Eliminating Construction Waste with Augmented Reality

AWE USA 2021

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Presentation Purpose & Agenda

To understand how McKinstry and Spectar partnered to apply Augmented Reality to accelerate pipe-hanger installation.

- Construction Industry Overview
- Why XR?
- Spectar Pilot at 840 HSB
- Hanger Installation
- Next Steps
- Q&A

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HALF

of the energy in buildings is wasted

HALF

of the labor in construction is wasted

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Industry Crises

Sustainability

Affordability

Equity

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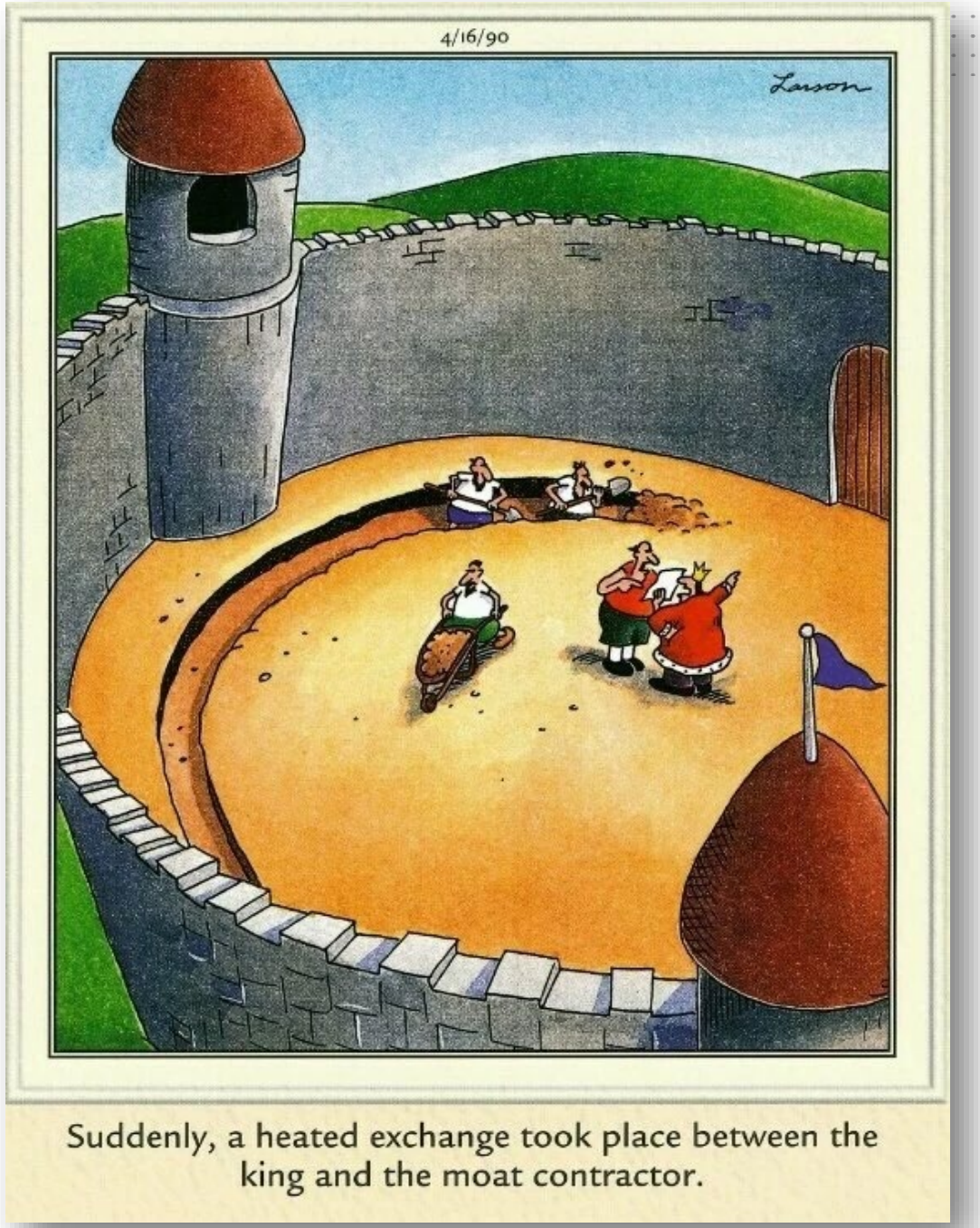
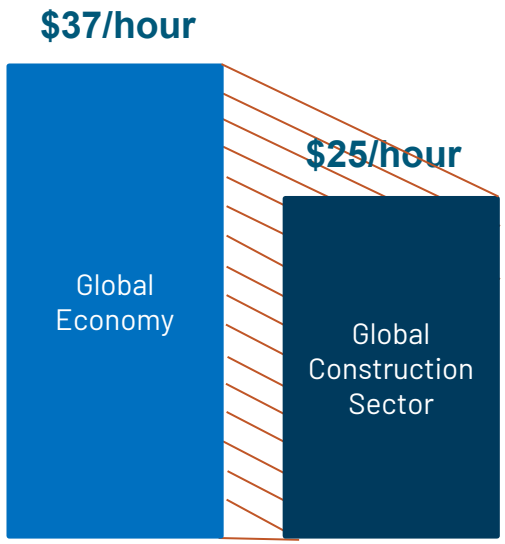

4/16/90
Larson
Suddenly, a heated exchange took place between the king and the moat contractor.

Productivity Gap:

$1.63 trillion



Average value added per employee per hour of work

SOURCE: MCKINSEY & COMPANY

Cost & Schedule Overruns

Average estimated overrun in capital expenditure: **80%**

Average delay beyond original schedule: **20 months**

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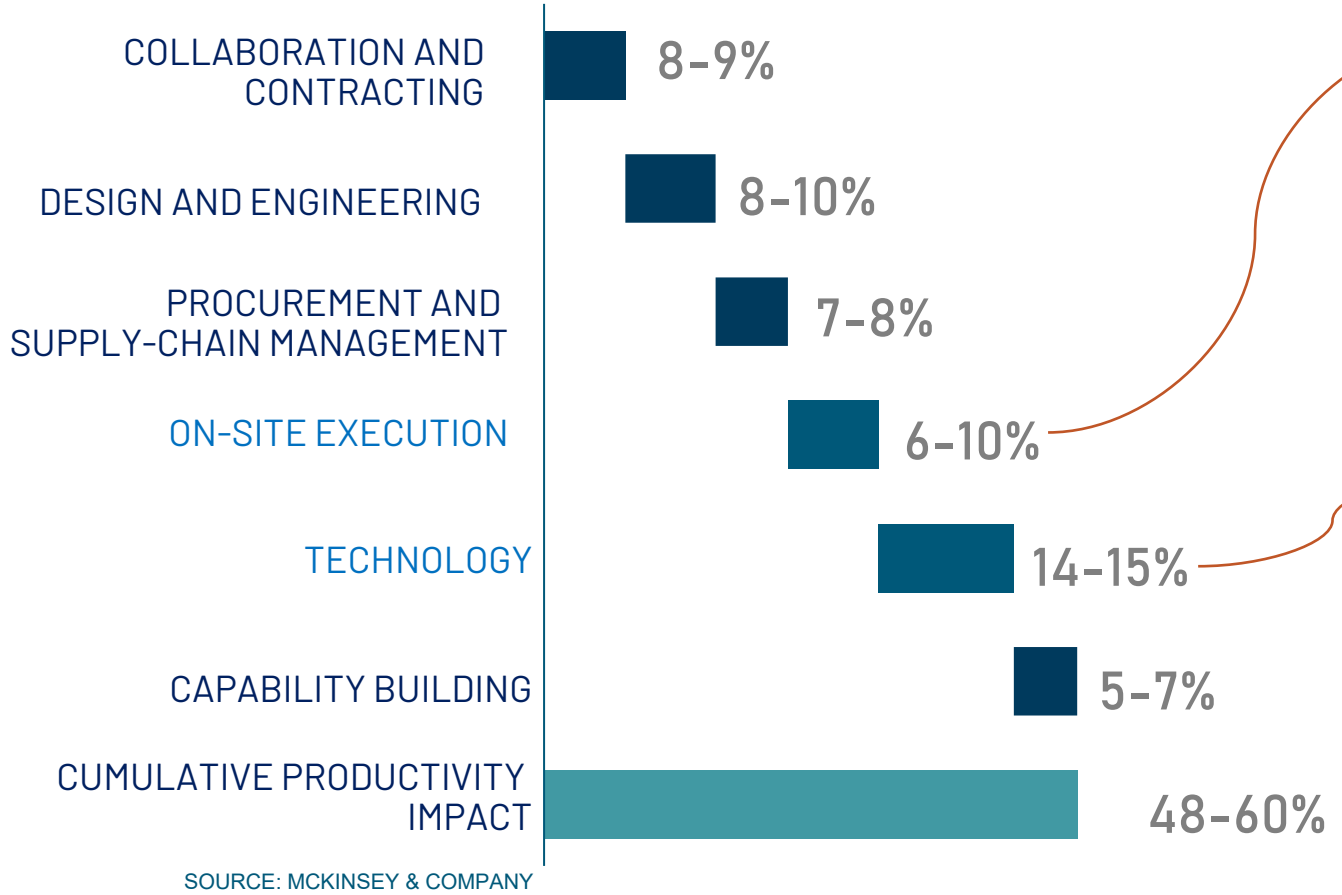
Levers for construction productivity improvement

ONSITE EXECUTION & TECHNOLOGY ARE THE GREATEST LEVERS OF PRODUCTIVITY



SOURCE: MCKINSEY & COMPANY

IMPROVE ON-SITE EXECUTION

- RIGOROUS PLANNING PROCESS
- CLEAR AGREEMENT ON KPIS
- NEW PROJECT MOBILIZATION
- LEAN-BASED TRADE COORDINATION

INFUSE DIGITAL TECHNOLOGY AND ADVANCED AUTOMATION

- 3D, 4D, 5D BIM
- ADVANCED ANALYTICS BY IOT
- DIGITAL COLLABORATION
- MOBILITY TOOLS
- BIG DATA UTILIZATION
- ROBOTIZATION
- AUGMENTED AND VIRTUAL REALITY

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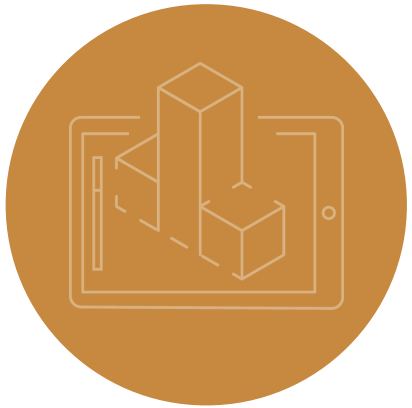
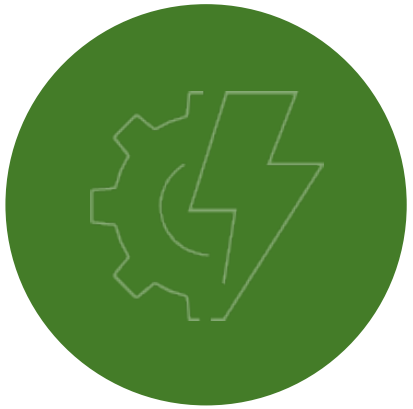
McKinstry Services & Capabilities



ENGINEERING & CONSULTING

BUILDING & MANUFACTURING



ENERGY OPTIMIZATION & RENEWABLES

FACILITY SERVICES

SMART & CONNECTED BUILDINGS

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Our Values

Put people first

Be constantly curious

Build trusted partnerships

Make a positive difference

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Why XR?

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...by increasing...

- Collaboration
- Communication
- Coordination
- Comprehension
- Confidence

...through **spatial experience** of design intent

- Intuitive
- Immersive
- Interactive

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XR Business Value in AECO

- Increased **revenue**
  - Market differentiation
  - Increased customer engagement
- Increased **profitability**
  - Increased productivity & efficiency
  - Decreased risk & write-downs
- Increased **quality**
- Increased **safety**
- Business **continuity**

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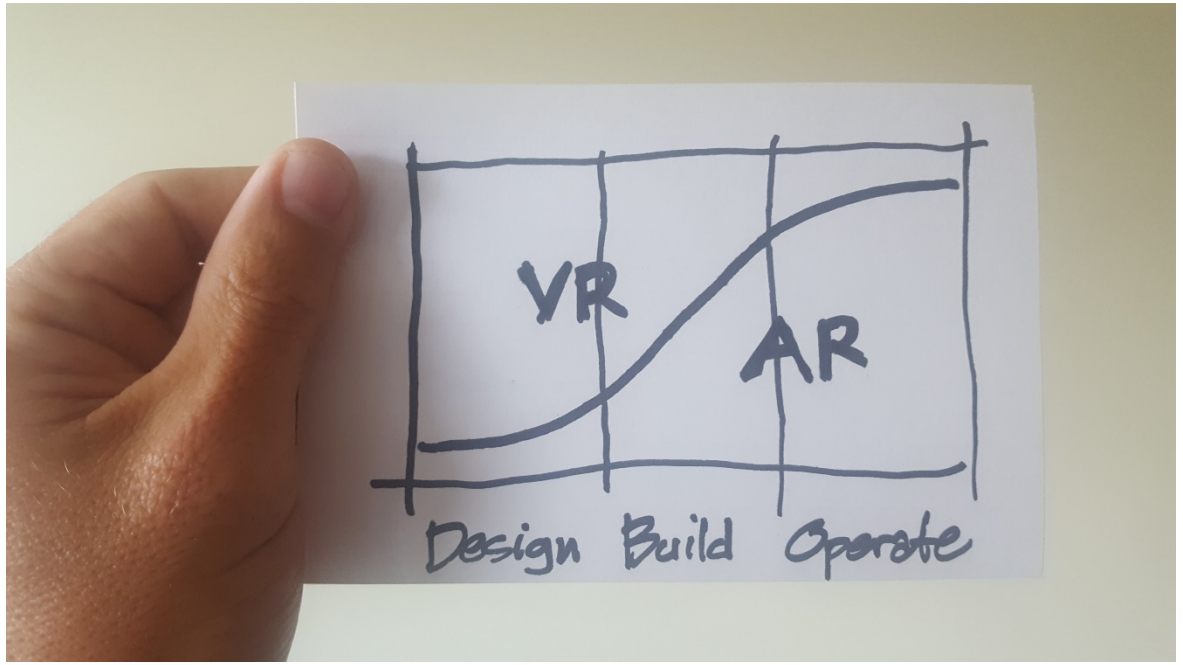
XR in AECO



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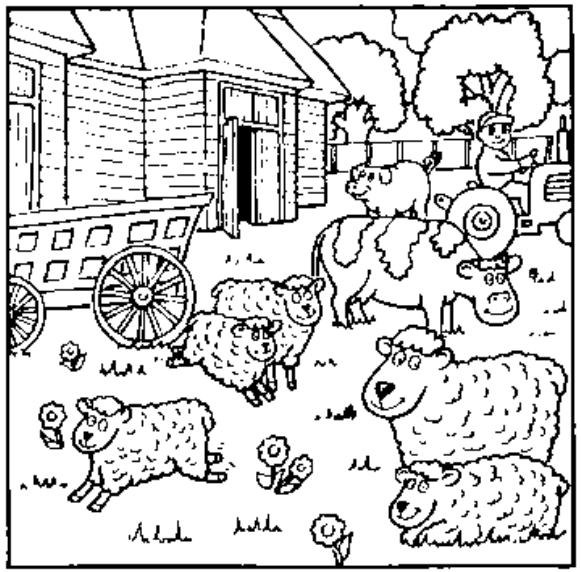
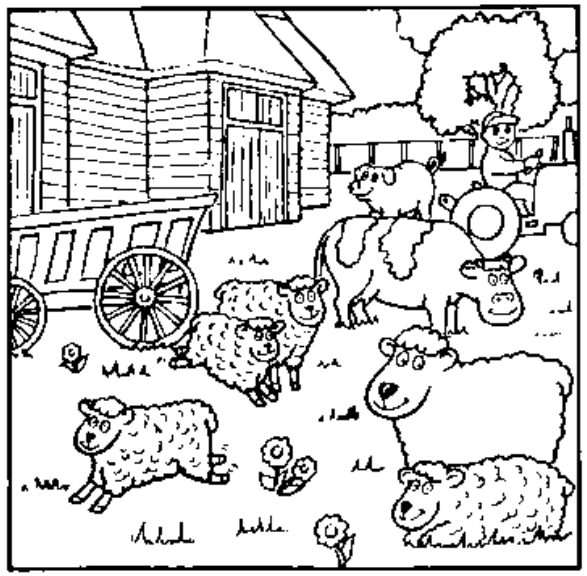
AR: Spot the Differences





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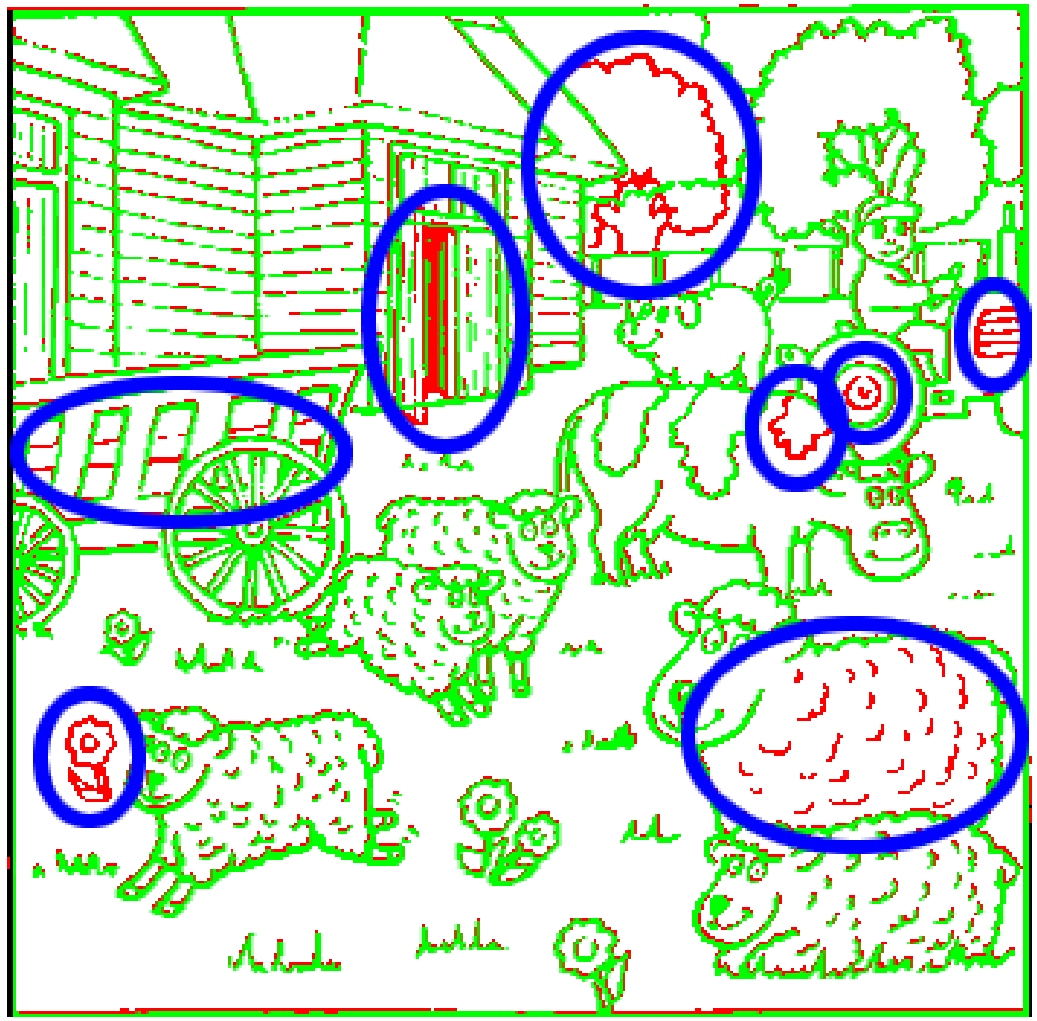

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AR is “Lean”

The right information,
the right tools,
and the right materials,
to the right person,
in the right place,
at the right time

- Maximize value and minimize waste
- Support just-in-time decision-making
- Empower the field to access and leverage rich data when and where it is needed

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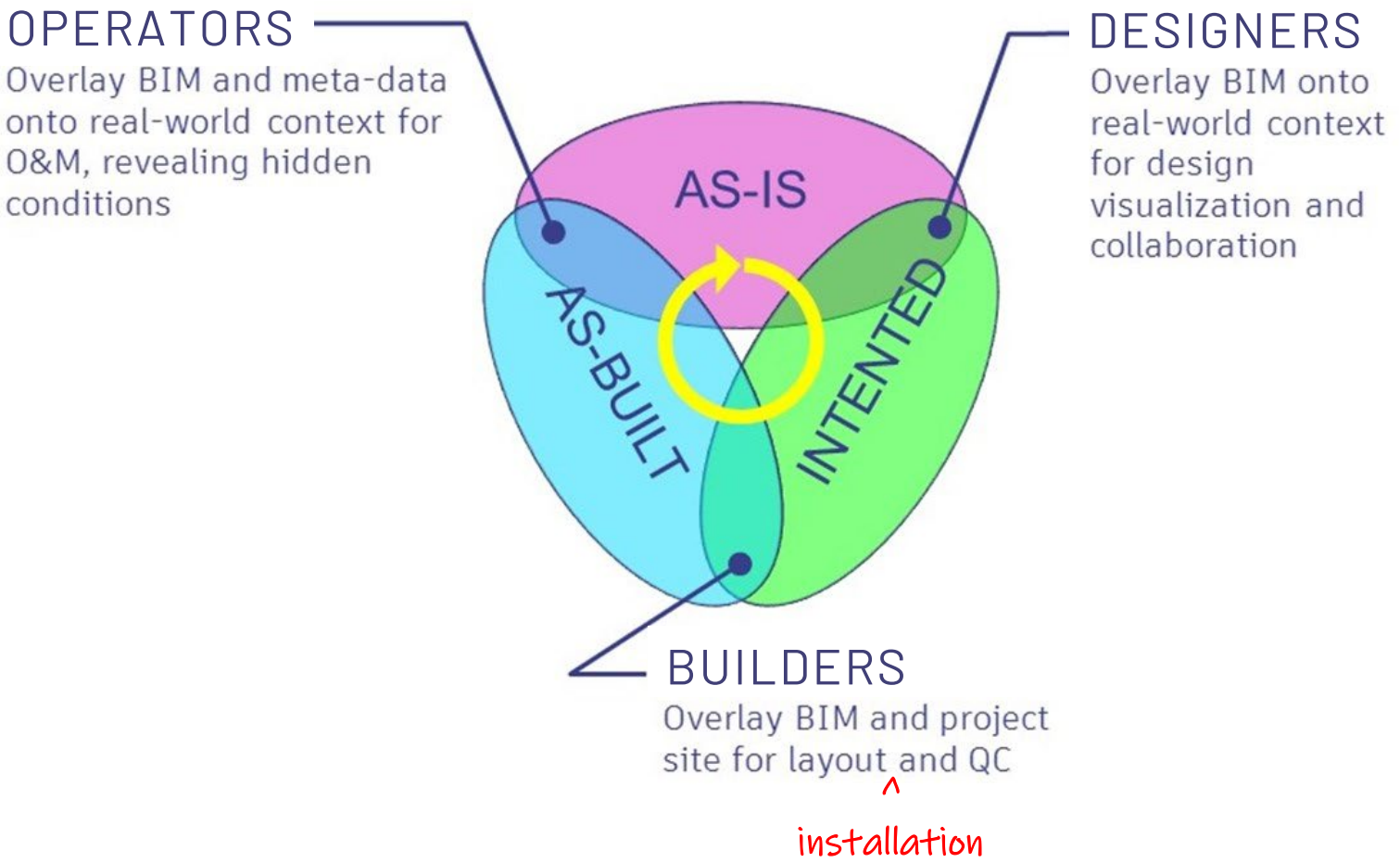
AR Use Cases in AECO



Spectar Pilot at 840 HSB

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What is Spectar?

Spectar is fully immersive AR for the field.

Focus Trades: Electrical, Mechanical, Wall & Ceiling, General Contractors

Focus Users: Craft Professionals

- Intuitive way to interact with rich dimensional data
- Learn and use one system; get access to a wealth of data
- A platform that enables custom tools and workflows
- Heads-up and hands-free for safe and continuous work on-site
- Addressing the biggest and most significant challenges to users

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The Decision

The Spectar Pilot

Question 1: Field, Fab Shop, or Both?
Question 2: Who is the control group?
Question 3: What applications should we evaluate?

Hypothesis:

The McKinstry Apprentices and Foremen on the jobsite can orchestrate all Fab and Install workflows from within the HoloLens, eliminating Non-Value Adding but Required (NVAR) workflows.

Assessment Criteria
Product works with my BIM Execution Plan and VDC
I can start working with AR in less than 1 minute
Works with my models
What I want is always less than 3 clicks away
I can download my typical model in AR in <5 minutes
I need to download only one file to get job done
I can work offline
I can place a model in <30 sec
The model accuracy is <1" in my work area
I can adjust the model when I need to in <30 sec
The model visually makes sense to me
I can access actionable data
I can perform my typical tasks using AR
The AR experience is not draining
I can get my typical task done faster using AR

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Opportunities to Apply Augmented Reality at 840…

- **“It saved us a lot of time identifying some major space issues out in the field.”** ~PM on 840 Spokane

- Explore potential use of AR in Q2 2021…

  - **Quality Control**
    - Identified $30k issue with housekeeping pad in relation to floor drain
    - **Mitigates write-downs**
  - **Client engagement**
    - Used XR to communicate designs in mechanical room and anatomy suite on 840 Spokane to coordinate with GC and customer
    - Showed design on site in live space in immersive, 3D environment to reduce coordination issues and get approval on layout
    - **Enhances confidence and understanding**
  - **Shop awareness/enthusiasm**
    - Mitigate uncertainty from unknown actual field conditions when building prefab assemblies
    - Provide shop labor crews more confidence and understanding of their work
  - **Led to… testing hanger installation!**
    - Demonstrated sufficient value to explore further
    - To measure potential savings and promote any success story

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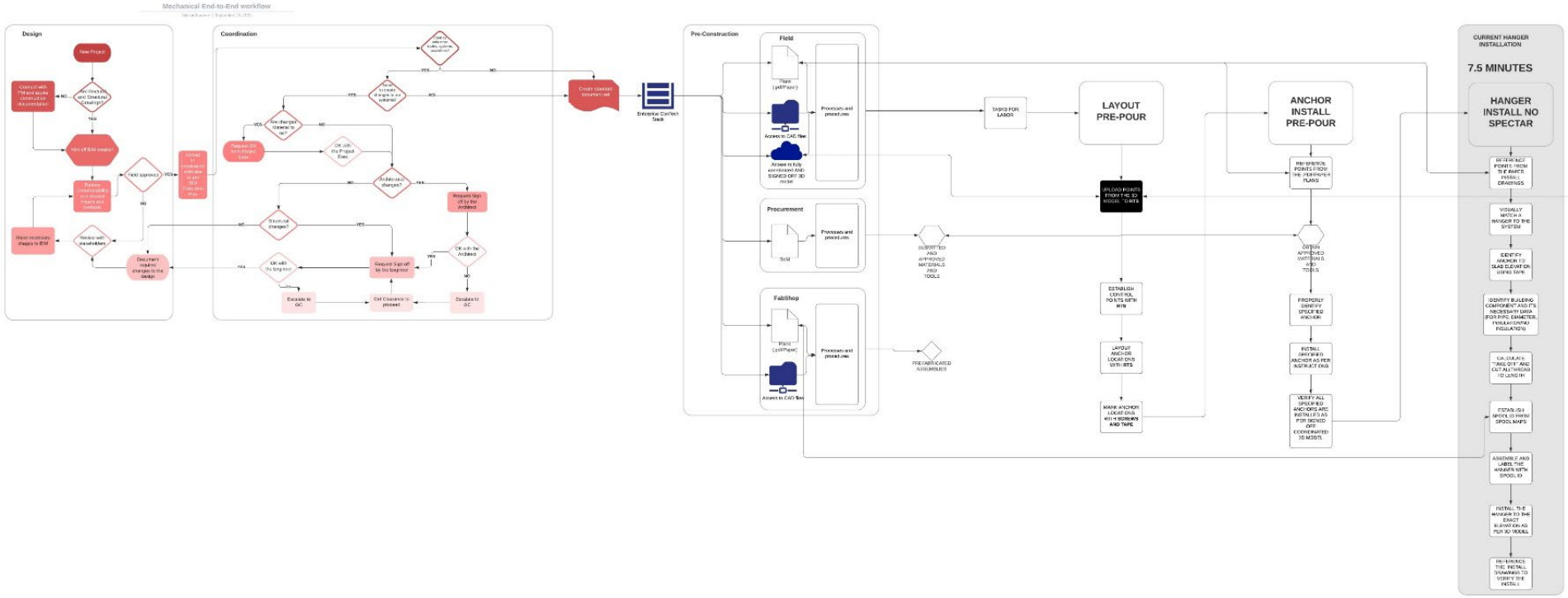
Mechanical Construction Workflow

- No two contractors, projects, or workflows are the same
- Understanding McKinstry's end-to-end construction workflow is critical in determining the most scalable, repeatable, and impactful use cases
- Assisted with the development and platform integration between HoloLens and Navis
  - *(Seamless Model Input, File Size, etc.)*
- McKinstry worked with Spectar BIM team to append model properties
  - *(McK Appearance Profiler, Bottom of Pipe, Center of Pipe, Insulation Thickness, System, Spool ID, etc.)*
- Created Hanger AR Installation Workflow to measure against conventional hanger installation



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Hanger Installation

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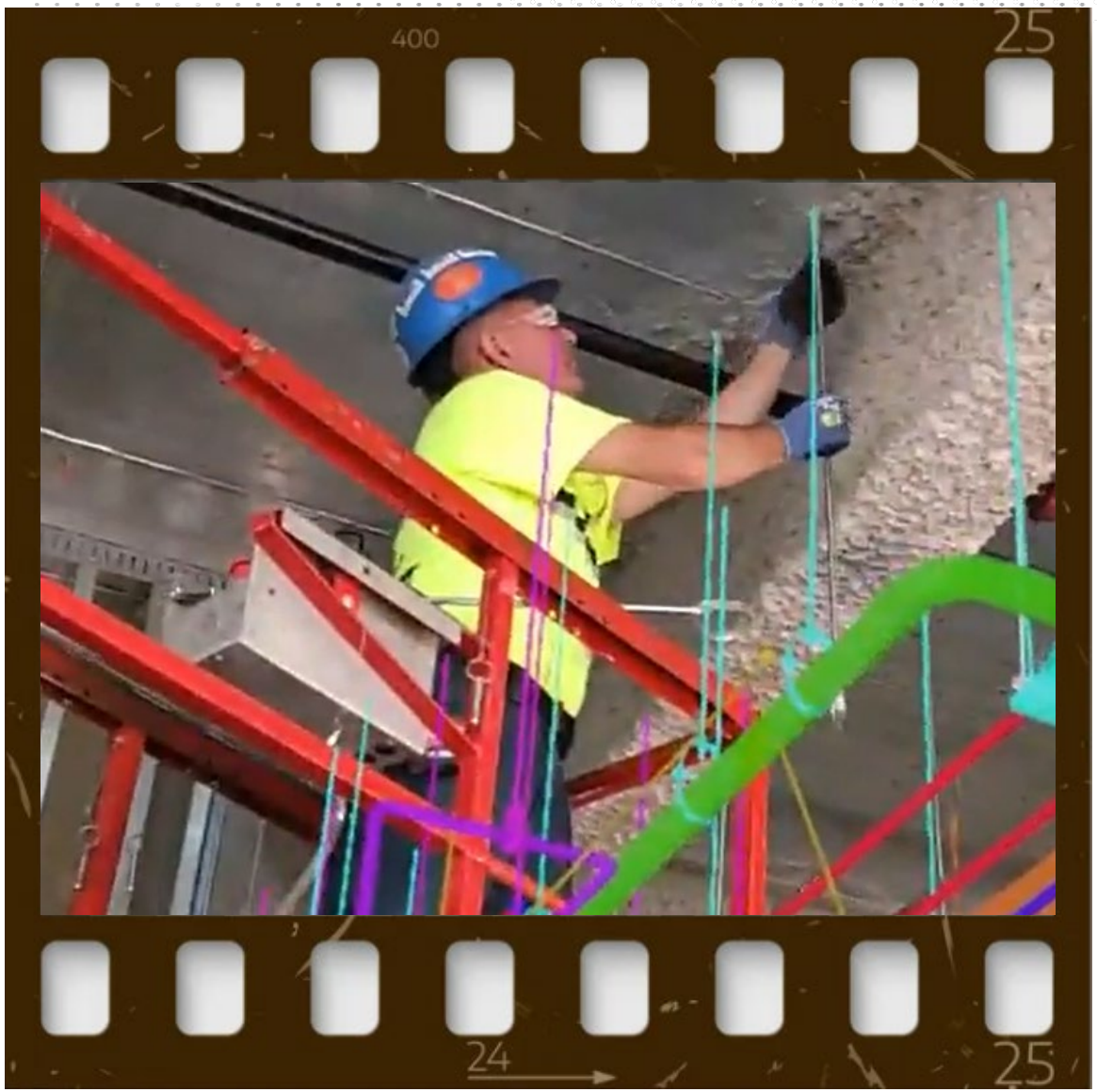
AR-Based Hanger Installation

Traditional hanger installation process

- Significant wasted time
  - Crews identify which anchors correspond to their systems on the underside of the deck
  - Installers to go up and down on a scissor lift
  - Cross reference drawings
  - Pull measurements
  - Confirm elevations
  - Confirm hanger dimensions
  - Verify Spool ID components
- Relies on the paper set of drawings derivative from source model
- Requires context-switching: 2D/paper side reference vs. 3D/spatial task

AR-based hanger installation process

- Increase efficiency and reduce jobsite waste
  - Instantly see which anchors correspond to which systems
  - One operator can remain on the scissor lift the entire time; takes measurements; install hangers
  - Hanger location and type pulled directly from the Spectar metadata, which presents the exact information the installers need to complete the task
  - Spectar user cuts all-thread, assembles hangers
- AR provides relevant data at the point of activity, when and where it is needed
- Streamline each user's tasks, and eliminate wasted time switching tasks



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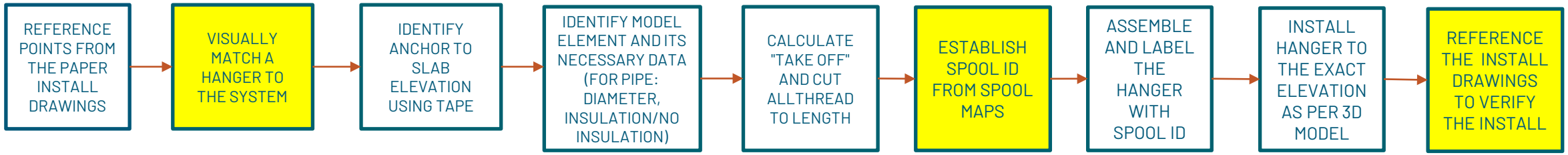
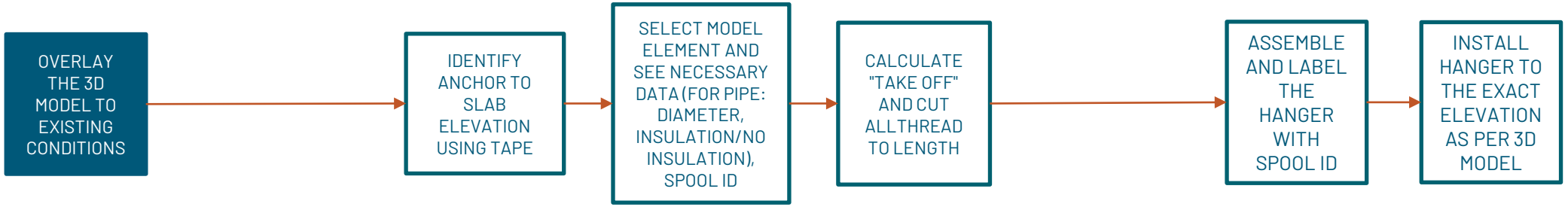
Hanger Install SOP

40% TIME REDUCTION PER HANGER

Current Hanger Installation – without Spectar: 7.5 minutes



Proposed Hanger Installation – with Spectar: 4.4 minutes



3.1 MINUTES FASTER
AT LEAST **3 STEPS ELIMINATED**

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Direct Impact – Implications for Project Savings

Based on pilot project at 840 HSB

HANGER INSTALLATION

840 Spokane HSB

CONVENTIONAL METHOD

7.5 MINUTES / HANGER

USING SPECTAR

4.4 MINUTES / HANGER

VALUE

3.1 MINUTES SAVED per HANGER

3.1 MINUTES SAVED per HANGER

275,000 HANGERS installed annually

14,000 HOURS SAVED per year

$100/HOUR labor cost

Potential $1.4M/year SAVED

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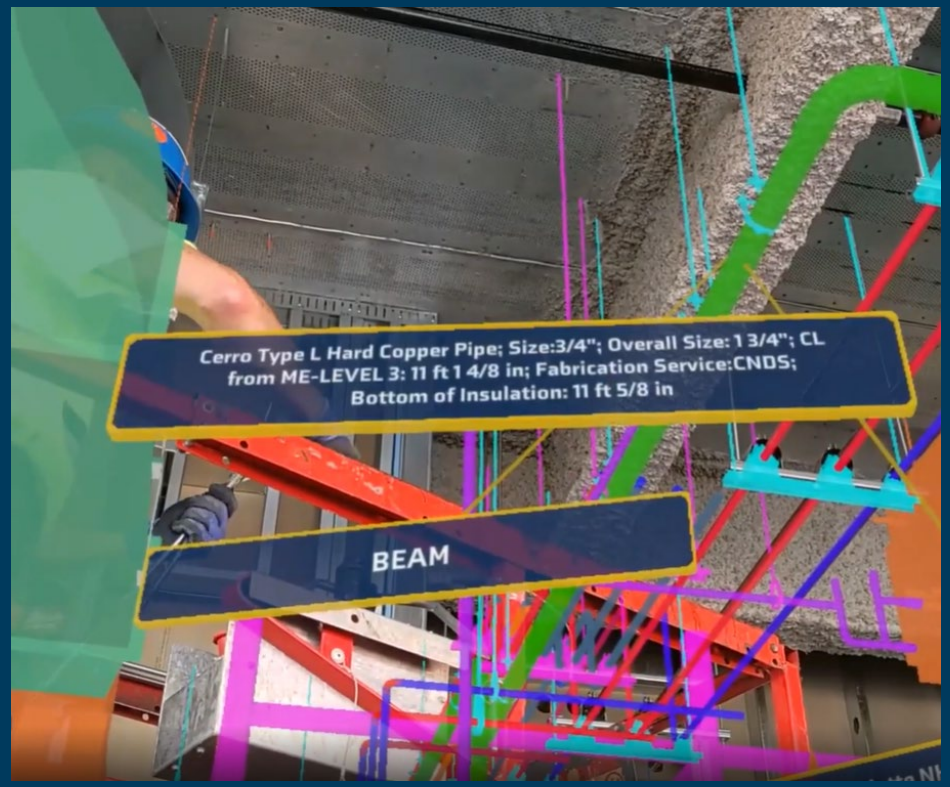
Results



Sustainability

Augmented Reality helped us **eliminate dependence on paper** drawings, **reducing jobsite waste**

- Reduce material wasted
- Reduce time wasted by providing confidence without having to refer to multiple sets of drawings and confirm which is current

Affordability

Augmented Reality helped **speed up hanger installation by 40%**, making our installation efforts dramatically more efficient

- Dimensions and attributes of each component available in context
- Eliminate time spent up/down scissor lift, visually match and reference drawings, pull measurements, confirm elevations, verify Spool ID components…

Equity

Augmented Reality **enabled a less-experienced labor crew** to leverage rich BIM data to deliver results

- Technology embraced and championed by young, female laborer
- Crew of two second-year apprentices, without direct supervision of journeyman

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Next Steps

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Next Steps

Rinse & repeat

- Operate at scale
- Improve our hanger-installation process, *and* the AR tool
- Define minimum and ideal project characteristics
- Awareness and marketing to build pipeline of projects
- Dedicate resources to “make this a thing”

Expand

- Integrate with Lean Manufacturing efforts to prefabricate hangers
- Identify and pilot adjacent use cases, tasks, or trades
    - Plumbing → piping → ducts → conduits
    - QC → installation → layout
    - (Pre)fabrication Shop
    - Operations & Maintenance / Service

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Thank you!

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