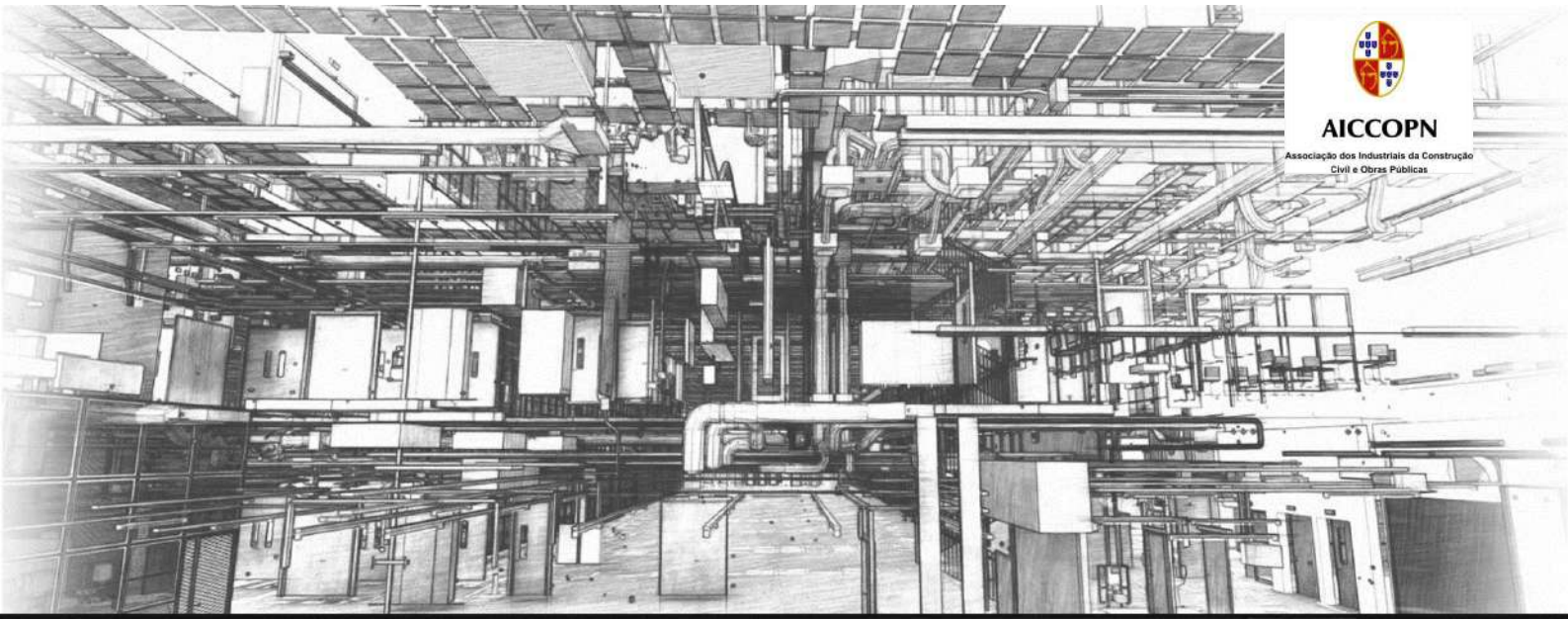


# TRANSIÇÃO DIGITAL DA INDÚSTRIA AECO – ATUAIS EXIGÊNCIAS, APLICAÇÕES E NOVOS DESAFIOS

CICLO DE SESSÕES "CIDADES INTELIGENTES E CONSTRUÇÃO 4.0 – AICCOPN – 06 de Maio 2022

AICCOPN
Associação dos Industriais da Construção Civil e Obras Públicas

BIMMS BUILDING INFORMATION MODELING & MANAGEMENT SOLUTIONS
www.bimms.net

Global Perspective

YOUR BIM PARTNER



## AGENDA

### 1- PRESENTATION

### 2- AECO INDUSTRY – OVERVIEW

Key Challenges | Employer Requirements | Market Trends | Investment Trends

### 3- PROJECTS

CHALLENGES & SOLUTIONS

Education | **Data Centers | Semiconductors**

### 4- R&D FRAMEWORK

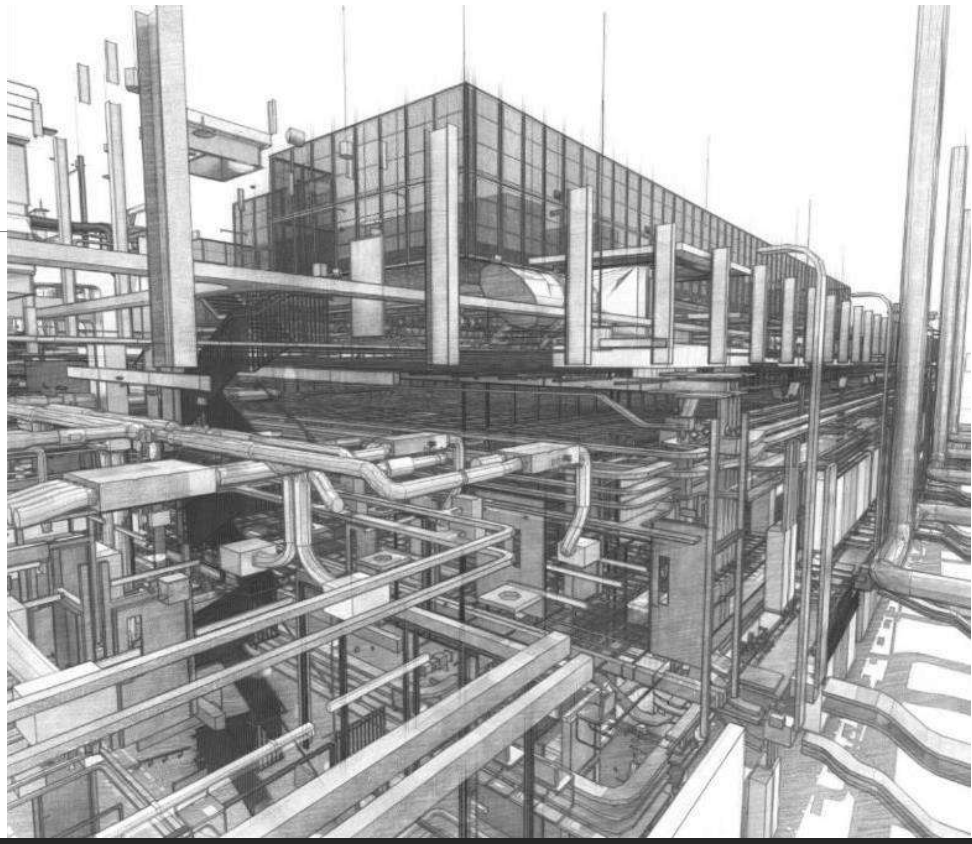
Overview | Industry Trends | Solutions

# What We Do

Integrated Engineering &
Digital Solutions
for AECO Industry

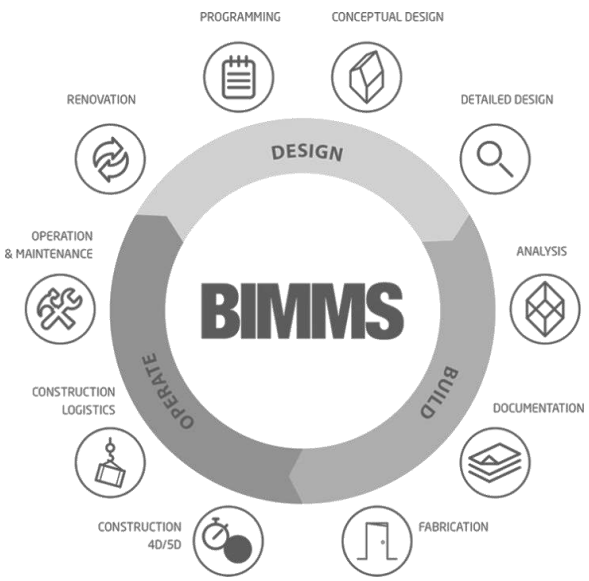
## INTEGRATED ENGINEERING DELIVERY

DESIGN TO CONSTRUCTION
&
CONSTRUCTION TO OPERATIONS



BIMMS BUILDING INFORMATION MODELING & MANAGEMENT SOLUTIONS

# Project Life Cycle




BIMMS BUILDING INFORMATION MODELING & MANAGEMENT SOLUTIONS

# AREAS

## DIGITAL CONSULTING

STRATEGY
IMPLEMENTATION

## DIGITAL CONSTRUCTION

INTEGRATED ENGINEERING
DELIVERY

## DIGITAL SOLUTION

PROGRAMMING
IOT INTEGRATION
Web Based Service

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## DIGITAL CONSULTING

- Consulting
- Advanced Training
- Implementation
- Strategy Framework


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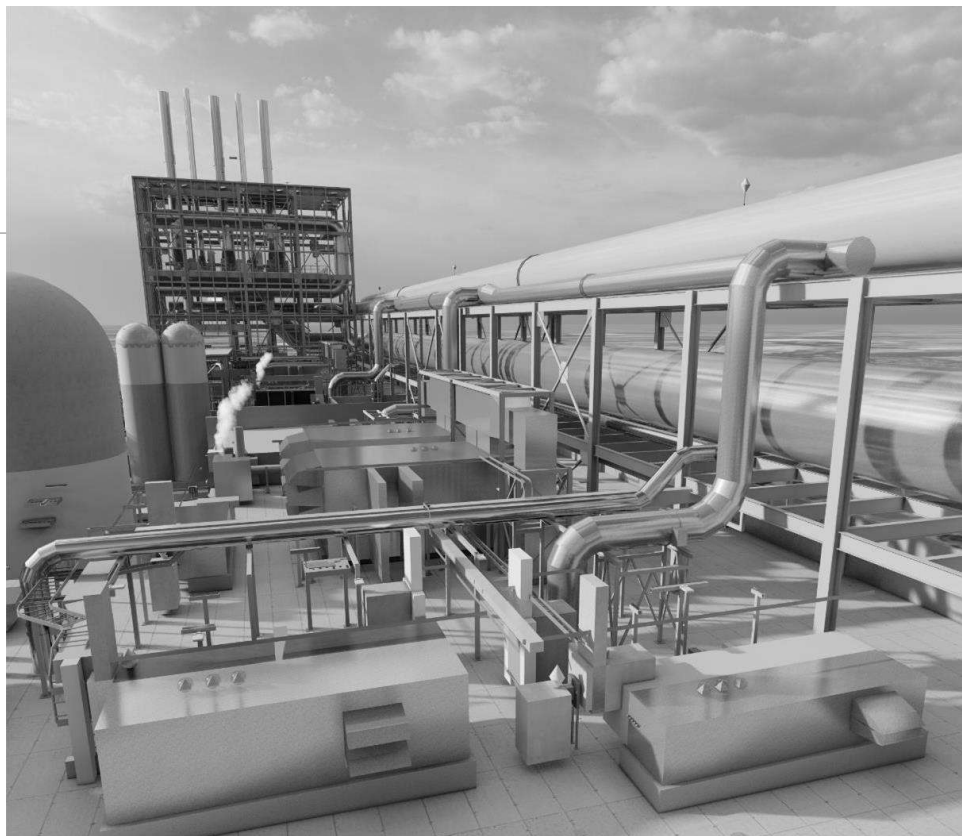
# Training


BIMMS BUILDING INFORMATION MODELLING & MANAGEMENT SOLUTIONS

## DIGITAL CONSTRUCTION

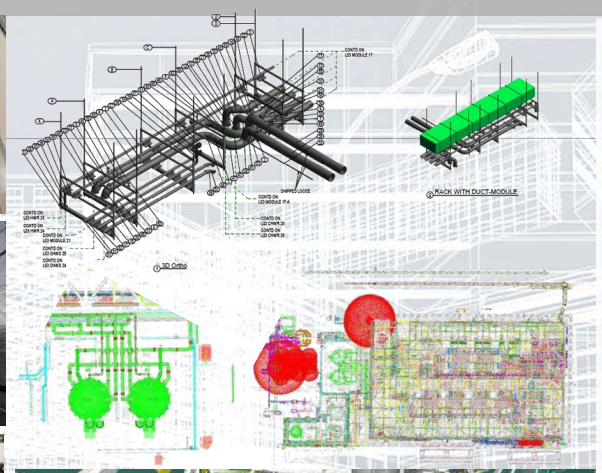
- Design Review & Value Engineering
- Modularization Feasibility Design
- Pre-Construction Review
- Space Management
- Spatial Coordination
- Engineering / Construction Drawings
- Site Support
- Quantities
- Procurement Support
- Planning
- Project Management Support
- Cost Control
- Quality Control
- Fabrication
- Analytics Reporting

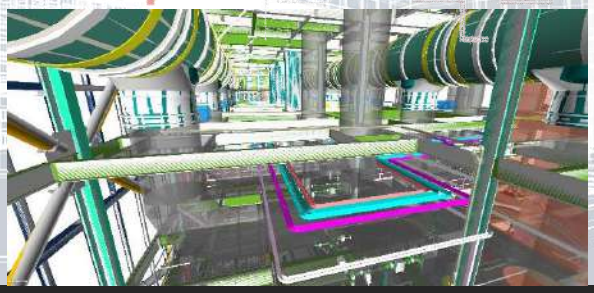


BIMMS BUILDING INFORMATION MODELLING & MANAGEMENT SOLUTIONS

Design | Modularization | Coordination | QTO | Deliverables | BIM To Field | Field to BIM | Analytics Integration

Digital Construction





MEP Fabrication Pipework Schedule

| Mark | Size | Description | End Prep | Length (mm) | |
|---|---|---|---|---|---|
| 1 | 250a | PIPE: A-53 Grade B ERW,CS, SCH 40 | GVxBW | 671 | 1 |
| 2 | 250a | PIPE: A-53 Grade B ERW,CS, SCH 40 | GVxBW | 305 | 1 |
| 3 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxBW | 343 | 1 |
| 4 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxGV | 3197 | 1 |
| 5 | 65a | PIPE: A-53 Grade B ERW,CS, SCH 40 | GVxGV | 1261 | 1 |
| 6 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | GVxBW | 513 | 2 |
| 7 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxGV | 3716 | 1 |
| 8 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxBW | 400 | 1 |
| 9 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | GVxBW | 673 | 1 |
| 10 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | GVxBW | 1189 | 1 |
| 11 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | GVxGV | 1255 | 1 |
| 12 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | GVxBW | 628 | 1 |
| 13 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxGV | 300 | 1 |
| 14 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxGV | 305 | 1 |
| 15 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxBW | 249 | 1 |
| 16 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | GVxBW | 290 | 1 |
| 17 | 80a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxGV | 4499 | 1 |
| 18 | 80a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxGV | 4785 | 1 |
| 19 | 65a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxGV | 242 | 2 |
| 20 | 65a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxGV | 4655 | 1 |
| 21 | 65a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxGV | 4819 | 1 |
| 22 | 65a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxBW | 1586 | 1 |
| 23 | 65a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxBW | 7565 | 1 |
| 24 | 65a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxBW | 68 | 1 |
| 25 | 65a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxGV | 500 | 1 |
| 26 | 65a | PIPE: A-53 Grade B ERW,CS, SCH 40 | BWxGV | 466 | 1 |
| 27 | 65a | PIPE: A-53 Grade B ERW,CS, SCH 40 | GVxBW | 1998 | 1 |
| 28 | 250a | PIPE: A-53 Grade B ERW,CS, SCH 40 | GVxGV | 3208 | 1 |
| 29 | 250a | PIPE: A-53 Grade B ERW,CS, SCH 40 | GVxGV | 3207 | 1 |
| 30 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | GVxGV | 1252 | 1 |
| 31 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | GVxGV | 1252 | 1 |
| 32 | 200a | PIPE: A-53 Grade B ERW,CS, SCH 40 | GVxGV | 1255 | 1 |
| 33 | 25a | PIPE : TYPE L HARD COPPER | | 5015 | 1 |
| 34 | 25a | PIPE : TYPE L HARD COPPER | | 419 | 1 |
| 35 | 200a-200a | BUTTWELD 90 DEG ELBOW - CS - SCH 40-SR | | | 3 |
| 36 | 80a-80a | WC 90 DEG ELBOW-LR | | | 2 |

BIMMS BUILDING INFORMATION MODELLING & MANAGEMENT SOLUTIONS

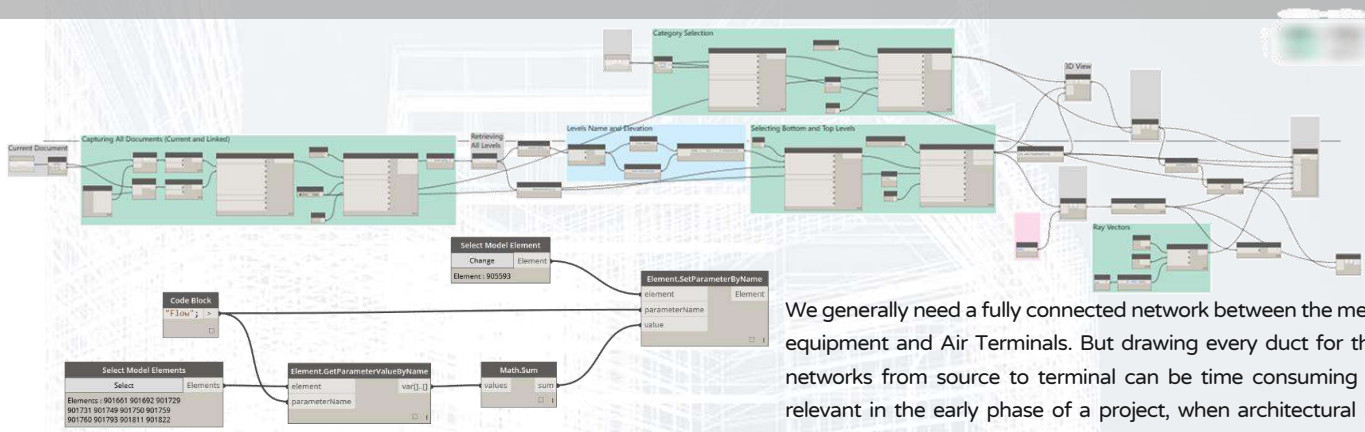
## DIGITAL SOLUTION

- Innovation
- Development
- Programming
- Software
- Business Intelligence

BIMMS BUILDING INFORMATION MODELLING & MANAGEMENT SOLUTIONS

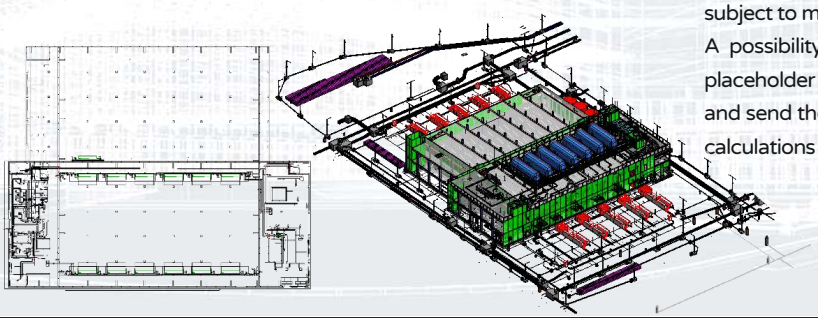
# IOT Integration

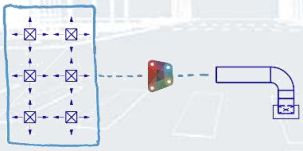

# Programming




We generally need a fully connected network between the mechanical equipment and Air Terminals. But drawing every duct for the entire networks from source to terminal can be time consuming and not relevant in the early phase of a project, when architectural layout is subject to major changes.

A possibility is to use Dynamo to virtually link every terminal to a placeholder family that will collect and sum Airflows in a given area and send the sum to a placeholder family used to perform duct sizing calculations on the main branch.





BIMMS Ecosystem

## Associations

BUILTCOLAB
DIGITAL BUILT ENVIRONMENT

## Standardization

buildingSMART

NB
CT197 BIM

BIMMS BUILDING INFORMATION MODELING & MANAGEMENT SOLUTIONS

## Universities

Universidade do Minho

NOVA
UNIVERSIDADE NOVA DE LISBOA

U.PORTO
FEUP FACULDADE DE ENGENHARIA UNIVERSIDADE DO PORTO

## Partnerships

BIM A+

BIM curso building information modeling

Pós Graduação BIM isep Instituto Superior de Engenharia do Porto



# Timeline

BIMMS TIMELINE

| | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | ... |
|---|---|---|---|---|---|---|---|---|---|---|
| People | BIMMS Foundation 6 | 8 | 9 | 15 | 16 | 16 | 30 | 70 | > 75 | |
| Installations | | | | New Office | | | | | New Office | |
| Departments | Consulting | Digital Construction | | BIMMS IT SUPPORT IT Support | Programming | Digital Solutions | | Human Resources | | |
| Activities | BIM Implementation | Full Design Coordination | BIM Coordination | Quantity Take-Off | Digital Fabrication | Project Management | Information Analysis | Bussiness Inteligence | First software Commercialization | |
| Sectors | Museum | University | Residential | Data Center | Healthcare | Infrastructure | Semiconductor | | | |
| Number of Projects | 3 | 6 | 16 | 23 | 25 | 30 | 32 | > 35 | | |

# Where Can You Find Our Work




## Sectors

Data Center

Semiconductor

Infrastructure

Art and Culture

Residential

Healthcare

Education

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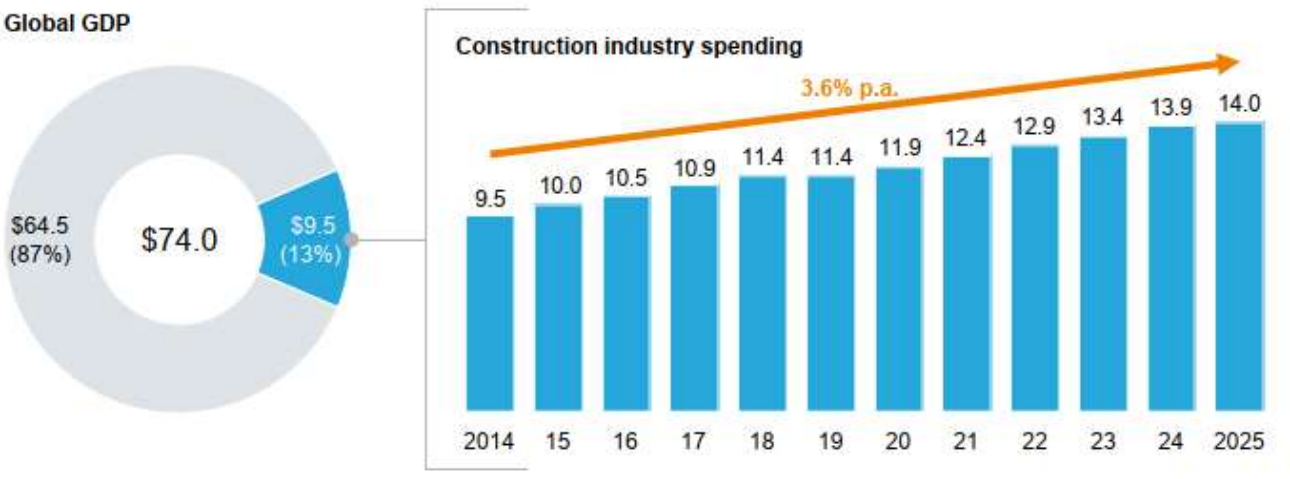
TRANSIÇÃO DIGITAL DA INDÚSTRIA AECO
ATUAIS EXIGÊNCIAS, APLICAÇÕES E NOVOS DESAFIOS

## Key Industry Challenges


Exhibit 1

**Construction matters: Construction-related spending accounts for 13 percent of global GDP**

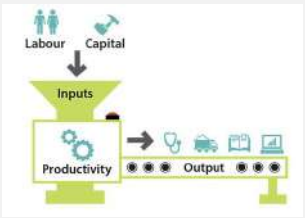
$ trillion



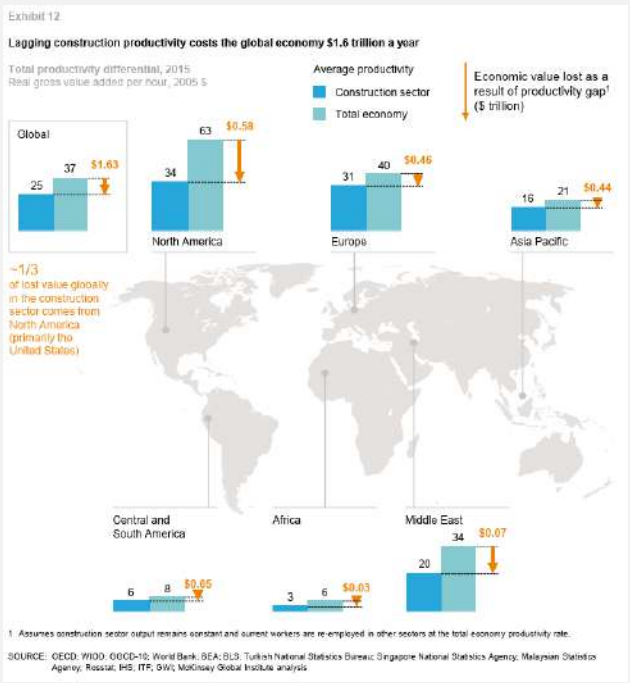

SOURCE: World Bank; IHS; ISSA; McKinsey Global Institute analysis

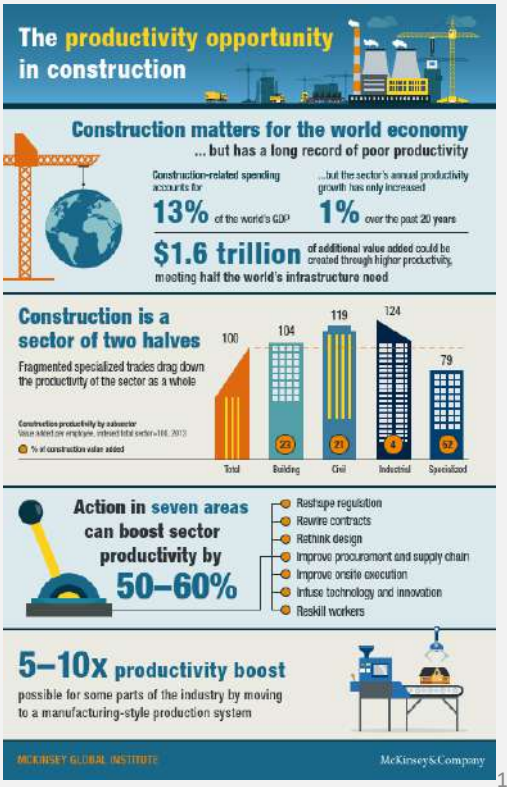
## Key Industry Challenges: Productivity Opportunities

*"Productivity is **a measure of economic performance that compares the amount of goods and services produced (output) with the amount of inputs used to produce those goods and services**."*





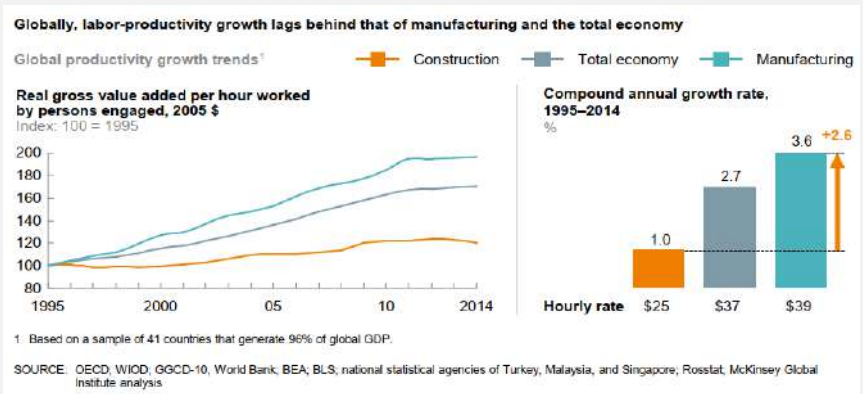


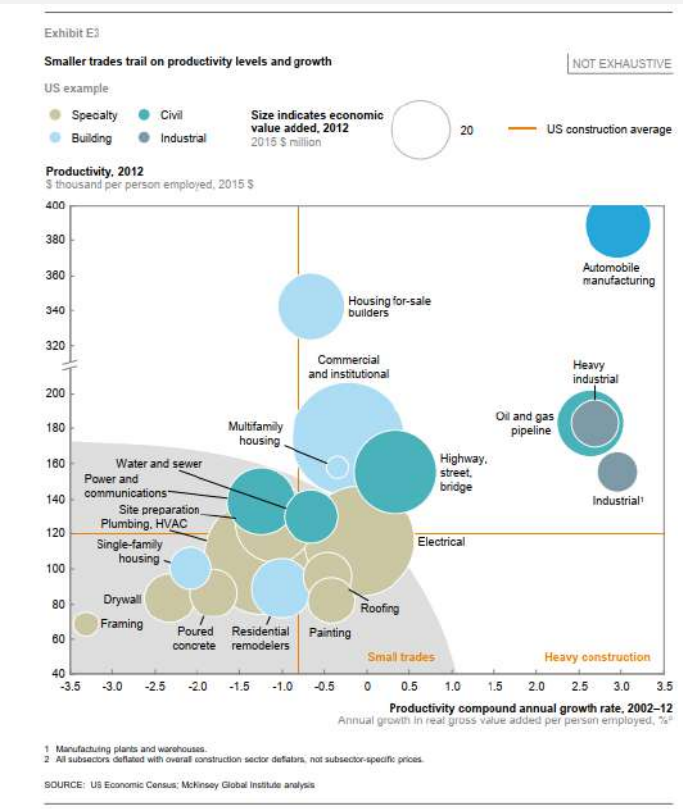






TRANSIÇÃO DIGITAL DA INDÚSTRIA AECO
ATUAIS EXIGÊNCIAS, APLICAÇÕES E NOVOS DESAFIOS

## Key Industry Challenges: Productivity Opportunities



## Key Industry Challenges: Productivity Opportunities

### - ROOT CAUSES

Exhibit E4

**We tested ten root causes for low construction productivity**


**Root causes**

- Increasing project and site complexities
- Extensive regulation, land fragmentation, and the cyclical nature of public investment
- Informality and potential for corruption distort the market

- Construction is opaque and highly fragmented
- Contractual structures and incentives are misaligned
- Bespoke or suboptimal owner requirements

- Design processes and investment are inadequate
- Poor project management and execution basics
- Insufficiently skilled labor at frontline and supervisory levels
- Industry underinvests in digitization, innovation, and capital

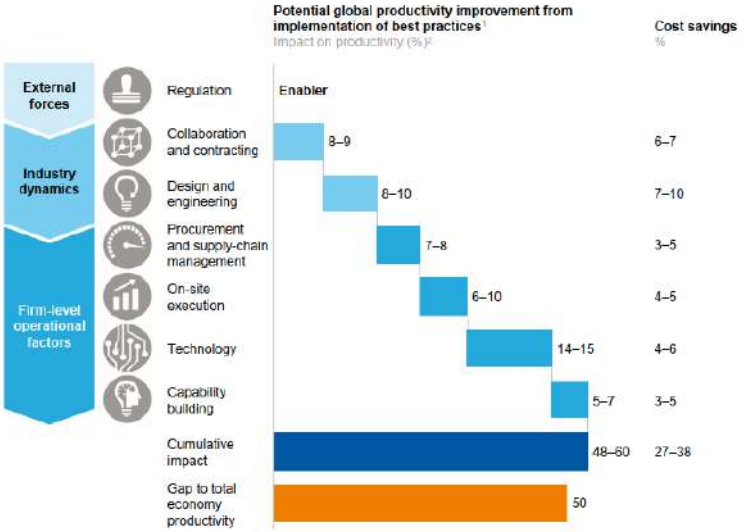
SOURCE: McKinsey Global Institute analysis

### - STRATEGY RESPONSE

Exhibit E5

**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

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## Employer Requirements

Five trends will shape construction and capital projects.


McKinsey&Company

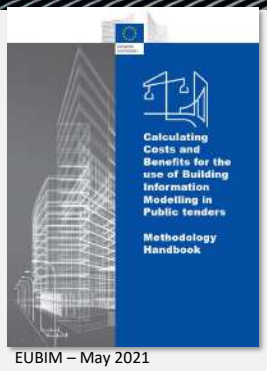
Digital solutions for construction need to deliver a seamless, real-time experience across eight use cases.

| Design management | Scheduling | Materials management | Crew tracking |
|---|---|---|---|
| • Visualize drawings and 3-D models on-site, using mobile platforms<br>• Update blueprints in the field with markups, annotations, and hyperlinks | • Create, assign, and prioritize tasks in real time<br>• Track progress online<br>• Immediately push work plan and schedule to all workers<br>• Issue mobile notifications to all subcontractors | • Identify, track, and locate materials, spools, and equipment across the entire supply chain, stores, and work front | • Provide real-time status updates on total crew deployed across work fronts, number of active working hours, entry into unauthorized areas, and so on |
| **Quality control** | **Contract management** | **Performance management** | **Document management** |
| • Offer remote site inspection using pictures and tags shared through app<br>• Update and track live punch lists across projects to expedite project closure | • Update and track contract-compli-ance checklists<br>• Maintain standerdized communication checklists<br>• Provide updated record of all client and contractor communications | • Monitor progress and performance across teams and work areas<br>• Provide automated dashboards created from field data<br>• Offer staffing updates and past reports generated on handheld devices | • Upload and distribute documents for reviewing, editing, and recording all decisions<br>• Allow universal project search across any phase |

McKinsey&Company

https://www.mckinsey.com/business-functions/operations/our-insights/imagining-constructions-digital-future

## Employer Requirements



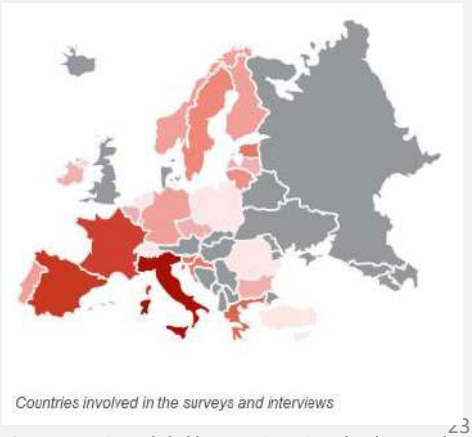

EUBIM – May 2021

**BIM ADOPTION IN PUBLIC TENDERS**

| STRENGTHS | WEAKNESSES |
|---|---|
| Improvement in management and coordination | Few or no benefits at the beginning |
| Improvement in maintenance activities - operation phase | Low productivity and additional effort required |
| Reduction of contingencies through improvement of clash detection and quality check | Specific knowledge and expertise required |
| Improved time management and efficiency in time scheduling | High costs of adoption |
| Improvement in costs estimation and information management | Complexity and lack of flexibility |
| Reduction of total projects' costs | Interoperability issues |
| Improvement in projects' quality | |

**BIM ADOPTION IN PUBLIC TENDERS**

| OPPORTUNITIES | THREATS |
|---|---|
| Regularisation and streamlining of the national AEC procedures | Lack of a clear regulatory framework and incentives for adoption |
| Digitalisation of the aec sector | Cultural and procedural obstacles |
| Specific studies on and analyses of costs and benefits associated with BIM | Monopoly of certain software companies |
| Development of a clear regulatory frameworks and introduction of incentives | High costs of adoption |




40 representative stakeholders were interviewed and surveyed





## Market Trends – The Future Construction Ecosystem will be radically different?


**Today's construction ecosystem**

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


The construction process is highly **project based**—developed from unique customer specifications, using designs **planned from scratch**, and with limited degree of repetition

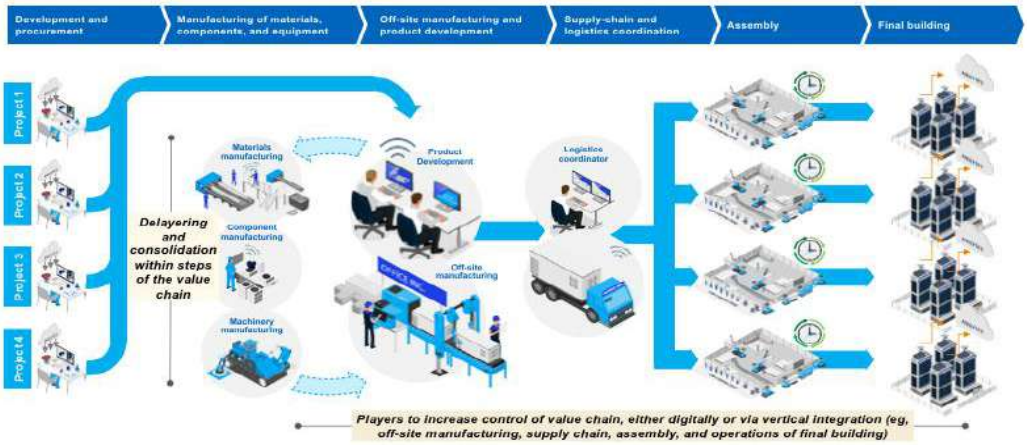
The value chain and player landscape are **local and highly fragmented vertically and horizontally**, resulting in a multitude of players involved at each step and major interface frictions

Construction is performed by generalists **on site in hostile environments**, with a large part of the workforce being **temporary and manual**

Limited use of **end-to-end digital tools and processes** as well as a capital-light delivery approach

## Market Trends – The Future Construction Ecosystem will be radically different?

**The construction ecosystem of the future** . . . A more standardized, consolidated, and integrated construction process




The construction process is increasingly **product based**, meaning structures will be products and manufactured off site by branded product houses **specializing** in certain end-user segments

Developers choose **entire designs or specific components** from a **library** of options developed in house or offered externally on the market

**Value chain is more consolidated, both vertically** (delayering) **and horizontally**, with increased degree of **internationalization**

**Disintermediation** takes place through digital marketplaces and direct channels

Contractors focus on **lean, on-site execution and assembly of products**

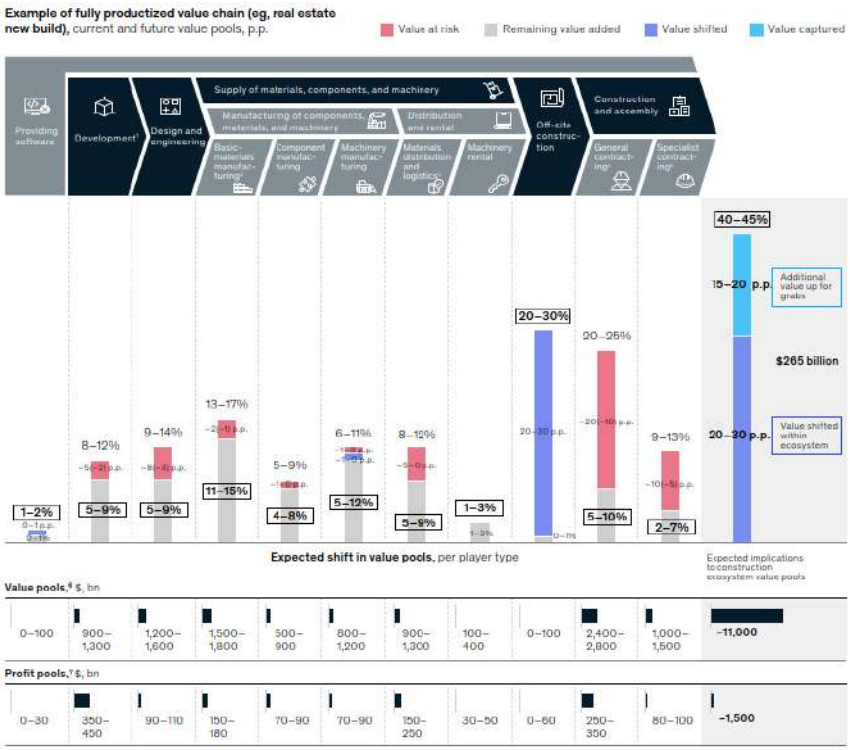
**Data and analytics** on customer behavior generated after completion to optimize total cost of ownership and future designs





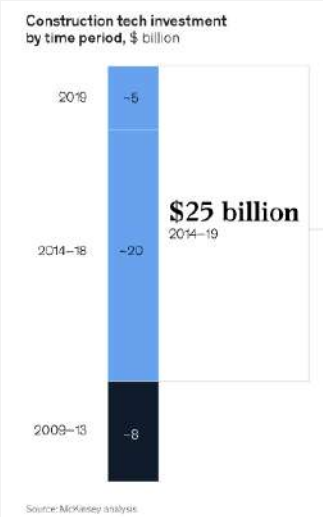
## Market Trends

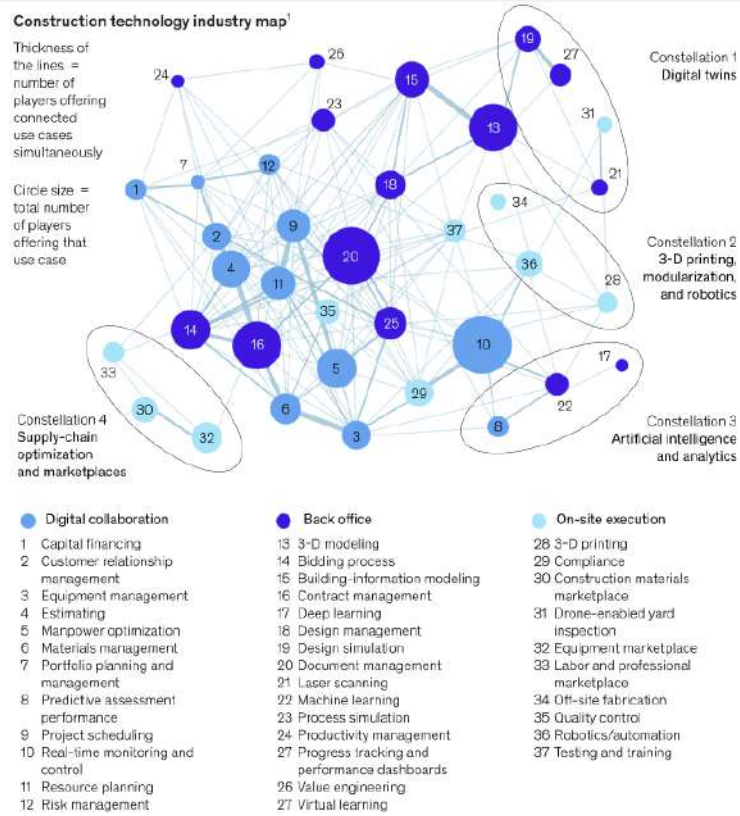
**Forty to 45 percent of value pools are expected to shift and impact all players along the value chain.**



## Investment Trends

Investment in **Construction Tech** has more than doubled over the past decade. Venture Capital.




*"…Recent analysis of the construction technology ecosystem finds emerging trends that are disrupting the way we plan, design and execute projects…"*

EMERGING TRENDS:
- Artificial intelligence and analytics
- *3-D printing, modularization, and robotics*
- *Digital twin technology*
- *Supply chain optimization and marketplaces (Digital Procurement)*

CLUSTERS:
- On-site execution ("field")
- Digital collaboration ("team") - *Digital twin technology*
- Back-office and adjacencies ("office")

https://www.mckinsey.com/business-functions/operations/our-insights/seizing-opportunity-in-todays-construction-technology-ecosystem



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# DATA CENTRES

## SCOPE:

- Design Review / Modularization Feasibility
- Design Coordinators – Pre-Construction and Construction Stage
- Construction / Fabrication Drawings
- Quantities / Cost Control
- Model Handover – PIM to AIM

## CHALLENGES:

- Programme – Design & Build + Fast Track Approach
- Multi-Stakeholder Interface
- Design Detailing – Elevated Level of Detail
- “Optioneering” – Client Request for Alternatives
- Accelerated rhythm on site – difficult to accompany
- Spatial Coordination Constraints
- Elevated Project Reporting

## SOLUTIONS:

- Implementation – BIM Project Standards (Industry Recognized) – Data Management & Stakeholder Collaboration
- Implementation of design coordination strategy – space management + clash detection process
- Live Model Concept – Complete collaboration with other stakeholder via Cloud
- API Programming – Optimization of Repetitive Tasks
- Implementation of HoloBuilder or equivalent solutions – daily view of site progress (back office)
- Integration of Data Analytics Techniques – Project Reporting / Asset Management
- Design Options Function – BIM Software Capacity

**DESIGN STAGE**

**PRE-CONSTRUCTION**
**INSTALL PREPARATION & APPROVAL**

**INSTALLATION**

**HANDOVER**

DESIGN AND MODEL REVIEW:

MEP COORDINATION & INSTALL DRAWINGS + APPROVAL PROCESS

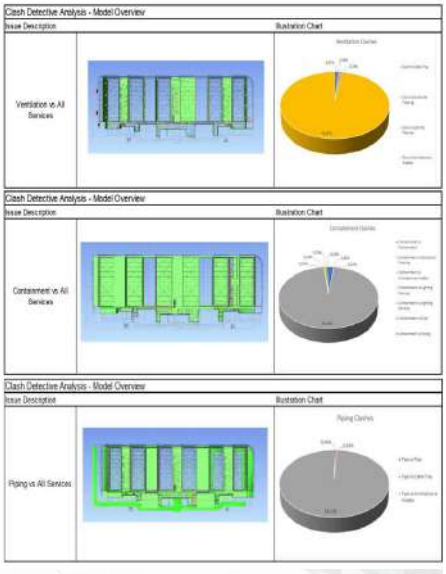
ONSITE SUPPORT

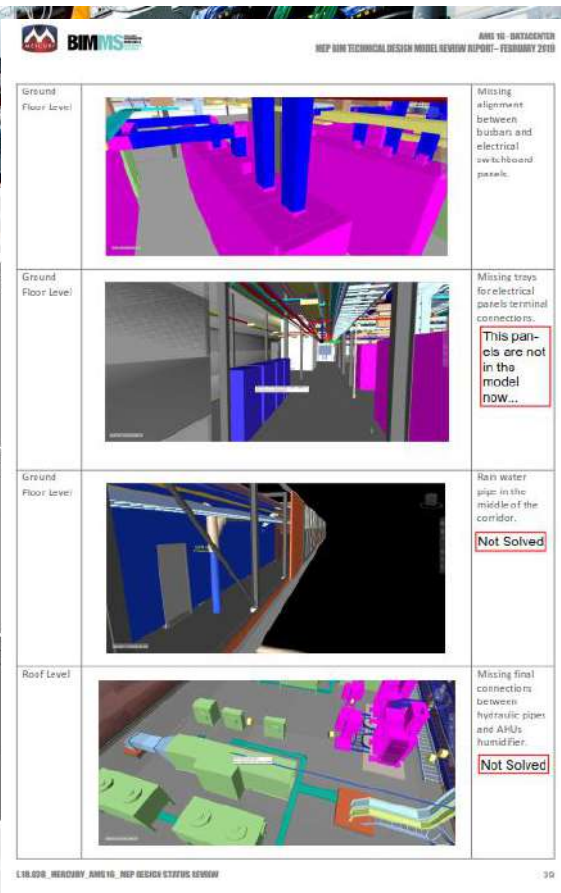
AS-BUILTS FOR HANDOVER + APPROVAL PROCESS
MODEL ASSET INFORMATION FOR HANDOVER

## PRE-CONTRACT - DESIGN & MODEL REVIEW

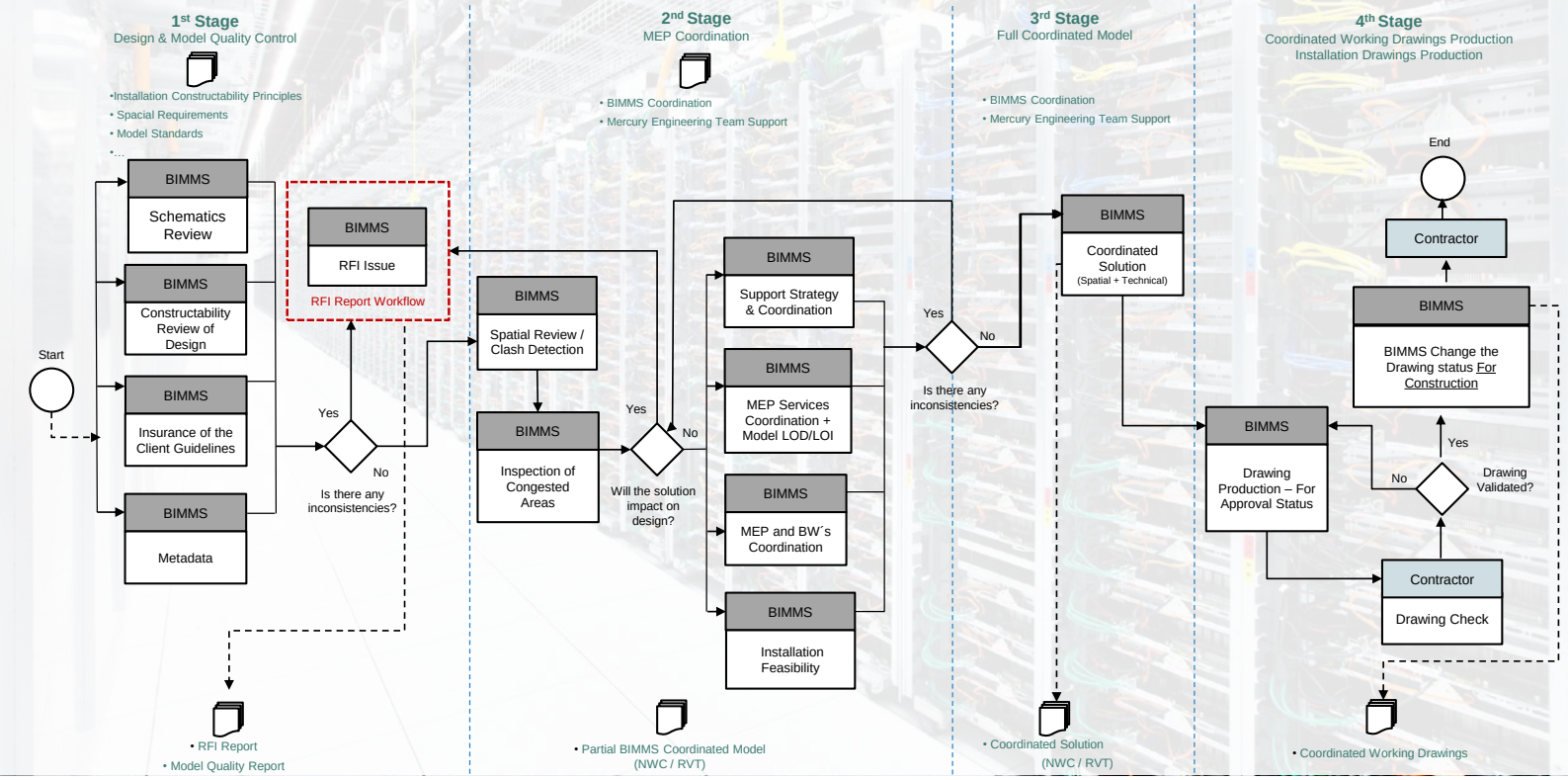
**KEY AREAS OF REVIEW:**

- Design Package Overview
- BEP Compliance – Model Content & Quality review
- Design Issues – Technical
- Design Co-ordination, Installation Feasibility & Accessibility Provision
- Model Co-ordination – Clash Detection
- Procurement – Model Support for Quantities

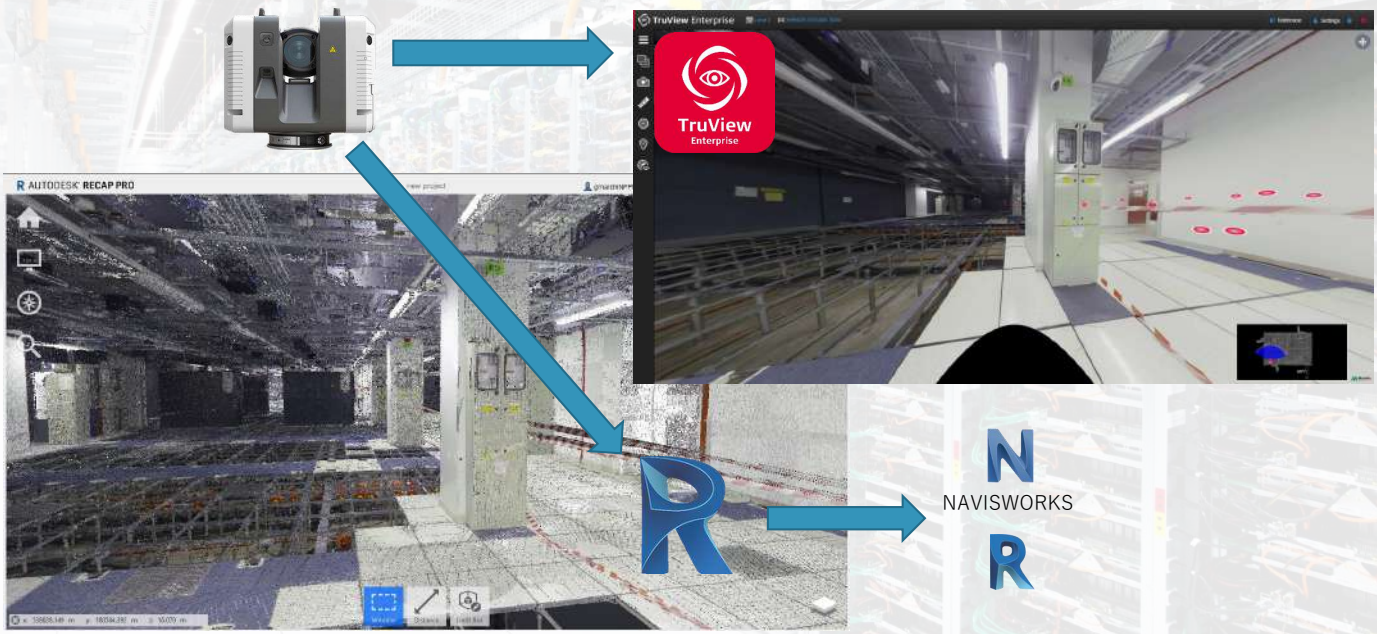


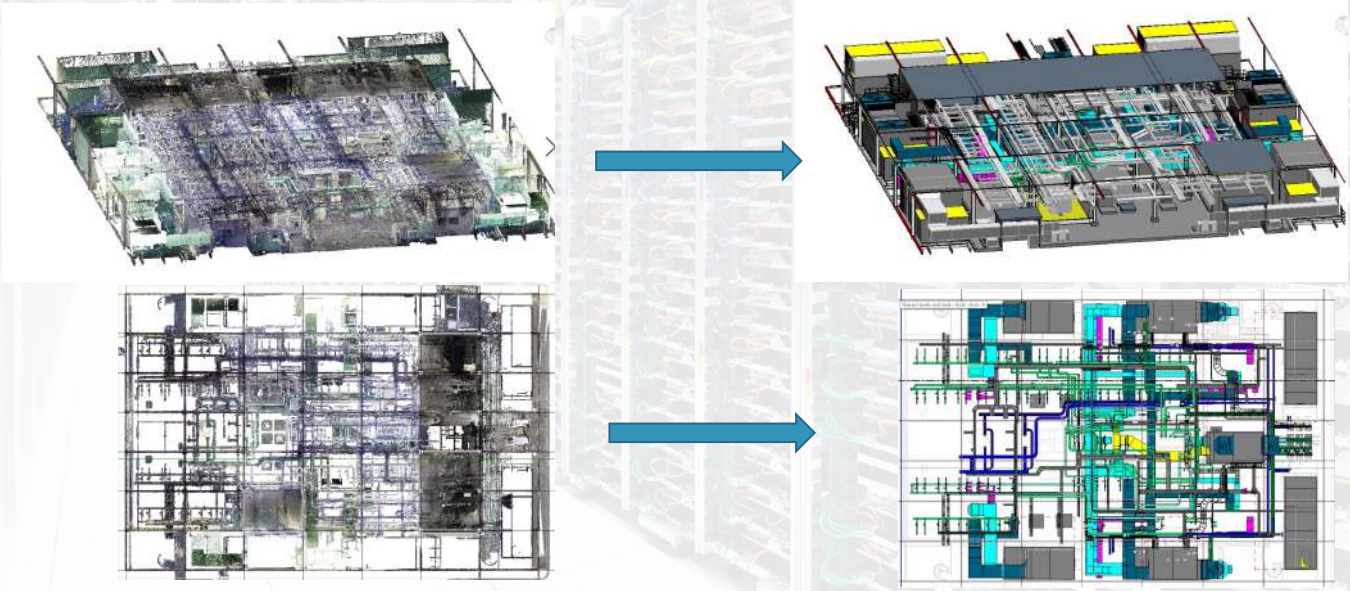
## MEP COORDINATION & INSTALLATION DRAWINGS - WORKFLOW




## POINT CLOUD TECHNOLOGY – REFURBISHMENT WORKS



## POINT CLOUD TECHNOLOGY – REFURBISHMENT WORKS

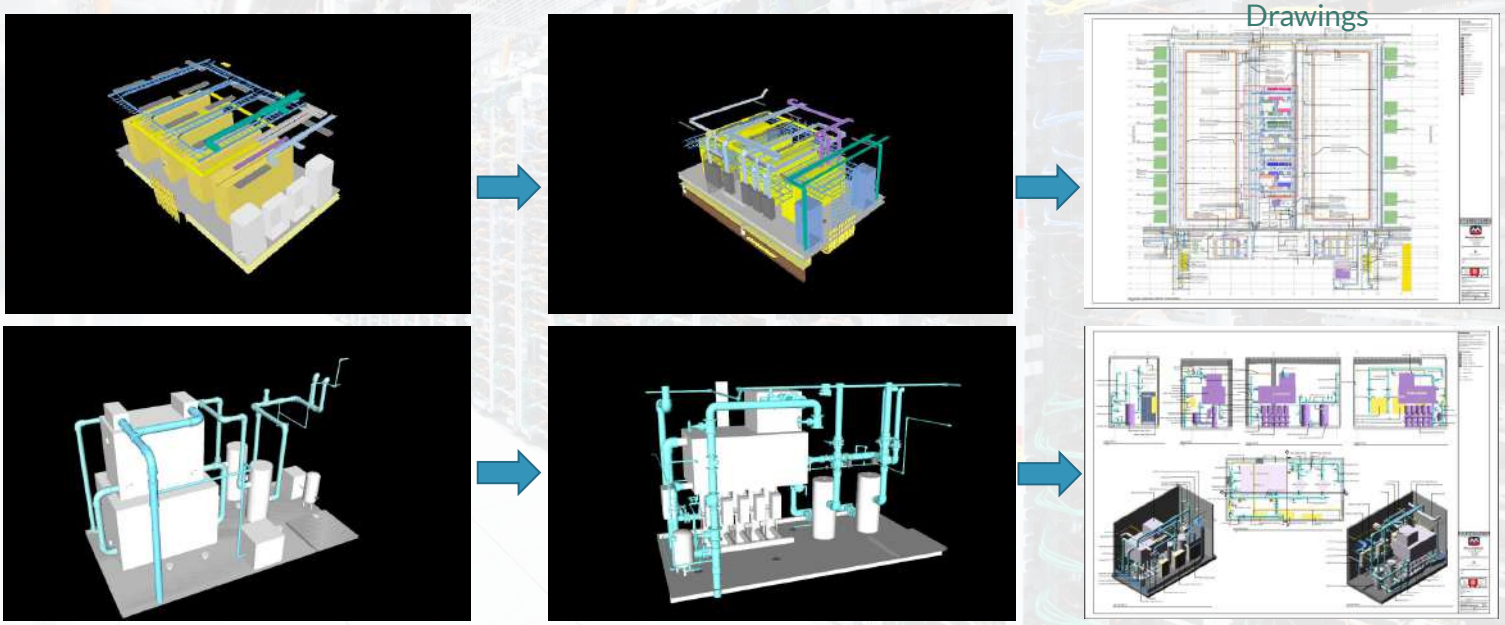


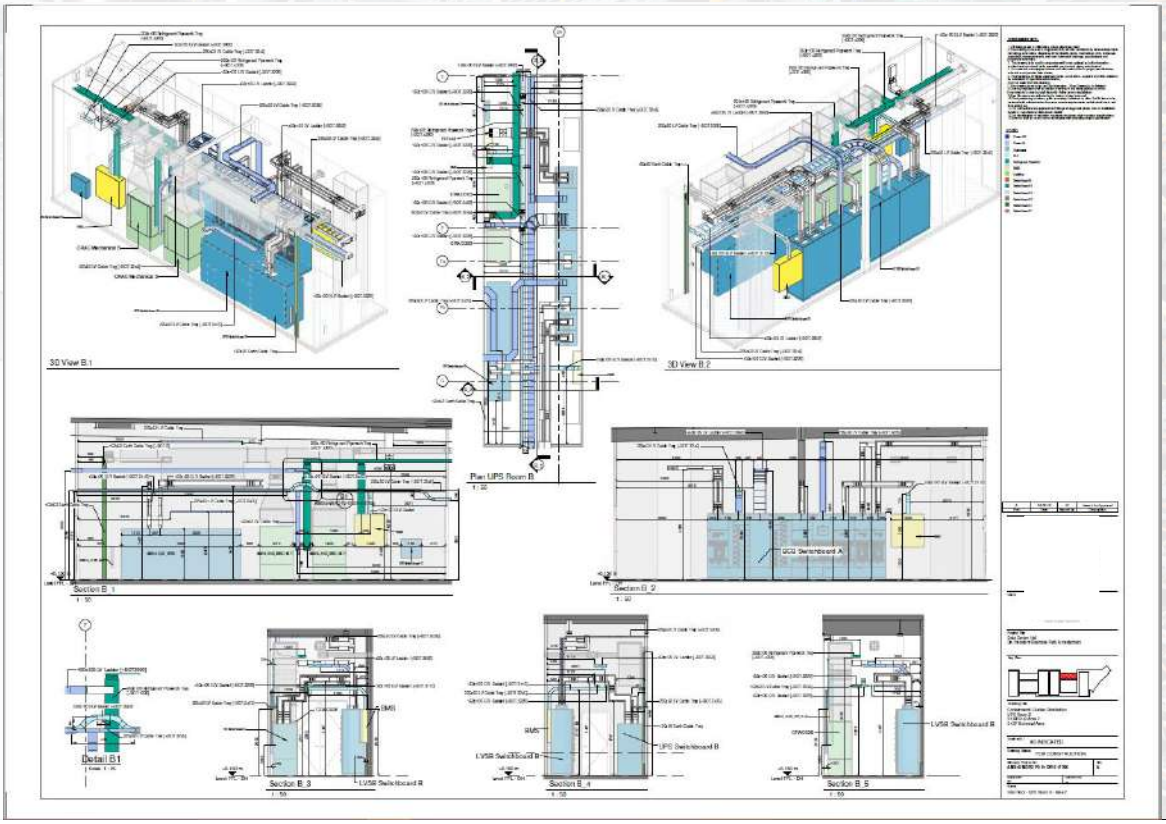
## MEP COORDINATION & INSTALLATION DRAWINGS - WORKFLOW

Not Coordinated Model

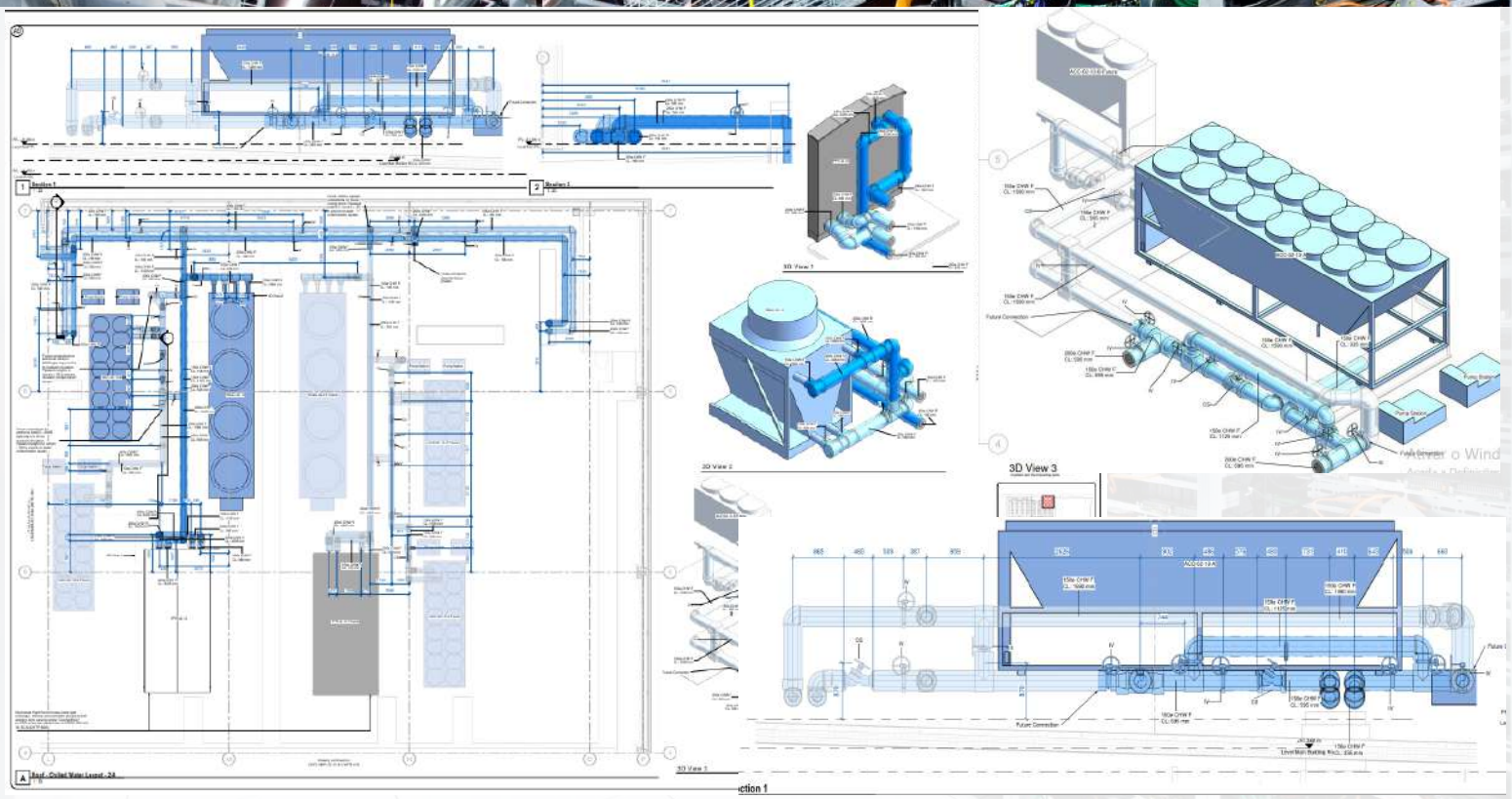
Coordinated Model

CWD / Installation Drawings



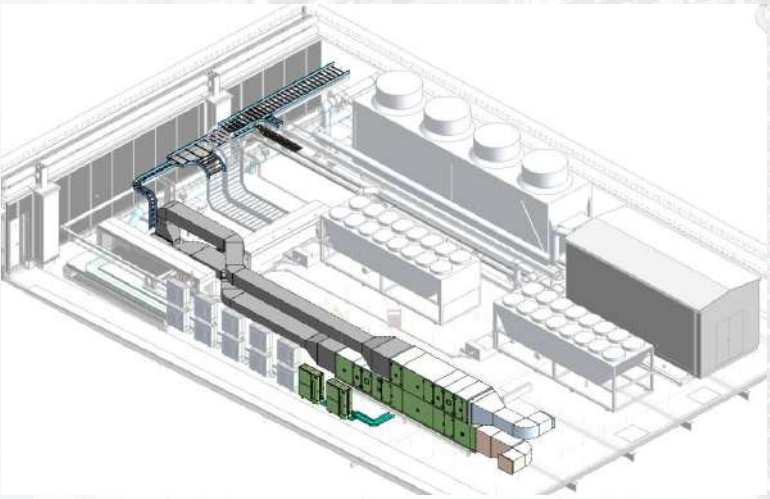


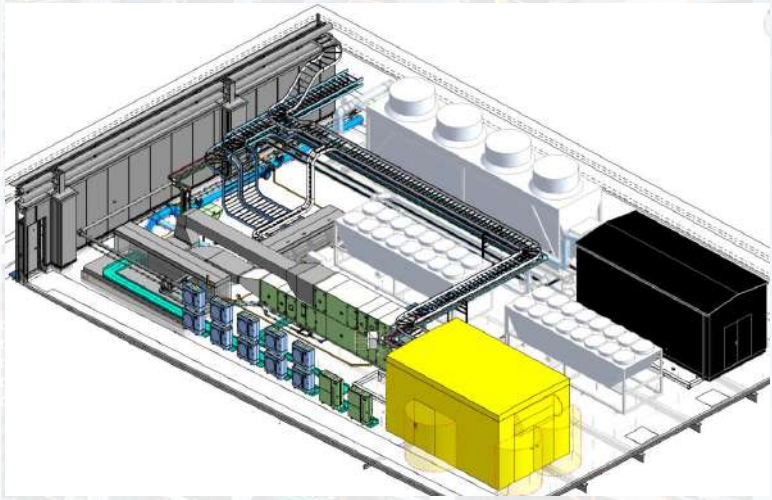

BIMMS BUILDING INFORMATION MODELING & MANAGEMENT SOLUTIONS



## DESIGN OPTIONNS

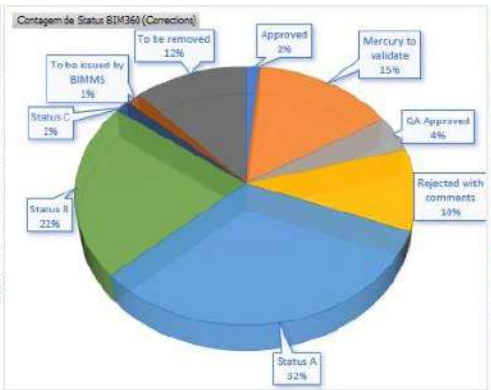
- Ability to provide different design alternatives in order to achieve the best alternative
- Ability to test different design options without messing or altering the Main Model



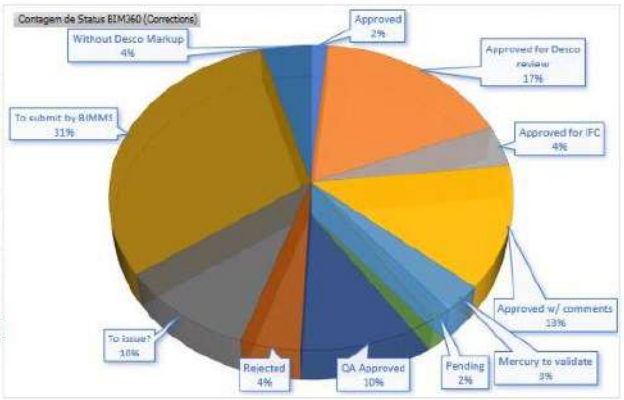


## PROJECT MANAGEMENT REPORTING

| Rótulos de Linha | Contagem de Status BIM360 (Corrections) |
|---|---|
| Approved | 1 |
| Mercury to validate | 10 |
| QA Approved | 3 |
| Rejected with comments | 7 |
| Status A | 22 |
| Status B | 15 |
| Status C | 1 |
| To be issued by BIMMS | 1 |
| To be removed | 8 |
| Total Geral | 68 |



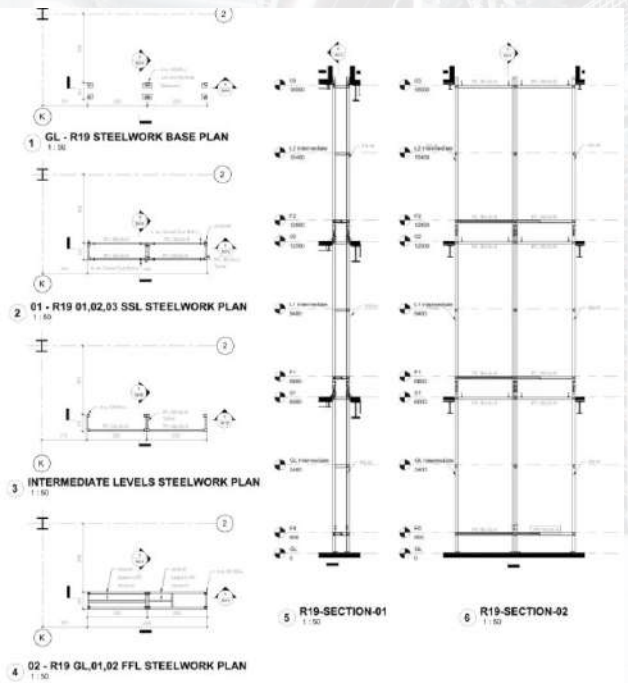

| Rótulos de Linha | Contagem de Status BIM360 (Corrections) |
|---|---|
| Approved | 1 |
| Approved for Desco review | 12 |
| Approved for IFC | 3 |
| Approved w/ comments | 9 |
| Mercury to validate | 2 |
| Pending | 1 |
| QA Approved | 7 |
| Rejected | 3 |
| To issue? | 7 |
| To submit by BIMMS | 21 |
| Without Desco Markup | 3 |
| Total Geral | 69 |

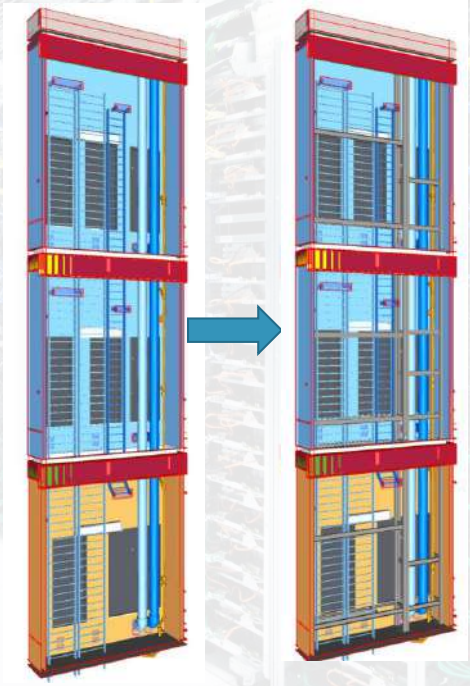


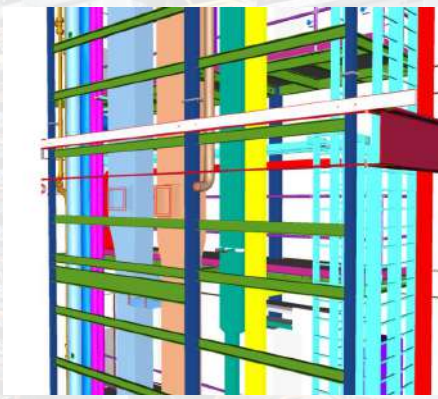
## BUILDERS WORKS


| OPE's Schedule: Copy 1 | | | | | |
|---|---|---|---|---|---|
| OPE | OPE: Number | OPE: Height | OPE: Thickness | OPE: Width | OPE: Service Type |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 143 | 200 | 200 | 200 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 144 | 150 | 200 | 550 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 145 | 150 | 200 | 325 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 146 | 150 | 200 | 550 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 147 | 150 | 200 | 325 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 148 | 200 | 200 | 200 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 149 | 150 | 200 | 550 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 150 | 200 | 200 | 550 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 151 | 150 | 151 | 325 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 152 | 150 | 196 | 400 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 153 | 200 | 200 | 532 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 154 | 200 | 200 | 900 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 155 | 200 | 200 | 300 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 156 | 200 | 200 | 300 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 157 | 141 | 200 | 325 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 158 | 169 | 200 | 722 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 159 | 127 | 200 | 325 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 160 | 120 | 200 | 304 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 161 | 200 | 100 | 730 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 162 | 250 | 220 | 700 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 163 | 250 | 220 | 700 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 164 | 150 | 220 | 325 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 165 | 255 | 200 | 550 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 166 | 250 | 220 | 894 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 167 | 250 | 220 | 894 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 168 | 150 | 220 | 325 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 169 | 225 | 220 | 550 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 170 | 300 | 300 | 900 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 171 | 300 | 200 | 300 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 172 | 200 | 200 | 400 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 173 | 225 | 200 | 550 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 174 | 150 | 200 | 700 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 175 | 255 | 200 | 700 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 176 | 150 | 200 | 400 | Refrigerant Tray |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 177 | 225 | 200 | 550 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 178 | 300 | 200 | 1476 | Electrical |
| ST Wall OPE: Rectangle 1: Rectangular | OPE: 179 | 200 | 200 | 325 | Electrical |

## FABRICATION DESIGN



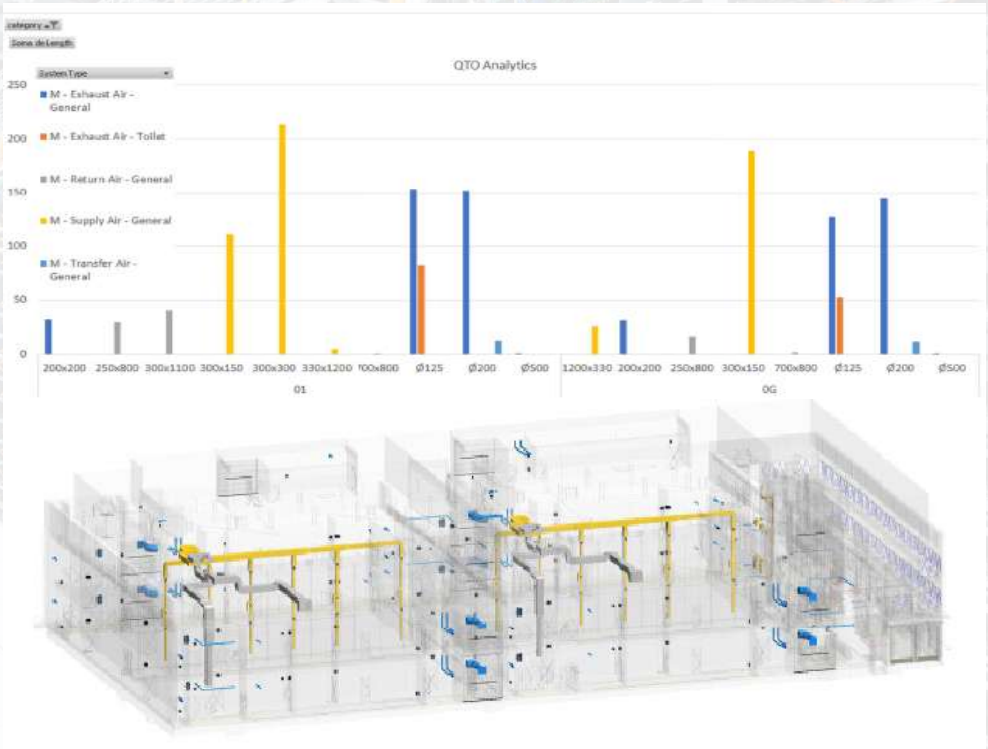





## QUANTITIES CONTROL & MONOTORING

Ductwork QTO - ∑ Length(m)

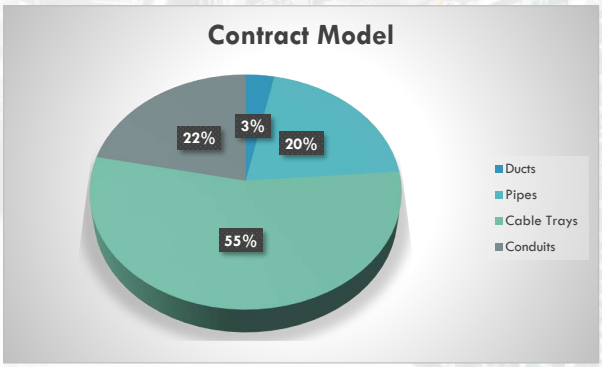
| ∑ Length (m) | System | | | | | |
|---|---|---|---|---|---|---|
| Level / Size | M - Exhaust Air - General | M - Exhaust Air - Toilet | M - Return Air - General | M - Supply Air - General | M - Transfer Air - General | ∑ Length (m) |
| 01 | 337,95 | 82,29 | 70,63 | 329,09 | 12,31 | 832,27 |
| 200x200 | 32,32 | | | | | 32,32 |
| 250x800 | | | 29,6 | | | 29,6 |
| 300x1100 | | | 40,33 | | | 40,33 |
| 300x150 | | | | 111 | | 111 |
| 300x300 | | | | 213,6 | | 213,6 |
| 330x1200 | | | | 4,49 | | 4,49 |
| 700x800 | | | 0,7 | | | 0,7 |
| Ø125 | 153,21 | 82,29 | | | | 235,5 |
| Ø200 | 152,18 | | | | 12,31 | 164,49 |
| Ø500 | 0,24 | | | | | 0,24 |
| 0G | 302,9 | 52,67 | 17,3 | 214,6 | 11,81 | 599,28 |
| 1200x330 | | | | 25,6 | | 25,6 |
| 200x200 | 31,4 | | | | | 31,4 |
| 250x800 | | | 16,1 | | | 16,1 |
| 300x150 | | | | 189 | | 189 |
| 700x800 | | | 1,2 | | | 1,2 |
| Ø125 | 127,14 | 52,67 | | | | 179,81 |
| Ø200 | 144,12 | | | | 11,81 | 155,93 |
| Ø500 | 0,24 | | | | | 0,24 |
| ∑ Length (m) | 640,85 | 134,96 | 87,93 | 543,69 | 24,12 | 1431,55 |

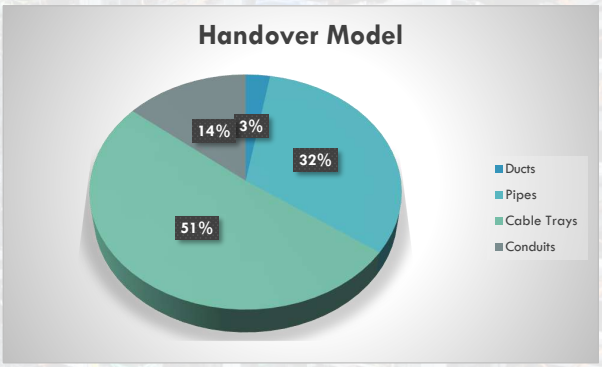





## QUANTITIES CONTROL & MONOTORING

Variations analysis from the design models (stage 3 / 4a) to the handover model (stage 5/6):



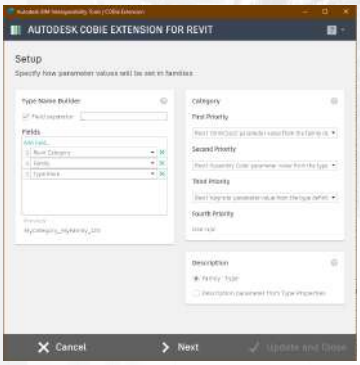



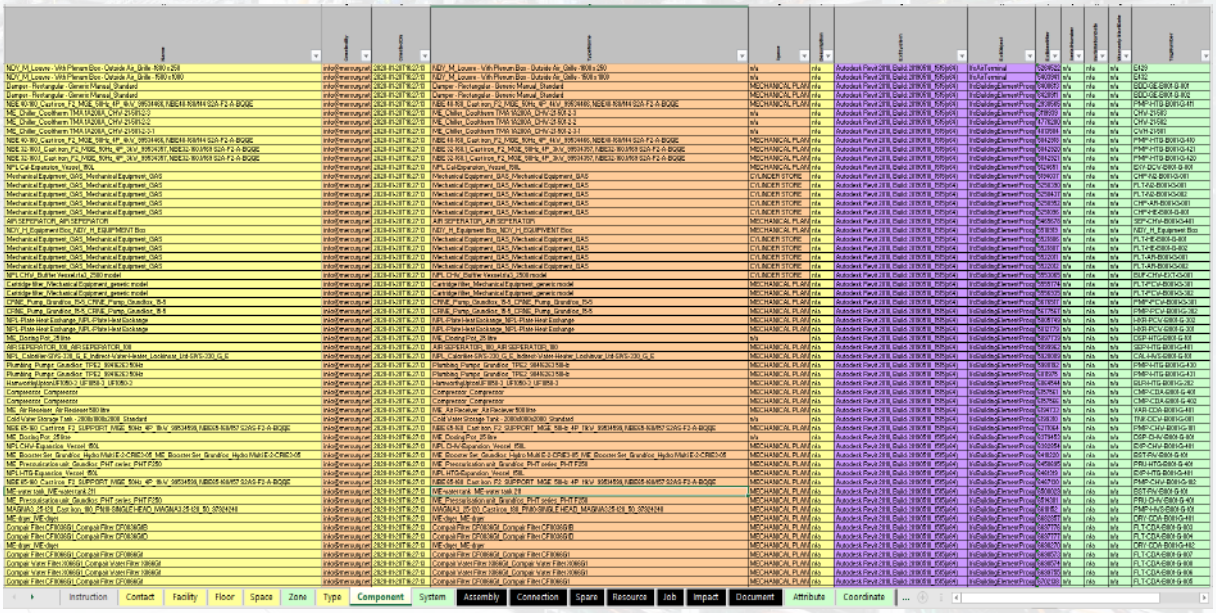

| Contract Model | |
|---|---|
| Service | Length (m) |
| Ducts | 391 |
| Pipes | 2480 |
| Cable Trays | 6603 |
| Conduits | 2621 |

| Handover Model | |
|---|---|
| Service | Length (m) |
| Ducts | 404 |
| Pipes | 4703 |
| Cable Trays | 7475 |
| Conduits | 2054 |

## ASSET INFORMATION MODEL – FM INTEGRATION

Metadata:

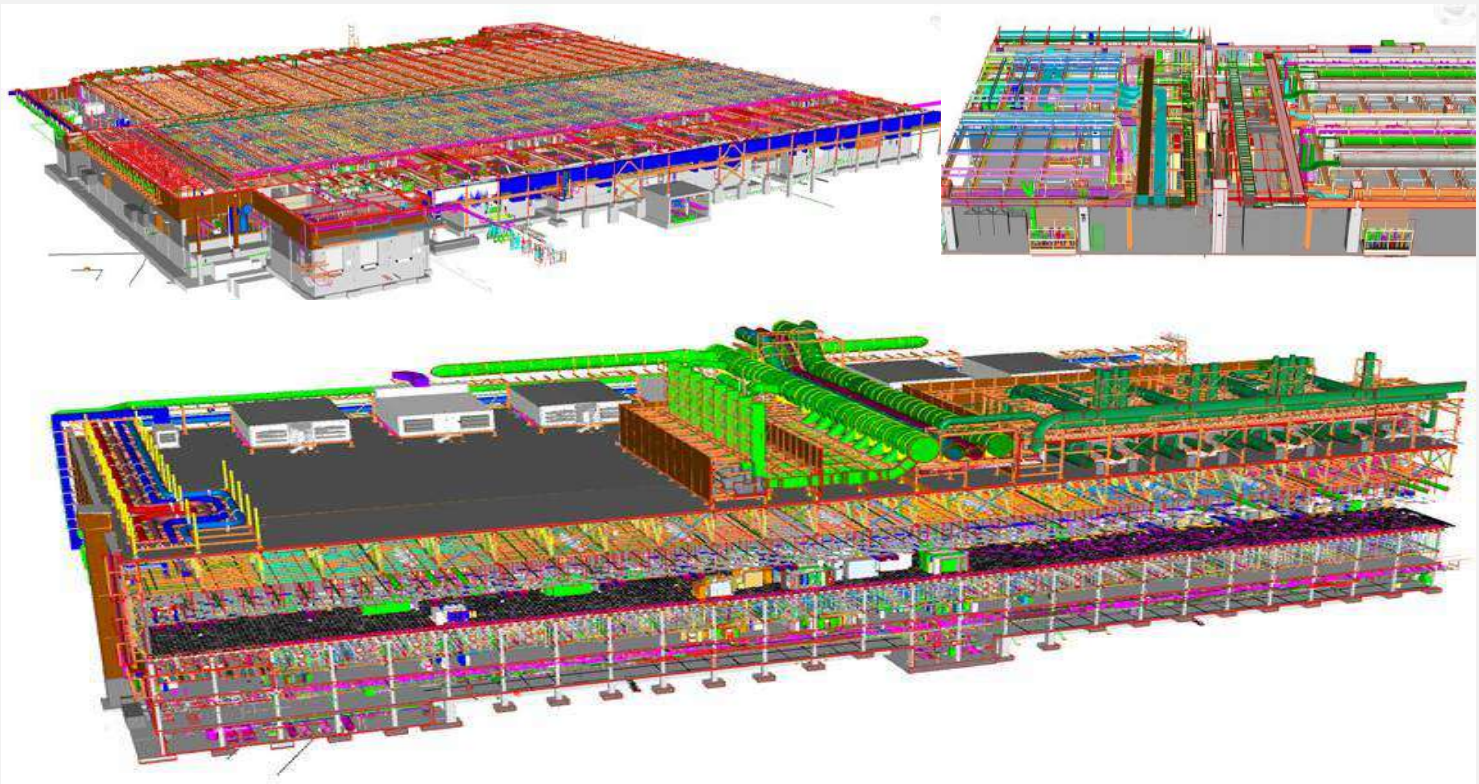



SEMICONDUTORS

## SEMI-CONDUCTOR FACTORY PROJECT





## SEMI-CONDUCTOR FACTORY PROJECT

### Scope

**Scope:**

Electrical Coordinators
Fabrication Design
Design / Support Optimization
Tool Install Coordinators

**Client BIM Uses – BEP:**

Quantity Take-Off (5D Modelling)
Content Reviews
QA/QC
Phase Planning (4D Modelling)
Code Validation
Specifications and Standard Details
Equipment List
MEP Space Management
Point of Connection (POC) Database (FASTR)
Provided Pre-engineered, Pre-manufactured, Off site fabrication content
3D Control and Planning (Digital Layout / BIM to Field)
Trade Partner Design and Fabrication
Construction Methods Design
3D Construction Coordination
Record Modelling

### BIMMS Roles

- BIM Manager
- BIM Coordinator
- BIM Specialist
- BIM Engineer

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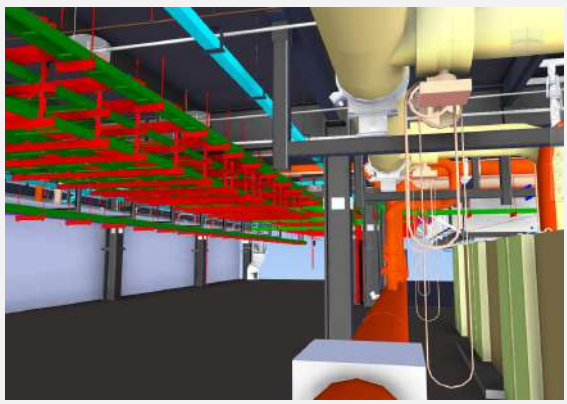
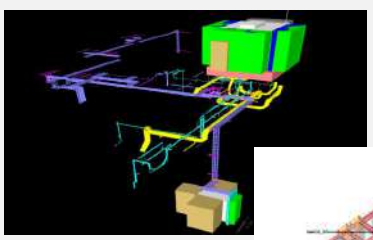
## SEMI-CONDUCTOR FACTORY PROJECT

### Challenges

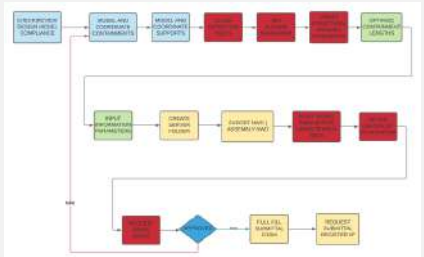
BIM Challenges

- Fast-track Programming
- Design Detail (LOD400 / LOD 500)
- Approval Gateway
- QA/QC Methodology
- Multidisciplinary Project
- + 300 stakeholders (Live)
- Precision – Digital Twin



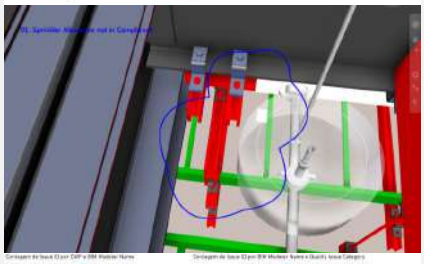


## METHODOLOGIES AND SOLUTIONS IMPLEMENTED



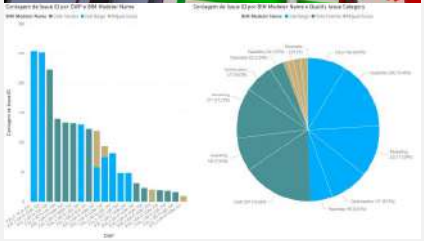
### Standards on Modelling Processes:

- Equipment validations
- Vendor specifications
- Feasibility principles
- Support Calculation Reports



### Internal QA/QC Processes and Standards:

- QA/QC Guidelines and Principles to be reviewed
- Review routines that produce rough data – analysed afterwards
- Feasibility verifications – specific allowances to be complied



### BIM Analytics:

- Quality issues quantification
- Management decisions based on quality report
- Meeting alignment with quality reports
- Coordination Progress valuation through data information
- Quantity controlling – time lapsed

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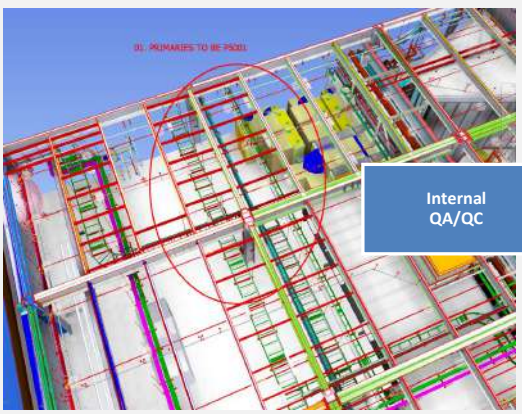
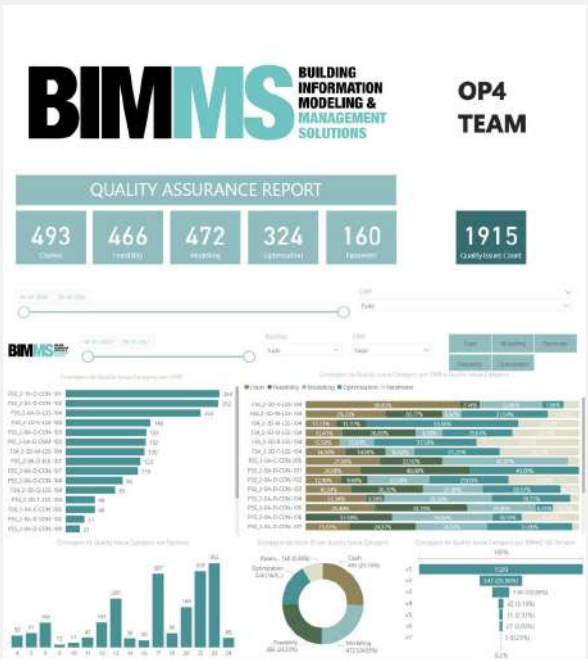
## INTERNAL QA/QC ROUTINES - BIM ANALYTICS

**Quality Assurance Processes:**

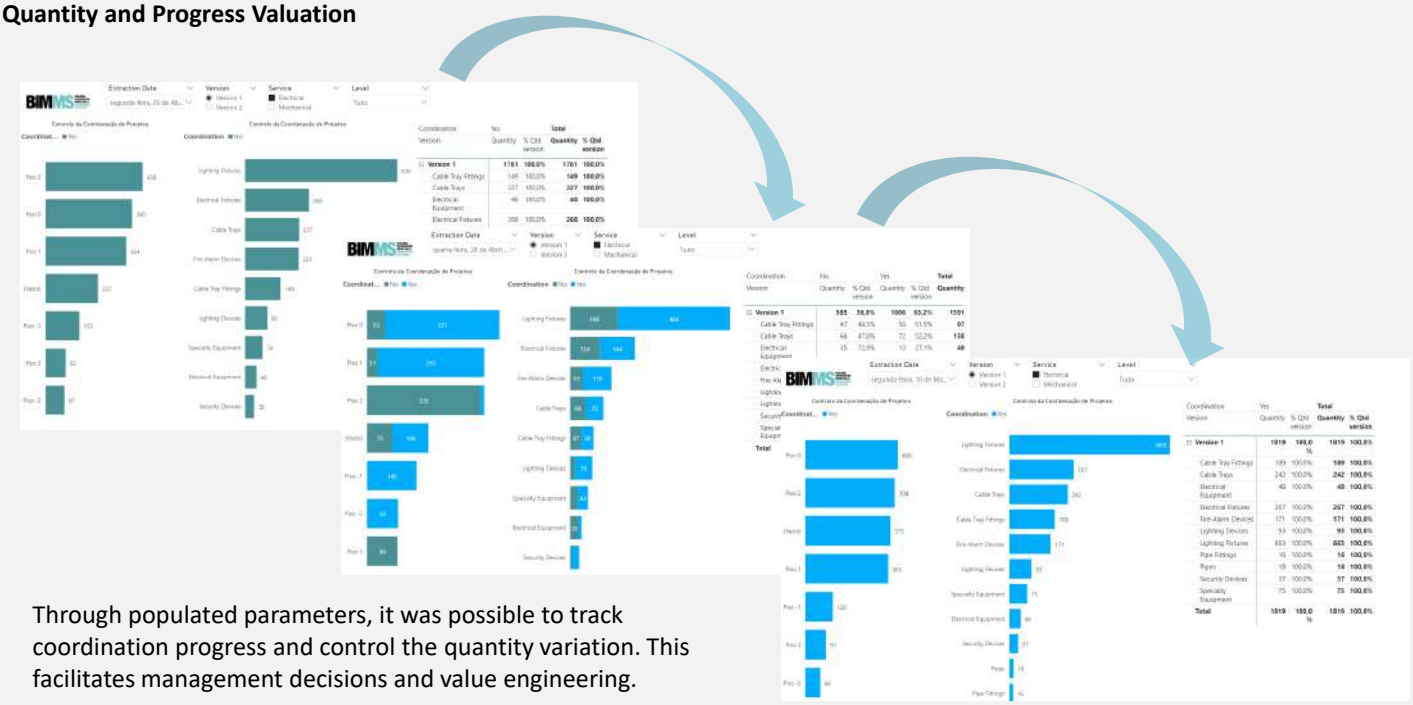
Considering the high-level project quality standards and detail level, it was required to implement Internal Quality Assurance and Control processes that generate value through rough data. These data were continuously extracted and transformed into valuable management information:



## BIM ANALYTICS

### Quantity and Progress Valuation



Through populated parameters, it was possible to track coordination progress and control the quantity variation. This facilitates management decisions and value engineering.

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## AGENDA

**1- PRESENTATION**

**2- AECO INDUSTRY – OVERVIEW**

Key Challenges | Employer Requirements | Market Trends | Investment Trends

**3- PROJECTS**

CHALLENGES & SOLUTIONS

Education | **Data Centers | Semiconductors**

**4- R&D FRAMEWORK**

Overview | Industry Trends | Solutions

## OVERVIEW

INDUSTRY – Current Challenges:

- Elevated Client Engagement
- Increment of Design Detail (Compliance Demonstration)
- Multi Stakeholder Coordination
- Additional Requisites for Spatial Coordination (CDM Compliance)
- Progress Reporting – BIM applied to Project Management
- Value Engineering is the standard
- Pre-Fab Solution / Off site construction is a reality
- Modularization Implementation
- Transparency
- Fast Track Approach is the Standard
- Value Engineering is the standard
- Optioneering by client team
- Homeworking – Distance from Site
- Quantity Control & Monitoring
- Handover – Asset Information Model
- …

CURRENT INDUSTRY DEMANDS STREAMLINED DIGITAL COLLABORATIVE LIVE PROCESSES, INTEROPERABILITY AND BIM MODELS PREPARED TO DEVELOP MULTI USES



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UK BIM FRAMEWORK

bsi. cdbb UKBIM ALLIANCE


## DIGITAL CONSTRUCTION – STRATEGY REVIEW

### STRATEGIC OBJECTIVES – SUMMARY

**EMPLOYER PRESPECTIVE:**
- Digital approach to Asset Management and Records. Digital Integration with AM softwares;
- Enhanced Interaction during key stages of design development & installation delivery;
- Overall Risk Mitigation;
- Marketing – Endomarketing & Public;

**PROJECT MANAGEMENT PRESPECTIVE:**
- Reporting Analytics – Progress / Quality Control / Performance KPIs;
- Implementation of an Integrated Digital Constraints Log;

**CONTRACTOR PRESPECTIVE:**
- Feasibility, optimization and detailed coordination reviews ahead of fabrication & installation;
- Enhance accuracy and consistency of construction / fabrication deliverables (drawings / schedules / etc...);
- Digital method to extract, control and review quantities and its respective BOQ interface;
- Programme simulations – enhanced visualization / communication for installation sequencing, definition of project milestones and critical path review;
- Integrated Cost Control;
- Procurement Support – Extracting Consistent Procurement Packages;
- Field Integration – Digital procedures for Snagging;
- Enhancing site planning and logistics;
- Health and Safety – Digitalization risk assessment and management procedures;

**DESIGN DEVELOPMENT PRESPECTIVE:**
- Enhancing compliance reviews (i) Requirements & Code (ii) multidisciplinary coordination, (iii) installation and (iv) accessibility;
- Enhancing the integration of O&M maintenance strategies and CDM compliance checks during design development;
- Quantity and BOQ control. Implementation of a Target Value Design, based on budget caps;
- Digitally integrated design information (BIM models / drawings / schematics / specifications / schedules). Avoidance of inconsistencies;
- Enhanced approach to value engineering;
- Sustainability: BREEAM / LEED & BIM integration;
- Site Analysis – Optimal Building positioning and demonstration of code compliance;
- Energy Analysis – Compliance demonstration and optimization approach;
- Design Change Management – Trackability Implementation;
- Pre-Fab Solution – Feasibility Review;
- Pre-Construction Acceleration – Enable first works.

### BIM USES & ADDED VALUE

**CONTENT REVIEWS – DESIGN, FEASIBILITY AND COMPLIANCE CHECK**
A process in which stakeholders view a 3D model / virtual reality and provide their feedbacks to validate multiple design aspects.
ADDED VALUE:
- Eliminate costly and timely traditional construction mock-ups
- Different design options and alternatives may be easily modelled and changed in real-time during design review base on end users and/or owner feedbacks
- Create shorter and more efficient design and design review process
- Evaluate effectiveness of design in meeting building program criteria and owner's needs
Easily communicate the design to the owner, construction team and end users
- Greatly increase coordination and communication between different parties. More likely to generate better decisions for design

**CLASH DETECTION – QA/QC APPROVAL REVIEW**
A process in which Clash Detection software is used during the coordination process to determine field conflicts by comparing 3D models of building systems
ADDED VALUE:
- Coordinate building project through a model
- Reduce and eliminate field conflicts; which reduces RFI's significantly compared to other methods
- Visualize construction
- Reduced construction cost; potentially less cost growth (i.e. less change orders)
- Decrease construction time
- Increase productivity on site
- More accurate construction / installation / fabrication drawings

**BIM ANALYTICS – REPORTING**
A process in which the project models are used for reporting and analytics purposes, namely to serve the interests of the project a management team and contractor team in terms of project management, quality control and performance reviews.
ADDED VALUE:
- Reporting indicators to better evaluate and manage progress, quality and performance;
- Enable the identification of critical constraints

**DESIGN ANALYSIS (INTEGRATED FROM BIM DESIGN MODELS)**
A process in which analysis software are able to integrated BIM models and digitally re-use the information to run analysis, enabling the definition of the design criteria and specification (e.g. structural / lighting / Mechanical / etc)
ADDED VALUE:
- Automating analysis and saving time and cost
- Improve the quality and reduce the cycle time of the design analyses
- Value Engineering and design optimization
- Confirm design changes on a fast-track basis

**SITE ANALYSIS, PLANNING & LOGITICS**
A process in which BIM/GIS tools are used to evaluate properties in a given area to determine the most optimal site location for a future project and respective construction site.
ADDED VALUE:
- Use calculated decision making to determine if potential sites meet the required criteria according to project requirements, technical factors, and financial factors
- Increase energy efficiency

**FACILITY ENERGY ANALSYSIS**
The BIM Use of Facility Energy Analysis is a process in the facility design phase which one or more building energy simulation programs use a properly adjusted BIM model to conduct energy assessments for the current building design.
ADDED VALUE:
- Save time and costs by obtaining building and system information automatically from BIM model instead of inputting data manually
- Optimize building design for better building performance efficiency and reduce building life-cycle cost

**SUSTAINABILITY TRACKING & EVALUATION – BREEAM & BIM INTEGRATION**
This process should occur during all stages of a facilities life including planning, design, construction, and operation. Applying sustainable features to a project in the planning and early design phases is more effective (ability to impact design) and efficient (cost and schedule of decisions).
ADDED VALUE:
- Facilitates interaction, collaboration, and coordination of team members early in the project process which is considered to be favourable to sustainable projects;
- Centralizes all relevant content, which is traceable
- Enables early and reliable evaluation of design alternatives

**POINT OF CONNECTIONS (POC) – SETTING OUT INTERFACES**
A process in which a series of models are used as a means to document Point of Connections within the facility. Information can be exported from 3D models to communicate POC data relating to IDs and Assignments.
ADDED VALUE:
- Provides a means to integrate Facility management of POCs with ongoing and future design efforts
- Enhances setting out works onsite
- Identification of available POCs in a specific area are quickly assessed through a custom model view

**PRE-FABRICATION SOLUTION INTEGATION**
A process in which BIM is used to capture trade and supplier provided pre-engineered, pre-manufactured, off site fabrication content.
ADDED VALUE:
- Increase constructability of a complex building system
- Increase construction productivity

**PROGRAMME INTEGRATION, SIMULATION AND OPTIMIZATION (4D MODELLING)**
A process in which a 4D model (3D models with the added dimension of time) is utilized to effectively plan the phased occupancy in a renovation, retrofit, addition, or to show the construction sequence and space requirements on a building site.
ADDED VALUE:
Better understanding of the phasing schedule by the owner and project participants and showing the critical path of the Project
- Integrate planning of human, equipment and material resources with the BIM model to better schedule and cost estimate the project
- Marketing purposes and publicity
- Monitor procurement status of project materials
- Identification of schedule, sequencing or phasing issues
- Health & Safety review

**QUANTITY TAKE-OFF, BOQ INTEGRATION & COST SIMULATIONS (5D MODELLING)**
A process in which BIM can be used to assist in the generation of accurate quantity take-offs and cost estimates and estimations throughout the lifecycle of a project. This process allows the project team to see the cost effects of their changes, during all phases of the project, which can help curb excessive budget overruns due to project modifications. Specifically, cost estimation coupled with BIM can enable Target Value Design to better estimate the cost effects of additions and modifications.
ADDED VALUE:
- Precisely quantify modelled materials
- Quickly generate quantities to assist in the decision-making process
- Generate more cost estimates at a faster rate (enables Target Value Design)
- Provide cost information to the owner during the early decision-making phase of design and throughout the lifecycle, including changes during construction
- Improved Budgeting - a BIM developed cost estimate can help track budgets throughout construction
- Easier exploration of different design options and concepts within the owner's budget

**DRAWINGS, SCHEMATICS, SPECIFICATIONS AND STANDARD DETAILS DELIVERY**
A process in which BIM utilizes software to produce and link project construction drawings, schedules, specifications and standard details. This allows design to easily create, monitor, modify, control, and coordinate between design authoring software and specifications, avoiding inconsistencies & discrepancies.
ADDED VALUE:
- SMART construction information, digitally interconnected. Coordinated design information
- Removes discrepancies between models and specifications

**BIM TO FIELD – SNAGGING**
A process in which snagging and construction quality reviews are based upon the digital model, enabling to verifying the digital and built solution.
ADDED VALUE:
- Enhances internal quality construction reviews
- Tractible and verifiable system

**RECORD MODEL & ASSET INFORMATION MODEL (AIM)**
Record Modelling is the process used to depict an accurate representation of the physical conditions, environment, and assets of a facility. The record model should, at a minimum, contain information relating to the main architectural, structural, and MEP elements. It is the culmination of all the BIM Modelling throughout the project, including operation, maintenance, and asset data in an as-built model intended for the owner or facility manager. Additional information including equipment and space planning systems may be necessary if the owner intends to utilize the information in the future.
ADDED VALUE:
- Improve documentation of environment for future uses (e.g. renovation, historical documentation)
- Digital Integration of AIM model with Asset Management Software
- Digital Integration of O&M manuals, as-builts, maintenance with AIM model.
- Implementation of a unique asset codes.



## R&D STEERING GROUPS

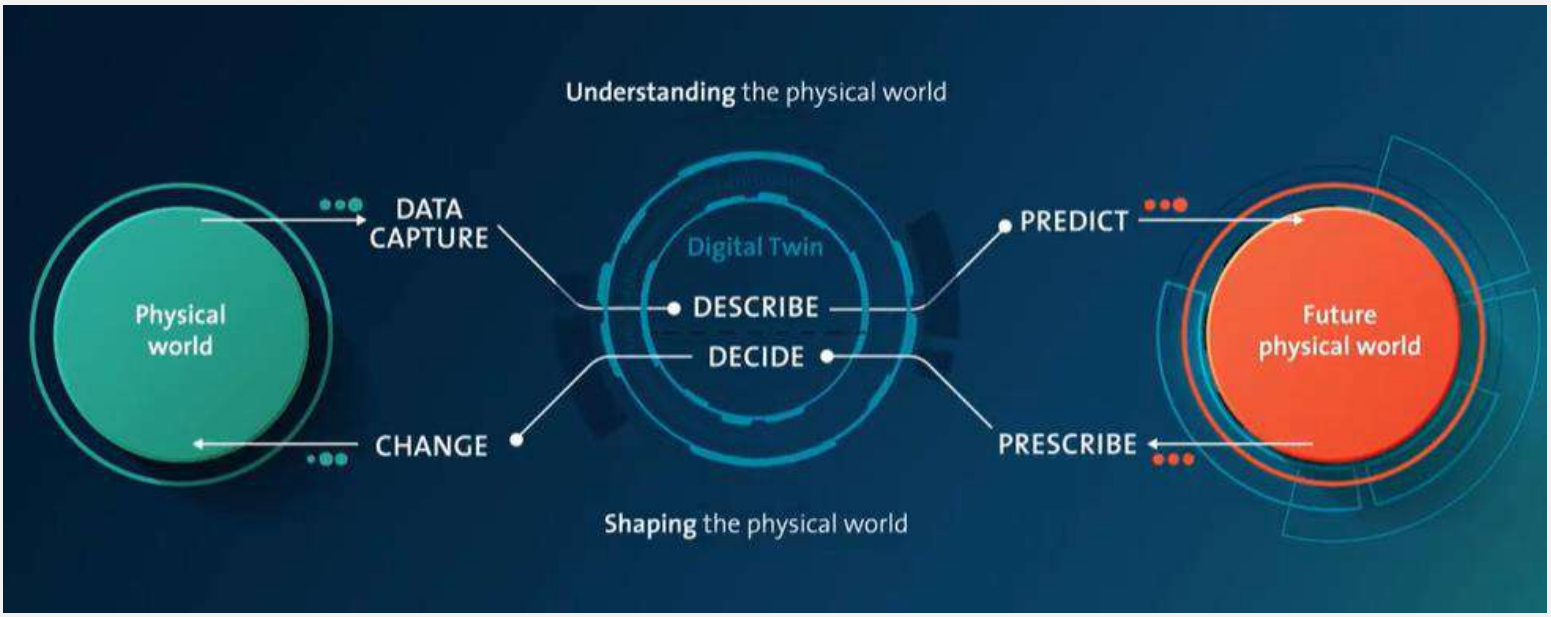
MANAGMENT
- Project Management
- Design Management

ENGINEERING
- Design / Value Engineering
- Construction Feasibility
- Asset Management

METHODOLOGY & OPTIMIZATION
- BIMMS Project Standards
- Data (BIM) Analytics
- API Programming

PROJECT SPECIFIC
- Enterprise Data Centre
- Semiconductor

## What is a DIGITAL TWIN?







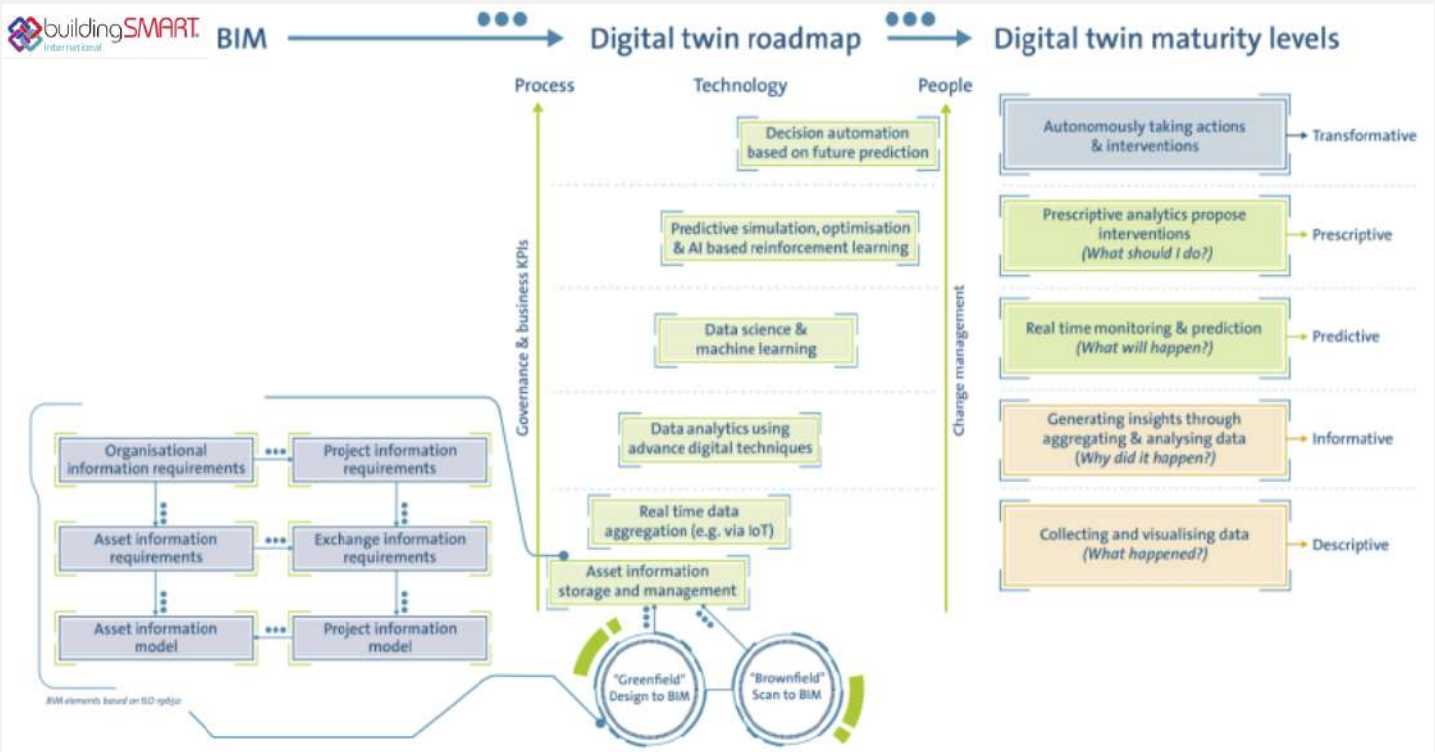
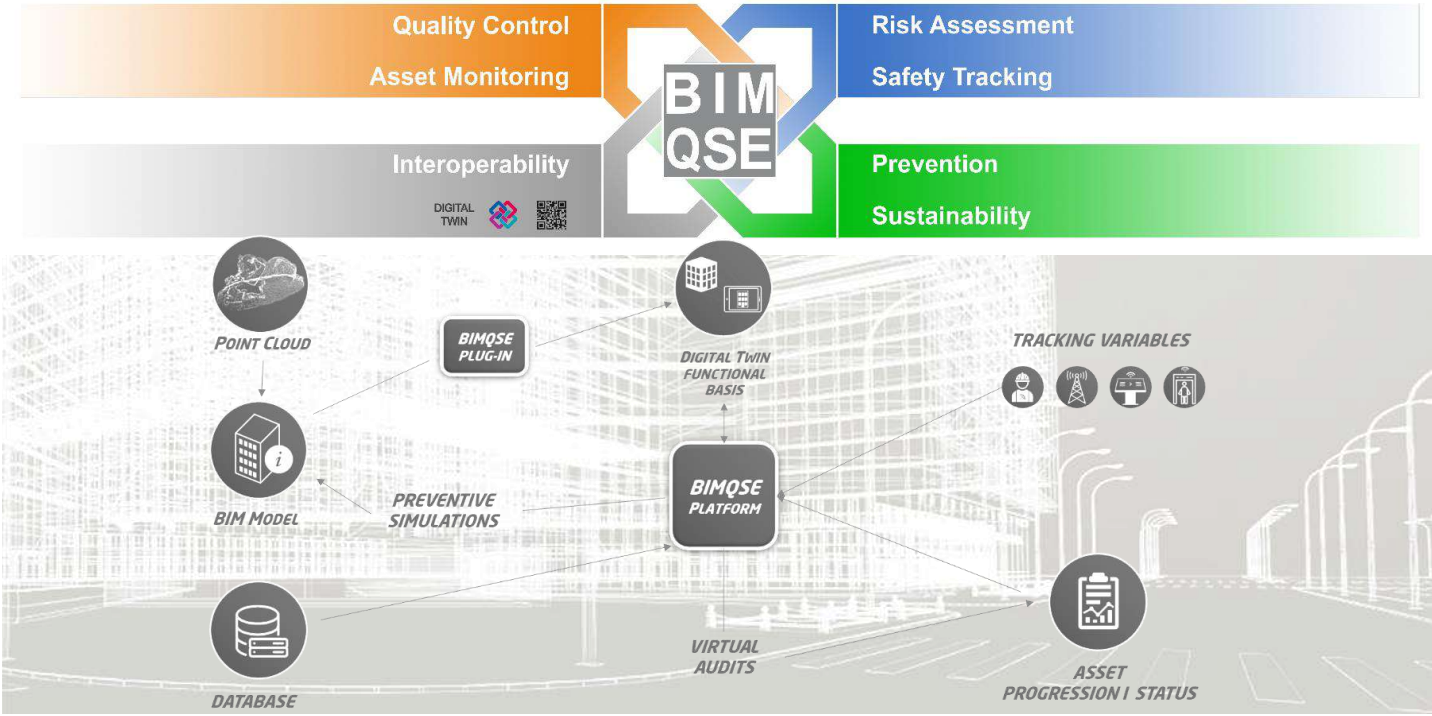




*Figure 1: Digital twin maturity levels and the role of the BIM process. Copyrights ©2020 Royal HaskoningDHV*

# Digital Twin & Business Intelligence Integration

BIMMS BUILDING INFORMATION MODELING & MANAGEMENT SOLUTIONS

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