BIM IMPLEMENTATION IN INDUSTRIAL PROJECTS

CASE STUDY AND LESSONS LEARNT

Emmanouil Patsoumadakis | Bilfinger Tebodin Netherlands B.V.
The BIM Conference | 12 October 2023 | Athens, Greece

Bilfinger Tebodin | Worldwide

Leading consultancy, engineering, process design and management company

75 YEARS OF EXPERIENCE
Founded in 1945,
the Hague, the Netherlands

LONG CLIENT RELATIONSHIPS
> 75% of turnover –
repetitive business

STRONG PRESENCE
33 offices in 15 countries

GLOBAL NETWORK
Part of Bilfinger Group

LARGE TEAM OF EXPERTS
3,100 consultants
and engineers

www.tebodin.bilfinger.com

SAFETY PARAMOUNT
LTIF 2020- 0

Geographical presence

North West Europe
Belgium, The Netherlands

Central and Eastern Europe
Czech Republic, Hungary, Poland,
Romania, Serbia, Russia, Ukraine, Slovakia

Middle East
Bahrain, Oman, Qatar, Saudi Arabia,
United Arab Emirates (Abu Dhabi, Dubai)

Bilfinger Tebodin | Markets

INDUSTRIAL MANUFACTURING

Construction Materials, Consumer Products & Electronics, Metals, Pulp & Paper

FOOD & BEVERAGE and AGRO

Food& Beverage and Agro Industry & Feed

CHEMICAL & PETROCHEMICAL

Polymers, Plastics & Fibers, Resins & Coatings, Specialty Chemicals, Base Chemicals

PIPELINES & INFRASTRUCTURE

Long- distance pipelines, ports & terminals

ENERGY & UTILITIES

Bio energy, Waste-to-Energy, Green energy (Windmills, Cogeneration & Trigeneration) CO_2 Capture, Utilization and Storage, Clean air facilities

OIL & GAS

Upstream, Midstream, Downstream

PHARMA & BIOPHARMA

R&D and QC Laboratories, (Bio)Pharmaceuticals, Finished Products, Medical Devices, Cosmetics

PROPERTY

R&D centers, laboratories, cleanrooms

Bilfinger Tebodin | Services

Consultancy

- Asset management & maintenance
- Environment
- Energy
- Logistics
- Process integrity & safety
- Industrial sustainability
- Compliance management
- Authority engineering & permitting
- Feasibility
- Due diligence

Design & Engineering

Conceptual, basic and detailed engineering in all relevant disciplines:

- Civil, structural and architectural
- Building services
- Pipelines and infrastructure
- Electrical,
- instrumentation and process control
- Energy
- Piping
- Logistics
- Mechanical
- Process

Project Management

- Management of EPCm services
- Estimating and cost control
- Scheduling and progress control
- Quality and safety assurance
- Commissioning management and assistance
- Program management

Procurement

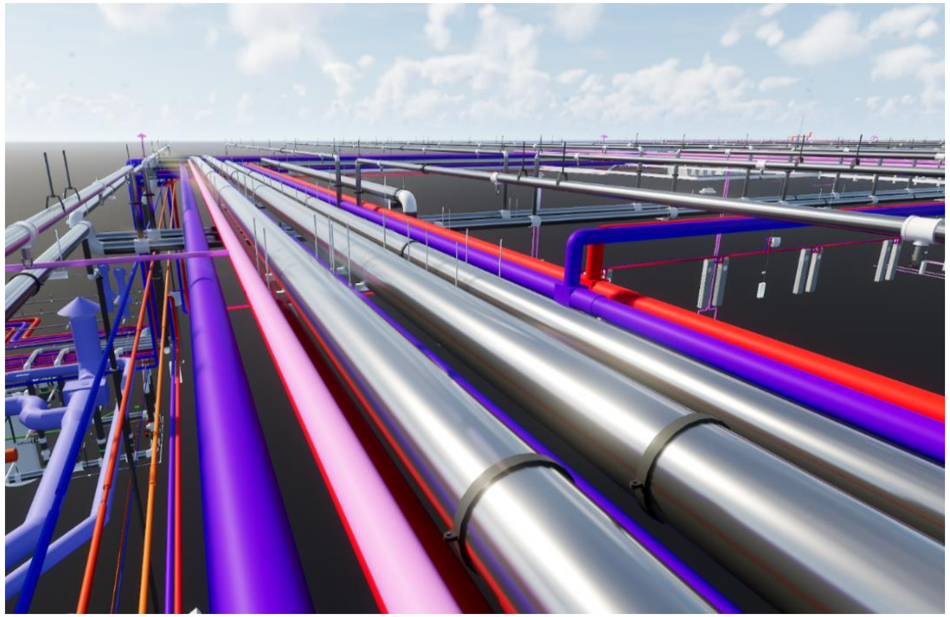
- Project purchasing, expediting and inspection
- European tenders
- (non) production related purchasing
- Performance based maintenance / tendering
- Contract management

Construction Management

- Construction quality, health, safety and environment (QHSE) management
- Site management
- Construction supervision
- planning, cost and progress control

Digitalization | Quality and efficiency | BIM Department

- International BIM team (100 professionals)
- BIM standards and implementation in projects
- Fully digital way of working aiming to offer optimal client support
- Automation and standardization of processes
- Sophisticated software tools



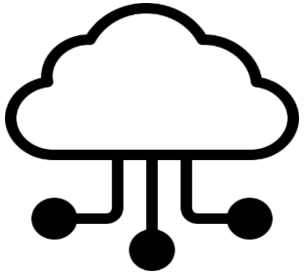
Additional features

Virtual reality /

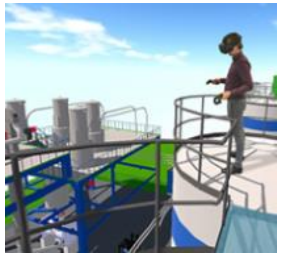
VR rooms

Reality capture –

3D Laser Scannning



Cloud-based collaboration platforms



Case study | Expansion of an existing production line in chemicals sector

Project information

Location: Belgium
Industry sector: Chemicals, Coatings, Polymers & Resins
Project site area: approx. 12.000m2

Purpose: Expansion of an existing production line
(4 floors + outside tanks and pipe rack)

Status: Under construction

Scope of work: Detailed engineering package
- Civil/Architectural/Structural
- Building services (HVAC)
- Mechanical/Piping
- Electrical/Instrumentation
- BIM Coordination
- Project management

Main challenges and success factors

Coordination of multiple stakeholders
2 companies (BT and client), 3 regions (BeNe, Ukraine, UAE), 8 lead engineers, 40+ engineers

Complex engineering requirements
Connection to existing lines, specifications from client

Schedule driven project
Tight deadlines, building permits, market pressure, concurrent activities

Limited expansion area
Tight room for equipment and piping, existing building foundation, existing pipe racks

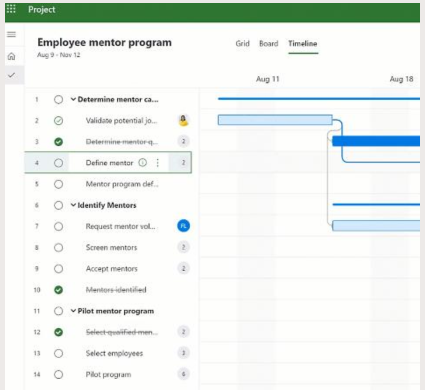
Maintenance and operability
Requirements for optimal future operability and maintenance

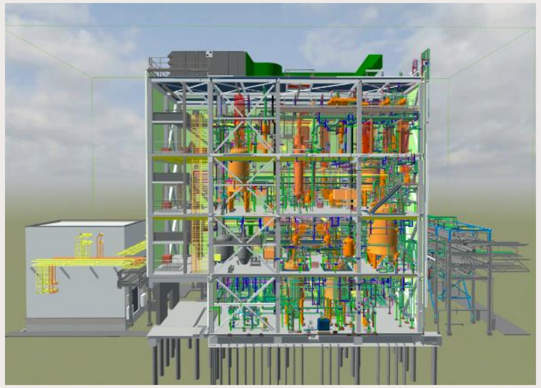
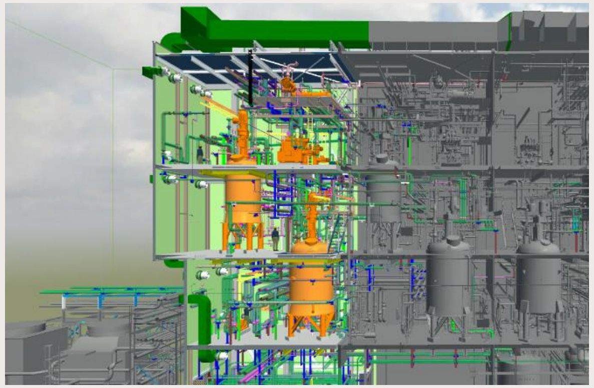
Foster collaboration and coordination

High design quality

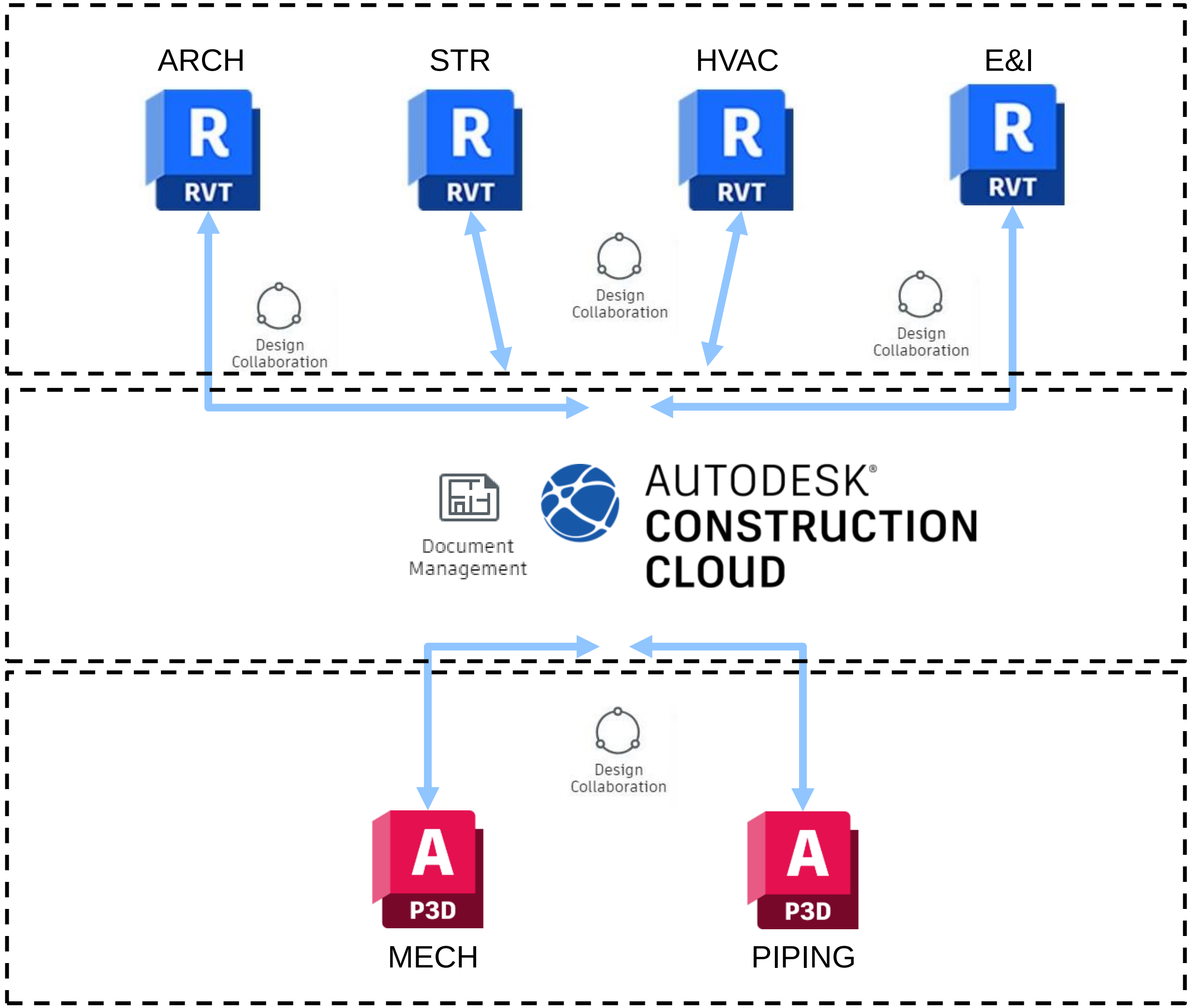
Delivery project on time

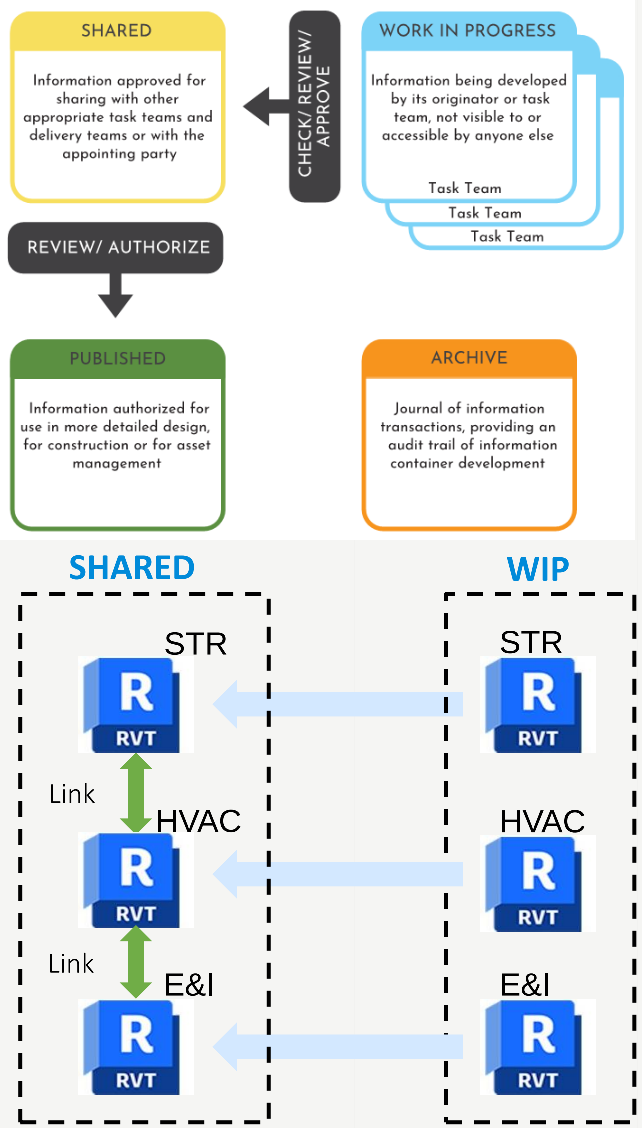
Standardization and efficiency



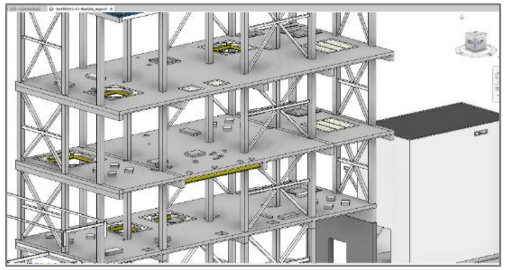

Design and collaboration

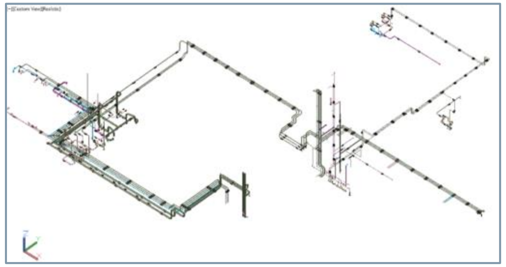


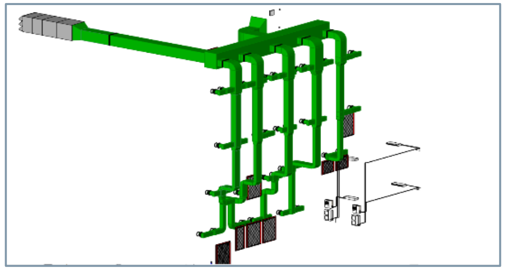


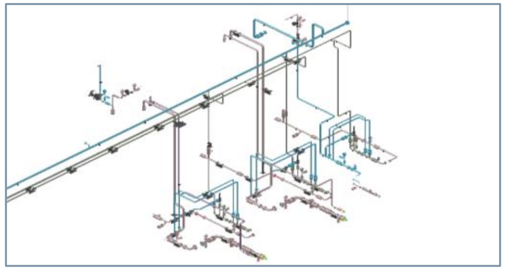
Design and collaboration | Model processing workflow

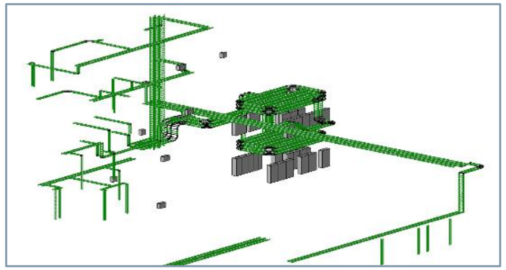
From aspect models

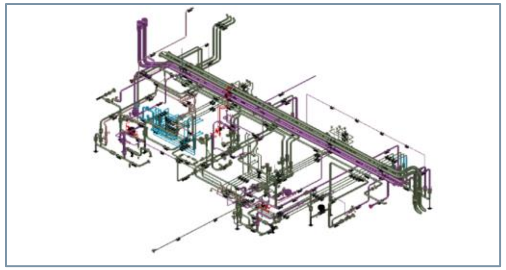




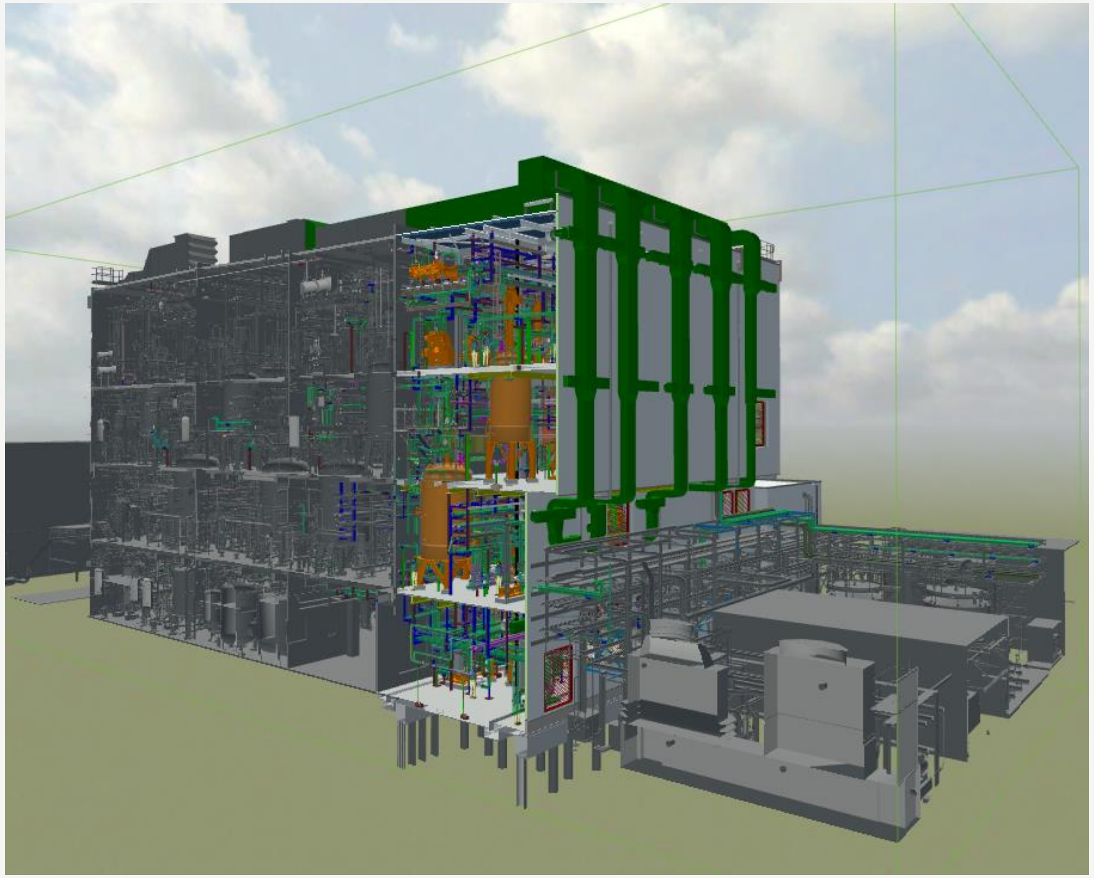








To 3D coordination model



Design and collaboration | Model processing workflow

Design and engineering

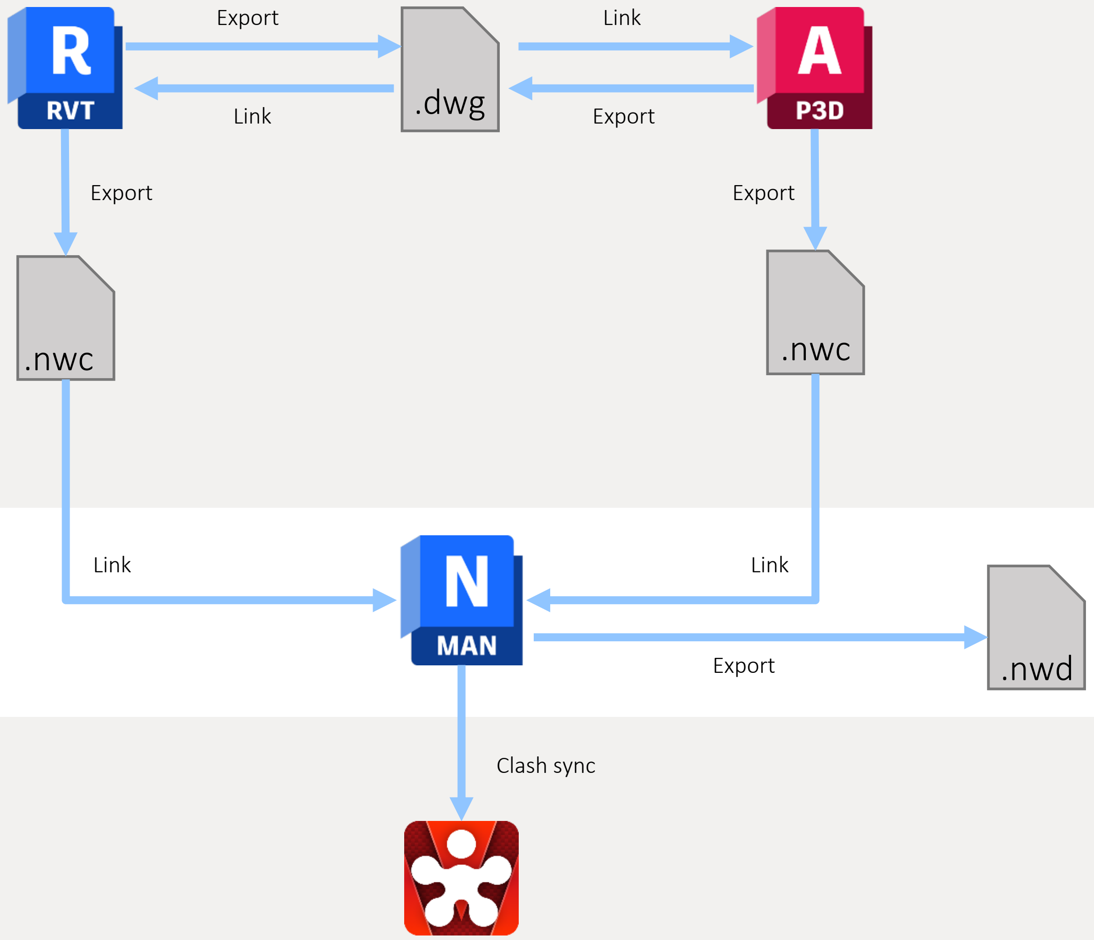
Run export weekly 2x
Monday/Thursday 12:00 CET

Clash detection

Run detection weekly
< Tuesday 12:00 CET

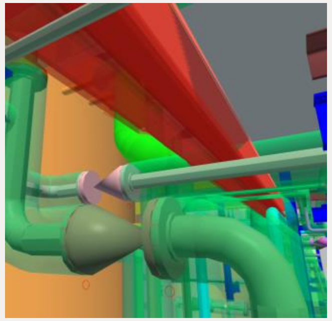
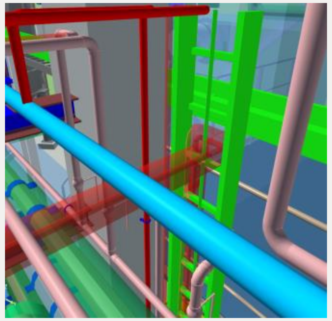
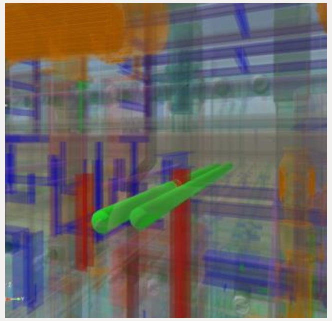
3D Coordination/ Issue tracking

Ongoing



3D coordination | Clash detection

- Early identification of design issues and avoid expensive rework
- Reduce onsite delays and rework during construction
- High quality of design documentation

CLASH AVOIDANCE

CLASH DETECTION

CLASH RESOLUTION

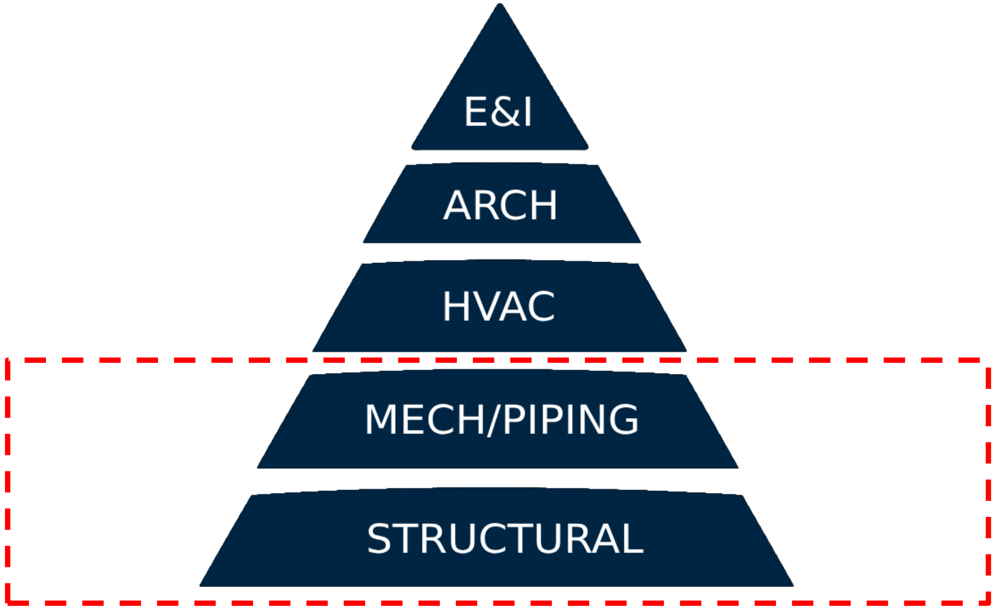
Objective: Be pro-active than re-active!
Eliminate clashes before they occur

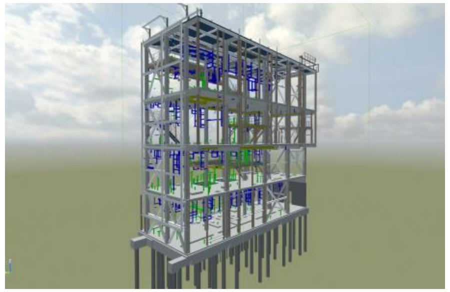
Focus: Beyond the tools - collaboration
Rigorous management and coordination

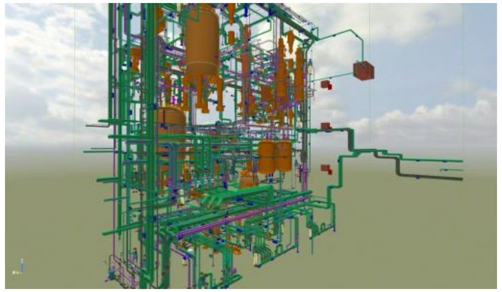
Re-active:
Longer iterations – over the wall syndrome
Administrative hours
Frustration – negative impact on team

3D coordination | Clash avoidance

1. Define system hierarchy



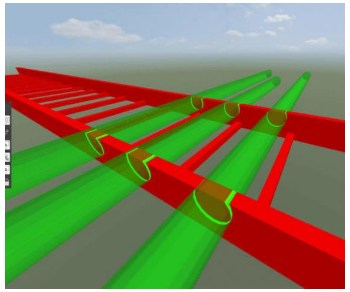


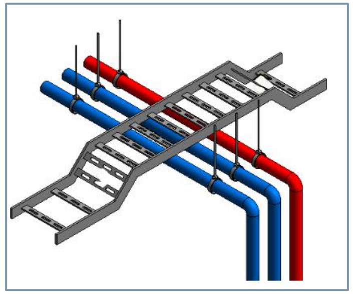


2. Space reservation

- Location and orientation of equipment
  - Tanks
  - Vessels
  - Pumps
  - Heat exchangers
- Piping space reservation
  - Critical lines
  - >4inch pipelines
- Space reservation for main HVAC ducting
- Electrical equipment
- False ceiling agreements:

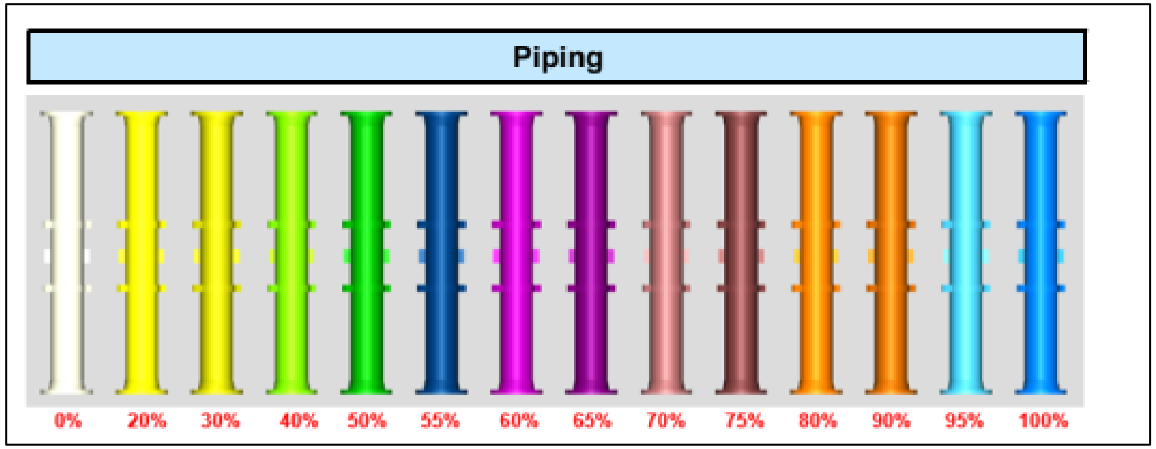
3. Sequence of modelling based on hierarchy

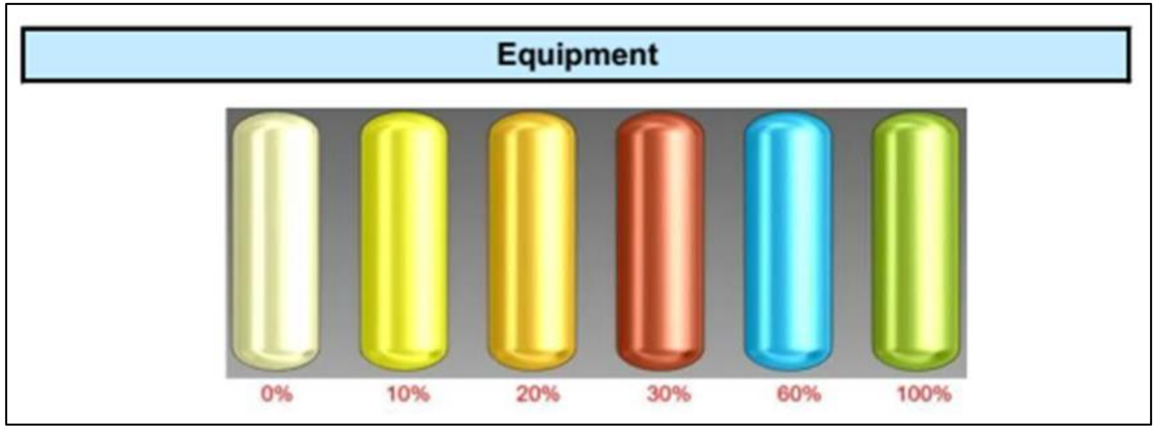




- Clearly defined agreements
- But: communication is key

3D coordination | Clash avoidance

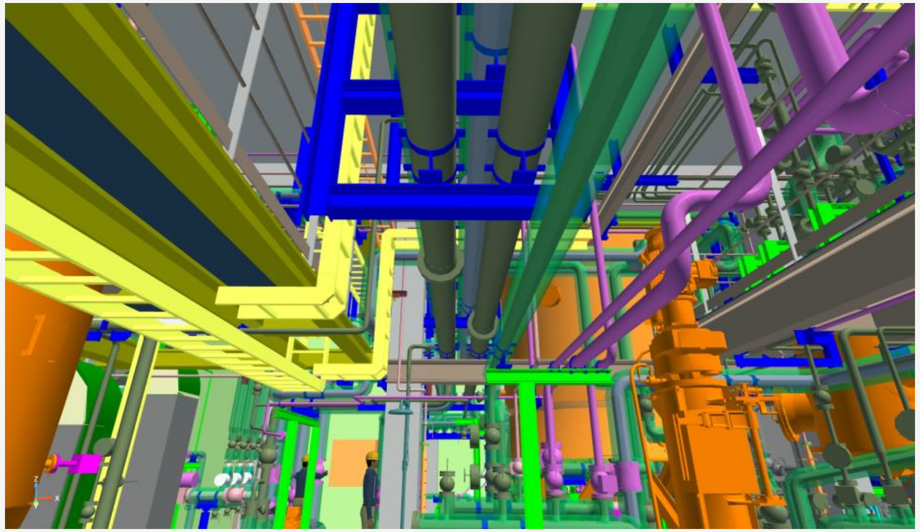




Color coding

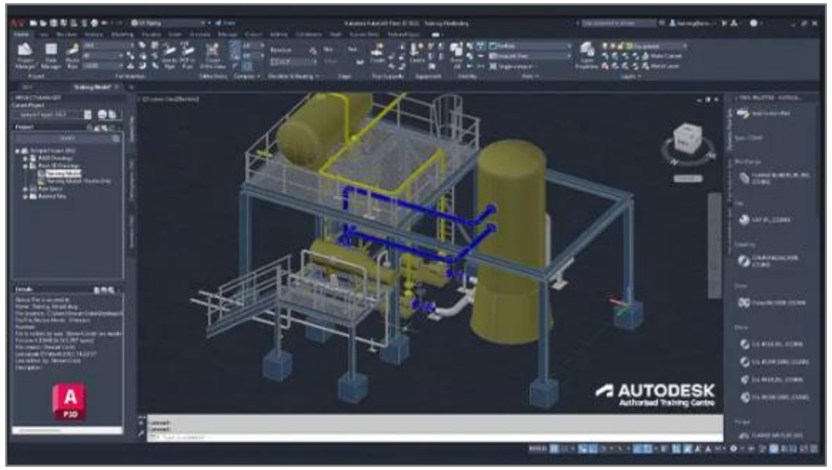
- New dimension of information: Representation of progress
  - ➢ Project members identify status of certain elements:

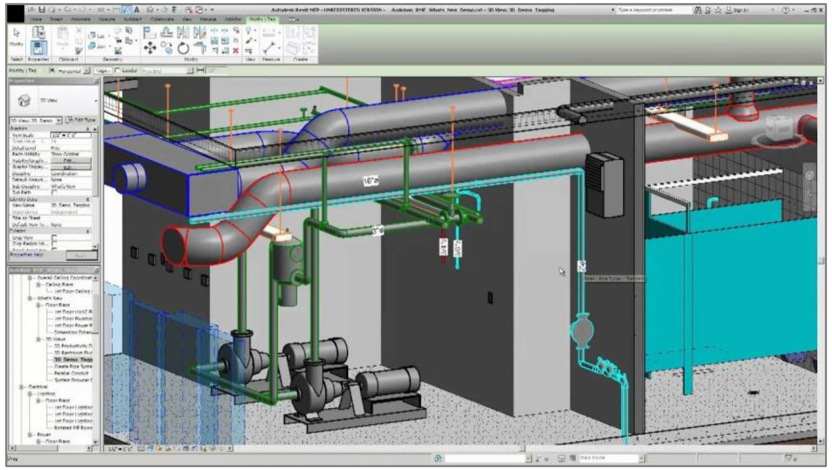
    E.g.: Pipe routing on study phase or approved by lead



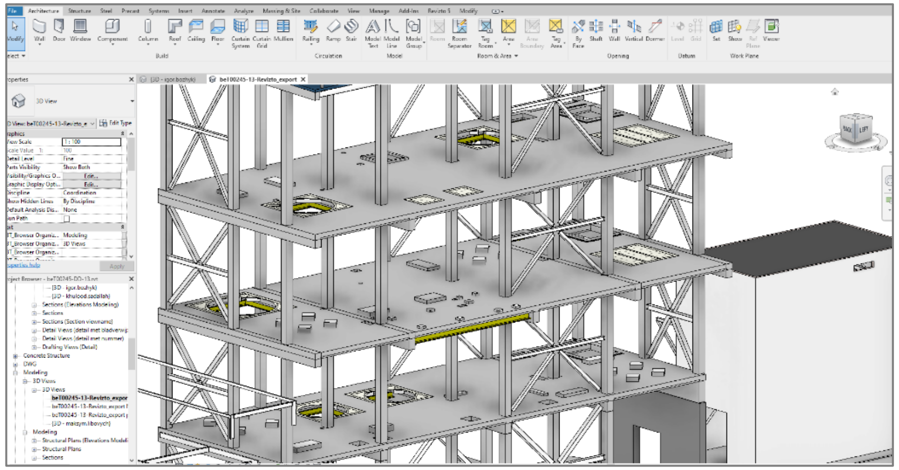
3D coordination | Clash avoidance

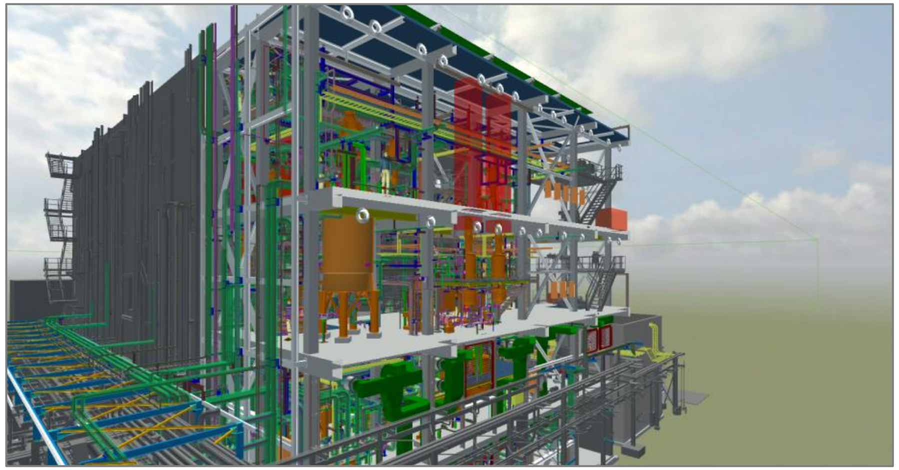
4. Work with other aspect models loaded in





5. Parallel use of design and coordination tools





3D coordination | Clash detection and resolution

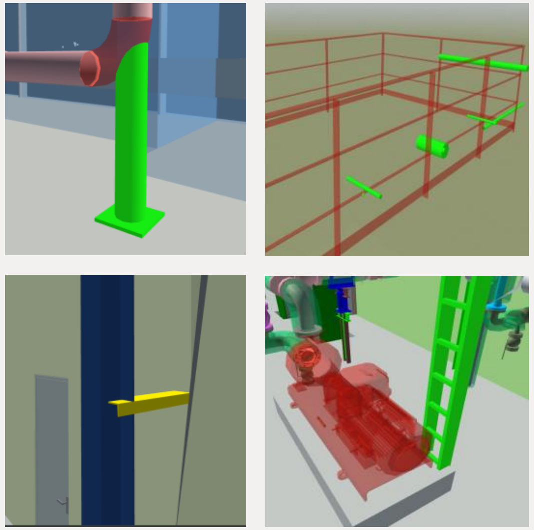
Categorization of models and setup of clash tests

(11) ARCHITECTURE			(13) STRUCTURE		
I	II	III	I	II	III
• Exterior: - Walls - Doors - Windows • Stairs • Exterior Curtain system • Roof • Floor	• Interior: - Walls - Partitions - Doors - Windows - Curtain system; • Ceiling • Insulation as part of the wall	• Furniture • Special devices • Plumbing fixtures • Drains • Railings • Roof hoist (crane)	• Column • Beam • Foundation • Concrete Wall • Floor(Slab) • Truss • Brace • Stairs	• Secondary steel (for equipment, supporting steel for facade, decking) • Connection Details	• Anchors • Embeds • Railings and Kick plates Typical supporting elements

(15) HVAC			(21) PIPING		
I	II	III	I	II	III
• Large Mechanical Equipment • Vertical Duct • Main Horizontal Ducts (by size)	• suspended equip+ hangers • Fabrication • Branch duct (by size) • Air terminal • Points of connections HVAC pipes • Heating	• HVAC pipes • Flex Duct • Louvers* • Hangers • Insulation	• Gravity (Sloped) piping (dia. 50+ mm) vertical and horizontal • Pressure piping vertical (dia) • Rain water piping	• Gravity piping (dia. 50- mm) • Pressure piping branches, • Drainage piping • Plumbing fixtures	• Flanges • Hangers • Pipe Insulations • Pipe Accessories

(41-43) ELECTRICAL		
I	II	III
• Electrical Equipment • Cable Trays (200mm+) • Cable Tray Fittings (200mm+) •Busbar Systems • •Electrical Fixtures	• Cable Trays (200mm<) Cable Tray Fittings (200mm<) • Lighting Fixtures • Lightning Protection Arrestors •Main	• Devices • Cable Tray Supports • Electrical Fixtures • Ligtning Protection Grid •Grounding Systes

Clash exclusions



Elimination of ''false positives''
Approx > 8000

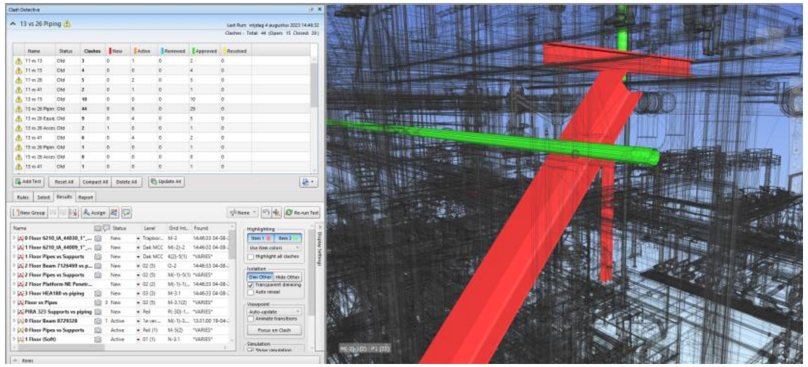
Avoid rework and unnecessary costs

Focus on clashes that matter

Clash grouping

Meaningful grouping based on

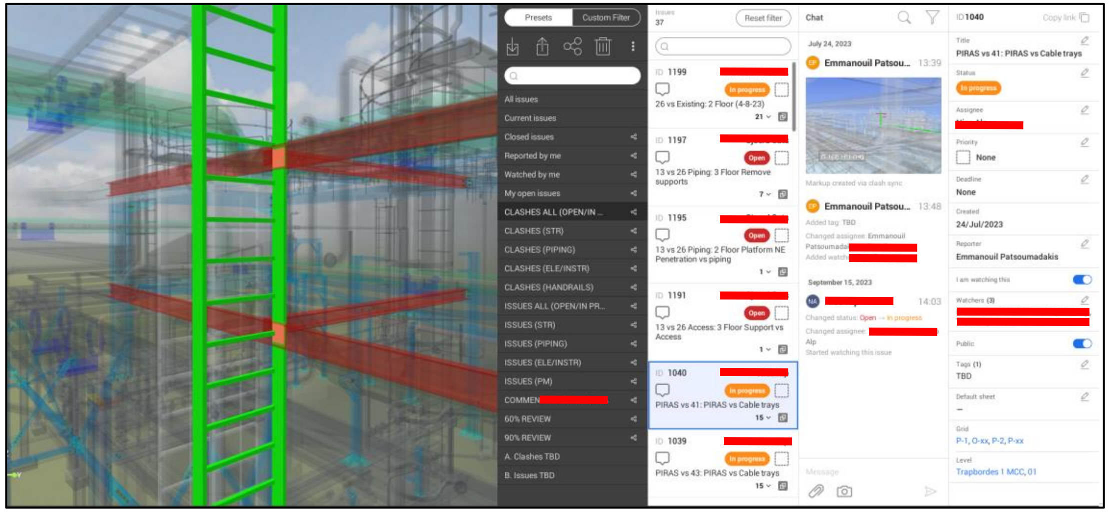
1. Areas
2. Buildings
3. Floors
4. Compartments
5. Categories



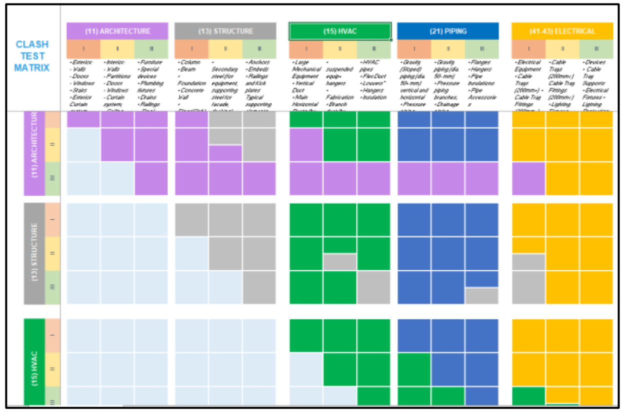
✓ Standardization
✓ Reduction of administrative hours
  • BIM coordinator
  • Engineers/designers
✓ Flexible assignment of responsibilities
✓ Better orientation and understanding of classes

3D coordination | Clash detection and resolution

Clash synchronization with coordination environment

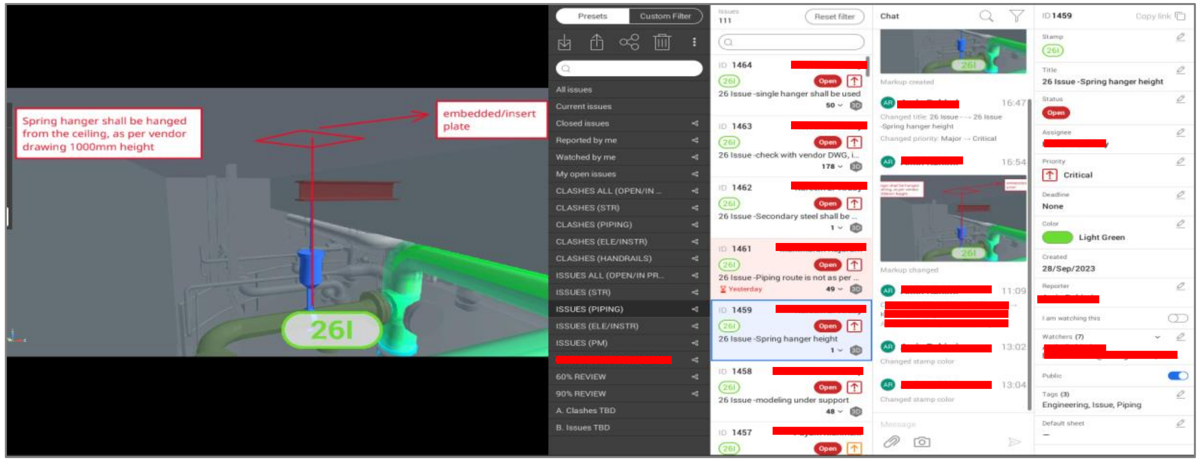


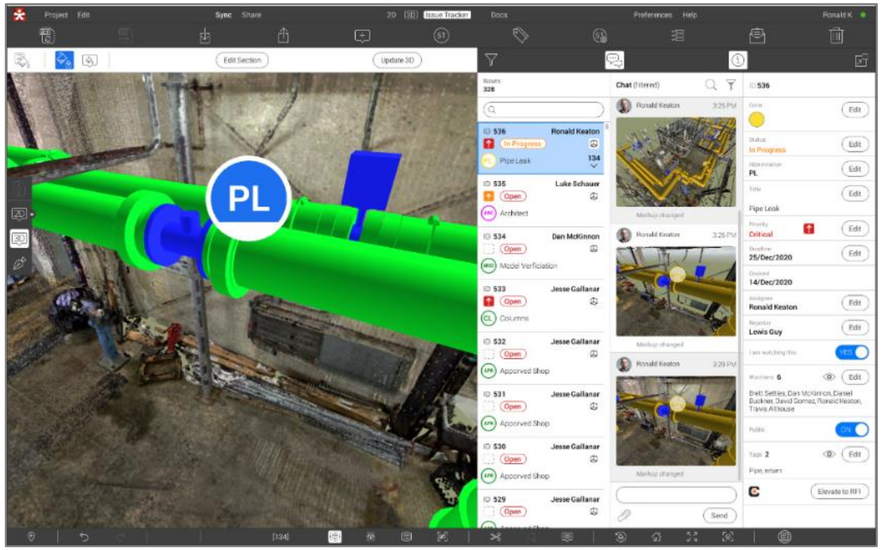
Role	Clash		
BIM coordinator Clash Detection Tool	Create & sync	Detect resolution & auto-close*	Exclude & auto-close*
Lead Engineer (LE)	Assign		Request exclusion keyword/property
Engineer / Designer	Resolve clash, or request for exclusion, or accept clash by mark as "solved"		

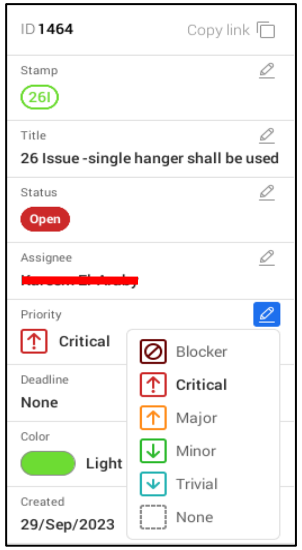


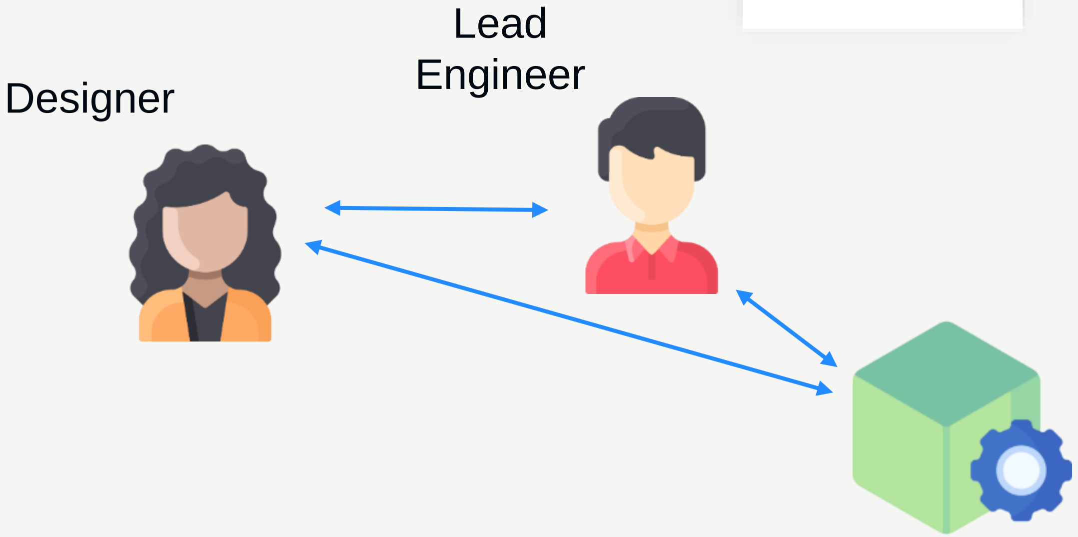
- Automatic assignment of classes based on priority matrix
- Classes to be reviewed in BIM meetings

3D coordination | Issue tracking









Role	Issue
BIM coordinator	Close ↑
Reporter (originator)	Create ↓ / Mark as "solved" ↑ ↓
Lead Engineer (LE)	Assign ↓ / Accept ↑ Return ↓ or forward to other LE ↑ ↓
Engineer / Designer	Act & reply Mark as "in progress" Re-assign back to LE

Access to information

Design data

Item →Type	AutoCad →Class	AutoCad →Status	Item →Source File	AutoCad →Tag
ACPPEQUIPMENT	Pump	New	D400-10-Equipment ...	P 791 A 6210
ACPPEQUIPMENT	Pump	New	D400-10-Equipment ...	P 751 6210
ACPPEQUIPMENT	Pump	New	D400-10-Equipment ...	P 746 6210
ACPPEQUIPMENT	Pump	New	D400-10-Equipment ...	P 741 6210
ACPPEQUIPMENT	Pump	New	D400-10-Equipment ...	P 781 A 6210
ACPPEQUIPMENT	Pump	New	D400-10-Equipment ...	P 786 A 6210
ACPPEQUIPMENT	Pump	New	D400-10-Equipment ...	P 781 B
ACPPEQUIPMENT	Pump	New	D400-10-Equipment ...	P 786 B
ACPPEQUIPMENT	Pump	New	D400-10-Equipment ...	P 791 B 6210
ACPPEQUIPMENT	Pump	New	D400-10-Equipment...	P 3712 6210
ACPPEQUIPMENT	Pump	New	D400-10-Equipment...	P 4712 6210
ACPPEQUIPMENT	Pump	New	D400-10-Equipment...	P 4102 6210
ACPPEQUIPMENT	Pump	Existing	D400-10-Equipment...	P 4301 6210

Item →Type	Item →Layer	AutoCad →Class	AutoCad →Status	Item →Source File
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ACPPPIPEINLINEASSET	6210_ALP_34015_6__D2	Tee	Existing	D400-10_Tie Poin
ACPPPIPEINLINEASSET	6210_ALP_34015_6__D2	Flange	Existing	D400-10_Tie Poin
ACPPPIPE	6210_ALP_34020_2__D2	Pipe	Existing	D400-10_Tie Poin
ACPPPIPEINLINEASSET	6210_ALP_34020_2__D2	Flange	Existing	D400-10_Tie Poin
ACPPPIPEINLINEASSET	6210_ALP_34021_2__D2	Tee	3. Phase - 60%	D400-10_Tie Poin
ACPPPIPEINLINEASSET	6210_ALP_34021_2__D2	Flange	3. Phase - 60%	D400-10_Tie Poin
ACPPPIPE	6210_ALP_34021_2__D2	Pipe	3. Phase - 60%	D400-10_Tie Poin
ACPPPIPE	6210_CHW_34003_6__A1	Pipe	Existing	D400-10_Tie Poin
ACPPPIPEINLINEASSET	6210_CHW_34003_6__A1	Elbow	Existing	D400-10_Tie Poin
ACPPPIPEINLINEASSET	6210_CHW_34003_6__A1	Flange	Existing	D400-10_Tie Poin
ACPPPIPEINLINEASSET	6210_CHW_34003_6__A1	Valve	Existing	D400-10_Tie Poin
ACPPPIPEINLINEASSET	6210_CHW_34003_6__A1	Tee	Existing	D400-10_Tie Poin
ACPPPIPEINLINEASSET	6210_CPG_34018_4__D2	Flange	Existing	D400-10_Tie Poin
ACPPPIPE	6210_CPG_34018_4__D2	Pipe	Existing	D400-10_Tie Poin
ACPPPIPEINLINEASSET	6210_CPG_34018_4__D2	Tee	Existing	D400-10_Tie Poin
ACPPPIPEINLINEASSET	6210_CPG_34018_4__D2	Flange	Existing	D400-10_Tie Poin
ACPPPIPEINLINEASSET	6210_CPG_34020_4__D2	Valve	Existing	D400-10_Tie Poin
ACPPPIPE	6210_CPG_34020_4__D2	Pipe	Existing	D400-10_Tie Poin
ACPPPIPEINLINEASSET	6210_CPG_34020_4__D2	Elbow	Existing	D400-10_Tie Poin

Location of equipment

Item →Type	Item →Name
ACPPEQUIPMENT	
ACPPEQUIPMENT	
ACPPEQUIPMENT	
ACPPEQUIPMENT	
ACPPEQUIPMENT	
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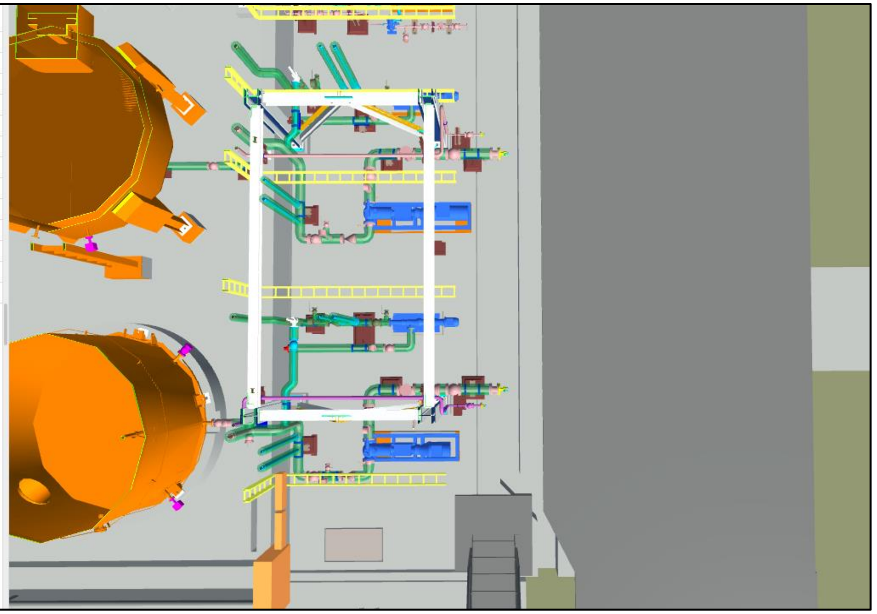
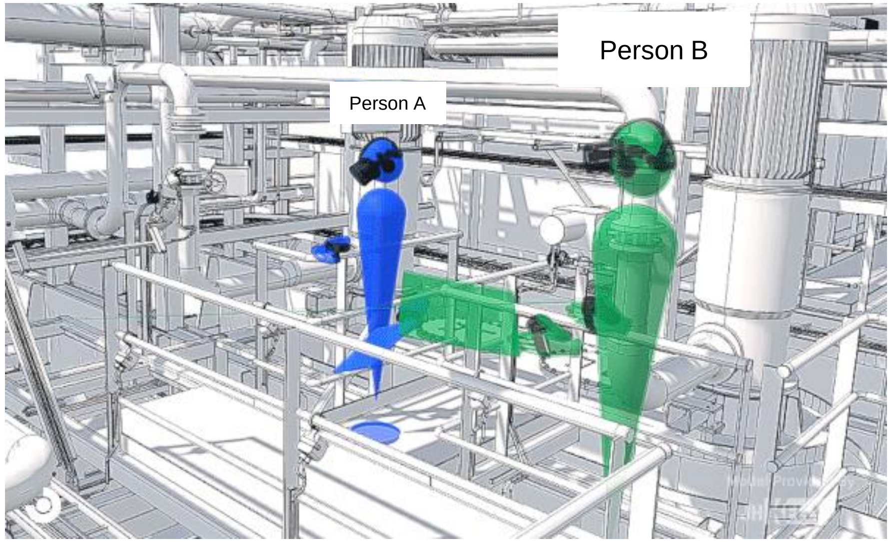
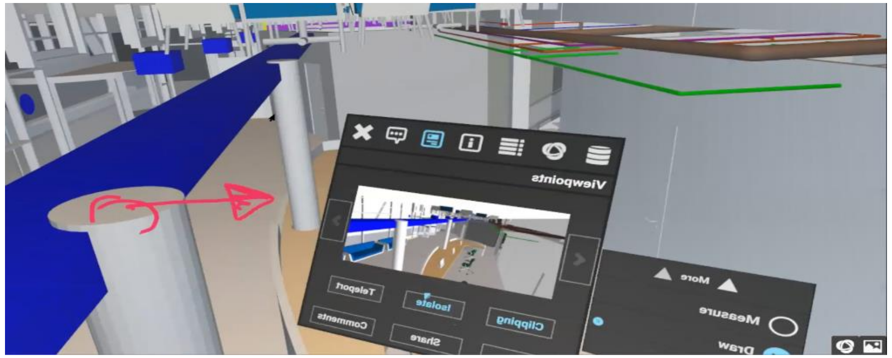
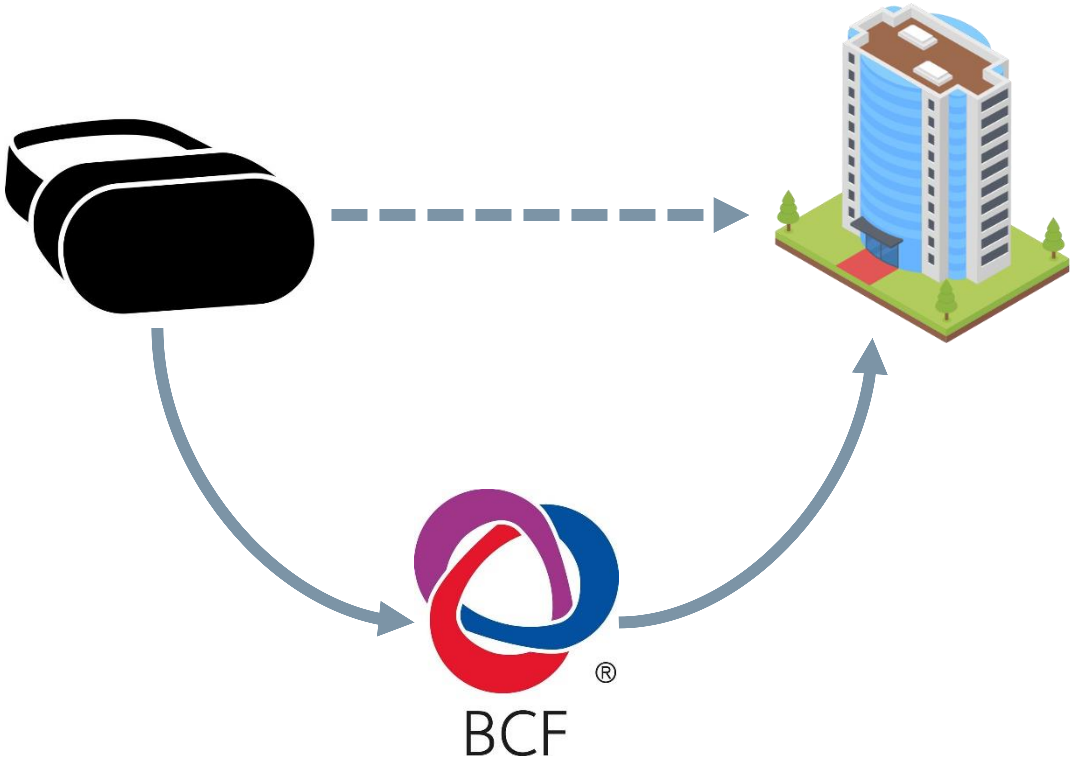


Virtual Reality (VR) | Maintenance and operability

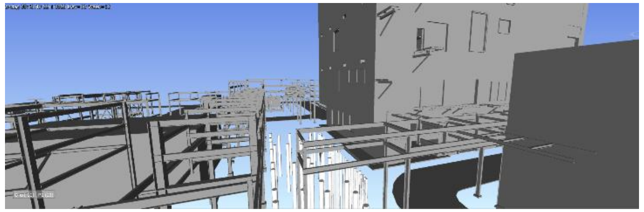
VR sessions with clients Maintenance and Operations Department leads

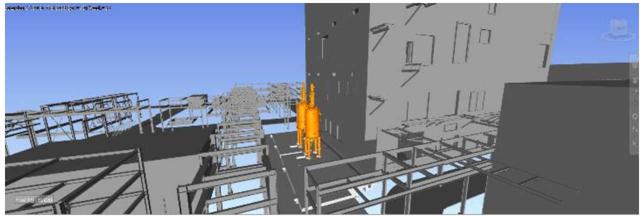


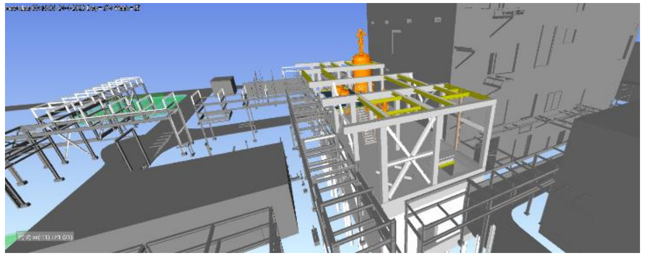


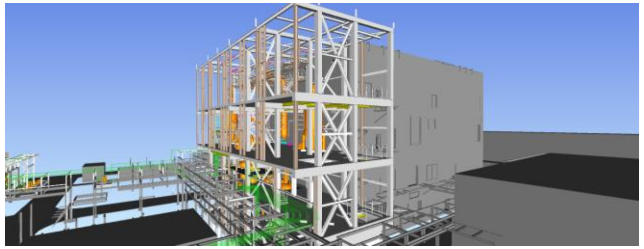


4D Simulation | Construction sequence planning



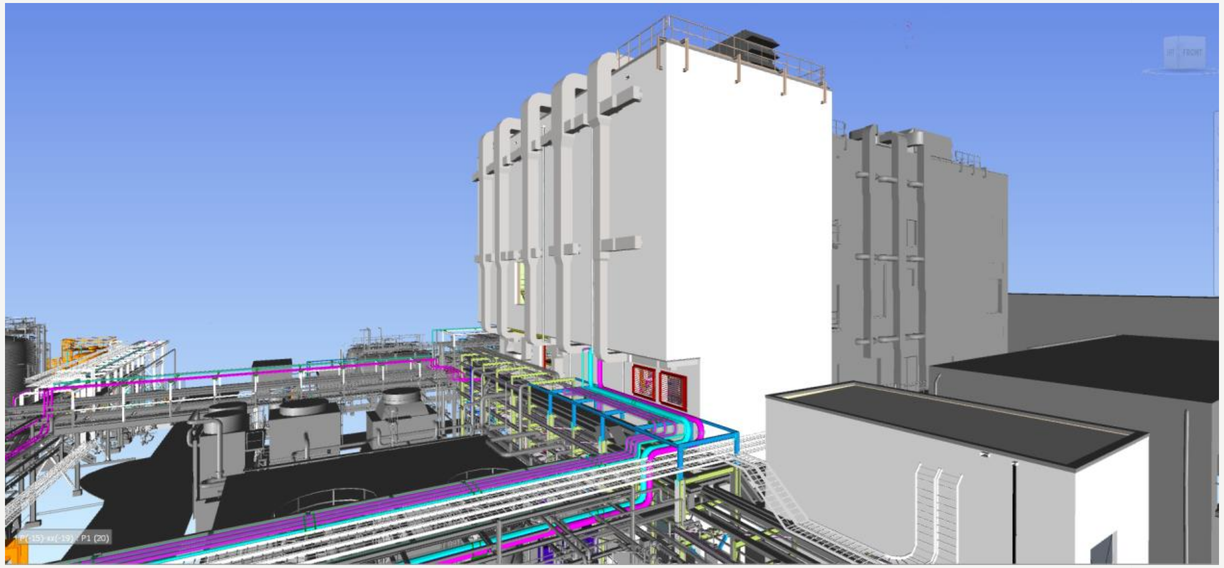






4D simulation model

- ✓ Identify problems that may not be visible via normal schedules
- ✓ Assess feasibility of execution and find the best solutions
- ✓ Risk mitigation during construction



Lessons learnt

Standardization and automation of processes

Clearly defined agreements

Not only tools but coordination and collaboration

THANK YOU