



# ICSC15

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# QR-CODED CLASH-FREE DRAWINGS: AN INTEGRATED SYSTEM OF BIM AND AR TO IMPROVE CONSTRUCTION PROJECT VISUALIZATION

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# OUTLINE

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- Introduction
- Methodology
  1. Problem Identification
  2. Study Objective
  3. Proposed Workflow
  4. Case Study Implementation
- Results
- Conclusion

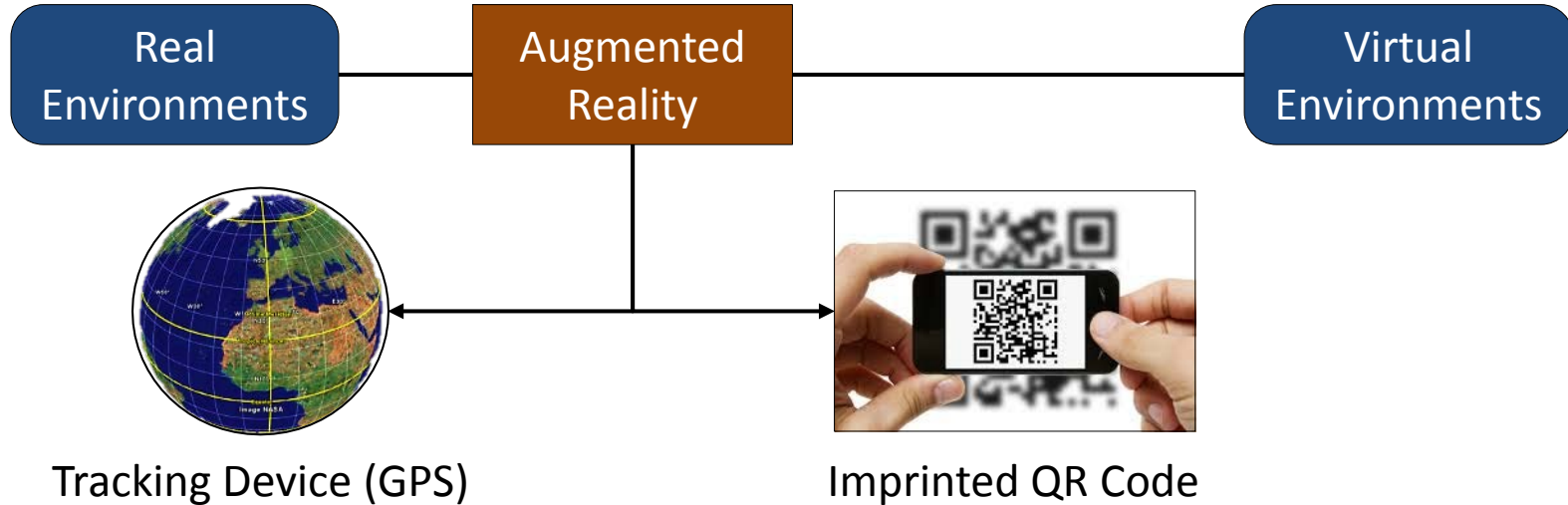
# INTRODUCTION

## **B I M** : **B**uilding **I**nformation **M**odeling

- ⇒ The more Information the more reliable
- ⇒ A type of nD CAD
- ⇒ Commercially available software worldwide

## **A R** : **A**ugmented **R**eality

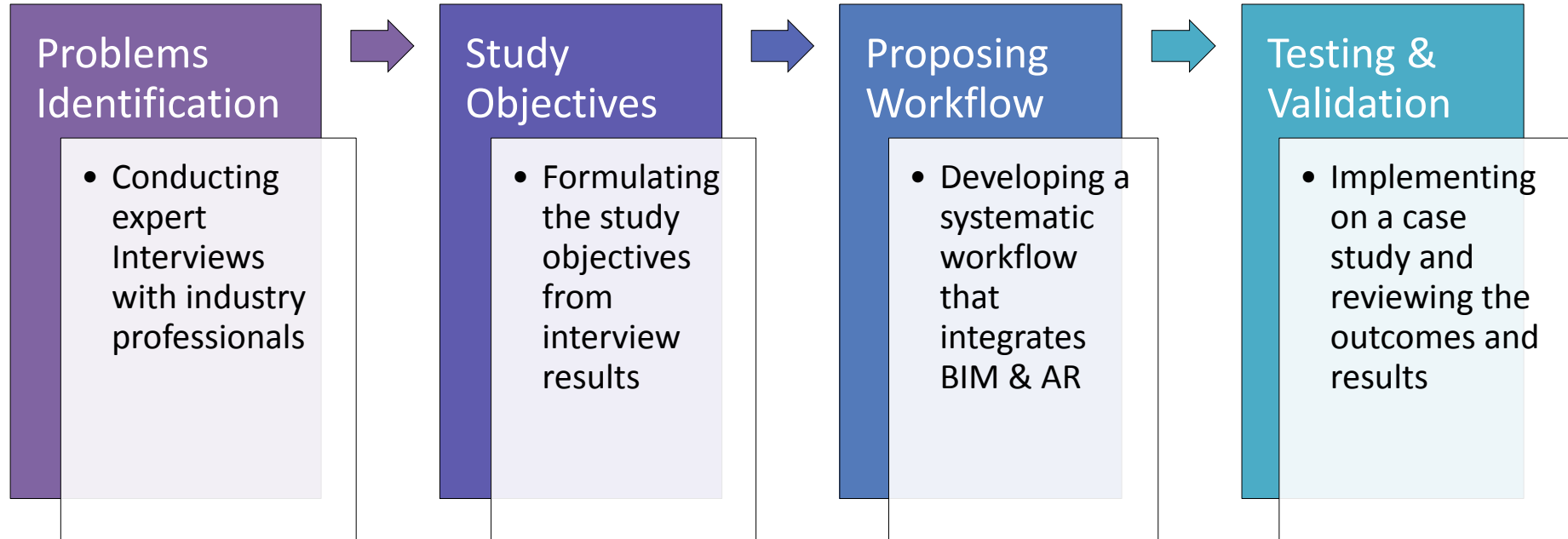
- ⇒ Superimposing objects stored digitally onto the Real World



**The applications of BIM and AR promise a paradigm shift in AEC industry**

# METHODOLOGY

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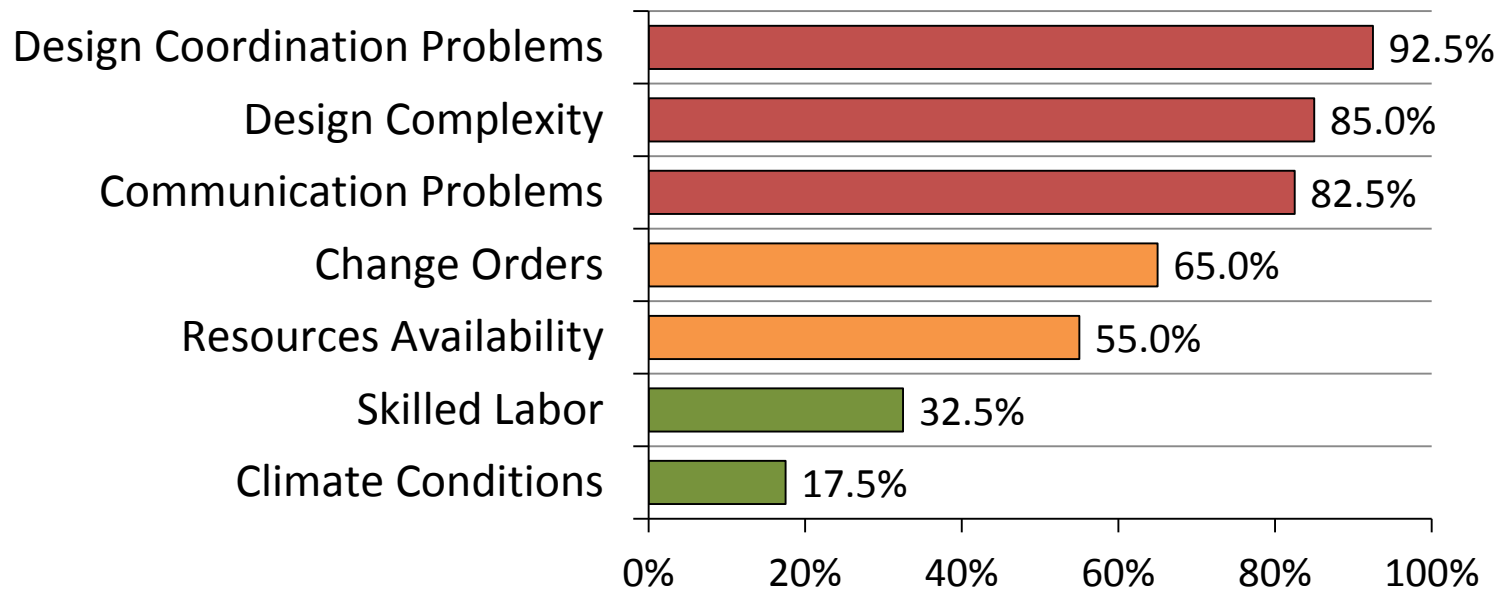
# 1. PROBLEMS IDENTIFICATION

Direct Interviews with 40 experts from the industry (10-20 yrs.) to identify the current practice in Egypt:

- ⇒ Contractors and Consultants
- ⇒ Project, Construction and Design Managers
- ⇒ Design Team Leaders and Site Super Intendants

1

## The major problems that drive project delays



# 1. PROBLEMS IDENTIFICATION

2

## The current use of BIM in Design and Construction

- 2D CAD software for design and construction drawings
- Design coordination on 2D CAD, problems with congested MEP zones
- BIM to generate building forms, basic 3D models and rendering

3

## The current use of AR in Design and Construction

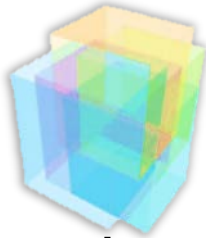
- AR is an unknown and unexplored

## 2. STUDY OBJECTIVE

Develop a systematic workflow that combines **BIM** and **AR** to solve the design problems and improve visualization from early project stages

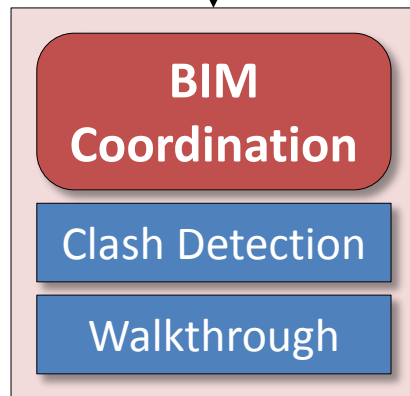
# 3. DEVELOPED WORKFLOW

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Combining BIM Models from all trades to a Multi-Model

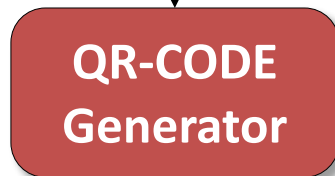
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## Two-step process:

1. Clashes identification and reporting
2. Model walkthrough

3



Generate QR Codes for all coordinated drawings



View the superimposed model using a smartphone's camera



## 4. CASE STUDY: INTRODUCTION

- Administration Building for Hospital Project in Cairo, Egypt
- Originally designed using Autodesk® Revit®
  1. Architecture
  2. Structure
  3. Mechanical: Plumbing
  4. Mechanical: Firefighting
  5. Mechanical: HVAC
- Used tools
  1. Autodesk® Navisworks® Manage
  2. QR-Code Generator
  3. Tablet / Smartphone

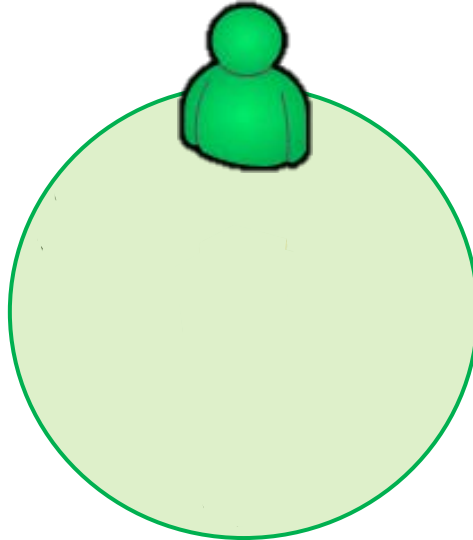




# CASE STUDY: TEAM COMPOSITION

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Design Manager

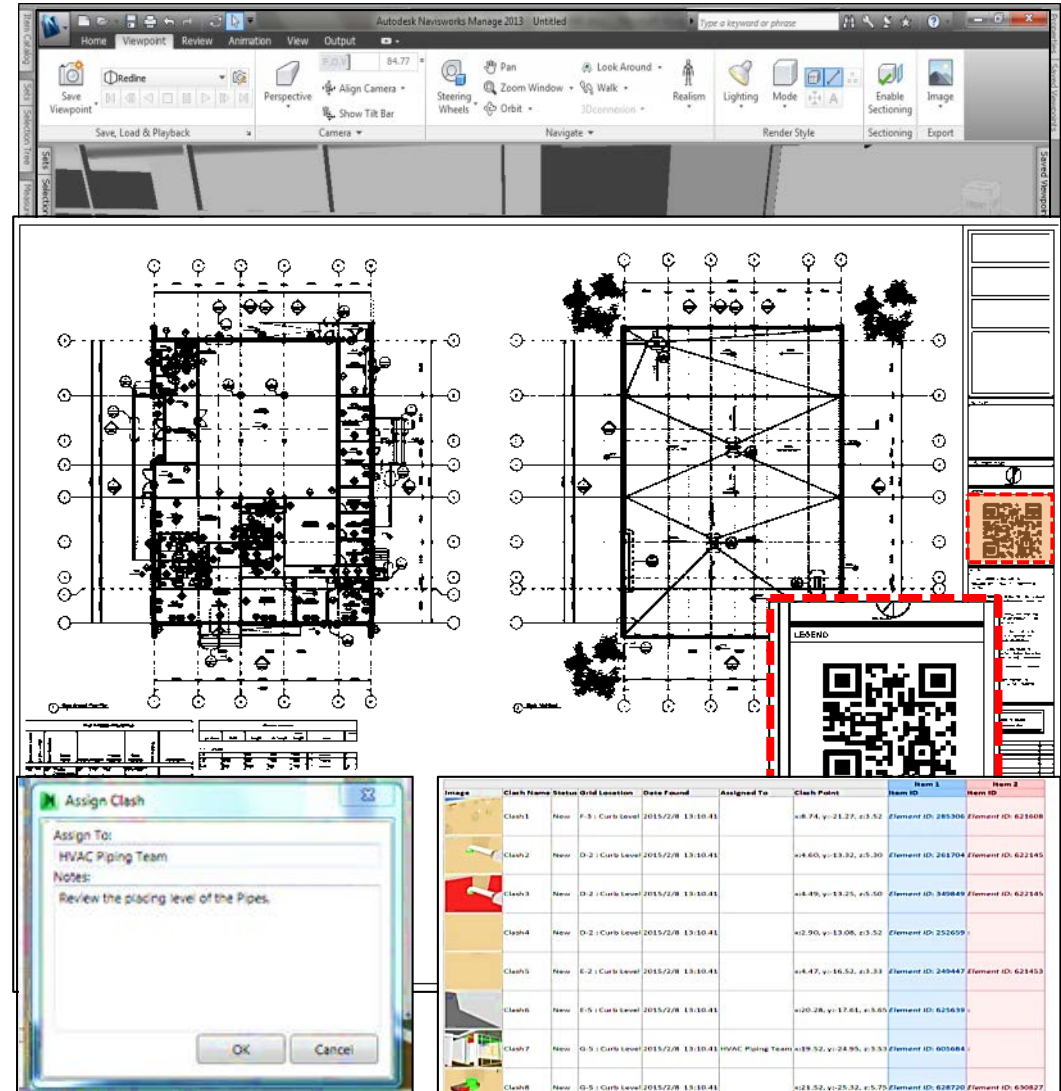
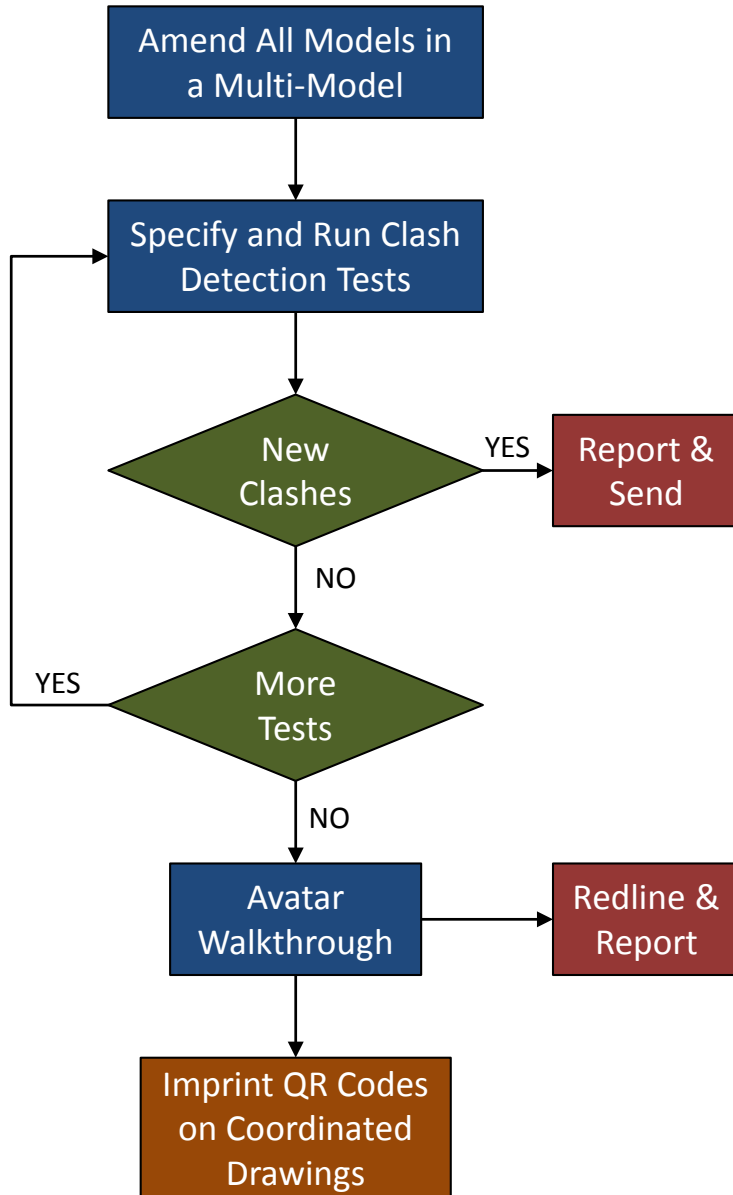


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## Design Manager:

- ✓ Performs clash detection and reports to design trades
- ✓ Performs model walkthrough and reports to design trades
- ✓ Advises on the generation of QR-Codes on the final coordinated drawings

# CASE STUDY: WORKFLOW IMPLEMENTATION



(Assign Clash)

(Clashes Report)

# CASE STUDY: **WORKFLOW IMPLEMENTATION**



**Layer Management, Section Planes, Scaling, Rotating, Dimensioning**

# CASE STUDY: RESULTS: CLASH DETECTION

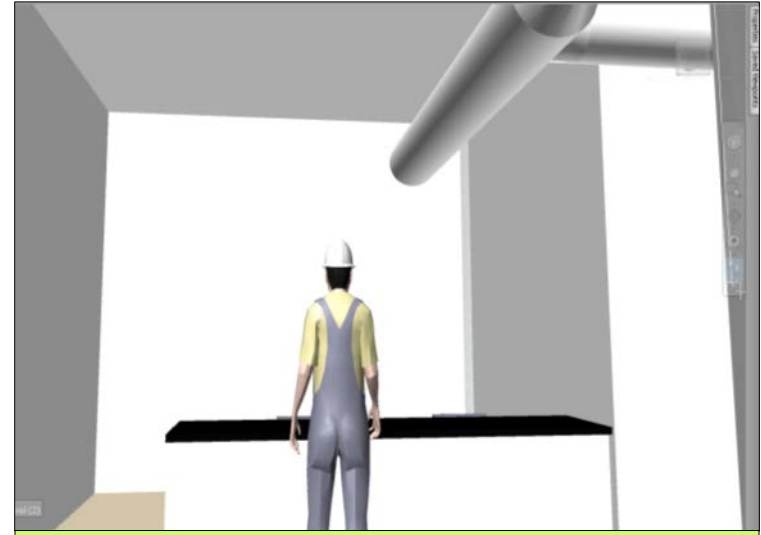
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Clash Test	Detected	Snapshot	Resolved
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# CASE STUDY: RESULTS: AVATAR WALKTHROUGH



AC unit misplaced



Chilled water pipes below false ceiling



Floating soak-away box



Floating entrance stair structure



Men toilet door dimensions



# CASE STUDY: RESULTS: AUGMENTED REALITY



**Layer Management**



**Perspective Viewing**



**Section planes**



**Sectioning, Scaling and Rotating**

# CASE STUDY: RESULTS

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## For Design Team:

- Coordination problems were easily communicated to all the design team
- Conflicts were resolved in an efficient and systematic way
- Avatar walkthrough determined some design errors

## For Constructability Review Team:

- Visualization improved
- Construction method was easily selected
- Construction safety considerations were noted
- Model manipulation and review was made easy using the tablet's screen



# CONCLUSION

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- Design coordination problems are one of the major driving project delays
- BIM offers detection of coordination and design problems from early project stages
- AR offers improved project visualization in real time
- Integration of BIM and AR proved effectiveness in terms of:
  - ⇒ Minimizing design errors → minimize delays and probable change orders
  - ⇒ Contractor/Engineer could minimize number of personnel deployed to create/review shop drawings, especially onsite
  - ⇒ Constructability and safety review sessions made easy
  - ⇒ Easy to implement, an integration of commercially available software and devices



THANKS FOR YOUR ATTENTION  
QUESTIONS ?