

Building Information Modelling (BIM) as a complementary Building Energy Auditing tool

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(Ph.D.)

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Director, **SHRC**, Peshawar

Director “**BIM Implementation P&DD**” World Bank



Today...

- Intro to SHRC and CIBEA
- What is BIM (Building Information Modelling)?
- How BIM can support Energy Auditing?
- Our Experiences
- Q&A



SUSTAINABLE HOUSING RESEARCH CENTER

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Office Address: *Office No. 7-8, JK Shopping Mall, Arbab Road Stop, University Road, Peshawar*

SMIP

SuperMud® Insulated Panels



SuperMud plastering with steel smoother on panels.

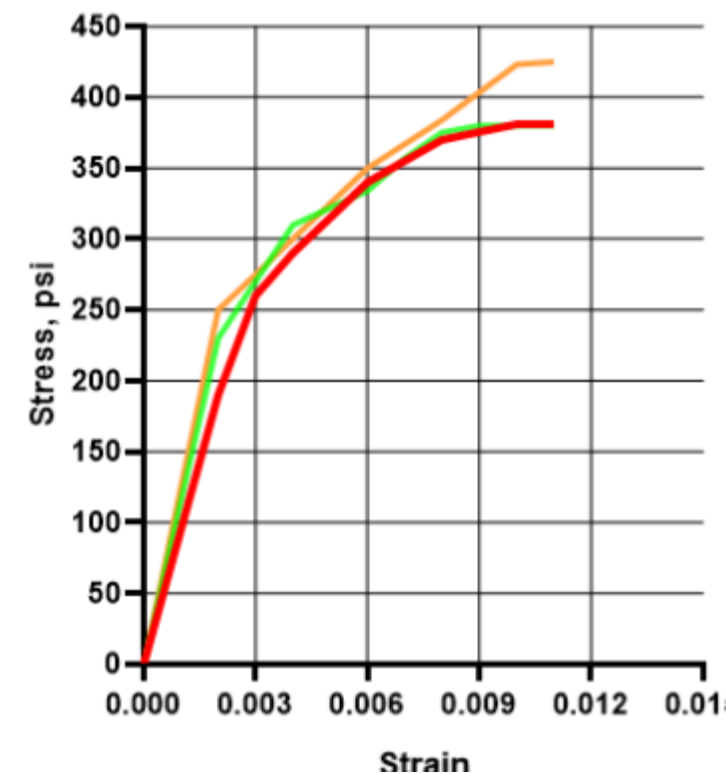


SMIP plaster finishing and curing





SuperMud[®] Brick Masonry



SCIP (Sandwich Concrete Insulated Panels)



Services and Products we provide

- Designing, supervision and construction services of SCIP and SMIP™.
- Manufacture Provides durable and sustainable SuperMud™ bricks.
- Provides SCIP panels.
- Mix Design of SuperMud™ for local soil.
- Architectural Modelling and Designing of buildings.

Partners With:



Supported by:



Sustainable Housing Research Centre

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Stem Lab Constructed at Qadir Nagar, Buner.

CONTACT

info@shrc.com.pk

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Sandwich Concrete Insulated Panel (SCIP)

Sandwich Concrete Insulated Panel (SCIP) is composed of an EPS (Expanded Polystyrene) foam core surrounded by spray-on reinforced concrete skins on both sides. The concrete contains Polypropylene fibers where the reinforcement is in the form galvanized wire mesh. The reinforcement on both faces are interconnected through shear connector to have a semi-composite behavior. The layers are applied in two layers, first by shotcreting and then normal plastering to finish the surface making the total wall thickness as 8 inches.



Mardan Masjid construction project
(Two story Structure on SCIP)



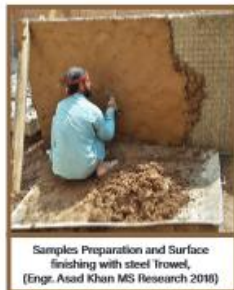
Steam Lab constructed using Sandwich concrete
insulated Panels (SCIP)



Highly Flexible and Unbreakable SCIP Joint
test at UET, Peshawar
(Imam Zaman Khan MSc Research 2019)

Sandwich Mud Insulated Panel (SMIP™)

In SMIP Sandwich Mud Insulated Panel, the difference to SCIP is that sprayed concrete is replaced by manually applied super mud which makes it environmental friendly, sustainable and low cost. Its strength is increased by using special chemical in specific proportion to the weight of soil considering soil liquid which is compared to concrete strength.



Samples Preparation and Surface
finishing with steel trowel,
(Engr. Asad Khan MS Research 2018)



Room constructed with SMIP™
(Engr. Zia, Ph.D. Research, 2020)



SUPER MUD crack control test at UET, Peshawar
(Wasim MSc Research 2019)

SuperMud™ Brick



SuperMud™ PVA6.67C bricks



Compression test on SuperMud™ PVA6.67C bricks



Compression Prism of SuperMud™ PVA6.67C bricks

SuperMud™ Brick are environmentally friendly Sundried Bricks with same strength and durability as a typical brick

Properties	SCIP	SMIP™	Masonry	SuperMud™ 2930psi	SuperMud™ 1750psi
Light weight (40% Reduction in weight.)	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆
Rapid Construction	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆
No Formwork Required	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆
Time and Labour Saving	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆
Energy Efficient	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆
Load Resistant (Flood, Hurricane and Earthquake Resistance).	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆
Sound Proofing	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆
Versatile	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆

COST COMPARISON

Masonry	SCIP	SMIP™	SuperMud™ 2930psi	SuperMud™ 1750psi
1200-1500 PKR/sft	1700 PKR/sft	1500 PKR/sft	1800-2250 PKR/sft	900-1125 PKR/sft

Cost is based on single storey typical house on November 2020 material rates.



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Address

Center for Industrial and Building Energy Audits, Office # 107, USPCAS-E, near SNGPL office, Phase 5 Hayatabad, Peshawar, Khyber Pakhtunkhwa

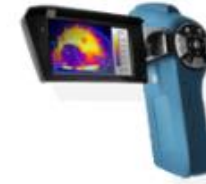
Equipment at CIBEA



11. Blowerdoor



1. Energy Analyzer (KW, KVA, PF, Harmonics)



2. Thermal Imager Baltech TR-0120



3. Anemometer EXTECHAN 340



4. Anemometer Dwyer VT-200



5. Video Boroscope EXTECH BR 250-4



6. Laser Range Finder



7. Moisture Humidity Meter EXTECH MO 295



8. IR Thermometer Fluke 572-2



9. Laser Distance Meter Fluke 419 D



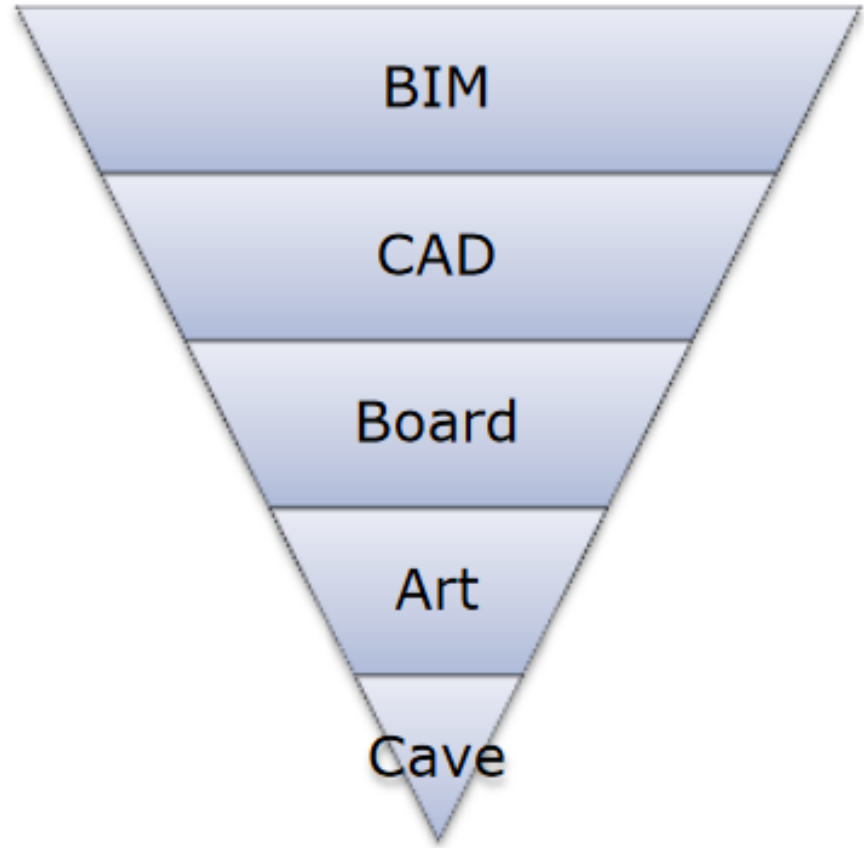
10. Flue Gas Analyzer Testo 320

INTRODUCTION TO BIM

Cave Art in Spain (14k BC)



What is BIM?



Late 20th and now 21st

Mid 20th and now 21st

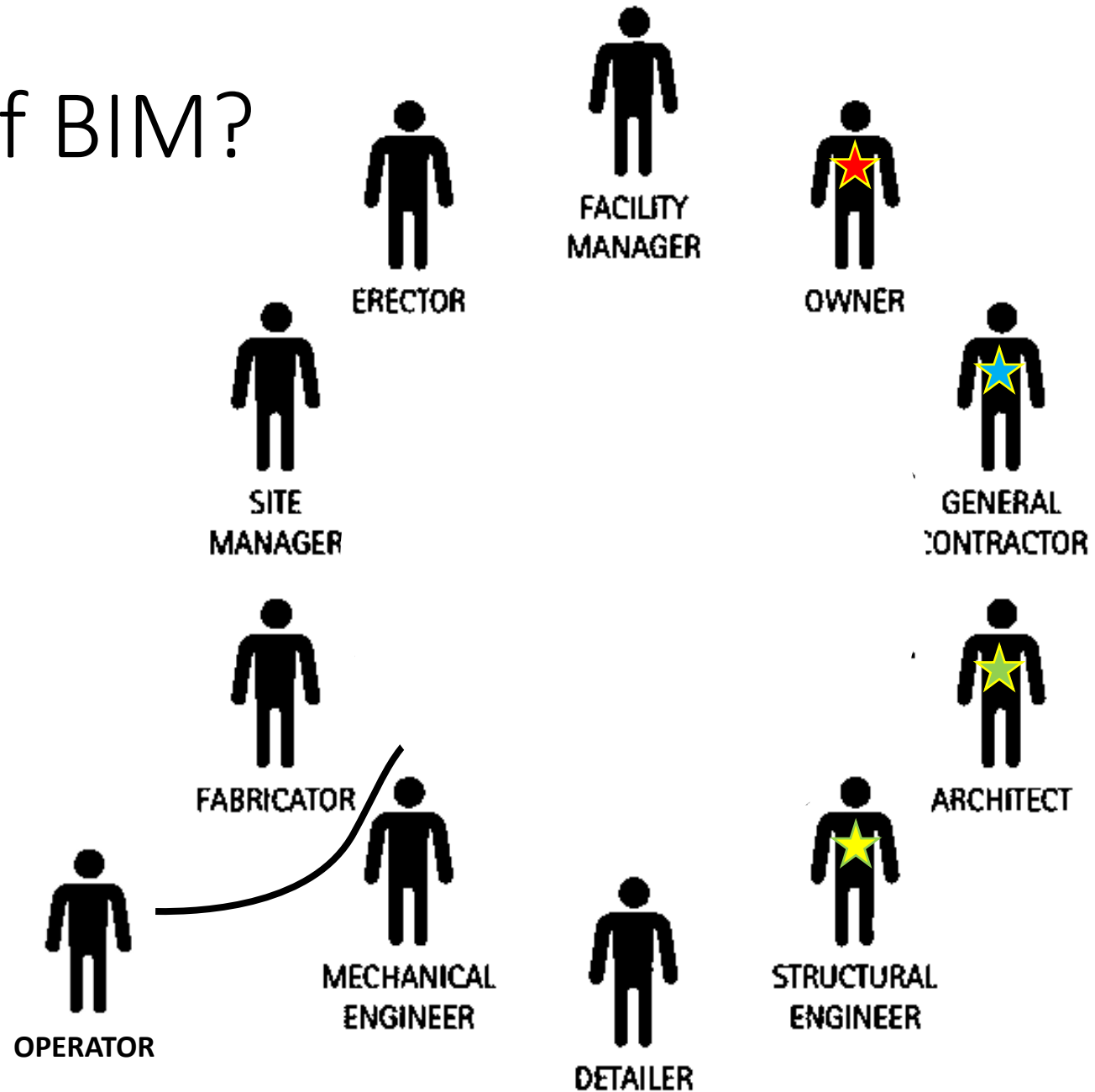
Early 18th and still in
the 21st

Early 10K BC and still in
21st

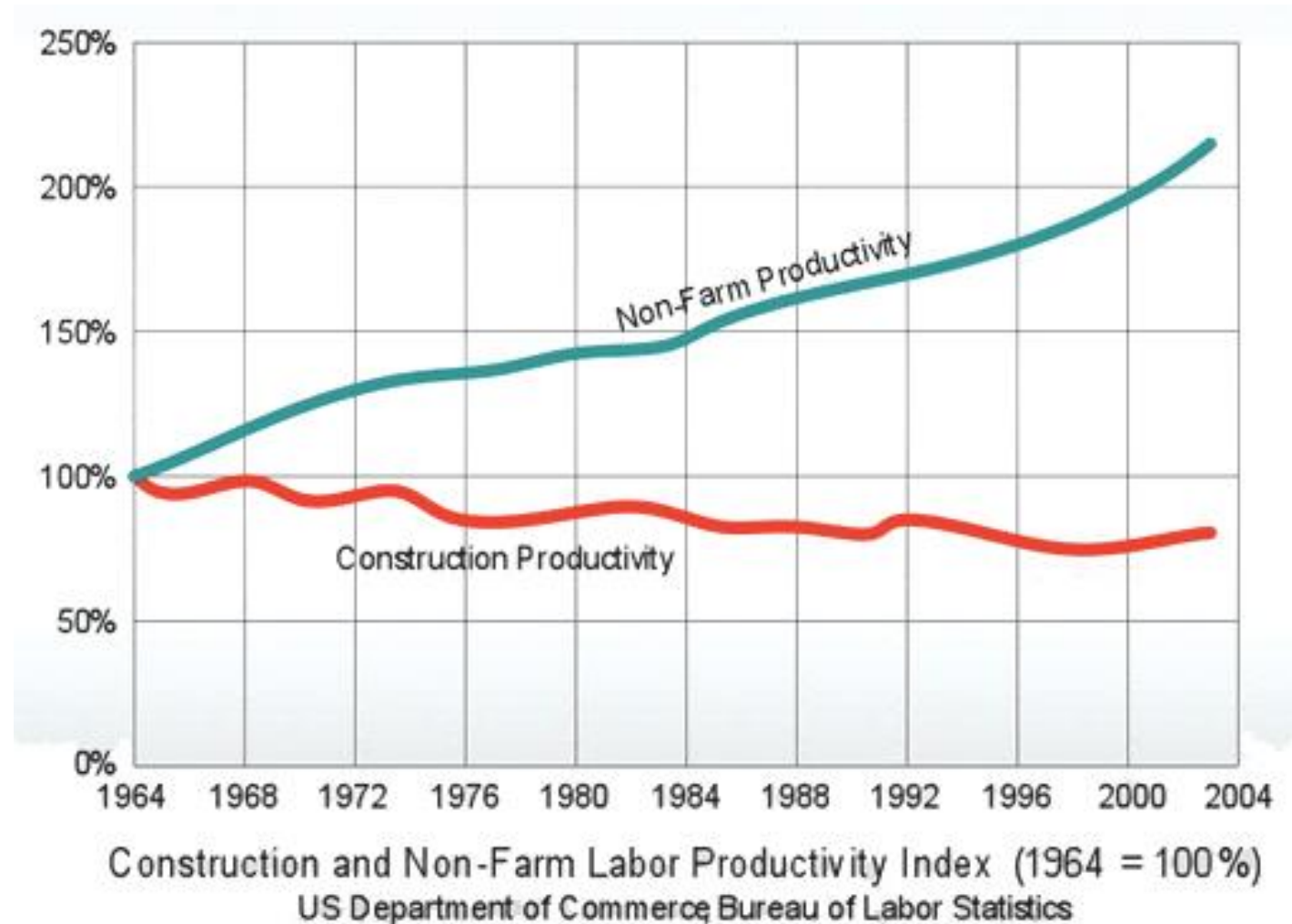
Early 35K BC and still in
21st

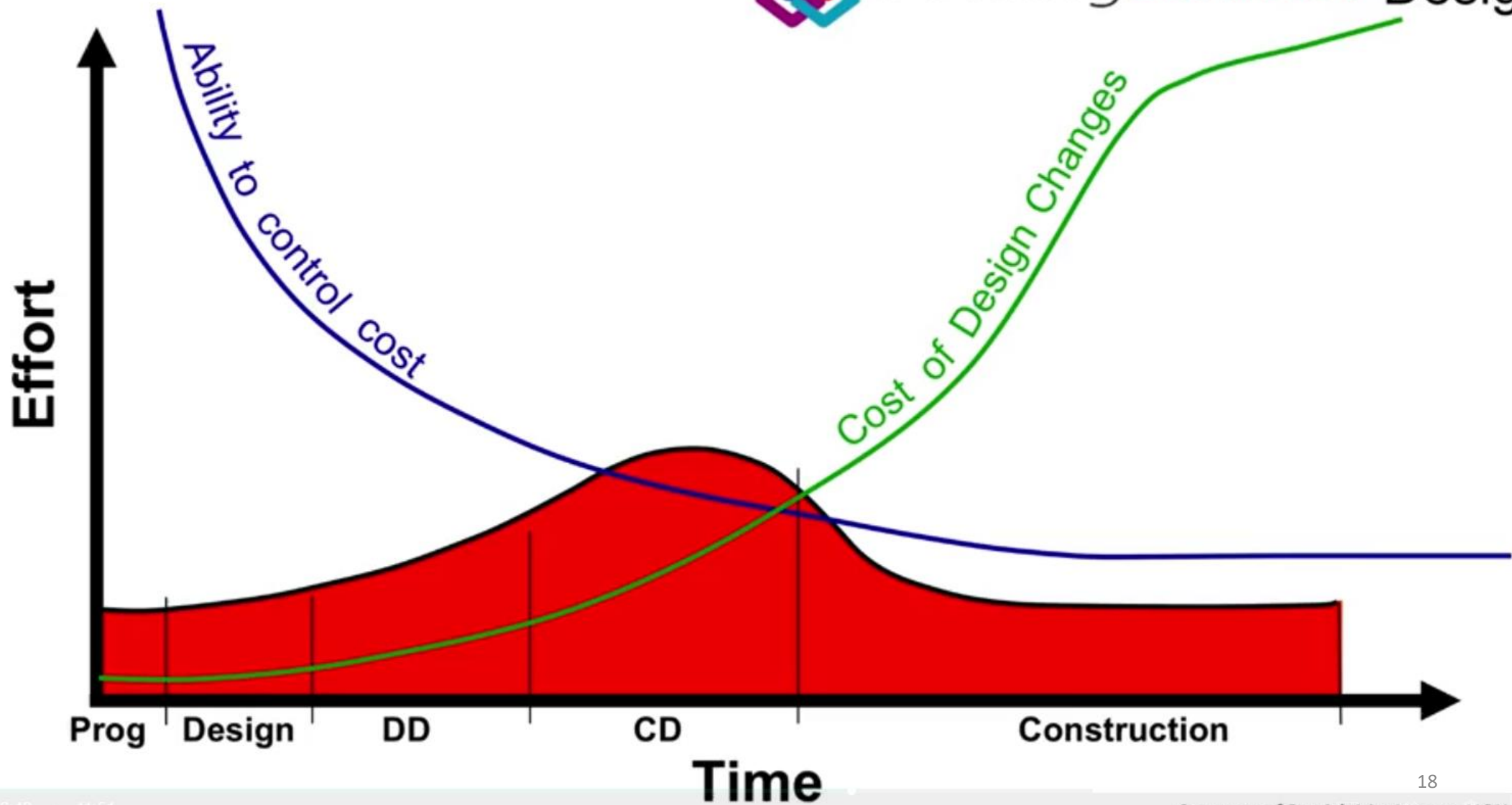


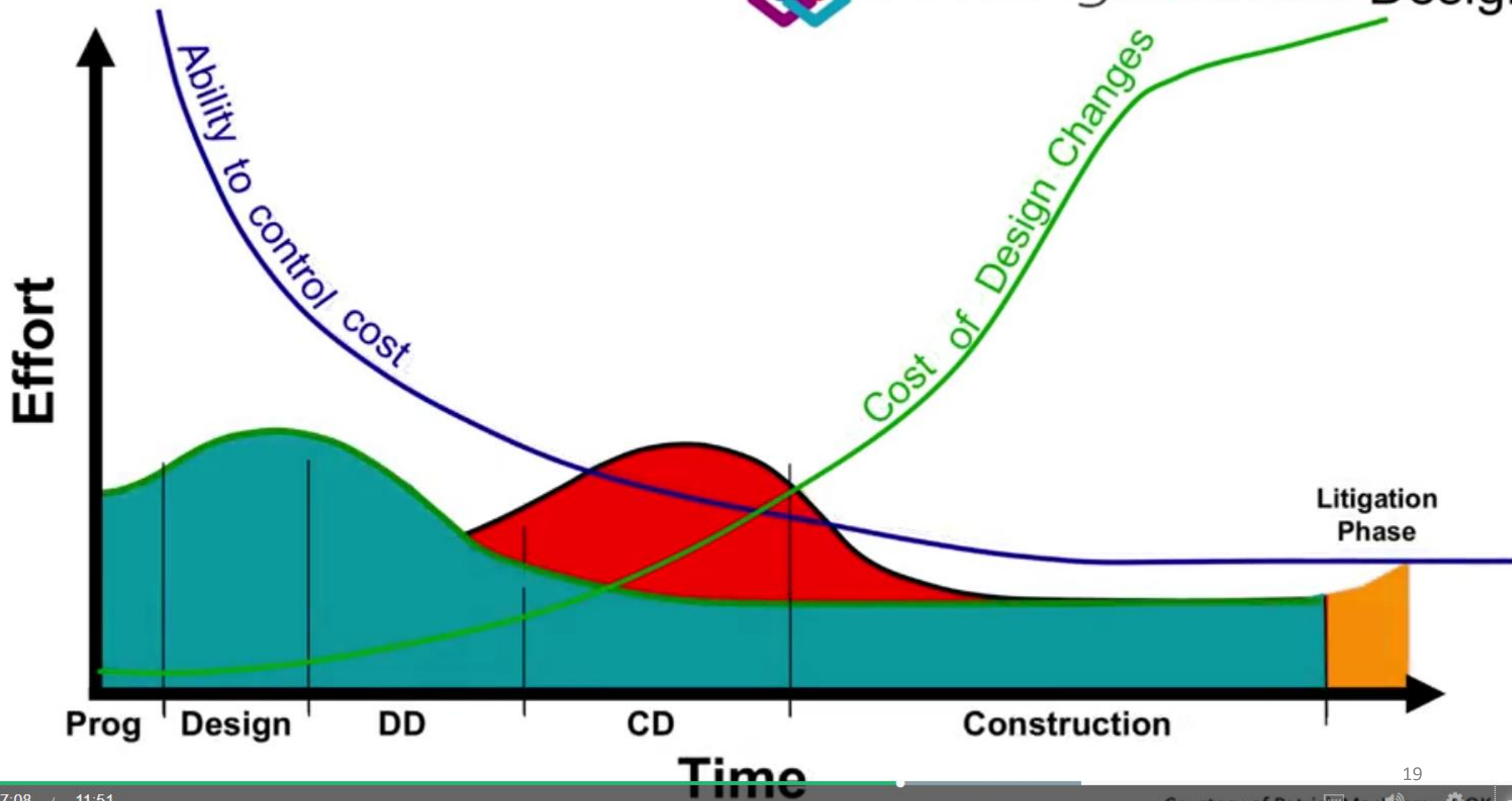
Stakeholders of BIM?

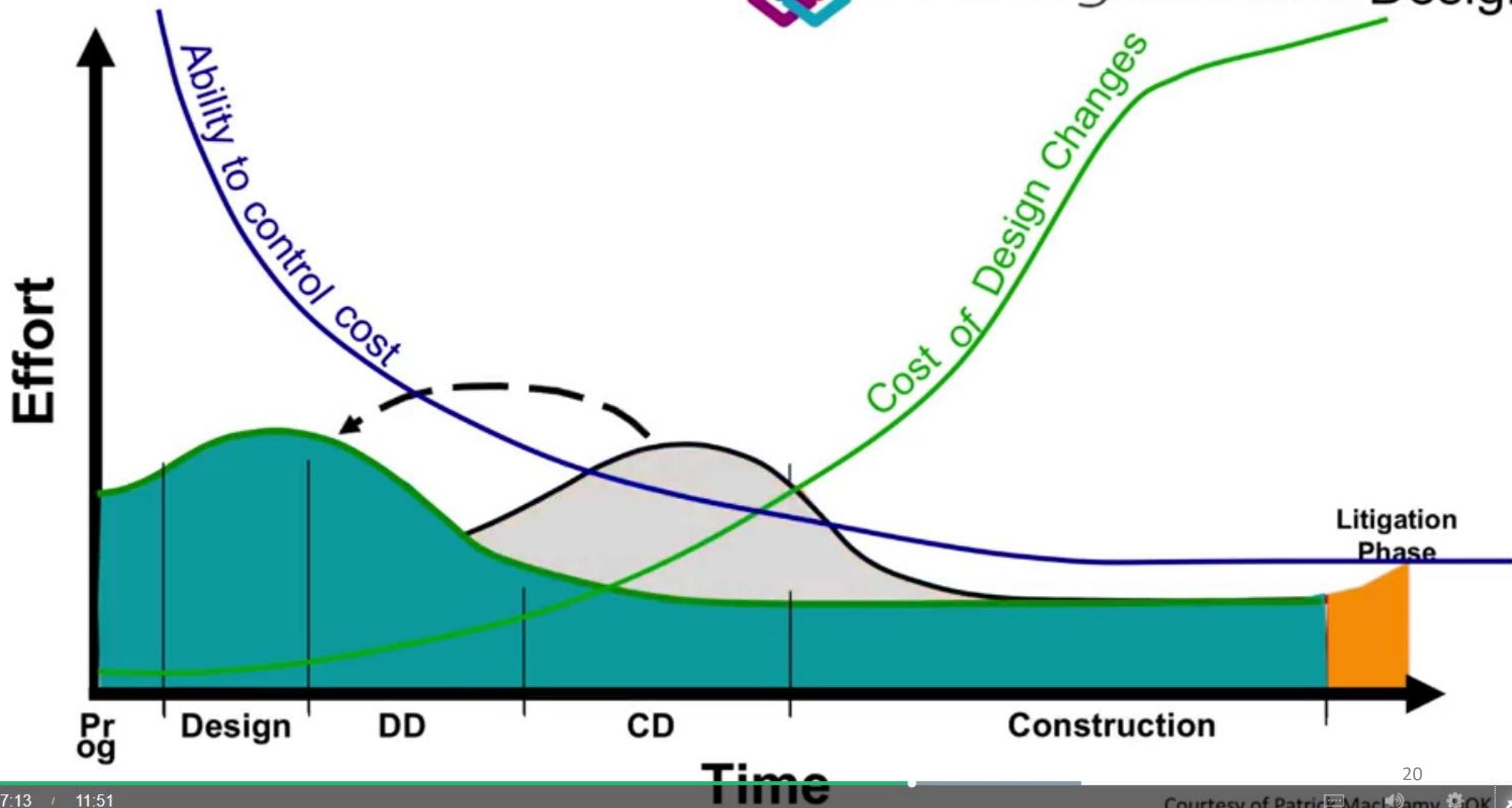


Labor Productivity with years...

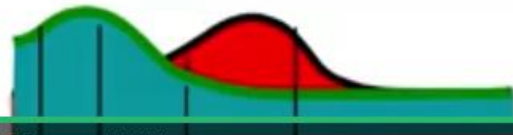
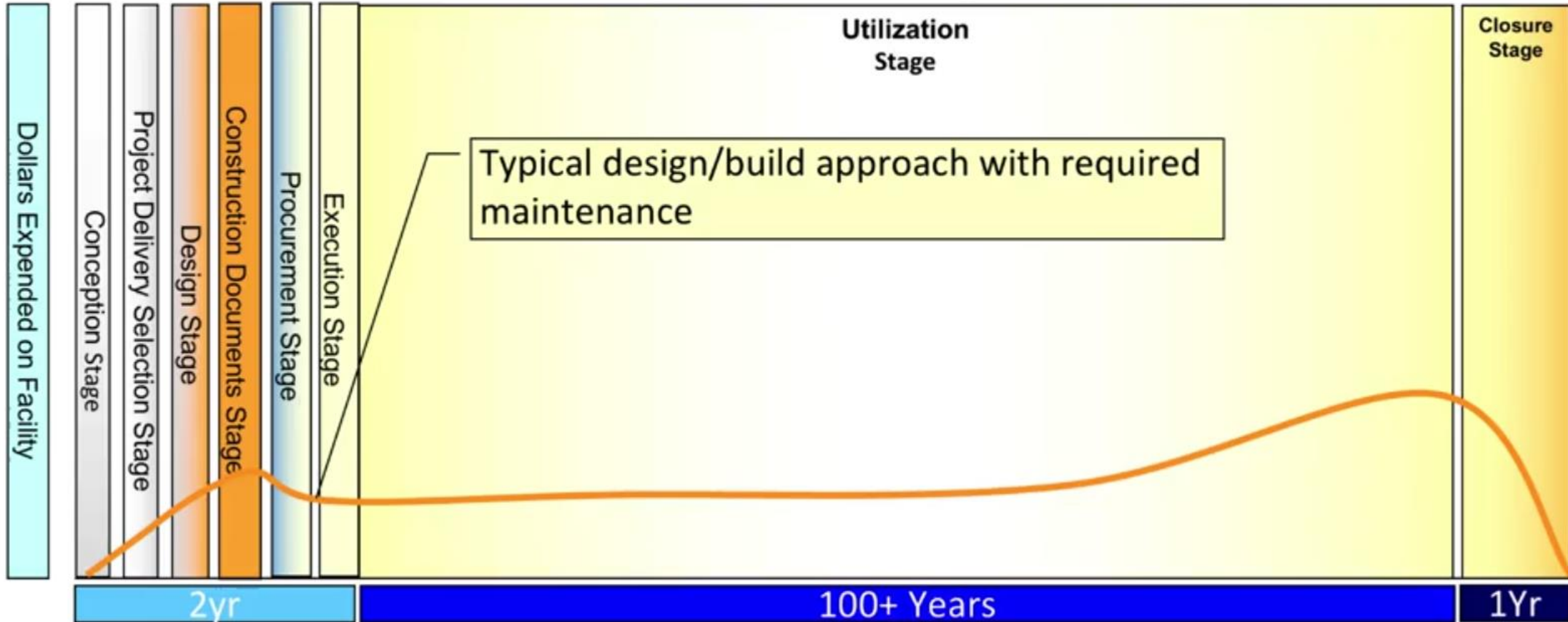




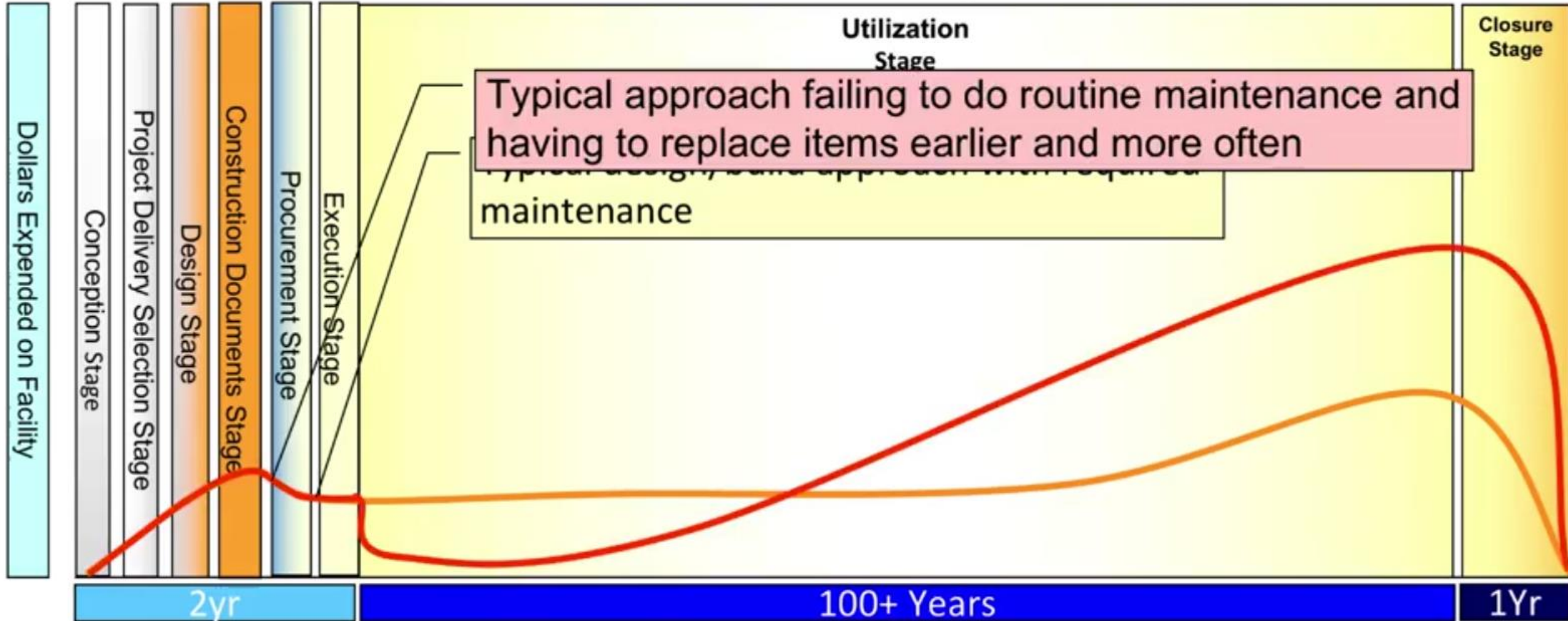




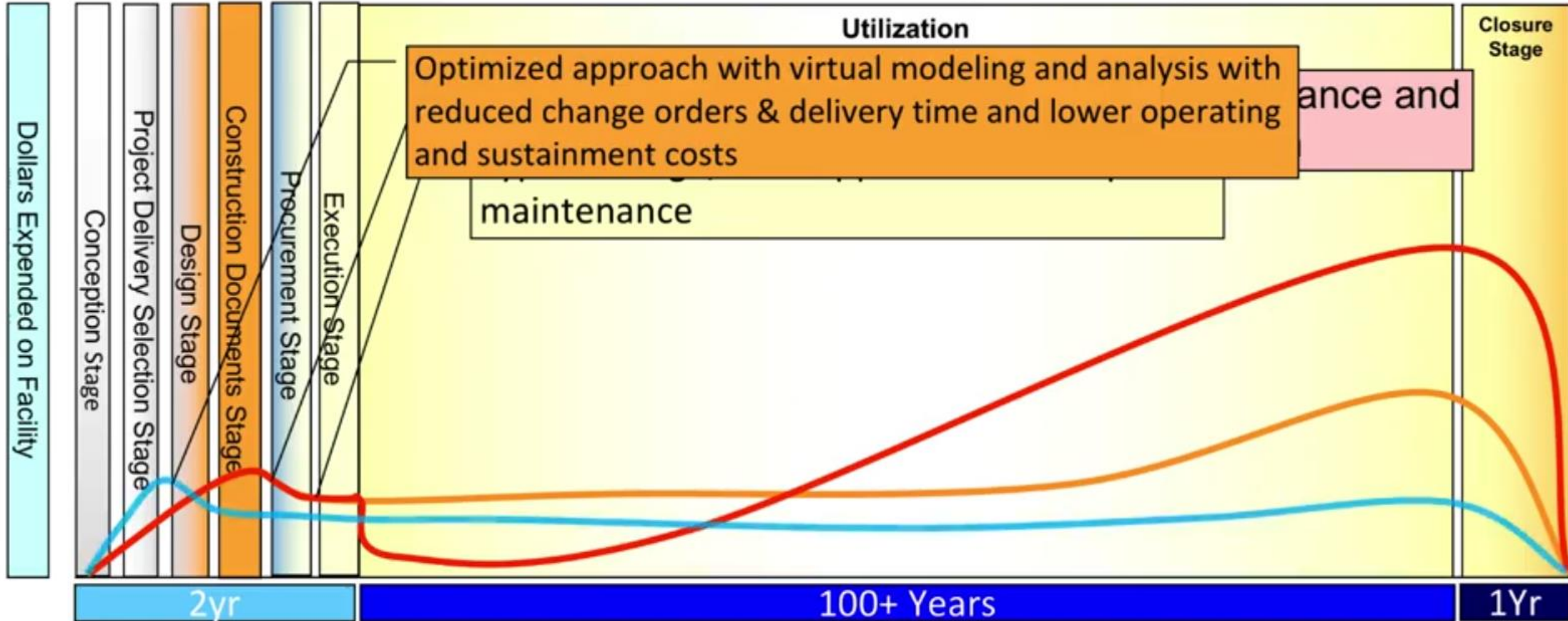
Business Model for Facility Management



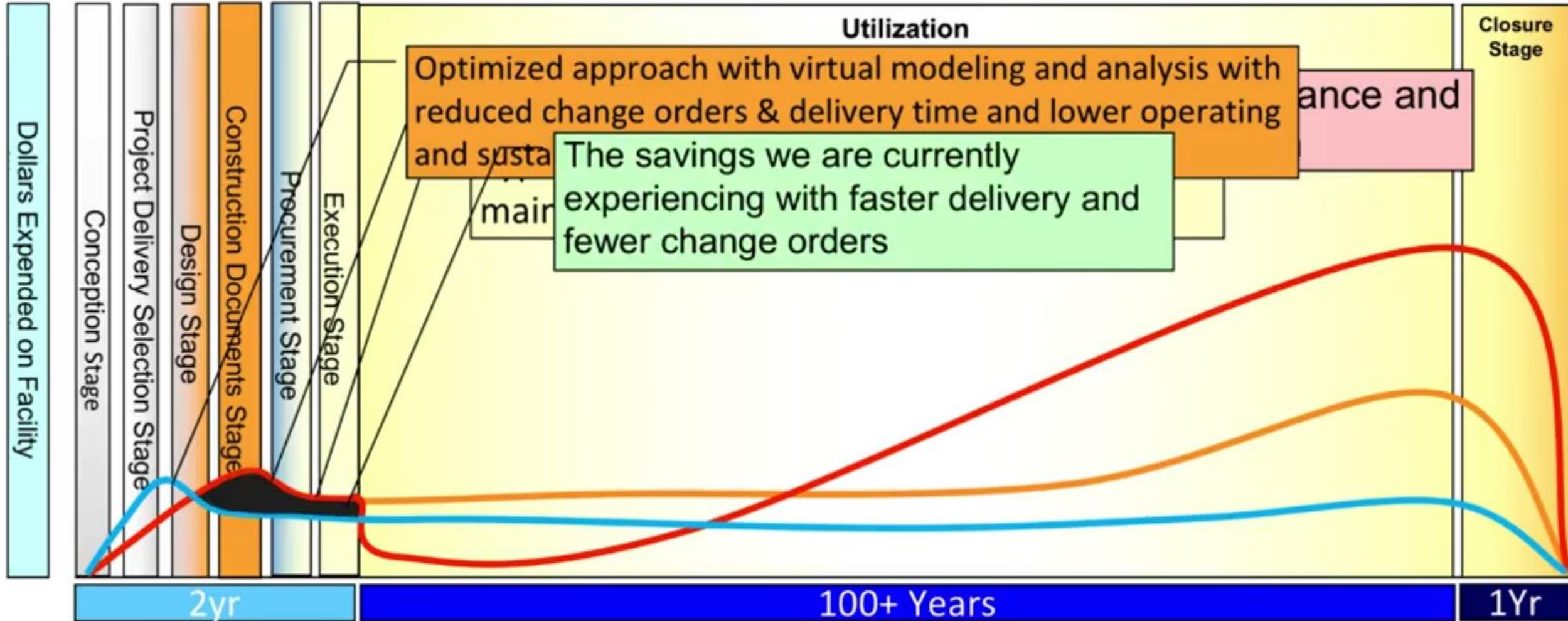
Business Model for Facility Management



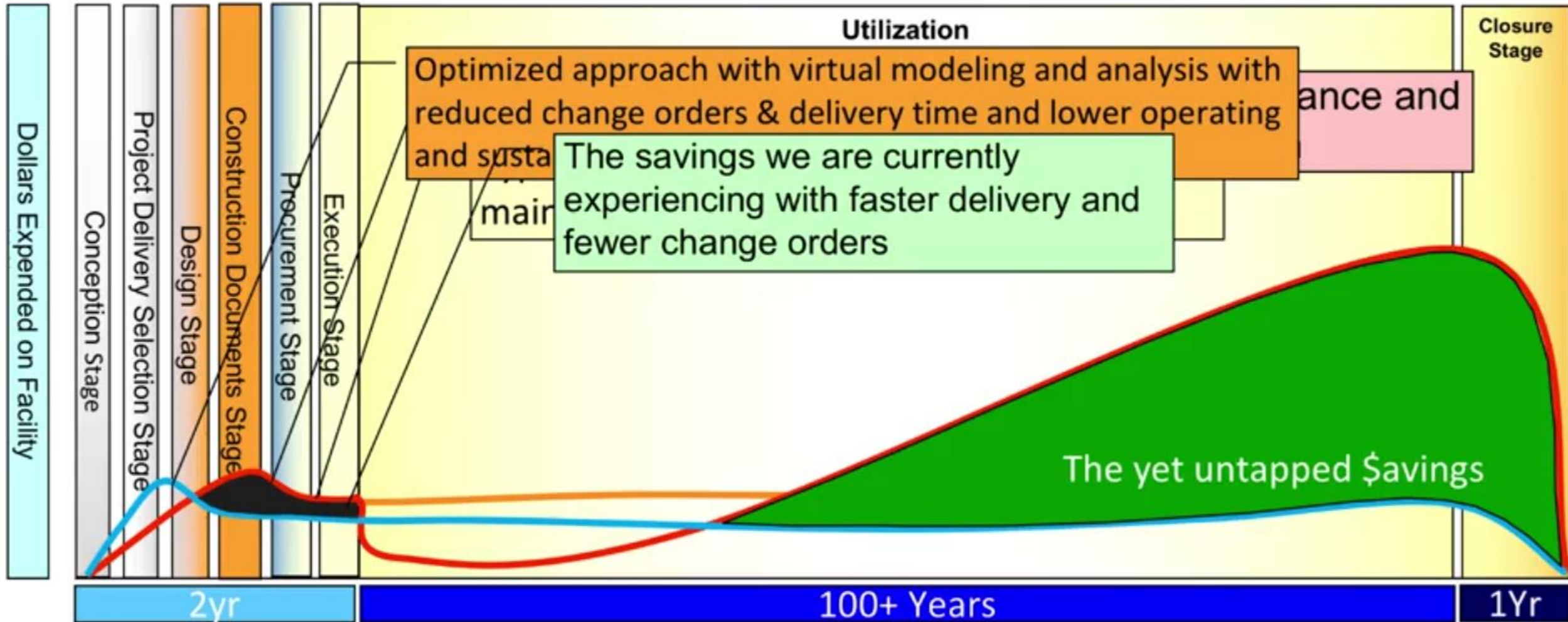
Business Model for Facility Management



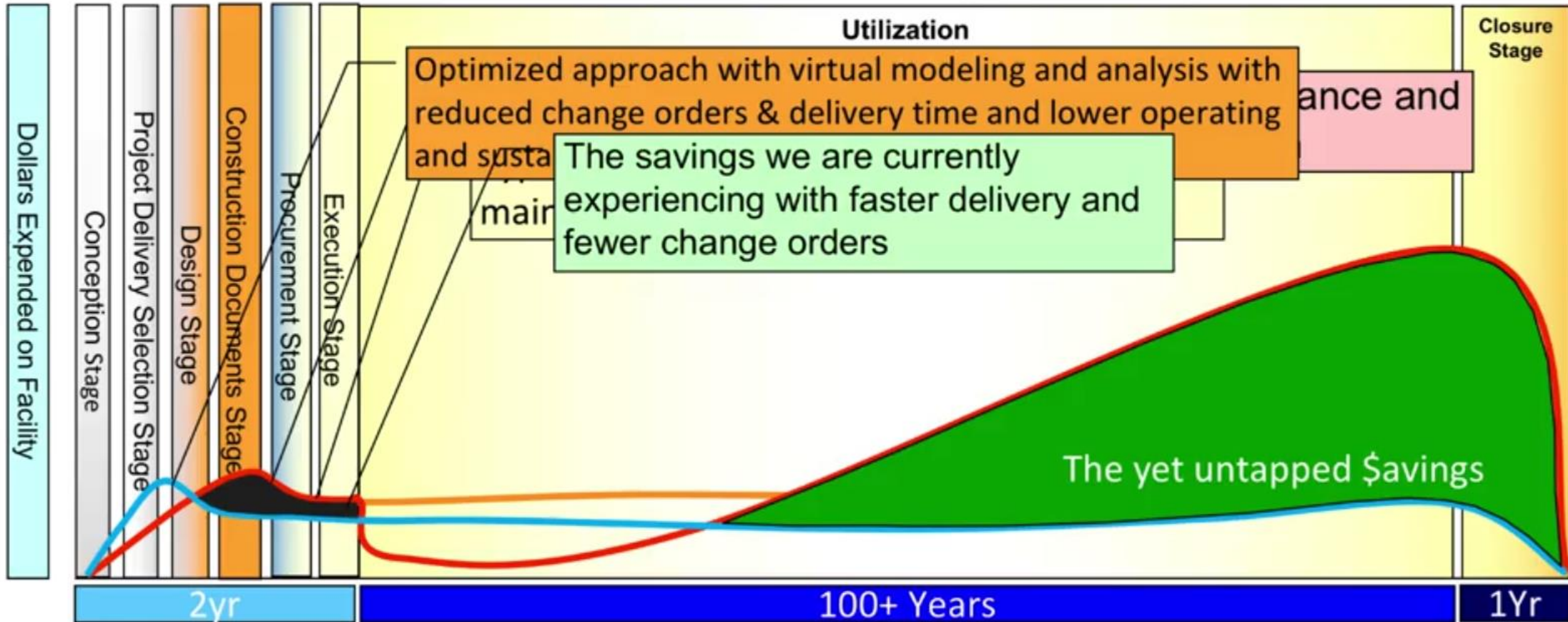
Business Model for Facility Management



Business Model for Facility Management



Business Model for Facility Management



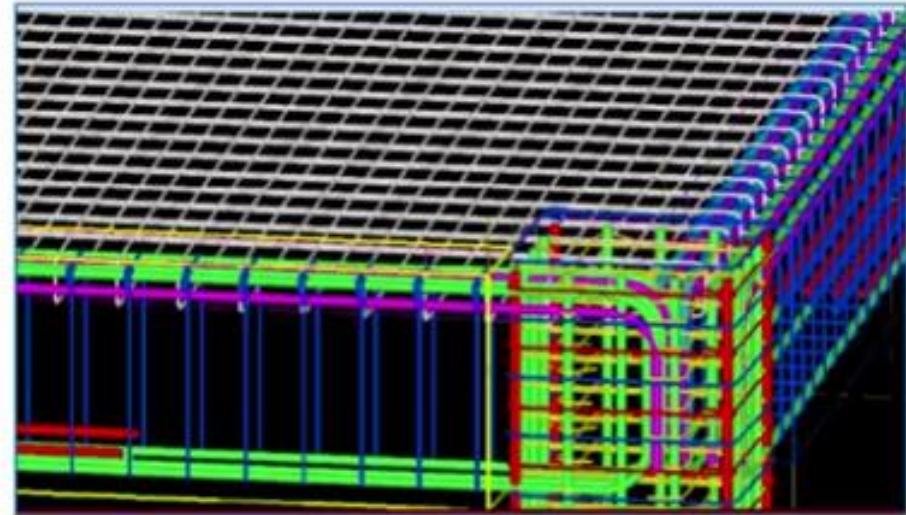
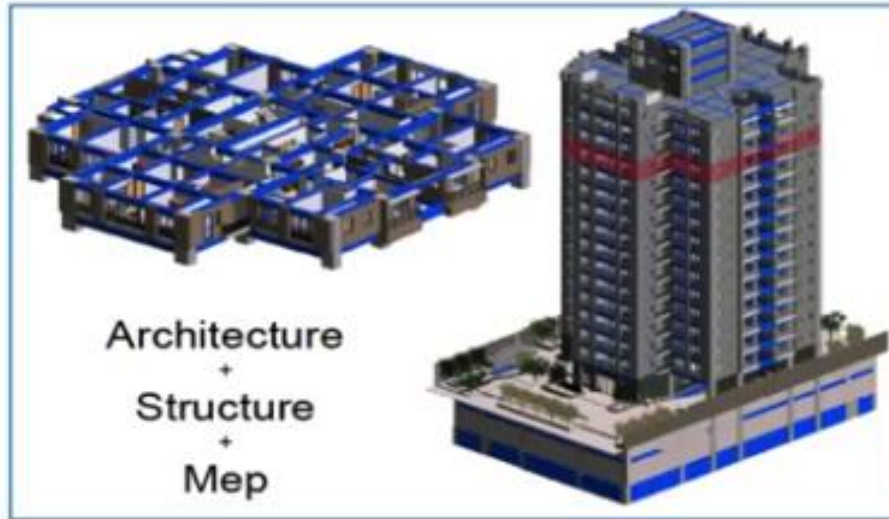
How BIM is used?



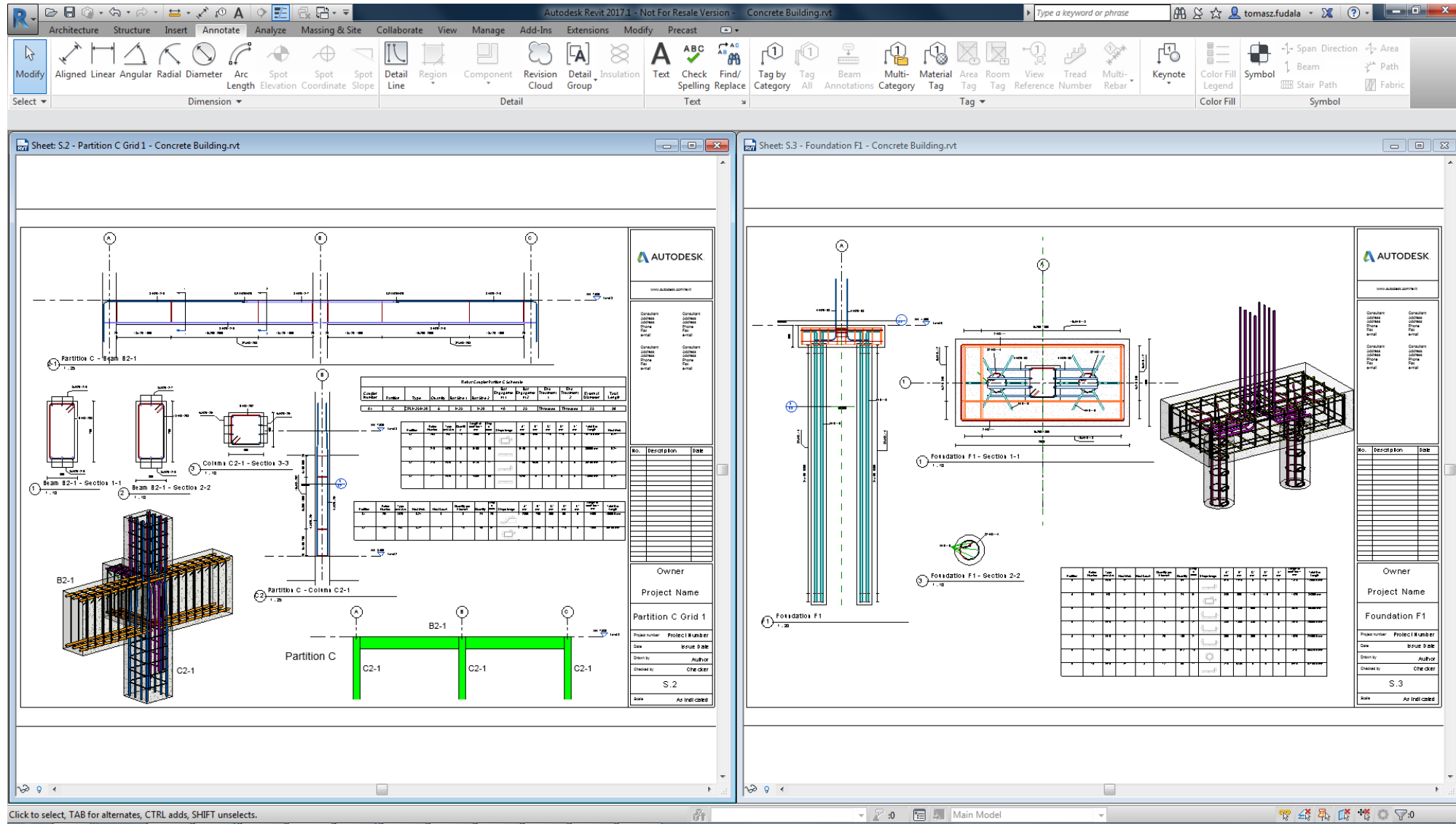
What is BIM?

- Building Information Modeling (BIM) is a set of **technologies, processes and policies** enabling **multiple stakeholders to collaboratively design, construct and operate a Facility in virtual space**.
- It is an **intelligent 3D model-based process** that usually requires a **BIM execution plan** for **owners, architects, engineers, and contractors or construction professionals** to more **efficiently plan, design, construct, and manage buildings and infrastructure**.

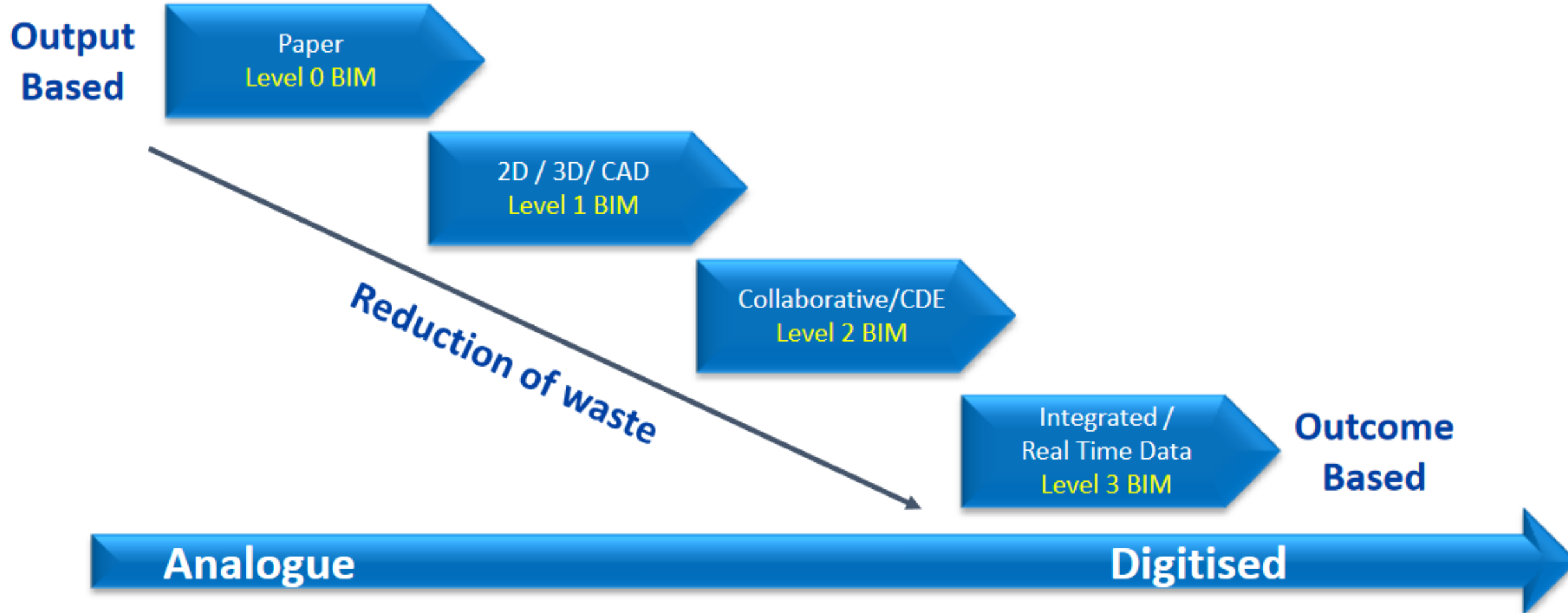
BIM Benefits



BIM Benefits



Levels of BIM.



Types of BIM software.

1. BIM Execution Planning Software
2. BIM Content Management Software
3. **BIM Modeling Software**
4. Generative Design Software / Algorithmic BIM Software
5. **BIM Performance / BIM Analysis Software**
6. BIM Collaboration Software
7. BIM Validation / BIM Checking Software
8. Preconstruction BIM 4D/5D Software
9. Construction BIM Software
10. Facilities Management BIM Software

BIM Implementations



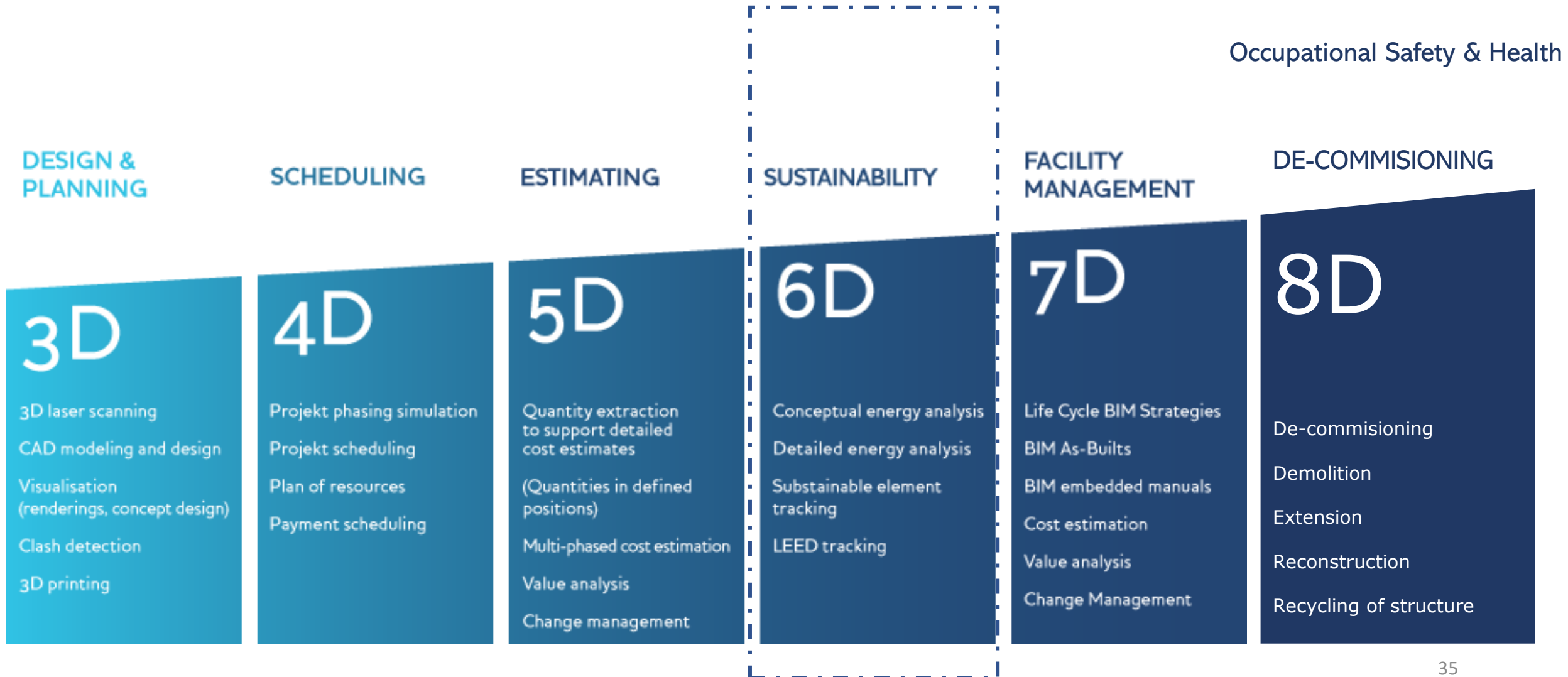
BIM4Client
BIM4Datacentres
BIM4Design
BIM4FitOut
BIM4FM
BIM4Health and Safety
BIM4Heritage
BIM4Highways
BIM4Housing
BIM4Infrastructure
UKBIM4Landscape
BIM4LG
BIM4M2
BIM4Rail
BIM4Regs
BIM4Retail
BIM4Security and Emergency
Services
BIM4SME
BIM4Water
Survey4BIM
....and other SIGs

BIM Standards

Committee: ISO/TC 59/SC13 Construction works information

- **ISO 19650-1 BIM Concepts and principles (based on BS 1192) (Nov 2018)**
- **ISO 19650-2 BIM Delivery phase of assets (based on PAS 1192-2) (Nov 2018)**
- **ISO 19650-3 Operational phase of assets (based on PAS 1192-3) (July 2020)**
- **ISO 19650-4 Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling — Part 4: Information exchange ?**
- **ISO 19650-5 Security minded BIM (based on PAS 1192-5) (June 2020)**
- **ISO 19650-6 sharing and use of structured health and safety information ?**

8Ds of BIM.



9th D of BIM?

LEAN CONSTRUCTION

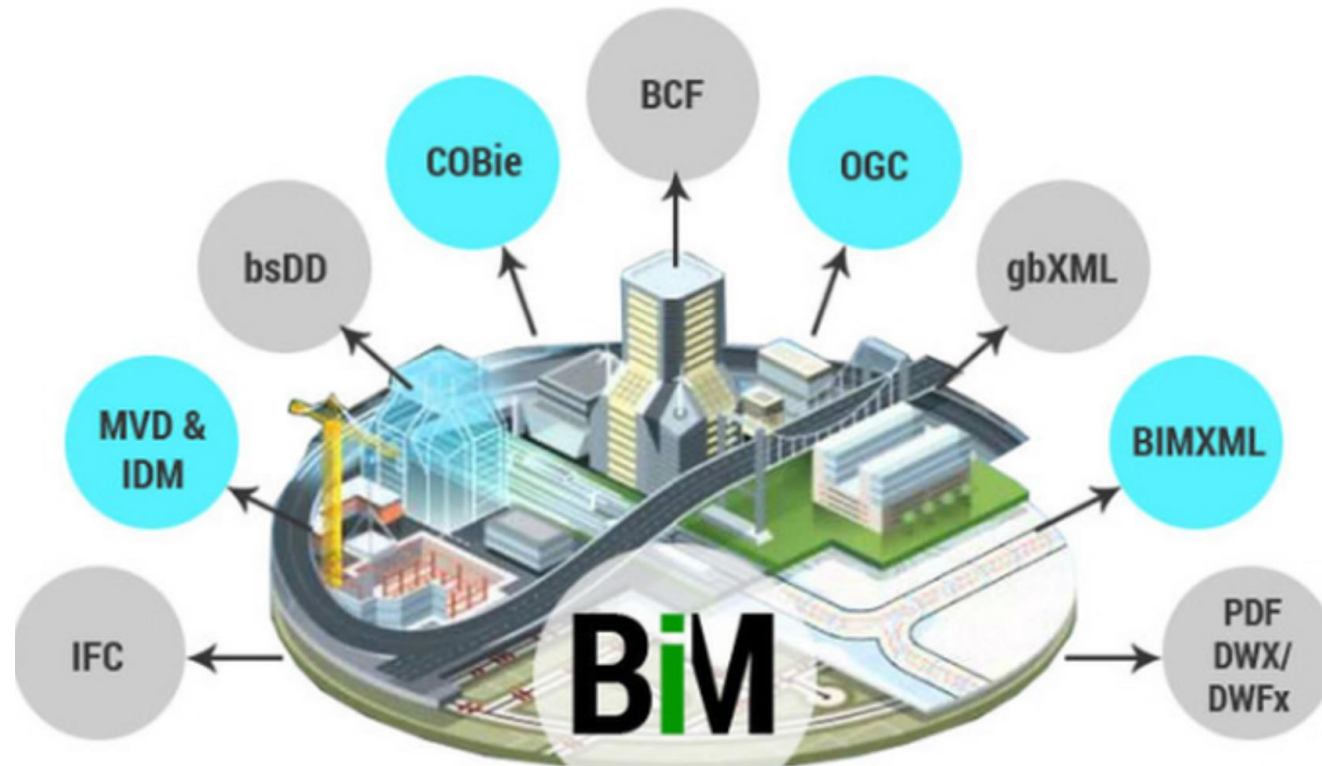
- Way to design production systems to **minimize waste** of materials, **time, and effort** in order to generate the **maximum** possible amount of **value**.

Industry Foundation Class (IFC)

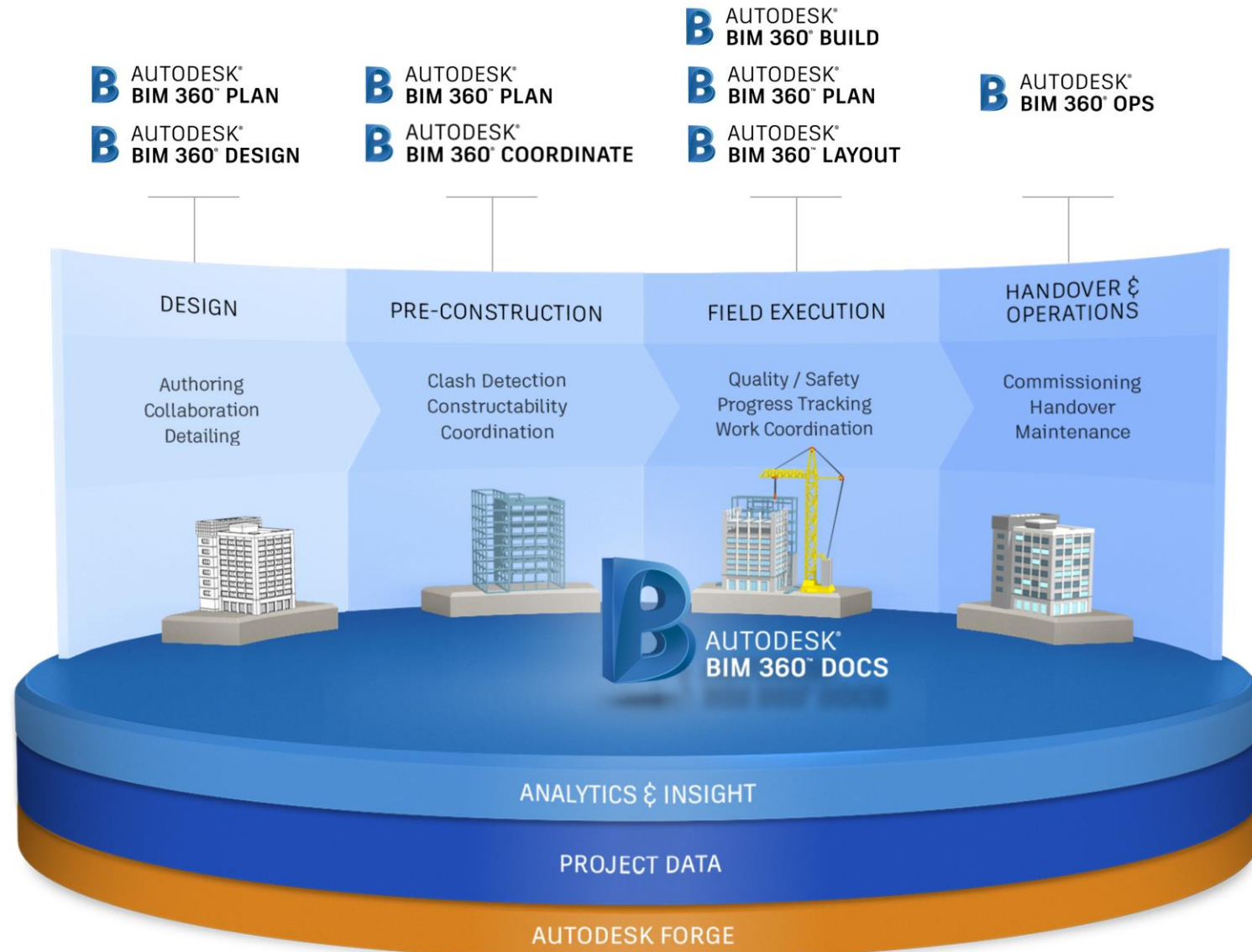


Other BIM formats

Open Standards for BIM



Autodesk BIM360



AECO

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Use powerful BIM and CAD workflows to create in new ways and build with confidence.



Revit

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InfraWorks

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Navisworks Manage

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ReCap Pro

Reality capture and 3D scanning software and services.

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Contd..



Advance Steel

3D modeling software for steel detailing.

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Insight

Building performance analysis software.



FormIt Pro

Intuitive 3D sketching app with native Revit interoperability.

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Dynamo Studio

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Robot Structural Analysis Professional

Advanced BIM-integrated structural analysis and code compliance verification tool.

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3ds Max

3D modeling, animation, and rendering software for design visualization.

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Autodesk Rendering

Fast, high-resolution renderings in the cloud.



Vehicle Tracking

Vehicle swept path analysis software.

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Fabrication CADmep

MEP detailing and documentation software.

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Structural Bridge Design

Structural bridge analysis software.

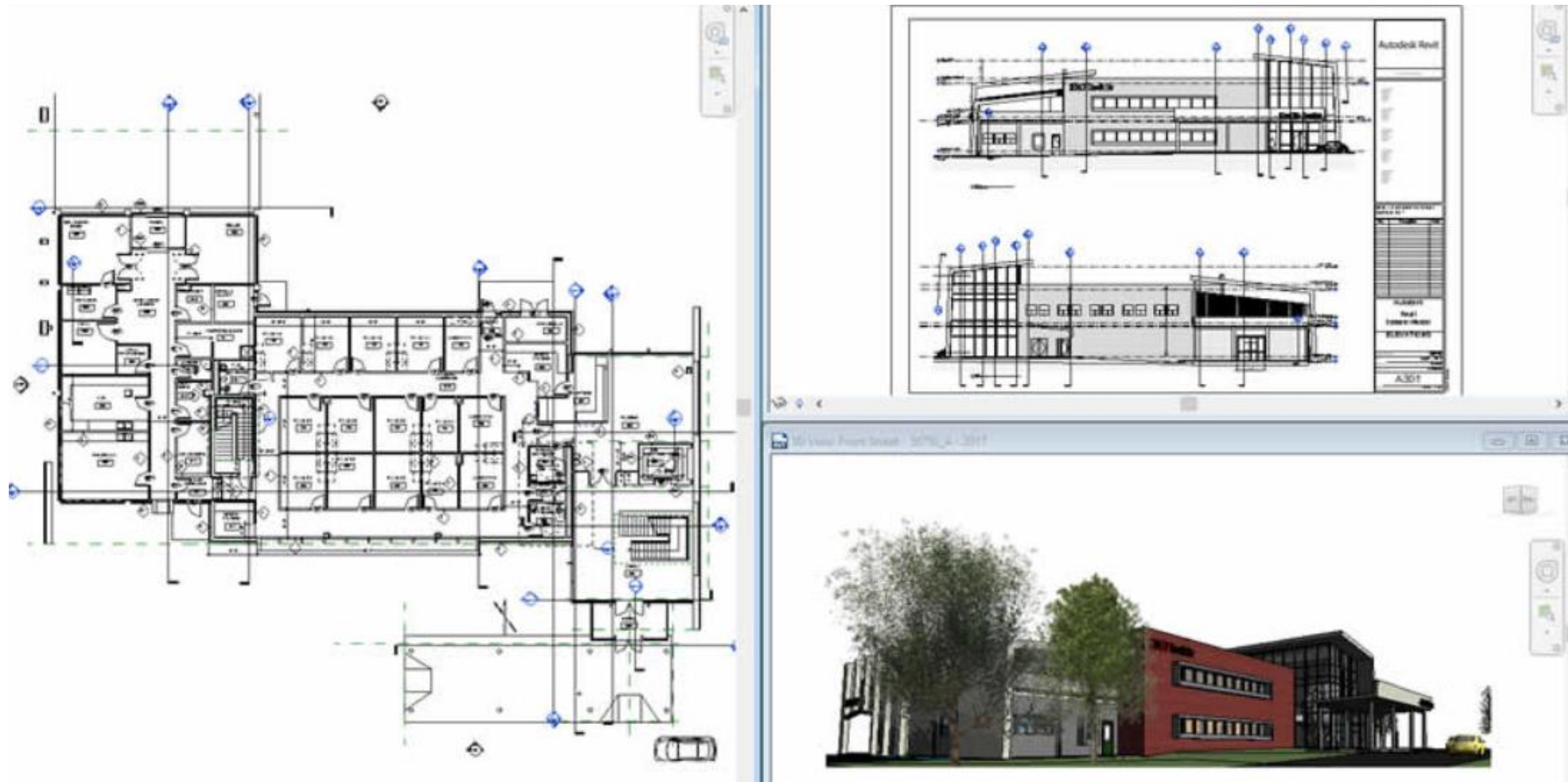
[Try now for free](#)



Autodesk Drive

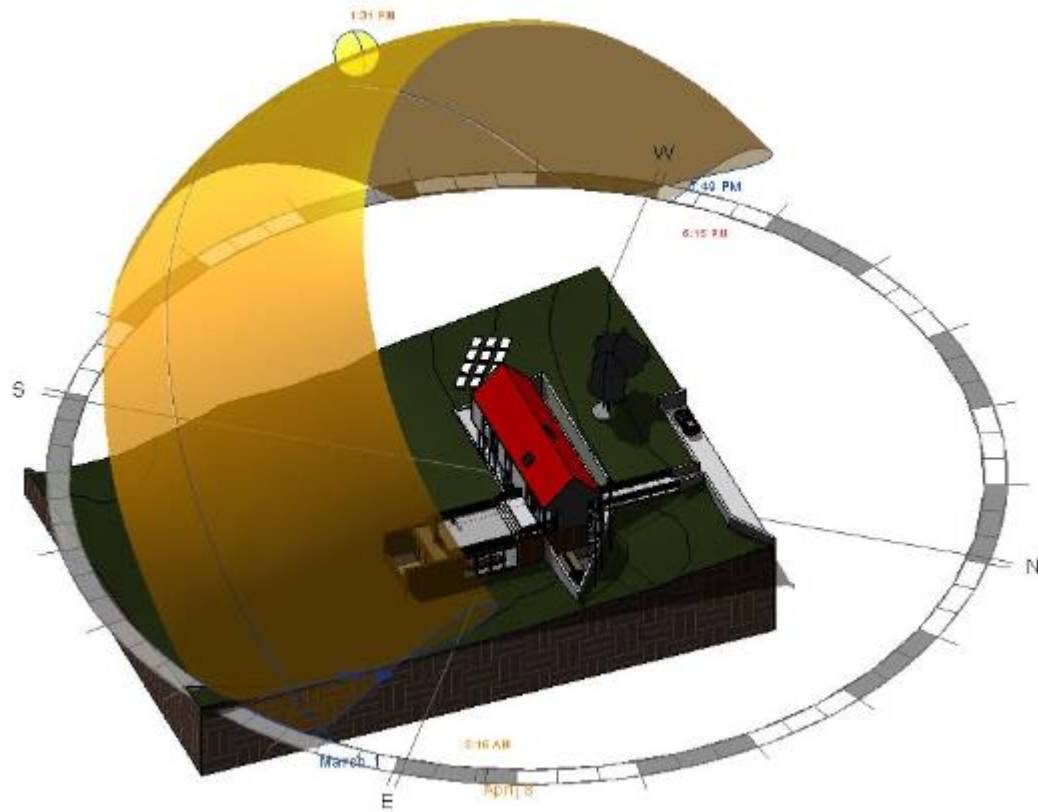
CAD-aware cloud storage for individuals and small teams.

Solution

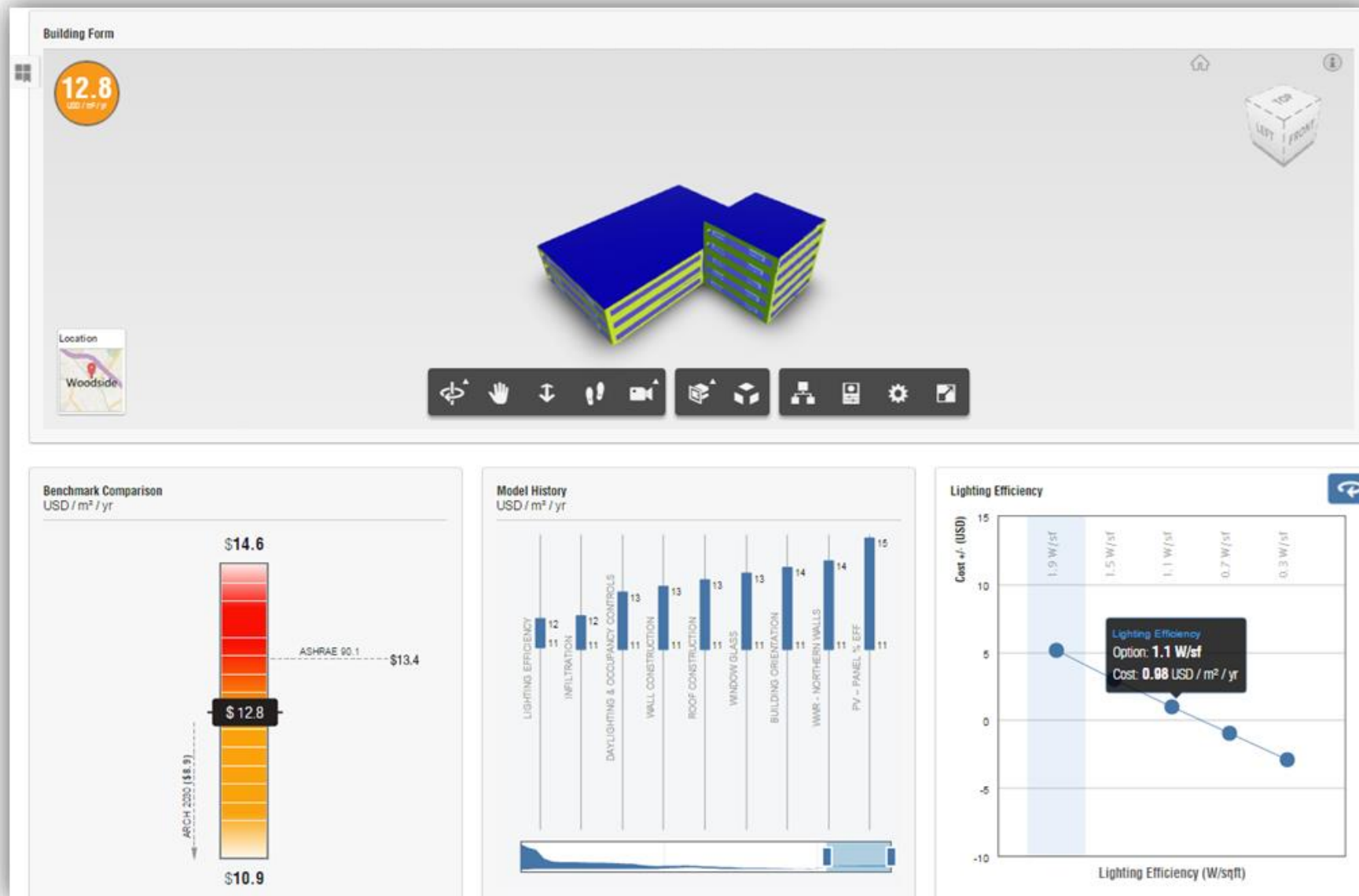


- Computer based BUILDING ENERGY MODELS may be built based on approved building plans
- Energy analysis be performed to predict energy demand of Energy Efficient model of existing building

One Year Simulation of solar path

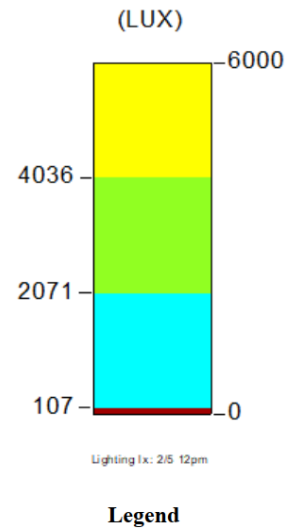


Energy Cost Range and Performance Factors

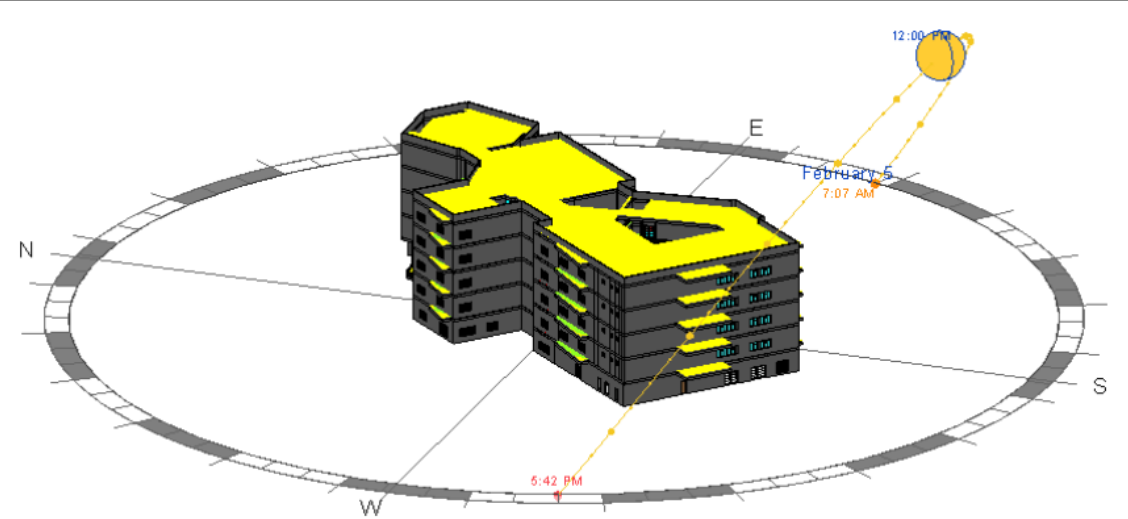


Case Study

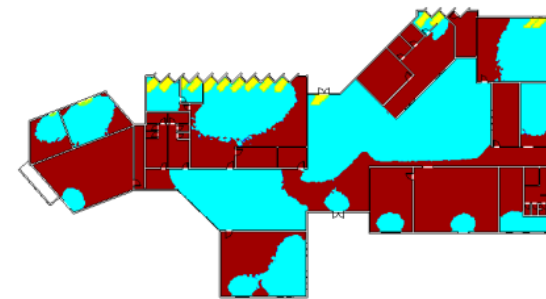
Academic Building in Swat Pakistan



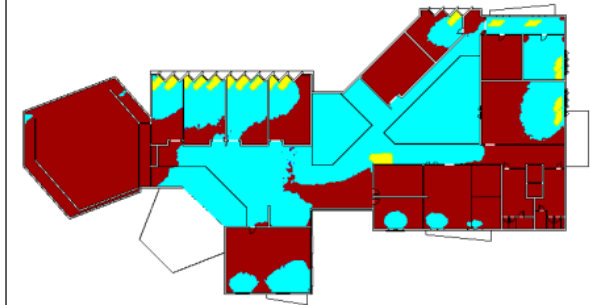
DAYLIGHT ANALYSIS:



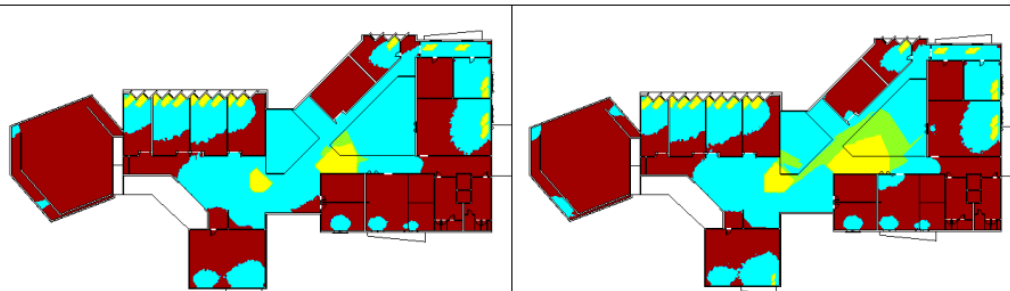
BUILDING MODEL



Ground Floor

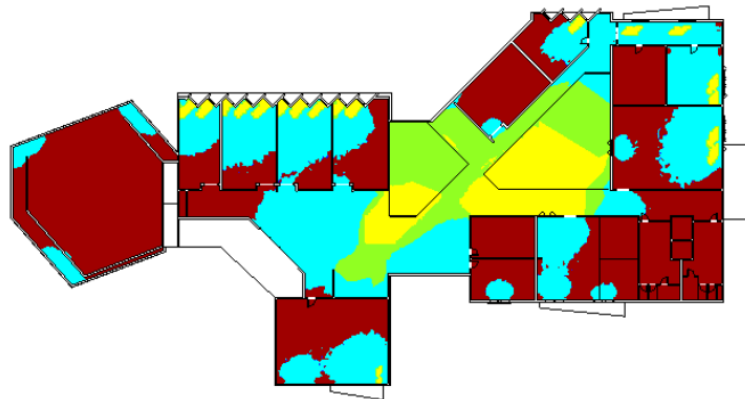


First Floor



Second Floor

Third Floor

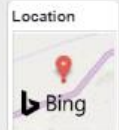
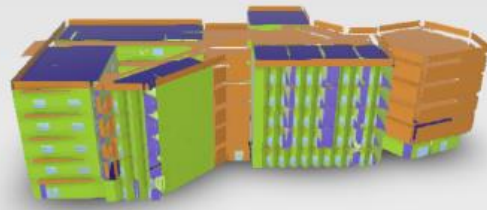


Fourth Floor

Building Form

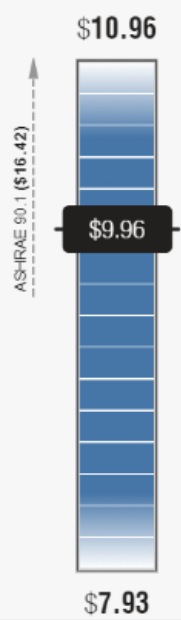


9.96
USD / m² / yr



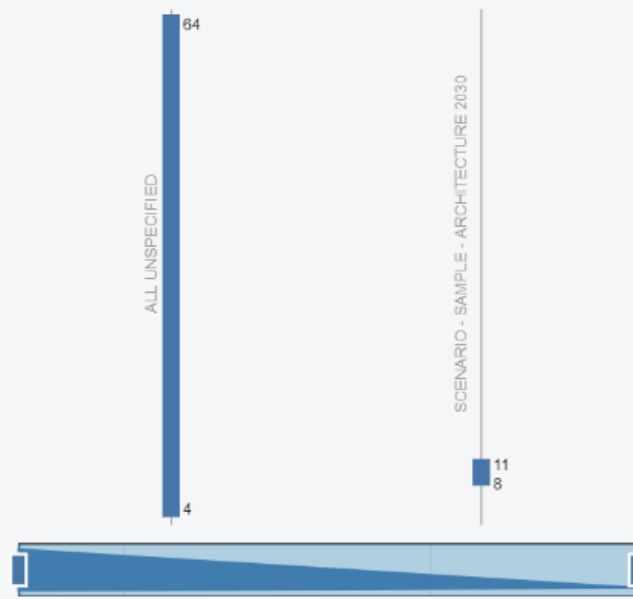
Benchmark Comparison

USD / m² / yr



Model History

USD / m² / yr



Building Orientation

Rotates a building clockwise from 0 degrees, e.g. 90 degrees rotates the North side of the building to face East.

Current Setting:
180

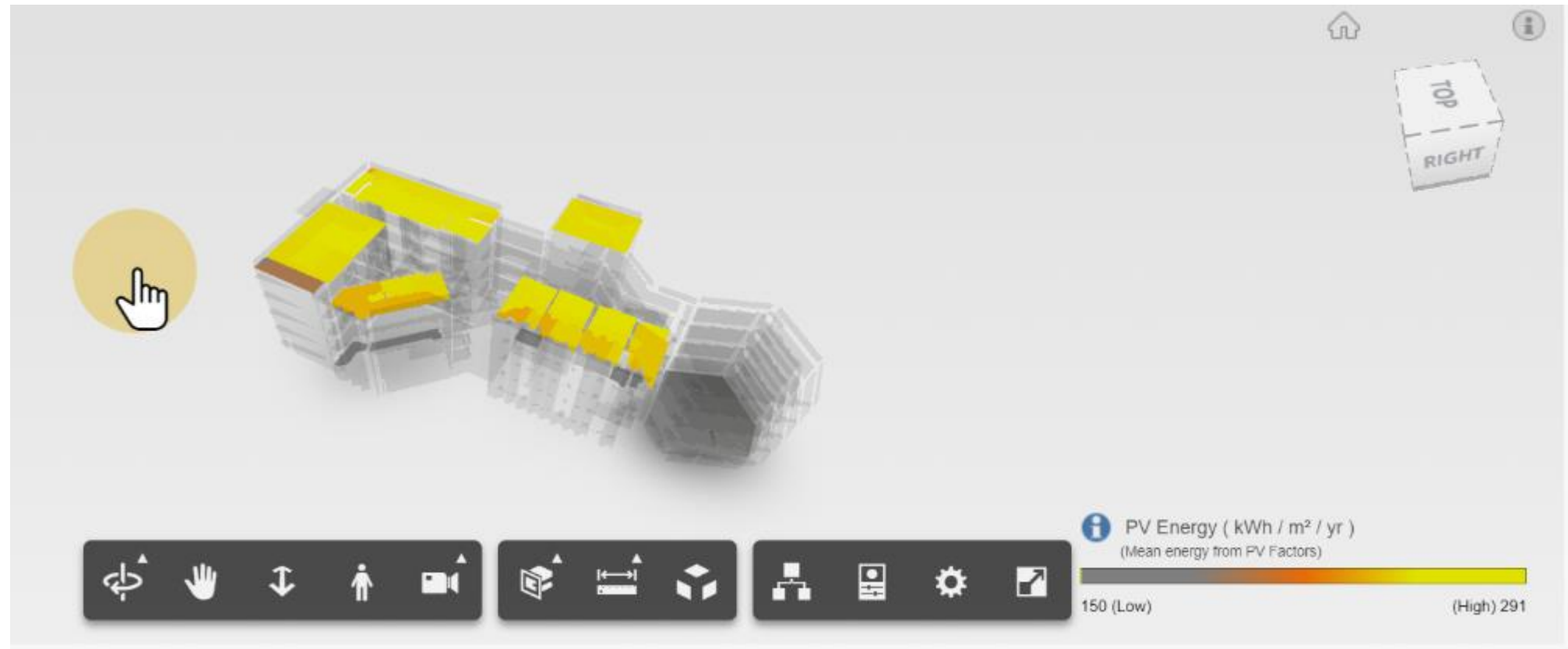


EDGE(GBCI) Evaluations

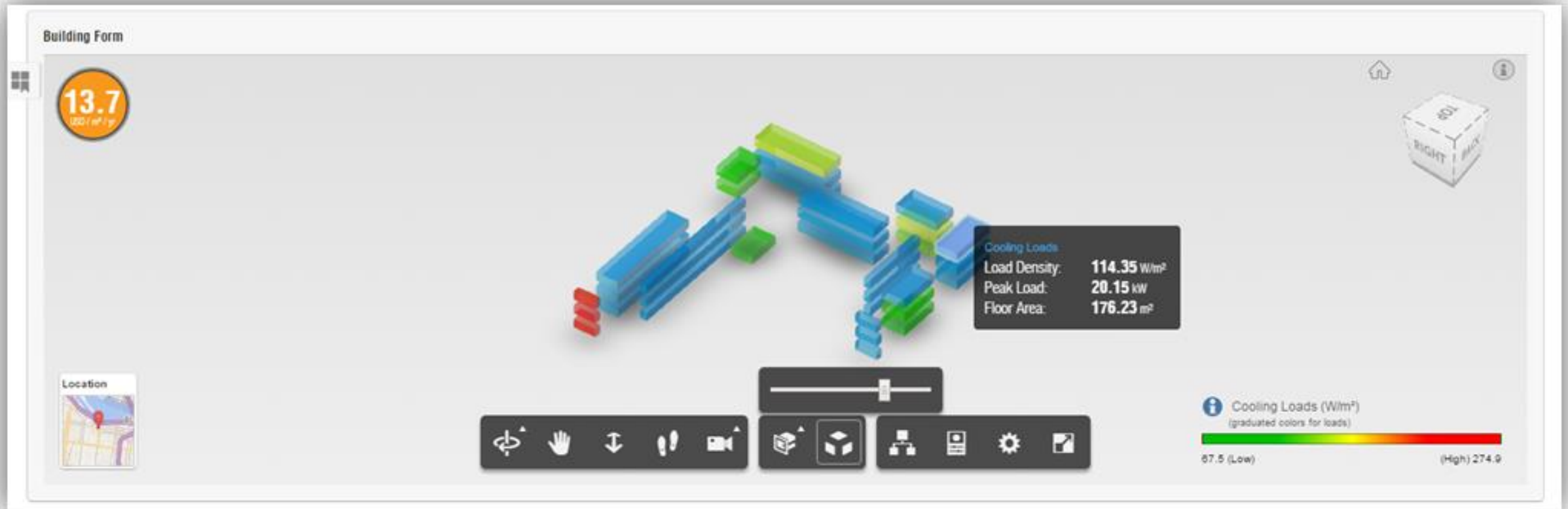
SUMMARY

Utility Cost Reduction (Rs/Month)	Incremental Cost (Rs/Unit)	Payback in Years	Operational CO ₂ Savings (tCO ₂ /Year)	Embodied Energy Savings (MJ/m ²)	Energy Savings (MWh/Year)	Water Savings (m ³ /Year)
Rs 61,763.56	Rs 1,173,969.07	1.58	37.53	1250.32	214.75	8146.98
Total Percentage Saving				44.98%	47.81%	34.07%

Photo-voltic Potential

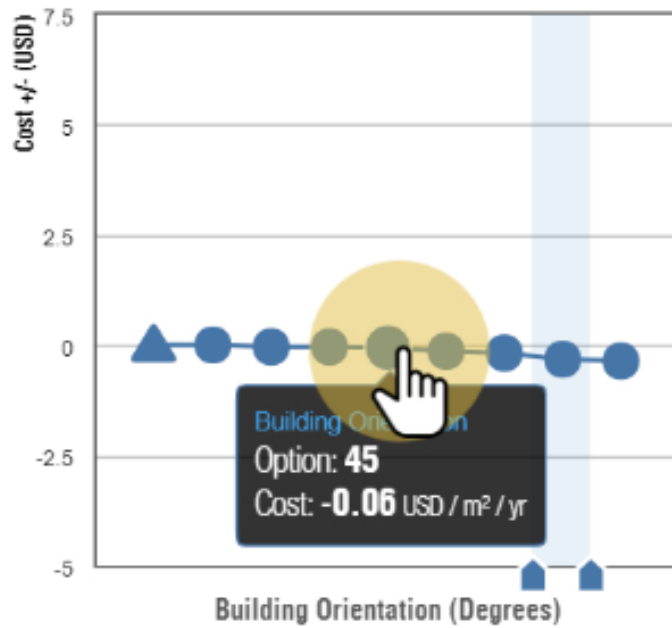


Heating and Cooling Loads

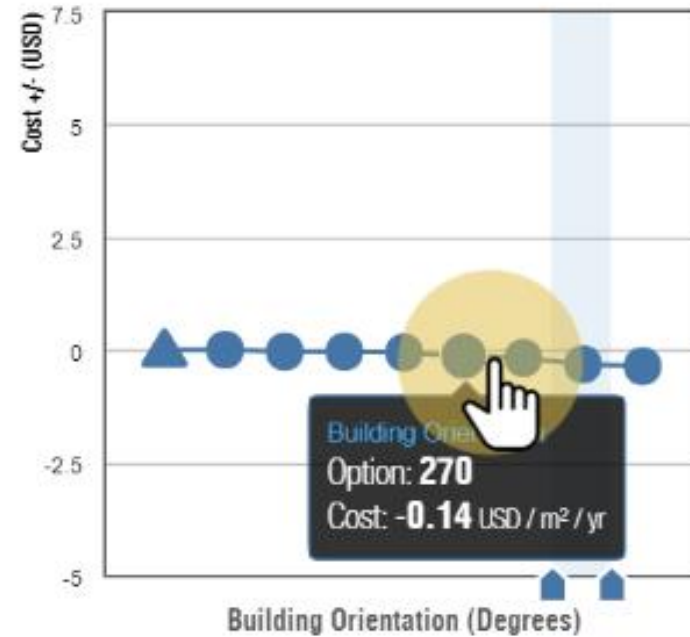


Effect of Orientation

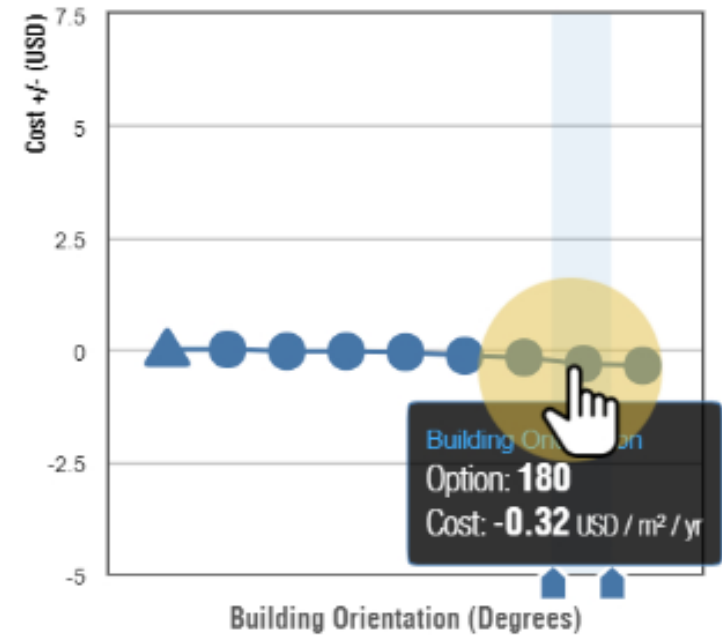
Building Orientation



Building Orientation



Building Orientation

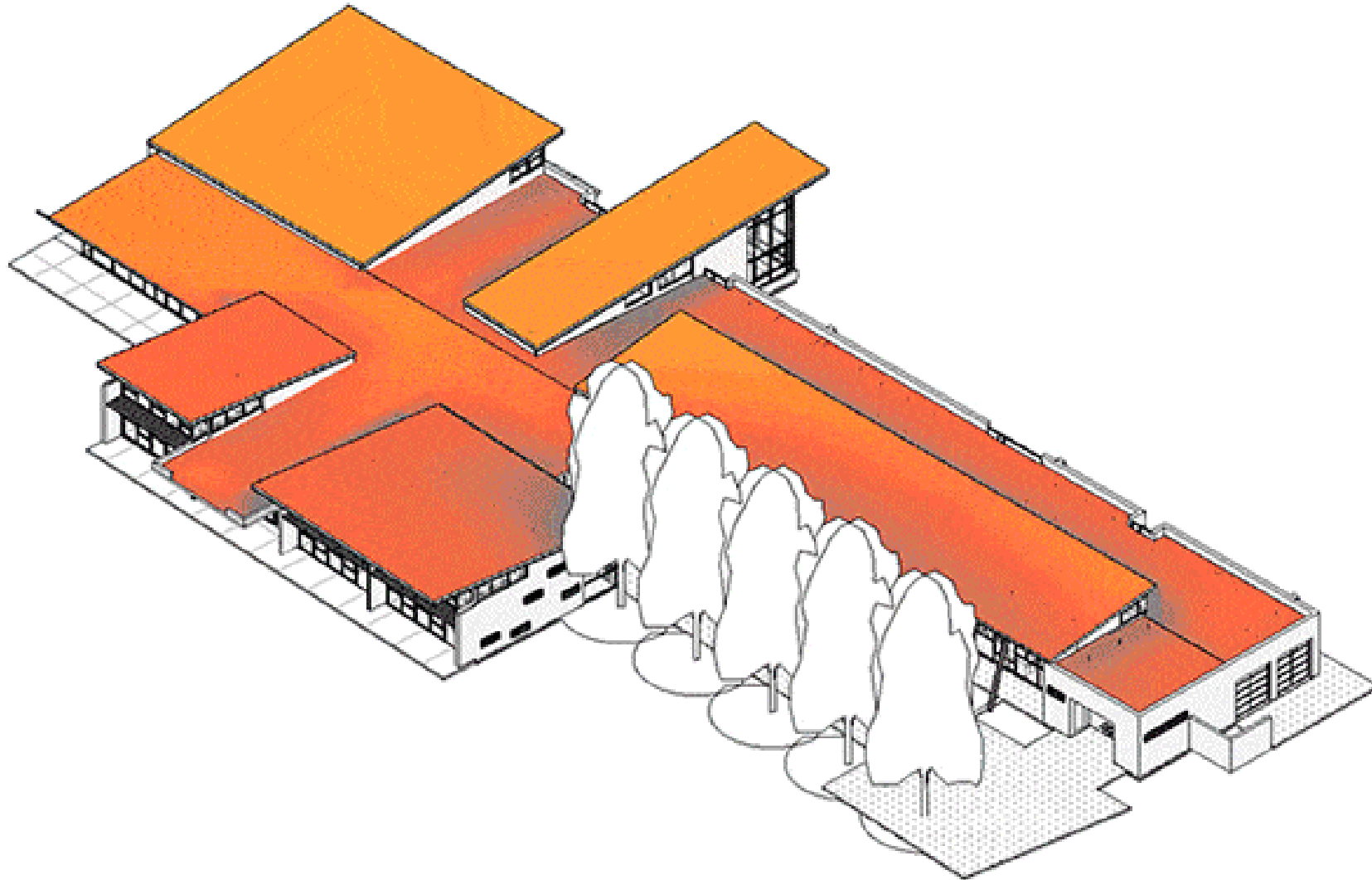


Finally

BIM **Energy Design** results are
compared with **existing Poor/No
energy Design** and Owner/Client is
informed about the possible savings and
methods **without expansive audit.**



Insight 360 and Revit can do this all...



Thank you

Any questions?