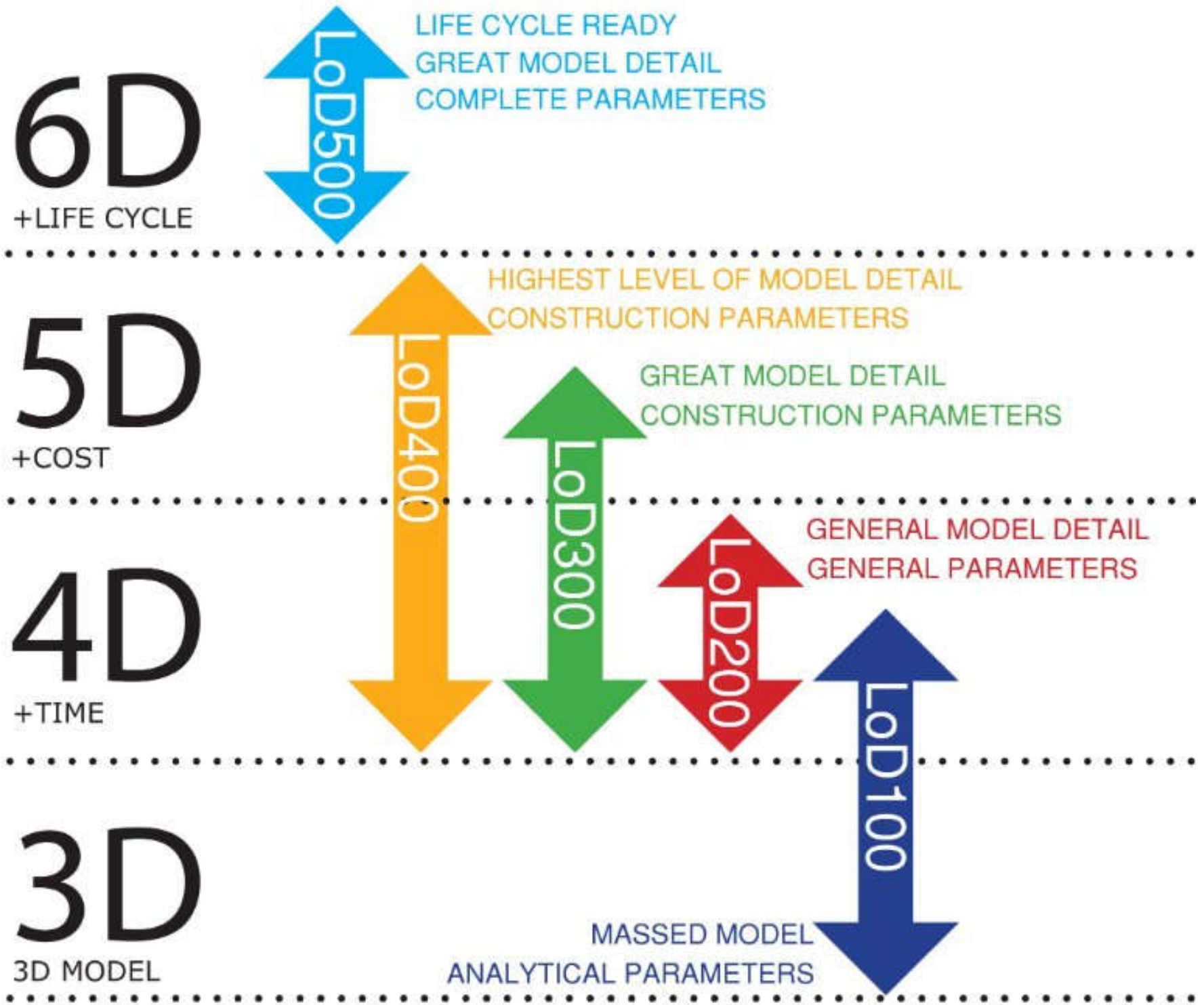
- BIM development in Hong Kong
  - Promoting BIM in government departments
    - e.g. Housing Authority, ArchSD, DSD, EMSD
  - Mandatory BIM adoption for capital works projects (Jan 2018); Construction 2.0 report
  - BIM initiatives by Construction Industry Council
    - e.g. roadmap for BIM, promotion & training, Certification of BIM Manager/Professionals, BIM competitions
  - Development of BIM standards & guidelines

Key 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)



BIM dimensions

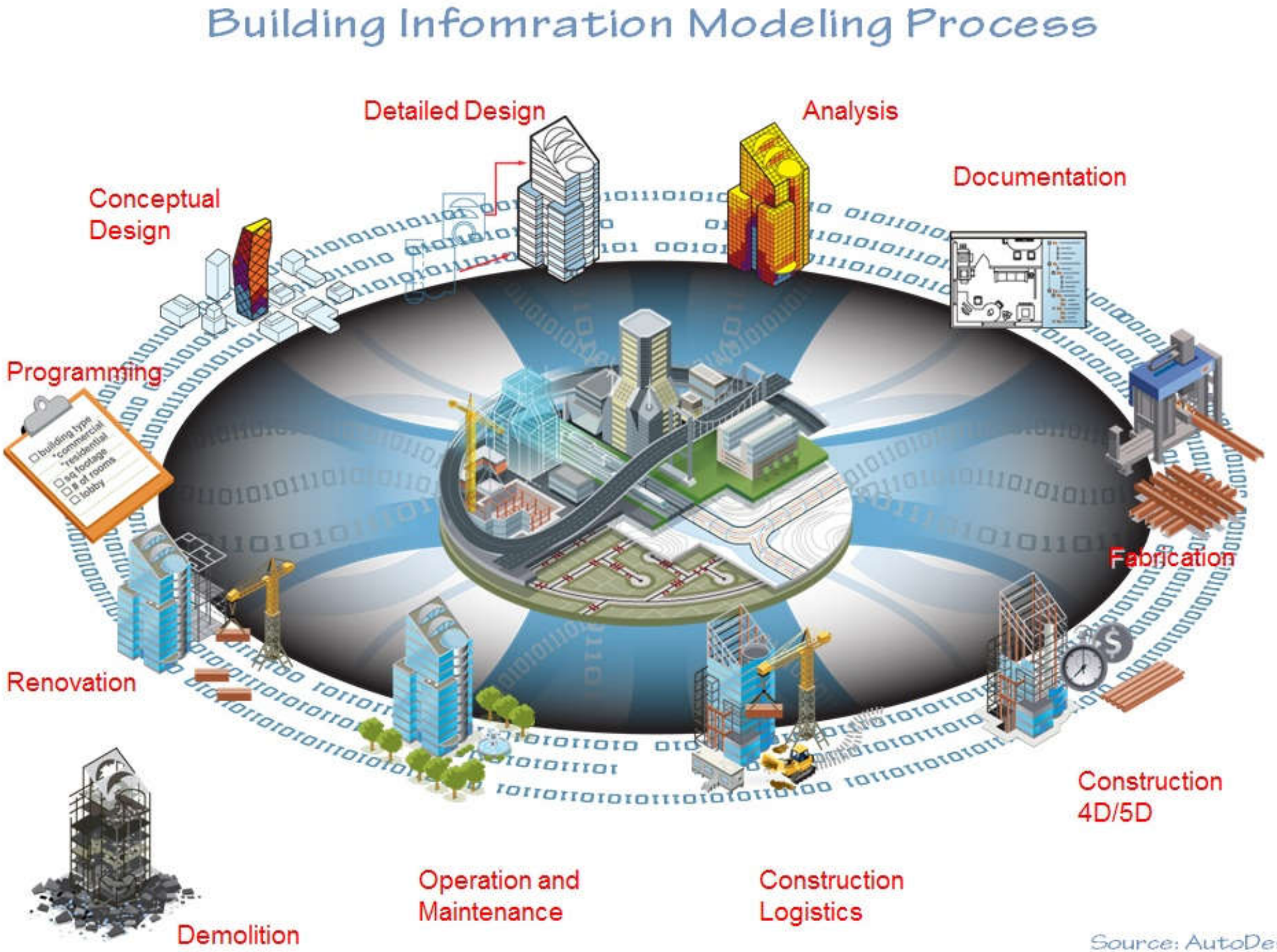


Key concepts of BIM

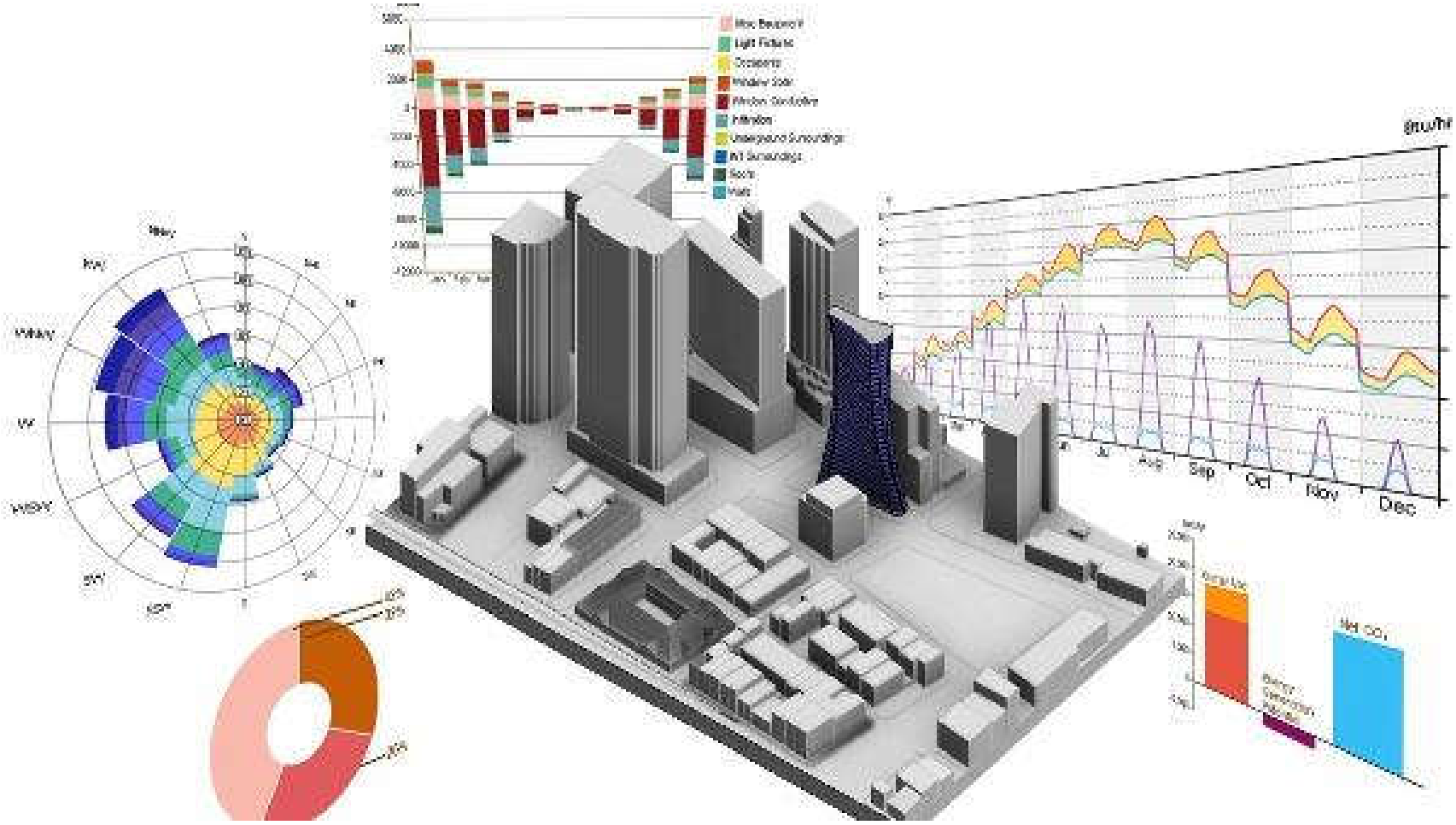
- The nature of BIM

  - 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)
  - Connects formerly disconnected silos of info

Basic concepts of BIM (for building asset lifecycle management)



BIM Process + Analysis Tools = Power of BIM



Energy, green building and structural analyses

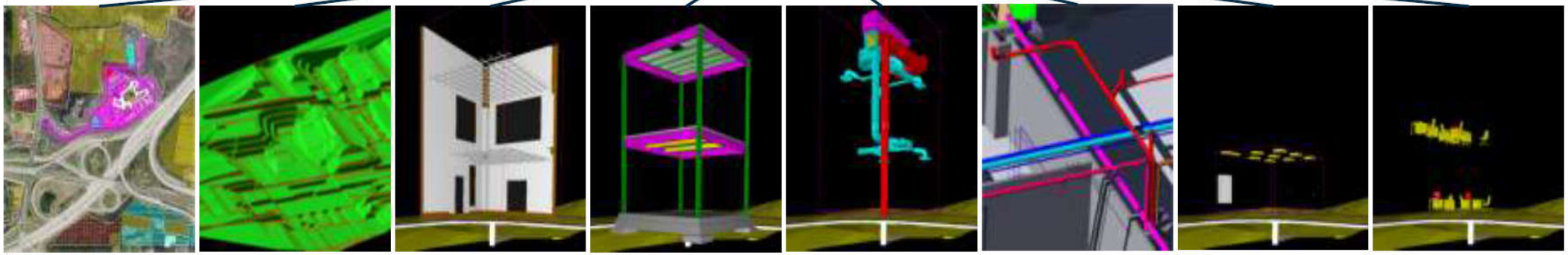
3D Scanning

Unmanned Aircraft System (UAS) / Drone

BIM for building, construction and infrastructure

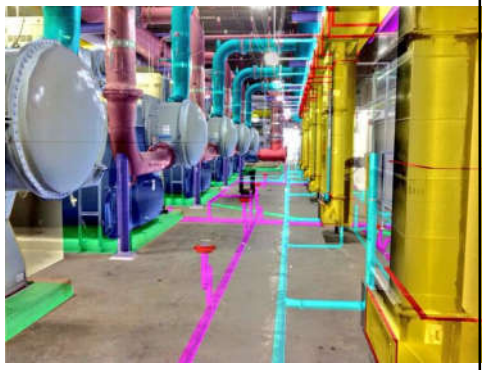
Design meeting

Construction meeting

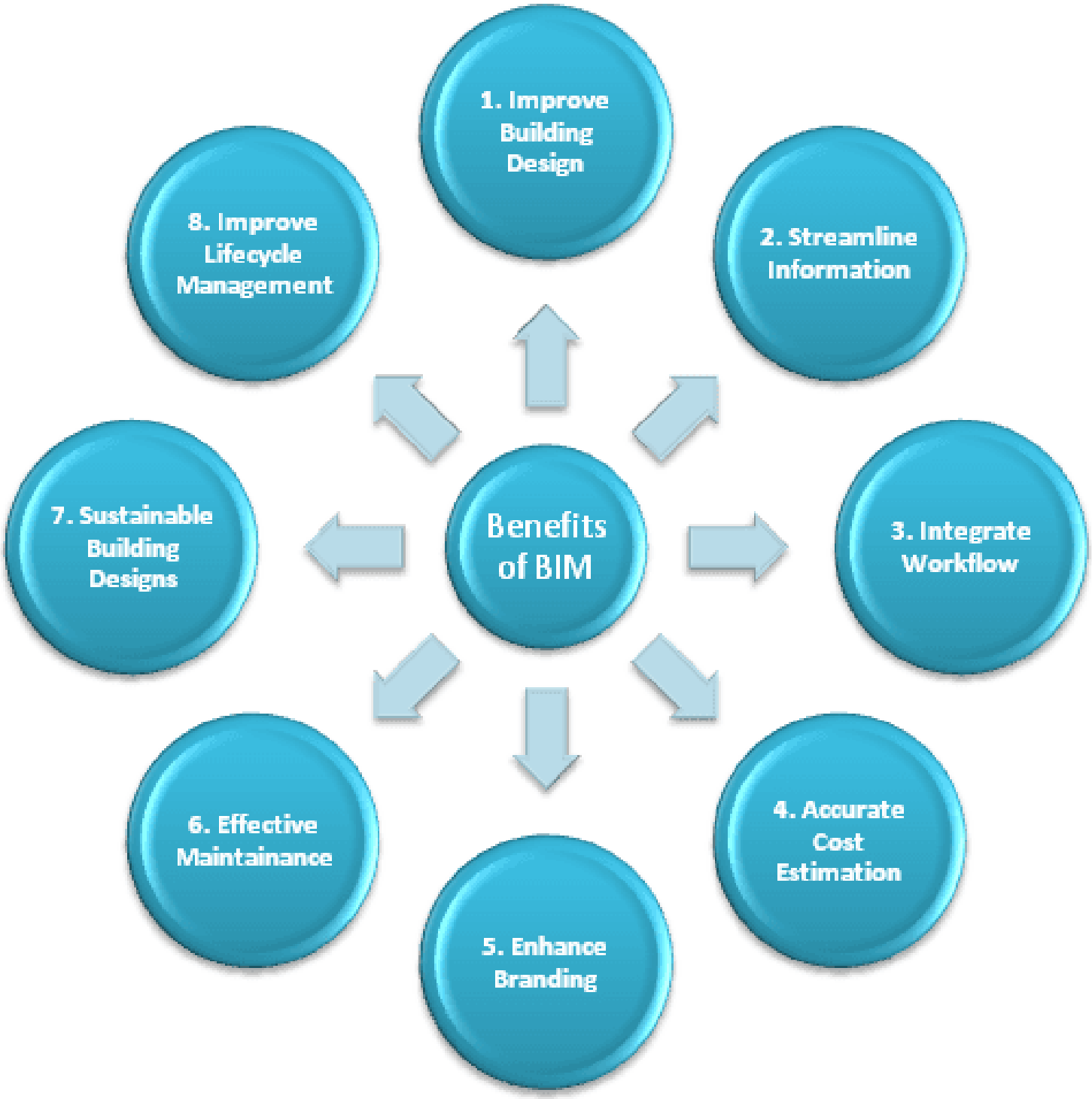


Key concepts of BIM

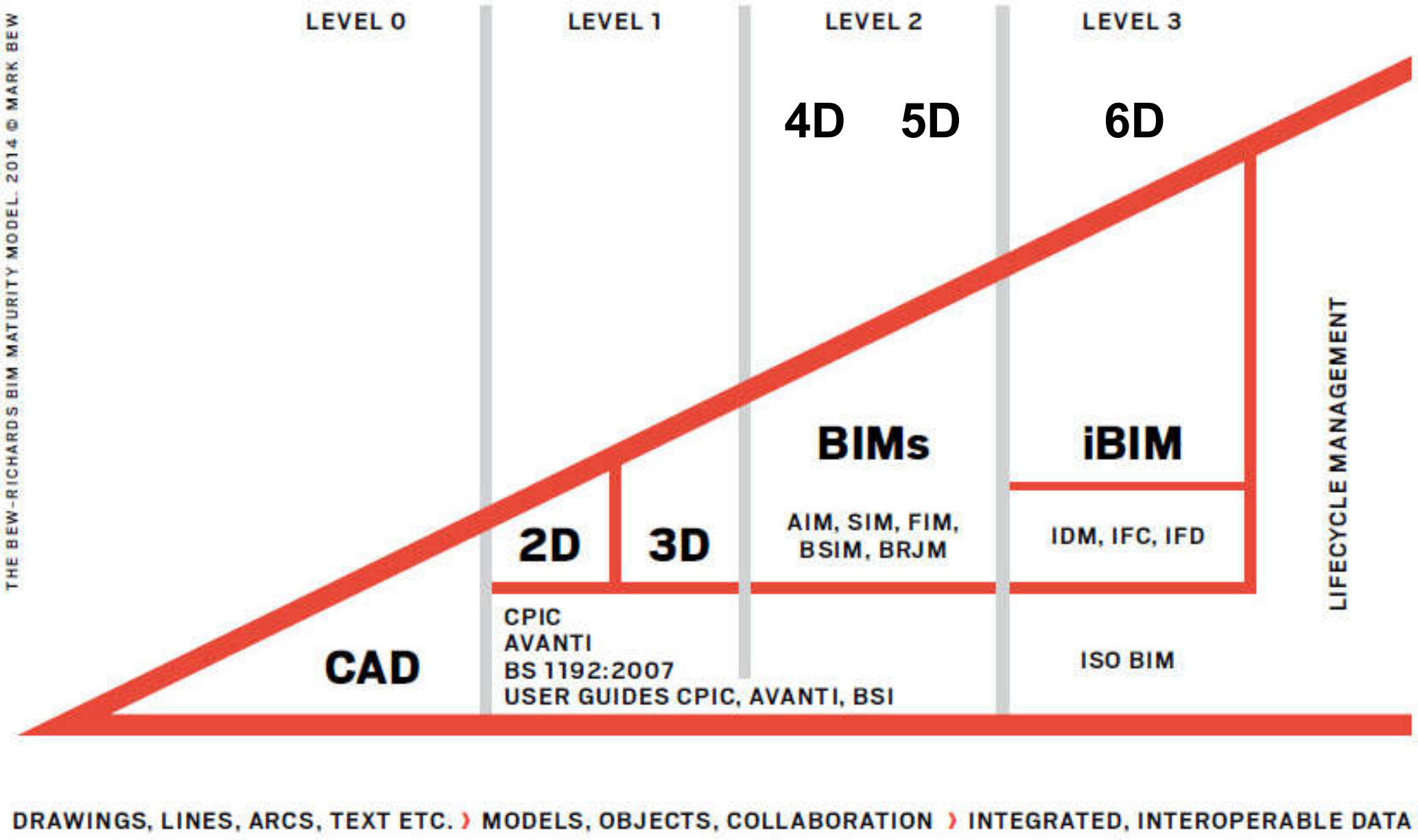
- Benefits of BIM
  - Promises better decision making
  - Accurate geometrical representation
  - Enhanced efficiency & lowered overall risk
  - Improved project sustainability
  - Decreased project cost
  - Increased productivity & quality
  - Reduced project delivery time
  - Enhanced communication & collaboration



Benefits of BIM



BIM maturity levels



(Image source: http://mitchj.info/suggest/explaining-the-levels-of-bim-bim.html)

LEVEL of DEVELOPMENT

LOD 100

Concept (Presentation)

DESCRIPTION:
Office Chair
Arms, Wheels
WIDTH:

DEPTH:

HEIGHT:

MANUFACTURER:
Herman Miller, Inc.
MODEL:
Mirra
LOD:
100

LOD 200

Design Development

DESCRIPTION:
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HEIGHT:
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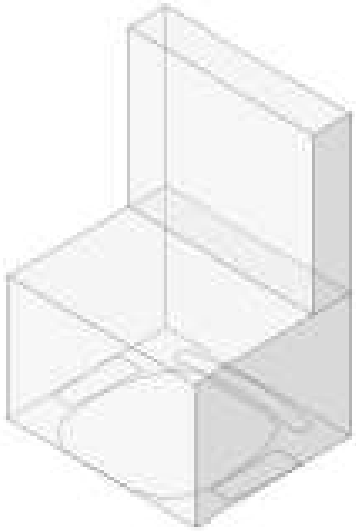
Herman Miller, Inc.
MODEL:
Mirra
LOD:
200

LOD 300



Documentation

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DEPTH:
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HEIGHT:
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MANUFACTURER:
Herman Miller, Inc.
MODEL:
Mirra
LOD:
300

LOD 400

Construction

DESCRIPTION:
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Arms, Wheels
WIDTH:
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DEPTH:
430
HEIGHT:
1085
MANUFACTURER:
Herman Miller, Inc
MODEL:
Mirra
LOD:
400

LOD 500

Facilities Management

DESCRIPTION:
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Arms, Wheels
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DEPTH:
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HEIGHT:
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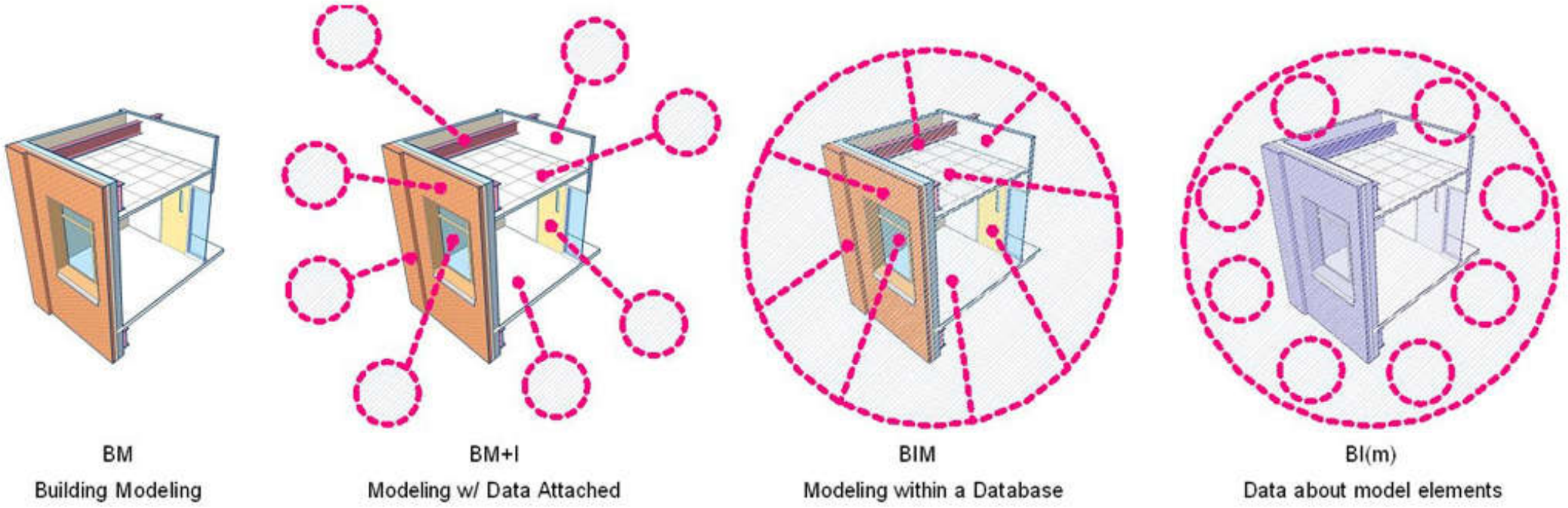
MANUFACTURER:
Herman Miller, Inc
MODEL:
Mirra
PURCHASE DATE:
01/02/2013

(Only data in **red** is useable)

practicalBIM.net © 2013

Four generations of BIM



1st Gen: BM
3D model (w/o data); purely physical, geometric components

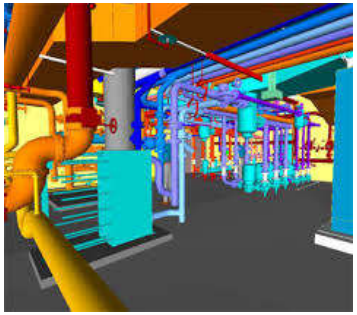
2nd Gen: BM+I
Data tags added to 3D objects; but not related to each other

3rd Gen: BIM
3D modelling embedded in a construction context; a database as its core

4th Gen: BI(m)
Information about 3D objects without the 3D object itself; e.g. using models for building O&M

(Source: https://www.eypae.com/index.php/publication/2017/brief-history-and-future-bim)

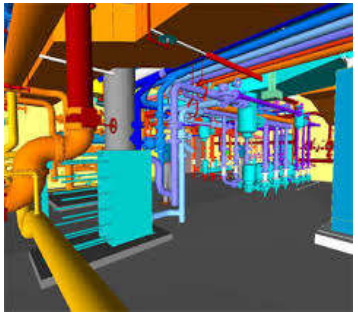
Challenges for BIM



- Top 10 "Evil BIM" List
  - 1. Owners Just Requesting "BIM"
  - 2. Not Enough BIM
  - 3. Too Much BIM
  - 4. Unclear Model Element Authors
  - 5. Unnecessary Clashes
  - 6. Evil Scope Agreements
  - 7. Poor Quality Modeling
  - 8. BIM Spreadsheet Contracts
  - 9. "LOD 500 + COBie" Requests
  - 10. Contracting To 2D

(Source: https://www.linkedin.com/pulse/top-10-evil-bim-list-clive-jordan-smartleanbim-/)

Challenges for BIM

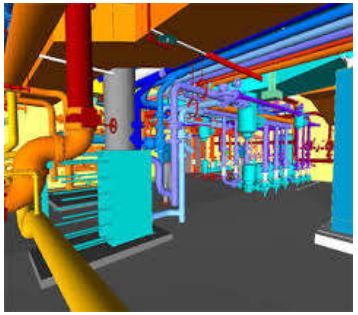


- Complexity of BIM software (so many of them!)
  - BIM modeling software
  - BIM execution planning software
  - BIM content management software
  - Generative design software / algorithmic BIM software
  - BIM performance / BIM analysis software
  - BIM collaboration software
  - BIM validation / BIM checking software
  - Preconstruction BIM 4D/5D software
  - Construction BIM software
  - Facilities management BIM software

BIM software

(Source: BIM Software guide https://www.buildingincloud.net/en/bim-software-guide/)

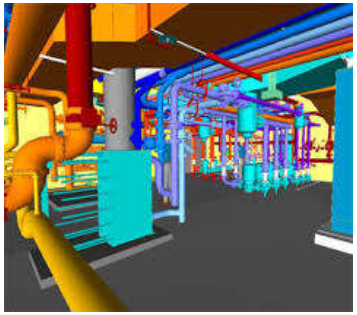
Challenges for BIM



- Major barriers include both technical and non-technical problems
  - Social-organizational (e.g. resistance to change, lack of understanding & motivation)
  - Technical (e.g. interoperability issues)
  - Financial (e.g. adoption/start-up costs)
  - Contractual (e.g. BIM contract issues)
  - Legal (e.g. BIM model ownership & liability)

(Ref.: Alreshidi E., Mourshed M. and Rezgui Y., 2017. Factors for effective BIM governance, *Journal of Building Engineering*, 10: 89-101.)

Challenges for BIM

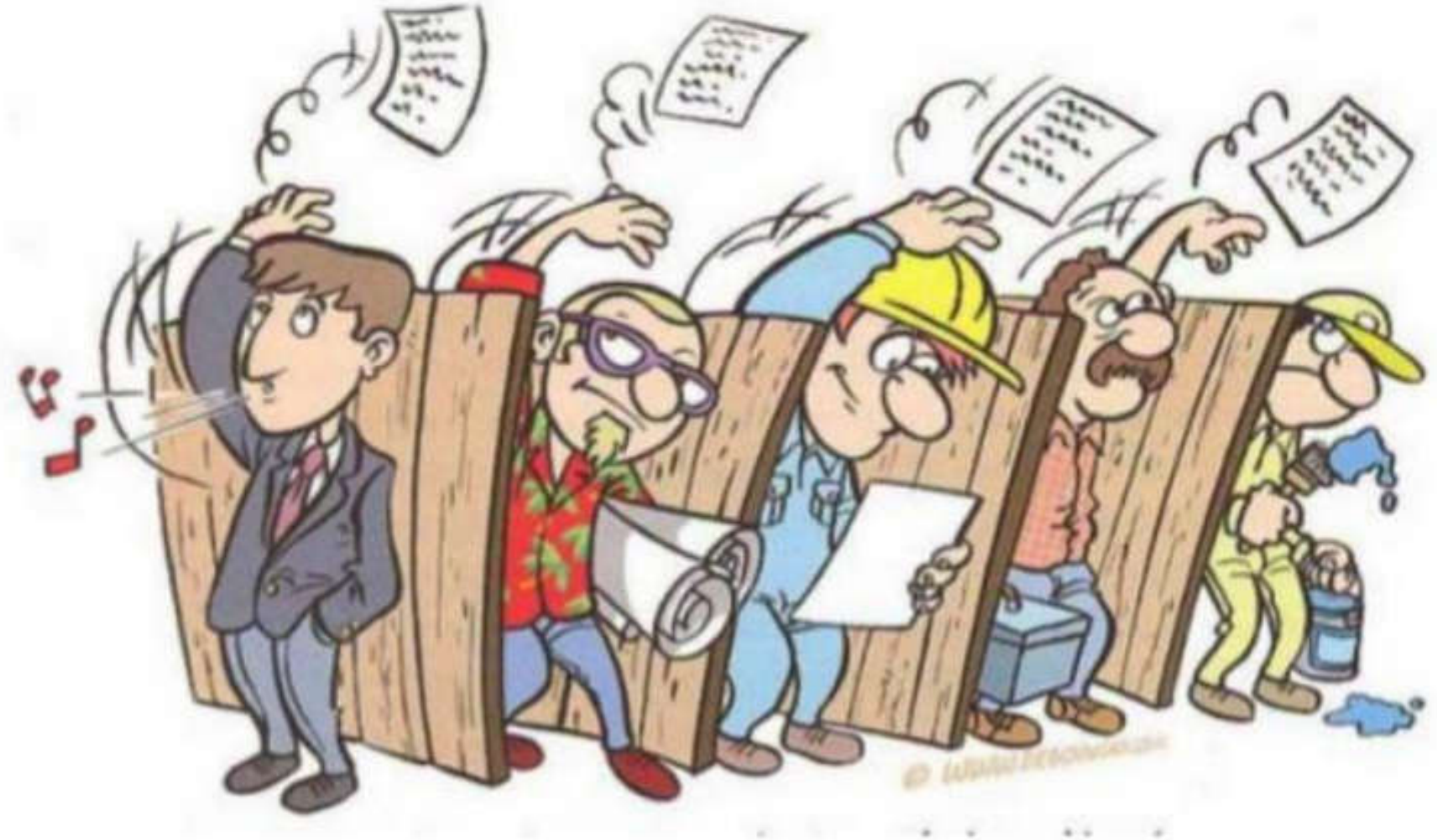


- Challenges with BIM implementation
  - Training of employees
  - Lack of standards for BIM
  - Management of data
  - Interoperability of software
- Critical success factors
  - Team collaboration of stakeholders
  - Organization during construction projects

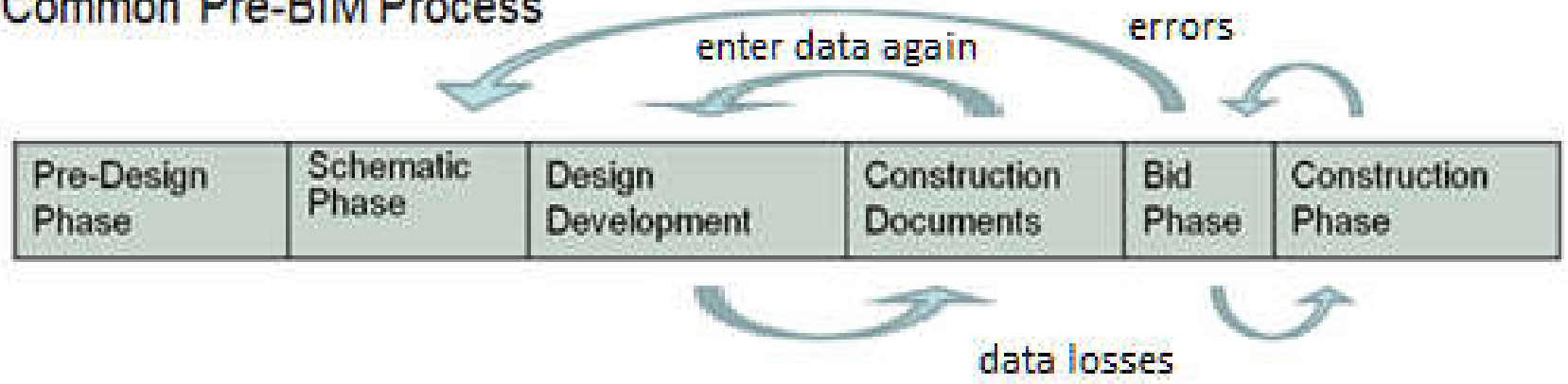
(Ref.: Langar S. and Criminale A., 2017. Challenges with BIM implementation: a review of literature, In *Proceedings of the 53rd Associated Schools of Construction (ASC) Annual International Conference 2017*, pp. 329-335.)


Teamwork

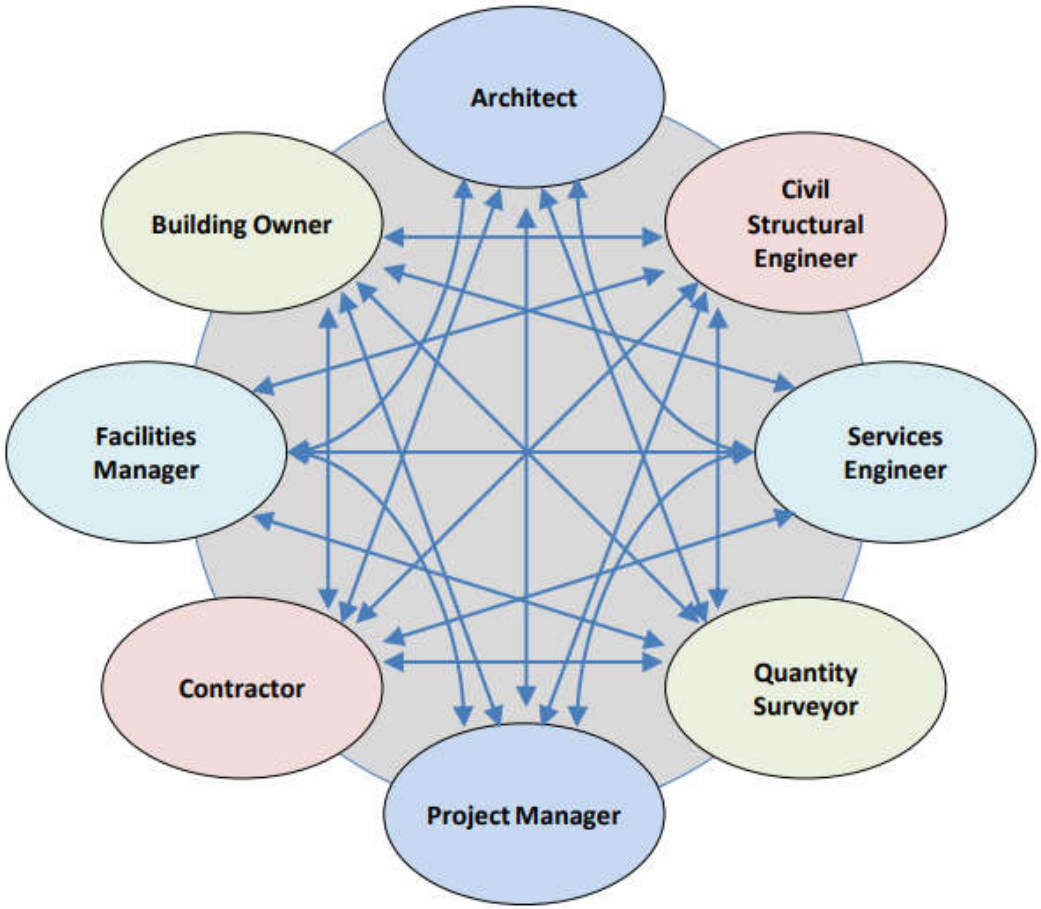
Current team working in the building industry



Common Pre-BIM Process



BIM can streamline fragmented work processes in construction – “silos”

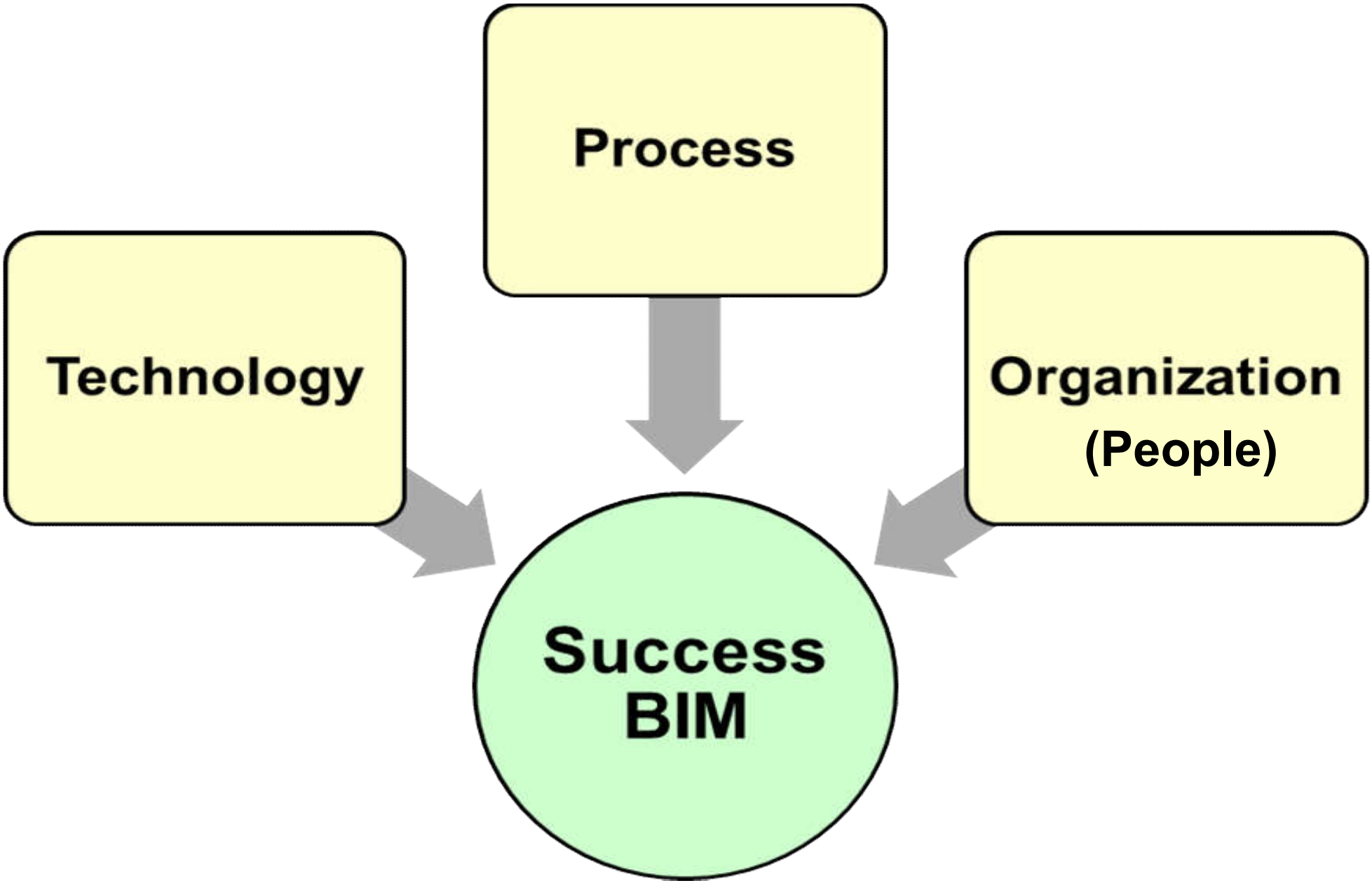


Information “Chaos”

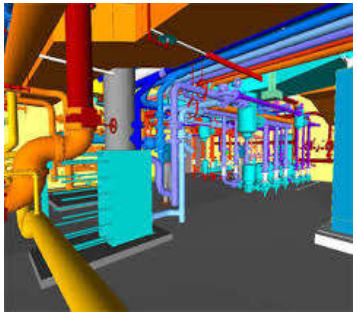
Shared Project Model

BIM simulates new project management style & culture for all disciplines to collaborate on building projects.

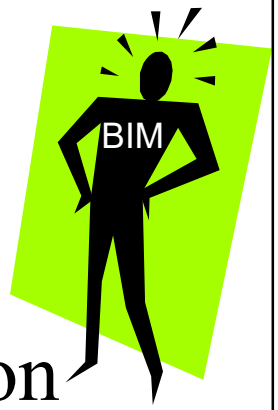
Three key aspects for successful BIM implementation



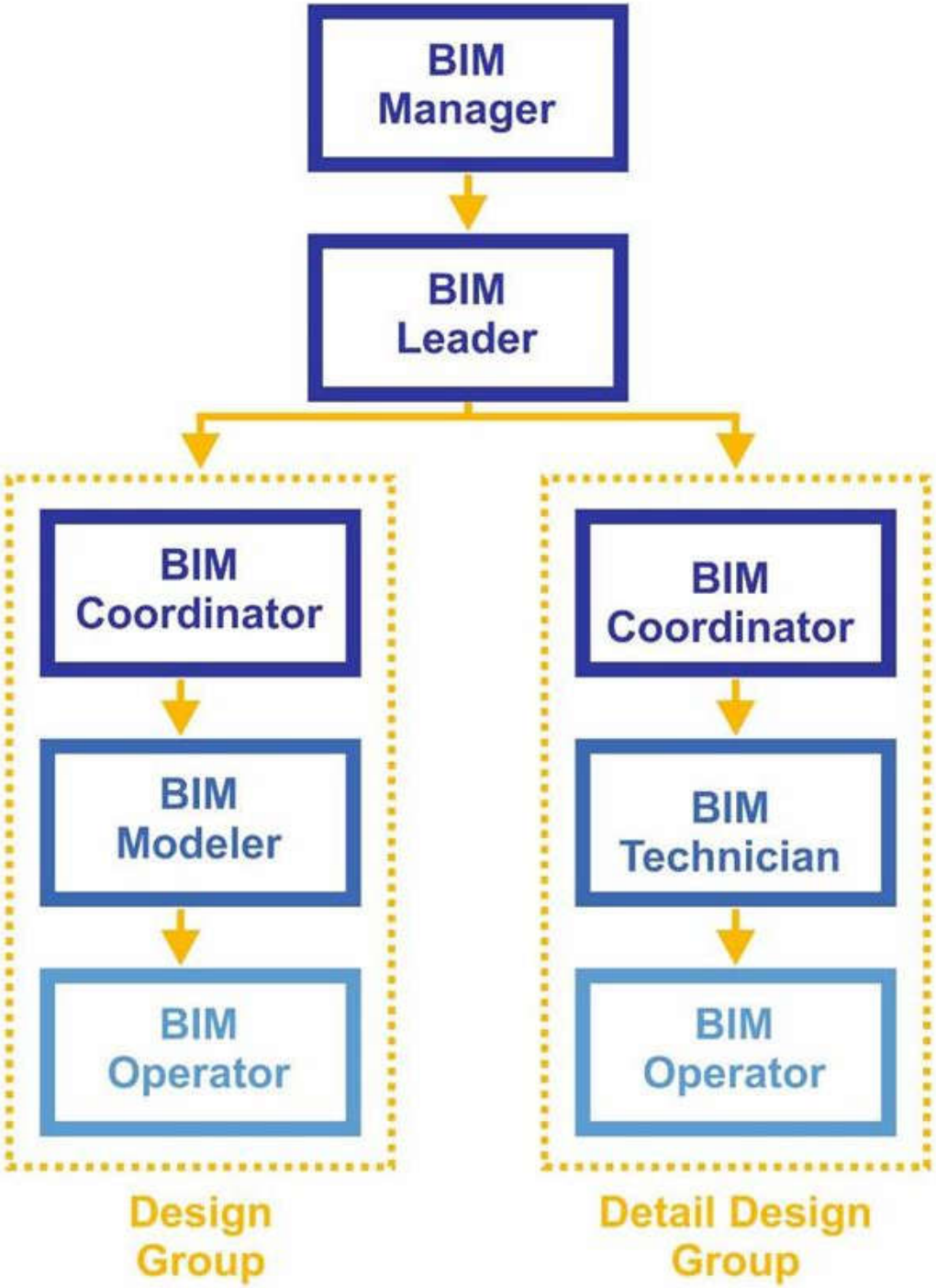
Challenges for BIM



- What constitutes BIM capability
  - People that understand design and construction
  - BIM as a collaborative method (a socio-technical system), to deliver a truly collaborative project
    - Focus on time, cost and quality
    - Overcome the fragmented nature of construction sector
  - Design in BIM
    - A high degree of design-driven modeling and documentation automation
  - BIM coordination: models, trades & information



BIM role classification



4 key areas of BIM management:

- Model & drawing management
- Information management
- Design & construction management
- Stakeholder management

(Source: BIM Role Classification http://www.esparlous-design.com/Pages.aspx?Id=26)

If BIM does not deeply alter your core DNA and profoundly change your psyche then you will not understand BIM at all.

(Source: https://www.cagbc.org)

BIM technology trends

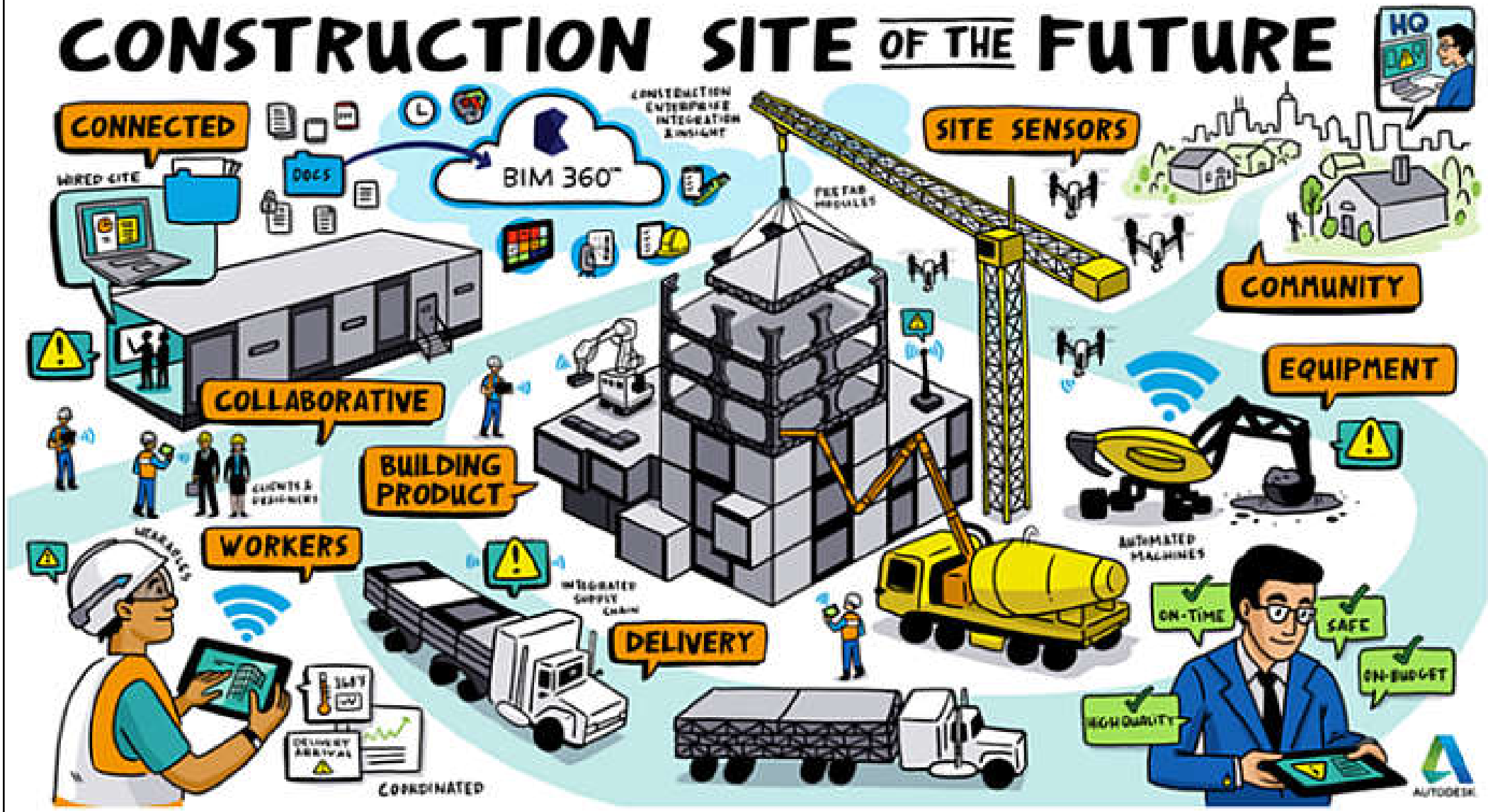
- BIM: a **paradigm shift** (典範轉移/思角轉向)
  - Workflow changes
  - Reengineering of the industry
  - Intelligent objects in a virtual building
  - BIM as a game changer
    - A driver for digital transformation/construction
  - BIM represents a disruption
    - Introduce new capabilities
    - New job skills

(See also: http://www.allenshariff.com/news-and-blogs/bim-paradigm-shift-engineering-perspective/)

BIM technology trends

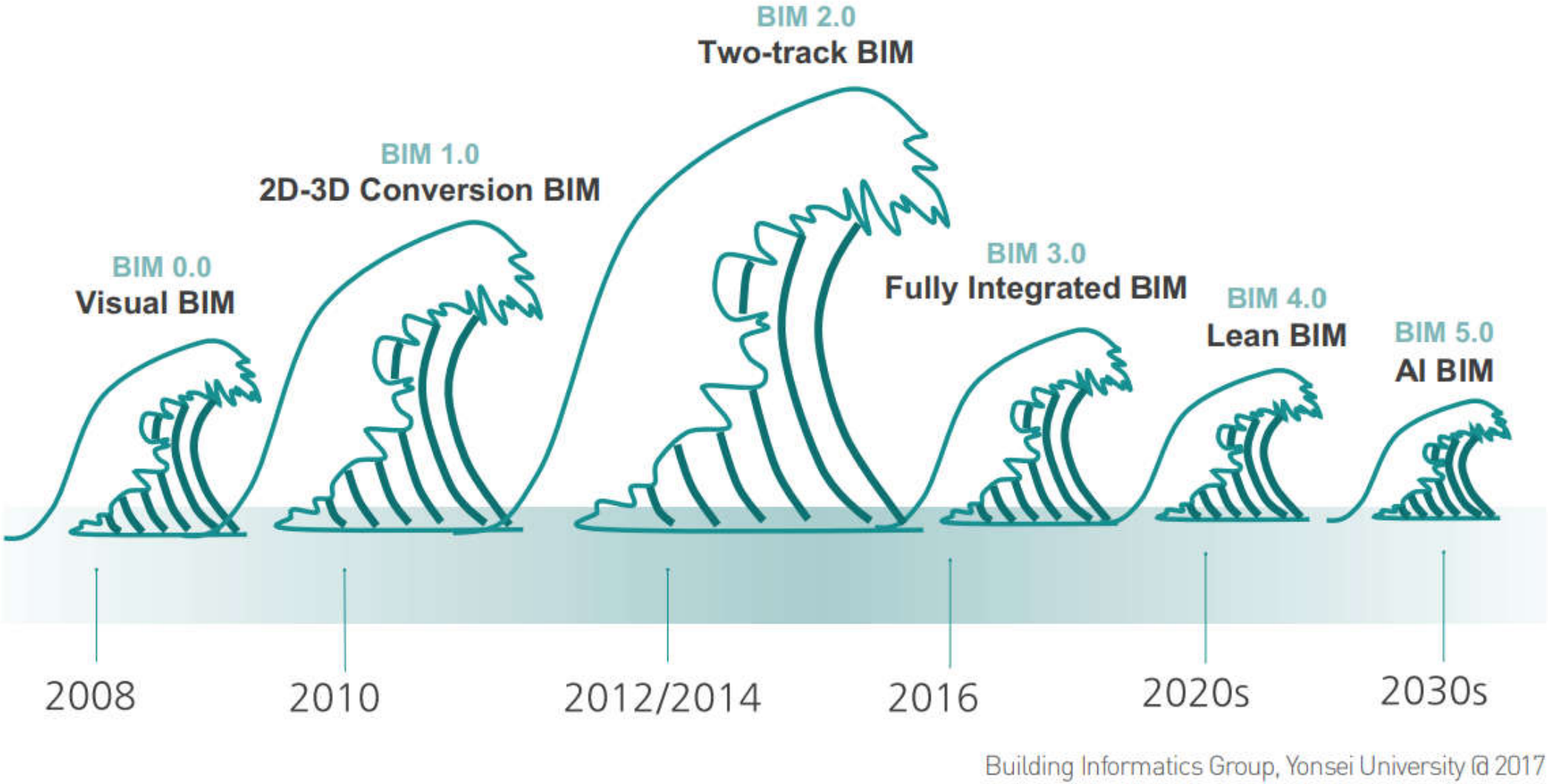
- BIM is an enabling technology
  - Common data environment (CDE): enhance collaboration & integration
  - Everything is connected: improve project/issue management, design/construction coordination
  - Virtual design & construction (VDC): increase efficiency, productivity & quality
  - Life-cycle information: facilitate off-site construction, using manufacturing approach, modular construction & automation

The future of BIM collaboration and construction site



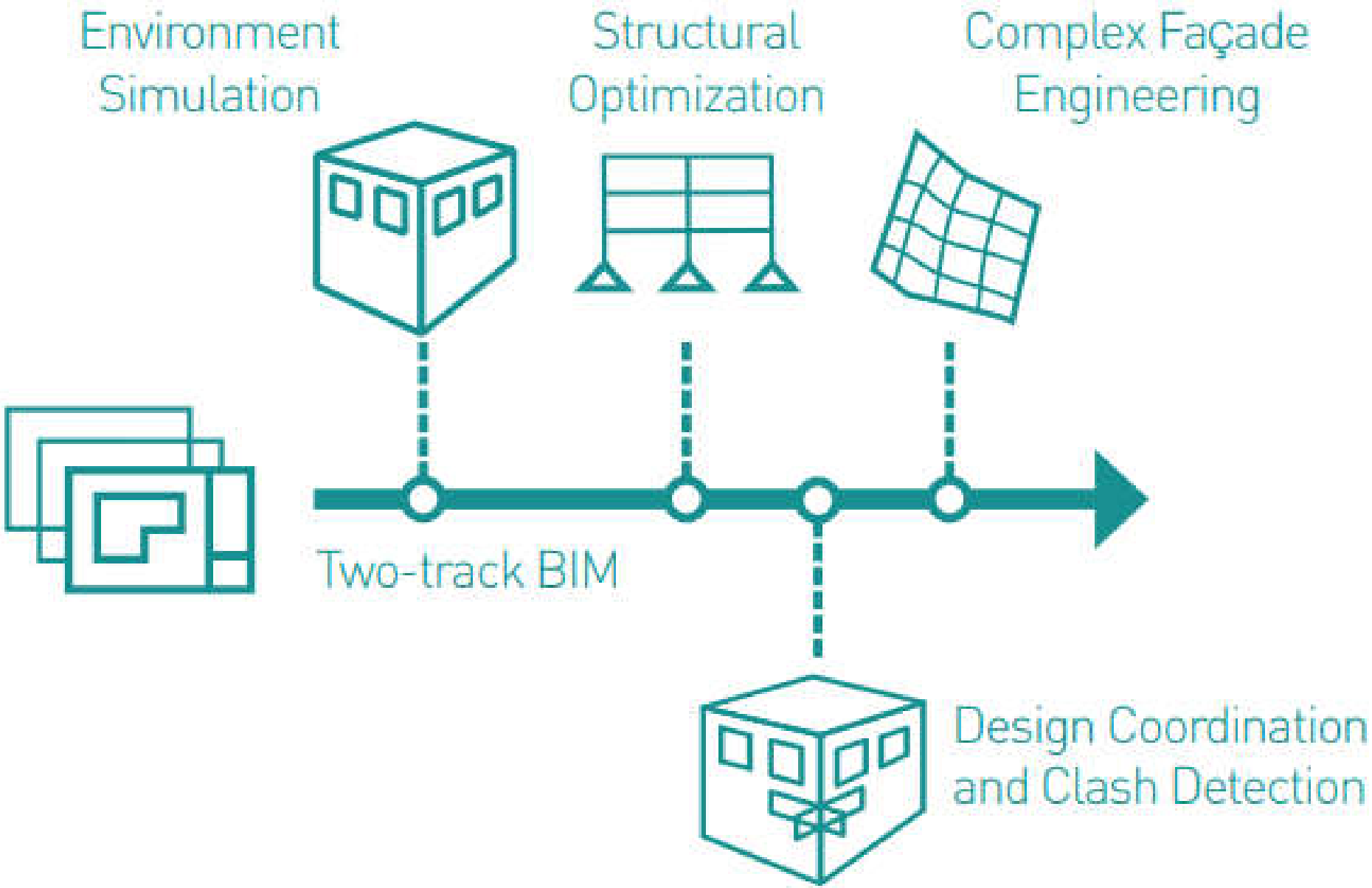
(Image source: Autodesk)

The six waves of BIM



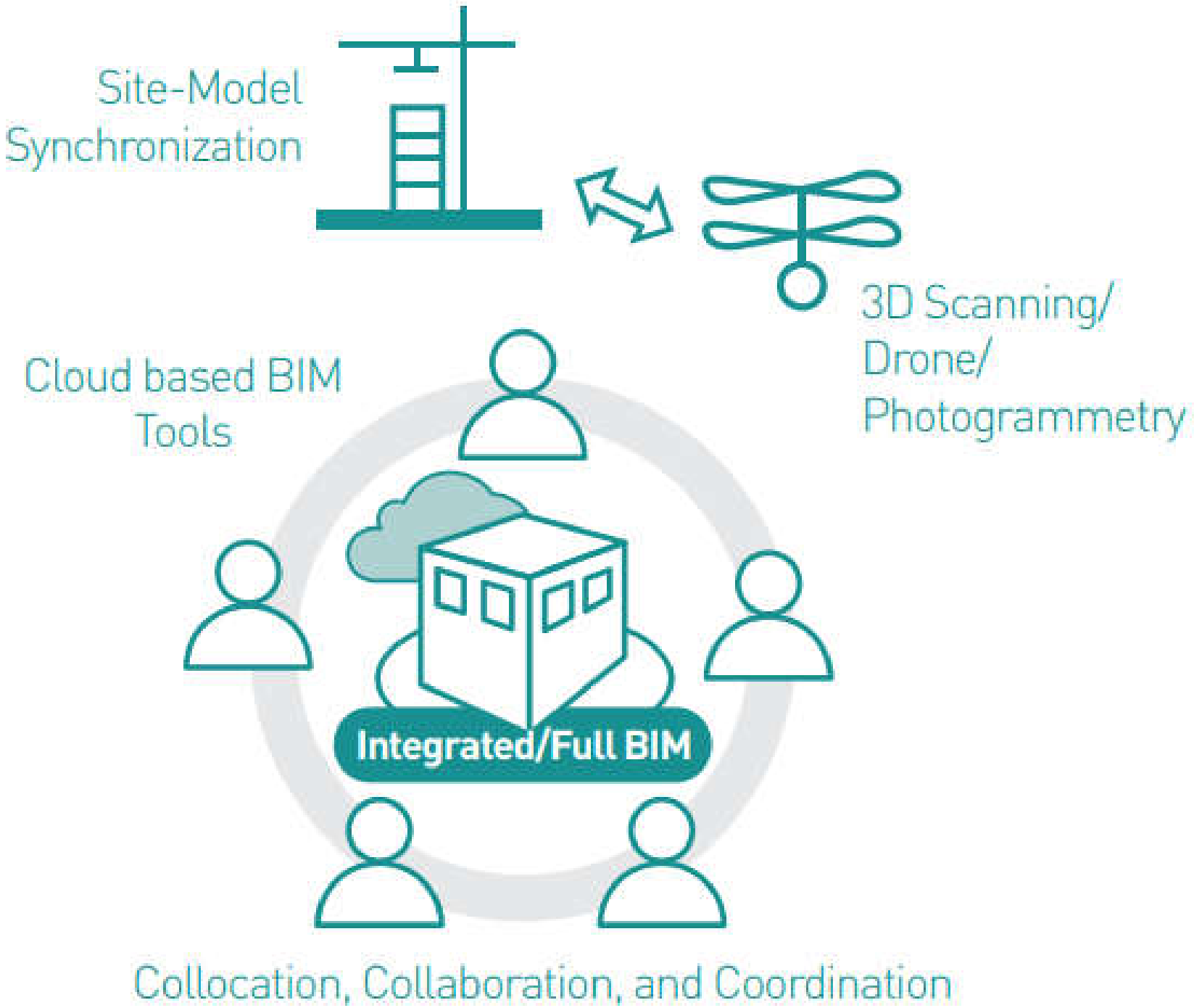
(Source: Rail BIM 2030 roadmap http://big.yonsei.ac.kr/railbim/)

BIM 2.0 Two-track BIM



(Source: Rail BIM 2030 roadmap http://big.yonsei.ac.kr/railbim/)

BIM Level 3: BIM 3.0 Fully Integrated BIM



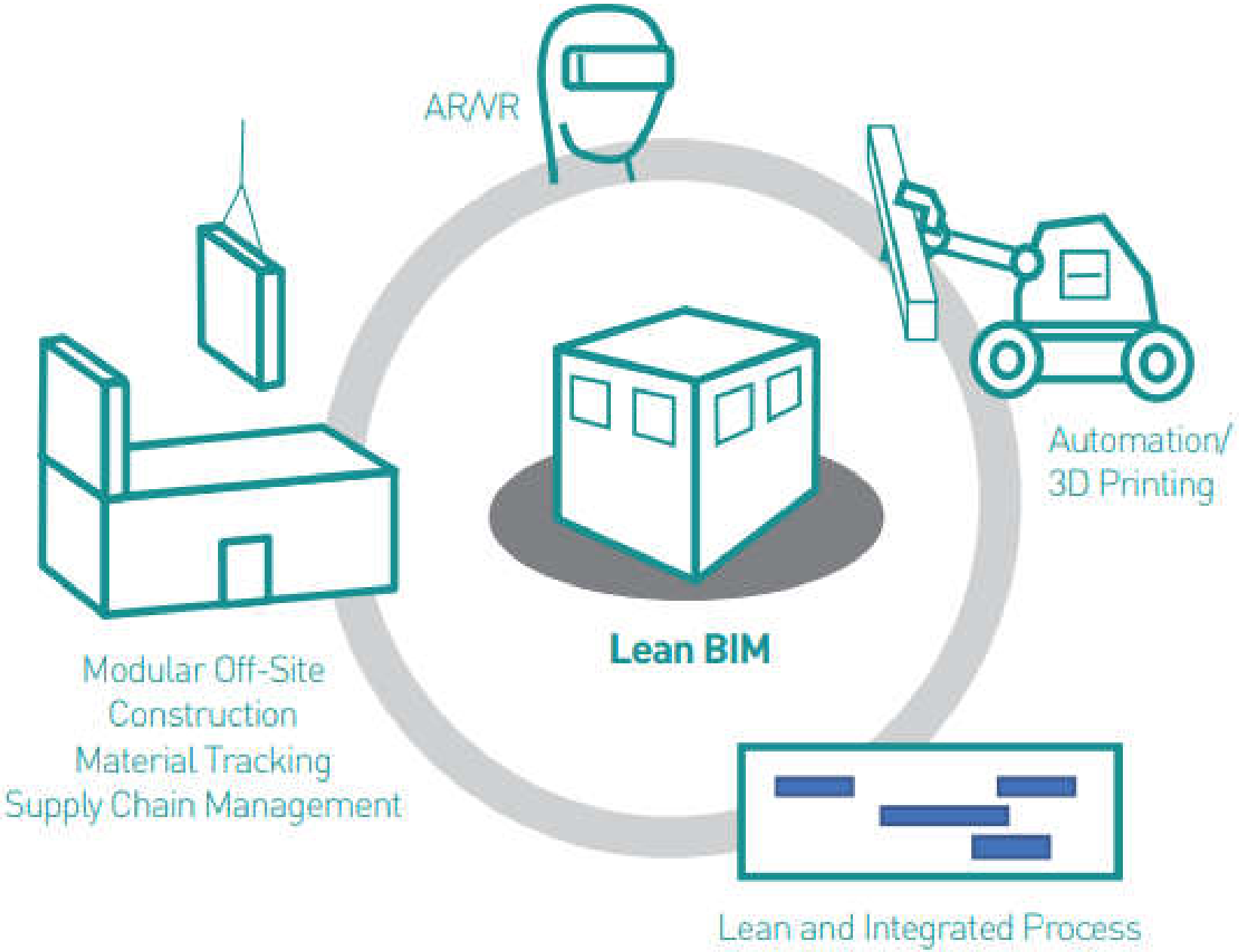
(Source: Rail BIM 2030 roadmap http://big.yonsei.ac.kr/railbim/)

BIM technology trends

- The future of BIM:
  - BIM 4.0 -- Lean BIM: Construction projects are carried out using the manufacturing approach, e.g. modular construction, lean construction, off-site construction, and construction automation
  - BIM 5.0 -- Intelligent BIM: Projects are carried out based on informed decision-making using big data and artificial intelligence (a.k.a. connected BIM or linked BIM)

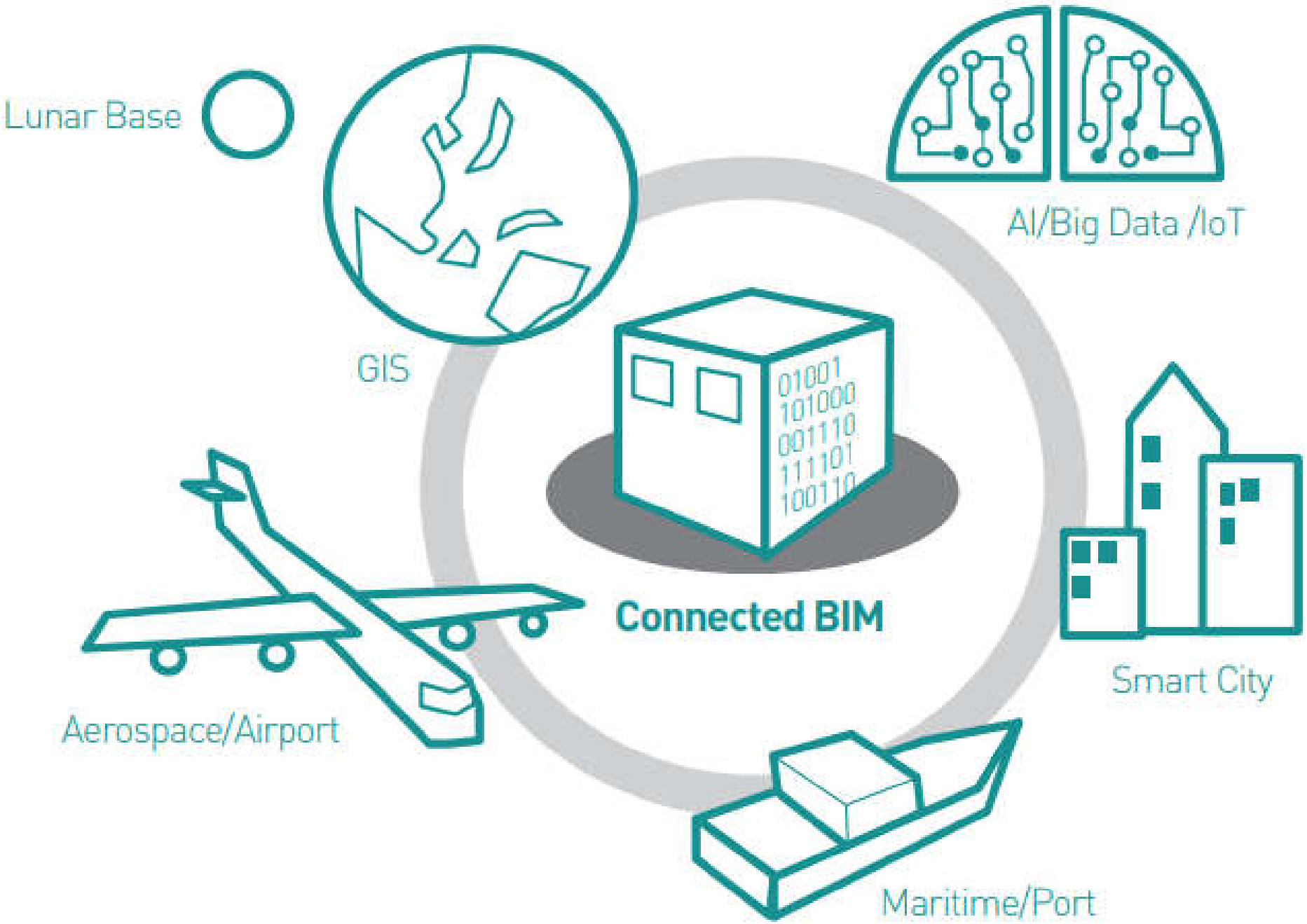
(Source: Rail BIM 2030 roadmap http://big.yonsei.ac.kr/railbim/)

BIM 4.0 Lean BIM



(Source: Rail BIM 2030 roadmap http://big.yonsei.ac.kr/railbim/)

BIM 5.0 Intelligent BIM



(Source: Rail BIM 2030 roadmap http://big.yonsei.ac.kr/railbim/)

BIM technology trends

- BIM related construction technologies:
  - Design for Manufacturing and Assembly (DfMA)
  - Modular Integrated Construction (MiC)
  - Prefabricated Prefinished Volumetric Construction (PPVC)
  - Construction Robotics (CR)
  - Construction 3D Printing (c3Dp)
  - Lean Construction (LC)

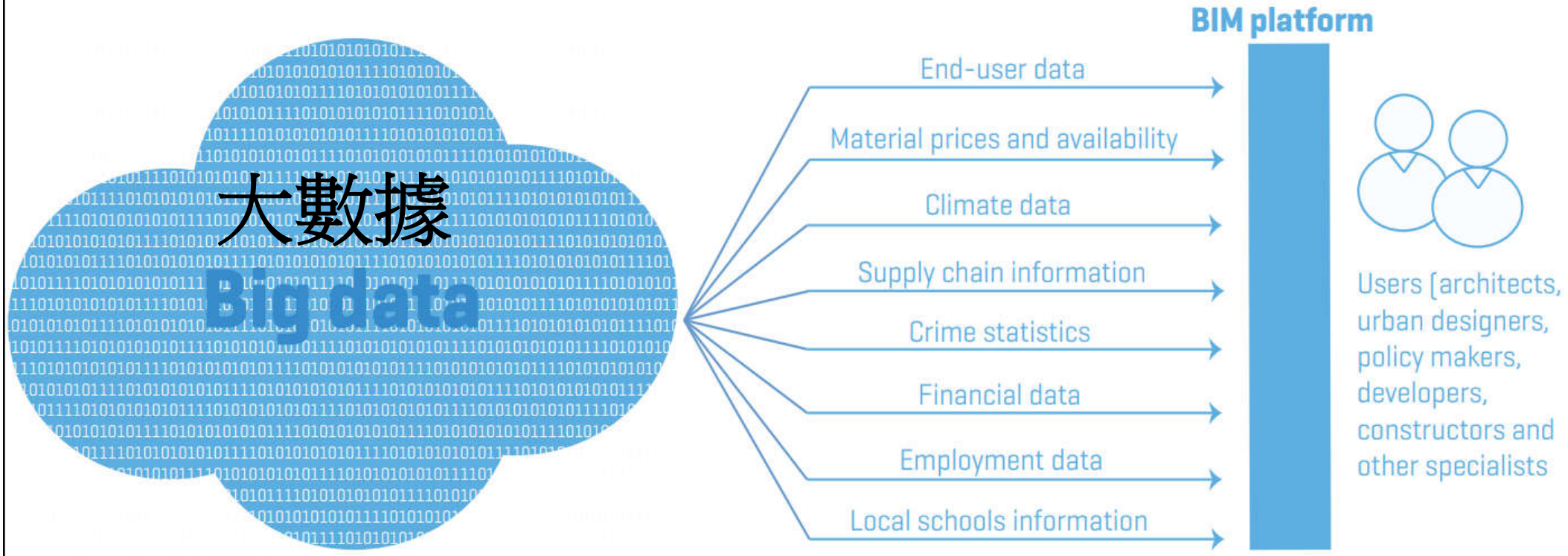
BIM technology trends

- Other technologies with significant impacts:
  - Augmented Reality (AR)/Virtual Reality (VR)
  - Cloud computing & analysis
  - Mobile technology & wearable devices
  - Global Positioning System (GPS)
  - 3D laser scanning & drones
  - Internet of Things (IoT) & intelligent sensors
  - Big data & data science
  - Artificial intelligence (AI)

BIM technology trends

- BIM => More data/information => Big Data
  - Big data of building/construction/lifecycle
- BIM and Artificial Intelligence (AI)
  - Machine Learning (ML)
  - Deep Learning (DL)
  - Image/visual/speech recognition
  - Problem/safety detection
  - Predictive modelling/analytics
  - Task automation & robotics

Big data-supported BIM platform



Big data provides unprecedented insight and improved decision-making. This technology can be tapped to enhance the design, construction, operation and maintenance of our built environment.

A BIM platform can be linked to a large volume of data that can enhance the decision-making power of the stakeholders in a team. A project can benefit from real-time information sources such as supply chain data, commodity pricing data, marketing data, sensor data, point-cloud data, crime statistics, employment data and so on.

(Source: RICS, 2014. *International BIM Implementation Guide*)

BIM technology trends

- Real business value of BIM:
  - Design improvements & optimization
  - Savings on time & costs
  - Faster response time to market & changes
  - Increased productivity & quality
- How to achieve the benefits:
  - Good understanding of BIM concepts
  - Effective integration of related technologies
  - Development of BIM capabilities

Conclusion

- BIM brings significant changes to design, construction and operation of building and construction projects
- It enables a paradigm shift & acts as a driver for digital construction/transformation
- It requires integrated & collaborative working process for all the stakeholders
- It offers good opportunities for innovation & digital team collaboration

THANK YOU 謝謝 !!