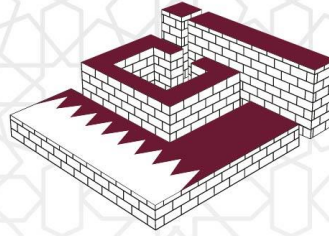


# Lean Construction Institute - Qatar

Transforming the Built Environment



المعهد القطري  
للتصميم والتشييد الفعال  
تغيير بيئة تصميم وتشيد المشاريع

“Whatever the circumstances, LCI-Qatar is committed to deliver its promise of Lean Education”

**Keep on Learning!**

**BIM as catalyst for enabling Lean practices towards transforming design and construction**

Webinar Facilitator



Nicos Dimos  
Managing Director  
i-Tekton P.C.

Webinar Facilitator



Theofanis Fanourakis  
MSc, CM-Lean Sr. BIM Manager  
Turner International Middle East (TIME) - Qatar  
Associate Director of Collaborative Practice ExCom - LCI-Q



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Platinum Sponsors



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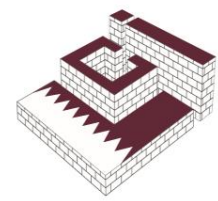


Silver Sponsor



Bronze Sponsor



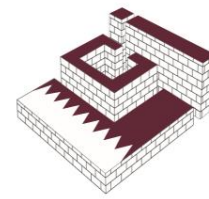


## The inefficiencies of Construction industry currently:

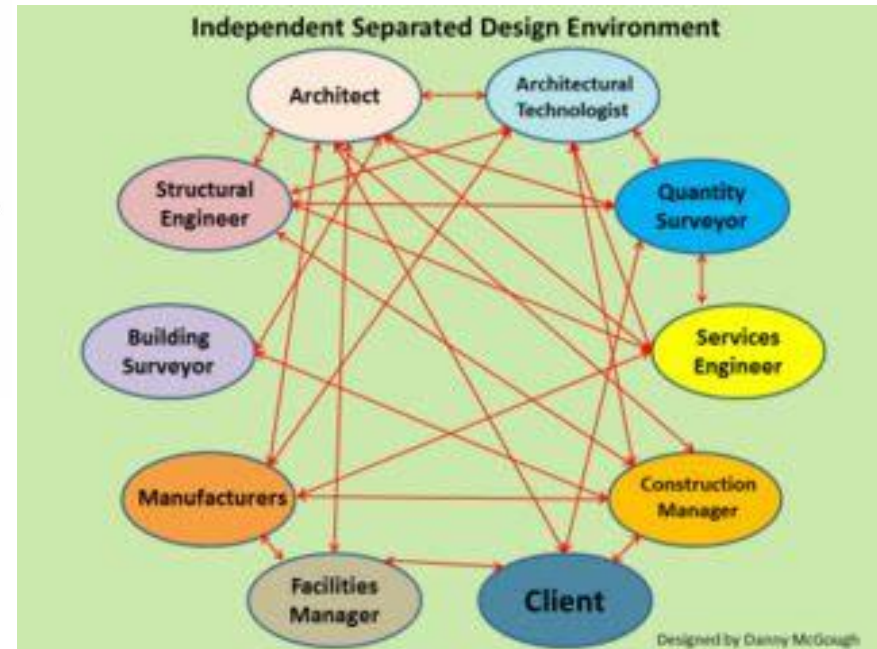
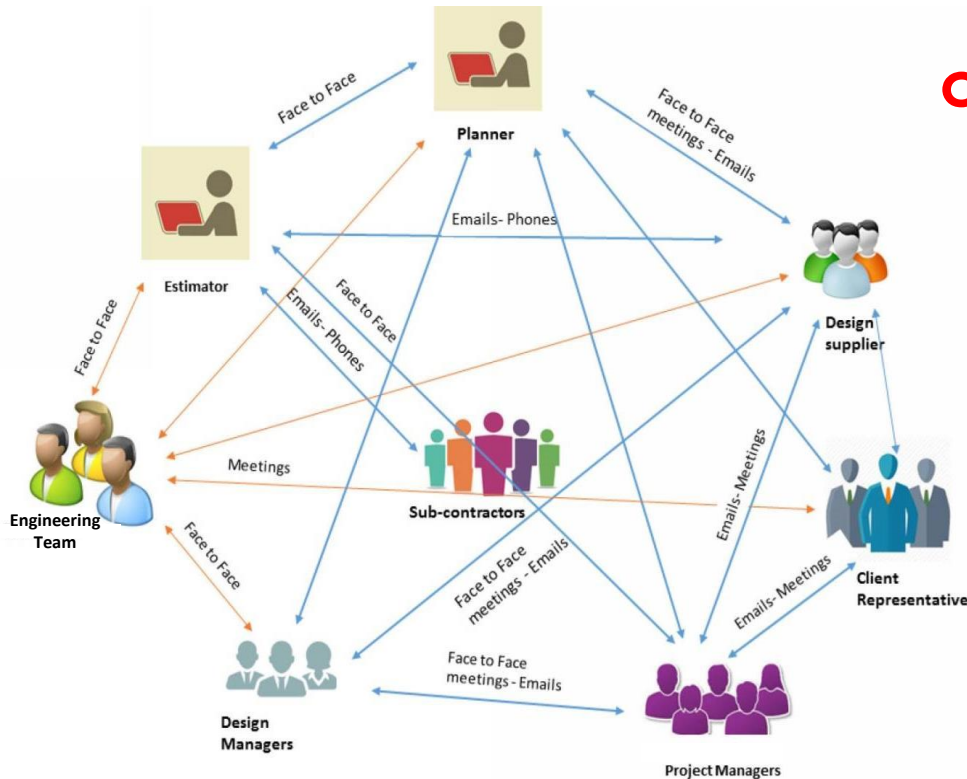
- **Excessive waste**
- **Low profit margins**
- **Major risk**
- **Overruns in budget and schedule**



# Traditional Design and Construction environment

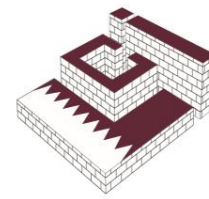


## Fragmentation of communication in traditional design & construction environment



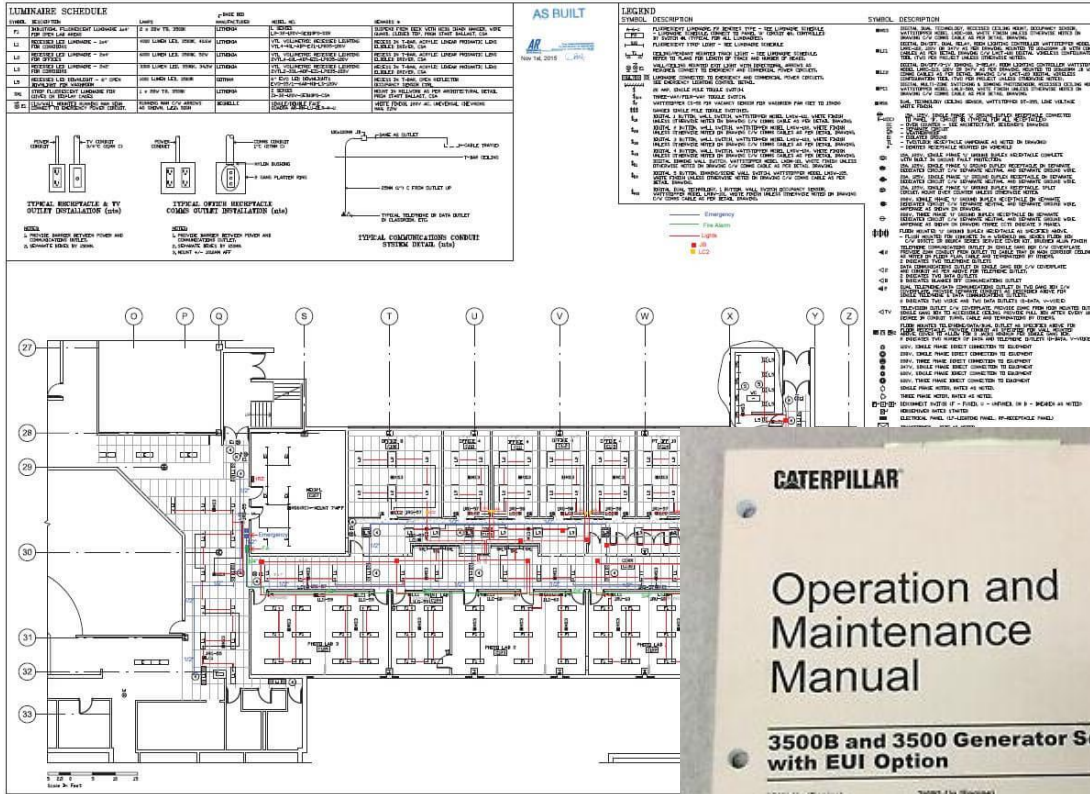


# Project Deliverables and Handover Documentation



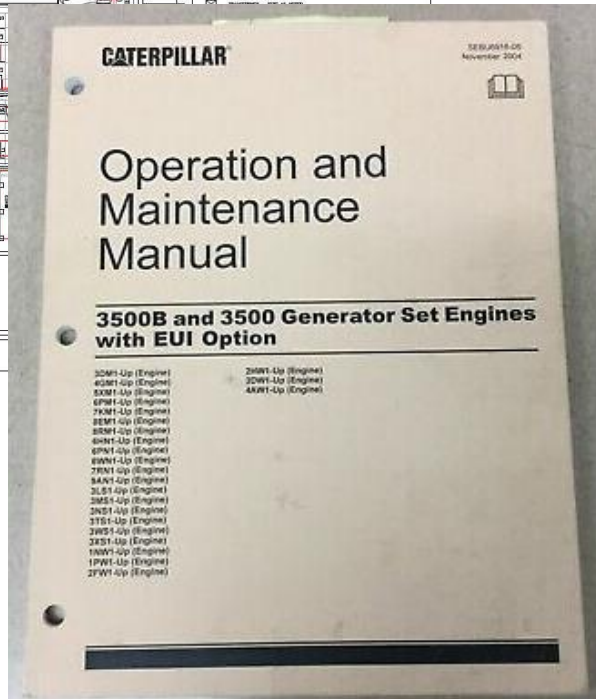
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Project deliverables and Handover documentation are paper-based, often inaccurate and of low quality.



## As-built Drawings

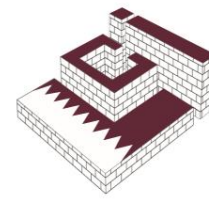
- Inaccurate geometry
- Do not depict as-built conditions
- Missing or contradicting drawings



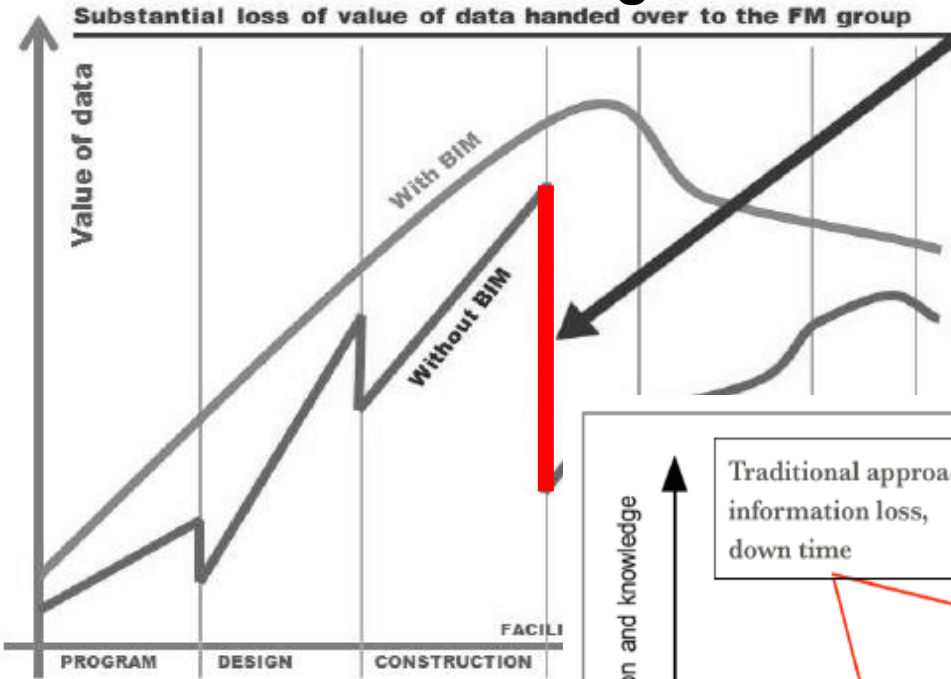
## Operation & Maintenance Manuals

- Many thousands of pages
- Disorganized Information
- Hard copies and Low-Resolution scans
- Little or no Correlation with As-built Drawings

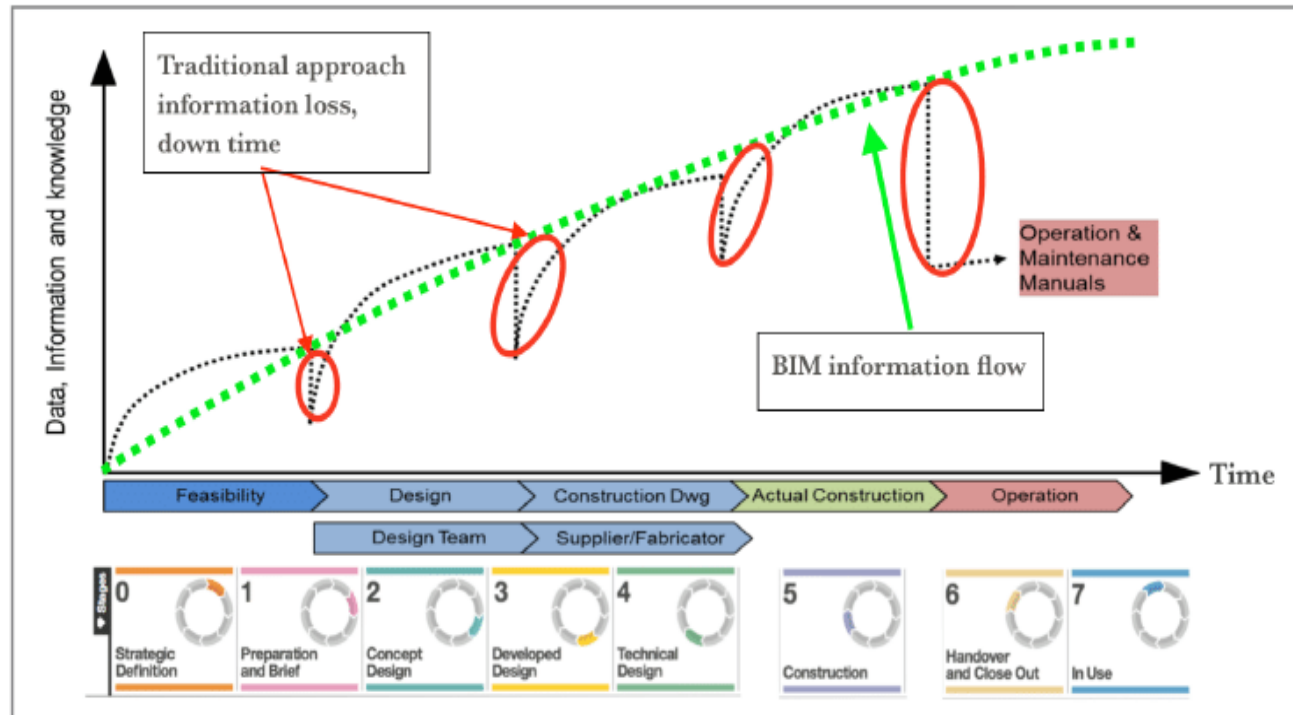
# Information exchange loss between project stages



## Information Exchange losses



Substantial cost and  
time impact



# Today's construction ecosystem

A highly complex, fragmented, and project based construction process...

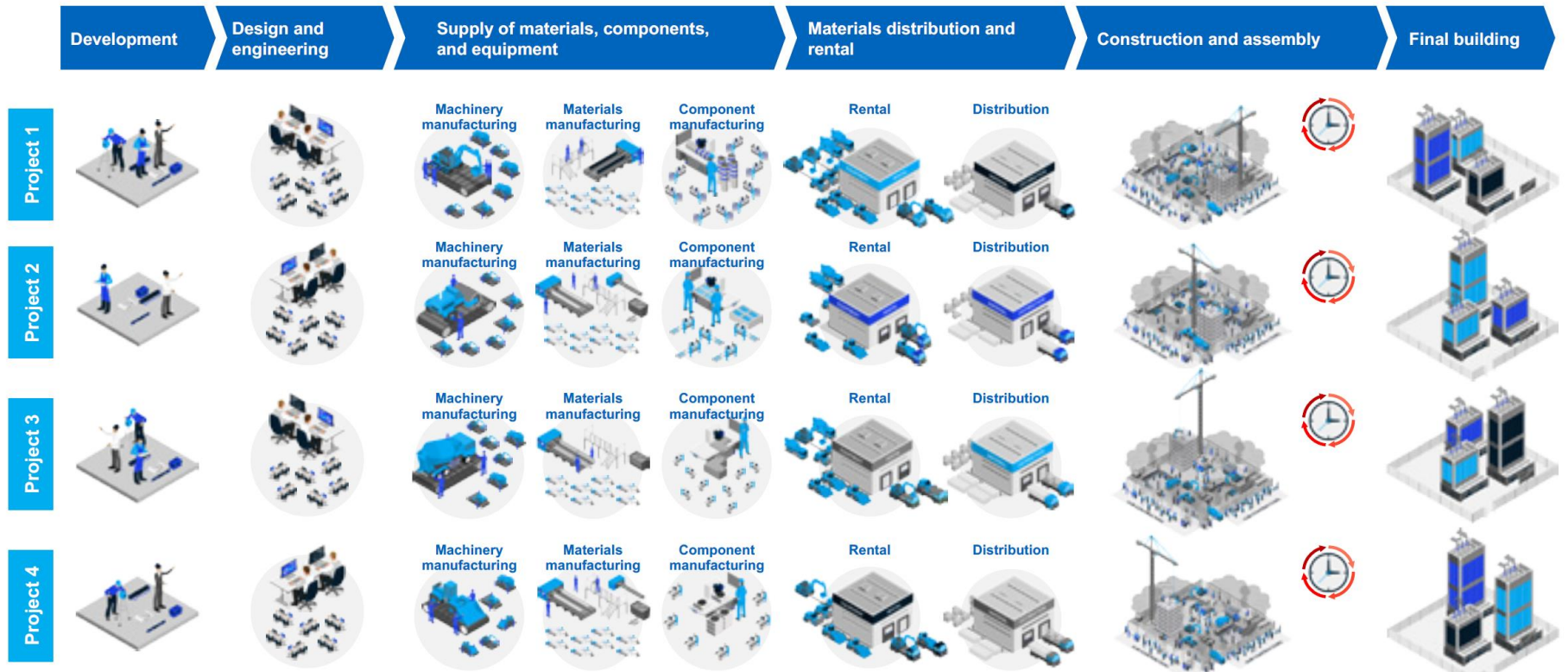
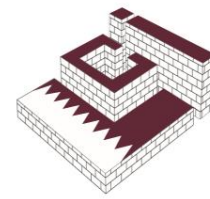


Image from McKinsey & Company, "The next normal in construction"

# Waste in Construction projects currently



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As per statistics from multiple studies in UK & US in construction projects following the traditional approach:

- Rework up to 30% of construction cost
- Labour utilized at 40-60% efficiency
- At least 10% of site material wasted
- Accidents equal to 3-6% of project costs

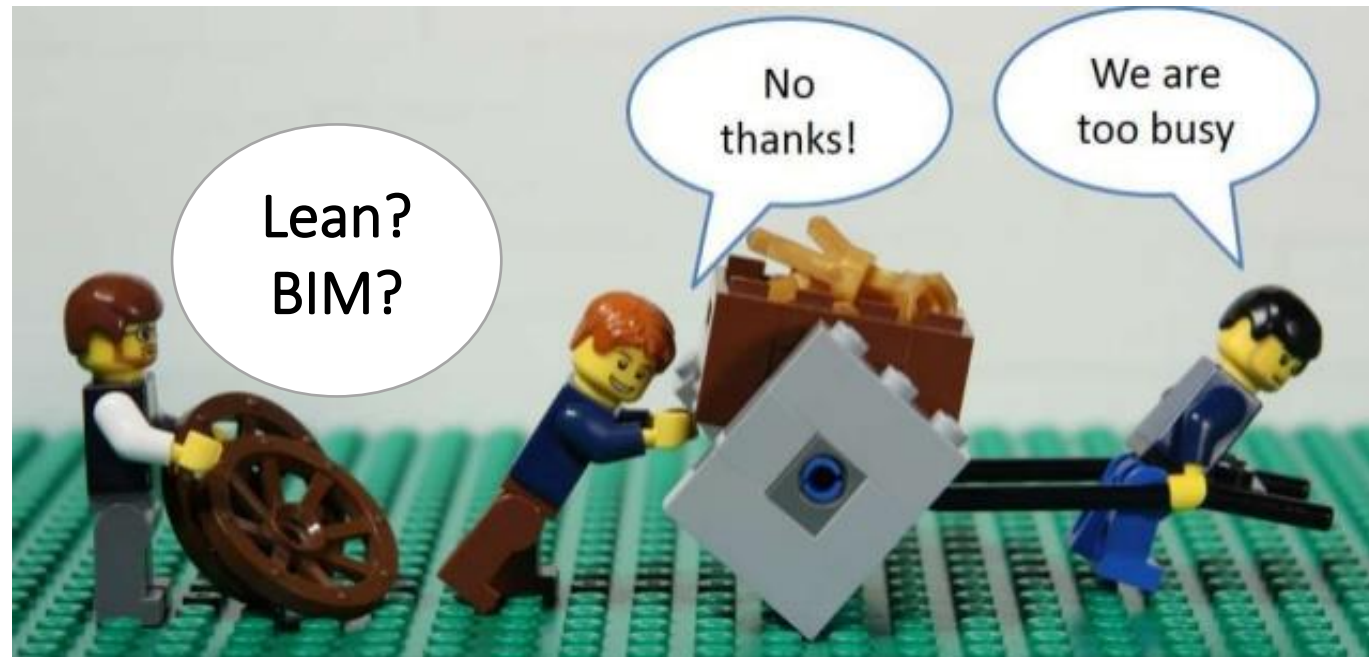
**TOTAL WASTE up to 50% of total cost!**



# Need for change

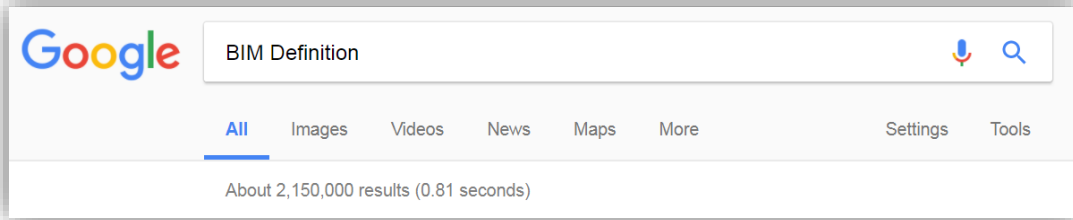
How we construct needs to change so that we can:

- **Meet the needs of an emerging digital change**
- **Minimise the impact on the environment**
- **Maximise the use and value of resources**
- **Provide economic viability and sustainability**



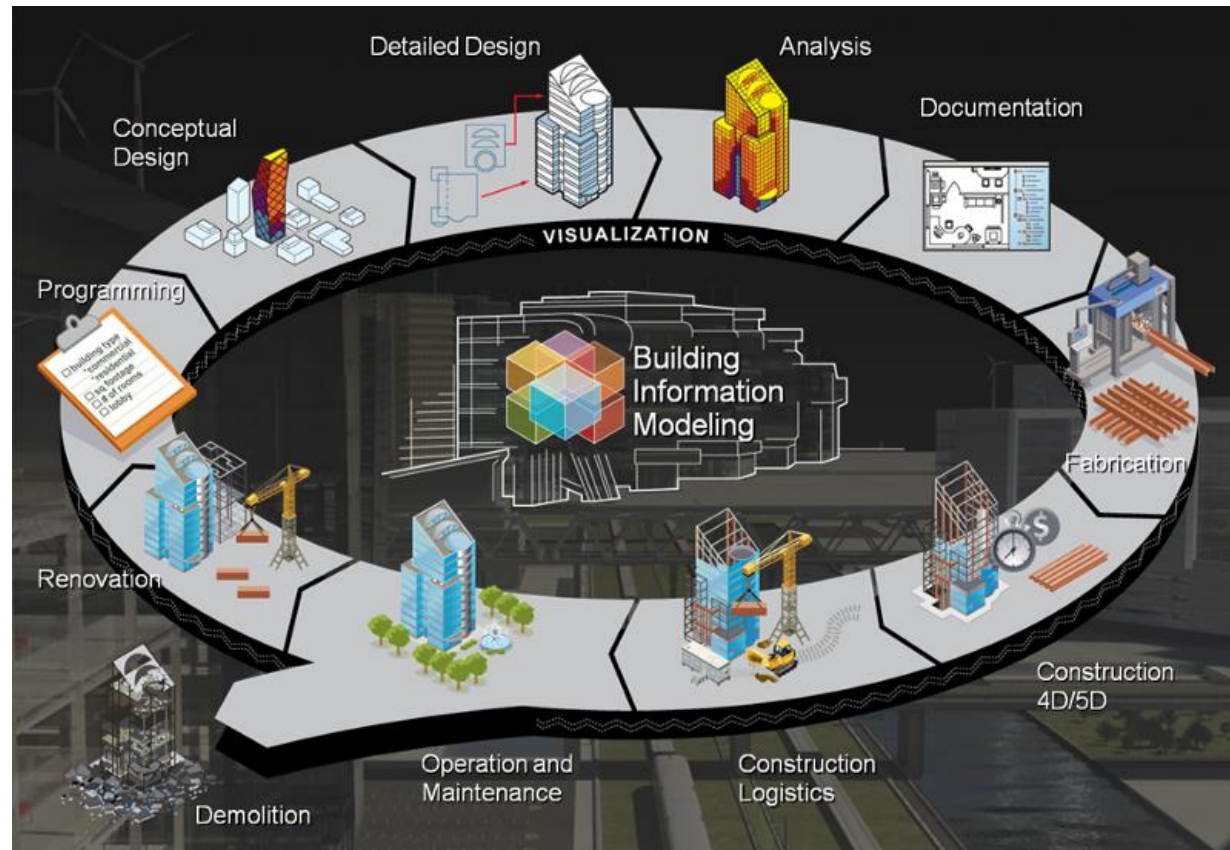


# What is BIM?



*"...a digital representation of physical and functional characteristics of a facility; a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition." United States. NBIMS*

## BIM is a process!



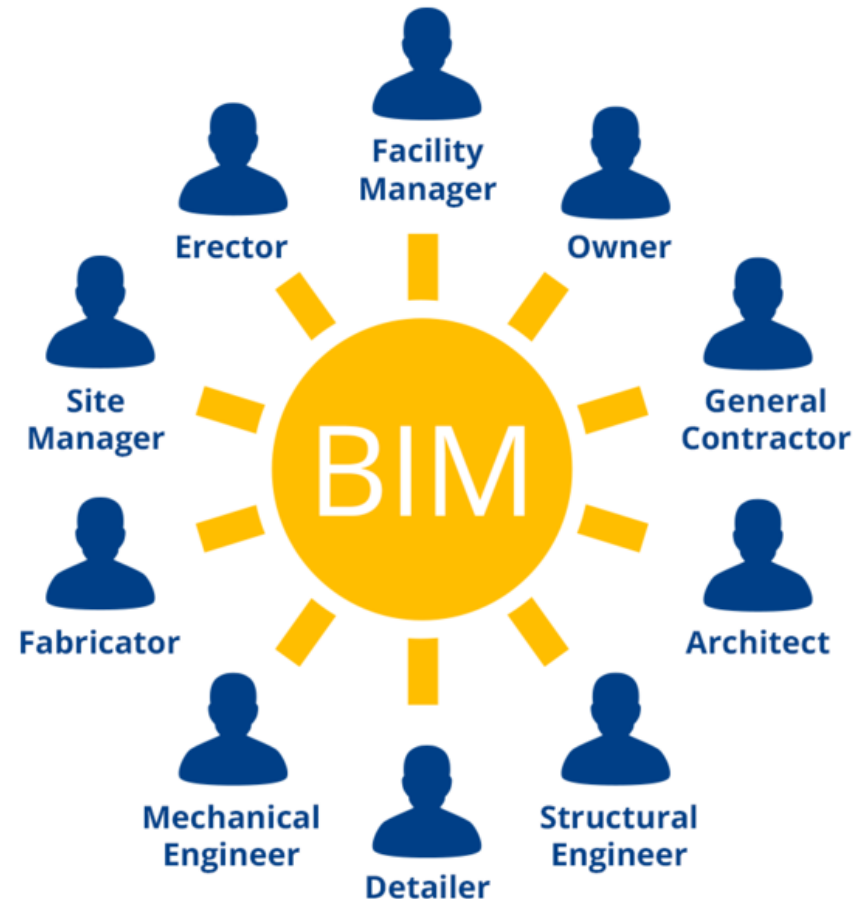
# What is BIM?

The strategic use of information technology and BIM, by integrating data, information, control and process, ...

**is not just the use of new software tools, but a transformational approach to business and organizational mission**

that includes a new way to work with multiple people together in a real time.

## Collaboration!



# What is BIM?

## BIM means....

### Building Information Modelling

... is a business process for generating and leveraging building data to design, construct and operate the building during its lifecycle.

### Building Information Model

...is the output of the business process resulting in a digital prototype, a virtual computer model of a project which holds selected structured data about the asset (design, quantity, time, cost, as-built, etc.).

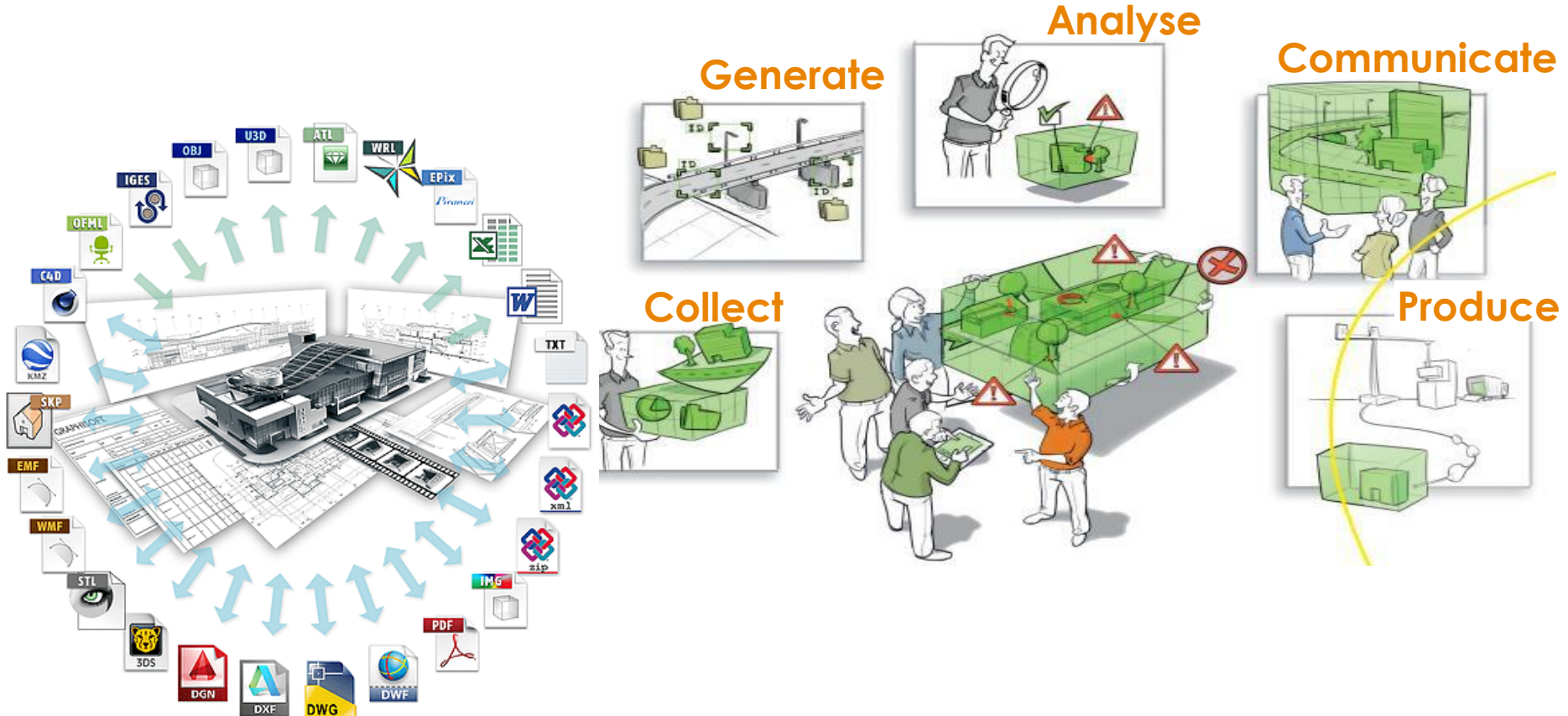
### Building Information Management

... Is the organisation and control of the business process using the digital prototype to effect the sharing of information over the entire lifecycle of an asset.

# What is BIM?

## BUILDING INFORMATION **MODELLING**

...a **business process** for generating and leveraging building data to design, construct and operate the building during its lifecycle.

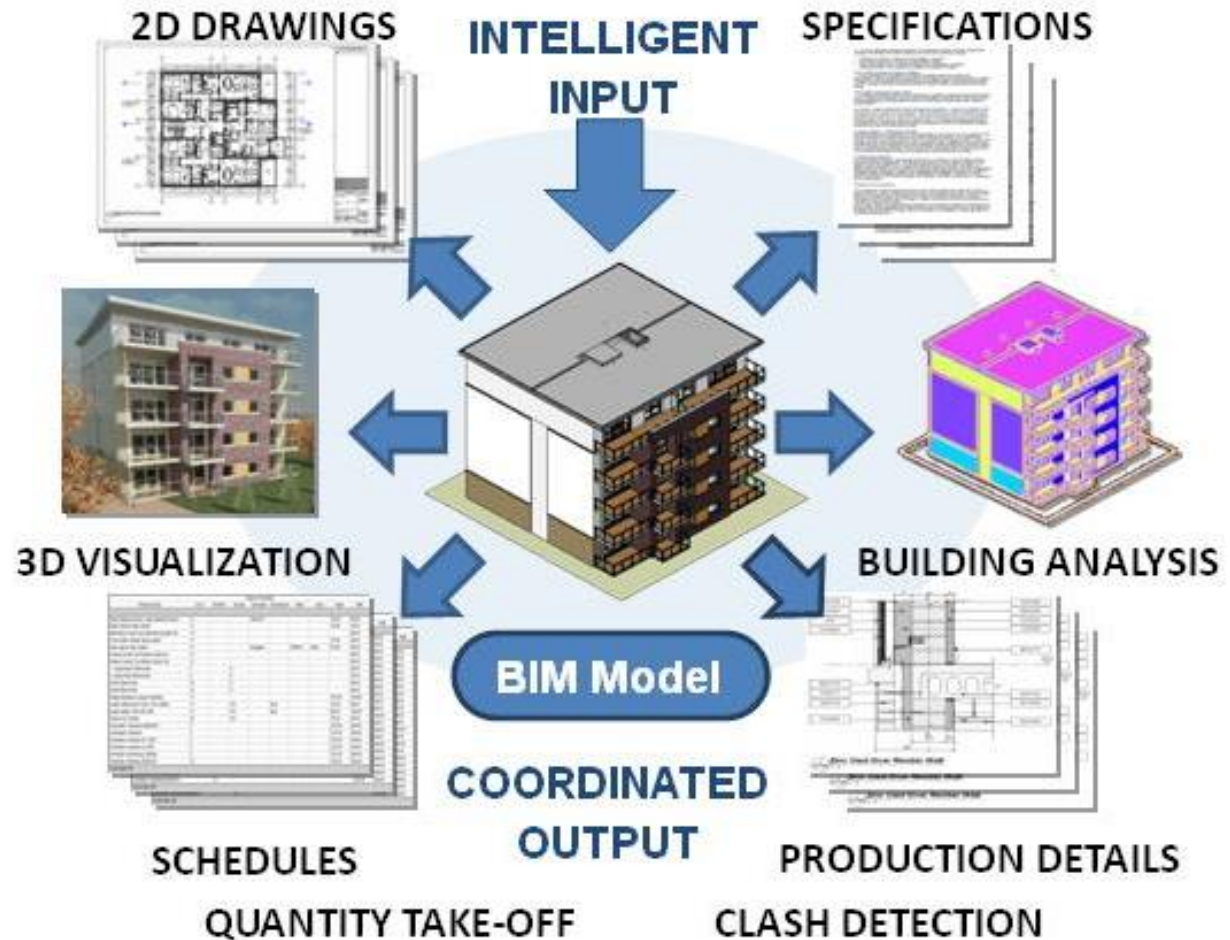




# What is BIM?

## BUILDING INFORMATION MODEL

... the output of the business process resulting in a **digital prototype**, a virtual computer model of a project which holds selected structured data about the asset (design, quantity, time, cost, as-built, etc.).



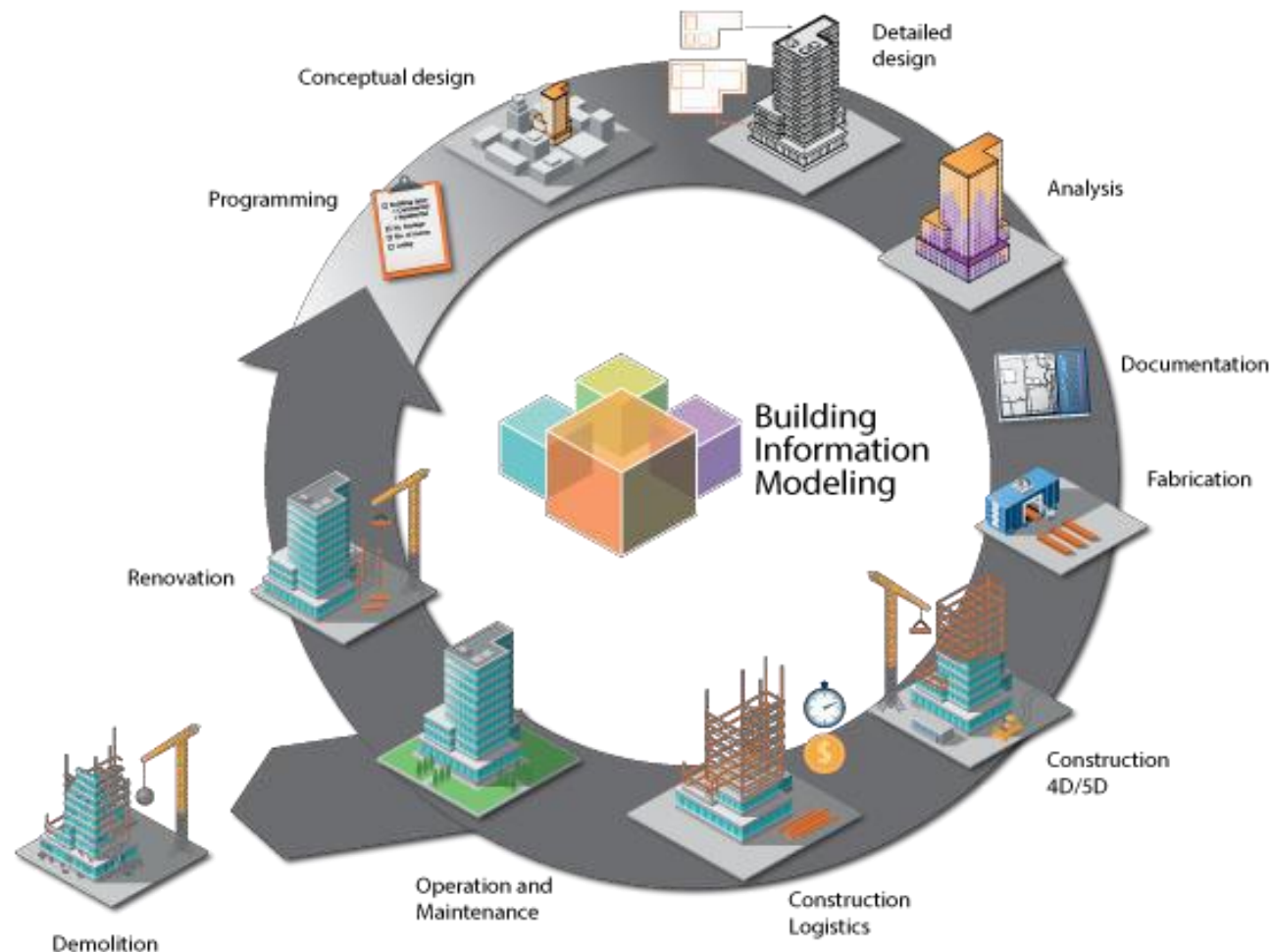
# What is BIM?

## BUILDING INFORMATION MANAGEMENT

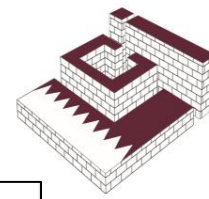
... the **organisation and control** of the business process using the digital prototype to effect the sharing of information over the entire lifecycle of an asset.

Information are:

- Graphical
- Non-Graphical
- Documents



# International Standards for BIM



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**2019**

**BIMFORUM**

**LEVEL OF DEVELOPMENT (LOD) SPECIFICATION PART I & COMMENTARY**  
For Building Information Models and Data  
April 2019

Model Elements

BS 8536-2:2016

**INTERNATIONAL STANDARD**

**ISO 19650-2**

First edition 2018-12

**INTERNATIONAL STANDARD**

**ISO 19650-1**

First edition 2018-12

**Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling — Part 1: Concepts and principles**

*Organisation et numérisation des informations relatives aux bâtiments et ouvrages de génie civil, y compris modélisation des informations de la construction (BIM) — Gestion de l'information de la modélisation des informations de la construction — Partie 1: Concepts et principes*

Reference number: ISO 19650-1:2018

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BS 1192-4:2014

**PAS 1192-6:2018**

Specification for collaborative sharing and use of structured Health and Safety

**PAS 1192-5:2015**

Specification for security-minded

**PAS 1192-3:2014**  
Incorporating Corrigendum No. 1

Specification for information management for the operational phase of assets using building information modelling

**PAS 1192-2:2013**  
Incorporating Corrigendum No. 1

Specification for information management for the capital/delivery phase of construction projects using building information modelling

BS 8536-1:2015

BSI Standards Publication

**Briefing for design and construction — Part 1: Code of practice for facilities management (Buildings infrastructure)**

bsi. ...making excellence a habit™

Sheet Contact

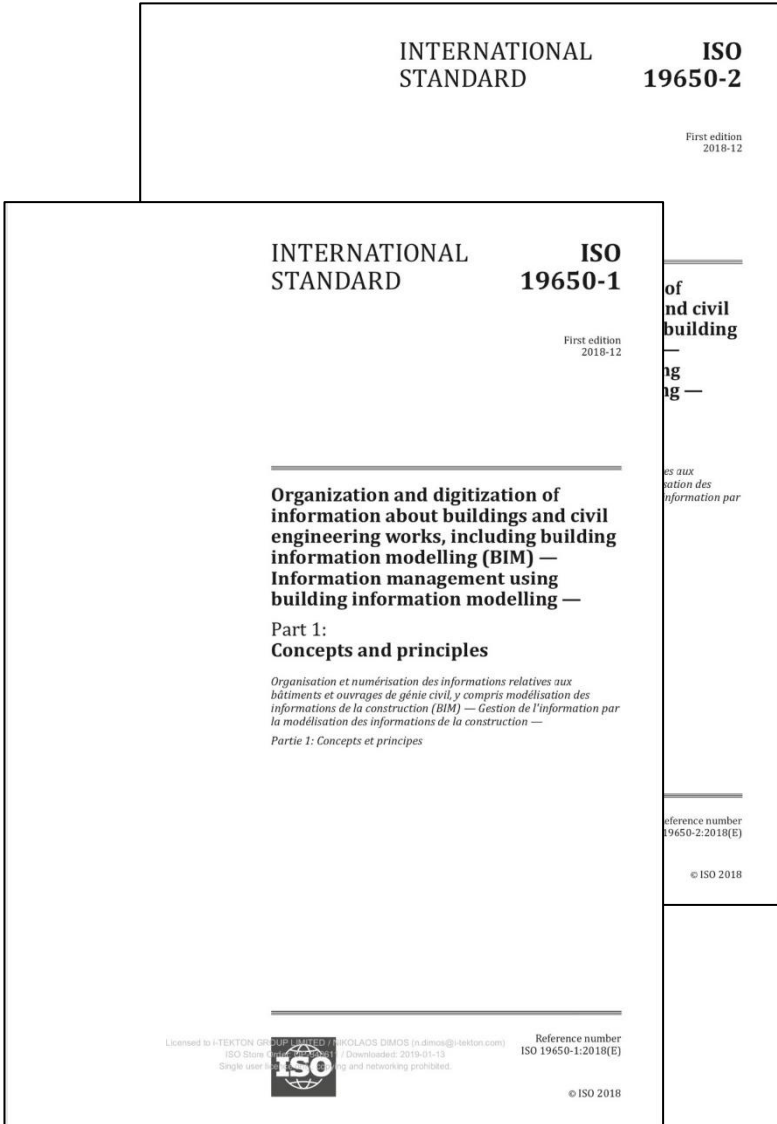
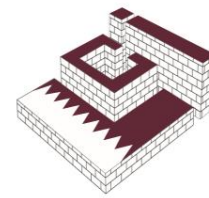
From	2012-01
To	2012-01
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To	2012-01
From	2012-01
To	2012-01

bsi.

bsi.

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- **BS EN ISO 19650–1** Organisation of information about construction works – Information management using building information modelling – Part 1: concepts and principles
- **BS EN ISO 19650-2** Part 2: Delivery phase of assets.
- **BS EN ISO 19650-3** Part 3: Operational phase of Assets.
- **BS EN ISO 19650-5** Part 5: Security minded approach to information management.

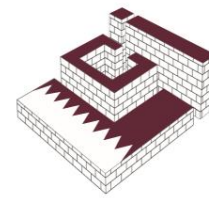


# LOD definition

## Level of development (LOD)

- **LOD 100:** Information can be conveyed with massing forms, written narratives, and 2D symbols.
- **LOD 200:** Modelled elements have approximate relationships to quantities, size, location, and orientation. So
- **LOD 300:** Modelled elements are explained in terms of specific systems, quantities, size, shape, location, and orientation.
- **LOD 400:** Continuation of LOD 300 with information added to facilitate fabrication, assembly, and installation.
- **LOD 500:** Modelled elements as installed and can be utilized for ongoing facilities management.





# LEVEL of DEVELOPMENT

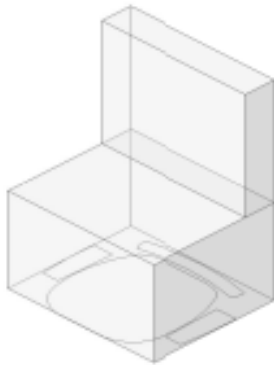
LOD 100

LOD 200

LOD 300

LOD 400

LOD 500



Concept (Presentation)

Design Development

Documentation

Construction

Facilities Management

DESCRIPTION:

**Office Chair**  
Arms, Wheels

WIDTH:

DEPTH:

HEIGHT:

MANUFACTURER:

Herman Miller, Inc.

MODEL:

Mirra

LOD:

**100**

DESCRIPTION:

**Office Chair**  
Arms, Wheels

WIDTH:

**700**

DEPTH:

**450**

HEIGHT:

**1100**

MANUFACTURER:

Herman Miller, Inc.

MODEL:

Mirra

LOD:

**200**

DESCRIPTION:

**Office Chair**  
Arms, Wheels

WIDTH:

**700**

DEPTH:

**450**

HEIGHT:

**1100**

MANUFACTURER:

Herman Miller, Inc.

MODEL:

Mirra

LOD:

**300**

DESCRIPTION:

**Office Chair**  
Arms, Wheels

WIDTH:

**685**

DEPTH:

**430**

HEIGHT:

**1085**

MANUFACTURER:

**Herman Miller, Inc**

MODEL:

**Mirra**

LOD:

**400**

DESCRIPTION:

**Office Chair**  
Arms, Wheels

WIDTH:

**685**

DEPTH:

**430**

HEIGHT:

**1085**

MANUFACTURER:

**Herman Miller, Inc**

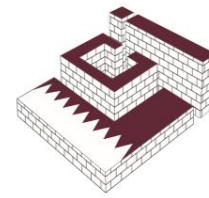
MODEL:

**Mirra**

PURCHASE DATE:

**01/02/2013**

(Only data in red is useable)



20  
19

## BIMFORUM

### LEVEL OF DEVELOPMENT (LOD) SPECIFICATION PART I & COMMENTARY

*For Building Information Models and Data*  
**April 2019**

**Milestones/Deliverables**

Model Elements	100	200	300	350	400
Structure					
Systems					
MEP					
Interior					
Exterior					
Landscaping					
Site					
Other					

**PARTICIPATING ORGANIZATIONS**

The American Institute of Architects

AGC of America  
THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA  
Quality People. Quality Projects.

BIM-M  
Building Information Modeling for Masonry

MBMA  
MASONRY BUILDING MATERIALS ASSOCIATION OF AMERICA  
Research. Leadership. Education.

CD-Certified Building logo

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300	<p>Element modeling to include:</p> <ul style="list-style-type: none"> <li>• Specific sizes of main vertical structural members modeled per defined structural grid with correct orientation</li> </ul> <p>Required non-graphic information associated with model elements includes:</p> <ul style="list-style-type: none"> <li>• Structural steel materials defined.</li> <li>• Connection details</li> <li>• Finishes, i.e. painted, galvanized, etc.</li> </ul>
350	<p>Element modeling to include:</p> <ul style="list-style-type: none"> <li>• Actual elevations and location of member connections</li> <li>• Large elements of typical connections applied to all structural steel connections such as base plates, gusset plates, anchor rods, etc.</li> <li>• Any miscellaneous steel members with correct orientation</li> <li>• Any steel structure reinforcement such as web stiffeners, sleeve penetrations, etc.</li> </ul>

*21 B1010.10-LOD-300 Floor Structural Frame (Steel Framing Columns)*

---

*22 B1010.10-LOD-350 Floor Structural Frame (Steel Framing Columns)*

LOD  
100

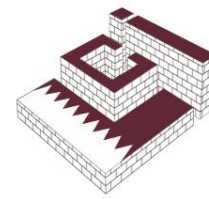
LOD  
200

LOD  
300

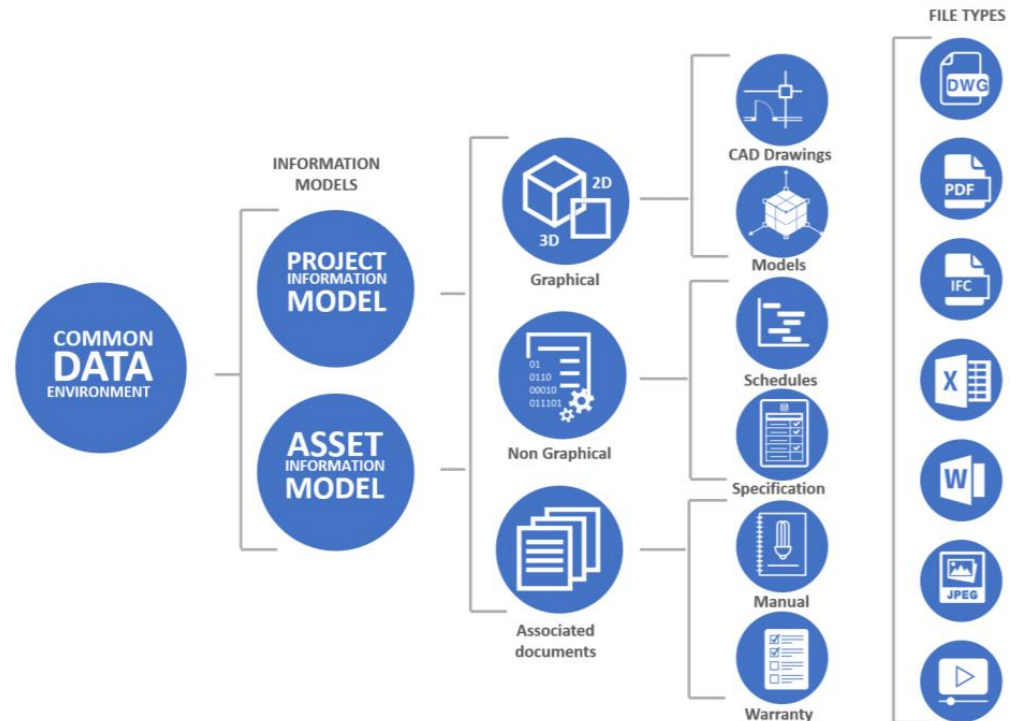
LOD  
350

LOD  
400

# Common Data Environment



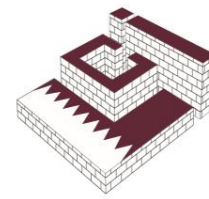
- Latest valid information is available to all stakeholders
- Much faster coordination/review cycle
- Search time for any document drastically reduced.
- Easy Filtering.
- Documents have attributes and can be linked.
- Can upload/share document in seconds.
- WIP/Share/Publish status



**Common Data Environment  
(CDE) is the basis for BIM  
Implementation!**



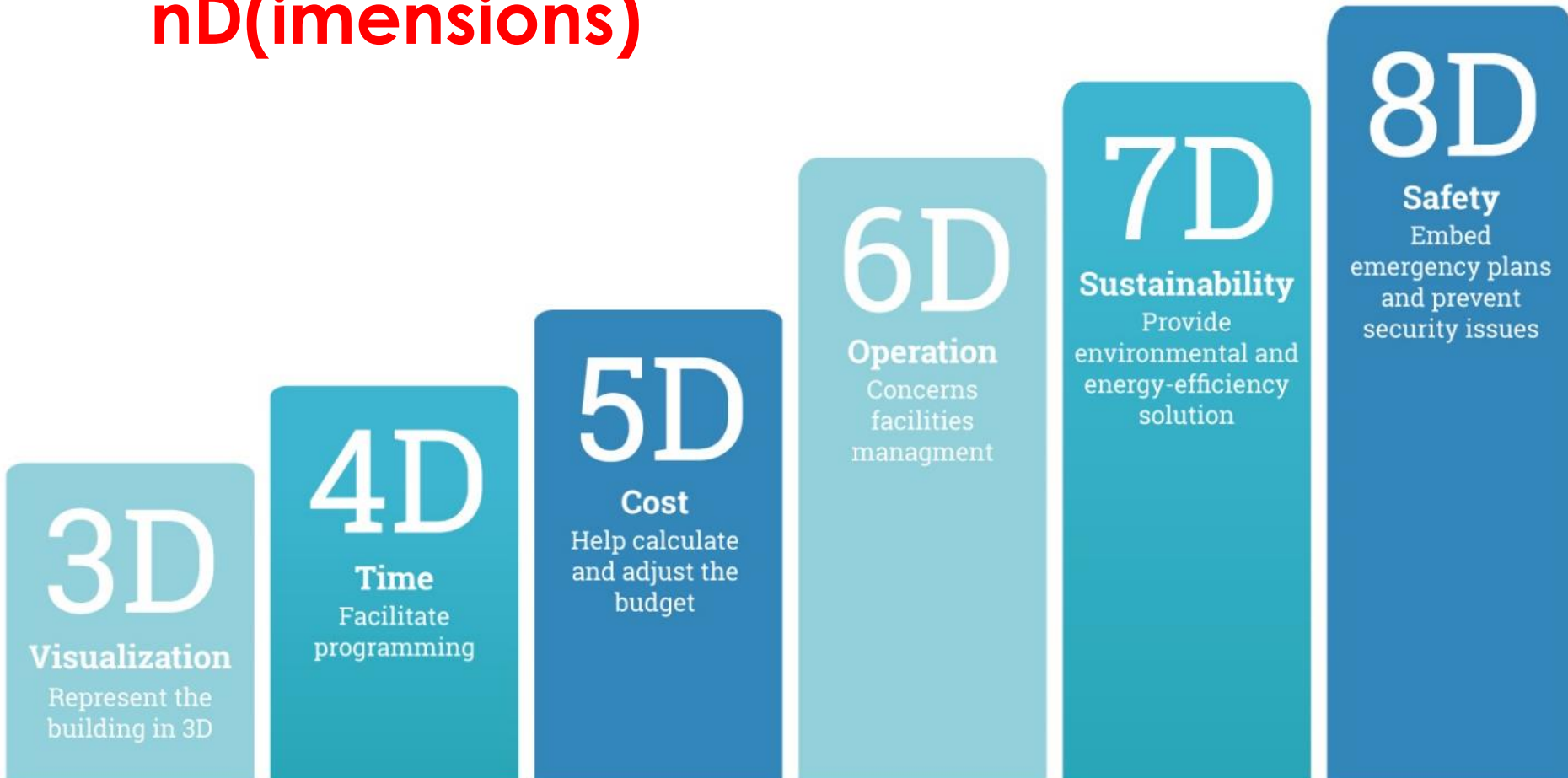
# BIM Dimensions



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## nD(imensions)



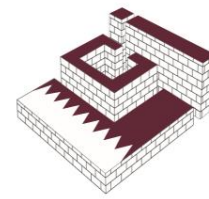
# BIM and Design software integration

Bi-directional link to design software platform →  
always up-to-date model design and documentation

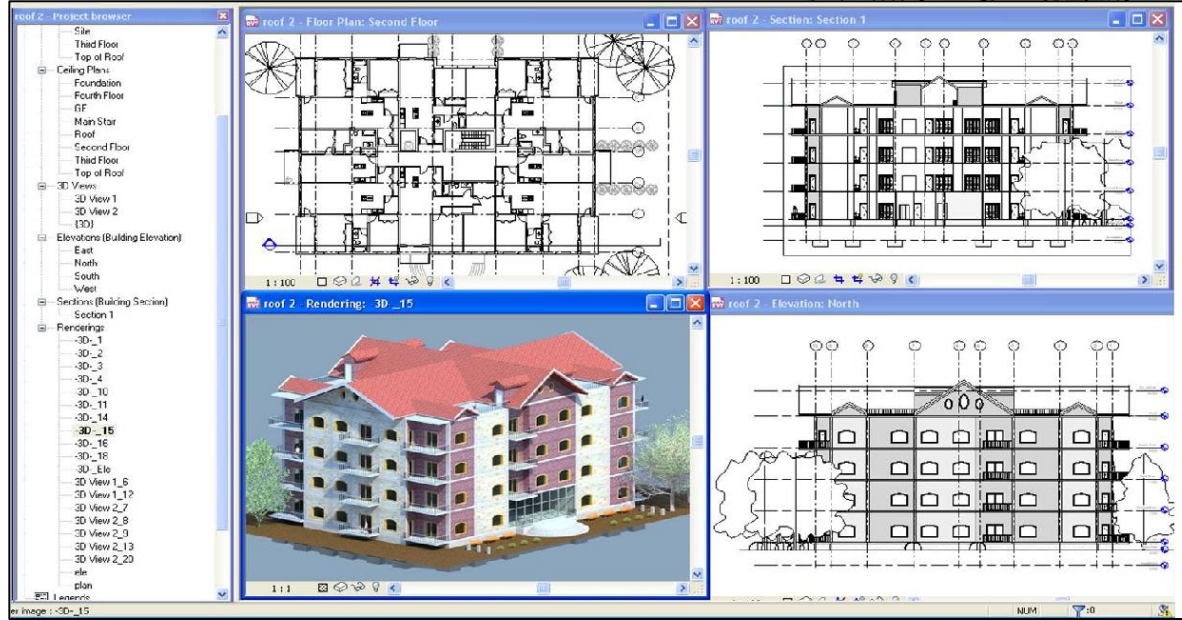
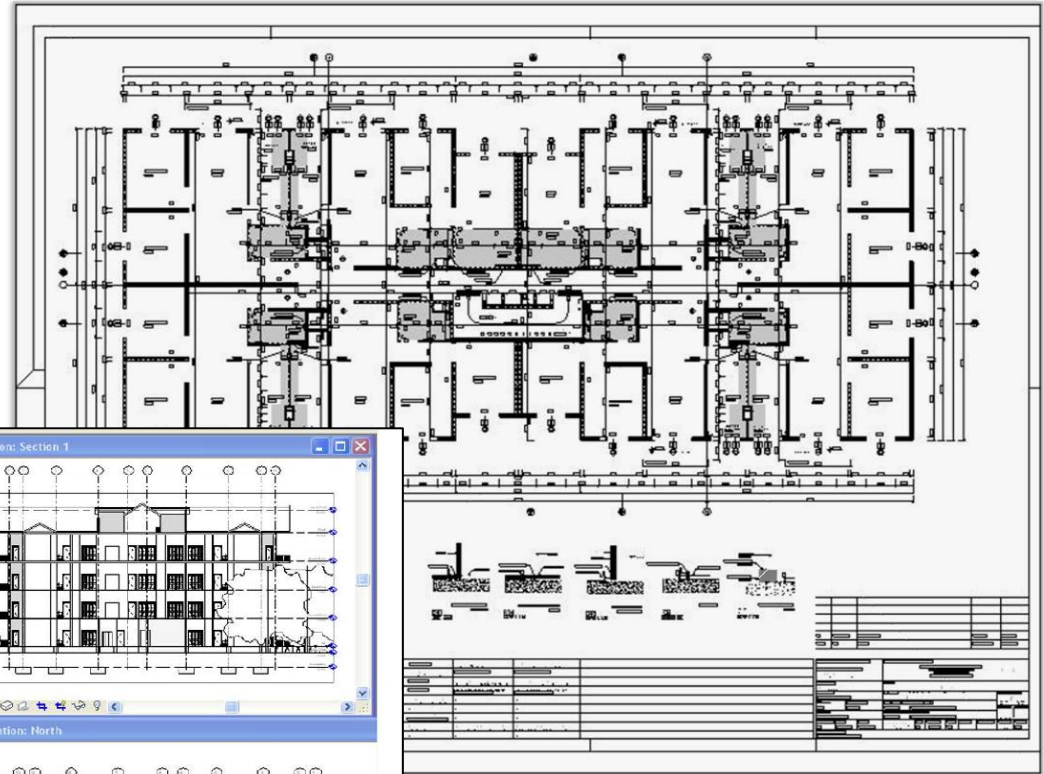
Choosing the right tools!



# Drawings and Project Documentation



- Automated drawings and schedule extraction
- Documentation always up-to-date
- Minimal revision time





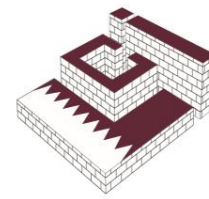
# Smart Objects Libraries

Libraries of smart objects, linked with the relevant attributes and materials are provided by manufacturers, promoting standardization and minimizing errors.





# Parametric Data Driven Design Development



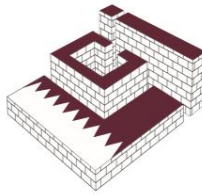
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## Visual programming – Dynamo, Grasshopper

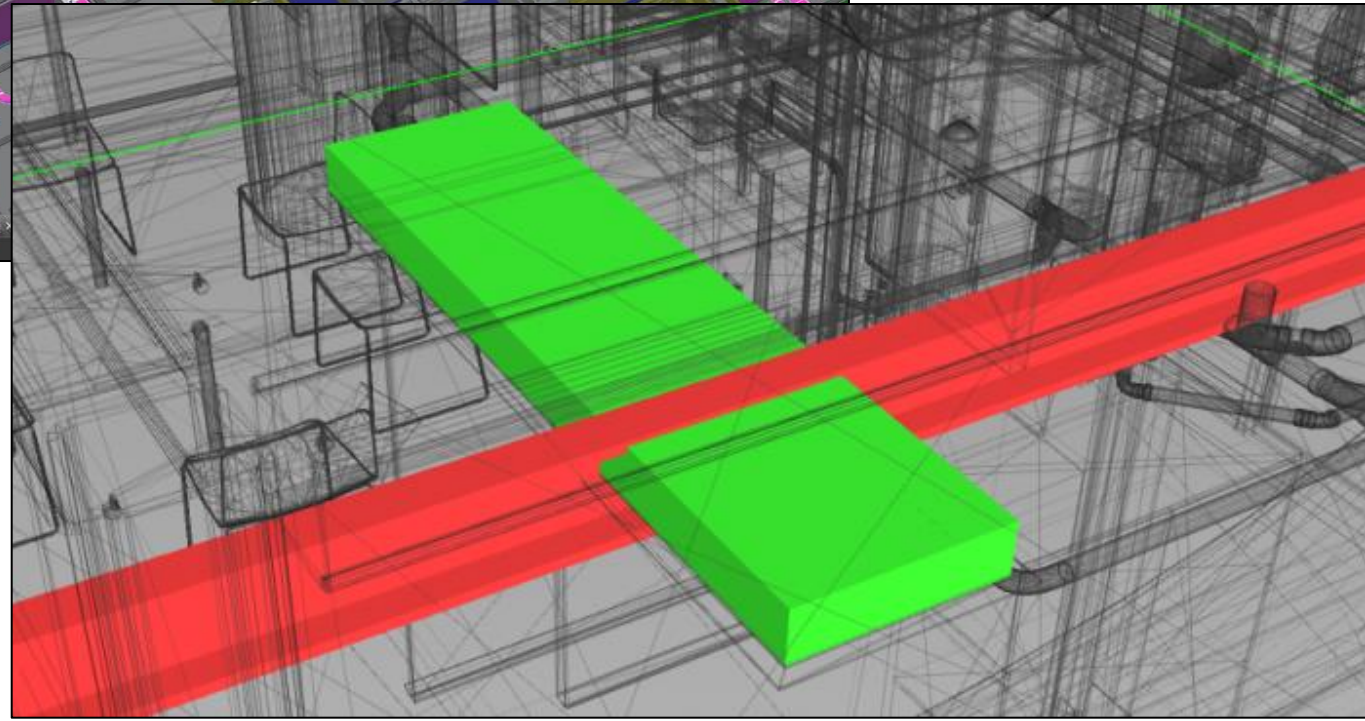
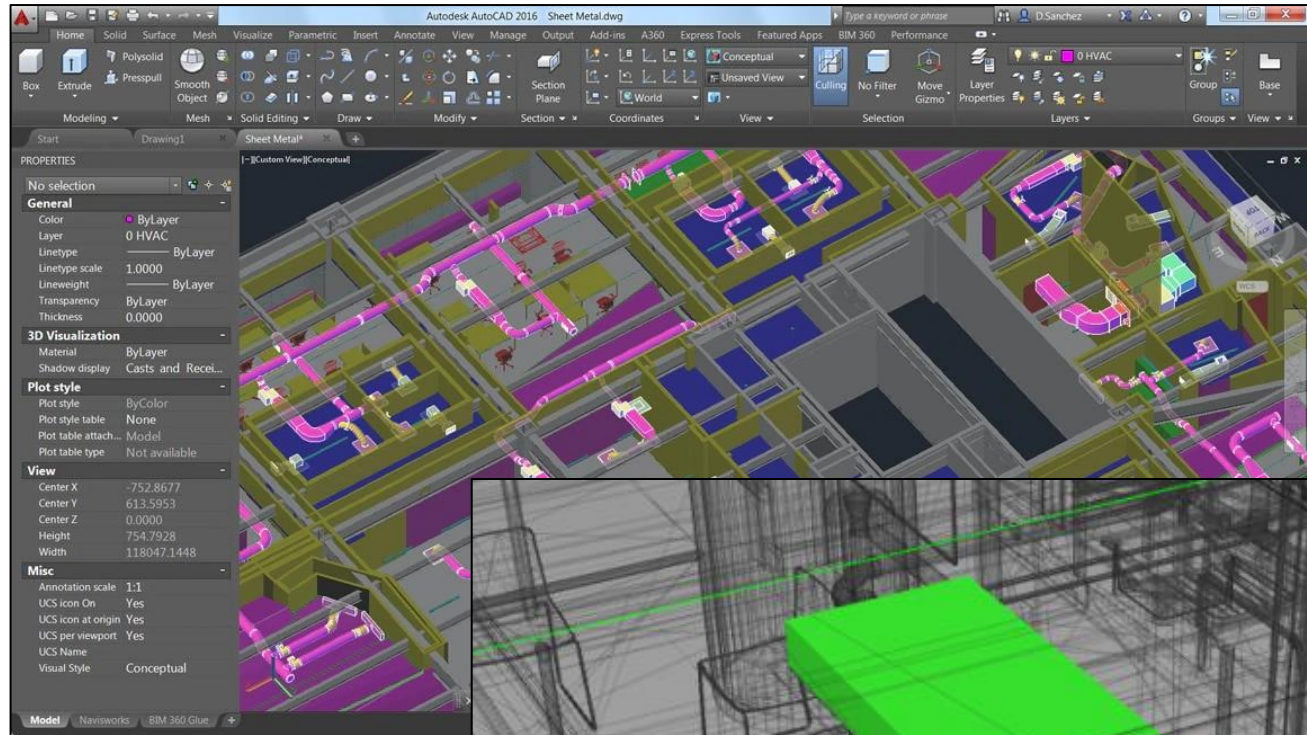
The image illustrates the workflow of parametric data-driven design development. It features four main components:

- Revit (Top Left):** The Autodesk Revit interface showing a 3D architectural model of a building. The Properties panel is visible, and the Project Browser shows a hierarchy of views including Floor Plans, Roof, and Ceiling Plans.
- Dynamo (Top Right):** The Dynamo visual programming environment. A script is shown with components like 'List.Flatten', 'NormalAtPoint', 'Surface.NormalAtPoint', 'Polygon.Center', and 'SunSettings.SunDirection'. The script is used to calculate surface normals and sun directions for a specific surface.
- Grasshopper (Bottom Left):** The Grasshopper visual programming environment. A complex script is shown with components like 'Range', 'Polyline', 'Random', 'Blend', and 'Divide'. The script is used to generate a 3D model of a red, faceted object.
- 3D Model and Floor Plans (Bottom Right):** A 3D model of a red, faceted object and its corresponding 2D floor plan outlines. The floor plans are shown in red and black, with labels like 'Walls' and 'Roofs'.

# Clash Avoidance and Spatial Coordination



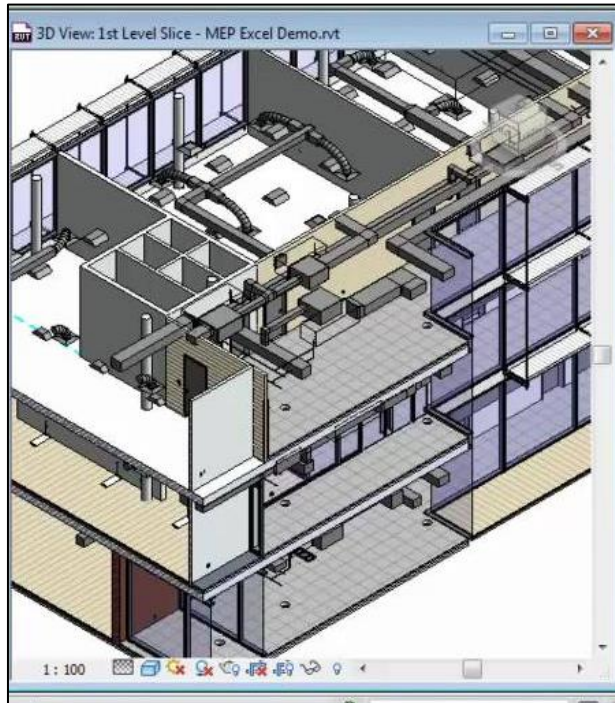
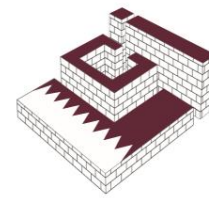
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# Room Schedules and Data Sheets



Schedule: Space Airflow Schedule - MEP Excel Demo.rvt

Space Airflow Schedule					
Level	Number	Name	Actual Supply Airflow	Specified Supply Airflow	Variance
Level 1	17	Workshop	1059.4 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	100.00%
Level 1	18	Stock	635.7 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	100.00%
Level 1	49d	Corridor	0.0 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	
Level 1	50	Cafeteria	1271.3 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	100.00%
Level 2	63	WC	0.0 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	
Level 2	62	WC	0.0 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	
Level 2	59	Meeting R	286.0 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	100.00%
Level 2	58	Archive	211.9 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	100.00%
Level 2	56	Copy	233.1 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	100.00%
Level 2	57a	Staff Roo	932.3 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	100.00%
Level 2	57b	Staff Roo	466.2 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	100.00%
Level 2	69	Meeting R	0.0 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	
Level 2	52	EDP III	572.1 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	100.00%
Level 2	53	EDP II	1525.6 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	100.00%
Level 2	47	Admin	317.8 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	100.00%
Level 2	46	Stock	423.8 ft <sup>3</sup> /min	0.0 ft <sup>3</sup> /min	100.00%



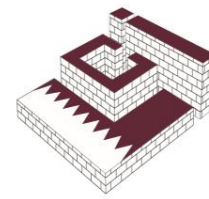
**ASSOCIATED ARCHITECTS**  
University of Birmingham - Main Campus Library  
ROOM DATA SHEET

Room Number	Room Name	Room Area	Room Volume	Room Height	Room Description
17	Workshop	1059.4	0.0		
18	Stock	635.7	0.0		
49d	Corridor	0.0	0.0		
50	Cafeteria	1271.3	0.0		
63	WC	0.0	0.0		
62	WC	0.0	0.0		
59	Meeting R	286.0	0.0		
58	Archive	211.9	0.0		
56	Copy	233.1	0.0		
57a	Staff Roo	932.3	0.0		
57b	Staff Roo	466.2	0.0		
69	Meeting R	0.0	0.0		
52	EDP III	572.1	0.0		
53	EDP II	1525.6	0.0		
47	Admin	317.8	0.0		
46	Stock	423.8	0.0		

ideate BIMLink



# Visualization - Detailing - Rendering

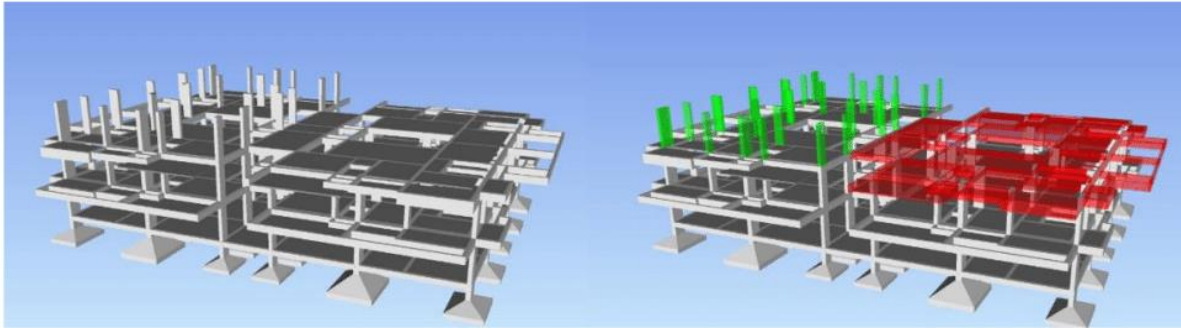
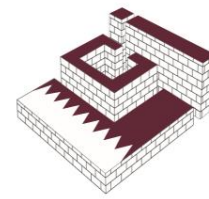


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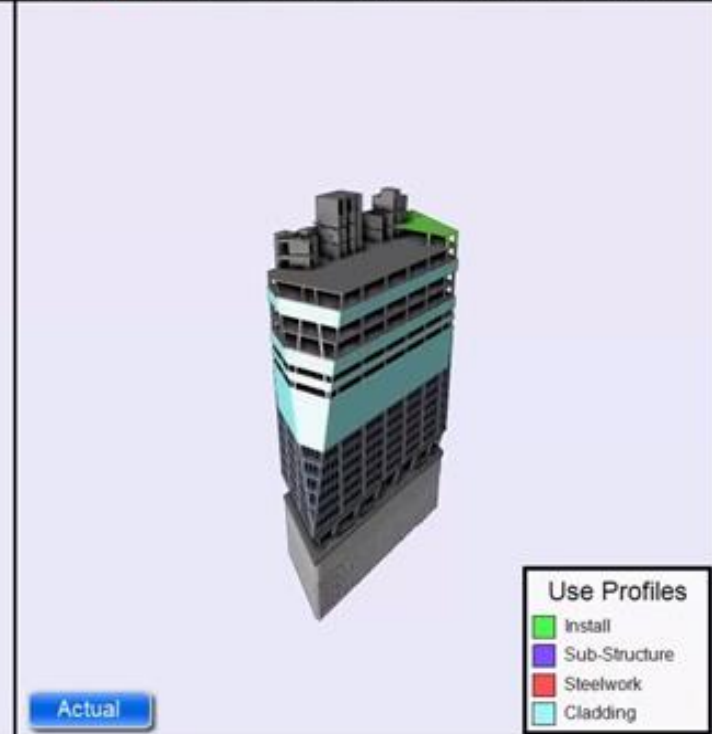
# Progress Reporting – Actual vs Planned



Planned Status

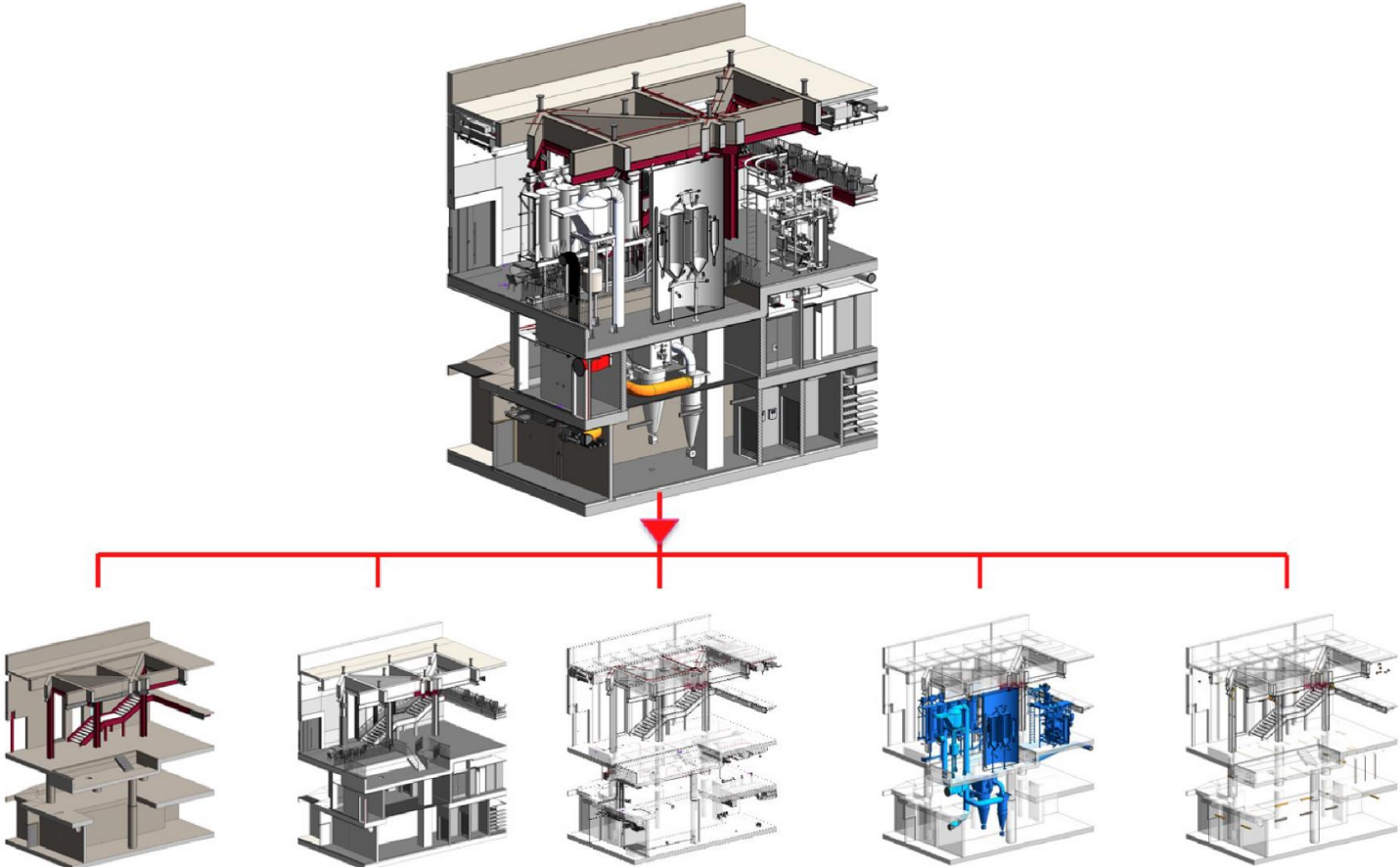
Actual Status

Jan 2012				Apr				Jul				Oct				Jan 2013				Apr				Jul				Oct				Jan 2014					
Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
wt 4	wt 8	wt 12	wt 17	wt 21	wt 25	wt 30	wt 34	wt 38	wt 43	wt 47	wt 52	wt 56	wt 60	wt 64	wt 69	wt 73	wt 77	wt 82	wt 86	wt 91	wt 95	wt 99	wt 104	wt 108	wt 112	wt 116	wt 121	wt 125	wt 130	wt 134	wt 139	wt 143	wt 148	wt 152	wt 157	wt 161	wt 166



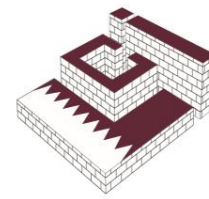


# Scope Analysis and Work Packaging





# 5D Quantities and Costing



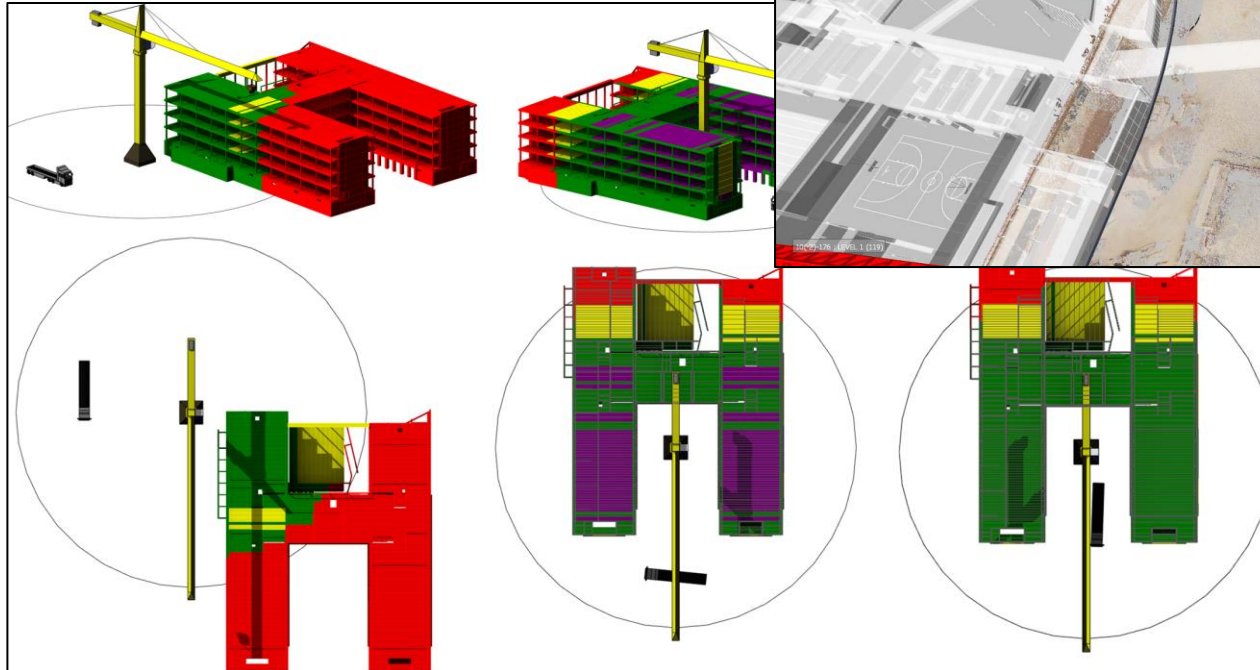
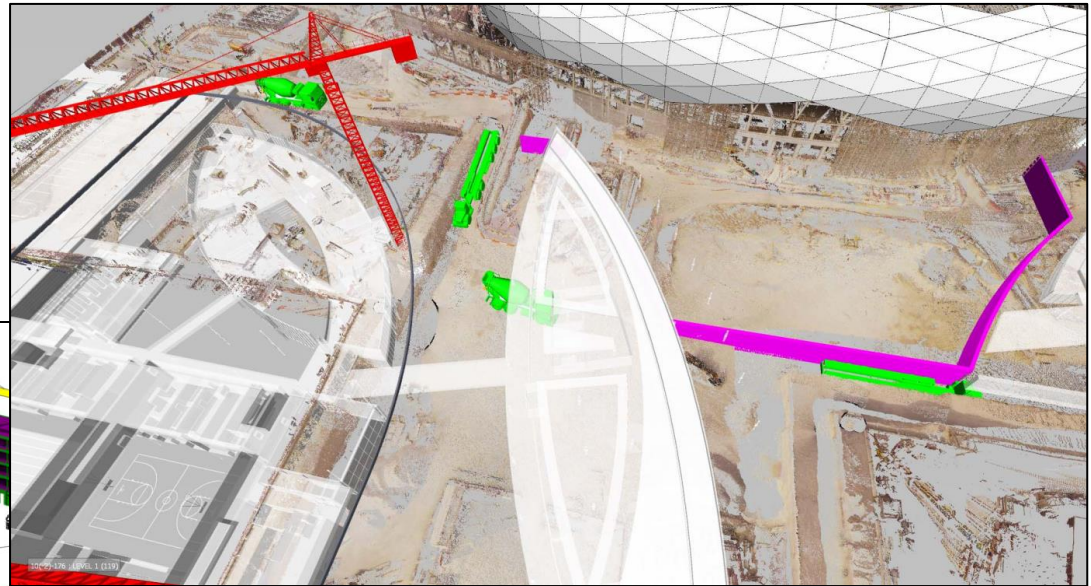
- Accurate reporting to the Object Level.
- Take-Offs and measurements can be (re)extracted within seconds
- Automated and always up-to-date Schedules.
- Management and visualization of VEs and VO's.
- Revisions/changes can be easily traced and quantified.

NO	UNIT	DESCRIPTION	QUANTITY	UNIT	PRICE
1	0.0000	Demolition of pavement in parallel to concrete, concrete, asphalt in areas a radius of 10m in full demolition of pavement. In parallel to concrete			
<b>MEASUREMENTS:</b>					
		takeoff1	12.20	12.20	
		takeoff2	1.02	1.02	
		takeoff3	1.02	1.02	
		takeoff4	1.02	1.02	
		area	14.81	14.81	
		area	15.61	15.61	
		length	7.02	7.02	
		area	11.78	11.78	
		argola circle	4.24	6.94	
		circle	18.00	36.00	
		rectangle	20.20	20.20	
		circle	11.00	22.00	
		square	1.80	1.80	
<b>NET TOTAL m2</b>					
			104.00	6.38	118.80
2	0.0000	Formazione sovrappavimento			
3	0.0000	Formazione di sottopavimento in	106.20	1.40	148.68
4	0.0000	Formazione di sottopavimento in	5.64	36.40	205.64
5	0.0000	Formazione di sottopavimento in	32.51	6.78	220.64
6	0.0000	Formazione di sottopavimento in			
<b>MEASUREMENTS:</b>					
			4.00	4.00	
<b>NET TOTAL m2</b>					
			4.00	6.80	27.80
7	0.0000	Formazione di sottopavimento in			
8	0.0000	Formazione di sottopavimento in	1.00	2.00	2.00
<b>MEASUREMENTS:</b>					
			1.00	1.00	1.00
<b>NET TOTAL m2</b>					
			1.00	360.00	360.00
9	0.0000	Formazione di sottopavimento in			
<b>NET TOTAL m2</b>					
			1.00	400.00	400.00

# Side Logistics – Crane Management

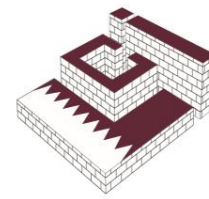
## Tower Crane Management & Site Logistics

- Location of Towers is being checked location-wise and Planning-wise.

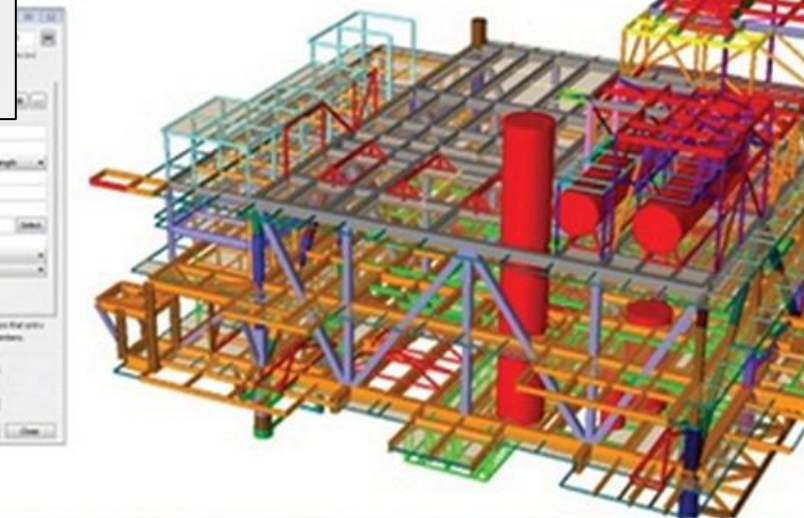
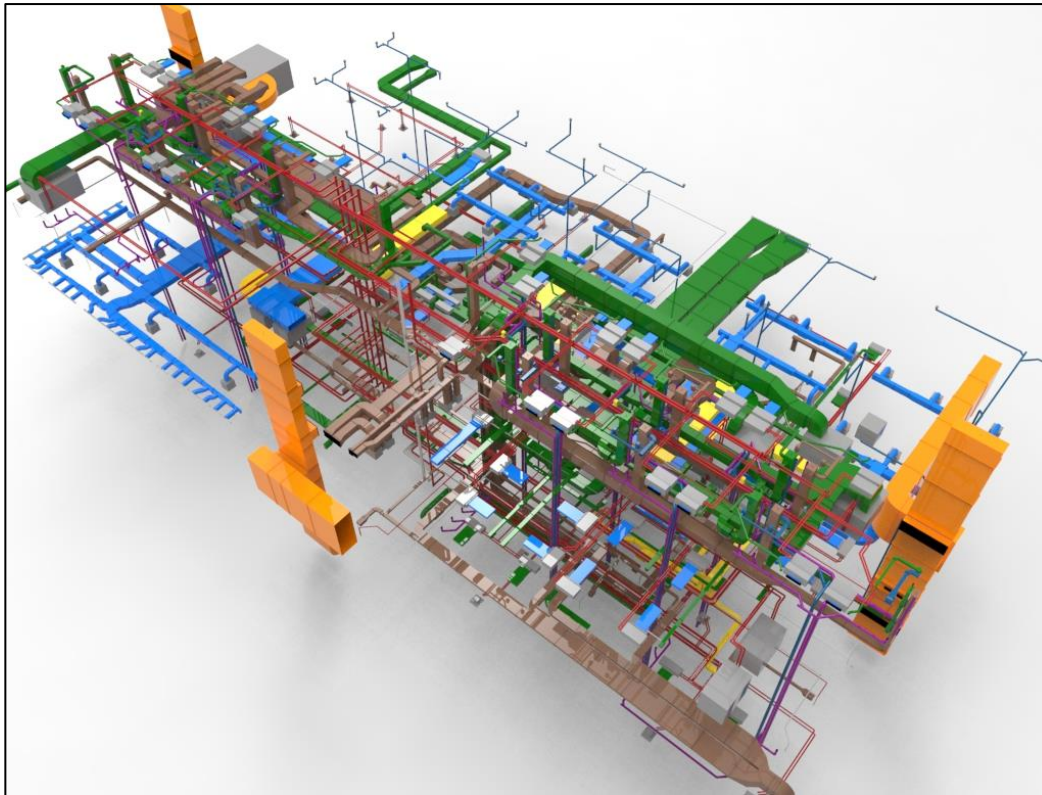




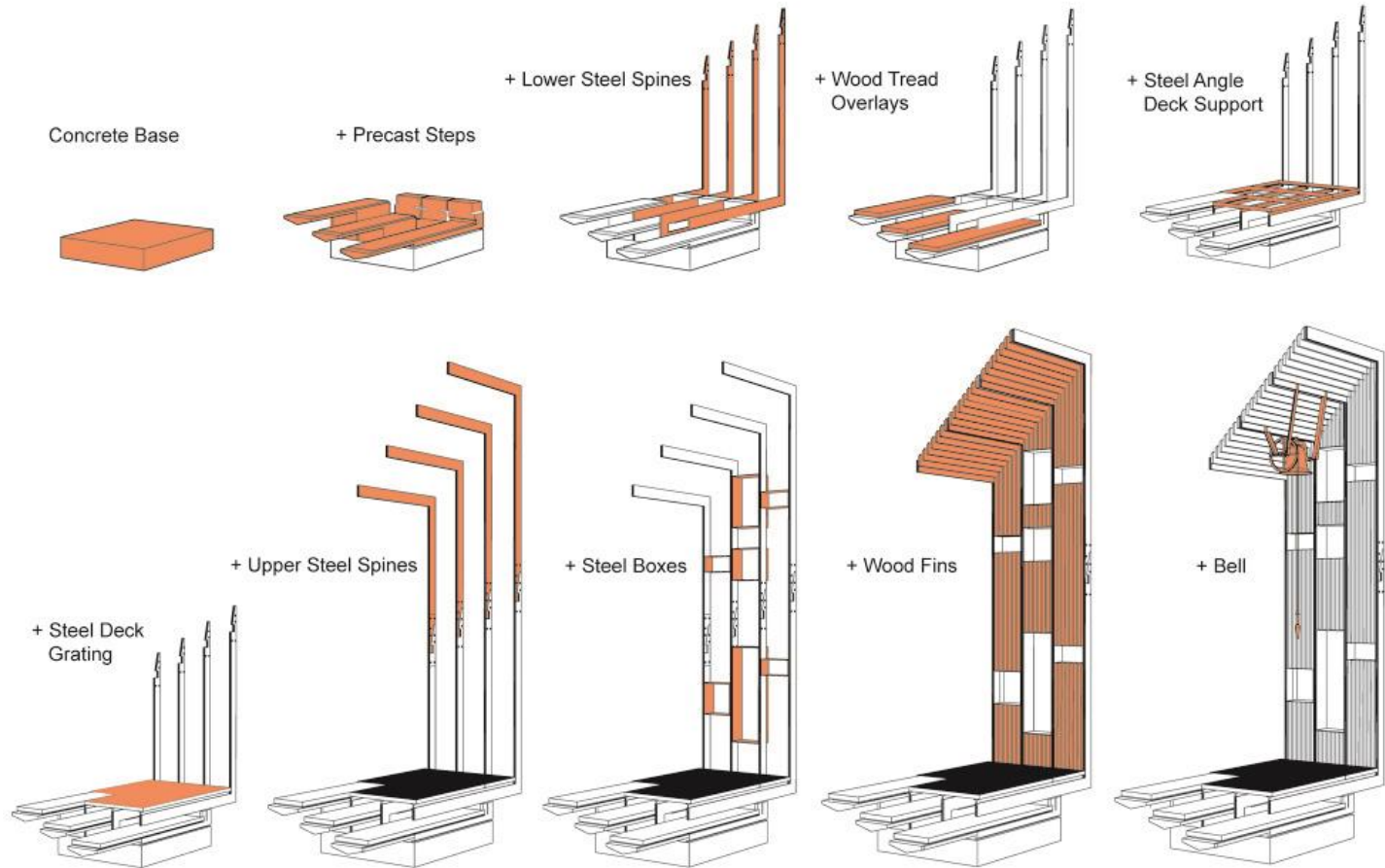
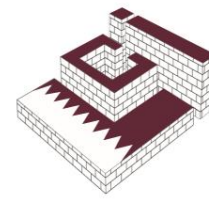
# Value Engineering



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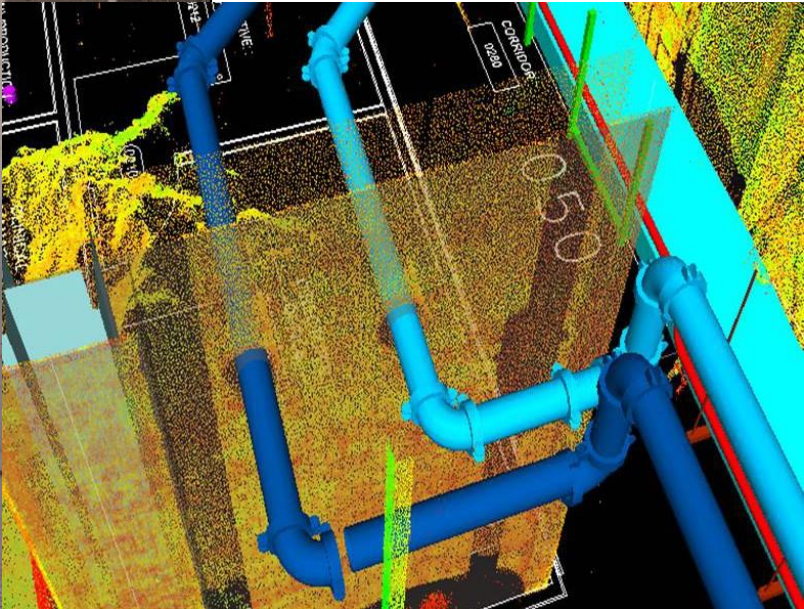
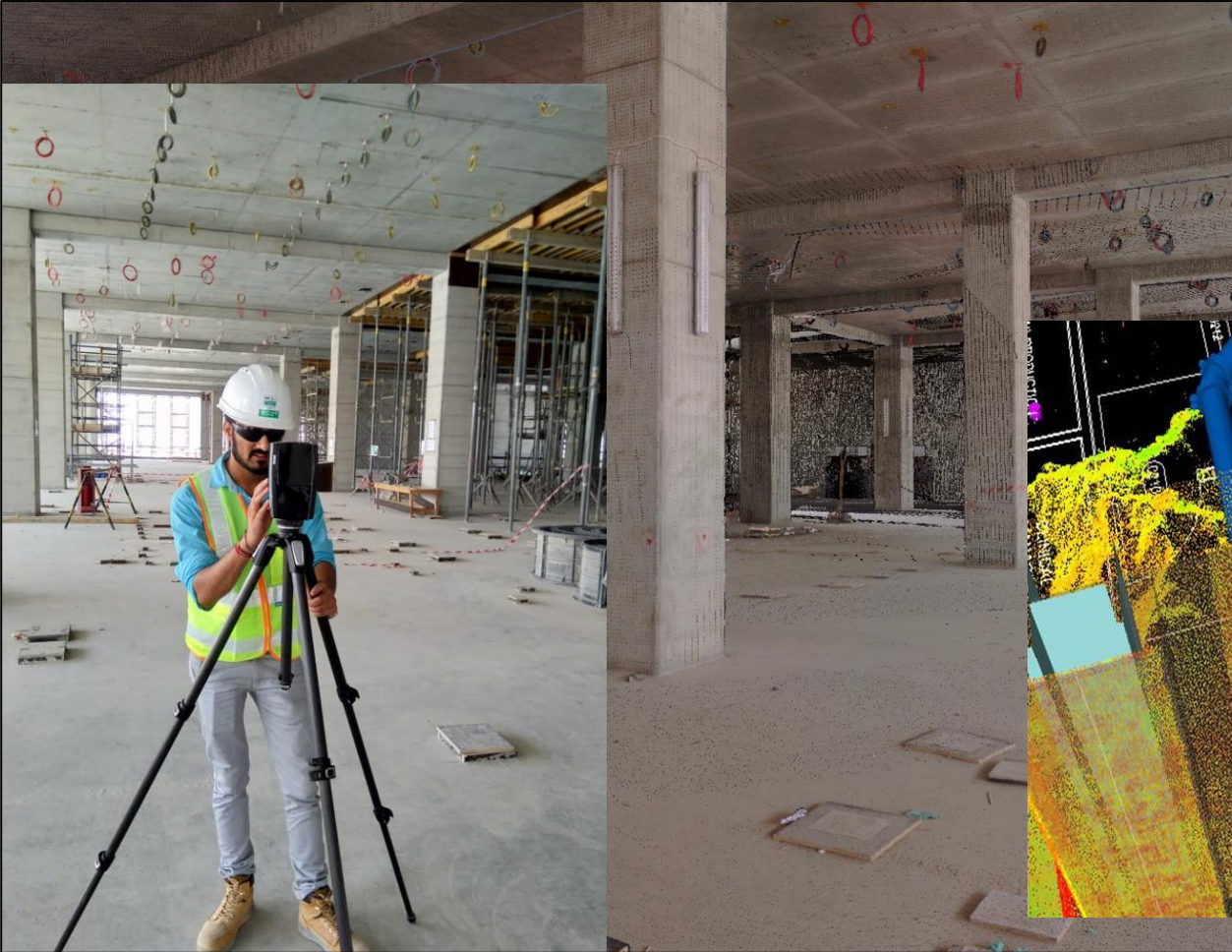
# Construction Methodology & Erection Sequence





# Laser Scanning

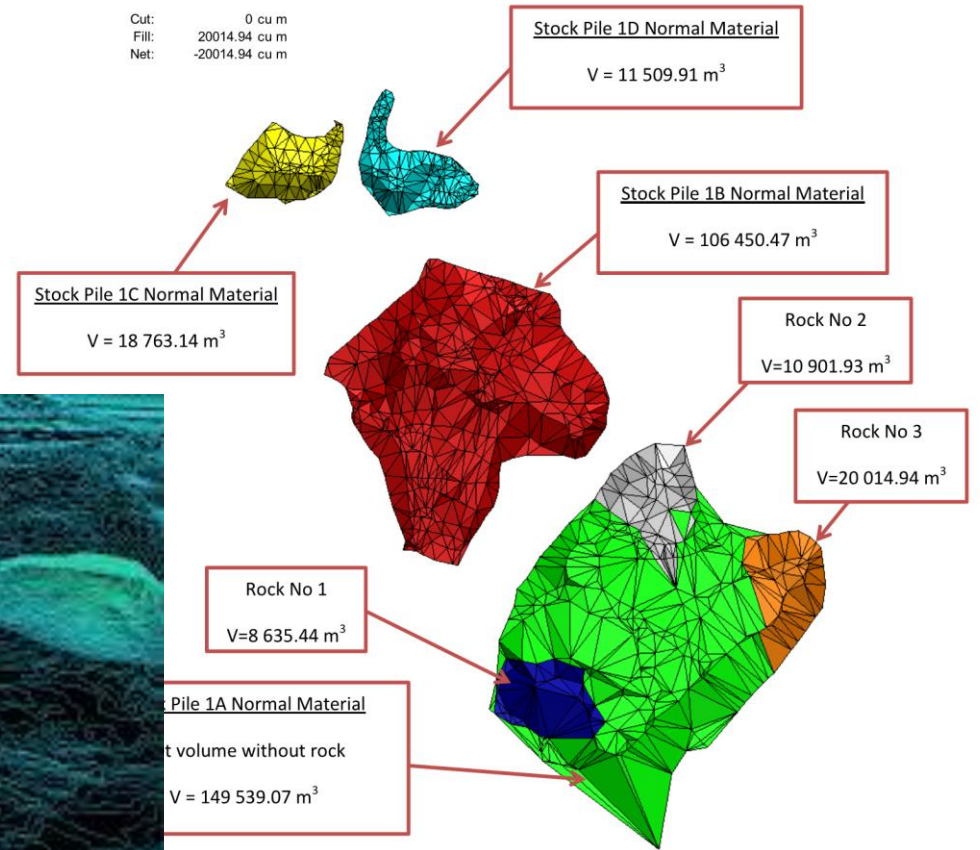
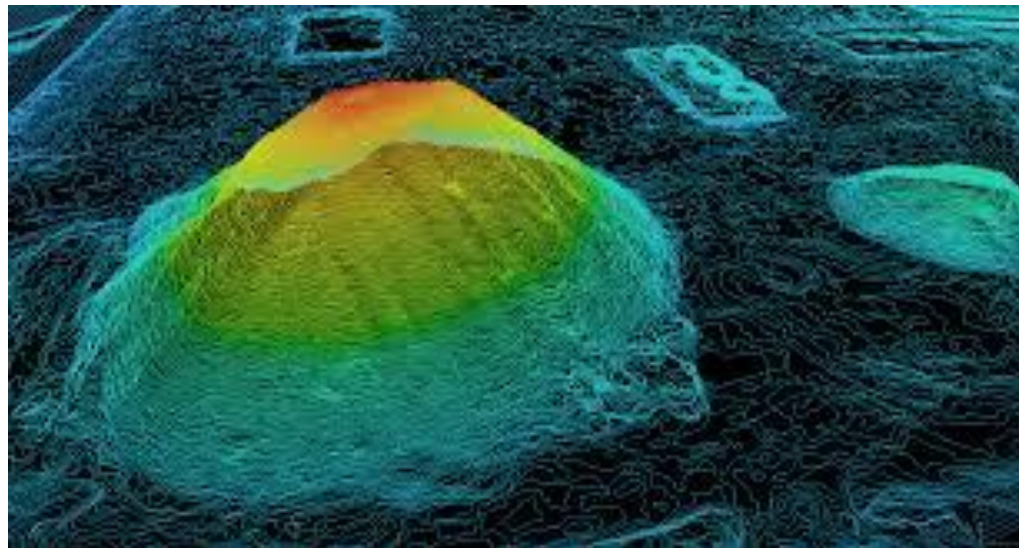
## Laser Scanning for Construction Verification



# Laser Scanning - Earthworks Management

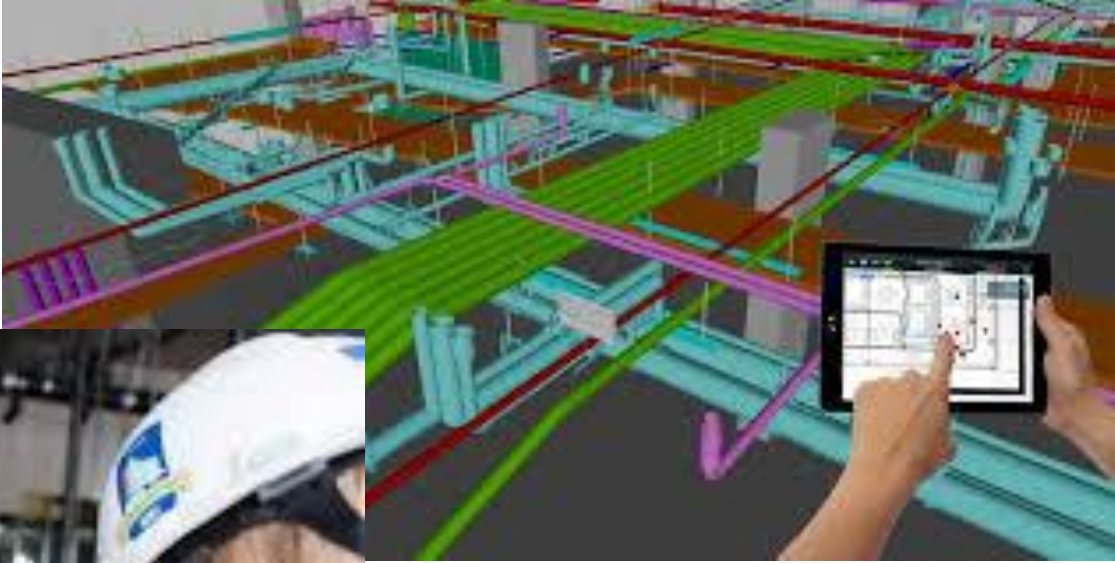
## Earthworks Management & Documentation

- Design documentation again will be extracted from the laser scanned Digital Terrain Models.
- The Earthworks Management will be continuously performed through the regular laser scans.



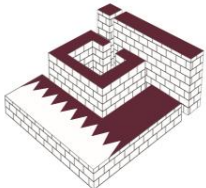


# Digital Collaboration / BIM-to-Field





# Augmented & Virtual Reality

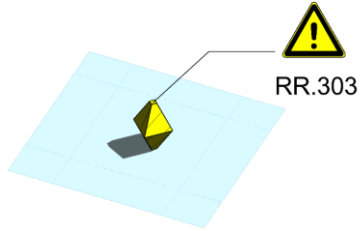


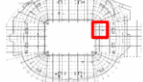
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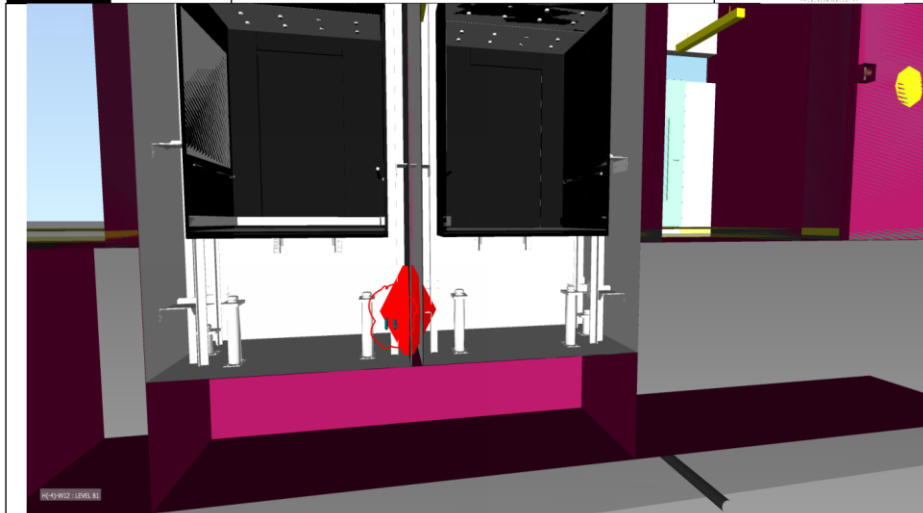


# BIM and CDM / H&S

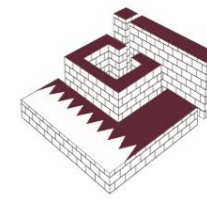
## CDM 2015 and Health and Safety provisions



Issue Number	0013	Element(s) Id	S-LF-10E	Key-plan
Discipline	Elevators	There are conduits inside the shaft. Element ID: 1326602		
Level	All Levels			
Status	Pending			
Date Found	25-Nov-17			

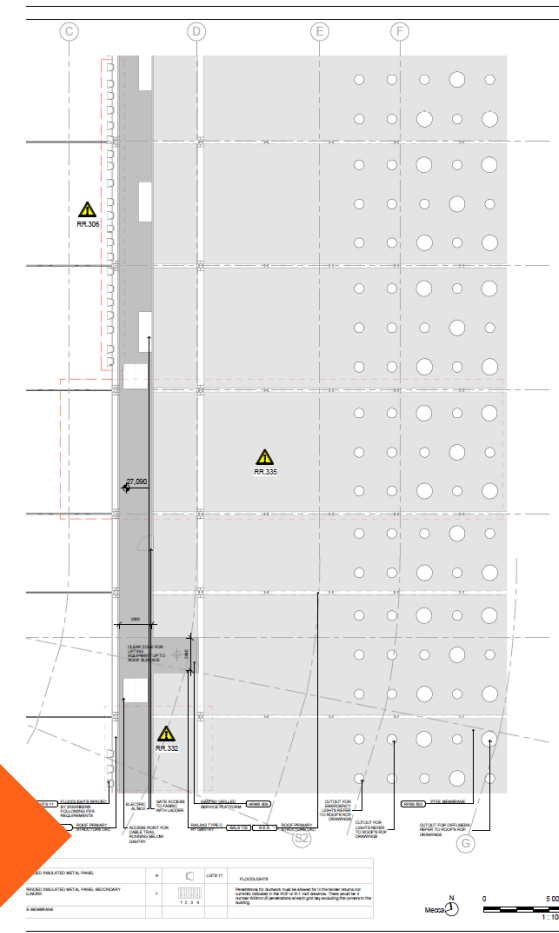


Response 1		By	
		Response Date	25-Nov-17
Response 2		By	
		Response Date	30-Nov-17



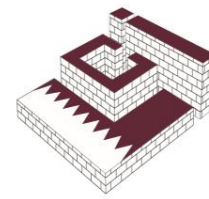
## CDM 2015 and Health and Safety provisions

BIM	Owner (Company/Institution)	Date Raised	Hazard Area	Persons at Risk/Phase	Hazard Details	Risk Level (Pre-Mitigation)	Mitigation of Risk Employed by Designer	Risk Level (Post-Mitigation) See Note 4	Method of Control
Item									SHE Box
RR.304	Pattern	30/10/12	Ground/Lower-ground level	Construction	Reduced level dig for plant areas to basement. Risk of ground-collapse, falling from height.	Medium		Low	TBC
RR.305	Pattern	30/10/12	Roof Level	Construction	Reduced level dig for plant areas for water feature.	Medium	Design omitted.	None	Reduced level dig for plant areas for water feature.
RR.306	Pattern	30/10/13	Roof Level	Construction Operation and Maintenance	Stadium Floodlights and House lights. Risk of injury from slips, trips and falling from height, risk of injury from objects falling from height.	High	Coordination workshops held with design team to discuss the overall coordination of the structure and services and the associated access and maintenance issues at roof level. DC has incorporated a gantry at Level R1 which runs the full perimeter of the pitch to provide safe access to floodlights. House lights are mounted level with the surface of the walkable mesh. These lights are retractable, affording safe access for maintenance and equipment replacement from within the walkable mesh level. MC to ensure that appropriate access is afforded to ensure that installation and maintenance activities can be undertaken safely.	Low	Risk of falling from height. Risk of objects falling from height. Contractor to provide Method statement for review prior to the installation.
RR.307	Pattern	30/10/13	Roof Level	Construction Operation and Maintenance	Installation of wind screen. Risk of injury from falling from height, risk of injury from objects falling from height.	High	Coordination workshops held with design team to discuss the overall coordination of the structure and services and the associated access and maintenance issues at roof level. DC to ensure that appropriate access is afforded to ensure that installation and maintenance activities can be undertaken safely. Wind screen to be assembled at roof level from prefabricated sections hoisted into place using piling mounted crane. Temporary scaffolding required to provide access to full height of wind screen.	Low	TBC
RR.308	Pattern	12/11/13	Exterior envelope of stadium	Construction	Installation and maintenance of Cyclorama (fabric screen behind media).	High	Design omitted.	None	Installation and maintenance of Cyclorama (fabric screen behind media).
RR.309	Pattern	13/11/13	Roof shading	Construction Operation and Maintenance	Retractable shading. Installation and maintenance of dynamic fabric shading structure to stadium ovalus. Risk of injury from falling from height, risk of injury from objects falling from height.	High	DC has liaised with specialist installer and maintenance team to establish construction sequencing and construction methods and access requirements. Roof design adjusted to ensure adequate space is provided around the installation to meet the requirements of safe installation and maintenance.	None	Risk of falling. Main Contractor to provide Method Statement describing the construction and maintenance activities associated with the installation prior to installation.
RR.310	Pattern	13/11/13	Building Envelope	Construction Operation and Maintenance	Unusual curved forms of built envelope. Risk of injury from slips, trips and falling from height, risk of injury from objects falling from height. GRP facade panels mounted at various angles. Various installation techniques required. DC has liaised with Bahrain Fibre Glass (BFG) to develop the construction details for the facade to ensure a simple assembly.	Medium	Various installation techniques required. DC has liaised with Bahrain Fibre Glass (BFG) to develop the construction details for the facade to ensure a simple assembly. Installation of panels to be undertaken by operatives in MEVPs.	Low	Risk of falling. Main Contractor to provide Method Statement describing the construction and maintenance activities associated with the installation prior to installation.
RR.311	Pattern	12/11/13	Access road	Construction Operations and Maintenance-Demolition	Elevated access road into the west elevation of the stadium. Construction, maintenance and demolition of elevated vehicular route presents risk of injury from falling from height, risk of injury from objects falling from height.	Medium	DC to liaise with Structural Engineer to ensure best practice construction methods are incorporated into the design and contract documentation.	None	
RR.312	Pattern	12/11/13	Access road	Construction	Construction of footings to elevated access road. Risk of electrocution from encountering buried services.	Medium	DC to liaise with Civil and Electrical Engineers to review site surveys for presence of buried services. Civil and Electrical Engineers ensure best practice construction methods are incorporated into the design and contract documentation. Where necessary, commission further surveys to establish status of services in the relevant area.	None	





# BIM & 3D Printing



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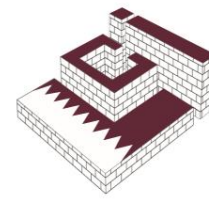
Transforming the Built Environment

Benefits include:

- Printed products only use as much material as needed = less waste
- Reduced transportation costs if products are printed on-site.
- Can achieve shapes that conventional techniques cannot.
- Lower labor costs.
- Reduced cost of customized design
- Reduced health and safety risks.



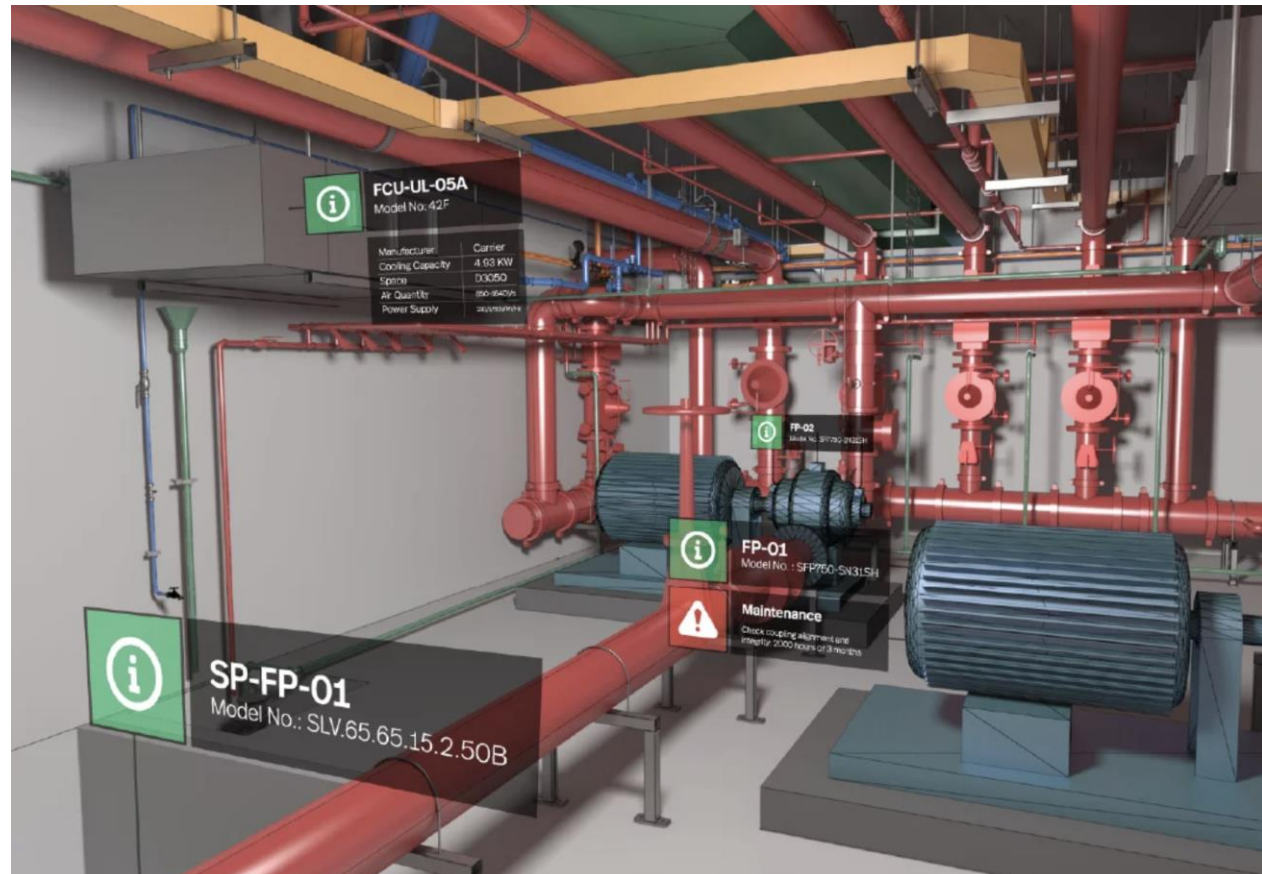
# BIM and FM Integration



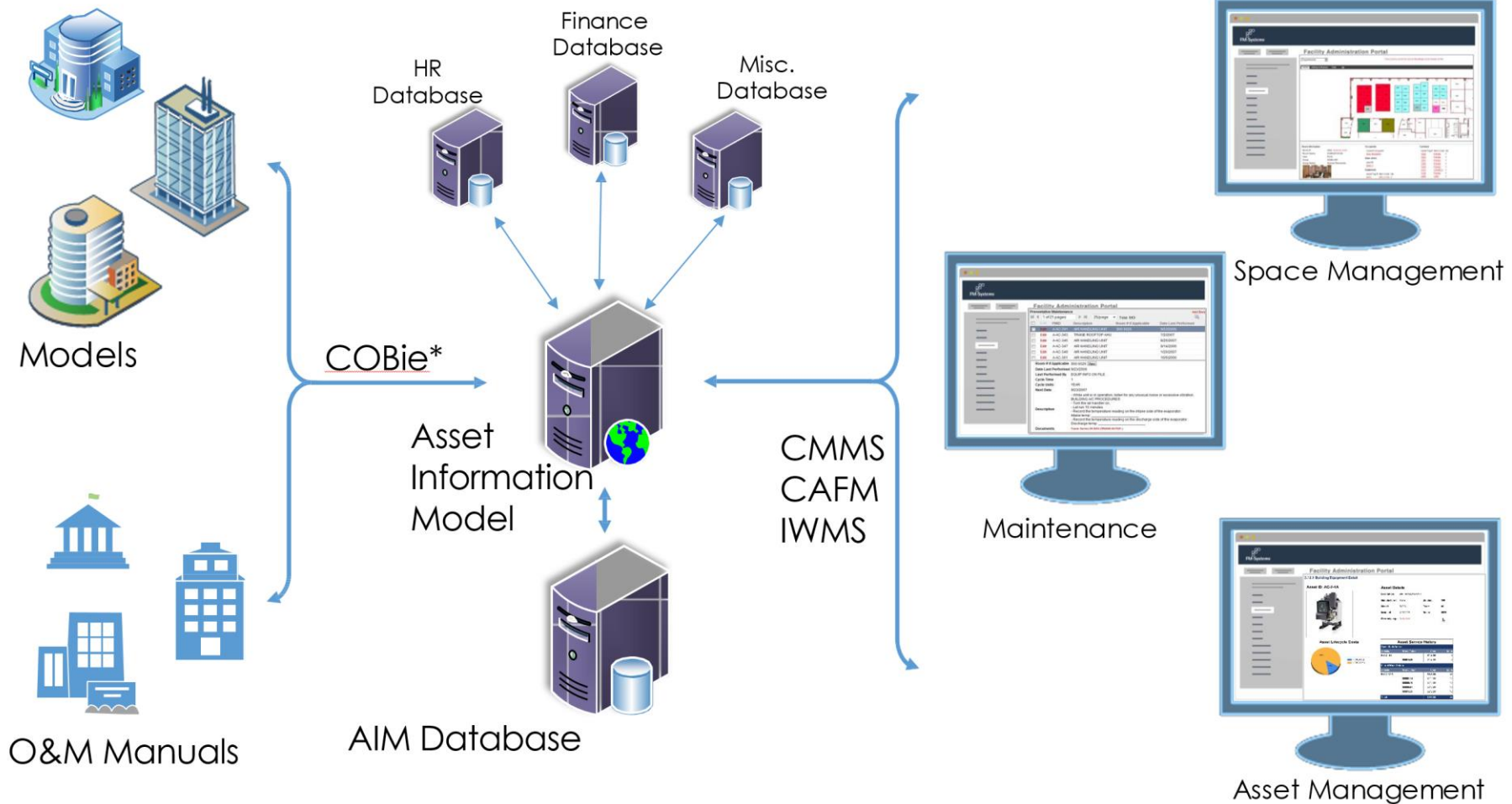
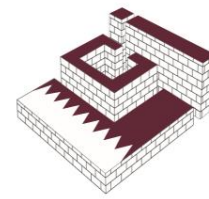
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Transforming the Built Environment

- Streamline projects handover
- Integrate FM data with BIM models
- CoBie worksheet
- Asset Information Model (AIM)

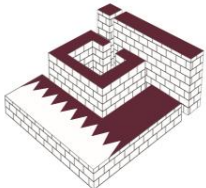


# BIM and FM Integration





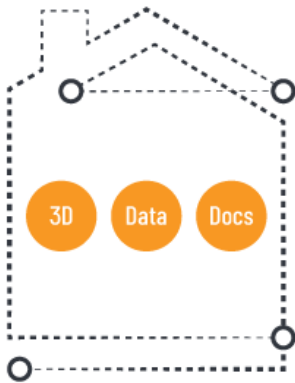
# BIM & Digital Twin



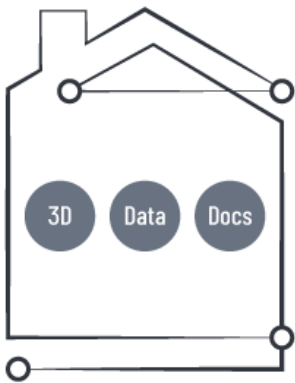
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## BIM

DIGITAL WORLD



as - DESIGNED model

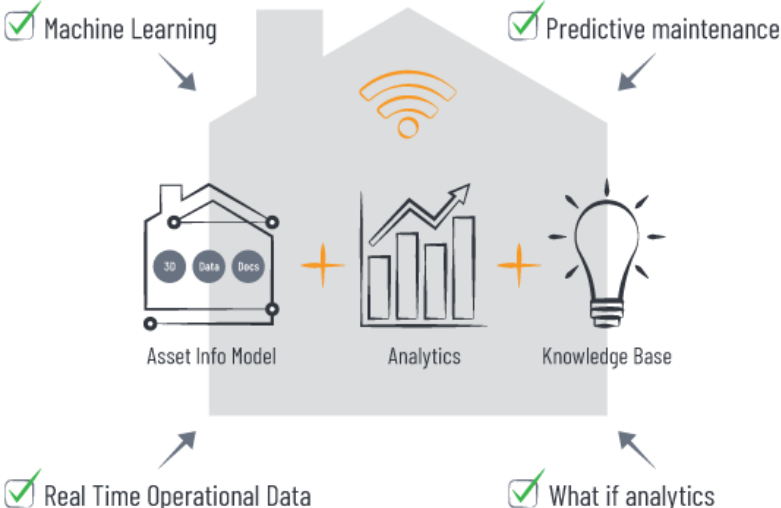


as - BUILT model

STRUCTURED INTEROPERABLE DATA

## DIGITAL TWIN

DIGITAL WORLD + PHYSICAL WORLD



CONCEPT DESIGN

DESIGN

CONSTRUCTION

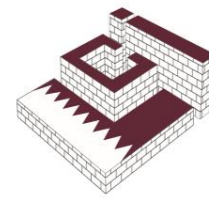
OPERATION AND MAINTENANCE

END OF LIFE

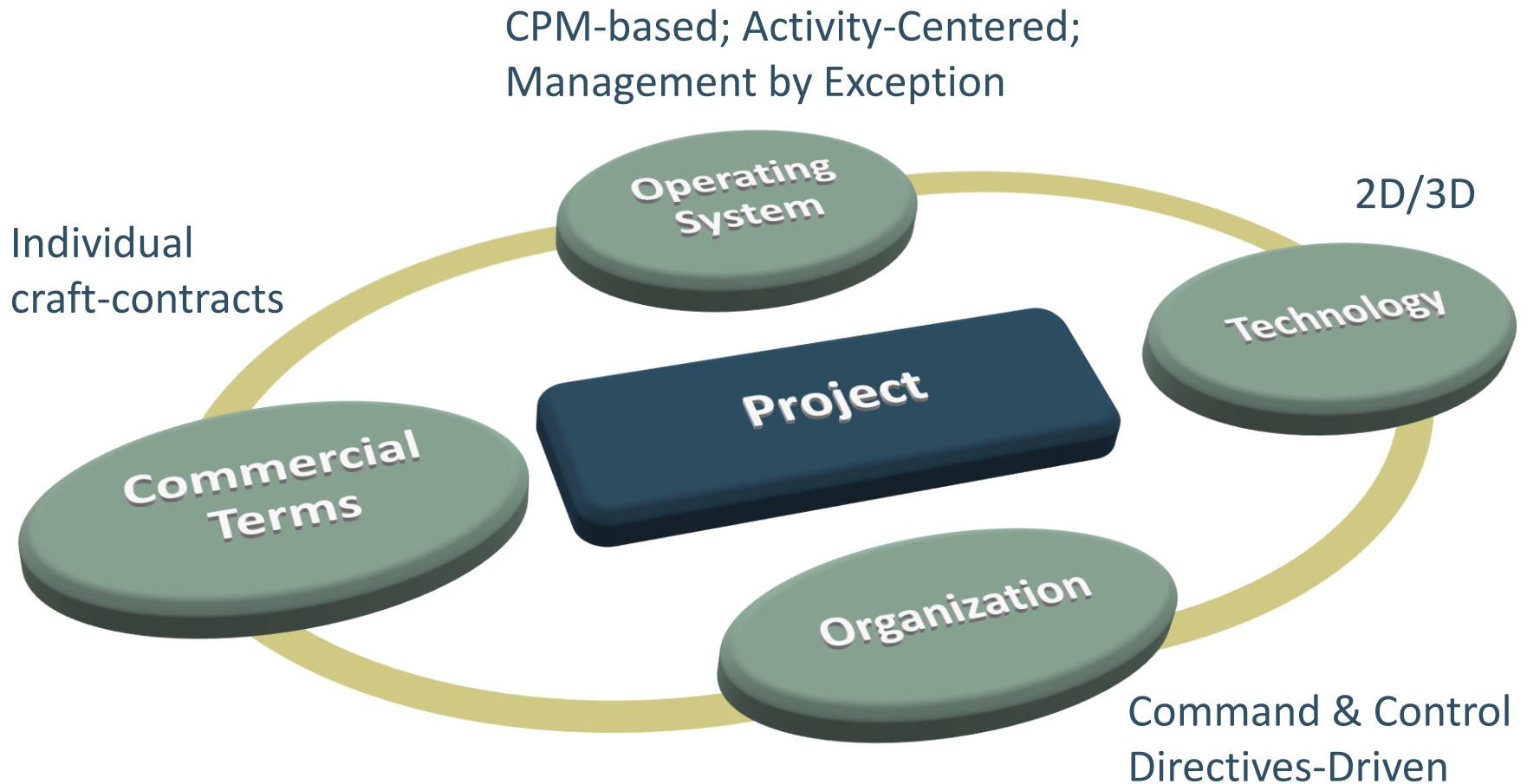
# Lean Principles



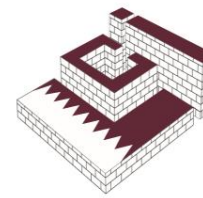
- **Identify Value** - Identifying value and understanding the customer's point of views is a key component within Lean construction management. All stakeholders such as the client, architect, engineer, general contractor, suppliers, operators are expected to work collaboratively.
- **Define Value Stream** - Once we have a clear understanding of the value from the customer's point of view, we can design the processes necessary needed to deliver that value. For each activity, the necessary labor, information, equipment, and materials are defined and any unnecessary non-value adding steps or resources can be eliminated.
- **Elimination of Waste** - Lean construction targets each major types of waste which include defects, overproduction, waiting, underutilization of talent, transportation, inventory, motion, and over processing.
- **Work Process Flow** - The ideal state of lean construction management is continuous workflow that is considered reliable and predictable.
- **Pull Planning and Scheduling** - Creating reliable workflows depends on work being released based on downstream demand. Lean uses collaborative planning (Last Planner) to enable participants to communicate and collaborate close with each other to determine the schedule of tasks.
- **Continuous Improvement** - Continuously improve processes and eliminate waste is the overall goal of lean philosophy. Opportunities for improvement are then identified and acted upon during the project and applied to future projects.



# DOMAINS OF PROJECT DELIVERY







# DOMAINS OF PROJECT DELIVERY



CPM-based; Activity-Centered;  
Management by Exception

**Lean-based; Management by Means**  
(planning inclusive of execution party; fire prevention)

Individual  
craft-contracts

2D/3D  
↓  
**BIM/VDC**

**IPD/IFOA**  
Relational

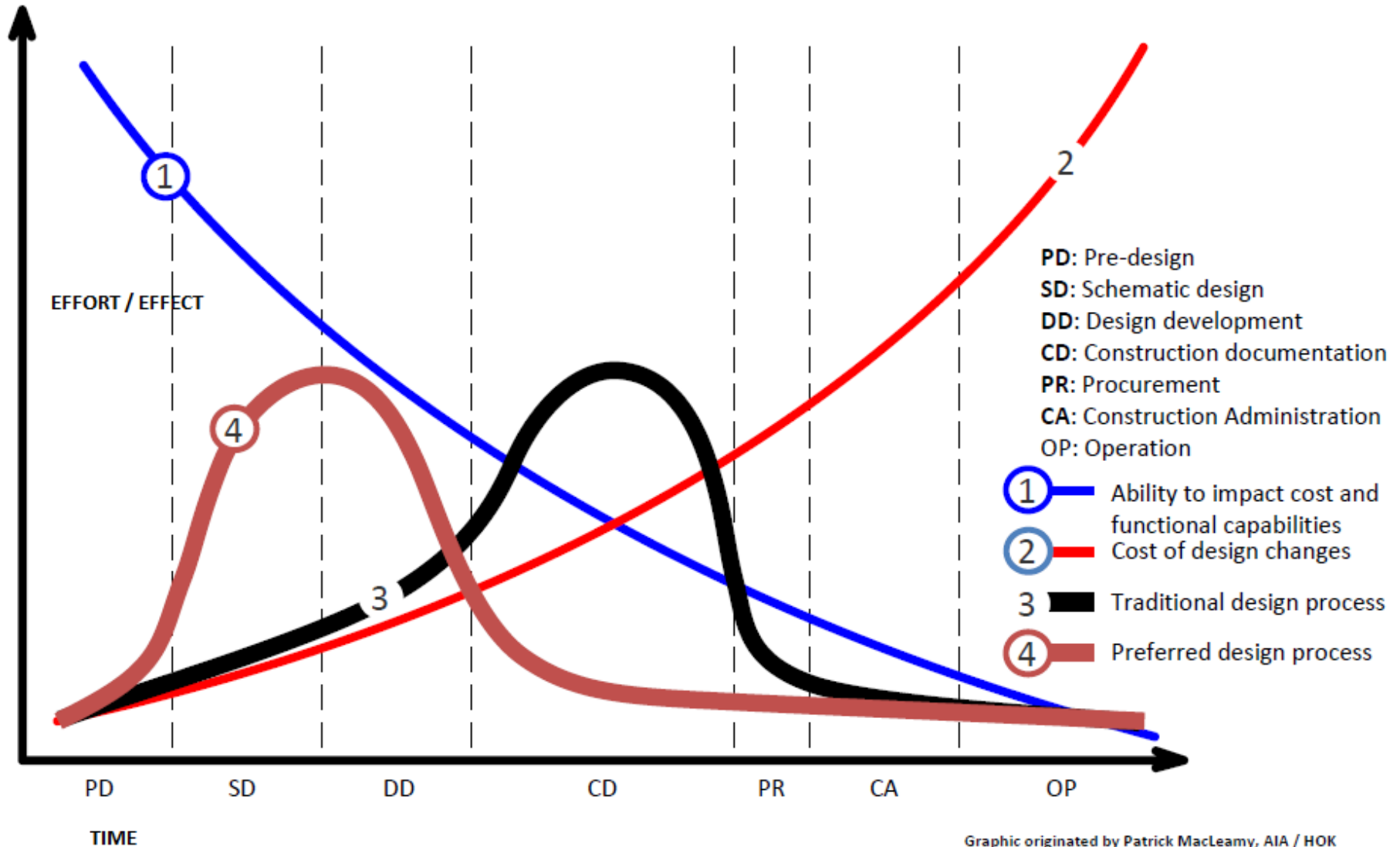
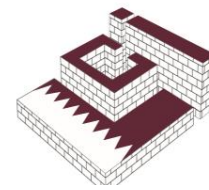
(system  
optimization)



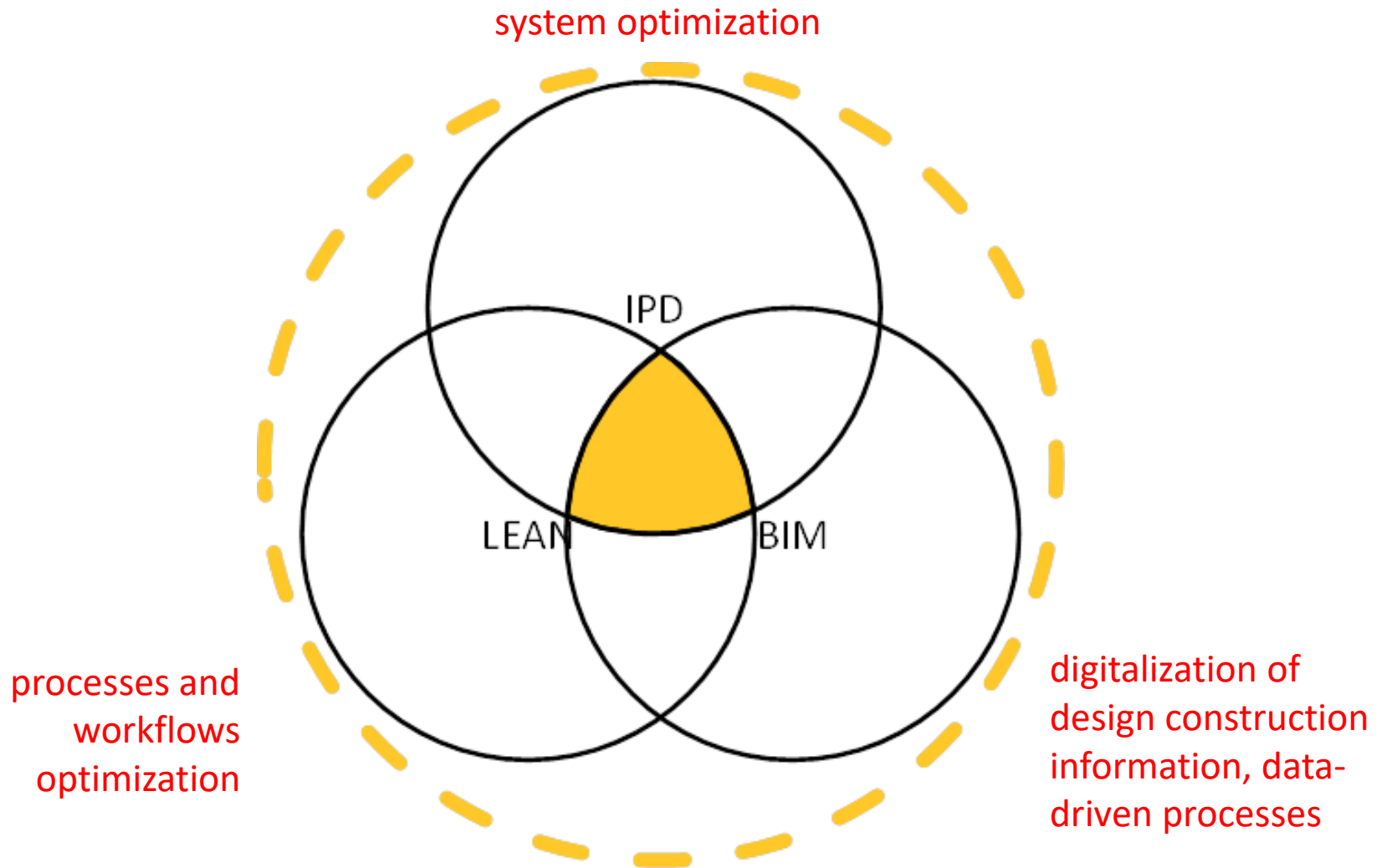
Command & Control  
Directives-Driven

**Dialogue & Collaboration**  
(planning is an ongoing conversations)

# BIM and Lean construction: MacLeamy curve

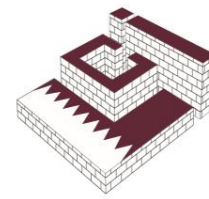


# The new iron triangle: IPD, Lean, BIM

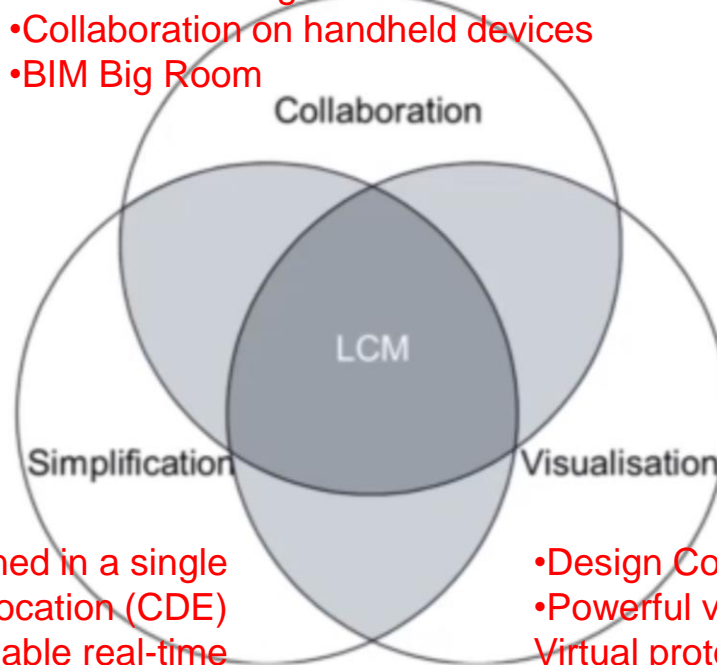




# BIM & Lean construction management



- Real time-collaboration between stakeholders
- Transparency, better scope management
- Identification of constrains
- Consistent design and construction documentation
- Collaboration on handheld devices
- BIM Big Room



- All information maintained in a single common location (CDE)
- Latest information available real-time
- All Drawings and Documentation extracted from a single source (of truth): the models

- Design Coordination
- Powerful visualization, VR, Rendering and Virtual prototypes
- Client early engagement and sign-off
- Visual Management
- Construction Sequence and Methodology

## BIM uses and outputs

# BIM & Lean construction



**Faster project delivery.**



**Better quality.**



**Cost saving due to reduced waste and less rework.**

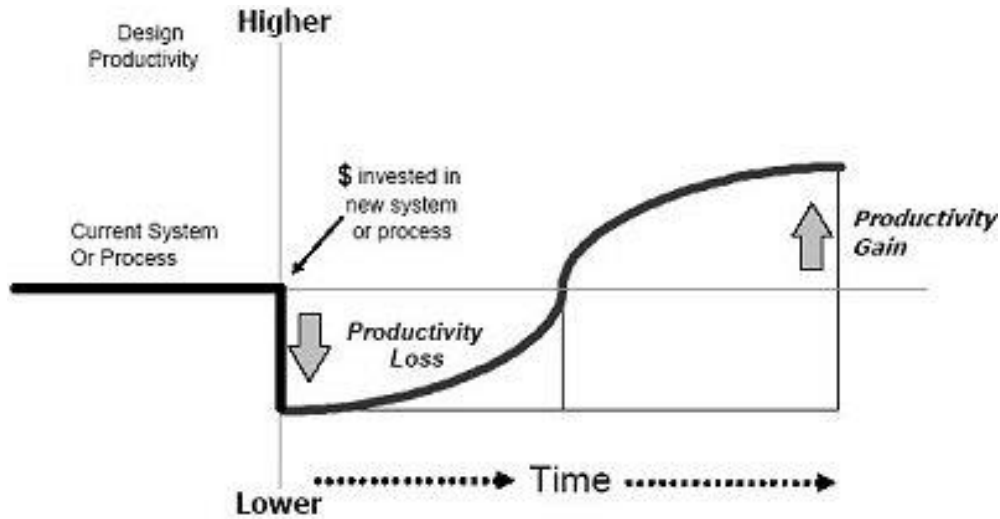
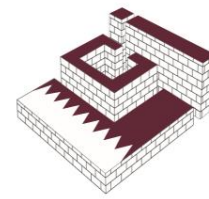


**Better value for all Stakeholders.**



**Lower risk.**

# BIM ROI



Building Information Modelling

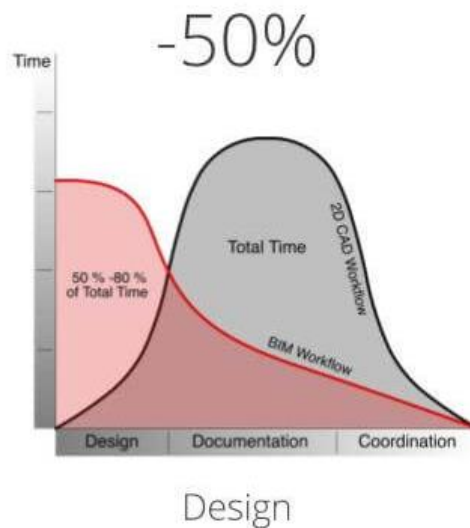
Return on Investment Calculator

You will find four main sections to complete, as described below. On completion you will be presented with a dashboard detailing your project which you can revisit at any time.

<p>Step 1 Project Details</p> <p>Enter key project details to inform ROI assessment.</p>	<p>Step 2 Qualitative Assessment</p> <p>Complete a qualitative assessment of the benefits BIM Level 2 will bring to the project.</p>	<p>Step 3 Quantitative Assessment</p> <p>Complete a quantitative assessment of the benefits BIM Level 2 bring will to the project.</p>	<p>Step 4 Investment Details</p> <p>Complete an assessment of any project specific investment costs required to implement BIM Level 2.</p>
--	--	--	--

Outcome  
ROI Dashboard  
Showing the results from all the inputs

## BIM can save us:





# Questions

