



The 23rd International Asset Facility and Maintenance Management Conference

An Integrated BIM-AR Framework for High-Rise Building Maintenance in Saudi



12-14 January 2026

Riyadh, KSA

Organized by

Executed by

www.omaintec.com #OmaintecConf

OMAINTEC In Partnership with



Organizational Partner TSG | EXICON. The Specialist Group

Motivations:

Increasing complexity of high-rise developments:

-Rapid urban growth driven by Vision 2030 has led to a sharp increase in high-rise residential, commercial, and mixed-use buildings in major Saudi cities.

-These buildings incorporate highly integrated MEP systems, significantly increasing operational complexity and long-term maintenance risks if accessibility and maintainability are not addressed early in the lifecycle
(Alsharif et al., 2019; Alrashed and Asif, 2015).

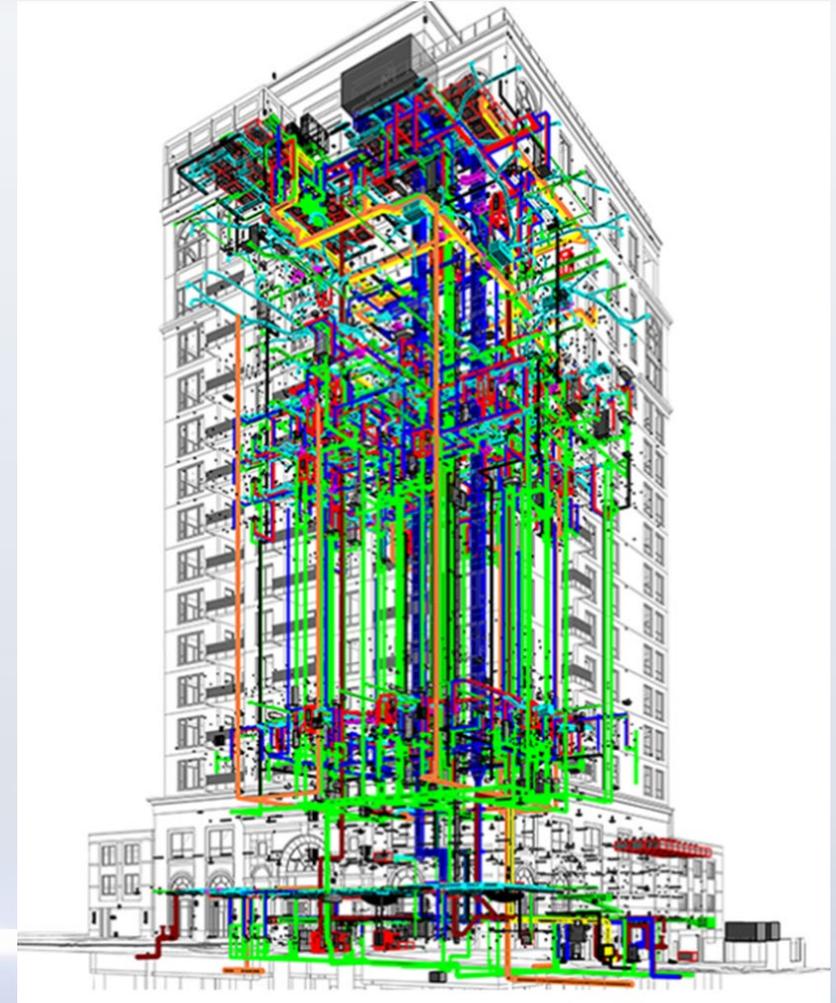


Motivations:

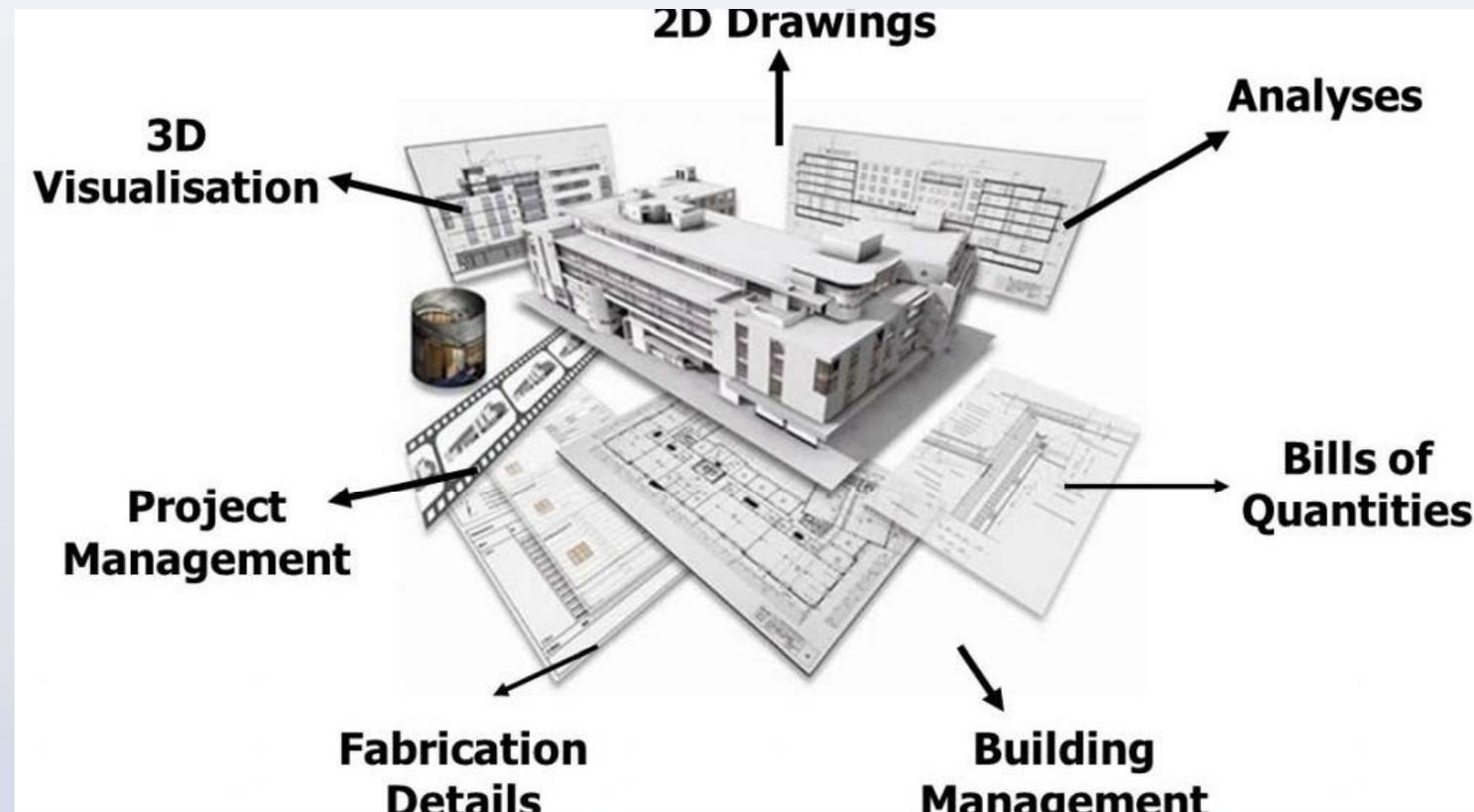
Limited accessibility and visibility of building systems:

-Maintenance of high-rise buildings is hindered by restricted physical access to embedded MEP components and limited knowledge of their actual condition.

-Inspection and rehabilitation activities are often intrusive, time-consuming, and disruptive, particularly in dense vertical environments where systems are confined within service zones (Volk et al., 2014; Kwon et al., 2021).

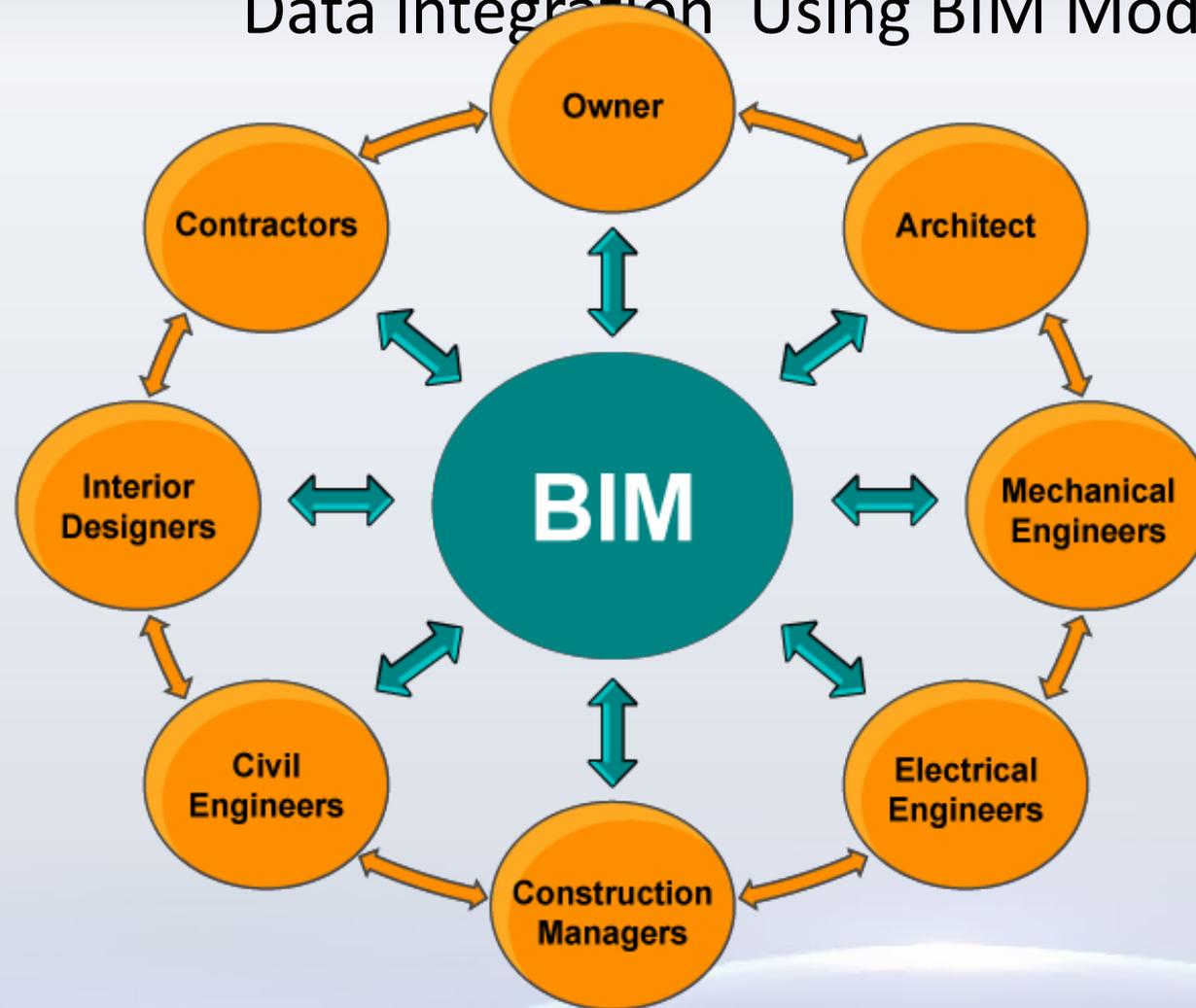


Traditional Practices : Stand Alone Data Exchange for Different Purposes



New practices Introducing BIM .. Why?

Data integration Using BIM Models

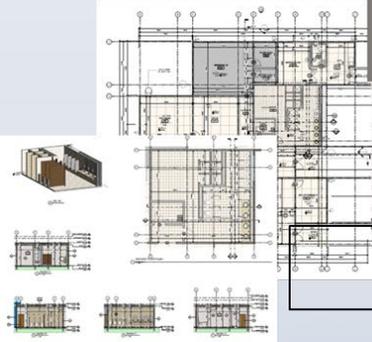
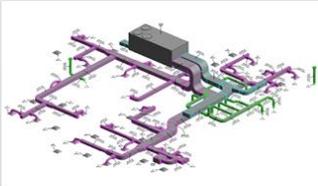
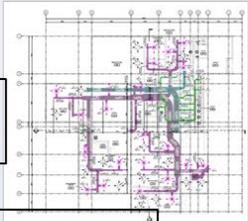
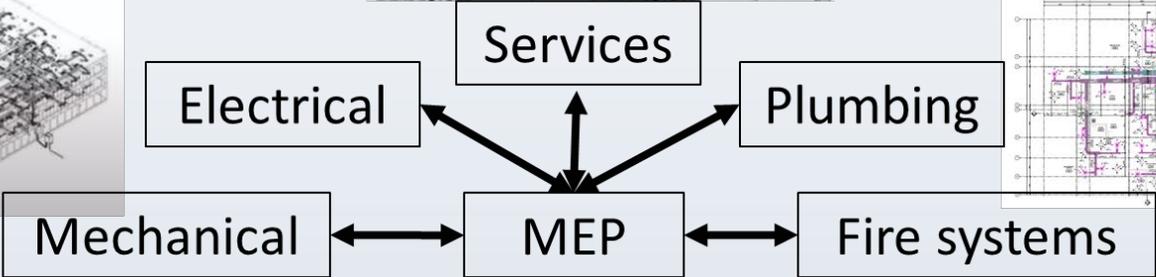
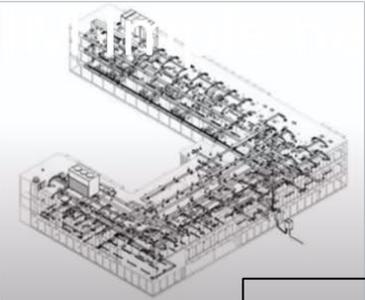
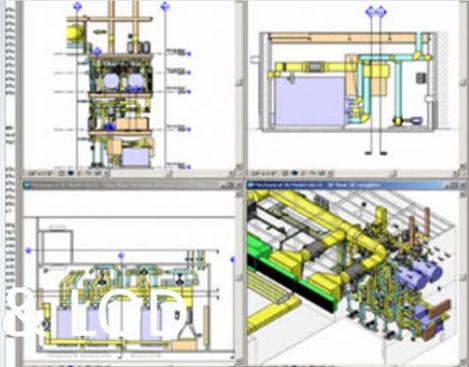


BIM Current Practices in construction ...

This is the starting point...

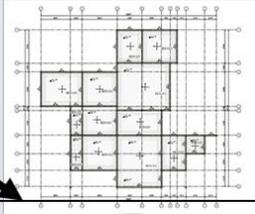


BIM Presentation & ICD



Architectural

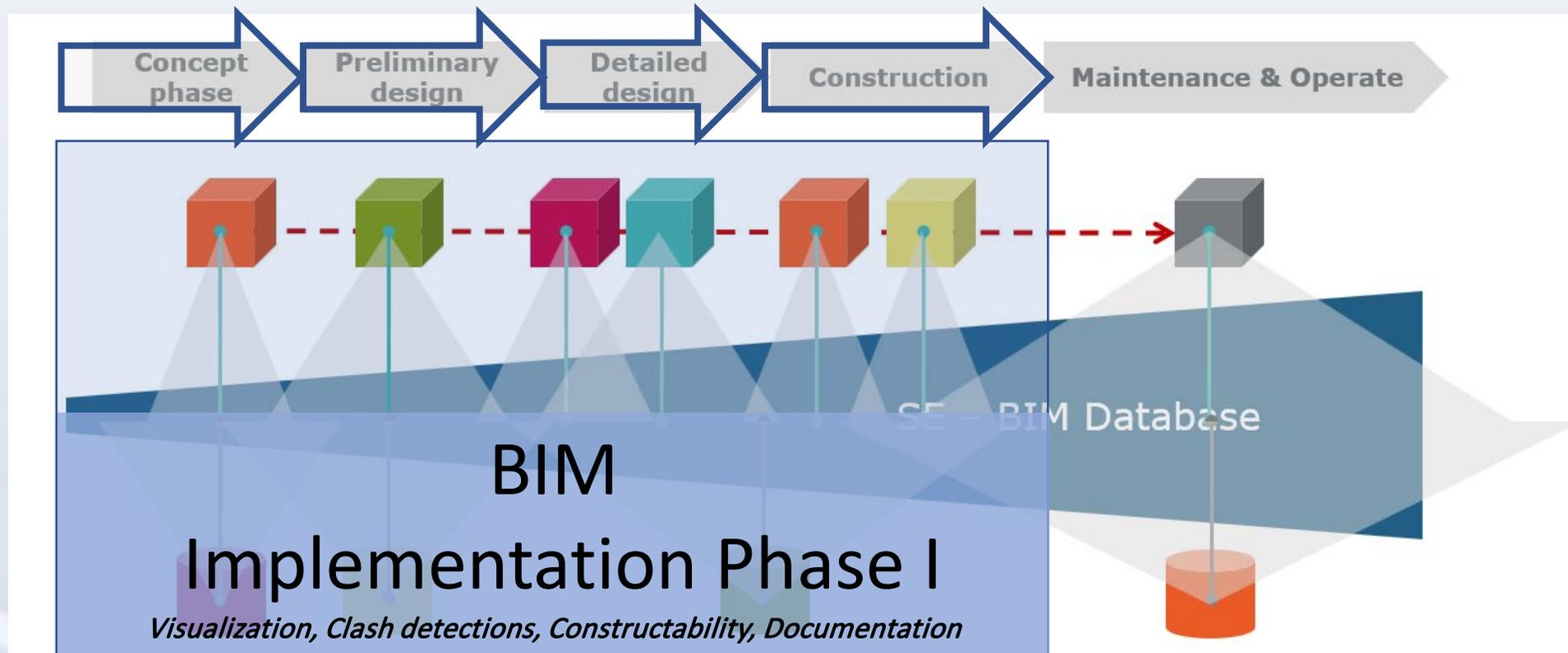
BIM Models

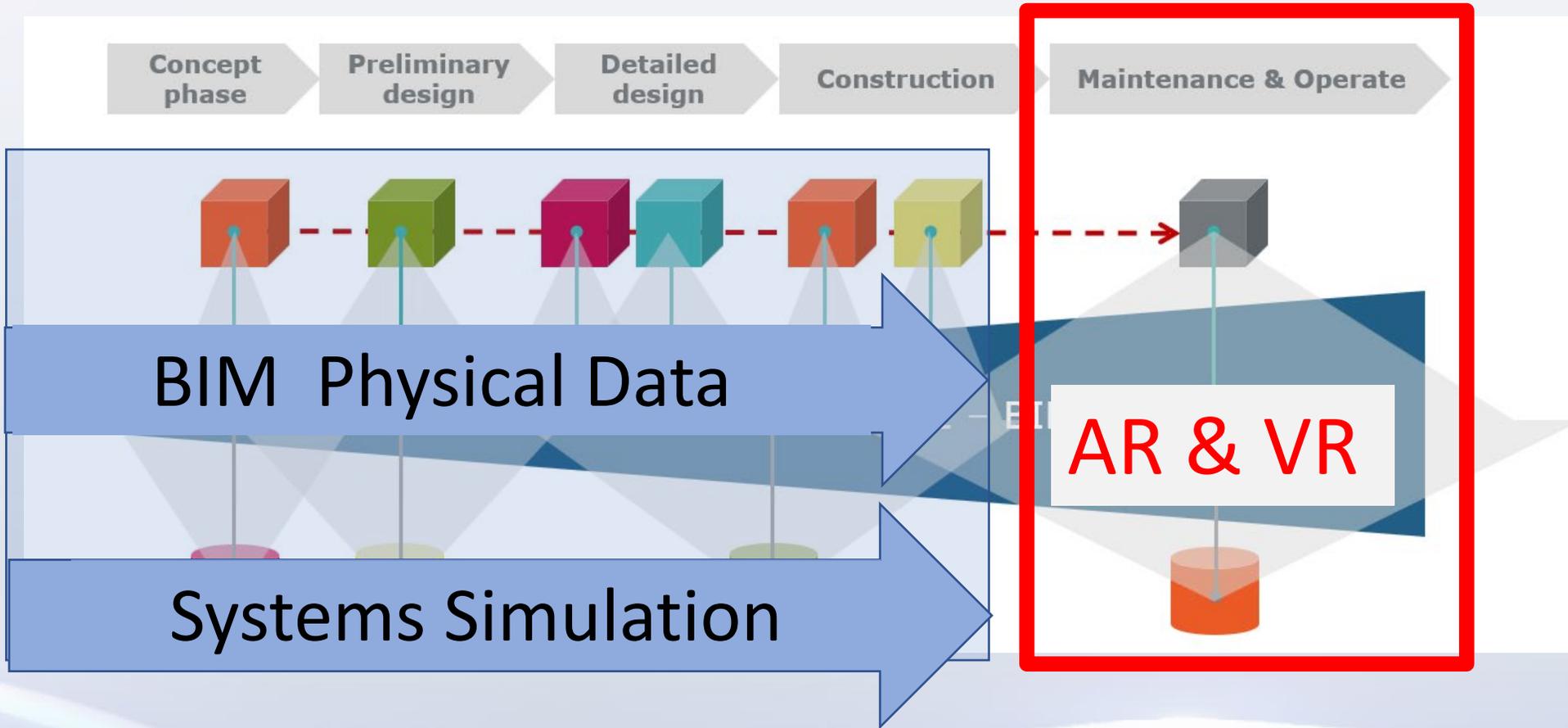


Structural Model



Current BIM Implementation through Project life cycle (construction phase) & as Build

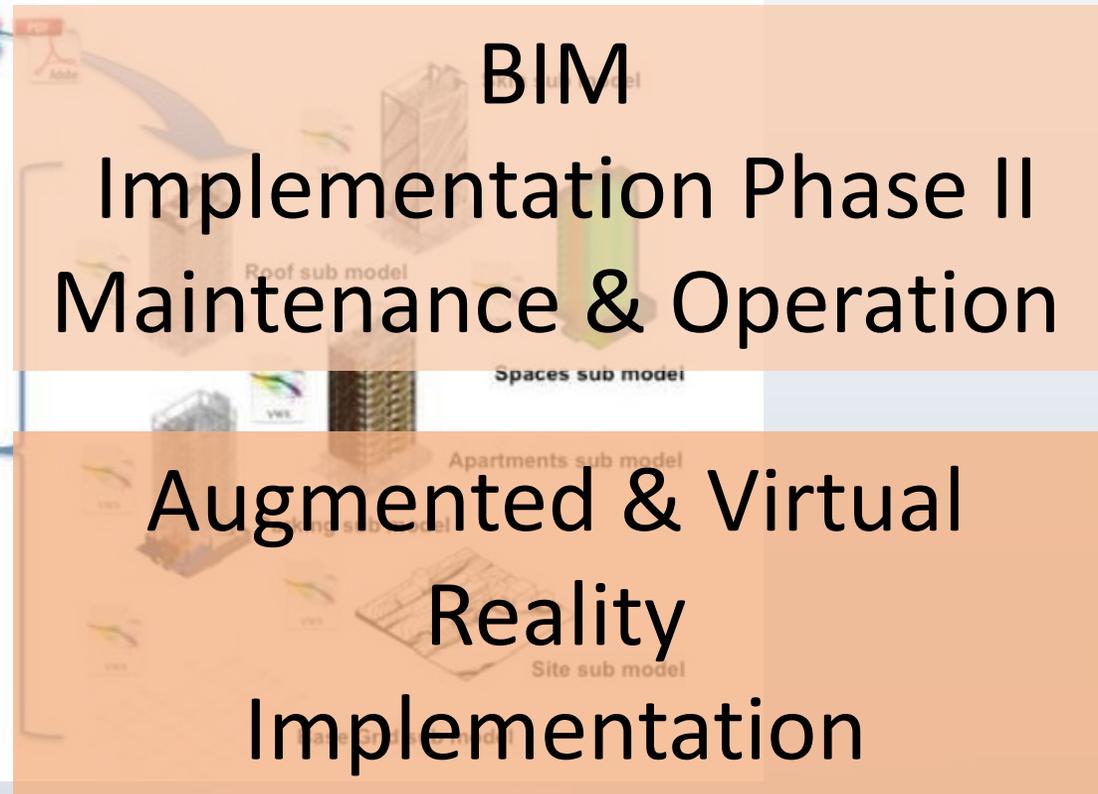




Data integration for BIM Models



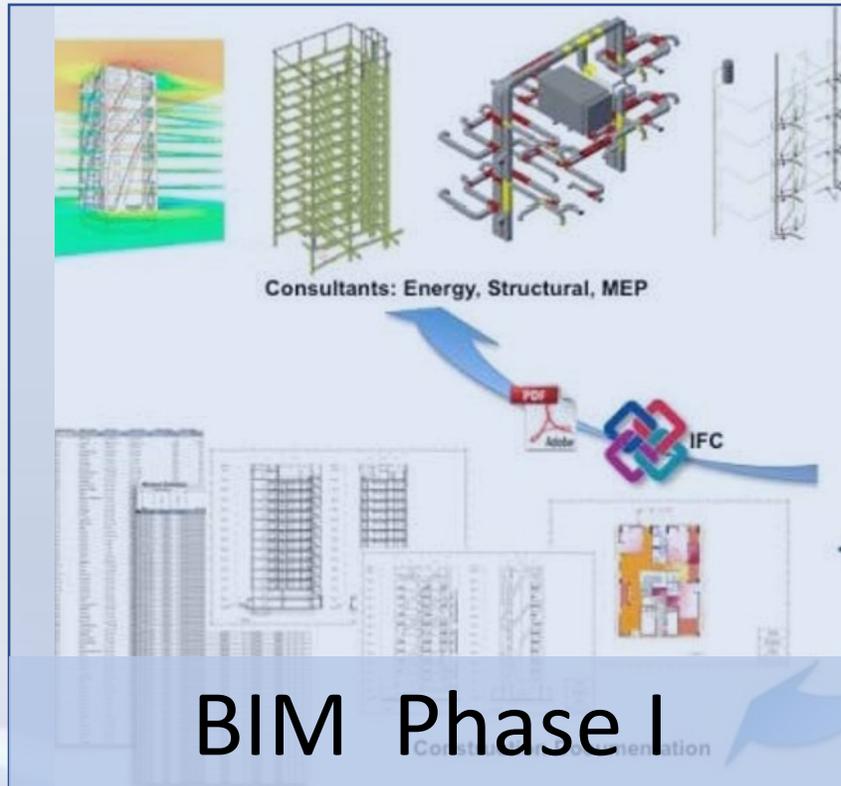
BIM
Implementation Phase I



BIM
Implementation Phase II
Maintenance & Operation

Augmented & Virtual
Reality
Implementation

BIM Phases (Construction & maintenance Phases)



Build & Simulate different Building Systems in the VR Environment

Build a Digital Twin Systems !!

*The higher the LOD the better
Data Hungry models*

Visualize Navigate and Simulate Different Building Systems in Real time

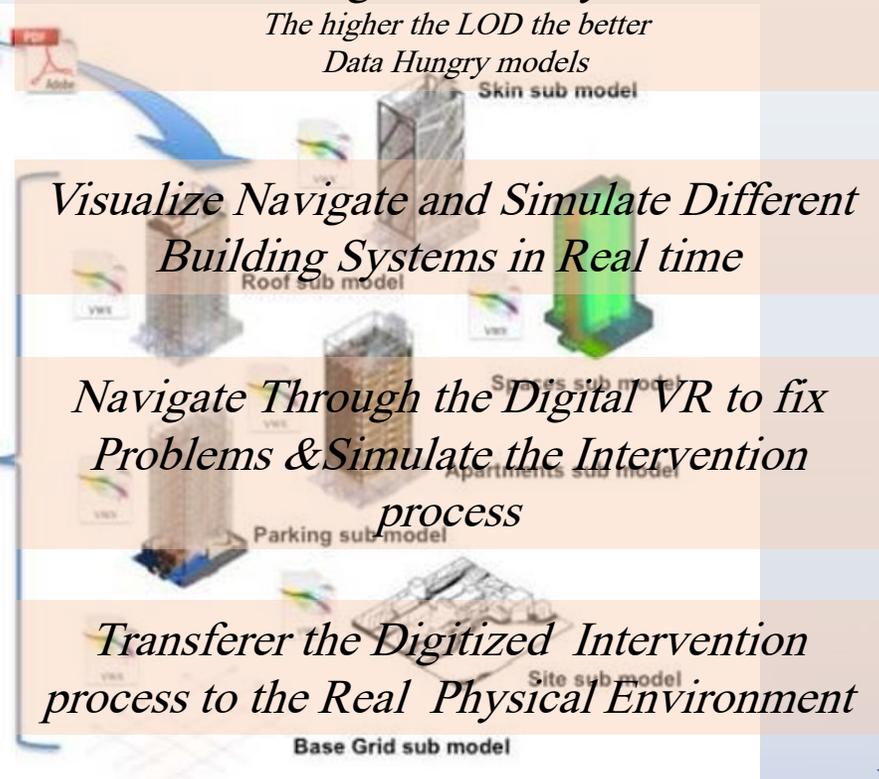
Navigate Through the Digital VR to fix Problems & Simulate the Intervention process

Transferer the Digitized Intervention process to the Real Physical Environment

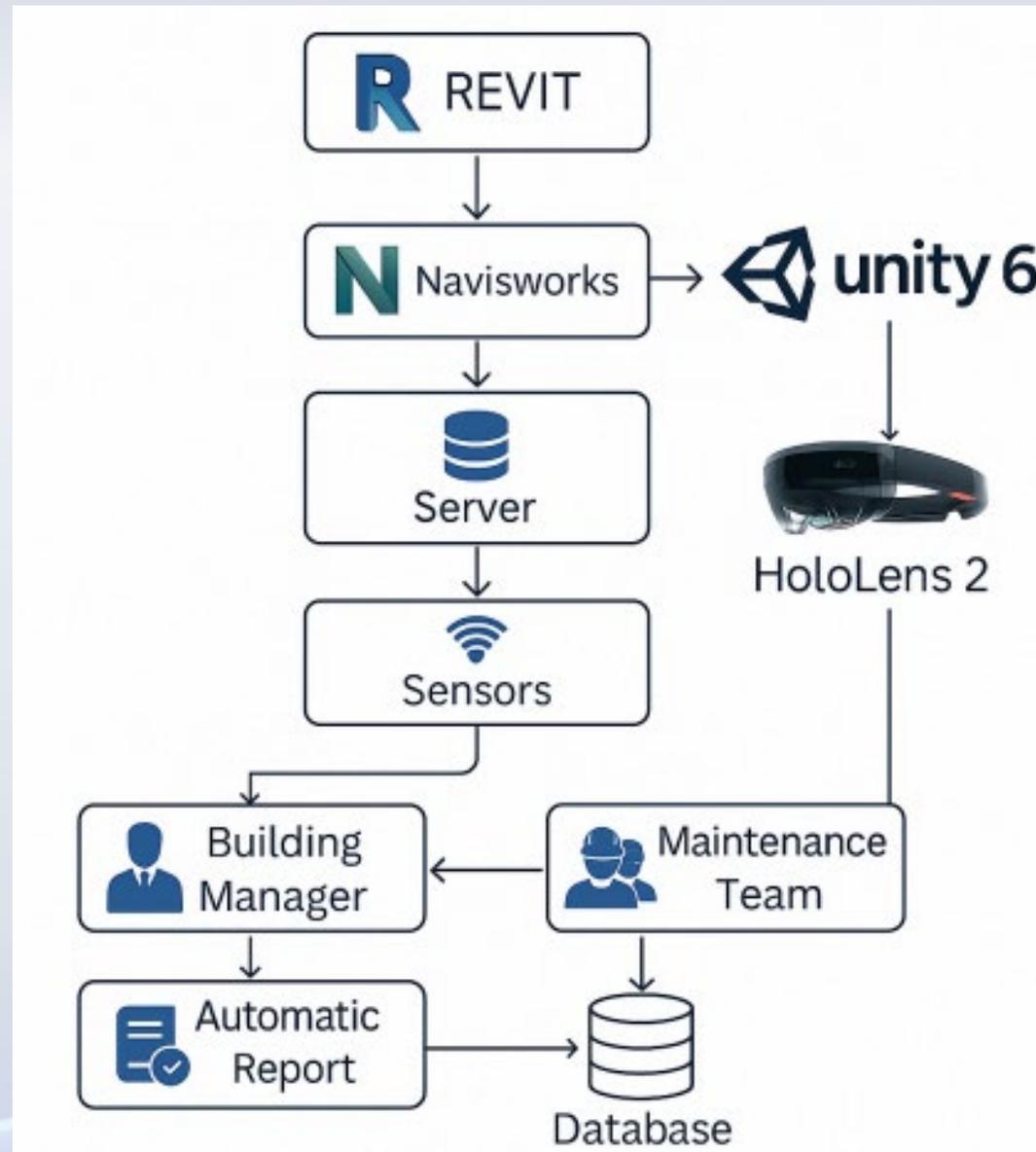
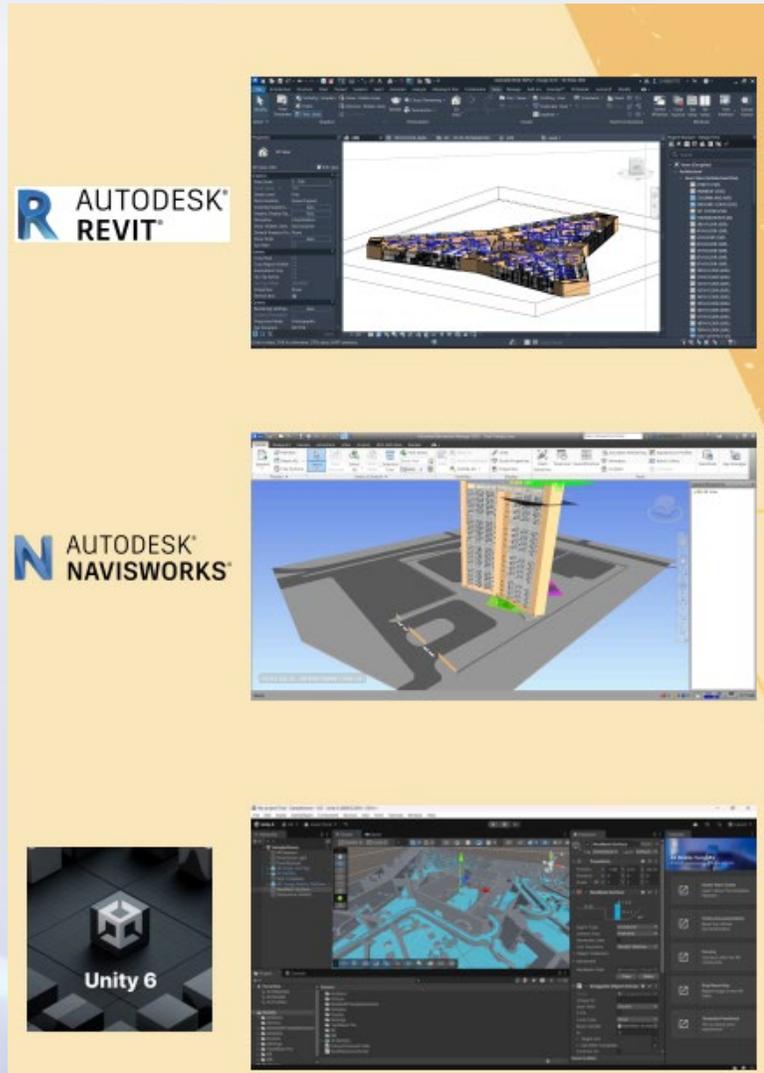
(BIM -AR) Phase II

Virtual Reality

Augmented Reality

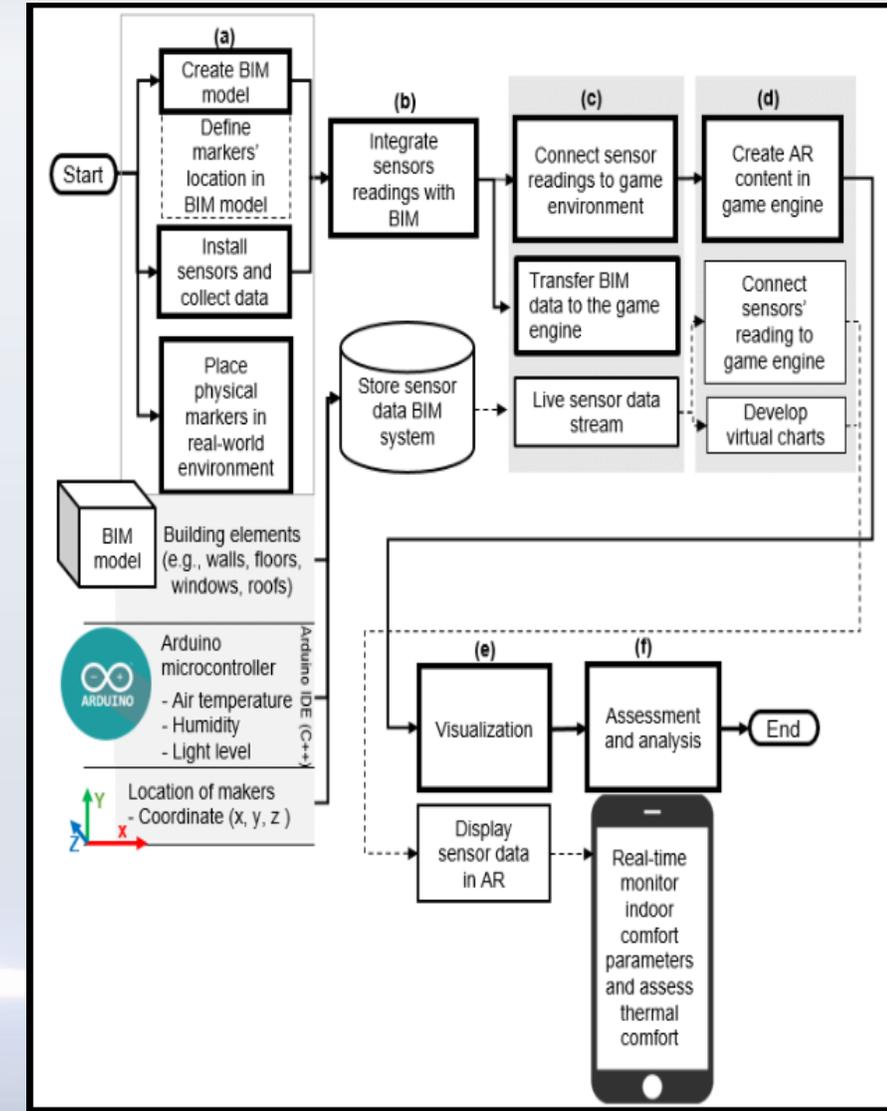


Methodology



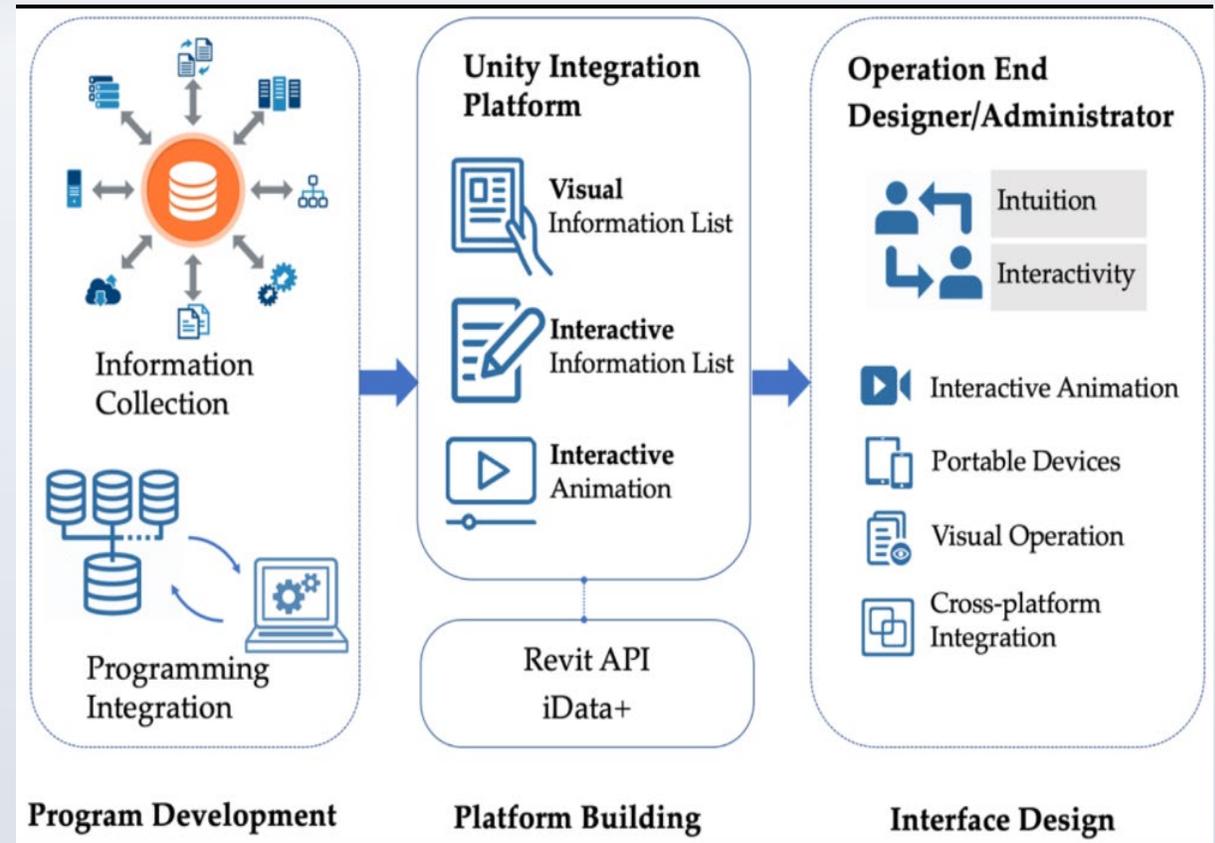
VR-based maintenance framework

- A **VR-based maintenance framework** is developed by integrating **Revit and Navisworks** models created from construction-phase documentation.
- Construction drawings are validated and confirmed as **as-built models** to ensure geometric and informational accuracy before system deployment.
- The validated BIM models represent the building's **infrastructure systems** (e.g., water supply, drainage, and mechanical networks).
- These systems are assumed to be equipped with **strategically located sensors** at critical and high-risk points to monitor operational performance.
- Sensors continuously collect data related to **flow, pressure, and quality parameters**, which are transmitted to the **Building Management System (BMS)** for real-time monitoring.

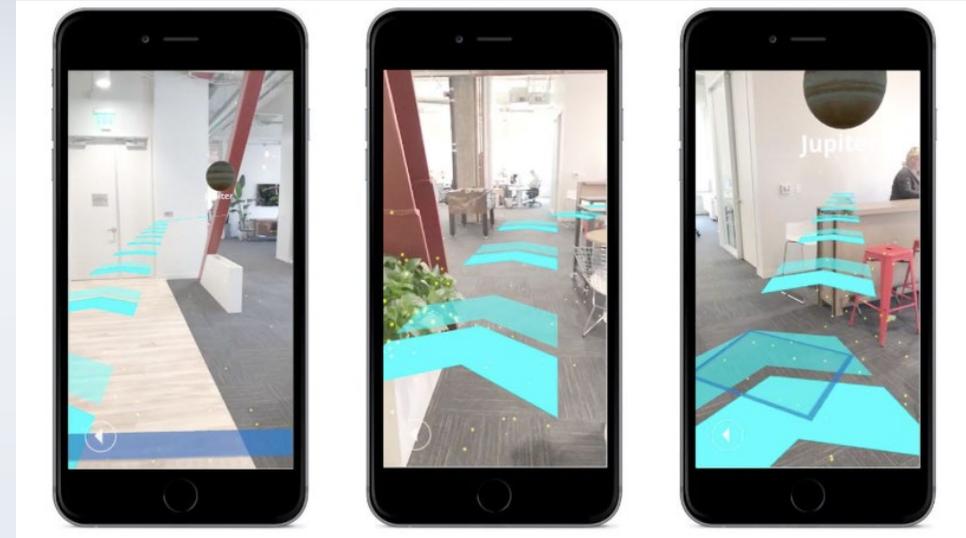


Failure Detection & Prediction (using ANN)

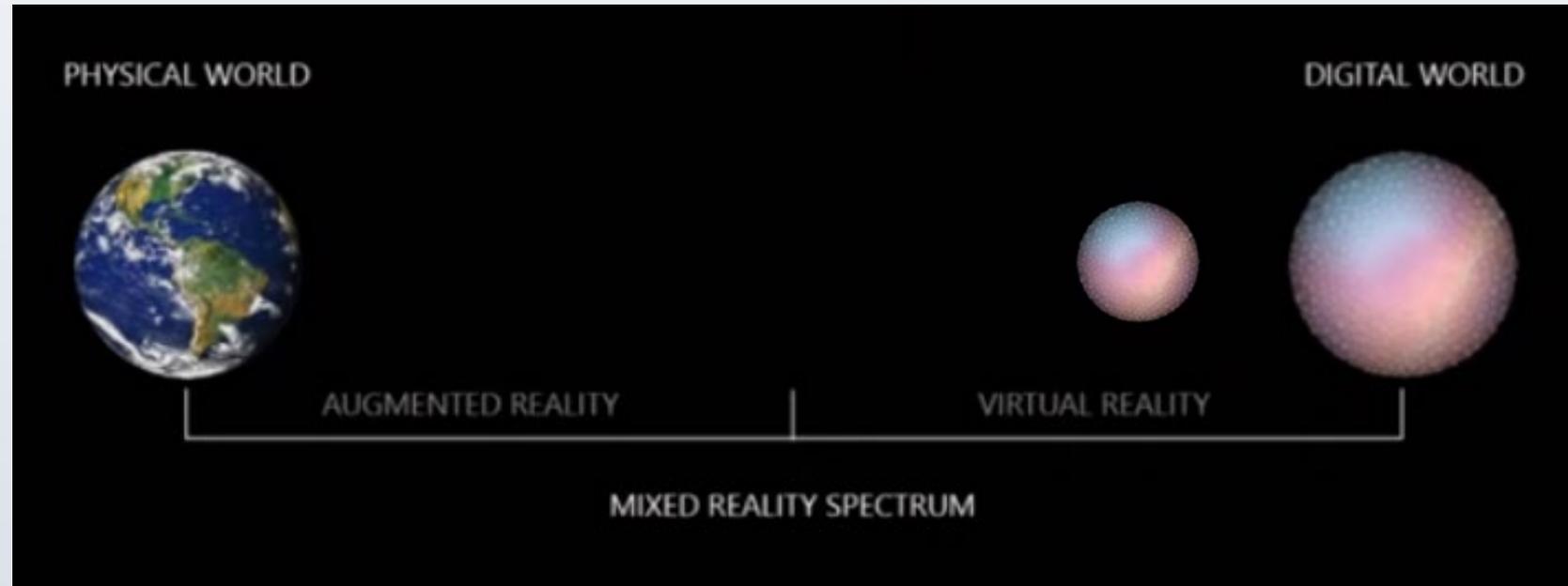
- Continuous data collection enables **early detection and prediction of failures**, including:
 - Physical failures (e.g., water leakage and flow obstructions).
 - Performance and quality failures (e.g., water quality degradation).
- Upon failure detection, the BIM model is imported into **Unity** to generate a **VR-based environment** for maintenance planning.
 - A **pathfinding and navigation system** is developed within the VR environment to guide maintenance personnel to the fault location using optimal access routes.
 - The navigation process is designed to **avoid interference with other building services** and minimize operational disruption.



VR Navigation System using Unity (failure access)



VR-AR Rehabilitation Implementation



Real Environment



Augmented Reality (AR)

Augmented Virtuality (AV)

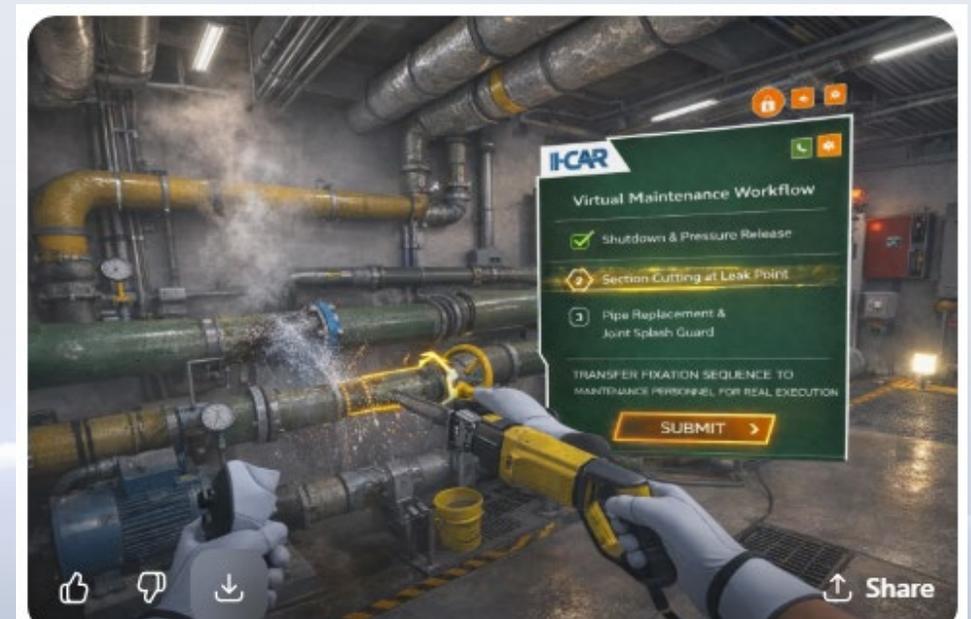


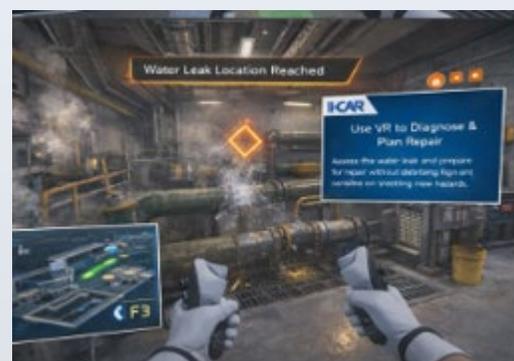
Virtual Environment

VR-AR Rehabilitation Implementation



- Within the VR environment, **rehabilitation and intervention procedures** are virtually performed over the failed component.
- The VR simulation enables the generation of **maintenance and rehabilitation maps**, which are provided to maintenance personnel for accurate on-site execution.
- This integrated BIM–VR–sensor approach improves **accessibility, decision-making, and efficiency** in high-rise building maintenance operations.





Process of Automated Path Generation, Repair Simulation, and Maintenance Plan Formalization in Unity Environment

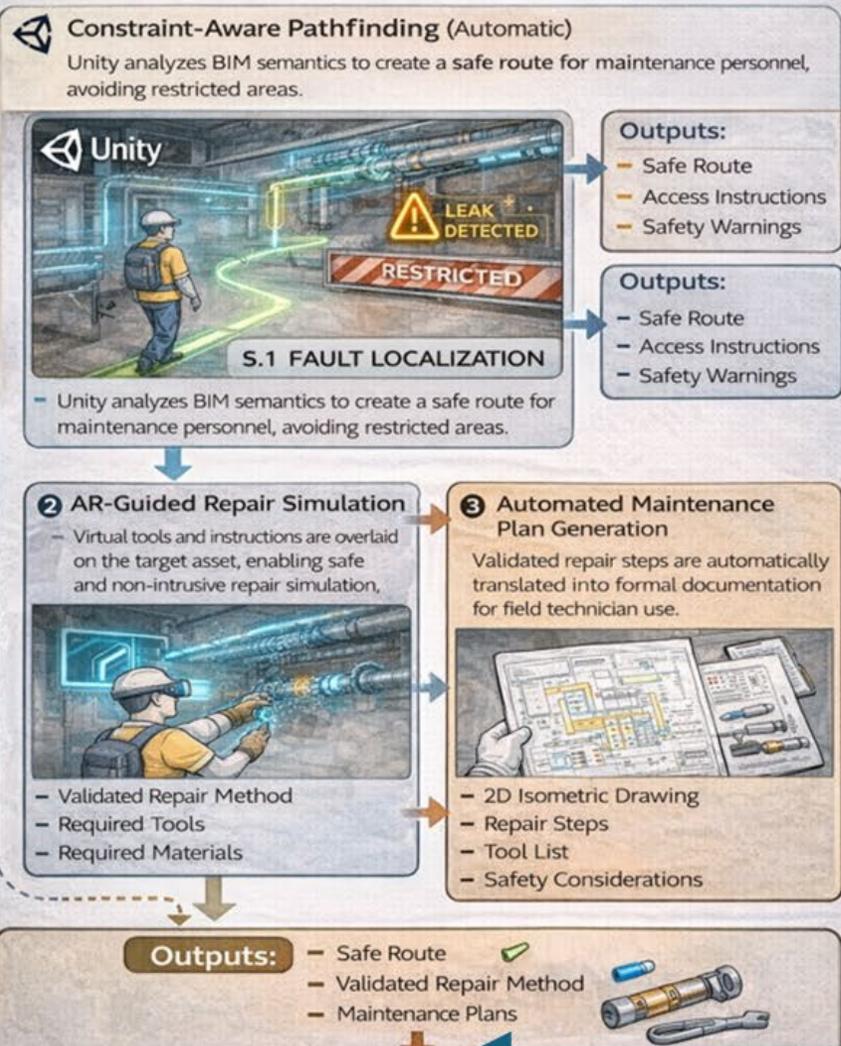
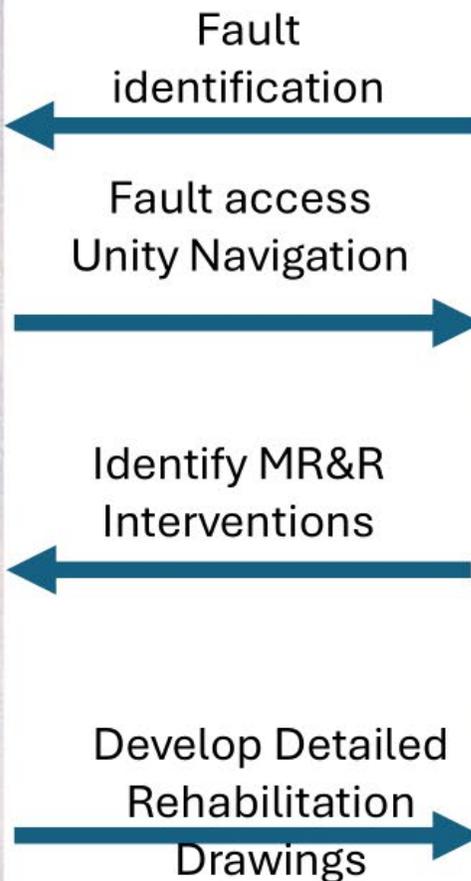


Figure 2. Entire process of automated pathfinding, VR-assisted repair simulation, and maintenance plan generation using Unity-based digital twin environment, ensuring safe, eff.



Methodology for Digital Twin Update Following VR/AR-Assisted Fault Localization and Repair Validation

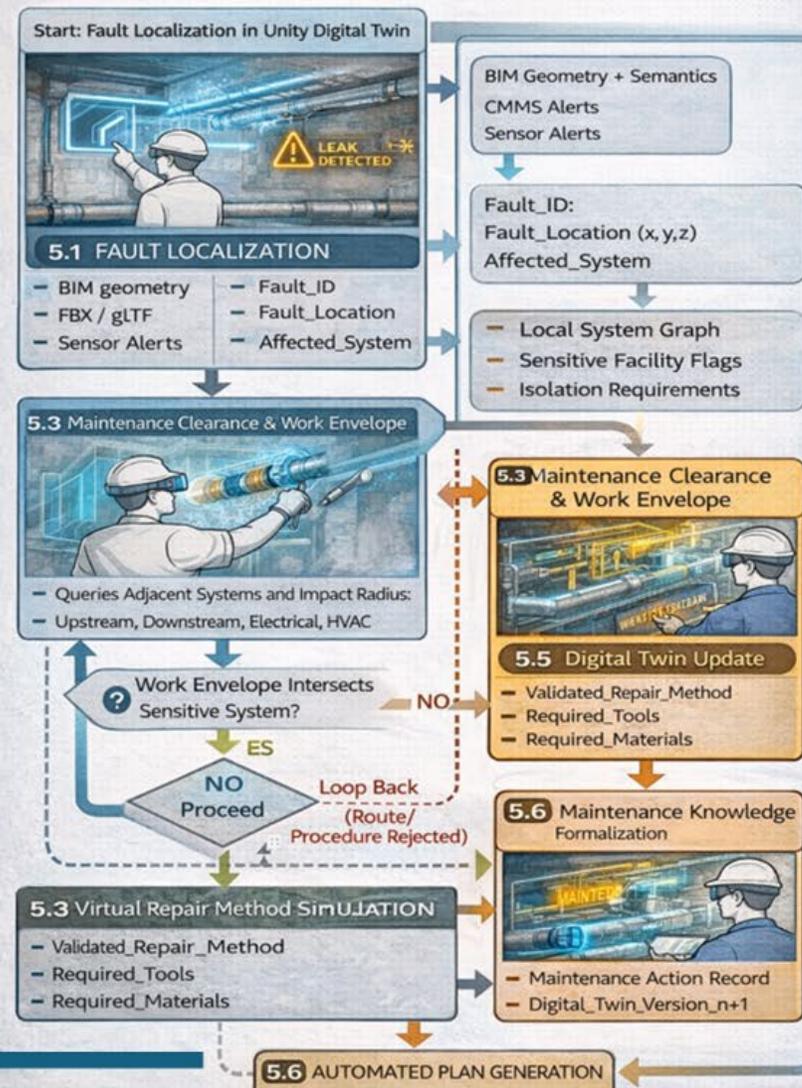
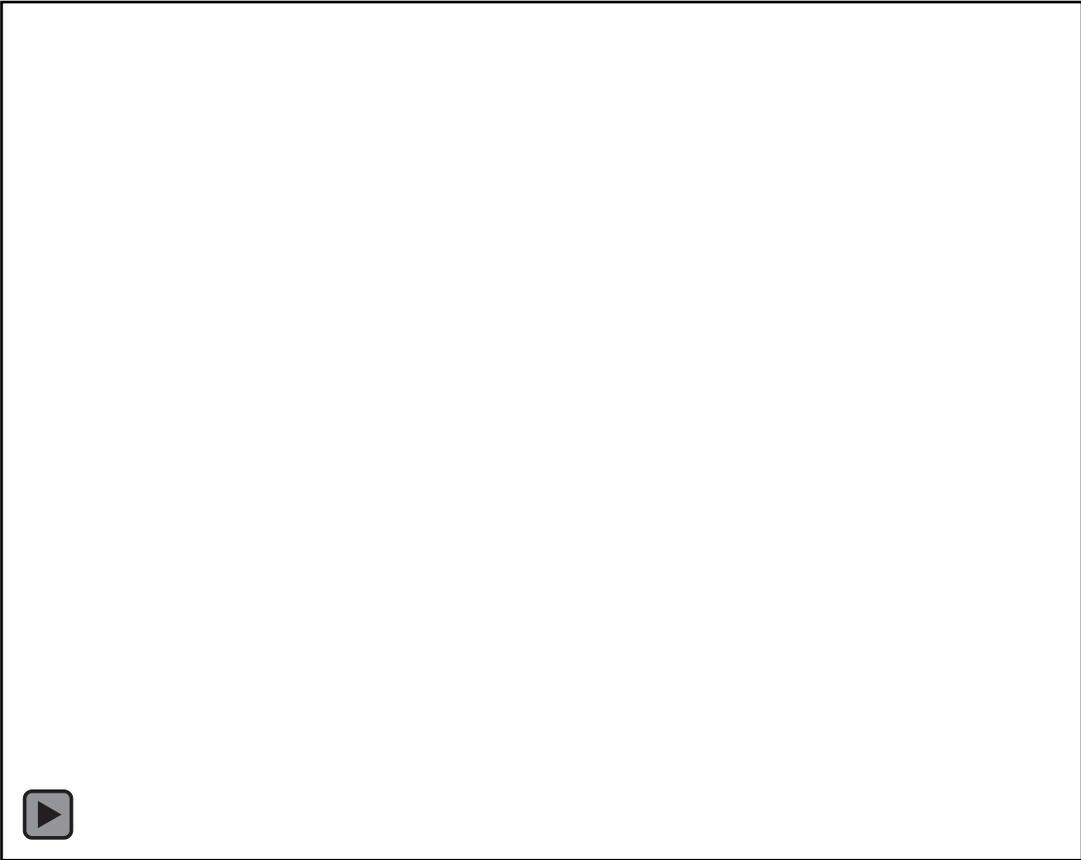


Figure 1. VR/AR-assisted digital twin update following VR/AR-assisted fault localization and repair validation.

VR & Animation sample (Revit & Naviswork)



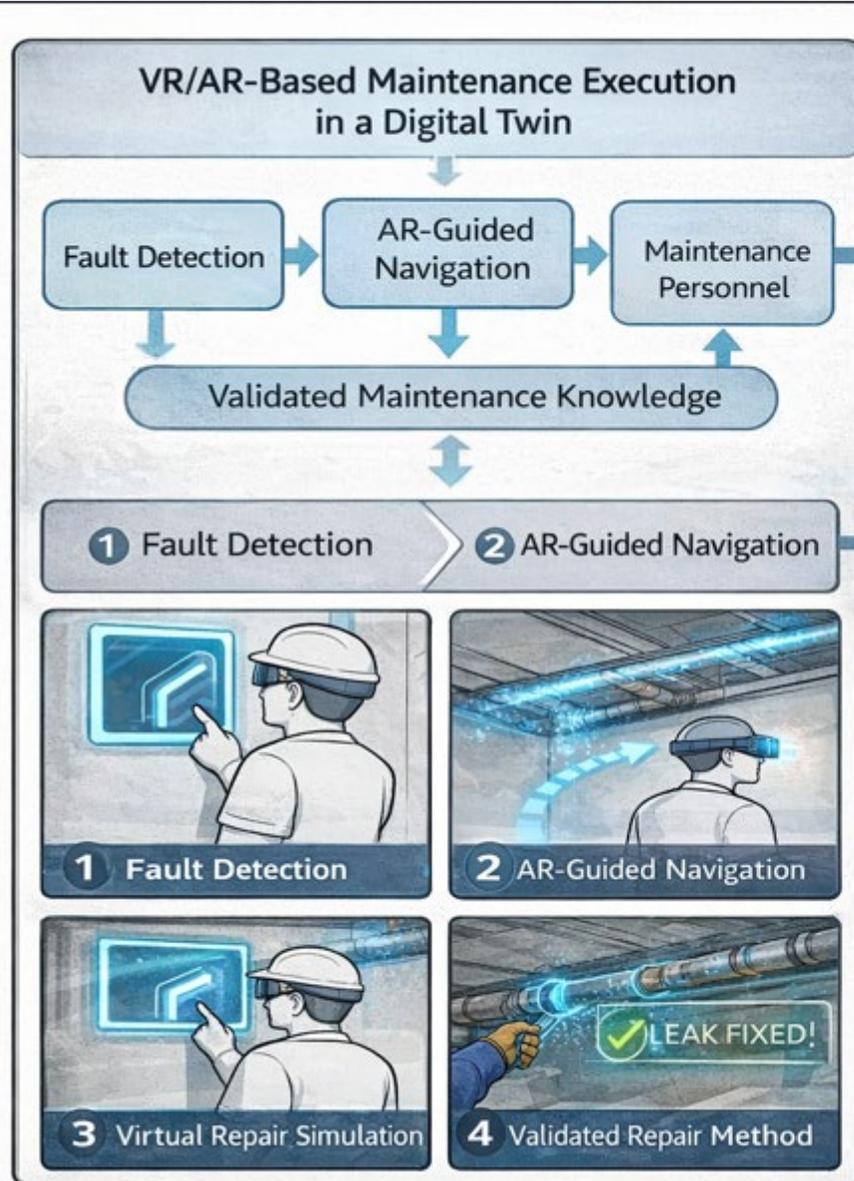


Figure 1. VR/AR-assisted maintenance execution and virtual rehabilitation of building

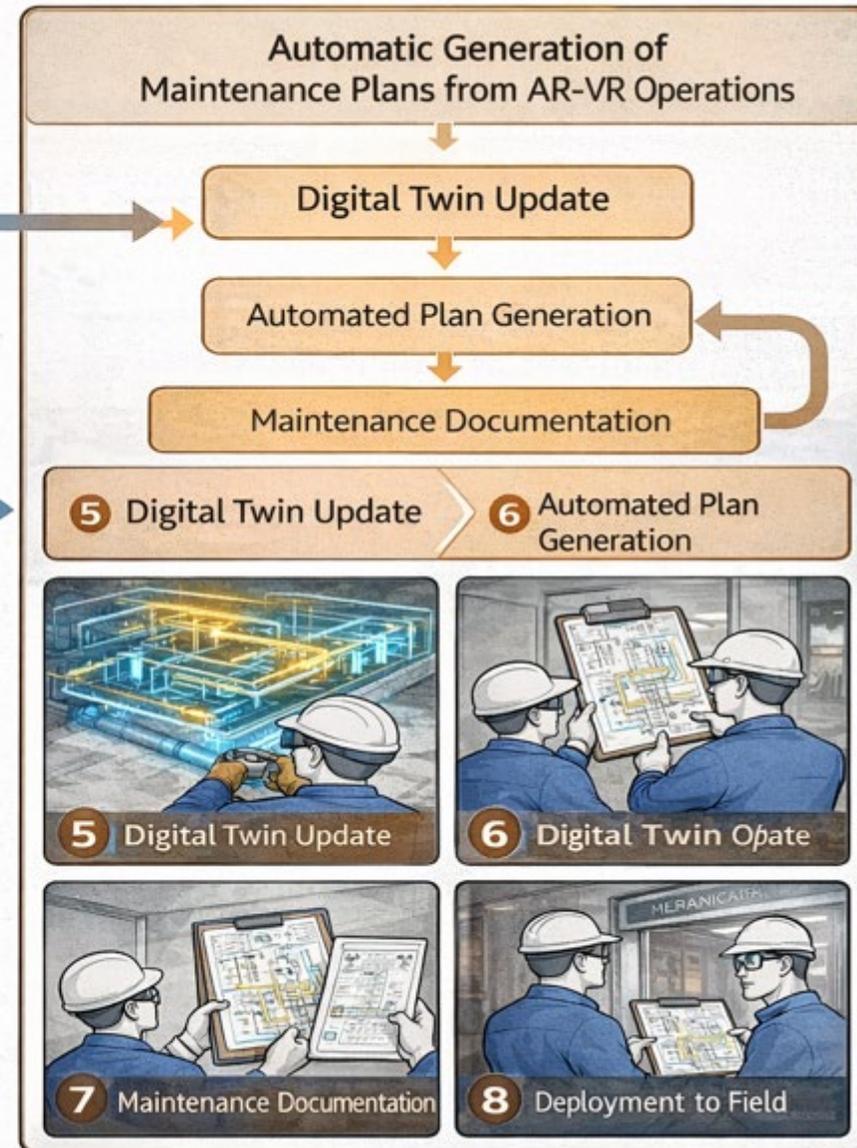


Figure 2. Automatic generation of maintenance plans from AR-VR digital twin interactions

Conclusions:

- BIM-AR integration improves maintenance accuracy by visualizing hidden systems in real-time.
- Reduces response time for maintenance tasks through on-site digital access. Enhances communication between facility teams using 3D interactive models
- Minimizes errors by linking maintenance activities directly to updated BIM data.
- Contributes to cost savings by reducing unplanned repairs and optimizing resource allocation.



The 23rd International Asset Facility and Maintenance Management Conference

THANK YOU!



 12-14 January 2026

 Riyadh, KSA

www.omaintec.com  #OmaintecConf

Organized by

OMAINTEC In Partnership with
المجلس العربي لإدارة الأصول والمرافق والصيانة
Arab Asset, Facility and Maintenance Management Council

 **SAFMMA**
الجمعية السعودية لإدارة الأصول والمرافق والصيانة
Saudi Asset, Facility & Maintenance Management Association

Executed by

Organizational Partner
TSG | EXICON.
شركه مجموعه المختص • The Specialist Group

Illustrative Example

Figure 1 — BIM in Unity (Input Layer)

Geometry + metadata become selectable, semantic objects

Figure 1: BIM model imported to Unity (Geometry + Metadata)

MEP systems, slabs, cores, and equipment become selectable objects.

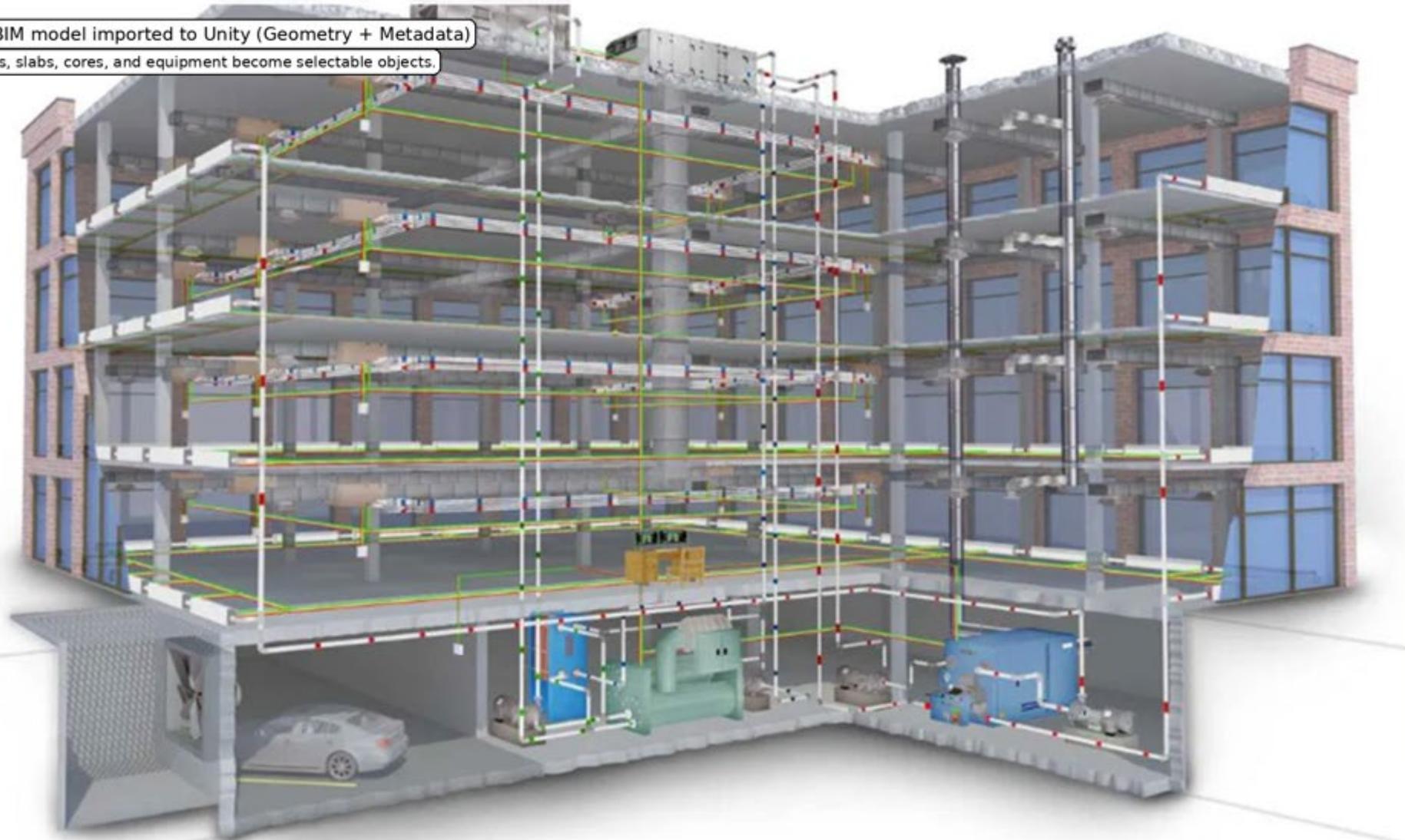


Figure 3 — Access vs Restriction Zoning
Walkable zones vs sensitive/restricted facilities

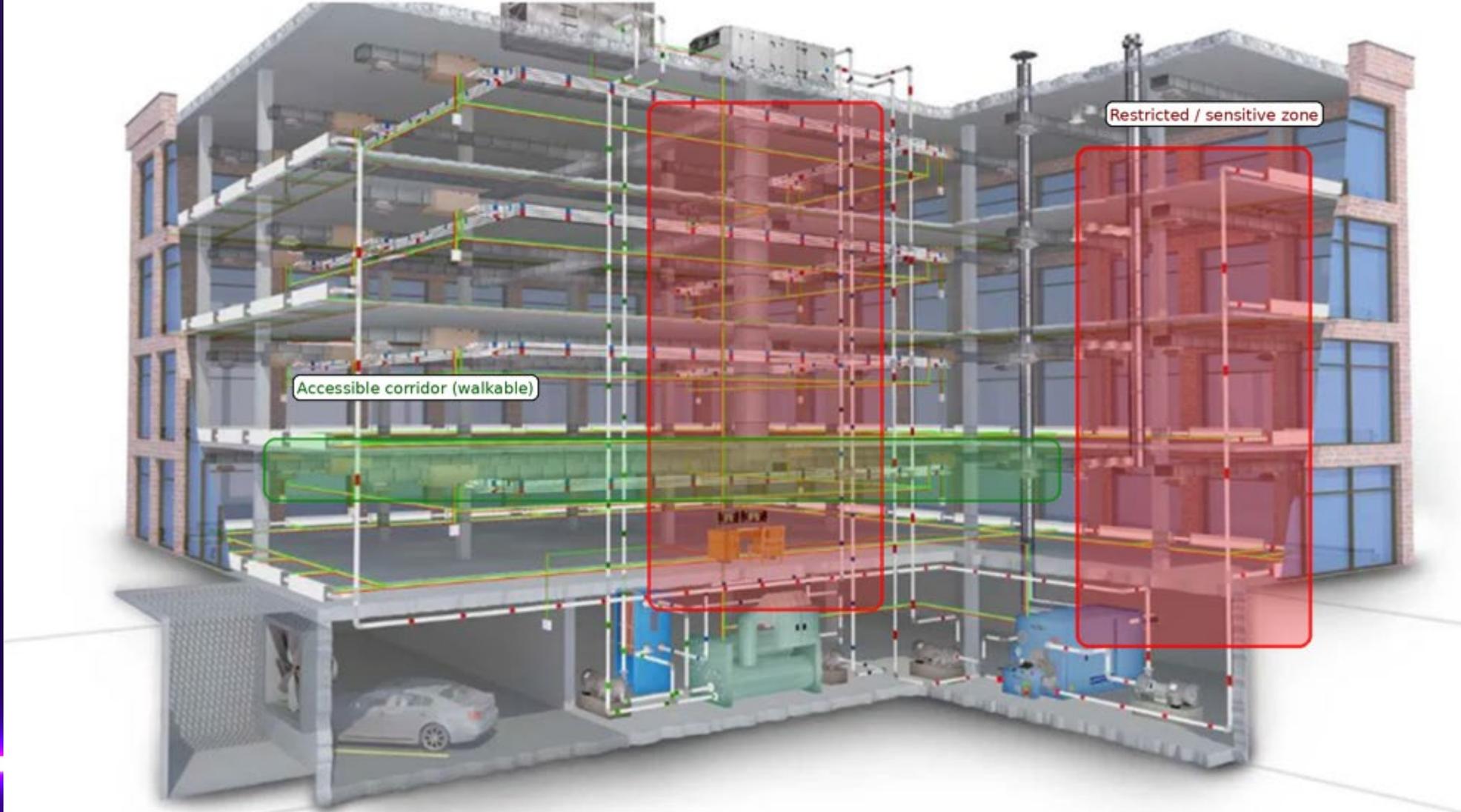


Figure 2 — Fault Localization

Select fault element and generate a clearance bubble

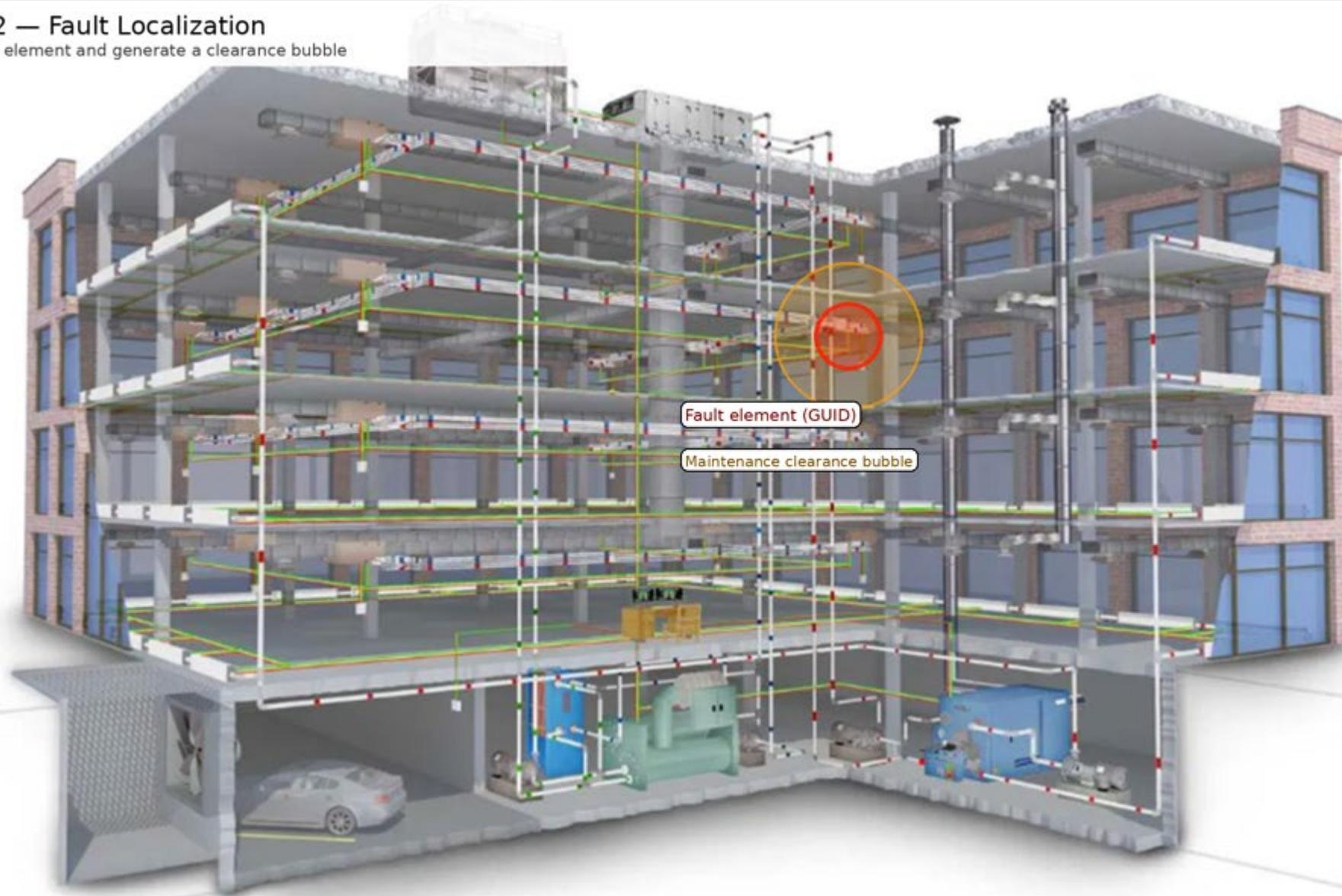


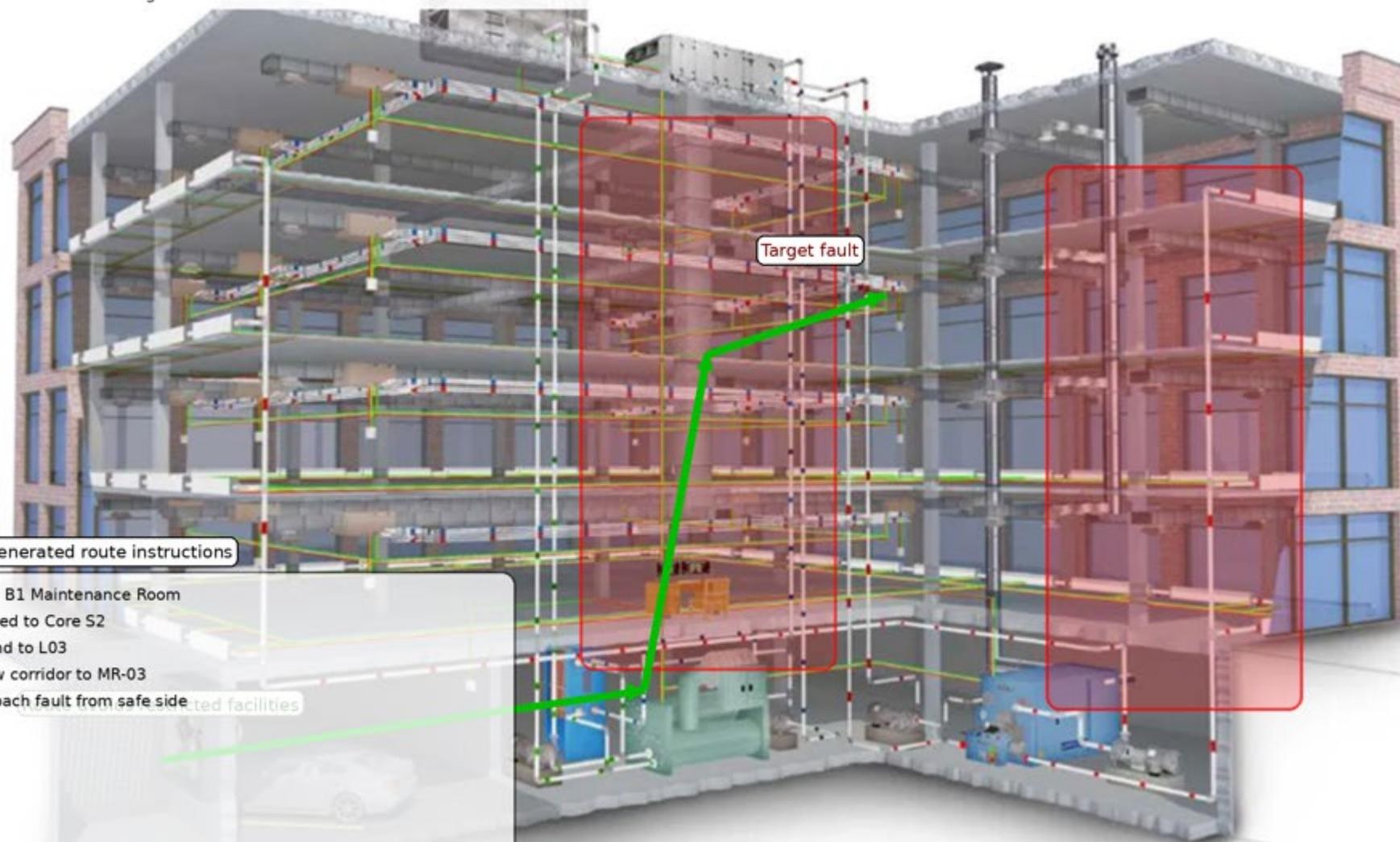
Figure 4 — Entry Points & Vertical Transitions

Start locations and stair/elevator nodes across floors



Figure 6 — Step-by-Step Maintenance Guidance

Human-readable instructions generated from the route

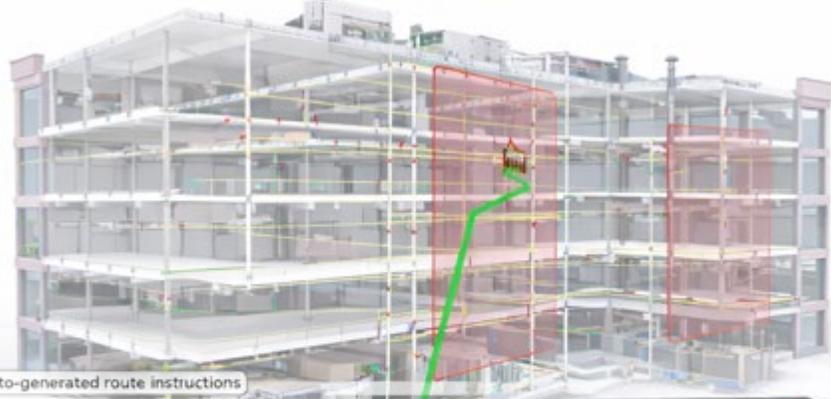


Auto-generated route instructions

- 1) Start: B1 Maintenance Room
- 2) Proceed to Core S2
- 3) Ascend to L03
- 4) Follow corridor to MR-03
- 5) Approach fault from safe side

ted facilities

AR Navigation to Fault



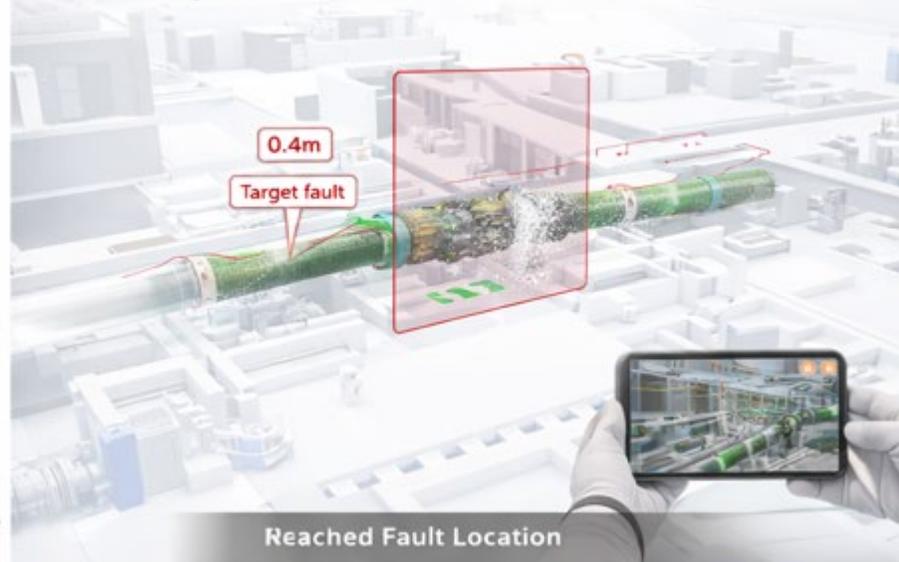
Auto-generated route instructions

- 1) Start: B1 Maintenance Room
- 2) Proceed to Core S2
- 3) Ascend to L03
- 4) Follow corridor to MR-03
- 5) Approach fault from left side



Navigating to Fault Location

| Access the Fault Area



Reached Fault Location

| VR Maintenance Simulation



- LCAR**
- Virtual Maintenance Workflow
- Shutdown & Pressure Release
 - 4** Section Cutting at Leak Point
 - 3** Pipe Replacement & Joint Splash Guard
- SUBMIT**



Fixing the Pipe in VR Simulation

| Rehabilitation Drawings



Preparing Rehabilitation Drawings