# BIM AND DIGITAL CONSTRUCTION WORKFLOWS WITHIN THE CONSTRUCTION INDUSTRY

# DIGITAL TWIN APPLICATIONS FOR MEGA HEALTHCARE PROJECTS

## REVOLUTIONIZING HOSPITAL OPERATIONS AND MAINTENANCE THROUGH AS-BUILT BIM BASED DIGITAL REPOSITORY

08/MAY/2025 ISSAM ELABSI

# MEDICAL & RESEARCH CENTRE DIGITAL TWIN

## Project Overview

The Medical & Research Centre, involved the completion of a number of floors of the hospital, external works, the Musalla, extensive repairs to the underground car park, the multi-level car park, and carrying out studies to ensure the facility fitness, commissioning and handover of all facilities. Sidra Medical & Research Centre is designed to operate all digital (nearly) paperless and filmless environments. The complex includes a Women's, Children and Adults' hospital, with a total built-up area of 404,000 m², providing 400 beds expandable to 580 beds.

**BIM SCOPE OF SERVICE**

The client, has requested the services of Building Information Model (BIM) Specialist/ CONSULTANT who will undertake sufficient SERVICES pertaining to the development, integration and implementation of BIM methodology to develop an as-built (LOD500) BIM design to be used for Facility management, Asset Management and Operation and Maintenance. Unique, back then, Mobile laser scanning technology was used to depict the as-built condition of the project and then integrate that within the BIM design developed by the consultant team of BIM professionals creating an LOD500 BIM model. All the available as-built documentation and information were added to the digital twin thus enabling the client to effectively manage the different assets to lower the total life-cycle costs over the life of the facility. BIM services offered shall facilitate and optimize tasks pertaining specifically to "Facility Management" through integrating BIM with the hospital CMMS system.

Accordingly the execution of this contract shall lead to having an integrated building information database that will facilitate effective building management environment, enable coordinated commissioning activities and facility management functions such as maintenance management, preventive maintenance and asset management.

AIDIGITS BIM Academy

# MEDICAL & RESEARCH CENTRE

BIM BASED DIGITAL TWIN AIMING AT FM AND O/M

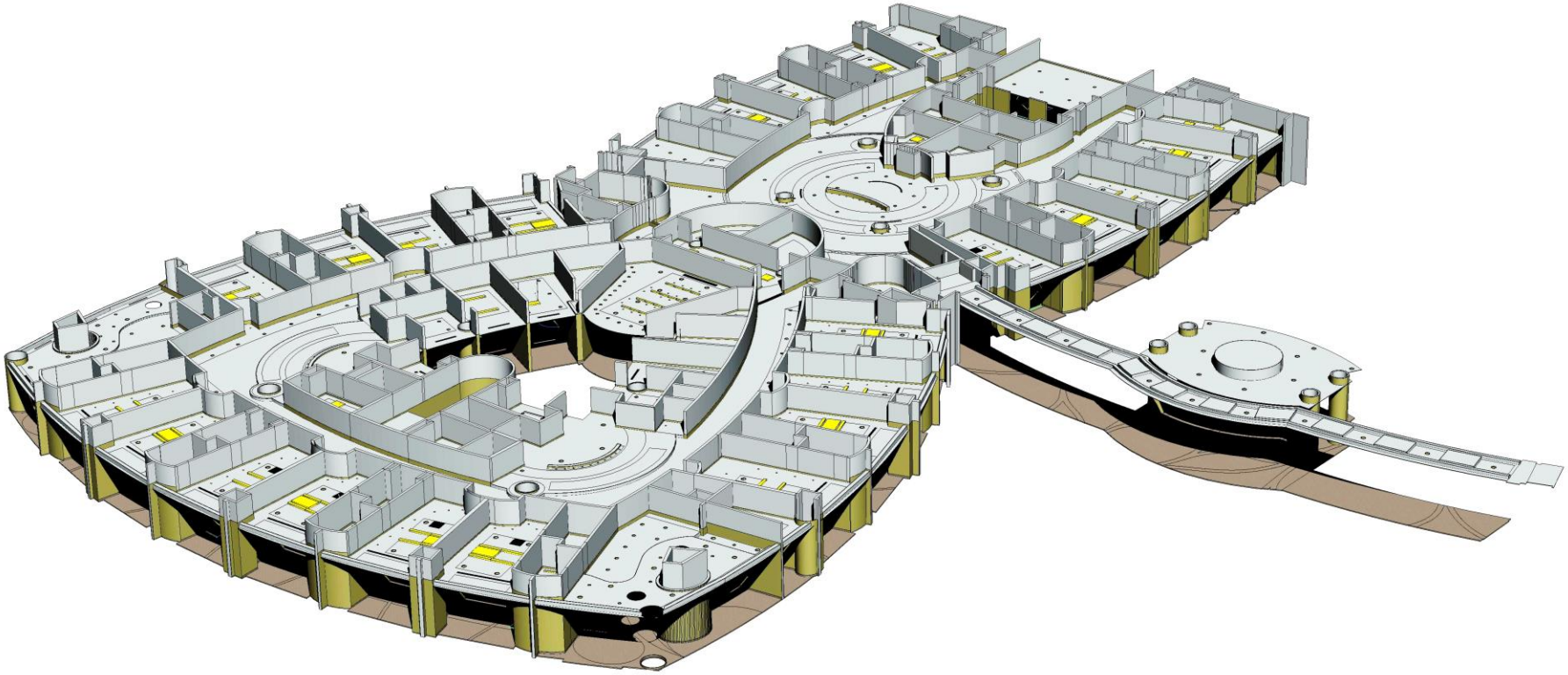
AIDIGITS BIM Academy

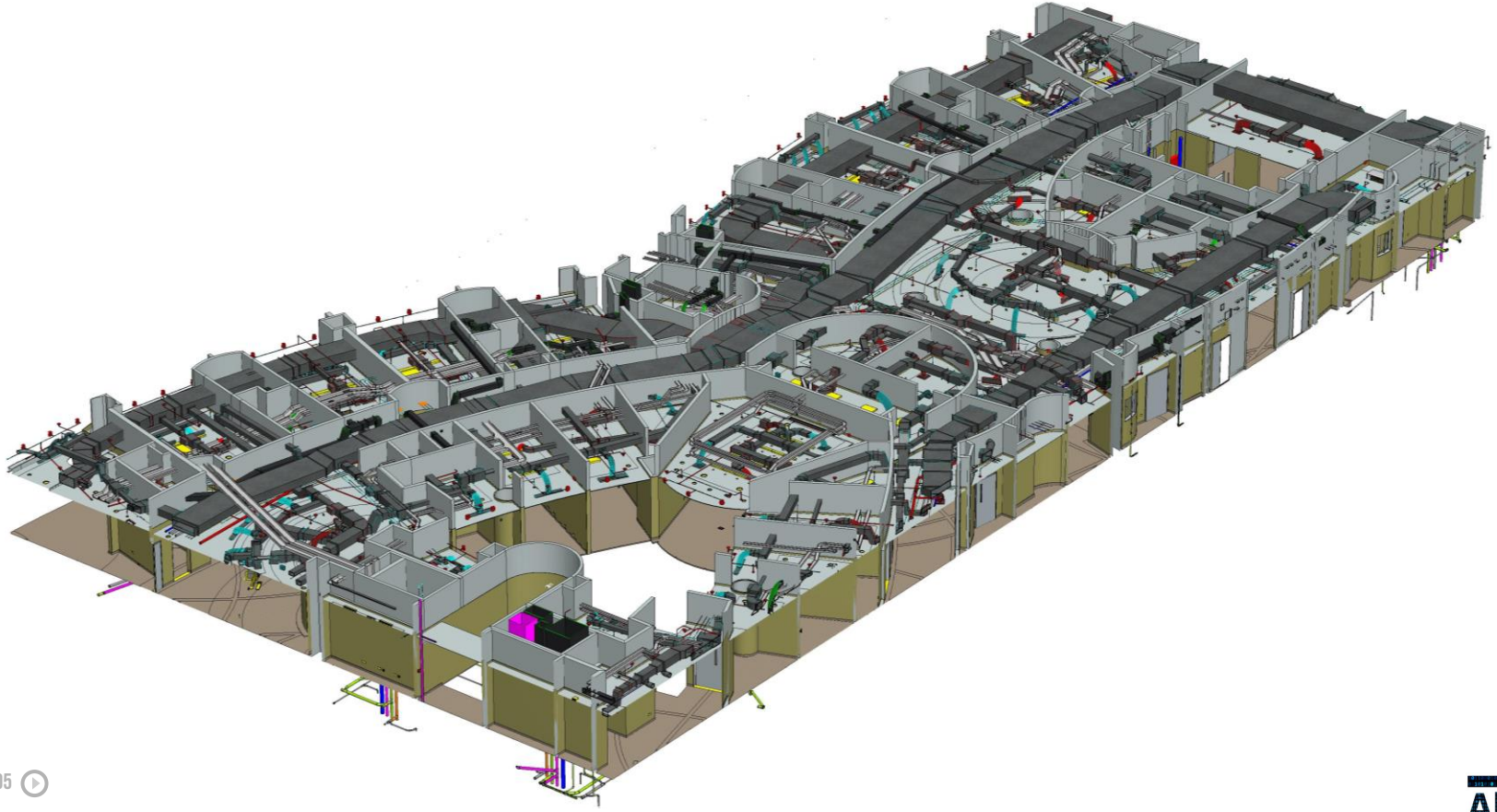
# PROJECT SCOPE

BIM DEVELOPMENT FOR THE AS BUILT STATUS FOR THE SIDRA HOSPITAL TARGETING FUTURE FACILITY MANAGEMENT INTEGRATION / OPERATION AND MAITENANCE

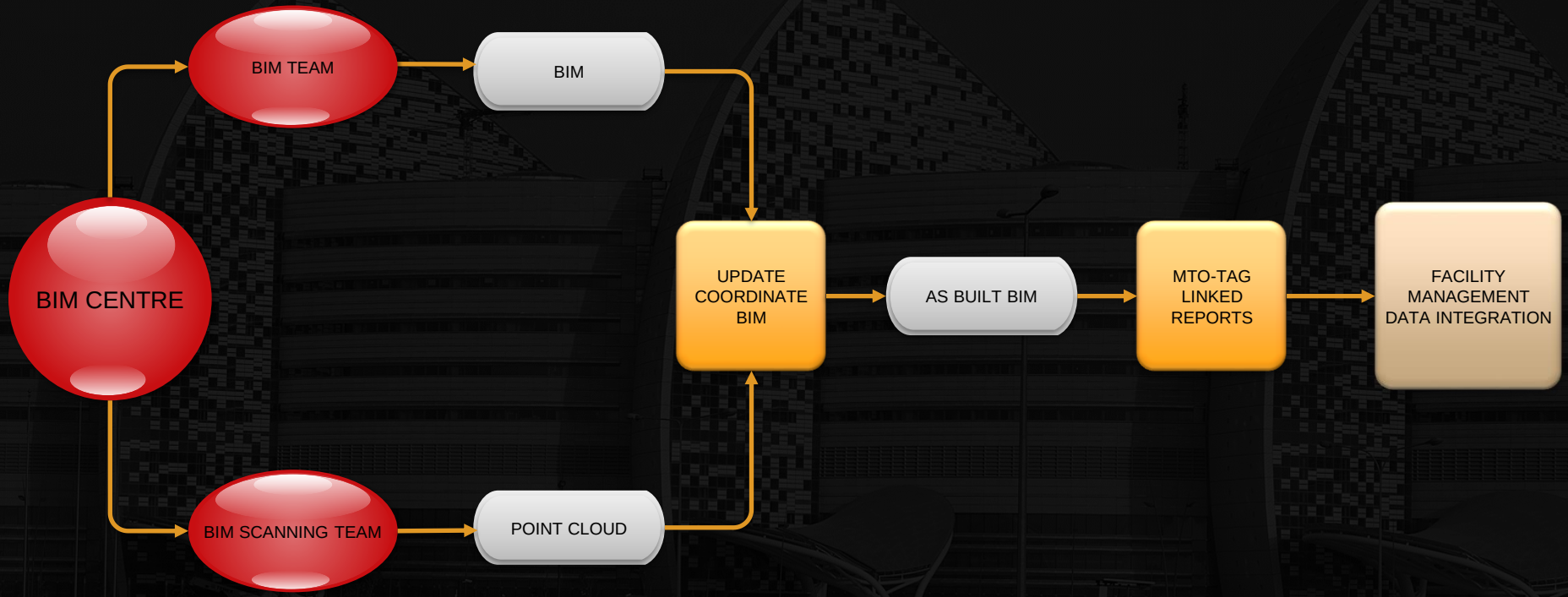
## BIM WORKFLOW ANALYSIS

1. BIM STANDARD CONFIGURATION
2. BUILDING INFORMATION MODELS
3. LASER SCANNING IMPLEMENTATION
4. AS BUILT BIM INTEGRATION





# BIM TEAM WORKFLOW DIAGRAM



# WORK PACKAGE ALLOCATION

HANDING OVER : AS – BUILD
FUTURE FM INTEGRATION



- **WP_1: BIM STANDARD CUSTOMIZATION**
  - BIM STANDARD
  - PART LIBRARY - COMPONENTS
  - DEVELOP AND IMPLEMENT AN RFI SYSTEM
- **WP_2: INCIPIENT BIM PRODUCTION**
  - ARCHITECTURAL DISCIPLINE
  - ELECTRICAL DISCIPLINE
  - MECHANICAL DISCIPLINE
- **WP_3: LASER SCANNING IMPLEMENTATION**
  - DATA ACQUISITION
  - REGISTRATION
  - DATA CLEANING
  - POINT CLOUD DELIVERABLE
- **WP_4: BIM UPDATE - COORDINATION**
  - BIM – PCD COMPARISON
  - BIM MODIFICATION BASED ON PCD DATA
- **WP_5: AS BUILT INTEGRATION**
  - BIM TAGGING PROCESS
  - LINKED MTO TAGGED REPORTS
- **WP_6: BIM INTEGRATION WITH CLIENT FM**
  - DELIVERABLES ORGANIZATION FOR FM

# BIM STANDARD CONFIGURATION

DEFINITIONS
WORK RULES

- REQUIREMENTS AND SPECIFICATIONS

PRODUCTION OF:

- LIBRARY PARTS
- COMPONENT PARTS
- CELLS
- MACROS

| Abbreviation | Description | Symbol |
|---|---|---|
| CAM | USB Camera |  |

# BIM STANDARD CONFIGURATION

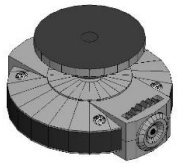
## BIM STANDARDS

ARCHITECTURAL ABBREVIATIONS

MECHANICAL ABBREVIATIONS

PART LIBRARY - COMPONENTS

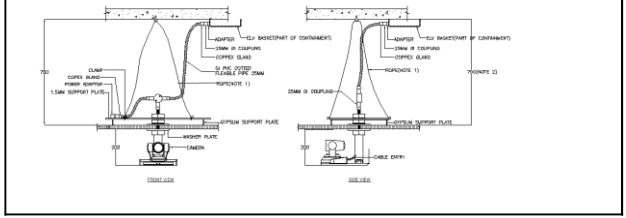
NAMING CONVENTIONS - ARCHIVE

| 3D Cell | Part |
|---|---|
|  | AV-CAM-USB |

## BENTLEY AECOSIM PLATFORM :

- INTELLIGENT MODELS GENERATION
- ADDRESSED THE COMPLEX DESIGN
- VISUALIZED ENGINEERING SITUATION

THROUGH ALL CONSTRUCTION PHASES

| Remarks |
|---|
|  |

## .XML

- PER DISCIPLINE

## FAMILIES AND PARTS

- BASED ON PROJECT'S REQUIREMENTS

## COMPONENTS

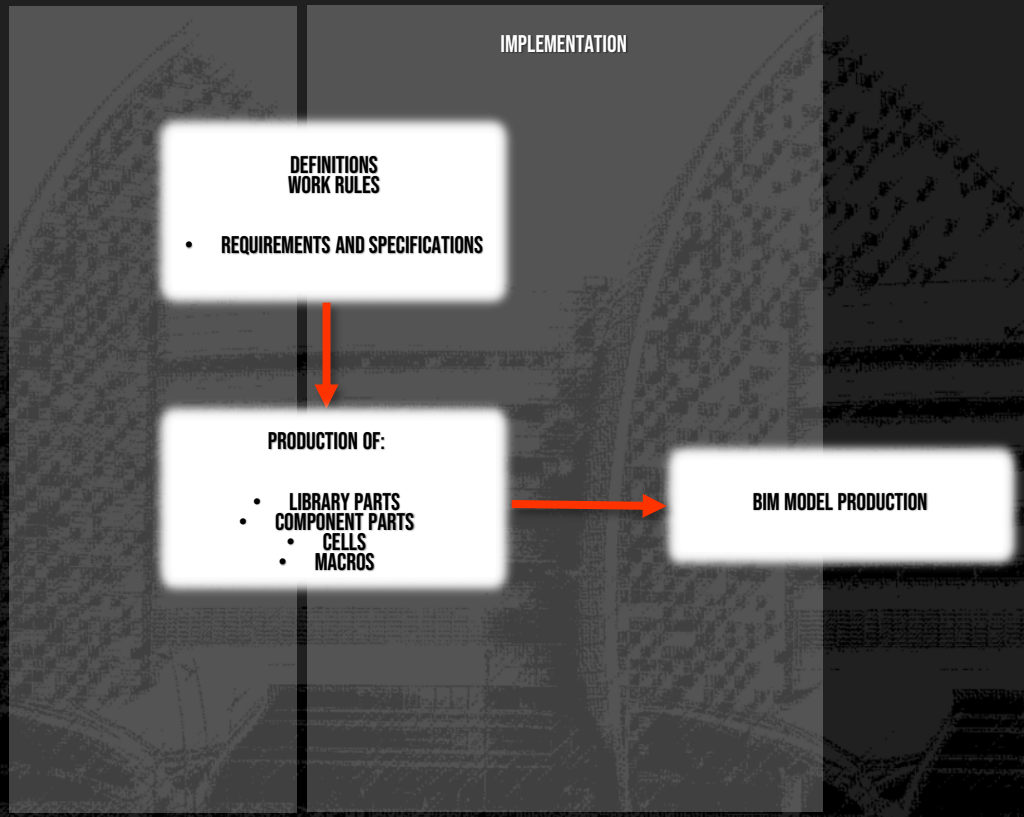
- BASED ON PROJECT'S REQUIREMENTS
- CSI MASER FORMAT

# NAMING CONVENTION

| L1 | | L2 | | L3 | | L4 | | L5 | |
|---|---|---|---|---|---|---|---|---|---|
| Code | PROJECT SCOPE | Code | BUILDING | Code | LEVEL | Code | SUB-ZONE | Code | DISCIPLINE |
| SMRC | Sidra Medical & Research Centre | B1 | Zone 2 | ML | Mall Level | A1 | Area A1 | ARC-BLW | Architectural Blockwork |
| | | B2 | Zone 3 | PL | Plaza Level | A2 | Area A2 | ARC-FIN | Architectural Finishes |
| | | B3 | Zone 5 | L1 | Floor 1 | A3 | Area A3 | ARC-XXX | Assembly - Multiple Architectural Disciplines |
| | | XX | Assembly - Multiple Buildings | L2 | Floor 2 | B1 | Area B1 | MEC-HVA | Mechanical - HVAC Ducts |
| | | | | L3 | Floor 3 | B2 | Area B2 | MEC-HVP | Mechanical - HVAC Pipes |
| | | | | L4 | Floor 4 | B3 | Area B3 | MEC-WSP | Mechanical - Water Supply |
| | | | | L5 | Floor 5 | C1 | Area C1 | MEC-SNT | Mechanical - Sanitary |
| | | | | L6 | Floor 6 | C2 | Area C2 | MEC-FFT | Mechanical - Fire Fighting |
| | | | | L7 | Floor 7 | C3 | Area C3 | MEC-MAV | Mechanical - Medical Air |
| | | | | RF | Penthouse and Roof | D1 | Area D1 | MEC-XXX | Assembly - Multiple Mechanical Disciplines |
| | | | | XX | Assembly - Multiple Levels | D2 | Area D2 | ELE-PWR | MV Main Networks |
| | | | | | | D3 | Area D3 | ELE-TEL | Telecom & IT Networks |
| | | | | | | XX | Multiple Sub-Zones | ELE-XXX | Assembly - Multiple Electrical Disciplines |

| MODEL FILE REVISION | | | |
|---|---|---|---|
| Code (EEE) | Drawings Design Phase | Code (FFF) | Model Major Rev. |
| ABT | As built Phase | r00 | Rev 00 |
| | | r01 | Rev 01 |

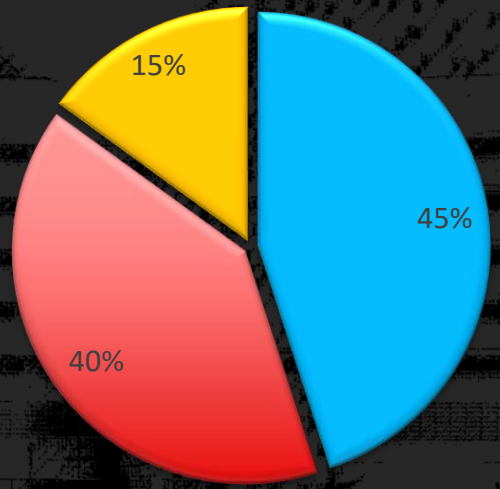
# BIM PRODUCTION



# WORK PACKAGE ALLOCATION

**WORKPACKAGE ALLOCATION**

INITIAL 3D BIM WORKPACKAGE ALLOCATION CONSISTS OF 3 MAIN DISCIPLINES




**ARC**

- PARTITIONS
- FLOOR FINISHES
- WALL FINISHES
- WALL PROTECTION
- DOORS-OPENINGS-TRANSITIONS
- FALSE CEILINGS
- FURNITURE

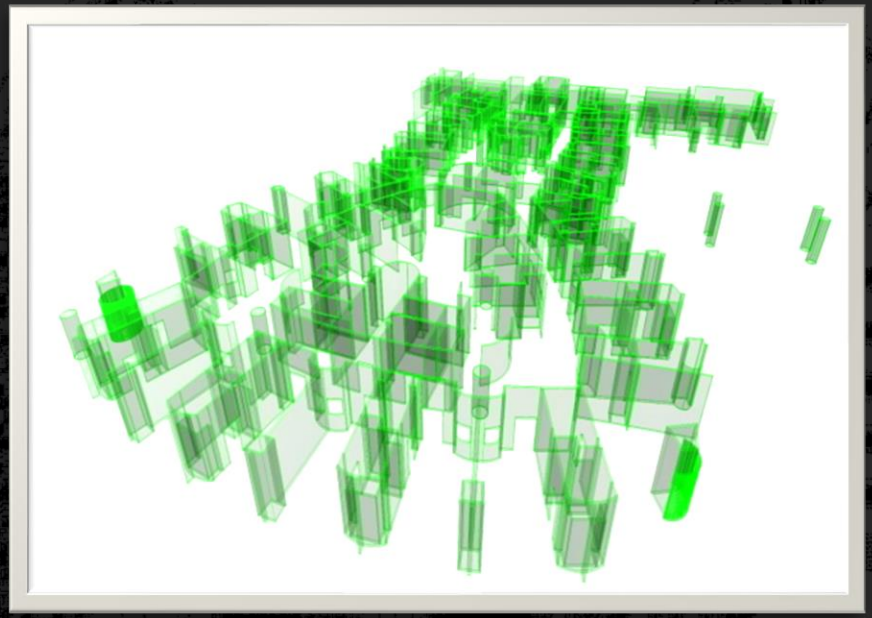
**MEC**

- VENTILATION (SMOKE AND HVAC)
- HOT AND COLD WATER SUPPLY
- SANITARY - DRAINAGE
- FIRE PROTECTION
- OXYGEN-MEDICAL AIR-VACUUM

**ELE**

- MEDIUM VOLTAGE
- LOW VOLTAGE
- LIGHTING FIXTURES

# WORK PACKAGE ALLOCATION



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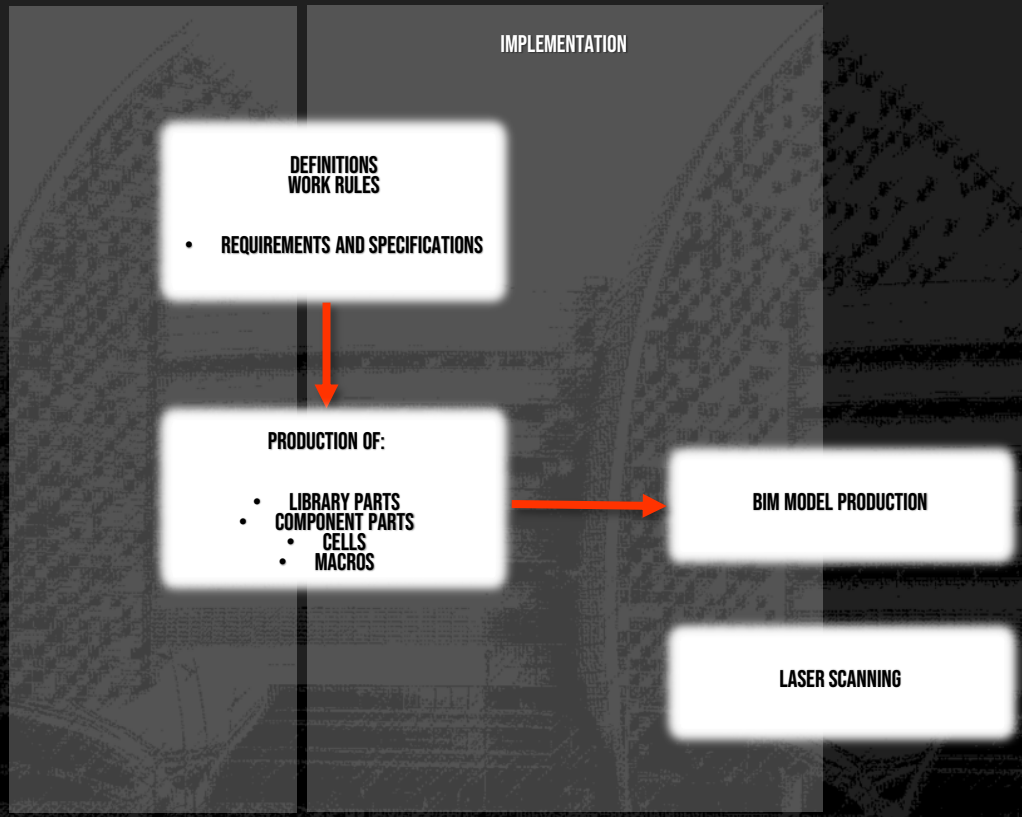
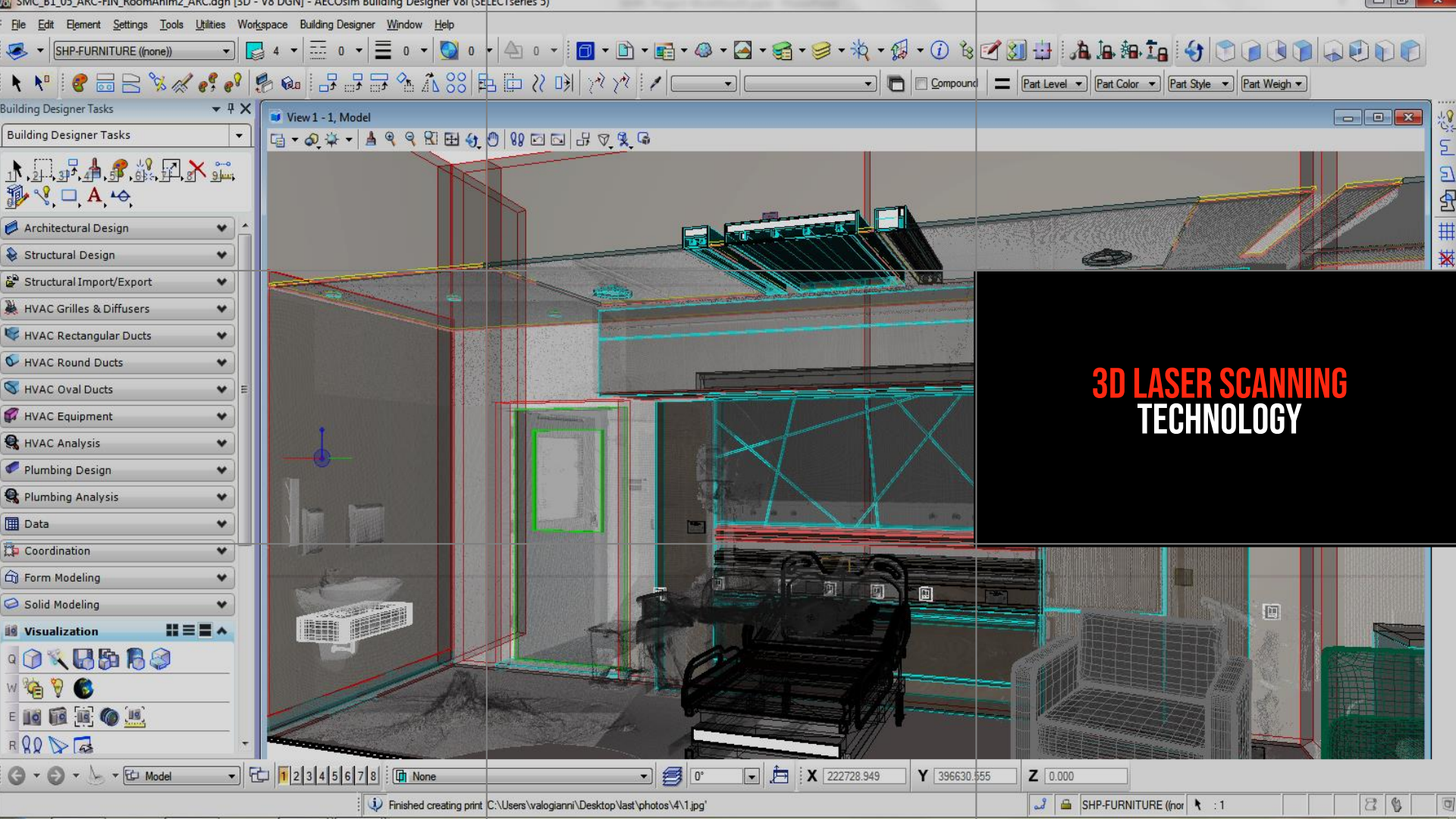
# LASER SCANNING IMPLEMENTATION

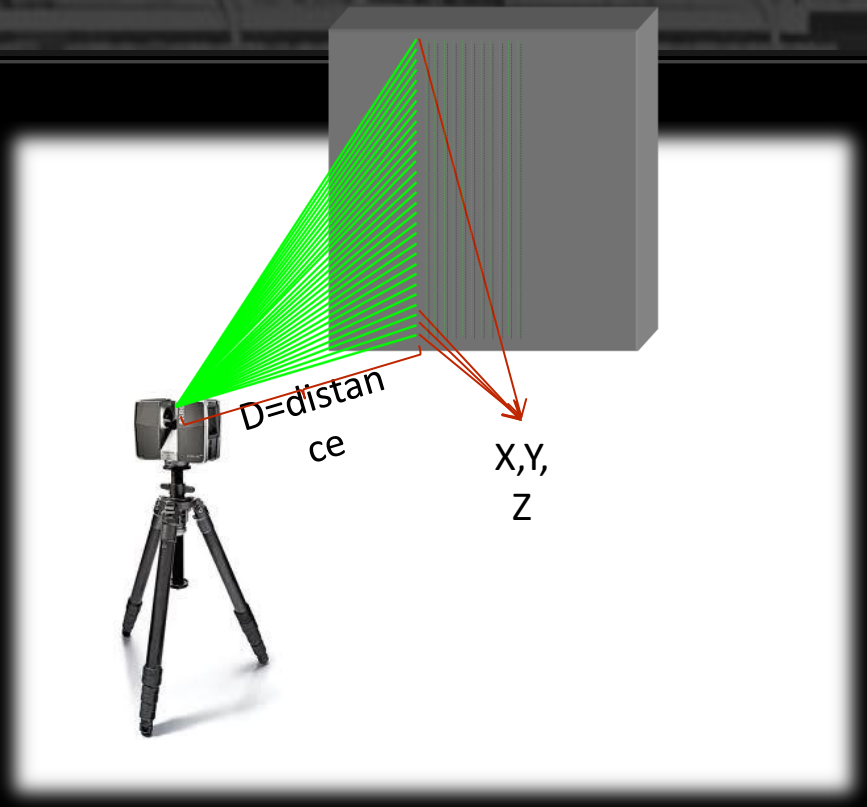



File Edit Element Settings Tools Utilities Workspace Building Designer Window Help
Building Designer Tasks
Architectural Design
Structural Design
Structural Import/Export
HVAC Grilles & Diffusers
HVAC Rectangular Ducts
HVAC Round Ducts
HVAC Oval Ducts
HVAC Equipment
HVAC Analysis
Plumbing Design
Plumbing Analysis
Data
Coordination
Form Modeling
Solid Modeling
Visualization
View 1 - 1, Model
3D LASER SCANNING
TECHNOLOGY

# LASER SCANNING WORKFLOW

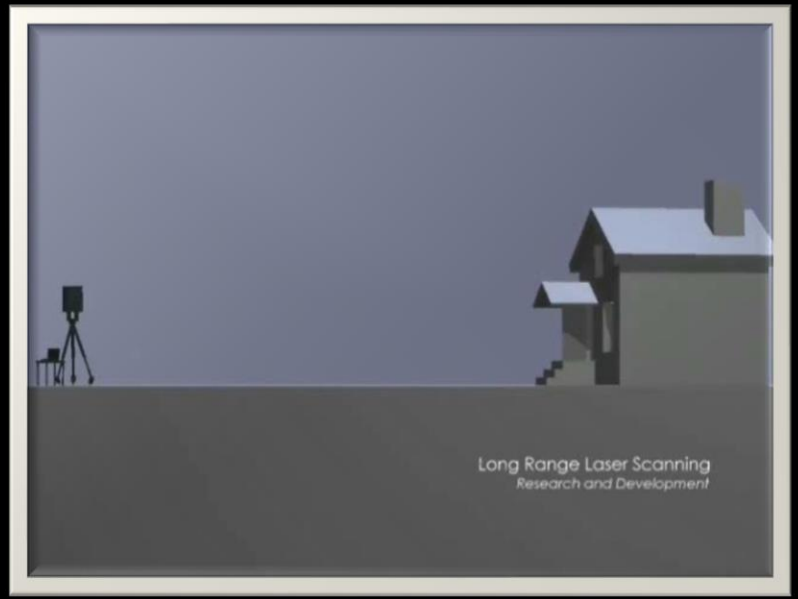
# TRADITIONAL VS NEW

- LASER SCANNERS CAN BE CONSIDERED AS HIGHLY AUTOMATED TOTAL STATIONS.
- FOR EACH ACQUIRED POINT A DISTANCE IS MEASURED ON A KNOWN DIRECTION: X, Y AND Z COORDINATES OF A POINT CAN BE COMPUTED FOR EACH RECORDED DISTANCE-DIRECTION.
- LASER SCANNERS ALLOW MILLIONS OF POINTS TO BE RECORDED IN A FEW MINUTES.



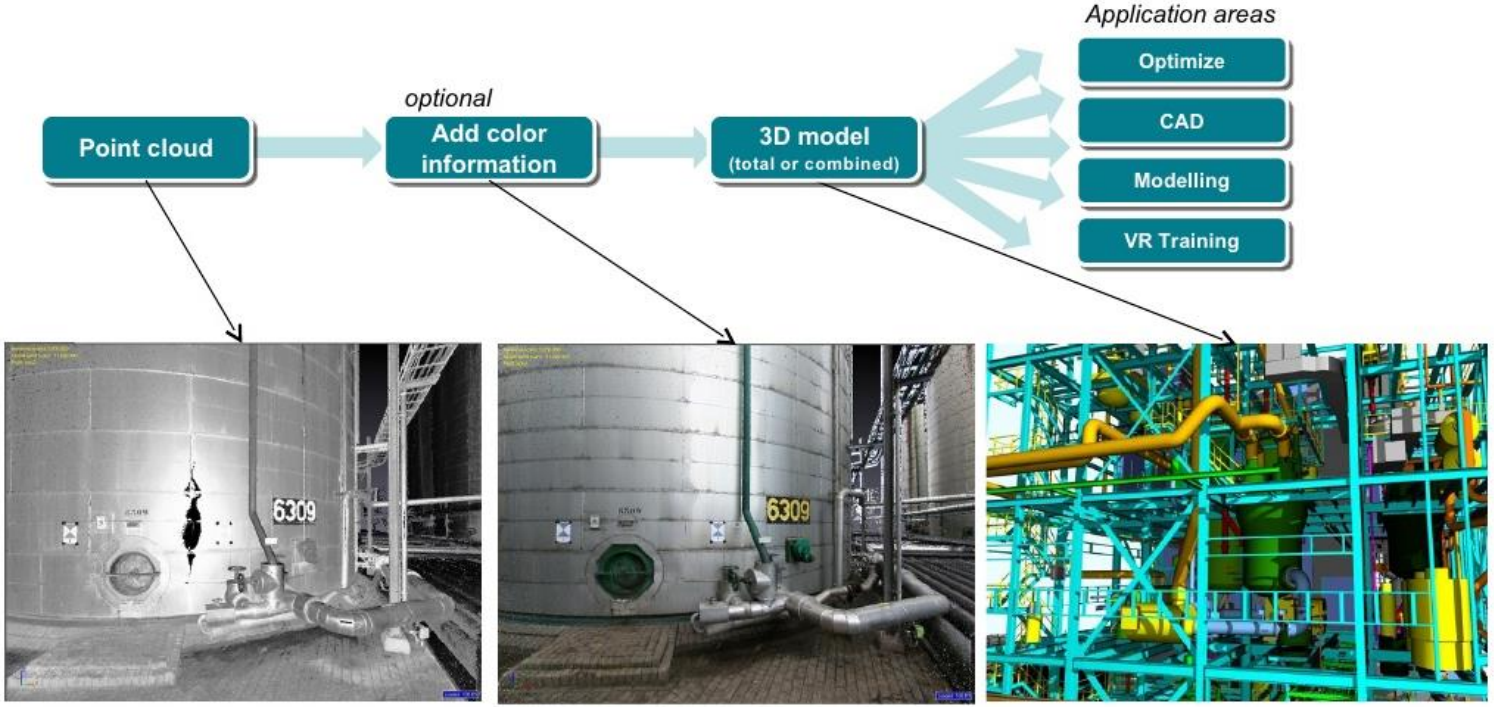
# LASER SCANNING PRINCIPLES

- METHOD OF SPATIAL DATA COLLECTION FROM A DISTANCE (NON-CONTACT).
- BASED ON LIDAR TECHNOLOGY (LIGHT DETECTION AND RANGING) OR LASER RADAR: DETECTION AND POSITIONING OF OBJECTS BY SENDING AND RECEIVING A LASER BEAM.
- BEAM IS DEFLECTED BY MIRRORS TO SCAN THE WHOLE OBJECT WITH THE REQUIRED DENSITY / RESOLUTION.
- IMMEDIATE PRODUCTION OF A CLOUD OF MEASURED POINTS (POINT CLOUD) WITH ADDITIONAL COLOR INFORMATION FOR EACH POINT (X,Y,Z,I) OR (X,Y,Z,R,G,B).
- BRINGS REALITY TO DESKTOP



# PCD DELIVERABLE

# POINT CLOUD APLICATIONS



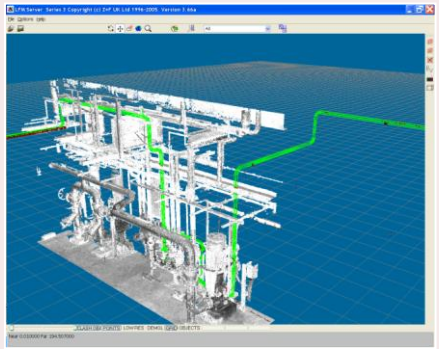

*An exact 3D 'as-built' representation in photographic quality.*

*Color information added to the scans is an optional feature.*

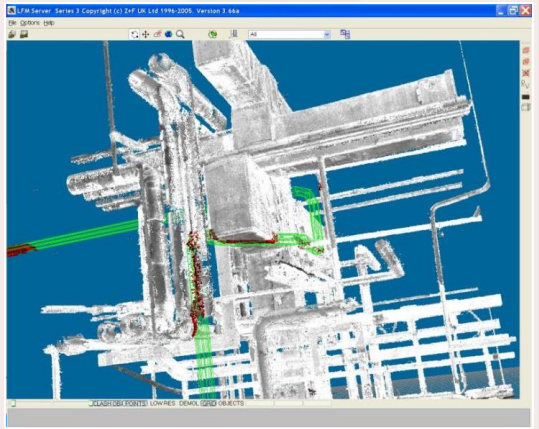
*Total or partial transformation to 3D models facilitates usage in various application areas*

# POINT CLOUD APLICATIONS

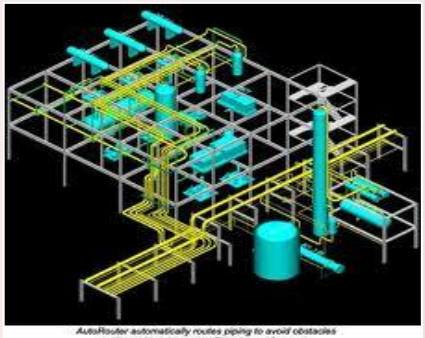
Point clouds



Clash detection

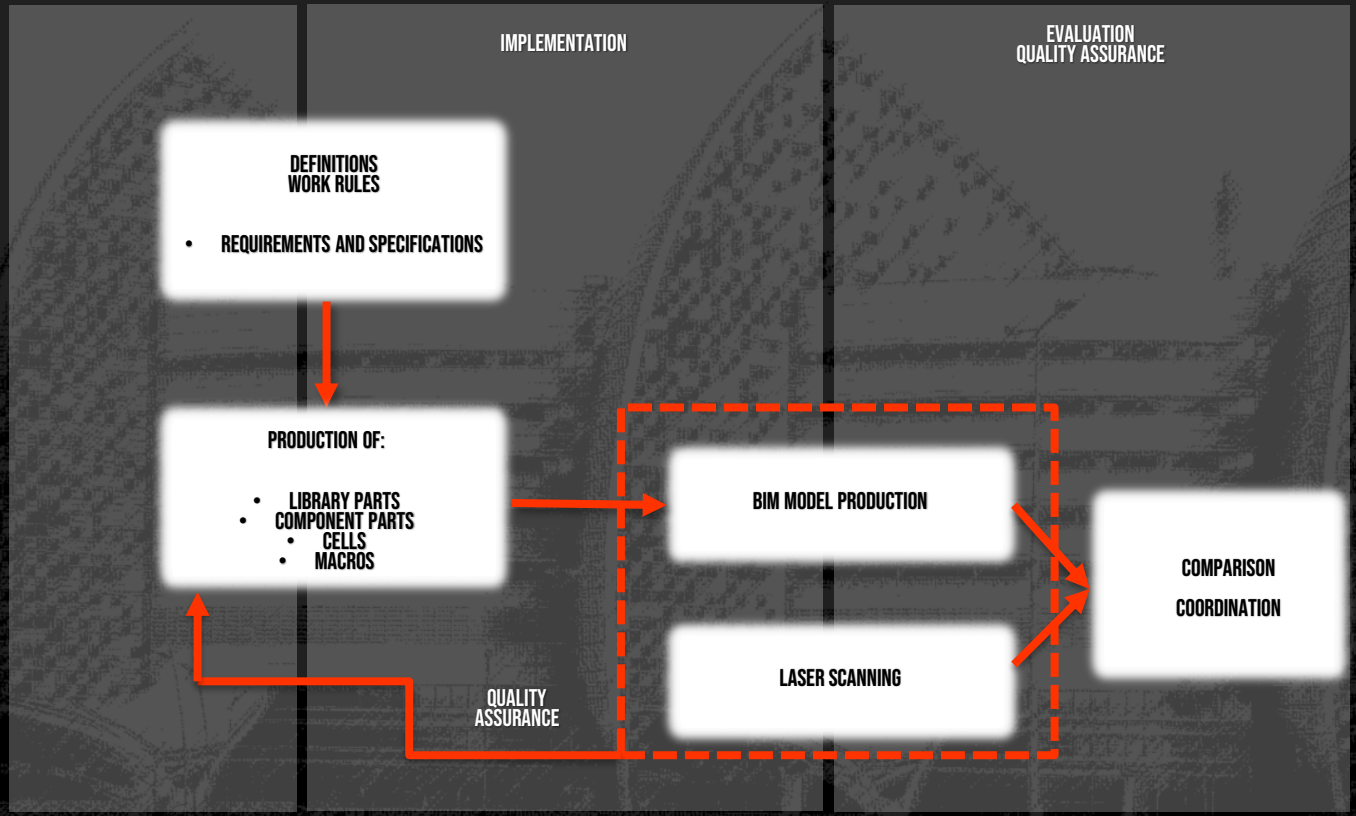


BIM



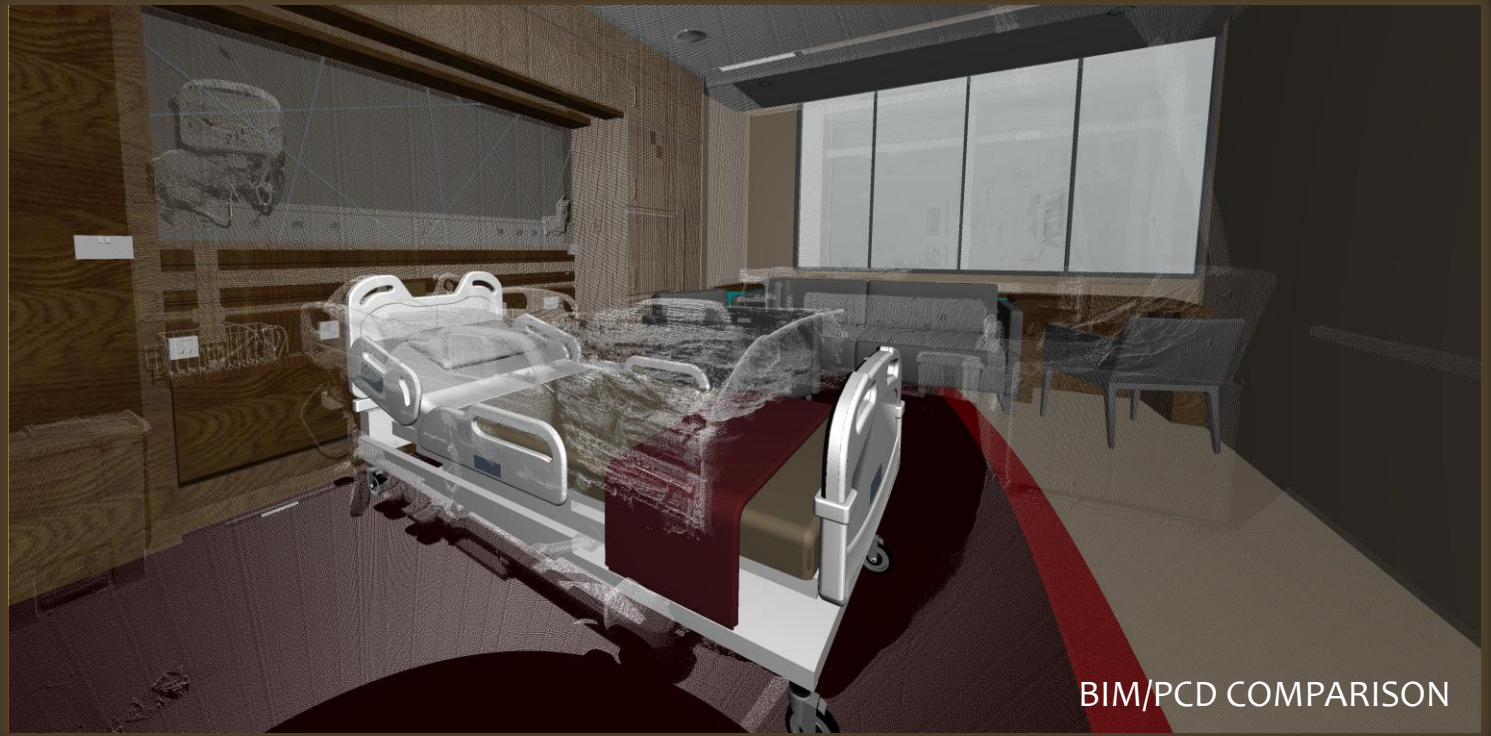
AutoRouter automatically routes piping to avoid obstacles while making the most efficient use of space.

# EVALUATION – QUALITY ASSURANCE

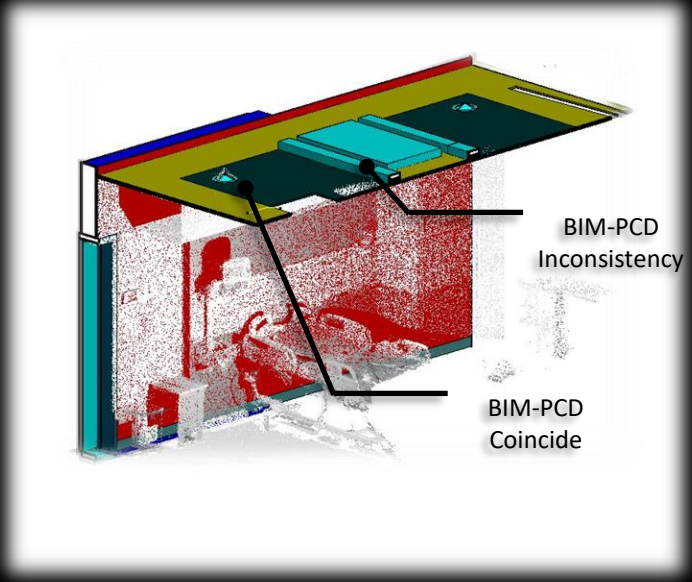


# BIM/PCD COMPARISON EXAMPLE

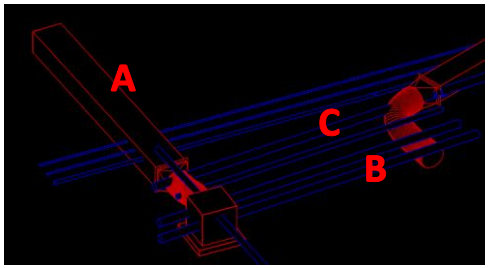
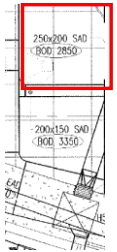
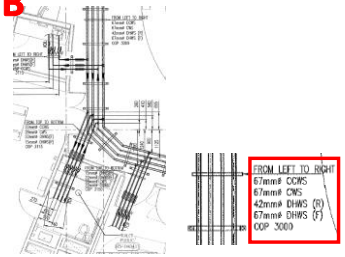
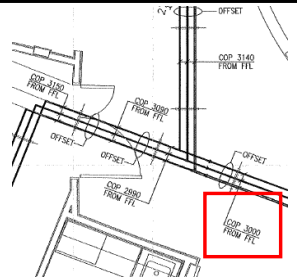
## ROOM H5-4027

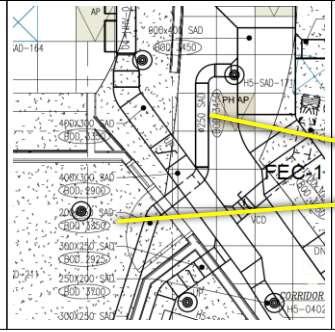
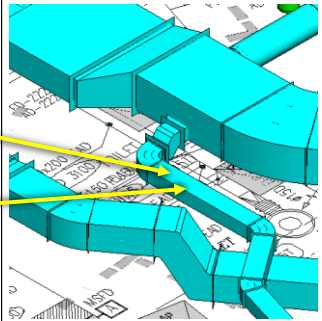


# BIM/PCD COMPARISON



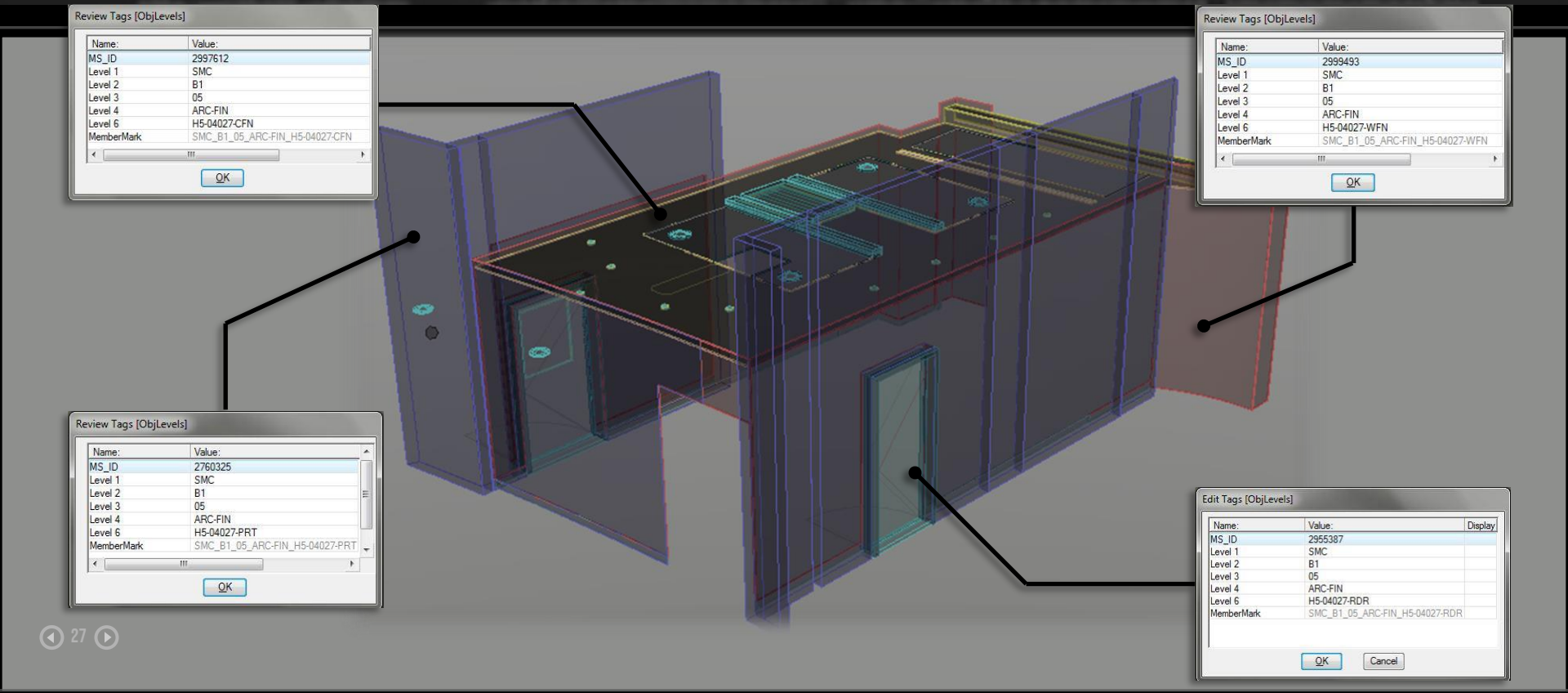
# CLASH DETECTION

| 3D MODEL | 2D REFERENCE HVA | 2D REFERENCE WSN | 2D REFERENCE MAV | NOTES |
|---|---|---|---|---|
| 1   | A   | B   | C   | HVA - WSN - MAV GENERAL DISCREPANCY IS THE DISCIPLINE CROSS BECAUSE OF HEIGHT GIVEN |

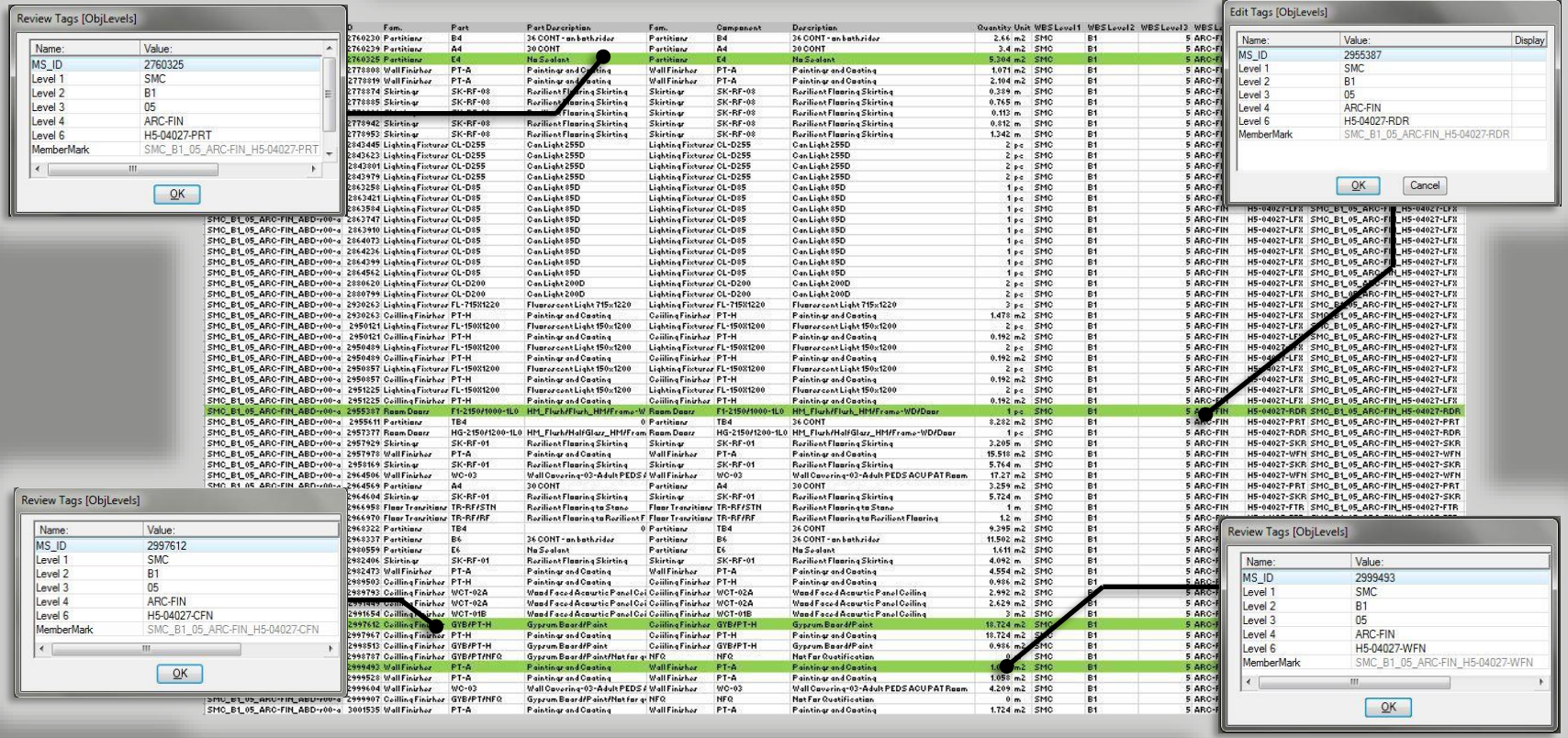
| No | PLAN VEW | LOCATION | BIM MODEL | DESCRIPTION |
|---|---|---|---|---|
| | | FOR THE HVA-HVP IS USED THE AECOSIM DEFAULT FAMILY | | |
| 1 | X=H, Y=20.2 |   |  | SAD DUCT IS NOTED AS ϕ250. IT IS MODELED AS RECTUNGULAR, TAKING INTO CONSIDERATION THE FOLLOWING BRANCH THAT IS CONSIDERED AS RECTUNGULAR 200X150 SAD |

# AS BUILT BIM INTEGRATION

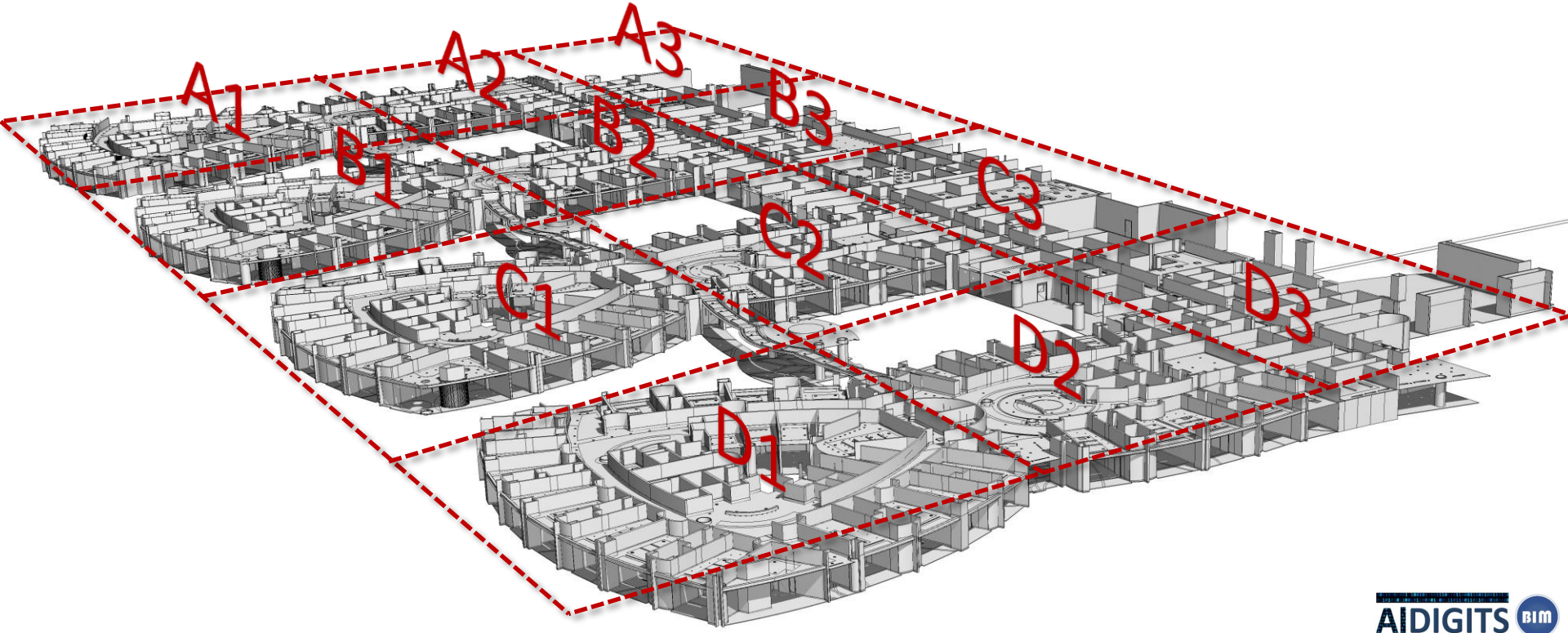
# TAGGING PROCESS



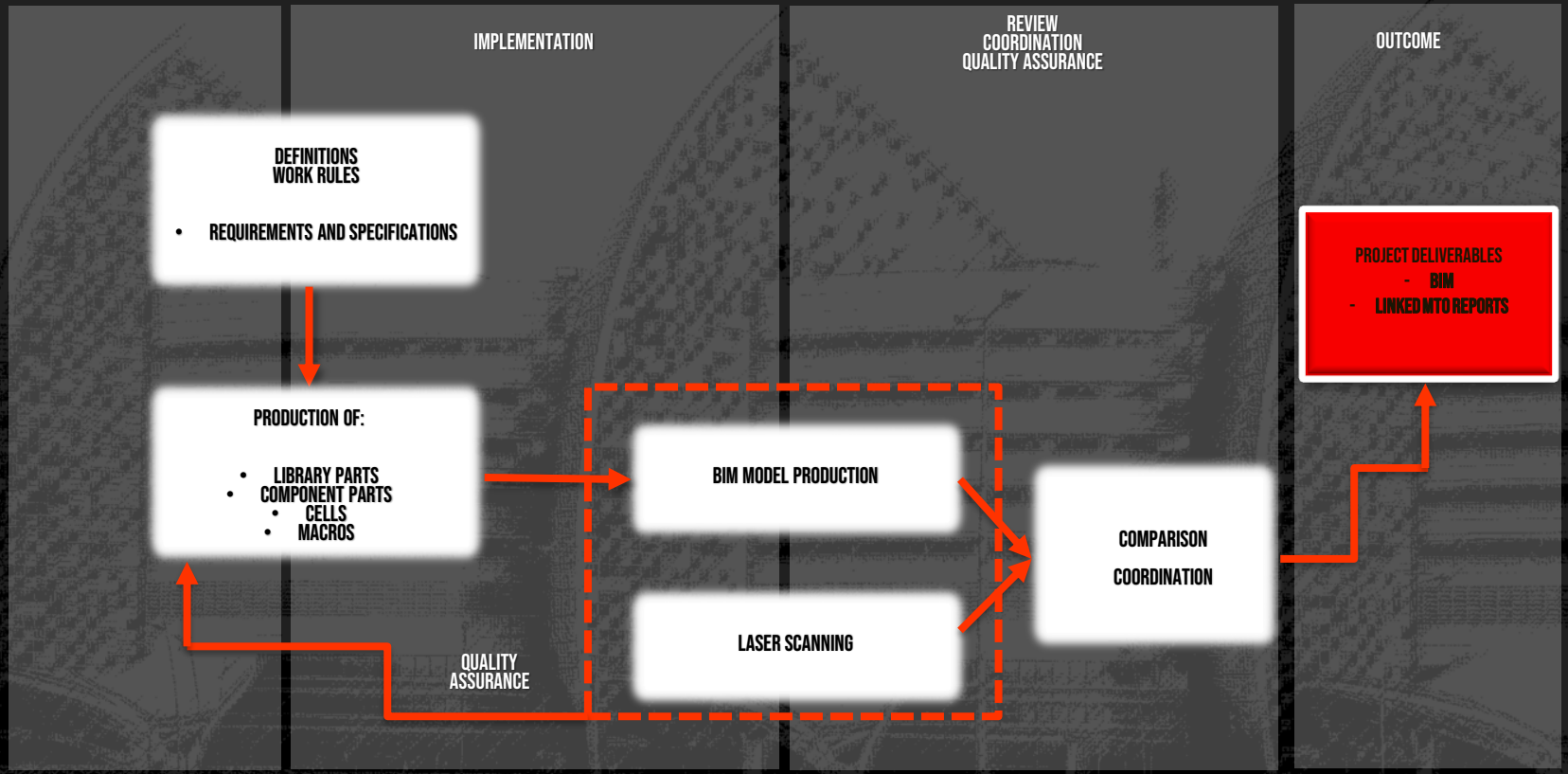
# LINKED MTO REPORTS



# WORKFLOW CONTROL



# BIM FUTURE FACILITY MANAGEMENT



# BEYOND DELIVERABLE

# 3D- 4D- 5D- 6D- 7D

## 3D

BIM DRIVEN PREFABRICATION

- Existing Conditions Models
- Safety and Logistics Models
- Animation Rendering Walkthrough

## 4D

SHEDULING

- Projects Phasing Simulations
- Detailed simulation Installation
- Visual Validation

## 5D

ESTIMATION

- Quantity extraction
- Value Engineering
- What-if-scenarios

## 6D

SUSTAINABILITY

- Conceptual Energy Analysis
- Detailed Energy Analysis
- Sustainable element tracking

## 7D

FACILITY MANAGEMENT APPLICATIONS

- Life Cycle BIM Strategies
- BIM As-Built
- BIM Embedded
- BIM Maintenance

# FM + BIM = COMBINING DATA

- THROUGH BIM IMPLEMENTATION PROCESS RICH DATABASE OF RELEVANT INFORMATION WILL BE CREATED THROUGH THE PHASES OF DESIGN.
- THIS DATABASE WILL MAKE FUTURE DECISION PROCESSES FOR THE FACILITY MANAGERS MORE EFFICIENT AND EFFECTIVE.
- Information identified and attributes specified, will be used in future by the client FM team for the maintenance of information in their database.
- The end goal is to develop a visual framework for the information collection, which can be stored in an interactive data management system.

# THANK YOU