



Praktické užití BIM na velkých infrastrukturních projektech – perspektiva zahraničního zhotovitele

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STRABAG





Highways
Bridges
Ports
Jetties
Power plants
Buildings
Pipelines

+ \$3.5bil
(small to mega)

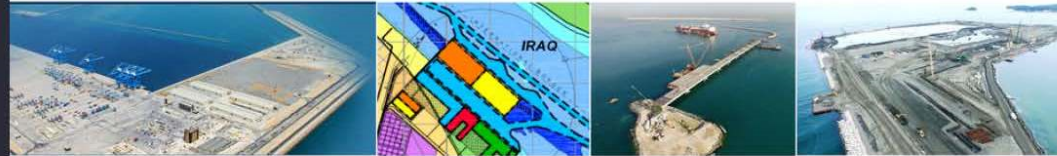
D-B-B, D&B, EPC, ECI

UK, UAE, Turkey,
Canada, Costa Rica,
Panama

ROADWORKS



MARINE STRUCTURES



BUILDINGS & EXTERNAL WORKS



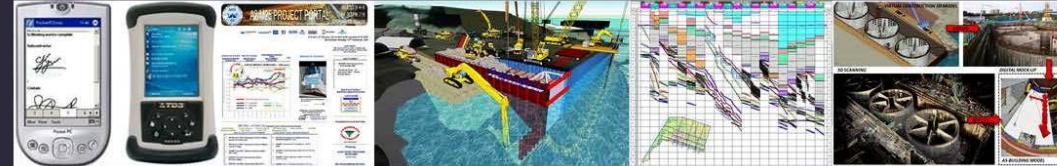
POWER PLANTS



TENDERS & BUSINESS DEVELOPMENT



TECHNOLOGY & INNOVATION





Digital Construction incubator (Dubai)

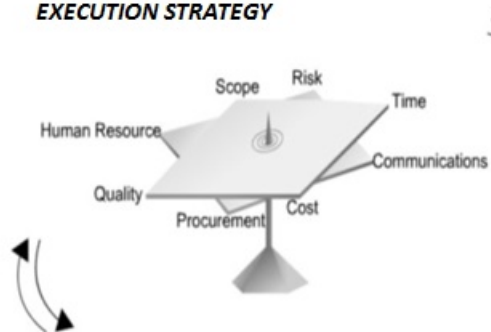
ADD VALUE TO TENDER AND PROJECT TEAMS, BY FOCUSING ON THEIR NEEDS AND APPLYING OUR ENGINEERING KNOW-HOW AND DIGITAL CONSTRUCTION TOOLS TO THEIR CHALLENGES





Attributes of successful projects

EXECUTION STRATEGY



BALANCED CONTRACT vs. ESTIMATE



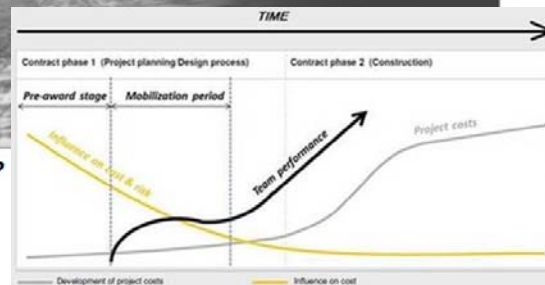
FOCUS ON PROGRAMME MILESTONES



COLLABORATION ACROSS PROJECT ORGANIZATION



LEADERSHIP



MANAGING RISK TRANSFER

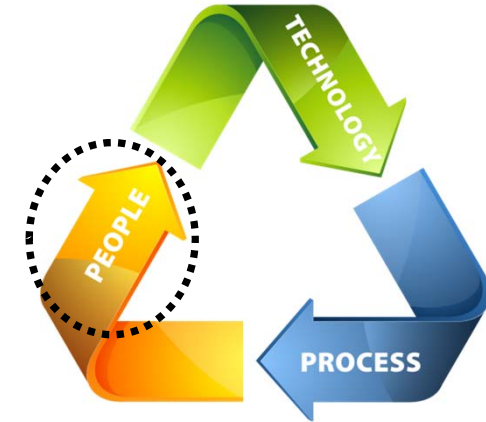


BIM



Attributes of successful large projects

Making
the
difference



- *Assign the project team early*
- *Choose the right project delivery strategy*
- *Develop realistic estimates*
- *Actively manage project risks*
- *Senior management commitment and leadership*
- *Develop project-specific policies and procedures*
- *Assign project-specific roles and responsibilities*
- *Have frequent team meetings*
- *Stakeholder communication*
- *Project controls integration*
- *Continuously improve*

* Source KPMG



DEFINITION



DEVELOPMENT



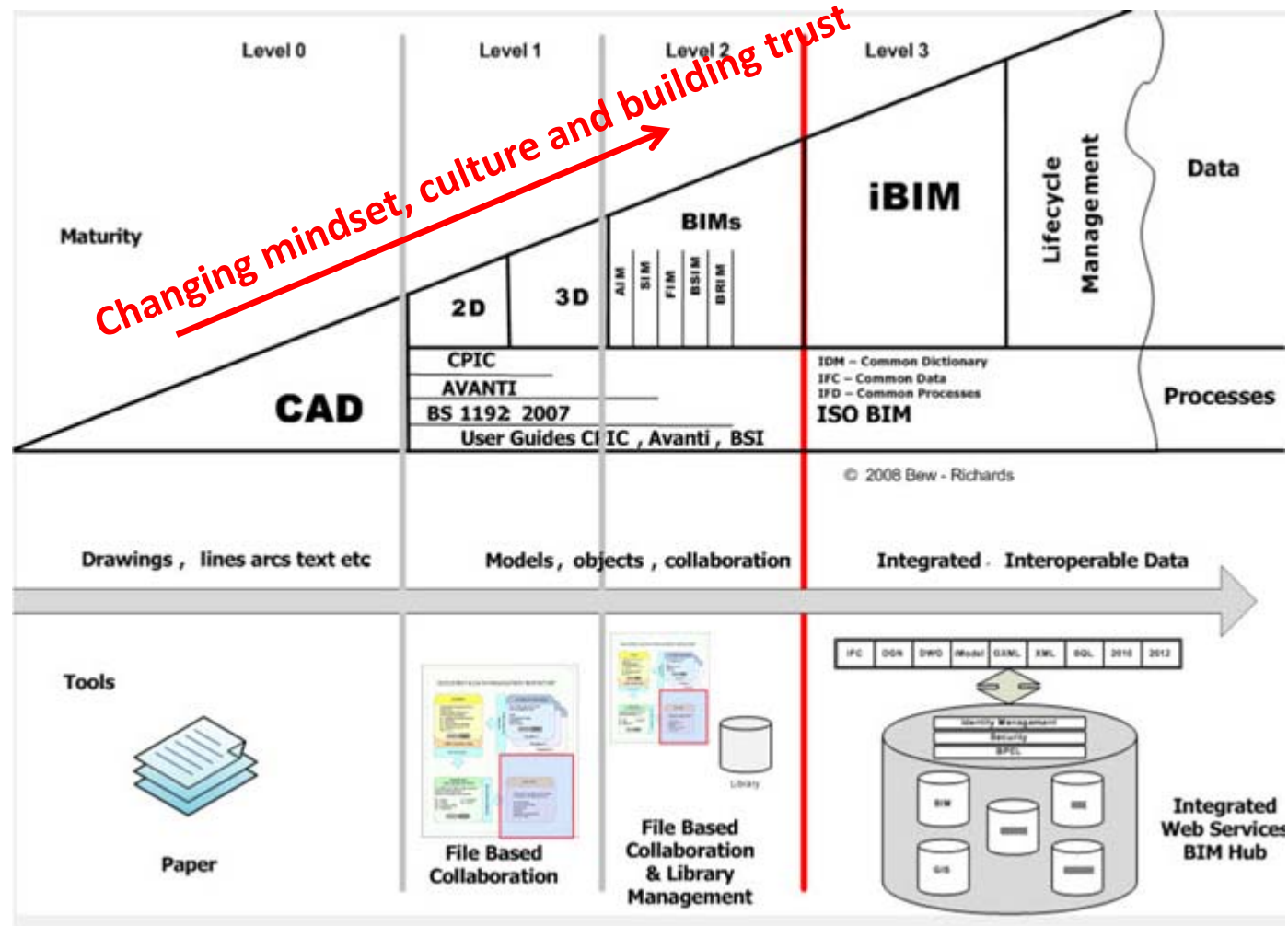
CONSTRUCTION



OPERATION



BIM maturity curve





BIM Level 1 (culture of silos)

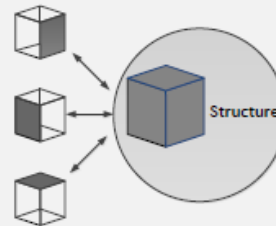
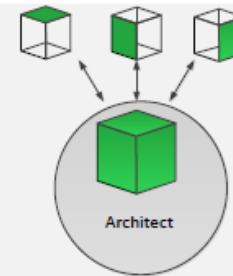


Pre BIM

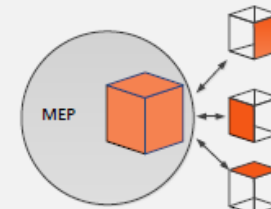


Object based **Modelling** / Lonely BIM

OBJECTIVE



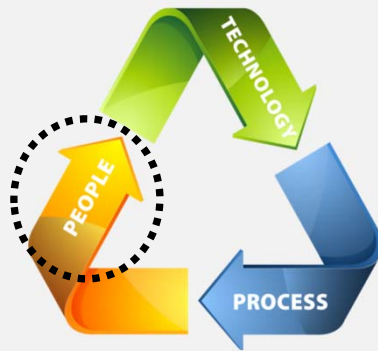
?



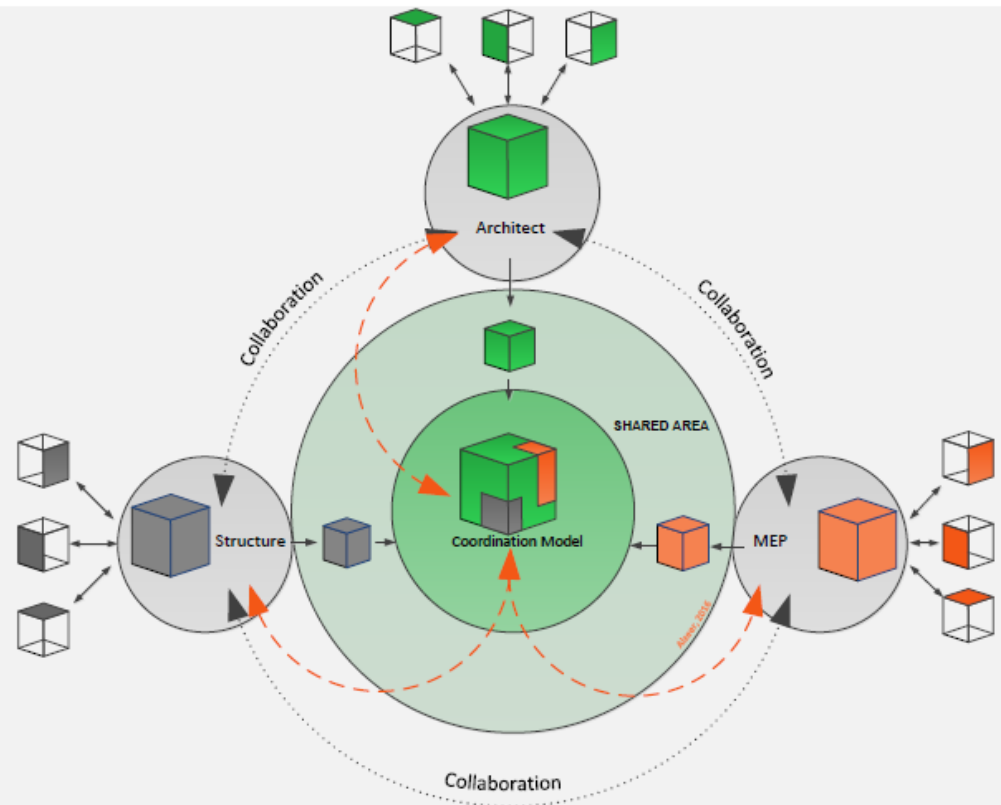


BIM Level 2 (challenge)

- **Pre BIM**
- Object based **Modelling** / Lonely BIM
- Model based **Collaboration** / Social BIM

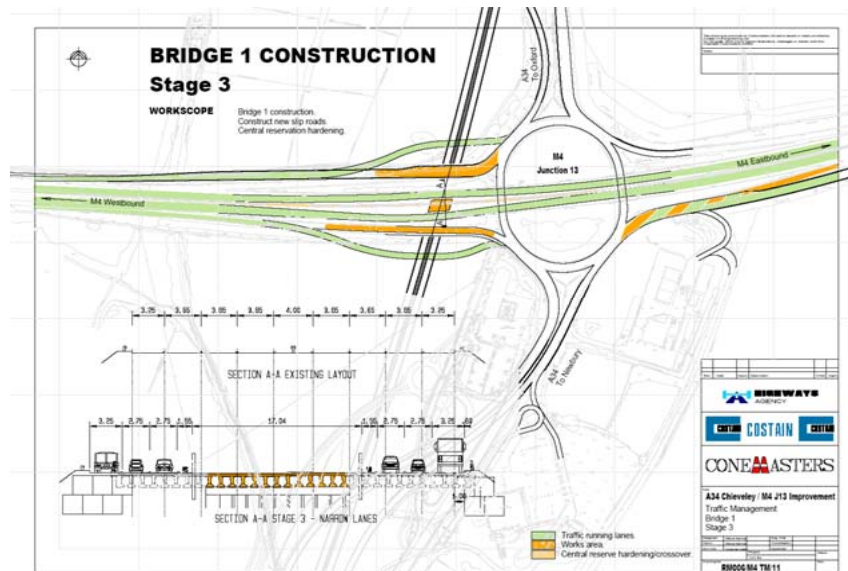


**CHANGE MANAGEMENT
LEADERSHIP
PROJECT BRAND / CULTURE
TEAMWORK DEVELOPMENT
RIGHT RECRUITMENT**





Pre-BIM era: collaboration in 2003 (D&B)

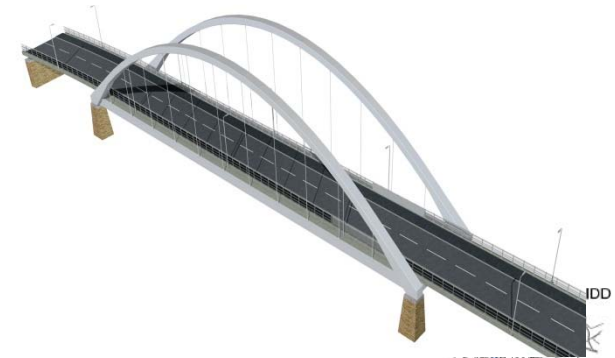
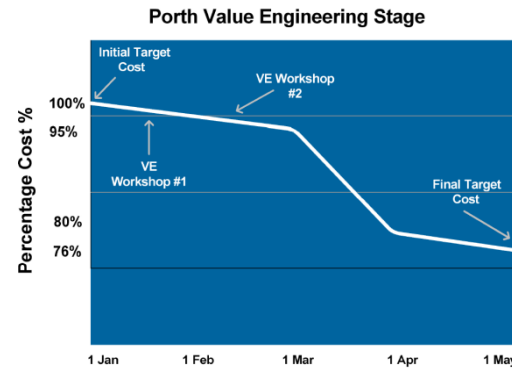


Top-down construction, self-weathering steel, concrete best-practice awards, recycling

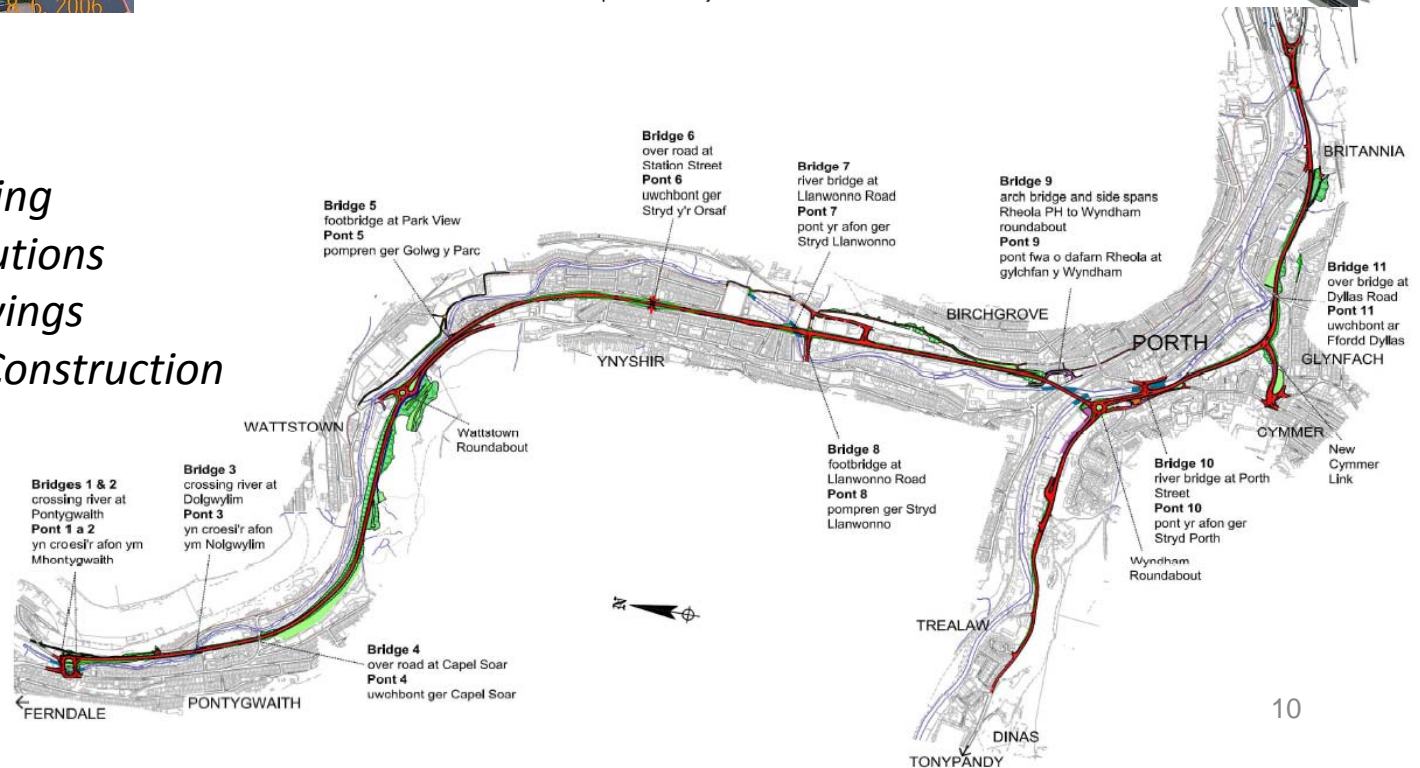




Pre-BIM era: collaboration in 2005 (ECI)



Lean construction
 Community relations
 Local material re-cycling
 Innovative design solutions
 Value Engineering savings
 Modern Methods of Construction





Pre-BIM era: collaboration driver (UK)

“A successful construction industry is essential to us all. We all benefit from high quality housing, hospitals or transport infrastructure that are constructed efficiently. Nevertheless, the industry recognises that it needs to modernise in order to tackle the severe problems facing it.”

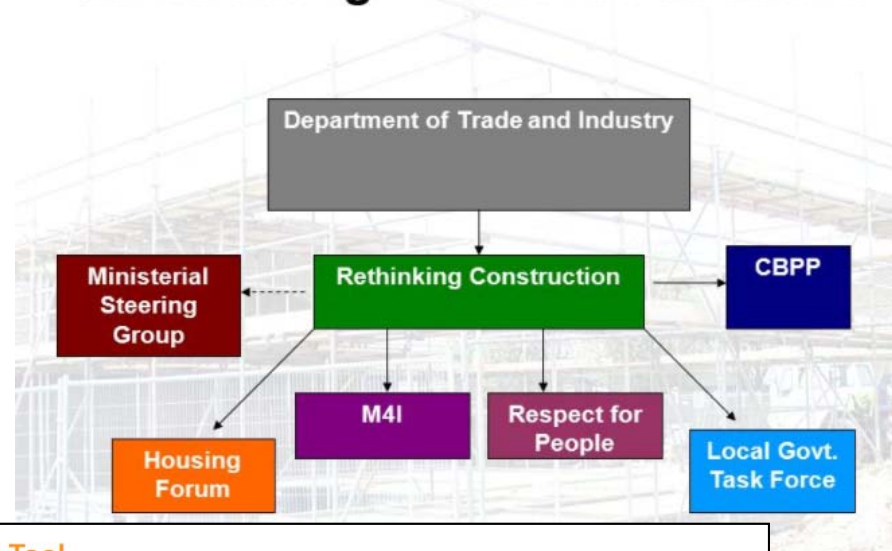
The Construction Task Force, Sir John Egan, 1998 (UK)



**NEC3, ECI,
PARTNERING,
LEAN, TRAINING,
etc.**

26/06/2017

Constructing Excellence Structure



Technology as a Tool

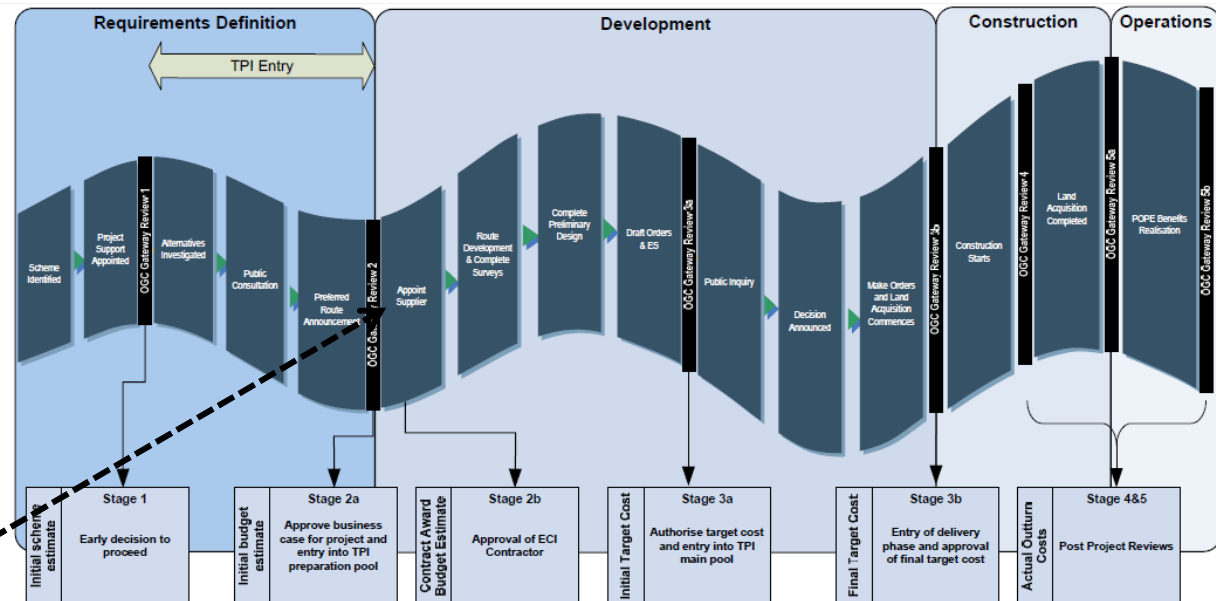
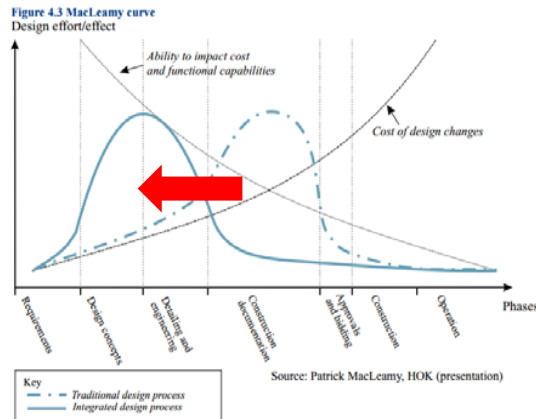
62. The Task Force does not consider that technology on its own can provide the answer to the need for greater efficiency and quality in construction. There have been celebrated examples of new technology being used to reinforce outdated and wasteful processes – and it does not work. The advice offered to construction by leading manufacturing industries is to approach change by first sorting out the culture, then defining and improving processes and finally applying technology as a tool to support these cultural and process improvements.



**BIM Task Group
Pilot projects**



Highways Agency procurement (UK)



Entry of preferred ECI contractor:

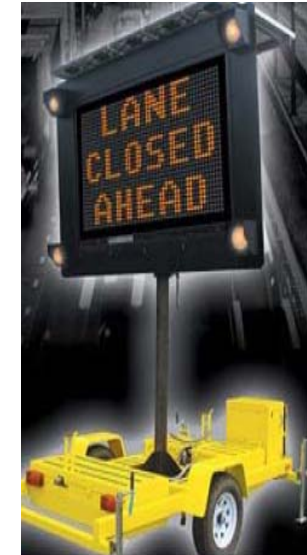
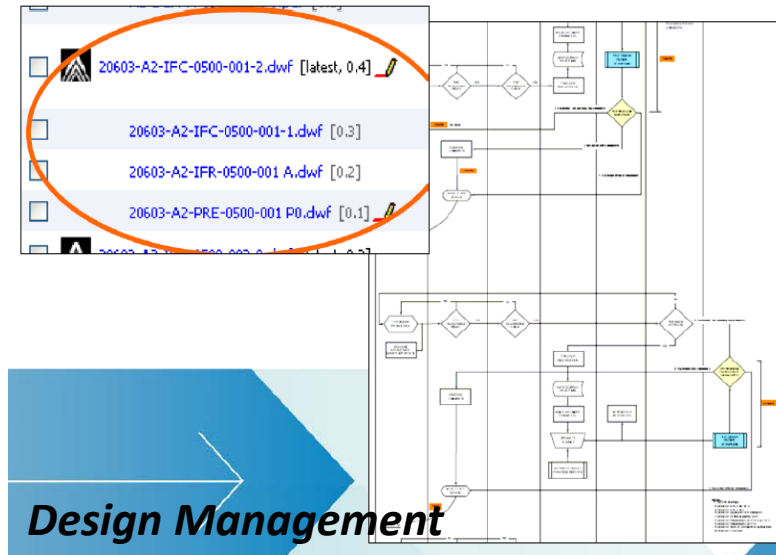
Phase 1 – Consultant
(input to constructability)

Phase 2 - Contractor

Scope of Process	Level 1/2	Level 1/2	Level 2/3	Level 4	Level 4	
	<ul style="list-style-type: none"> Initial Risk Assessment Comparison with similar projects Outline parametric pricing 	<ul style="list-style-type: none"> Comparison with similar projects Parametric pricing Contractor Input Risk Assessment 	<ul style="list-style-type: none"> Parametric Pricing using Cost Benchmarks Understanding of main cost drivers Tendering Contractor Input 	<ul style="list-style-type: none"> Developed design Programme Bills of quantities 	<ul style="list-style-type: none"> Some detailed design Detailed Programme Public Inquiry Scope Changes Bills of quantities 	<ul style="list-style-type: none"> Actual Costs
Purpose For Estimate	<ul style="list-style-type: none"> Route Selection Public Consultation Capital Funding 	<ul style="list-style-type: none"> Commit to Procure Preferred Route Announcement TPI Entry Ministerial Approval Capital Funding 	<ul style="list-style-type: none"> Award Contract 	<ul style="list-style-type: none"> Agree Target Cost Publish Orders Sponsor Approval Public Inquiry 	<ul style="list-style-type: none"> Commit to Construct Ministerial Approval 	<ul style="list-style-type: none"> Road Open Contract Complete
Department Accountable	Department for Transport	Department for Transport	Major Projects Highways Agency	Major Projects Highways Agency	Major Projects Highways Agency	Major Projects Highways Agency

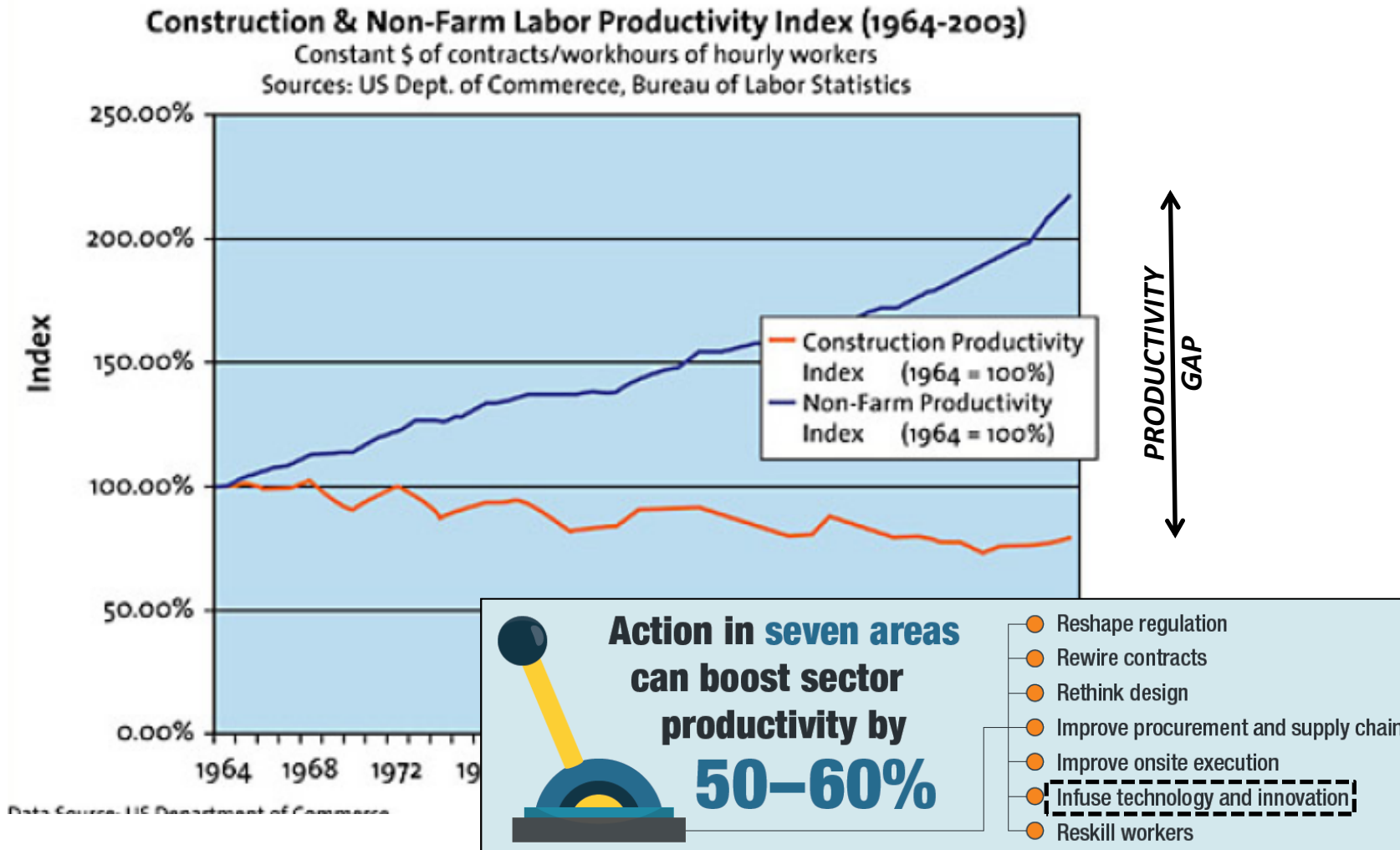


DIGITAL COLLABORATION (without model)





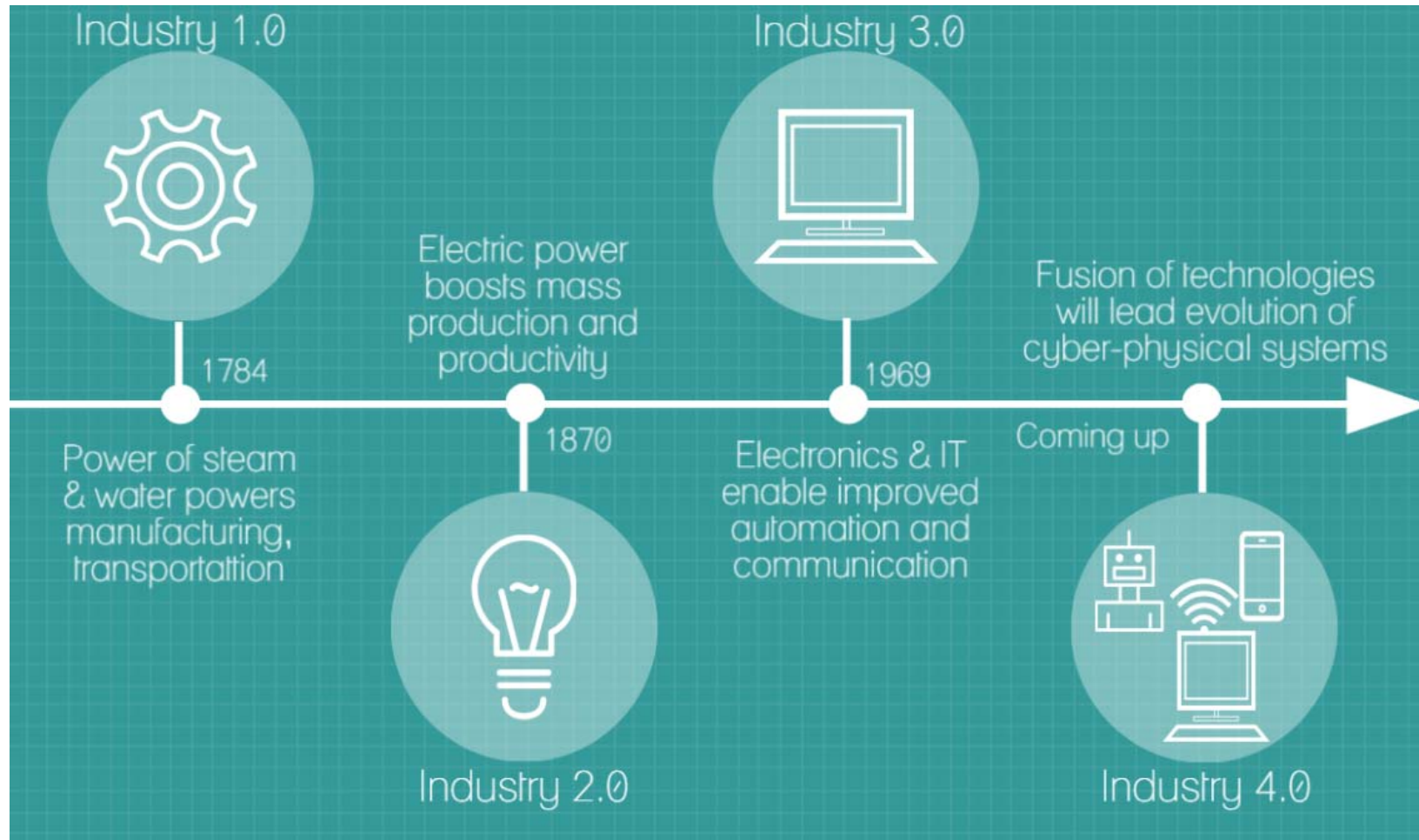
Technology – a driver of change



* McKinsey 2016



BIM – Why now?





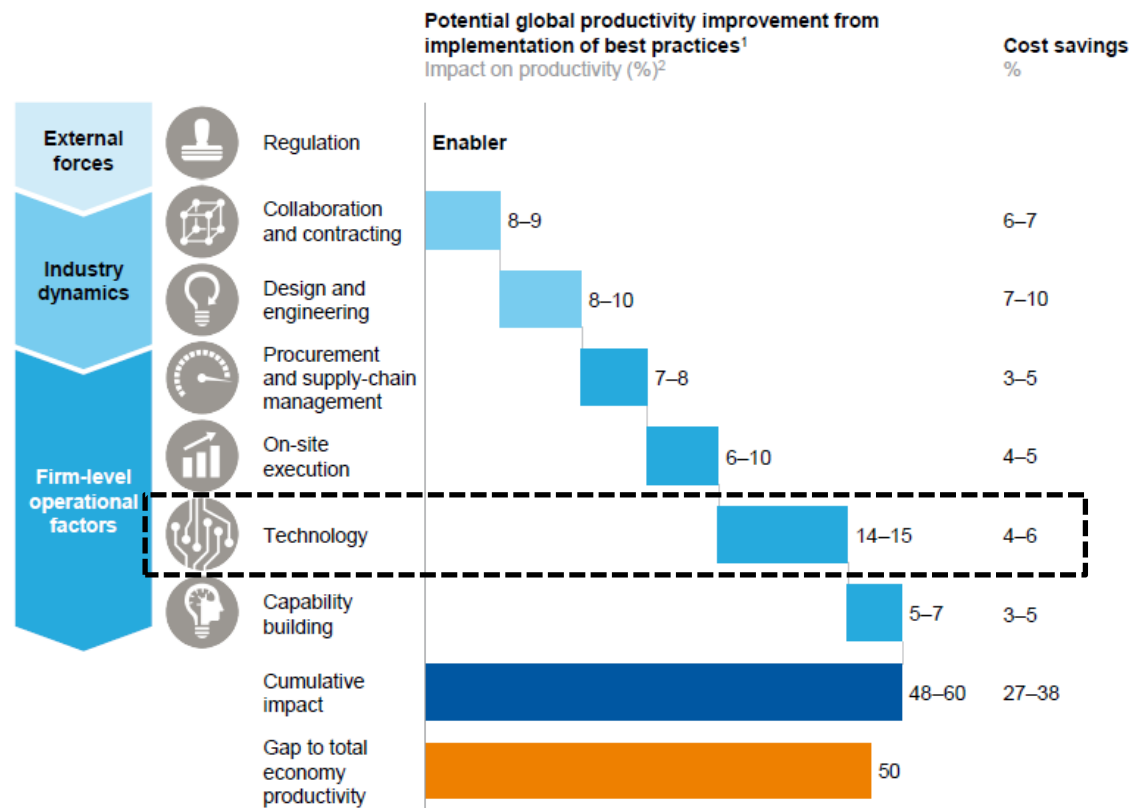
BIM – Why now?

MCKINSEY
GLOBAL
INSTITUTE

Construction can catch up with total economy productivity by taking action in seven areas

Cascading effect

Regulation changes facilitate shifts in industry dynamics that enable firm-level levers and impact



¹ The impact numbers have been scaled down from a best case project number to reflect current levels of adoption and applicability across projects, based on respondents to the MGI Construction Productivity Survey who responded "agree" or "strongly agree" to the questions around implementation of the solutions.

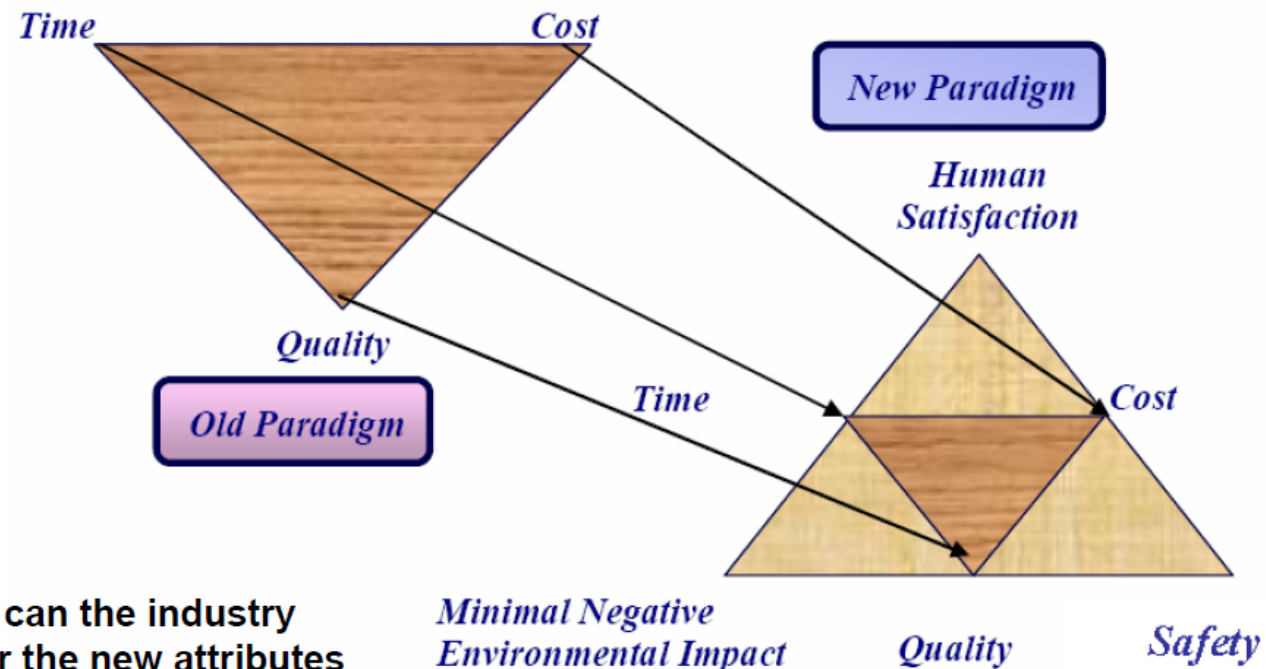
² Range reflects expected difference in impact between emerging and developed markets.

SOURCE: McKinsey Global Institute analysis



BIM – Why now?

Changing Paradigm – owners want more



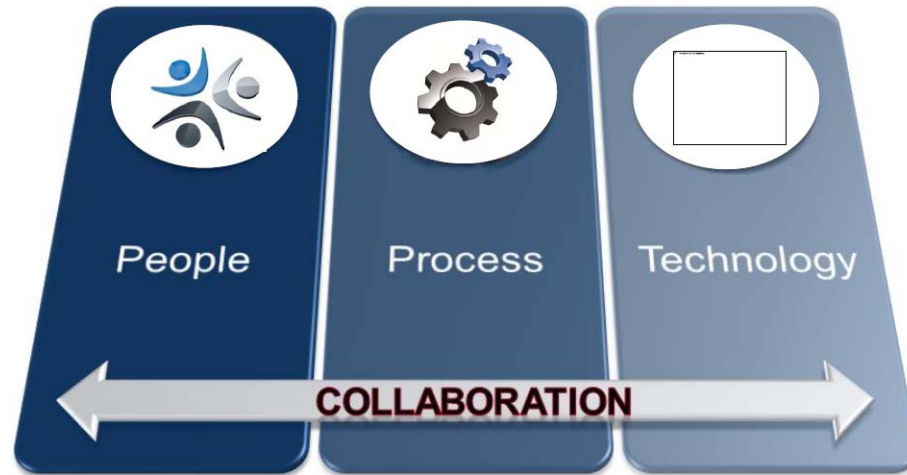
HOW can the industry deliver the new attributes if it had trouble with the original triangle???

Tariq Abdelhamid- CMP831- Michigan State Unive

- | | |
|--------------------|---------------------------|
| •Value-engineering | •Safety |
| •Design-build | •IT |
| •Partnering | •Productivity Improvement |
| •TQM /QFD | •Computer Simulation |
| •Constructability | |



ICT - enabled collaboration (BIM MODEL)



T5 Heathrow (pilot demonstration of Single Model Environment across 25 design teams)



Uptake of BIM: pull and push factors

Pull factors

Technologies ready and available off the shelf

Sustainable construction a priority for the EU

Expertise in BIM giving companies a competitive edge

Availability of standards to facilitate BIM use

Push factors

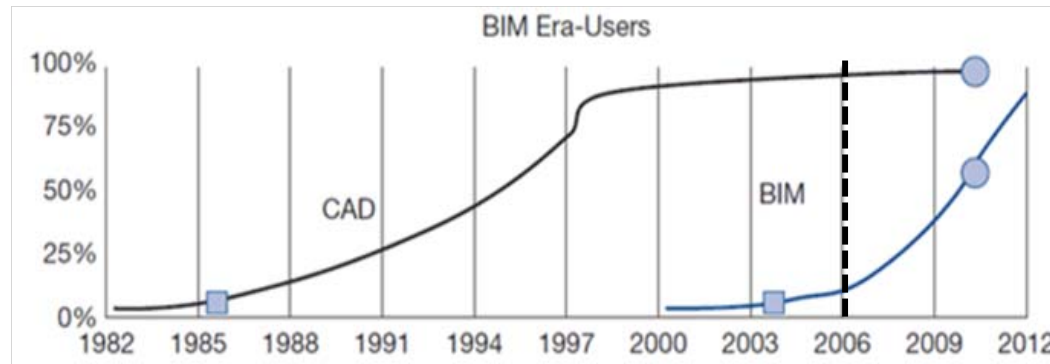
Need to improve productivity

Inefficiencies of using unstructured, non-computable information

£100 million wasted every year in UK through non-interoperable working (see p. 8)



BIM tools (early days)

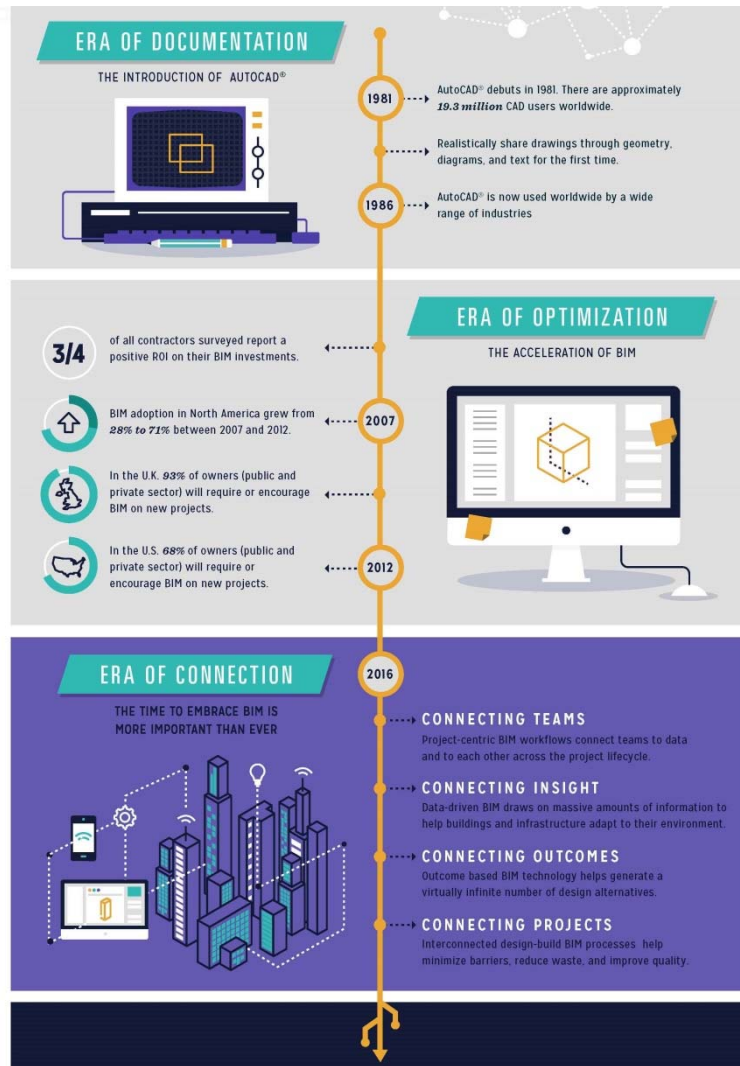


Stakeholders liaising





BIM tools (development)

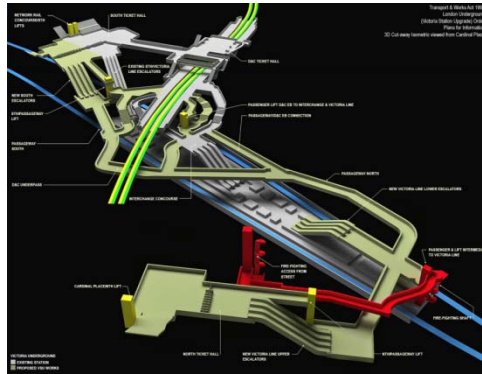


BIM WORKFLOWS

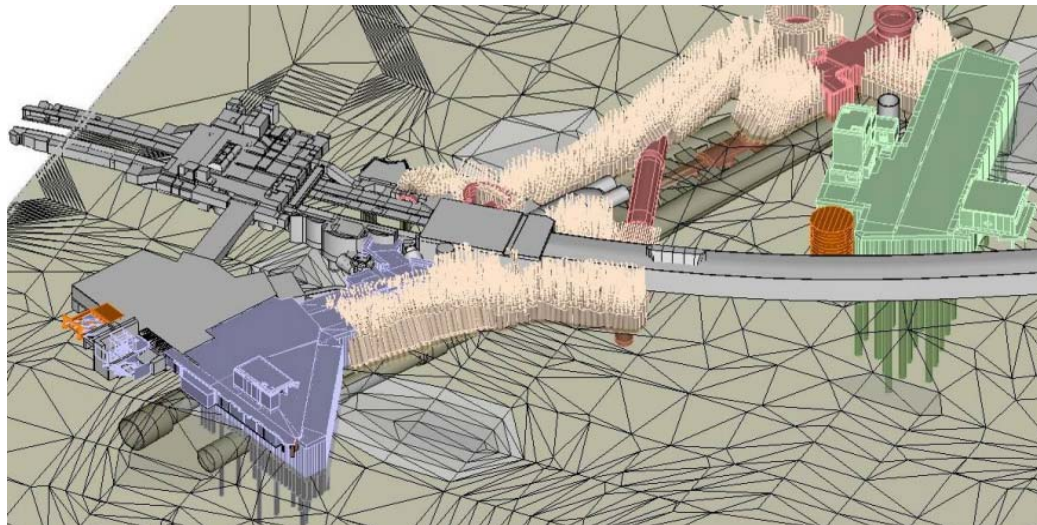
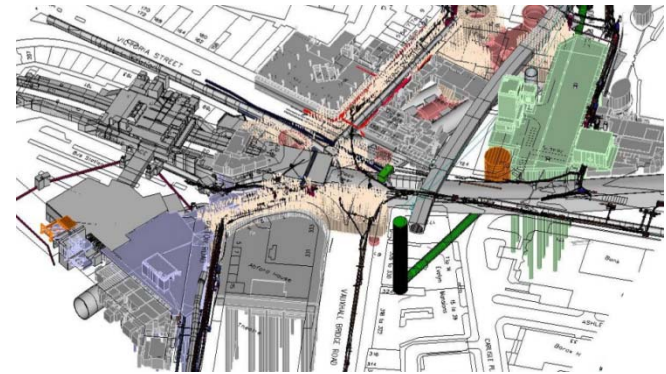
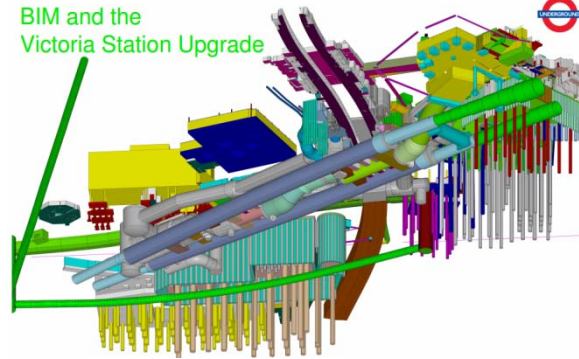




3D multidisciplinary model - development



BIM and the
Victoria Station Upgrade

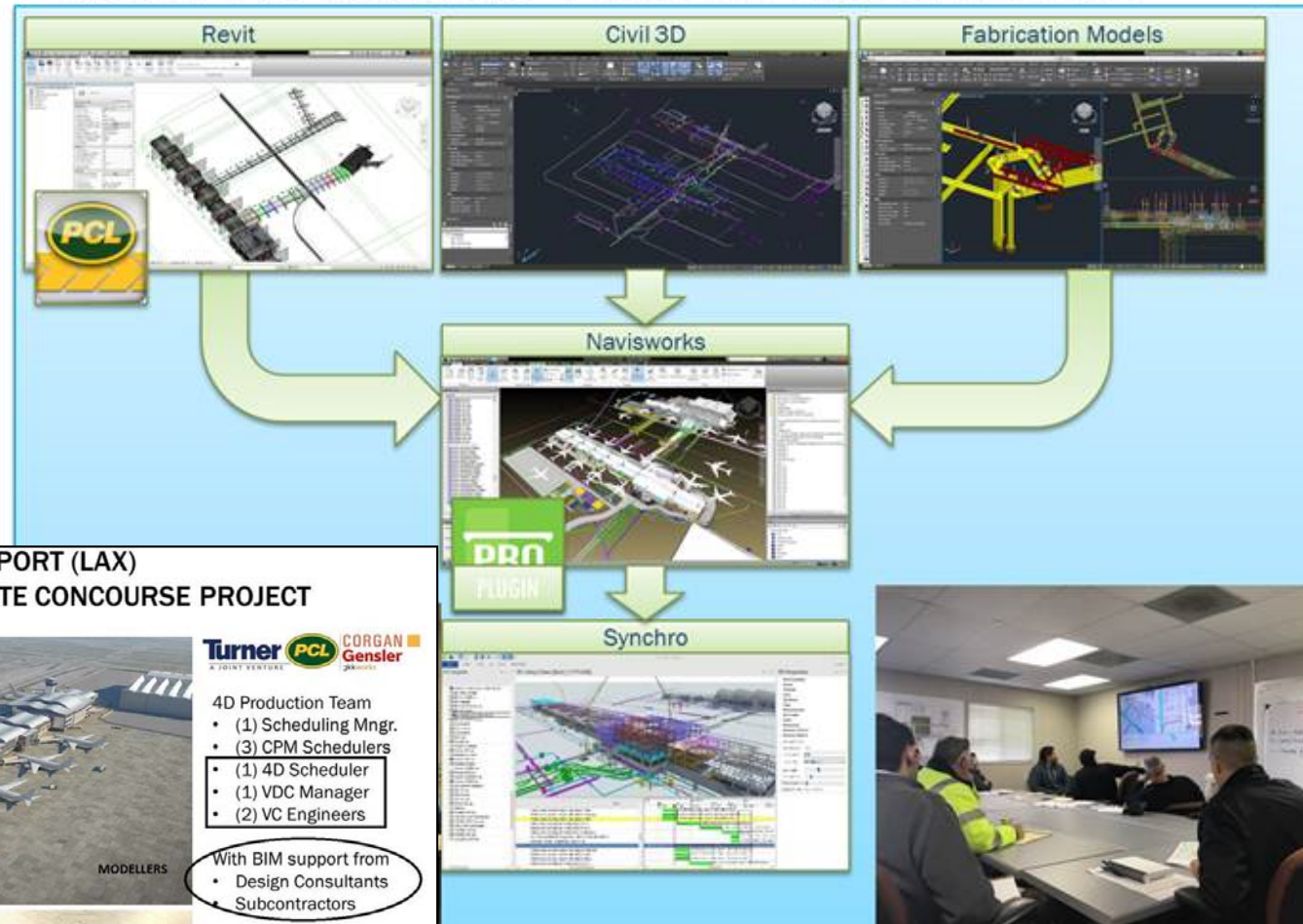


- Early collaboration
- Stakeholder engagement
- Improved quality
- Fewer coordination errors
- Potential production efficiency
- Reduced project risk
- Asset management potential



3D multidisciplinary model - development

LOS ANGELES AIRPORT (LAX) MIDFIELD SATELLITE CONCOURSE PROJECT





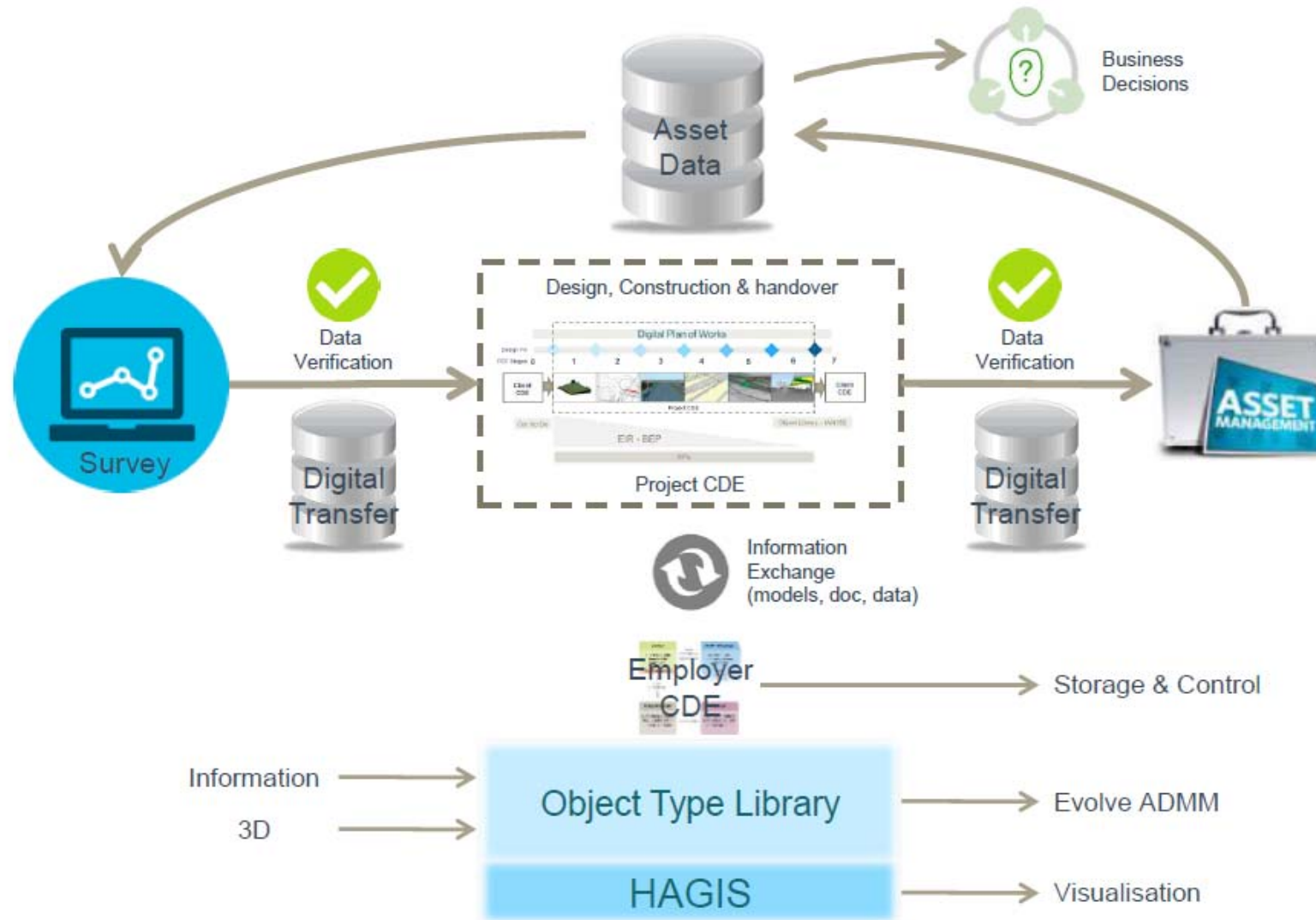
BIM process (2017)



- *Intelligent GIS-enabled engineering model*
- *One version of truth (easily accessible information)*
- *Reduce silo working (better decision making)*
 - *Whole asset lifecycle*

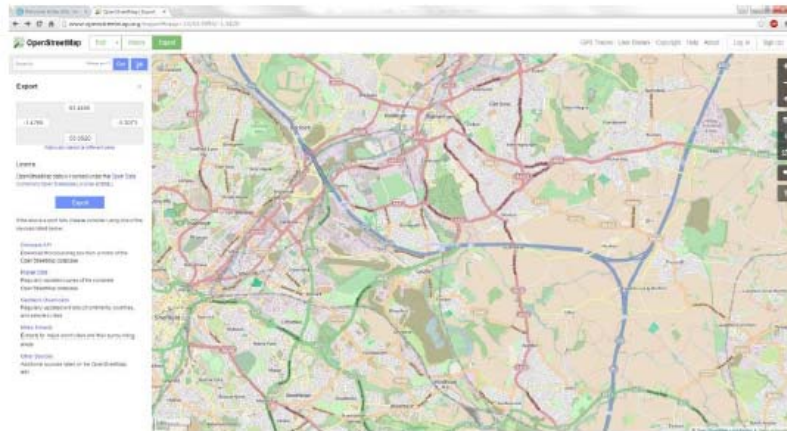


Information Management

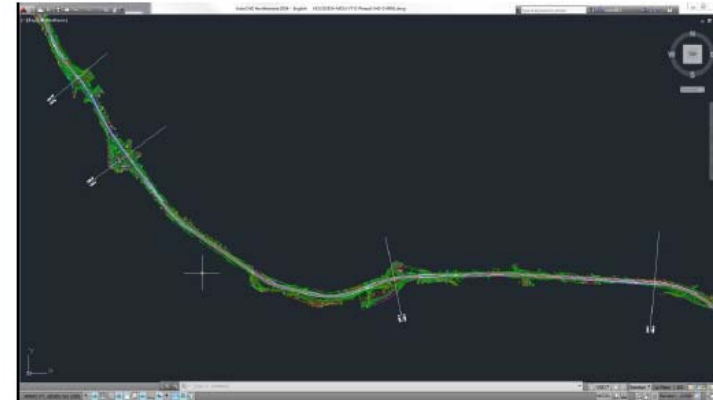




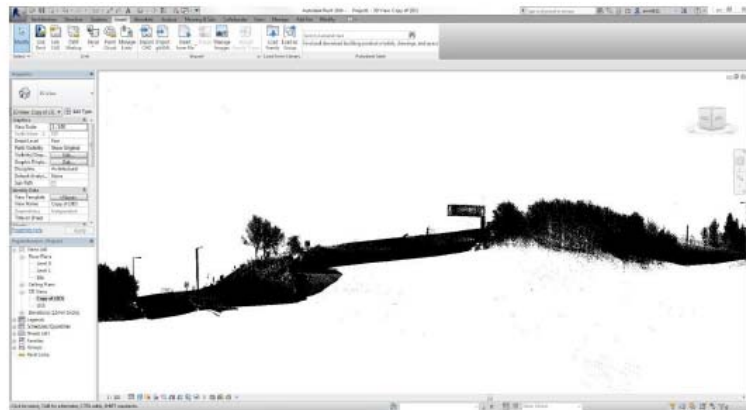
Base model input (2017)



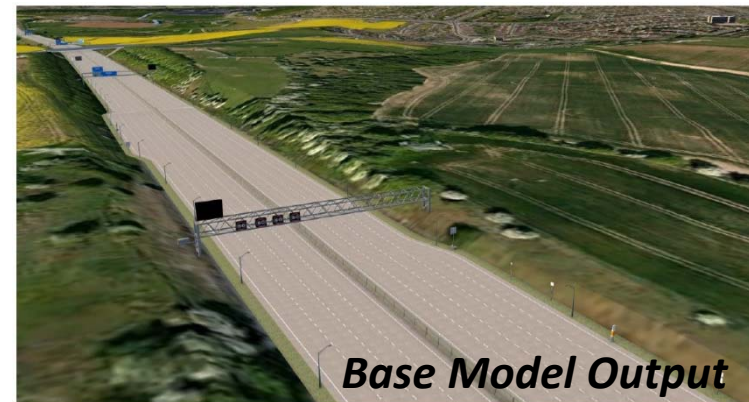
- Open Street Map Data



- LIDAR surveys



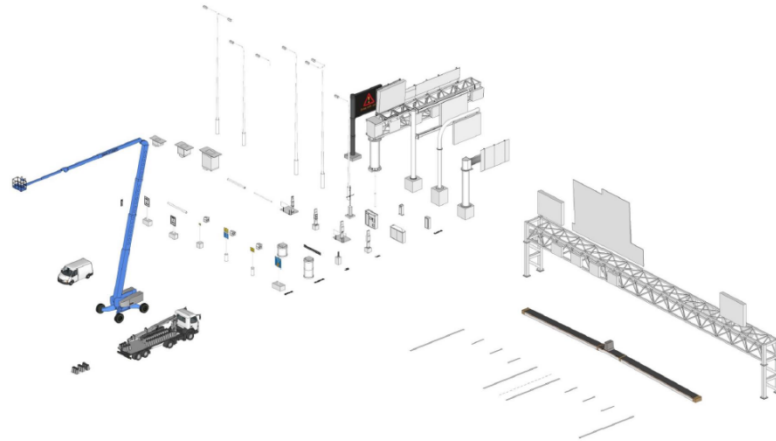
- Point cloud surveys



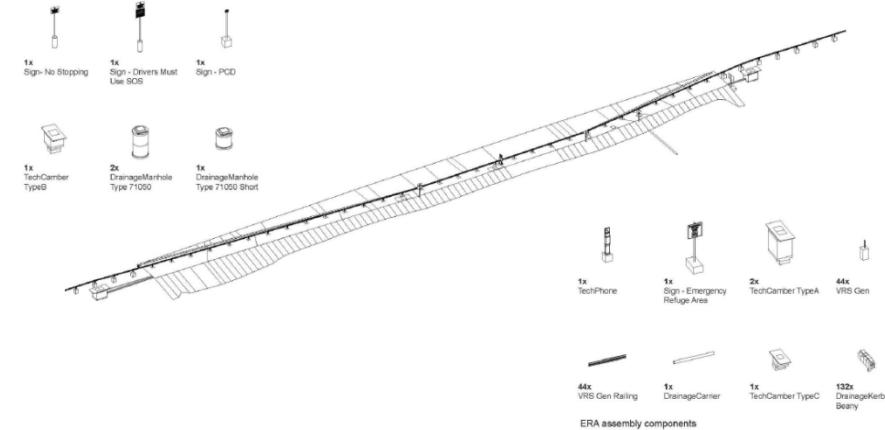


Base model input (2017)

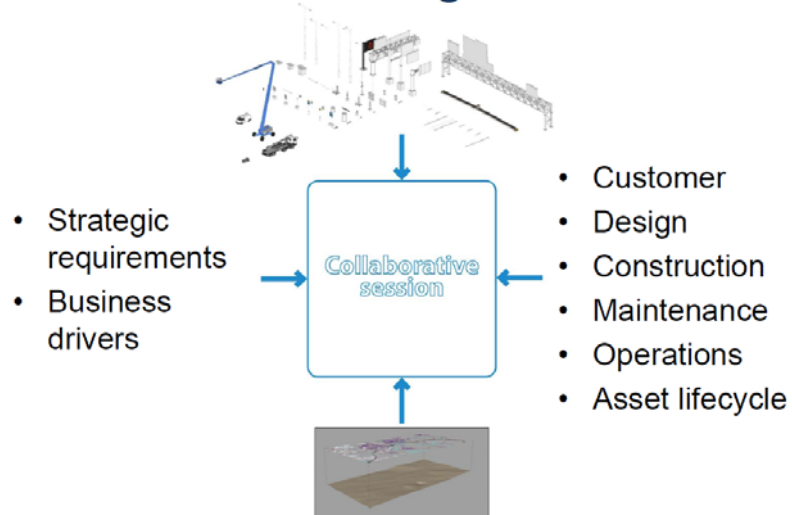
BIM component library (Initially Smart Motorways and Expressways)



BIM component library Assemblies



Collaborative modelling

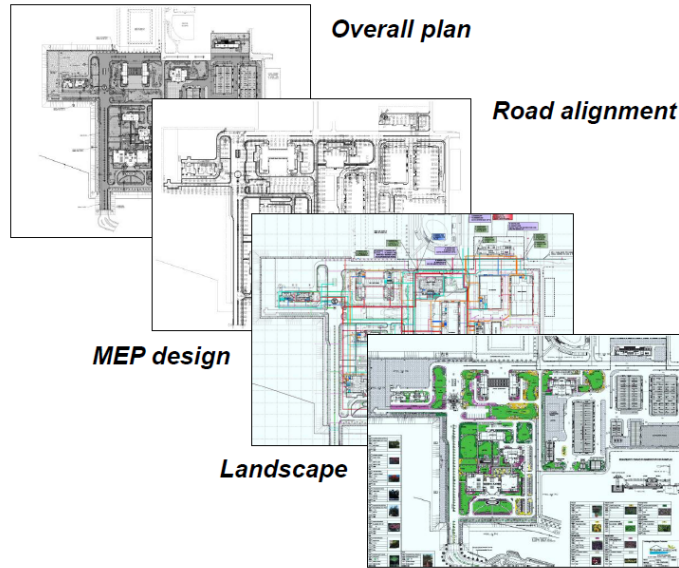


ERA location study



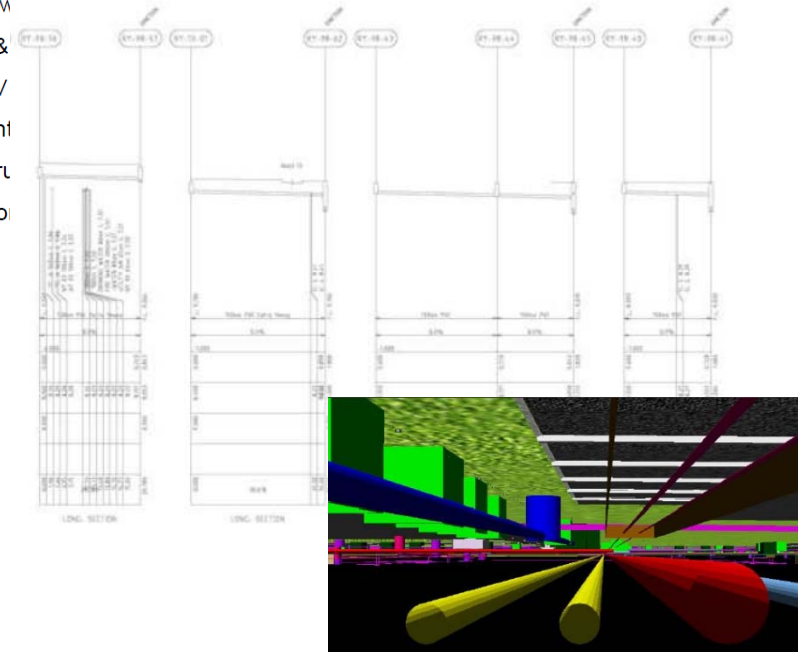


3D workflows – discipline collaboration



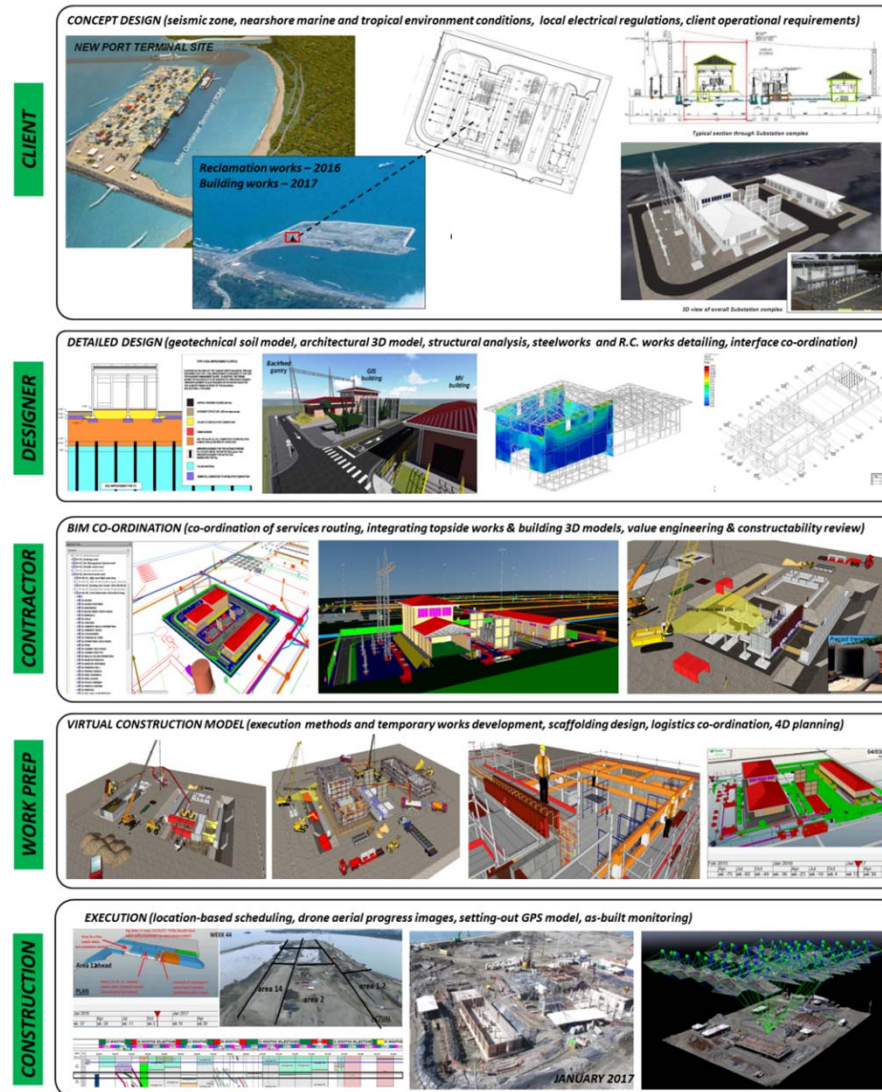
- Architect – site layout
- Civil – road alignment
- Civil - roadmarking
- Landscape Architect - plants
- Mechanical – sanitary drainage
- Mechanical – accidentally-oily drainage
- Mechanical – chilled water
- Mechanical – fire water
- Mechanical – utility service (water / air)
- Mechanical – stormw
- Eletrical – telecom &
- Eletrical – power HV
- Eletrical – street light
- Structural – misc stru
- Landscape - irrigatio

X,Y,Z clash detection / offsets



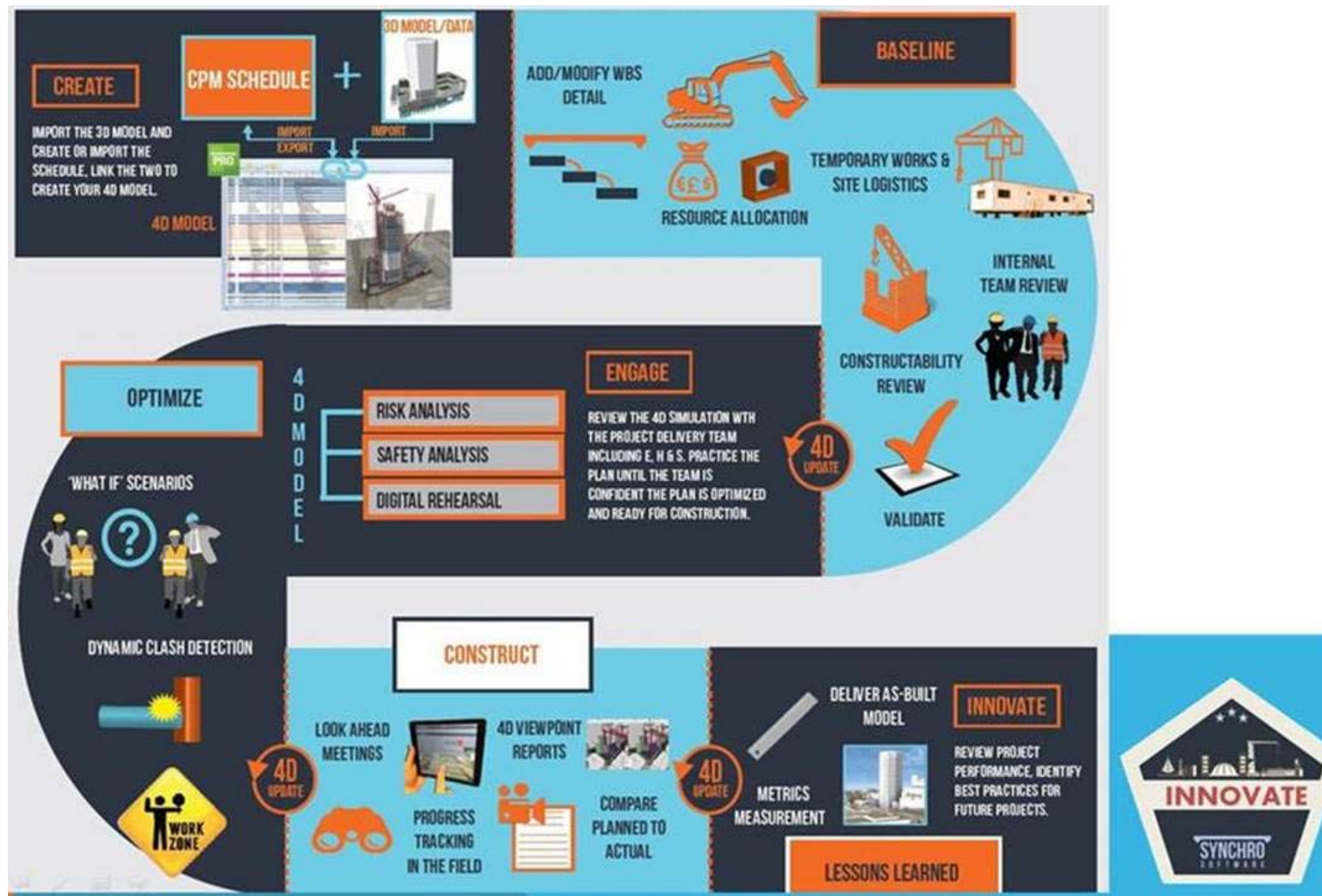


From design to site (work preparation)





4D workflow





E18 UNISUB - NISBANSAN Overall Time Schedule (REV. 02 OCT 2005)





5D workflows – estimation

LEGACY ESTIMATION SYSTEMS (complexity of integration and change management)

The screenshot displays a software interface for 5D construction estimation. The main window is divided into several panes:

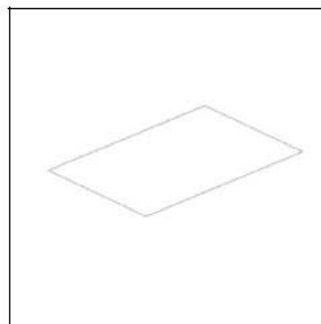
- Top Menu Bar:** Includes 'Start', 'View', 'Element Planning', 'Objects', 'Quantities', and 'General'.
- Toolbars:**
 - View:** Home, Perspective, Show All, Show Selected Only, Toggle Visibility, Deselect All.
 - Selection:** Visible Only, Toggle Selection, Select, Orbit, Look Around, Walk, Move, Zoom, Measure.
 - View Options:** Solid, Wireframe, Grid.
 - Tools:** Screenshot, Copy.
- Navigation Bar:** Model Check, Element Planning, Assignment, Quantities, BoQ Assignment.
- Element Planning Table:**

Structure	Code	Description	Quantity/Query	Quantity	UoM	Selection Set
Element Planning						
1	1.10	Rough work				
1.10	1.10.10	Walls				
1.10.10	1.10.10.10	Masonry				Masonry walls
1.10.10.10	1.10.10.10.10	Walls Sandline Brick 11.5 cm (m2)	QTO((Type < "AreaMax" ConstrElement = "DepthOptBBBy" <= (11.5 [cm]))	449.152	m2	
1.10.10.10.10	1.10.10.10.10.20	Walls Sandline Brick 24 cm (m3)	QTO((Type < "Volume" ConstrElement = "DepthOptBBBy" <= (24 [cm]))	139.006	m3	
1.10.10.20	1.10.10.20	Concrete Work				Reinforced concrete
1.10.10.20.10	1.10.10.20.10	Concrete Walls - 12" thick - 3000 psi	QTO((Type < "Volume" ConstrElement = "DepthOptBBBy" <= (20 [cm]))	22.140	m3	
1.10.10.20.20	1.10.10.20.20	Concrete Walls - including form work	QTO((Type < "Volume" ConstrElement = "DepthOptBBBy" <= (20 [cm]))	472.142	m3	
1.10.10.20.61	1.10.10.20.61	Formwork, smooth, Walls	QTO((Calculates the volume of the object element -			
1.10.10.20.62	1.10.10.20.62	Concrete Steel IV S (500/550)	QTO((Type < "Volume" ConstrElement = "DepthOptBBBy" <= (20 [cm]))			
1.20	1.20	Precast elements				
1.20.10	1.20.10	Precast Beam Type T231	QTO((Type < "Volume" ConstrElement = "DepthOptBBBy" <= (20 [cm]))			
1.20.20	1.20.20	Precast Column Type S451	QTO((Type < "Volume" ConstrElement = "DepthOptBBBy" <= (20 [cm]))			
1.20.30	1.20.30	Precast Column Type S452	QTO((Type < "Volume" ConstrElement = "DepthOptBBBy" <= (20 [cm]))			
1.30	1.30	Slabs				
1.30.10	1.30.10	Formwork Slab	QTO((Type < "Volume" ConstrElement = "DepthOptBBBy" <= (20 [cm]))			
1.30.20	1.30.20	Floor Slab - 3000 psi, 9 inches thick	QTO((Type < "Volume" ConstrElement = "DepthOptBBBy" <= (20 [cm]))			
1.30.30	1.30.30	Floor Slab - 3000 psi, 6 inches thick	QTO((Type < "Volume" ConstrElement = "DepthOptBBBy" <= (20 [cm]))			
1.30.65	1.30.65	Concrete Steel IV S (500/550)	QTO((Type < "Volume" UoM = "m3") * BVWG/1000	84.202	t	
2	2	Finish Work				
2.20	2.20	Room types				
2.20.10	2.20.10	Corridors				
- Parameter Table:** A detailed table on the right showing parameters like Length, Width, Height, Area, Piece, Value, UoM, Object, and InstanceC for various concrete wall and slab items.
- Object - Visualisation:** A 3D model of a building structure with a yellow highlighted section, showing the spatial context of the elements.



5D workflows – at what LOD?

LOD 100



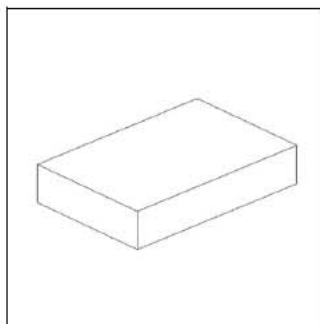
LOD

The foundation location is represented either by the external surface geometry (in plane) and form or by a geometric placeholder with an approximate geometry. The placeholder may be a base plate that shows the entire foundation.

LOI

Type
Dimensions (approx.)

LOD 200



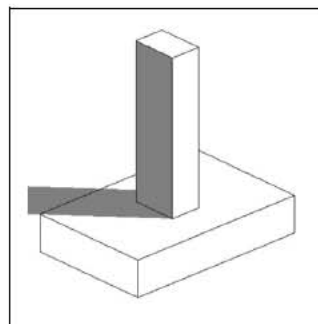
LOD

The foundation is represented as a generic foundation object with an approximate shape, where quantities, size, shape, location and orientation is specified.

LOI

Type
Dimensions
Elevation
Classification
Materials

LOD 300



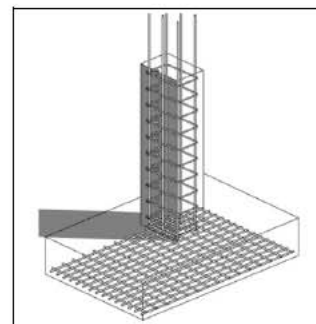
LOD

The foundation has real quantities, dimensions, shape and location. Moreover the orientation. Phasing plus slopes and holes plus recesses are included. Reinforcement plus building parts and connection details are clarified.

LOI

Type
Dimensions
Elevation
Classification
Materials
Reinforcement degree

LOD 350



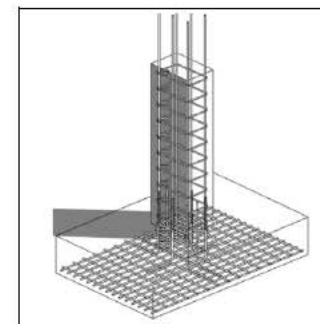
LOD

The foundation contains holes and recesses. Moreover, the insulation modelled.

LOI

Type
Dimensions
Elevation
Classification
Materials
Reinforcement
Concrete strength
Environmental class
Blinding layer
Concrete, coarse

LOD 400



LOD

The foundation contains chamfers, location of embedded parts and main reinforcements appears in the model including laps and hooks.

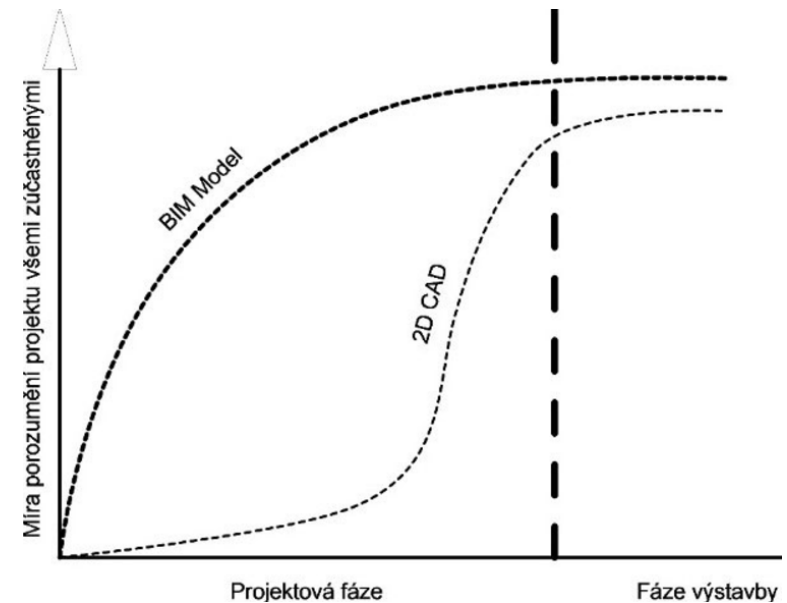
LOI

Type
Dimensions
Elevation
Classification
Materials
Reinforcement
Concrete strength
Environmental class
Blinding layer
Concrete, coarse
Surface Requirements / performance requirements
elevation Tolerances
Drying Protection



BIM – Why now?

BIM provides insight for creating and managing projects faster, more economically, and with less environmental impact.





5D BIM – Disruptive technology

