



## Reality Capture Dramatic Return on Investment

Chad Zuberbuhler  
Innovation Advisor

Mike Whaley  
President

 AUTODESK UNIVERSITY 2014

Join us on Twitter: #AU2014

 AUTODESK

### About the speakers:



Mike Whaley, is the President of TURIS Systems, with 25 years in the architectural industry, and 8 years in the construction industry. He has spent the last 3 years helping to guide TURIS on Exploration to Development to Implementation of BIM for every aspect of our industry.



Chad brings over ten years of A/E and Revit experience to the team. His primary involvement has been in the architectural environment with a focus on Science and Technology projects and his BIM innovation has brought him to the front of our industry.



## Class summary

Learn how the implementation of reality capture provides immediate and substantial return on investment for owners, architects, and contractors. We will use recent multiple case studies to demonstrate the value of implementing reality capture through the use of laser scanning, ReCap software, and Revit software. Our case studies will look at preconstruction, construction, and post-construction documentation. We will show the power of this vastly underused application, and you will learn how it will enhance your business and bring you real value.

## Key learning objectives

At the end of this class, you will be able to:

- Understand the applications of laser scanning and reality capture.
- Comprehend the various applications of reality capture in design, construction, and post construction.
- Learn a process for reality capture implementation.
- Understand the value your business gains from an investment in reality capture.

## Agenda

- The History of Reality Capture
- Pre-Construction Case Studies
- Construction Case Studies
- Post-Construction Case Studies
- The Future of Reality Capture

## The History of Reality Capture

## The Scanning Process



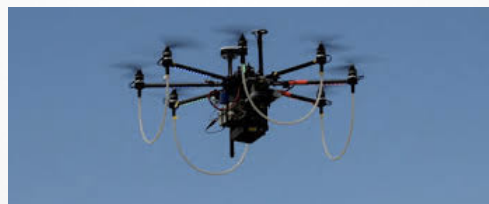
A 3D laser scanner works by first projecting laser light onto the object or surface, then detecting the reflected light. Based on where the lights fall in relation to each other, the scanner calculates their positions and creates data points. These points help a computer recreate it visually.

Software and equipment utilized;  
 Faro 120 Focus  
 AutoDesk ReCap  
 Faro Scene  
 AutoDesk Revit  
 AutoDesk Navisworks  
 AutoDesk 3DS Max

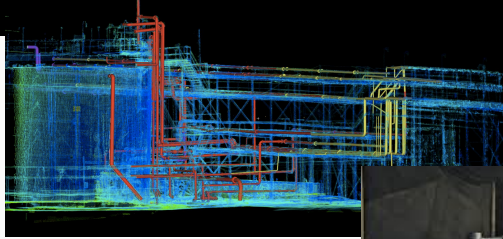
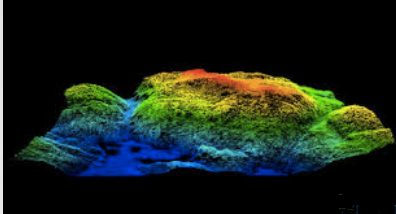
## Reality Capture



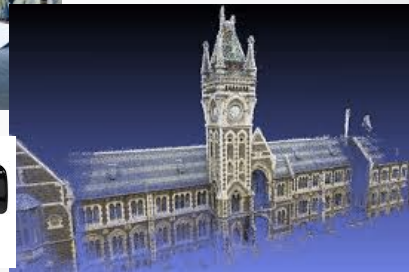
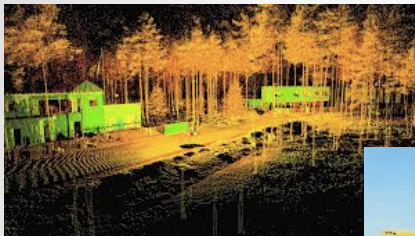
- 1960's earliest scanning: camera and projector theory
- 1980's white light & lasers implemented
- 1990's major refinements with equipment mobility
- Today: Mobile to Drone



## The Reality Capture Revolution

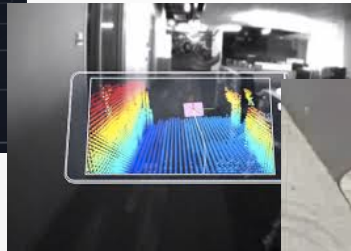


## The Reality Capture Revolution





## The Reality Capture Revolution



## Pre-Construction Scanning Case Studies

## Pre-Construction Case Study #1

Pabst Brewing, Building 29 Bottling Facility

Project Architect: HGA Architects Milwaukee, WI

Project Objective: Documentation of 19<sup>th</sup> century beer bottling facility for design team

Process;

- 70 exterior scans
- 180 interior scans
- 237,000gsf

Advantages:

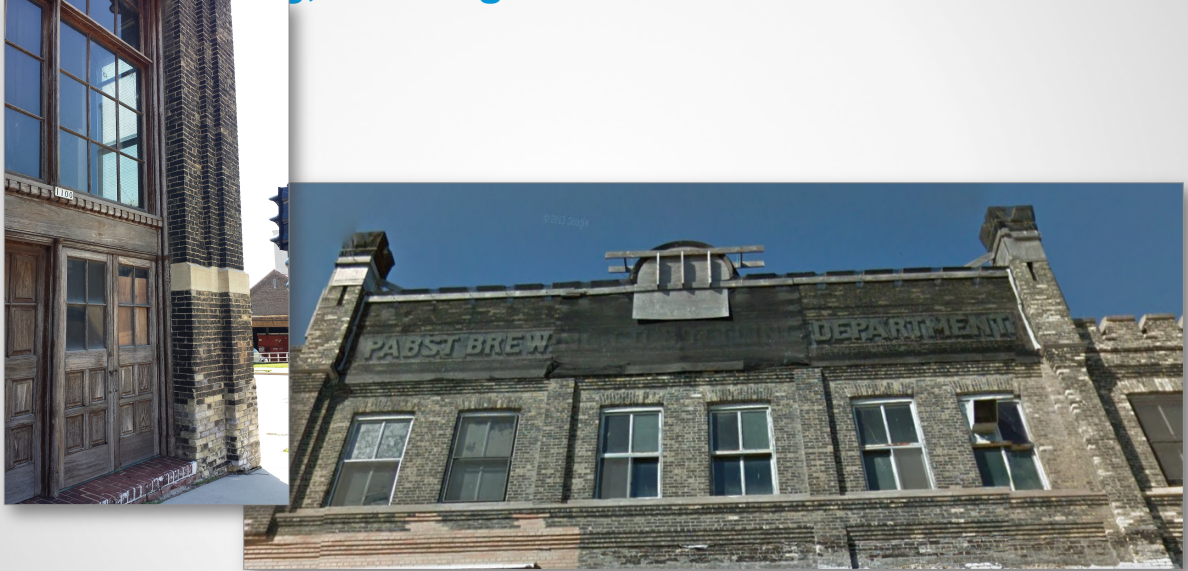
The Architect was able to use the scan data to accurately document and replicate intricate exterior and interior details of the building.

## Pabst Bottling, Existing Conditions

Exterior Existing Conditions



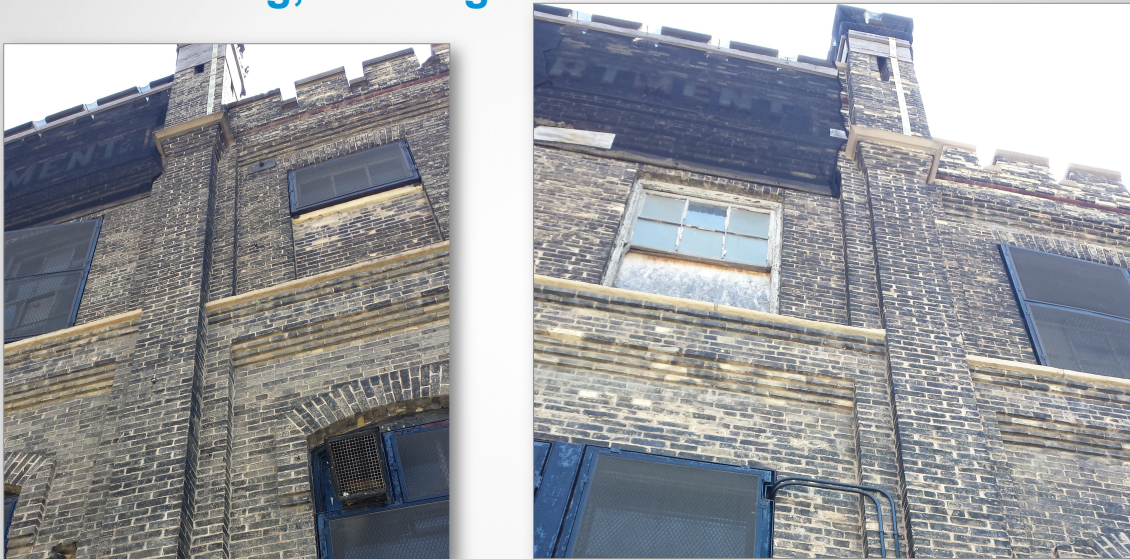
## Pabst Bottling, Existing Conditions



AUTODESK UNIVERSITY 2014

AUTODESK.

## Pabst Bottling, Existing Conditions



AUTODESK UNIVERSITY 2014

AUTODESK.



## Pabst Bottling, Existing Conditions

Exterior Revit Model



## Pabst Bottling, Existing Conditions

Exterior Point Cloud & Revit Model





## Pabst Bottling, Existing Conditions

Interior Point Cloud



## ROI for Case Study #1

### Pabst Brewing, Building 29 Bottling Facility

#### Advantages

The Architect was able to use the scan data to accurately document and replicate intricate exterior and interior details of the building.

#### Cost Savings

Estimated Cost of Field Measurement:	\$48,000
Scan Cost:	<u>\$12,500</u>
<b>Savings:</b>	<b>\$35,500</b>

#### Time Savings

Estimated Field Measurement	60 man days
Scan & Register	9 man days

## Pre-Construction Case Study #2

Building: Beloit Powerhouse

Project Architect: Studio Gang Architects

Project Objective: Conversion of the Alliant Energy/WPL Blackhawk Generating Station to Beloit College's activity and recreation center.

Process;  
277 interior scans  
68,000 gsf

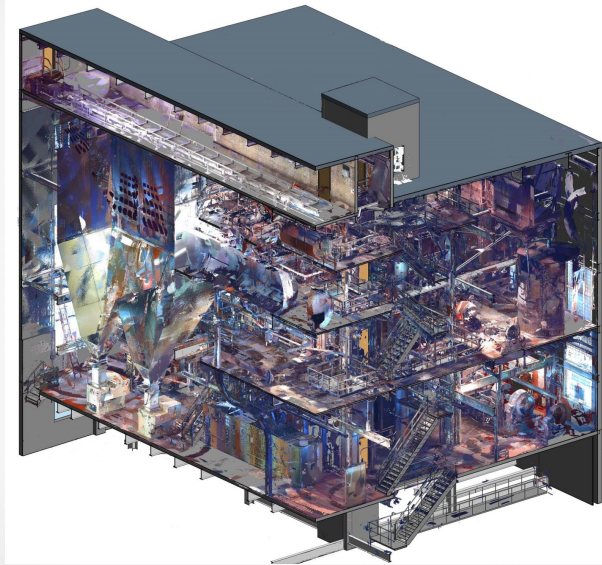
Advantages;  
The existing facility had a complex system of catwalks and elevated structures. The scan data and model allowed the architect to start their design around accurate existing information.

## Beloit Powerhouse, Existing Conditions



## Beloit Powerhouse, Existing Conditions

Building Point Cloud & Revit model

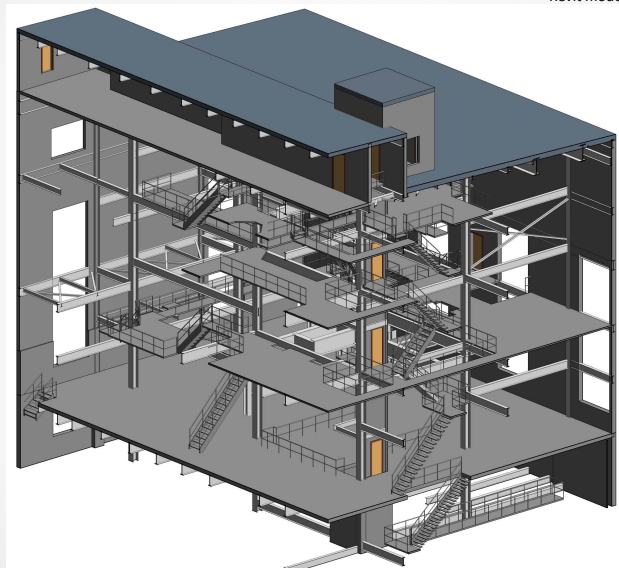


AUTODESK UNIVERSITY 2014

AUTODESK

## Beloit Powerhouse, Existing Conditions

Revit model



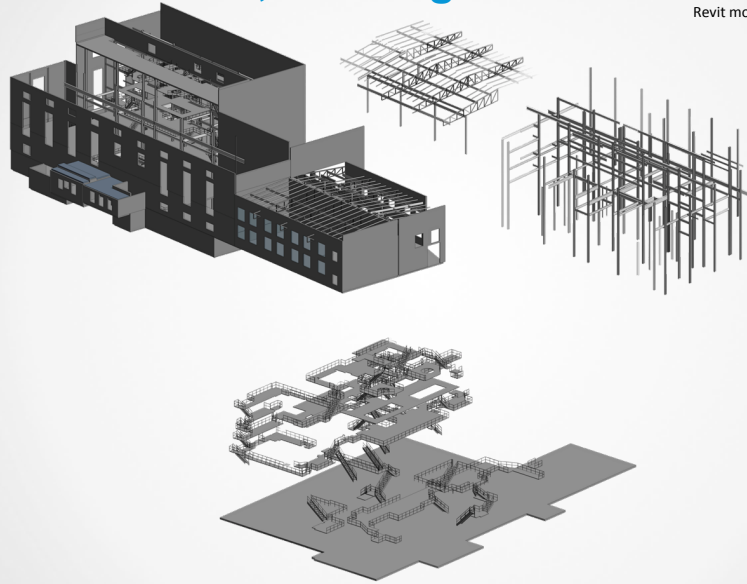
AUTODESK UNIVERSITY 2014

AUTODESK



## Beloit Powerhouse, Existing Conditions

Revit model

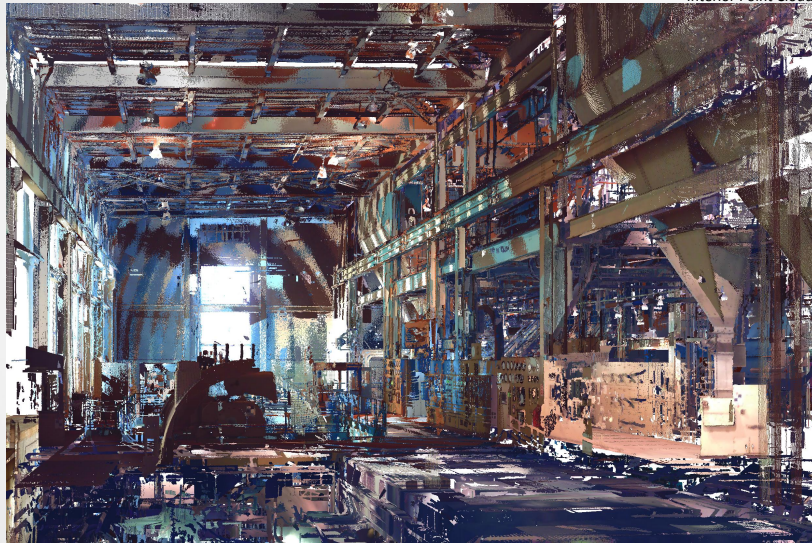


AUTODESK UNIVERSITY 2014

AUTODESK

## Beloit Powerhouse, Existing Conditions

Interior Point Cloud

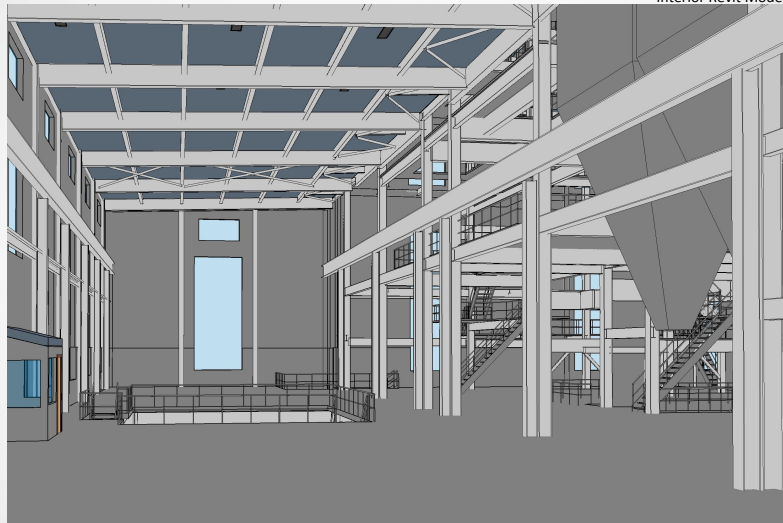


AUTODESK UNIVERSITY 2014

AUTODESK



## Beloit Powerhouse, Existing Conditions



## Beloit Powerhouse, Finished Conditions



## ROI for Case Study #2

### Beloit Powerhouse Conversion

#### Advantages

The existing facility had a complex system of catwalks and elevated structures. The scan data and model allowed the architect to start their design around accurate existing information.

#### Cost Savings

Estimated Cost of Field Measurement:	\$40,000
Scan Cost:	<u>\$15,500</u>
<b>Savings:</b>	<b>\$24,500</b>

#### Time Savings

Estimated Field Measurement	40 man days
Scan & Register	11 man days

## Pre-Construction Case Study #3

### Building: University of Wisconsin – Madison Auditorium Renovation

Project Architect: KEE Architects

Project Objective: Renovation of an existing auditorium space on the University of Wisconsin's campus.

#### Process:

50 interior scans  
5,000 gsf

#### Advantages:

The auditorium had a unique bowl shaped floor that needed to be accurately modeled for refinishing purposes. The scan data allowed the architect to document and replicate the floor accurately.

## University of Wisconsin Aud, Existing Conditions

Point Cloud of existing conditions



## University of Wisconsin Aud, Existing Conditions

Revit model





## University of Wisconsin Aud, Existing Conditions

Point Cloud & Revit model



AUTODESK UNIVERSITY 2014

AUTODESK

## ROI for Case Study #3

### University of Wisconsin Auditorium

#### Advantages

The auditorium had a unique bowl shaped floor that needed to be accurately modeled for refinishing purposes. The scan data allowed the architect to document and replicate the floor accurately.

#### Cost Savings

Estimated Cost of Field measurement:	\$8,000
Scan Cost:	<u>\$3,500</u>
<b>Savings:</b>	<b>\$4,500</b>

#### Time Savings

Estimated Field measurement	10 man days
Scan & Register	1.5 man days

AUTODESK UNIVERSITY 2014

AUTODESK



## Pre-Construction Case Study Summary

### Case Study #1

Field Measurement:	\$48,000	
Scan Cost:	<u>\$12,500</u>	
	Savings: \$35,500	
	Percent savings:	74%

### Case Study #2

Field Measurement:	\$40,000	
Scan Cost:	<u>\$15,500</u>	
	Savings: \$24,500	
	Percent savings:	61%

### Case Study #3

Field Measurement:	\$ 8,000	
Scan Cost:	<u>\$ 3,500</u>	
	Savings: \$ 4,500	
	Percent savings:	56%

## Pre-Construction Case Study Summary

On average we have realized a 64% savings over traditional field measurement.

## Construction Scanning Case Studies

### Construction Case Study #1

Building: Confidential Client

Project Objective: Document existing utilities and space for the change out of assembly line equipment.

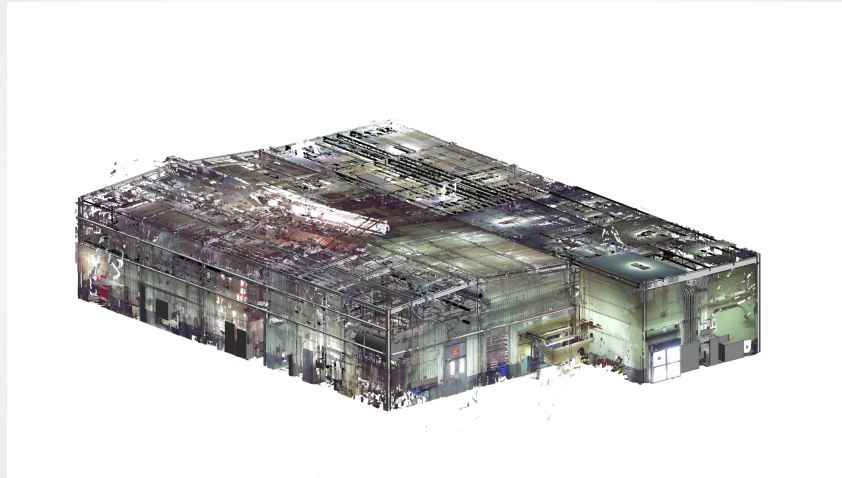
Process:

- 75 interior scans
- 8,000 gsf

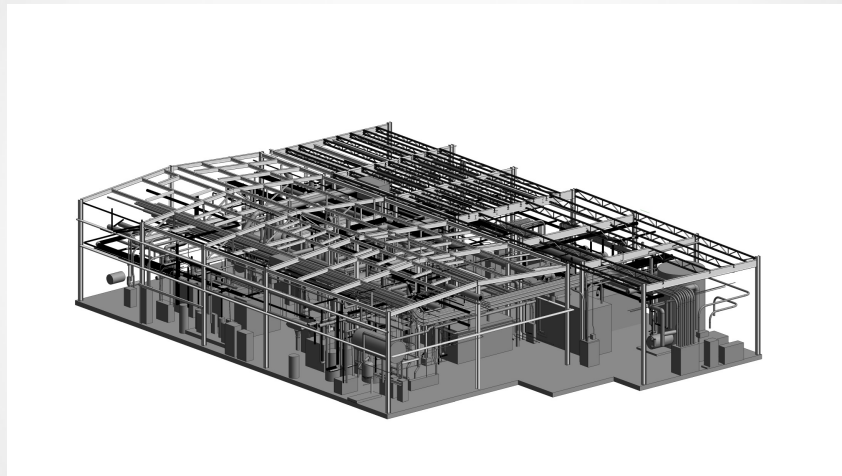
Advantages:

The owner used the point cloud data to layout new equipment and test utility hook-ups for the change over of assembly line equipment.

## Construction Phase: Process Line Turn Over



## Construction Phase: Process Line Turn Over



## Construction Phase: Engine Room

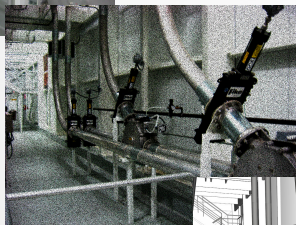


Coordination Model Conditions

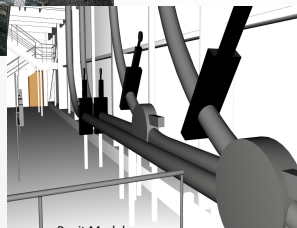
## Construction Phase: Equipment Verification



Photograph



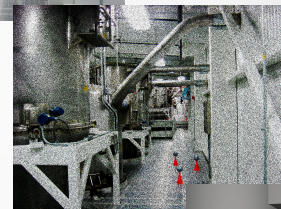
Point Cloud



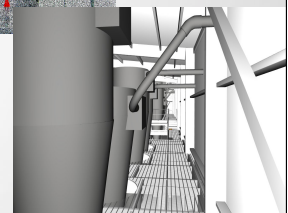
Revit Model



Photograph



Point Cloud



Revit Model

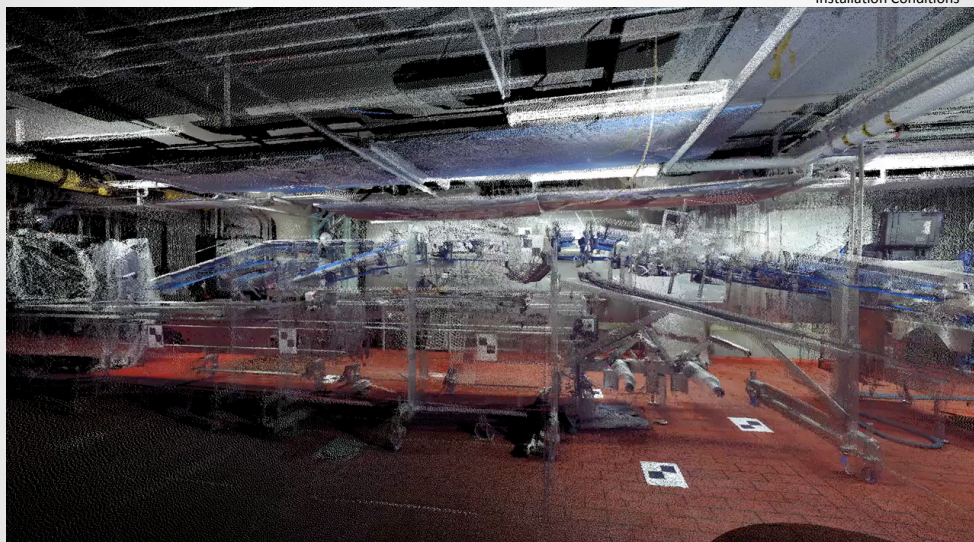


## Construction Phase: Engine Room



Installation Conditions

## Construction Phase: Process Line Turn Over



Installation Conditions

## ROI for Case Study #1

### Assembly Line change over

#### Advantages

The owner used the point cloud data to layout new equipment and test utility hook-ups for the change over of assembly line equipment.

#### Cost Savings

Estimated Cost of Field Measurement:	\$16,000
Scan Cost:	<u>\$ 7,500</u>
<b>Savings:</b>	<b>\$ 8,500*</b>

#### Time Savings

Estimated Field Measurement	20 man days
Scan & Register	3 man days

## Construction Case Study #2

### Field Documentation

#### Project Objective:

Scan project areas during construction for coordination purposes.

#### Process:

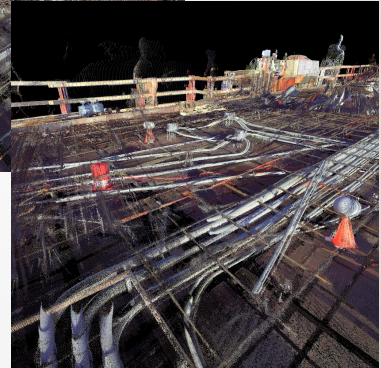
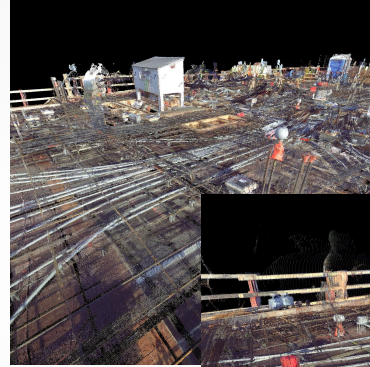
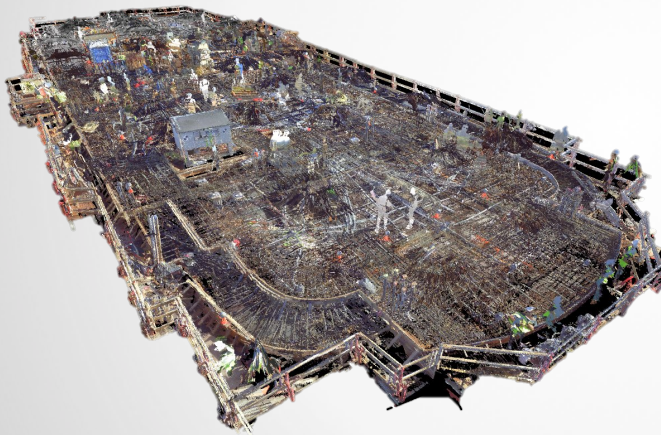
Concrete Deck Scanning and sleeve coordination

#### Advantages:

The goal of field documentation is to document as-built conditions, enhance coordination, and avoid risks that may occur during construction.



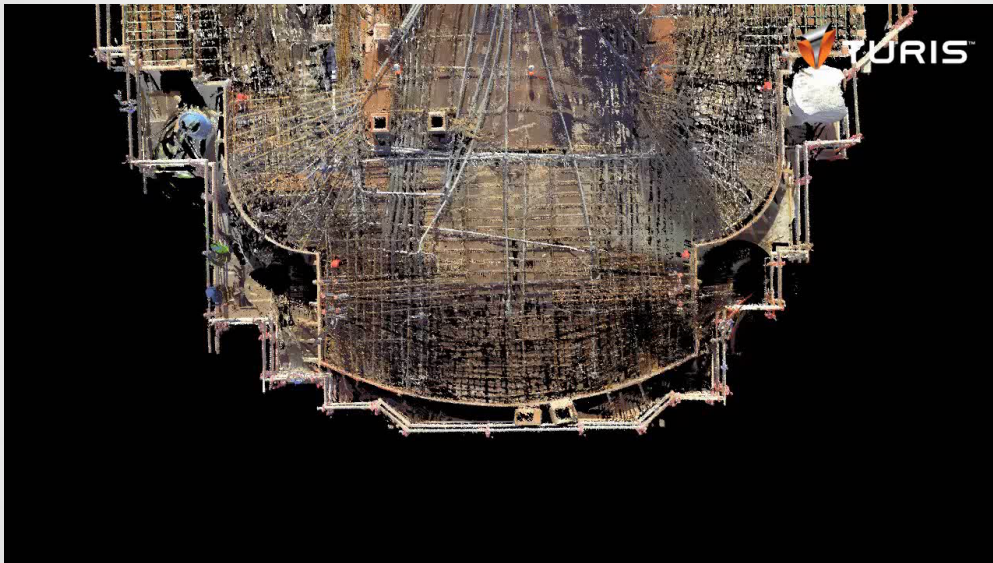
## Construction Phase: Field Documentation



AUTODESK UNIVERSITY 2014

AUTODESK

## Construction Phase: Field Documentation



AUTODESK UNIVERSITY 2014

AUTODESK

## ROI for Case Study #2

### Field Documentation

#### Advantages

The goal of field documentation is to document as-built conditions and risk avoidance during construction for the contractor.

#### Cost Savings

No x-raying of decks to add sleeves.

No costs due to sleeves being in the wrong location.

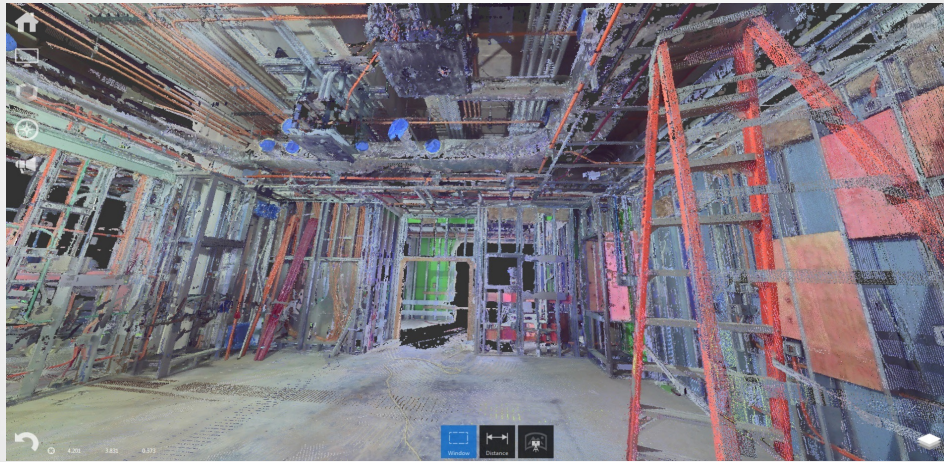
No costs for of floors to tie into electrical conduit.

Risk Avoidance.

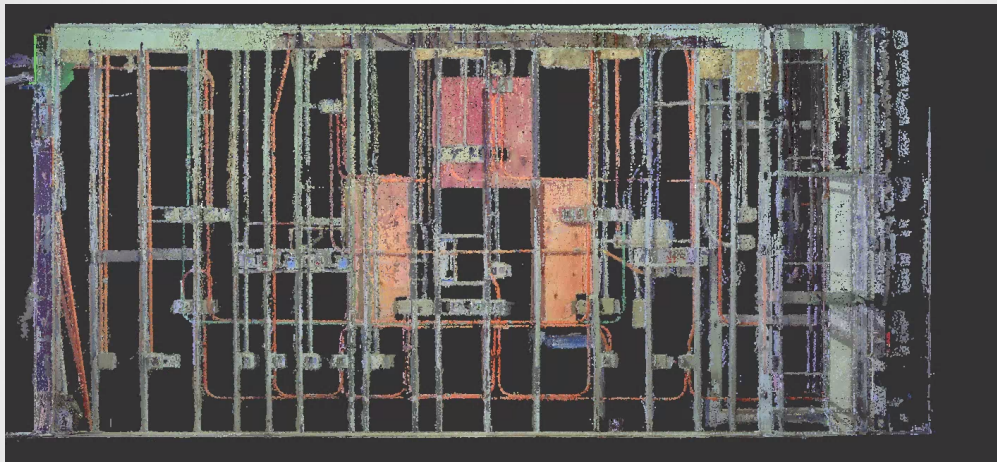
## Additional Construction Applications



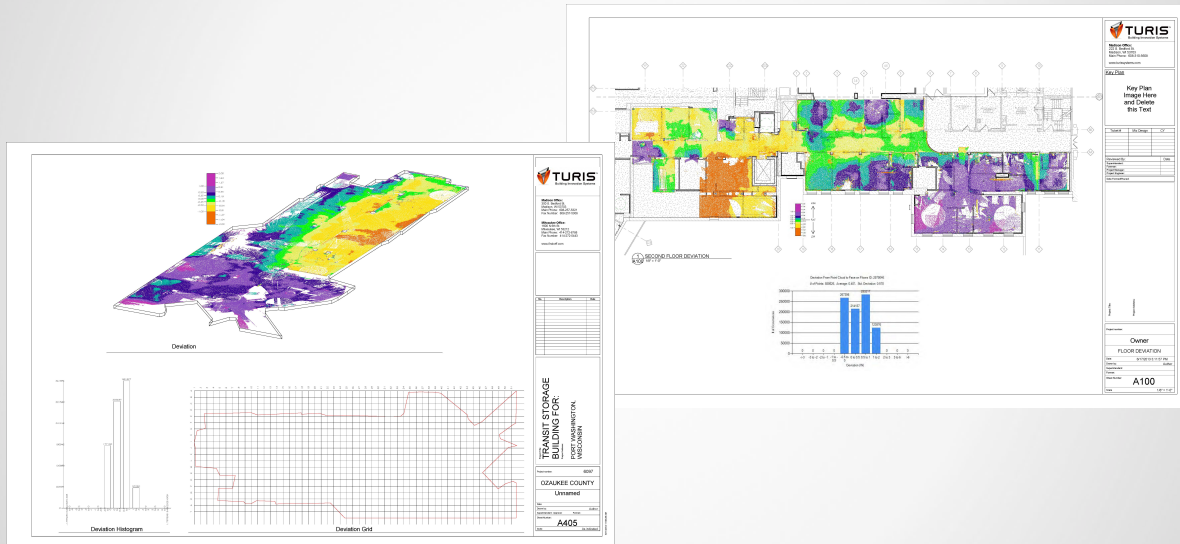
## UW model to scan comparison



## Construction Phase: Field Documentation



## Construction Phase: Floor Deviation Plan



## Construction Phase: Field Documentation



## Construction Case Study Summary

ROI on what did not happen is hard to measure.

Risk Avoidance = ROI

## Post Construction Scanning Case Studies

## Post Construction Case Study #1

Building: Regional Bank Madison, WI

Project Objective: Newly installed ceiling panels need to be replaced due to the product delaminating.

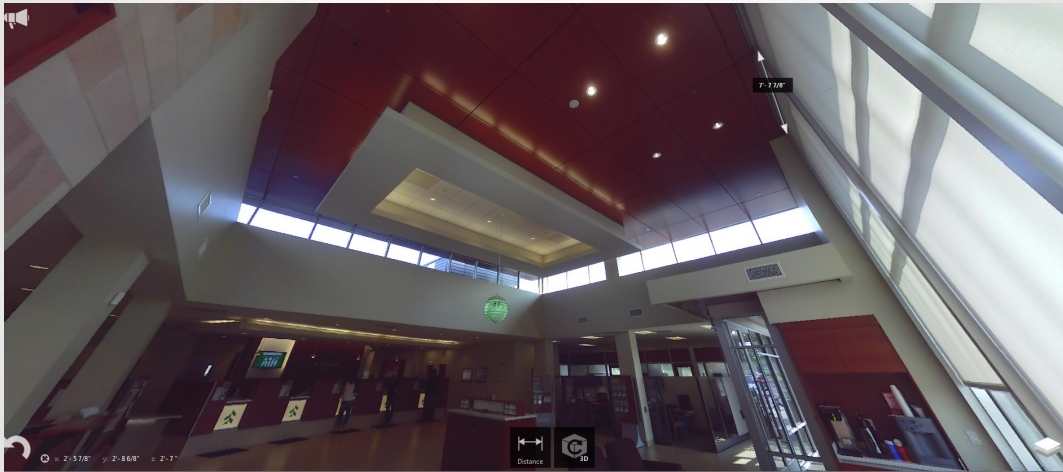
Process:

- 15 interior scans
- 5,000 gsf

Advantages:

Contractor was able to pre-cut and prep new ceiling panels offsite thus reducing the disruption on business day to day operations.

## Post Construction: Install Verification





## Post Construction: Install Verification



## ROI for Case Study #1

Building: Regional Bank Madison, WI

### Advantages

Contractor was able to pre-cut and prep new ceiling panels offsite thus reducing the disruption on business day to day operations.

### Cost Savings

Estimated Cost of Field Coordination:	\$4,000
Scan Cost:	<u>\$2,500</u>
<b>Savings:</b>	<b>\$1,500*</b>

### Time Savings

Estimated Field Coordination	5 man days
Scan & Register	1 man days

\*Did not require lifts or ladders which would have disrupted business and was done during business hours not requiring overtime pay.

## Post Construction Case Study #2

Building: Lucky Building Madison, WI

Project Objective: Interior renovation of an existing space. Primary focus was to accommodate an undulating ceiling system with existing fire protection and drain piping.

Process:

- 15 interior scans
- 5,000 gsf

Advantages:

Contractor was able to coordinate new elements around the point cloud which was used as existing conditions. This eliminated the need for field coordination with existing piping during install.

## Construction Phase: Modeling within a Point Cloud



## Construction Phase: Modeling within a Point Cloud



AUTODESK UNIVERSITY 2014

AUTODESK

## Construction Phase: Modeling within a Point Cloud



AUTODESK UNIVERSITY 2014

AUTODESK



## Construction Phase: Modeling within a Point Cloud



## ROI for Case Study #2

Building: Lucky Building Madison, WI

### Advantages

The contractor was able to model their new design around the point cloud therefore not needing an existing model.

### Cost Savings

Estimated Cost of Field Coordination:	\$4,000
Scan Cost:	<u>\$2,500</u>
<b>Savings:</b>	<b>\$1,500</b>

### Time Savings

Estimated Field Coordination	5 man days
Scan & Register	1 man days

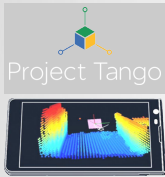


## Post - Construction Case Study Summary

ROI for Bank: Minimal Disruption  
Wave Ceiling: Speed of Coordination

## The Future...

## The Future of Scanning



Google Tango



Oculus Rift



eBee Drone



Photogrammetry



Aerial



Mobile



Faro Drone



Hand-Held

## Laser Scanning Drone



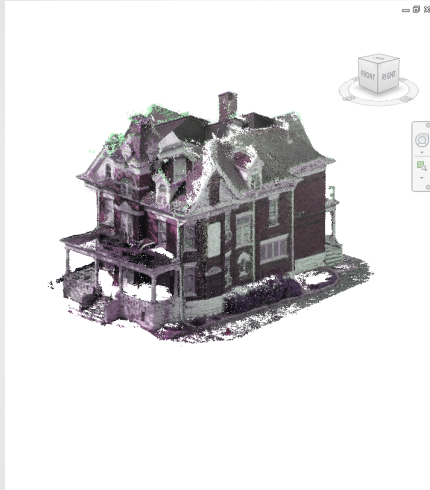
## Photogrammetry



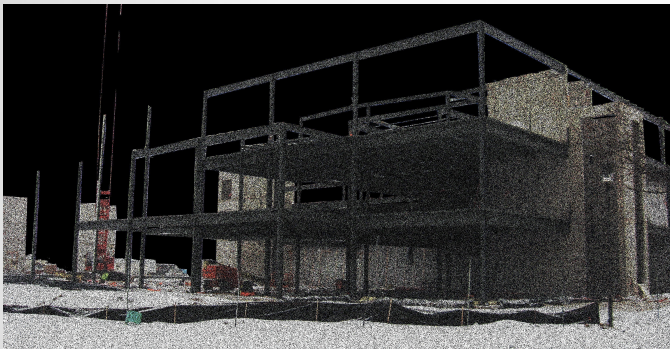
## Photogrammetry



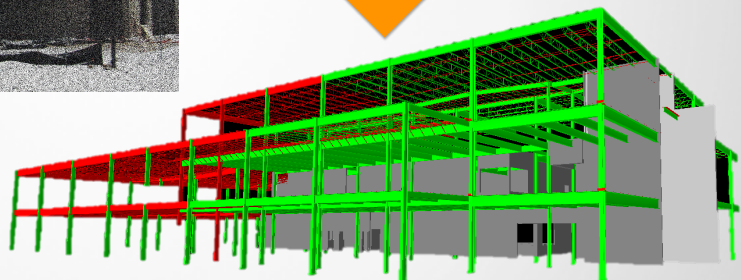
## Photogrammetry



## Capture and Monitor during Construction

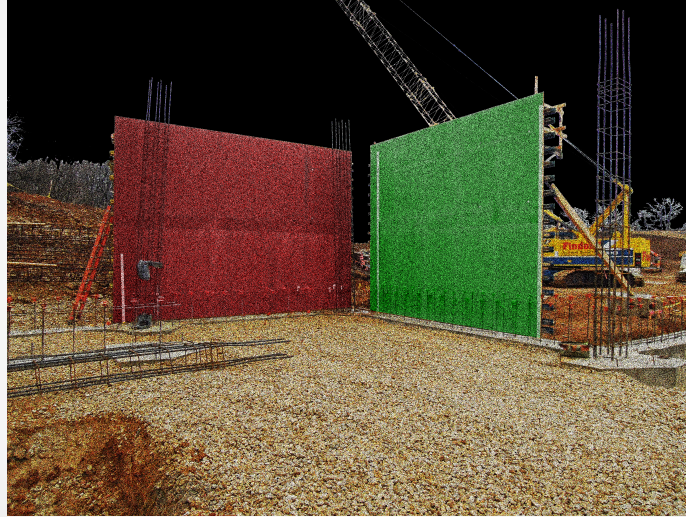


72% Complete

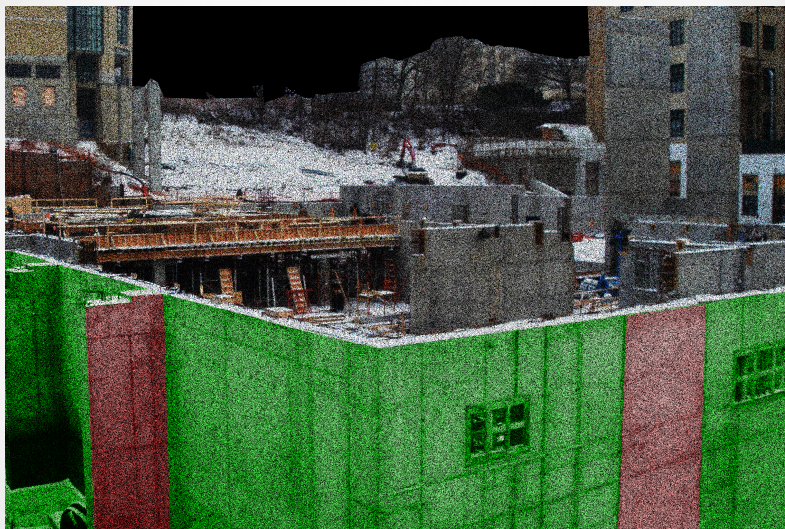




## Capture and Monitor during Construction



## Capture and Monitor during Construction



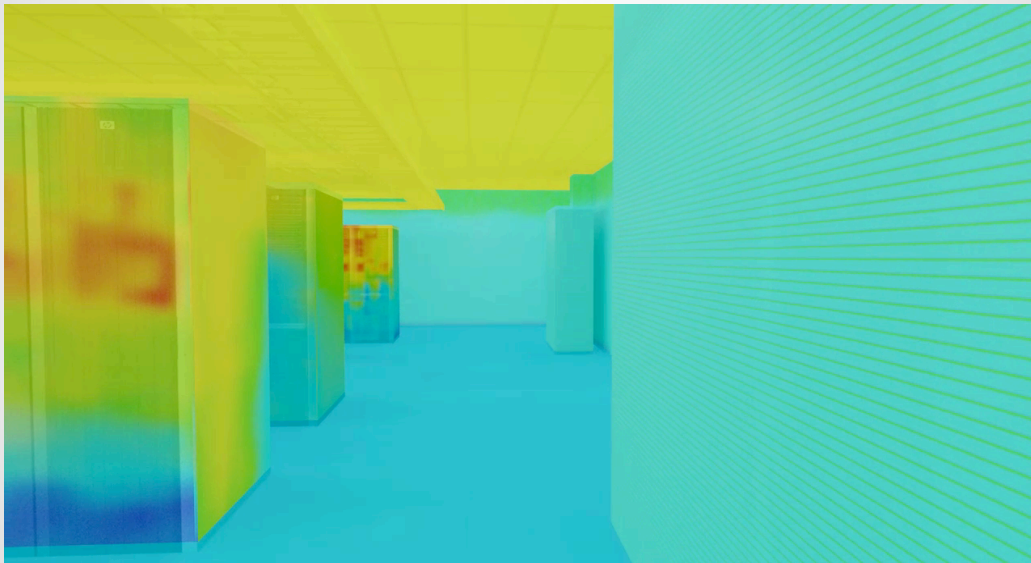
## Pre-cut Drywall



AUTODESK UNIVERSITY 2014

AUTODESK

## Reality Capture for Operational Analysis



AUTODESK UNIVERSITY 2013

AUTODESK

## Summary

- Whether you have a large project or small, laser scanning has shown to provide a greater return on investment when compared to traditional methods.
- During the construction phase laser scanning is a valuable tool for risk avoidance.
- There are many different applications and methods for Reality Capture and the list in the future will continue to grow.

## Questions & Answers

Mike Whaley;  
[mwhaley@turissystems.com](mailto:mwhaley@turissystems.com)

Chad Zuberbuhler;  
[czuberbuhler@turissystems.com](mailto:czuberbuhler@turissystems.com)