New Age Reality Capture: Capitalizing on Machine Learning and BIM to Organize Field Data

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VDC Director – Skanska, Founder and CEO – Smartvid.io

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Class summary

Sources of video and photo content are rapidly increasing within construction. In addition to mobile phones and tablets, drones and even wearables are starting to generate their own views of “reality” from the job site. How can this information best be capitalized on for value during construction, and managed afterward for future retrieval? In this case study-driven class, Oliver Smith of Skanska and Josh Kanner of Smartvid.io will explore how a new set of technologies are helping to deal with the content proliferation—and are also going beyond to elevate the power and value of this visual data. New techniques in machine learning are enabling mining of the native content to help tag and search the ever-growing set of videos and photos coming from the field. Once tagged, the content can be integrated with Building Information Modeling (BIM) for ongoing progress updates during the project and other workflows. We will present examples of drone-generated and mobile-phone-generated field-progress capture. This session features Navisworks Manage, AutoCAD, and Revit. AIA Approved

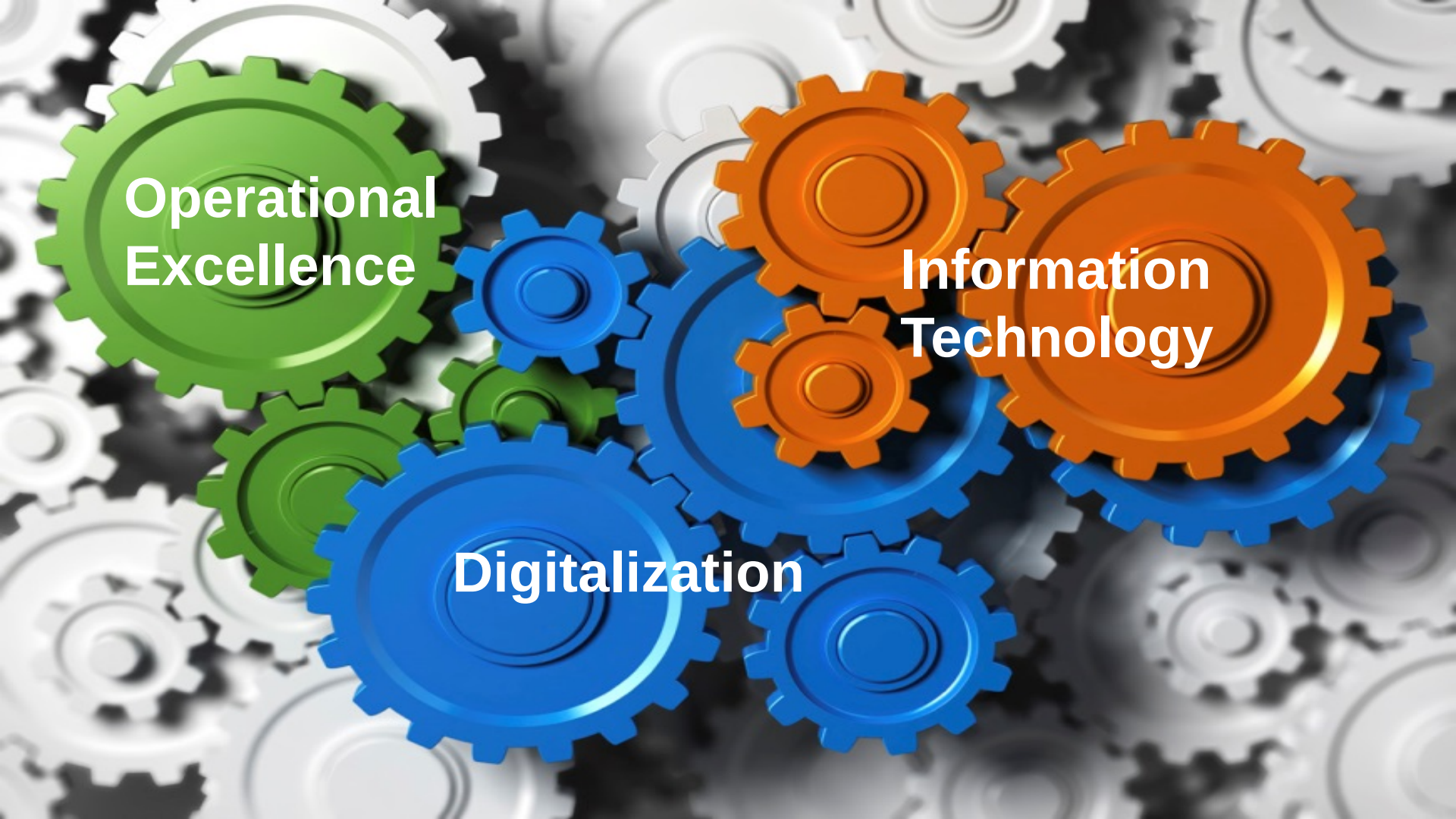
Key learning objectives

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

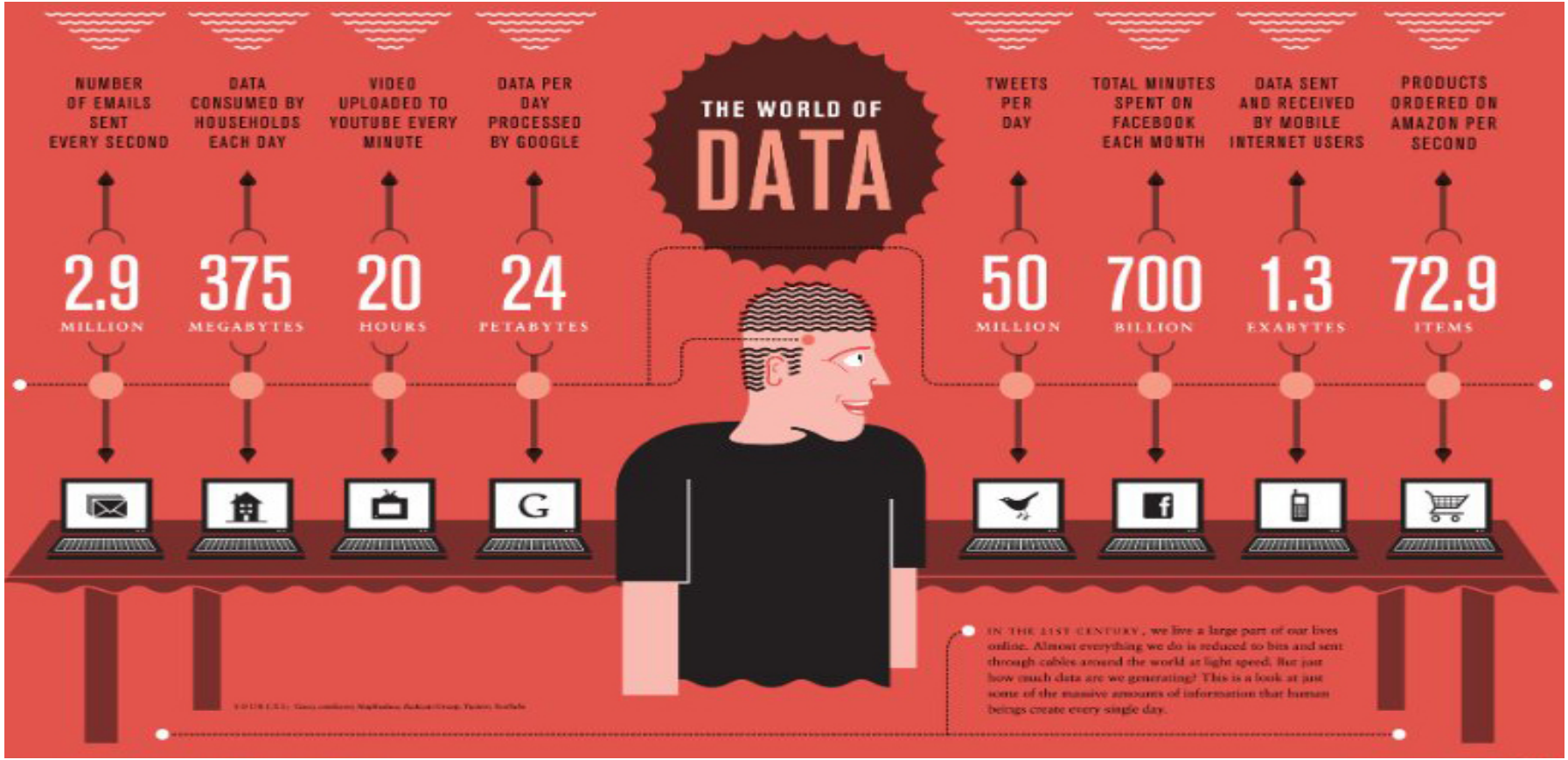
- Understand various different technology platforms and data driven deliverables for use in the construction process
- Understand the challenges and perceptions the construction industry is currently facing with implementation of new technology
- Understand how to use data in an effective way to make timely and educated decisions

The World is changing

We are not building the same as we once were…


Operational Excellence
Information Technology
Digitalization

Digitalization - changing construction's landscape



Statement of Problem

Construction jobs provide many unique challenges on a daily basis. Proper planning and risk mitigation help to forecast and alleviate many of those challenges in an effective manner. Emerging technologies within the construction industry are aiding and facilitating those efforts through various applications and processes. **The implementation of drone technology and other data capturing technologies can provide enhanced solutions to the fields of safety, quality control, logistics and planning, visual communication, and security to name a few.** Many applications are a cost effective solution compared to the current methods and limitations with aerial photography and other job related activities.

Goals and Intended Benefits

A. **Safety and Security:** safety planning and verification, inspections at perimeter, trash chute maintenance, scaffolding inspections, crane boom inspections, elevator shaft inspections, (any inspection that gets people out of lifts, off of ladders, etc.
B. **General Site Overview:** develop site logistics plans, erosion control measures, daily progress tracking, media recording of scheduled events (concrete pours, etc.)
C. **Visualization:** site progress photos or videography, photogrammetry and laser scanning for as built documentation and reference, sales and marketing for pursuits,
D. **QA/QC:** Exterior flashing, exterior facades, high ceiling inspections, bridge work, roof, etc.

Technology Collaboration

Cementation
SKANSKA
Cementation
SKANSKA
KEVIN
Mobile
Working

Skanska Mobile Applications

Leak Prevention
A tool that allows superintendents to manage their daily reports in one place, from a computer or the field

inSite Monitor
Real-time, remote jobsite environmental data monitoring system: Noise, Vibration & Air Quality

DayFacts®
Electronic Daily Superintendent Log

Project Corners
Project news app to easily share information to stakeholders or community

Elements
Plan room software to accompany the Digital Resource Station

T&M Tracker
Real-time management tool for time and material tickets

Safety Coach
Pre-task planning coach for Subcontractors

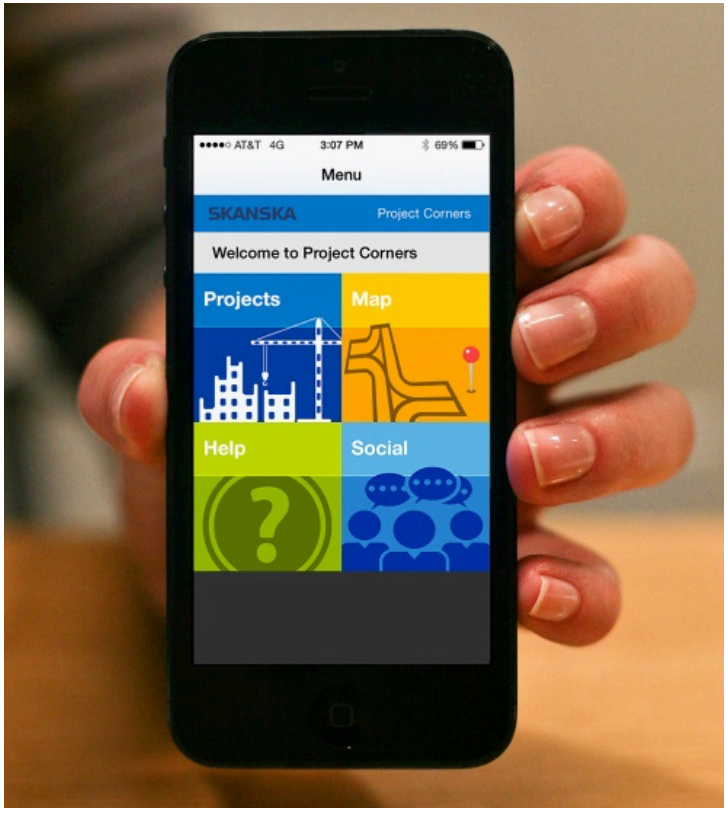
Project Corners

Relay project information to stakeholders or community members affected by construction in real-time.

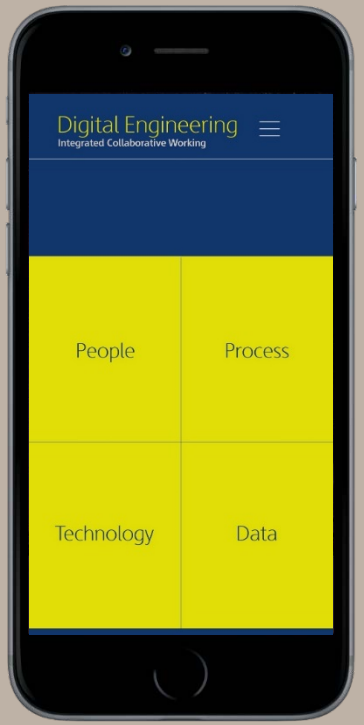
- Project alerts (real-time pop-ups)
- Milestones
- News
- Photos

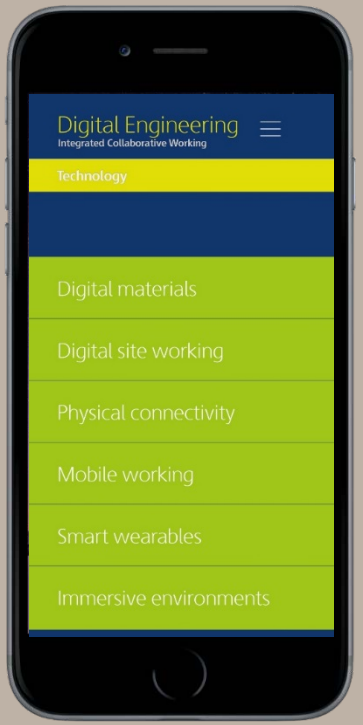
Benefits:

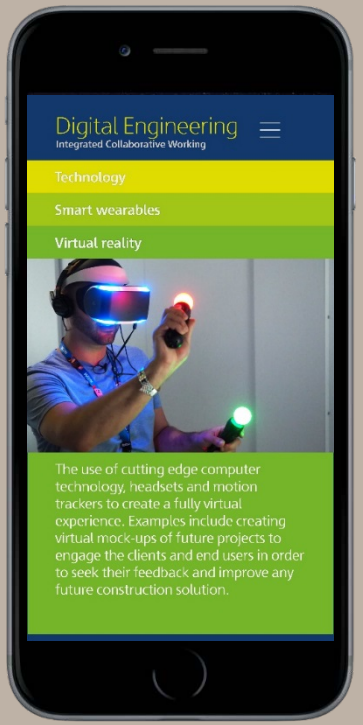
- Available free through iTunes
- 24/7 real-time access to project news
- Engagement with community



Digital Engineering in your pocket







Data Capture and Management

UAS

UAS – Safety

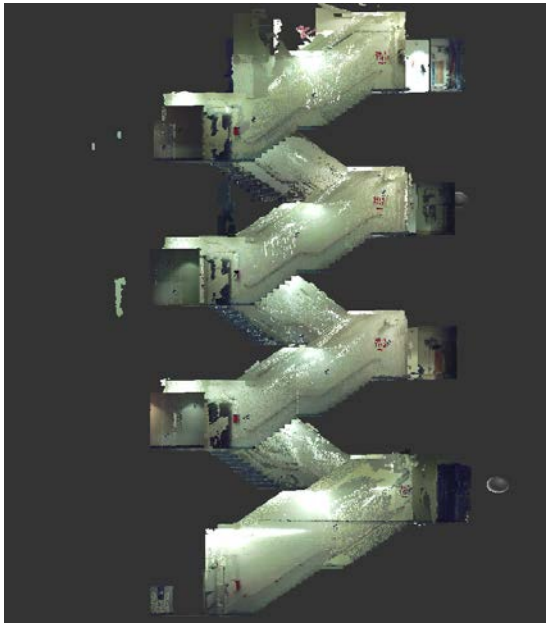
UAS – General Site Overview and QA/QC

UAS – Visualization and Planning

Laser Scan

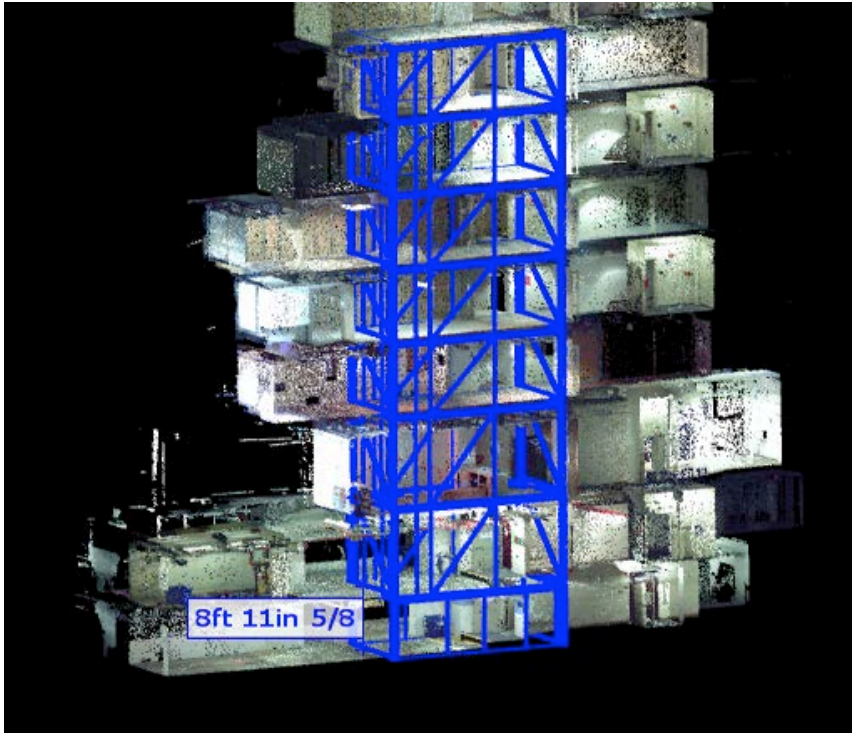
Data Capture – Laser Scanning

Laser Scan from inside stairwell



Unified scan of stairs

Data Capture – Laser Scanning



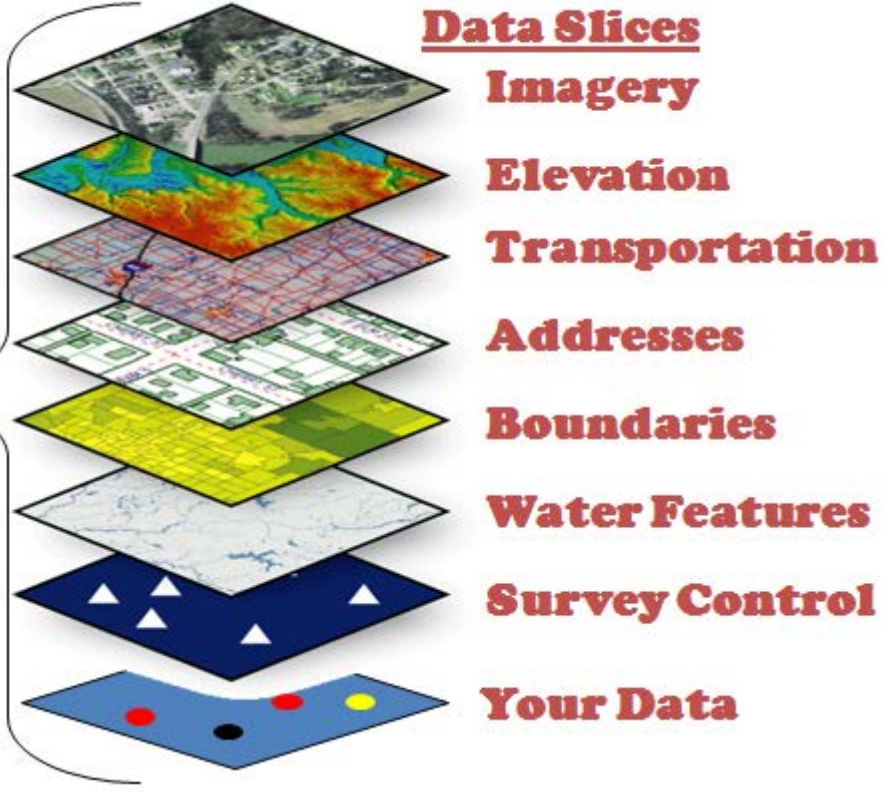
NavisWorks composite file of pod scans and building cross-section.

HERO3+
GoPro

GIS

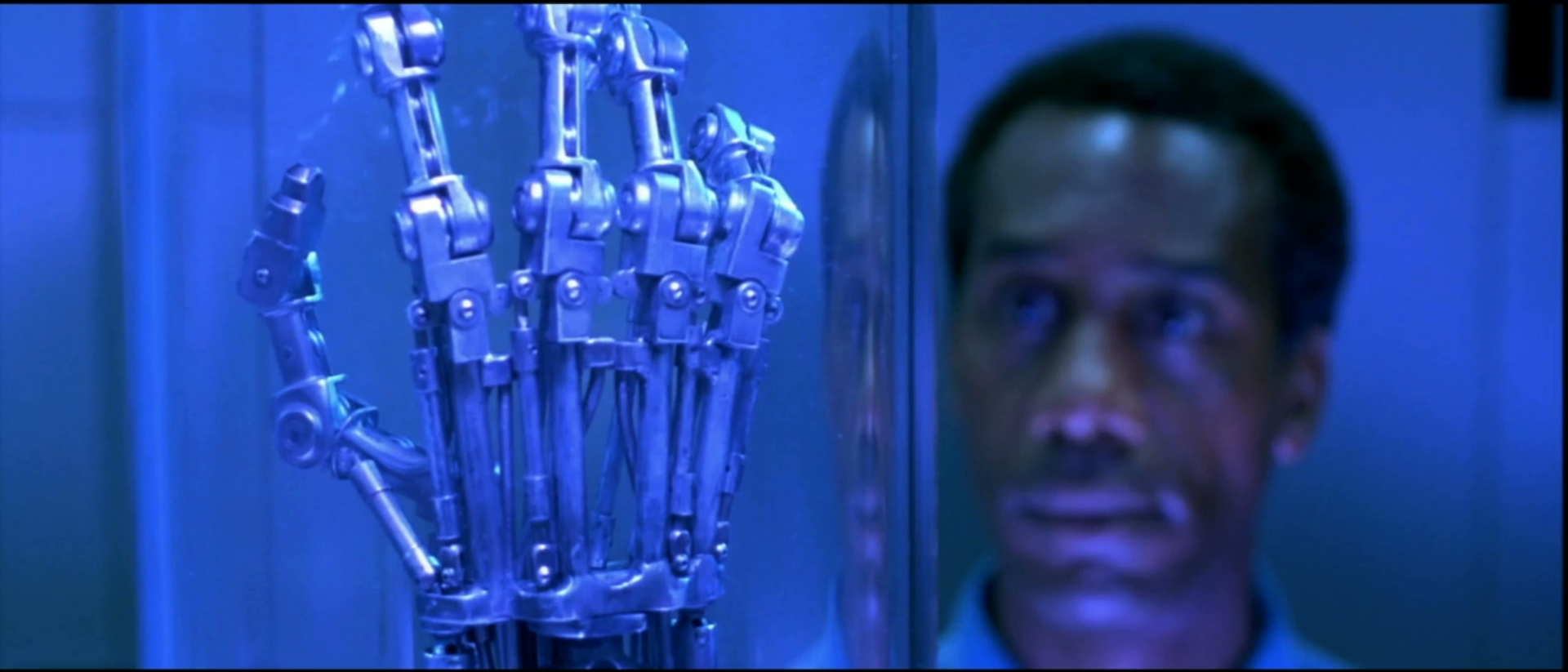
The Real World

GIS World Model



Management and Tools

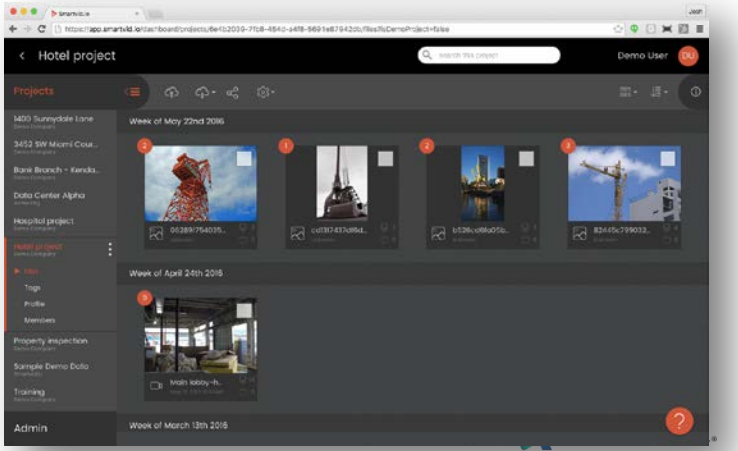
- Various methods of capturing data from the field today
  - Photography
  - Audio recordings
  - Video recordings
  - Laser scanning
  - Etc
- Enhancement of the 3 C’s - Communication, Collaboration, and Connection
- Technology is advancing at a faster rate than ever before – machine learning



SMARTVID.IO

Introducing… Smartvid.io

- Industrial media management, collaboration and analytics SaaS platform
  - Using Machine learning on speech and vision for automatic tagging of content from mobile, drones (UAVs), wearables, more…
- Team from Vela Systems (now BIM 360 Field)



Smartvid.io how it works

Announcing

External Systems

Videos & Photos

Media Manager

Model Objects
Statuses
Activity IDs

Tag Dictionary

Smart Tag™ Engine

Media Reviewer

Smart Comment

Smart Share

AUTODESK.

External Systems

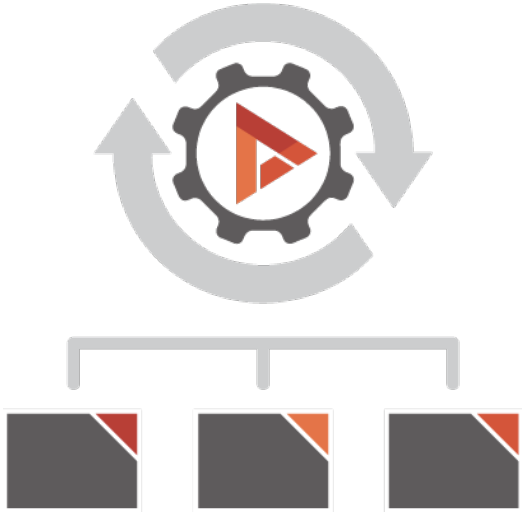
Search

Media Analytics

Our vision: make machine learning work for industrial uses

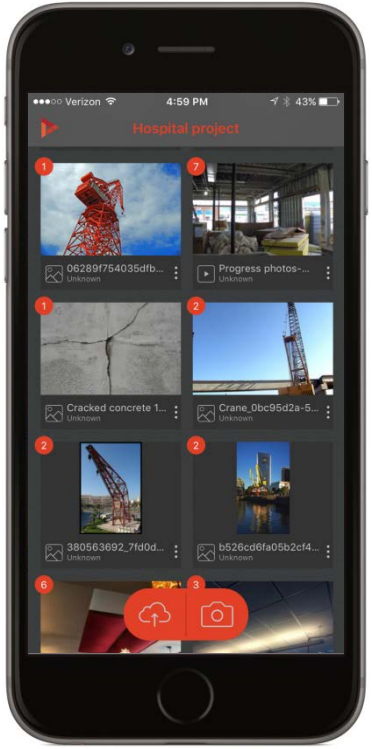
Smart Tag™ Engine

- Speech recognition
  - Key word spotting
- Image recognition
  - Image classification (stills & video)

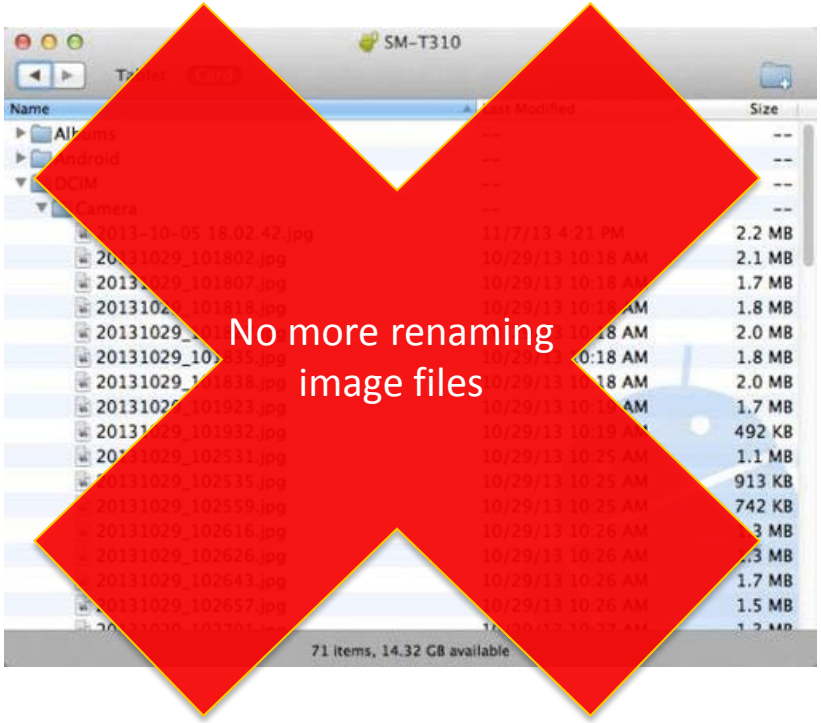


Smartvid.io is used for…

- **Progress & Milestone tracking** and communication
- Photo & Video-based **reality capture** tied to 2D documentation or Building Information Models (or other 3D model) for **handover**
- **Image search** of photo and video content for **safety**, **billing**, **marketing** retrieval
- **Drone** photo and video management
- **Best practices** and training management and sharing (including project handover)



Who takes the time to rename files?



Machine learning on voice and images is powerful, but industrial uses are different…

Siri (Voice)

Can recognize *Room service*

But not *Room 1513-A*

Google Photos (Images)

Great at classifying “Cats”

Not great at “Cracks”

Speech recognition

- Keyword detection in video
- Output: Creates tagged data specific to timeline of video
- How used
  - Field user narrates content
  - Office user (manager) can search and find specific content
  - Example: see all installation of blocking in building, by location

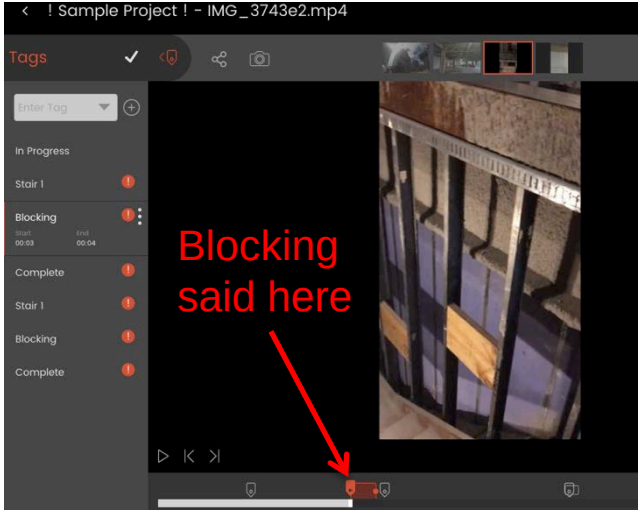


Image recognition

- Basic: Object presence in frame
  - Is there a crack in this picture? (Yes/No)
    - Time required: Seconds

- Advanced: Object analytics: counting, quantitative analysis
  - There are 23 cracks in this image, here are the locations, and the total crack area is 450 cm^2
    - Time required: Depends on # images, analytics req.

Answering key questions through image search

To…	Search on tag…
Improve safety and compliance	• Search on “people” to see if you have images of people on your projects in unsafe situations (like missing a hard hat or other PPE)?
Check billing	• Search on “crane” or “scaffolding” to determine the timing and amount of equipment visible on the project.
Provide images for marketing	• Search on “building”, “window”, “steel” or “Marketing approved” to find some “hero shots” to use in an upcoming proposal.
Create location-based images for handover	• Search on tags “Main Lobby”, “Above Ceiling” to see the history of field observations for the main lobby (or other location), including daily photos and milestone documentation.

o Data

people Search this project

Search Results for " people "

Search Results for

Share Search...

constructbank...
Unknown

1366_cec-ha...
Unknown

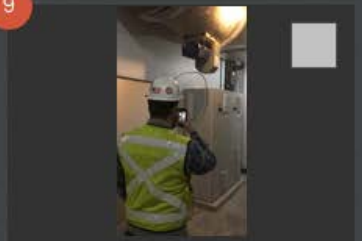
0028.JPG
Unknown

Tom_Barrett_...
May 08, 2010 09:13AM

GOPR0144-00...
Unknown

GOPR0144-00...
Unknown

GOPR0144-00...
Unknown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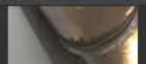


Smartvid.io

Josh

impersonate-app.smartvid.io/dashboard/projects

Skanska USA Building

Oliver Smith OS

Projects

22M Street
Skanska USA Building

Bohannon Site Logist...
Skanska USA Building

Bohannon Site Logist...
Skanska USA Building

Chris Evert Children's...
Skanska USA Building

Image Recognition D...
Skanska USA Building

Miami Science Muse...
Skanska USA Building

Pegasus Project
Skanska USA Building

Admin

22M Street
Skanska USA Building

Bohannon Site Log
Skanska USA Building

Bohannon Site Log
Skanska USA Building

Chris Evert Childrei
Skanska USA Building

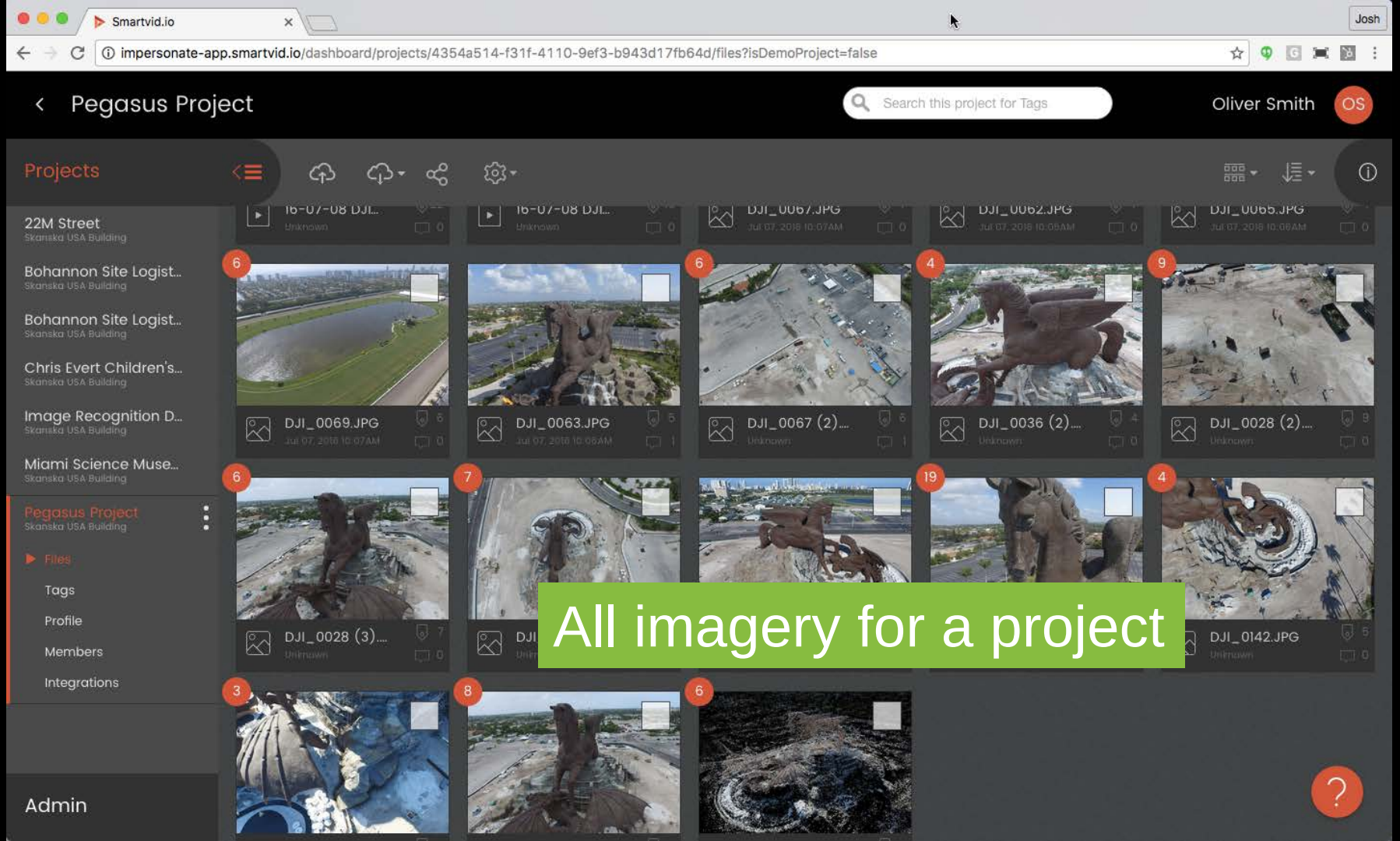
Image Recognition
Skanska USA Building

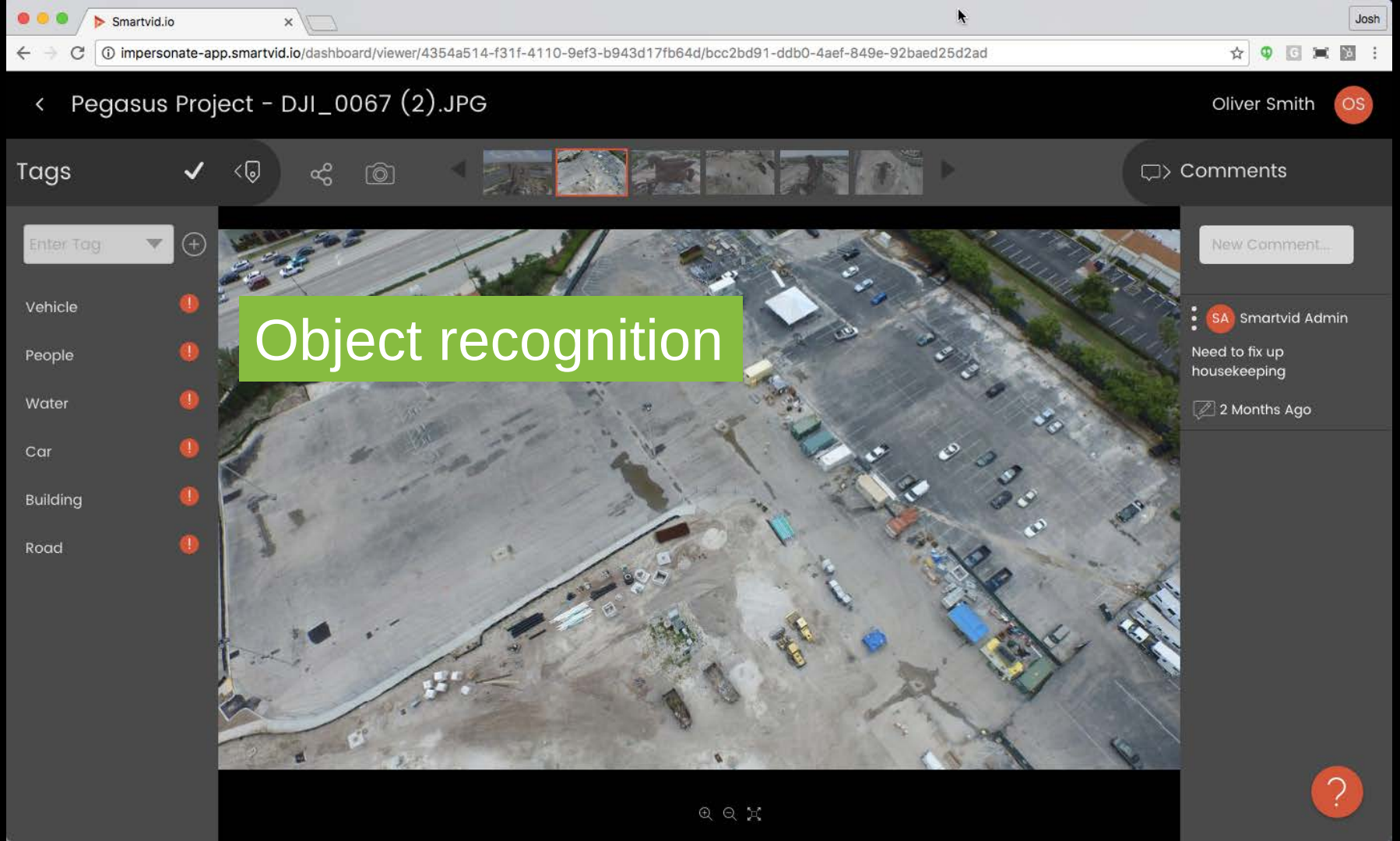
Miami Science Mus
Skanska USA Building

Pegasus Project
Skanska USA Building

Add Project

Projects view


Smartvid.io
Josh
impersonate-app.smartvid.io/dashboard/projects/4354a514-f31f-4110-9ef3-b943d17fb64d/files?isDemoProject=false
Pegasus Project
Search this project for Tags
Oliver Smith
OS
Projects
22M Street
Skanska USA Building
Bohannon Site Logist...
Skanska USA Building
Bohannon Site Logist...
Skanska USA Building
Chris Evert Children's...
Skanska USA Building
Image Recognition D...
Skanska USA Building
Miami Science Muse...
Skanska USA Building
Pegasus Project
Skanska USA Building
Files
Tags
Profile
Members
Integrations
Admin
DJI_0069.JPG
DJI_0063.JPG
DJI_0067 (2)....
DJI_0036 (2)....
DJI_0028 (2)....
DJI_0028 (3)....
DJI_0142.JPG
All imagery for a project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Pegasus Project - DJI_0067 (2).JPG
Oliver Smith
OS
Tags
Comments
Enter Tag
Vehicle
People
Water
Car
Building
Road
Object recognition
New Comment...
SA
Smartvid Admin
Need to fix up housekeeping
2 Months Ago

Smartvid.io

Josh

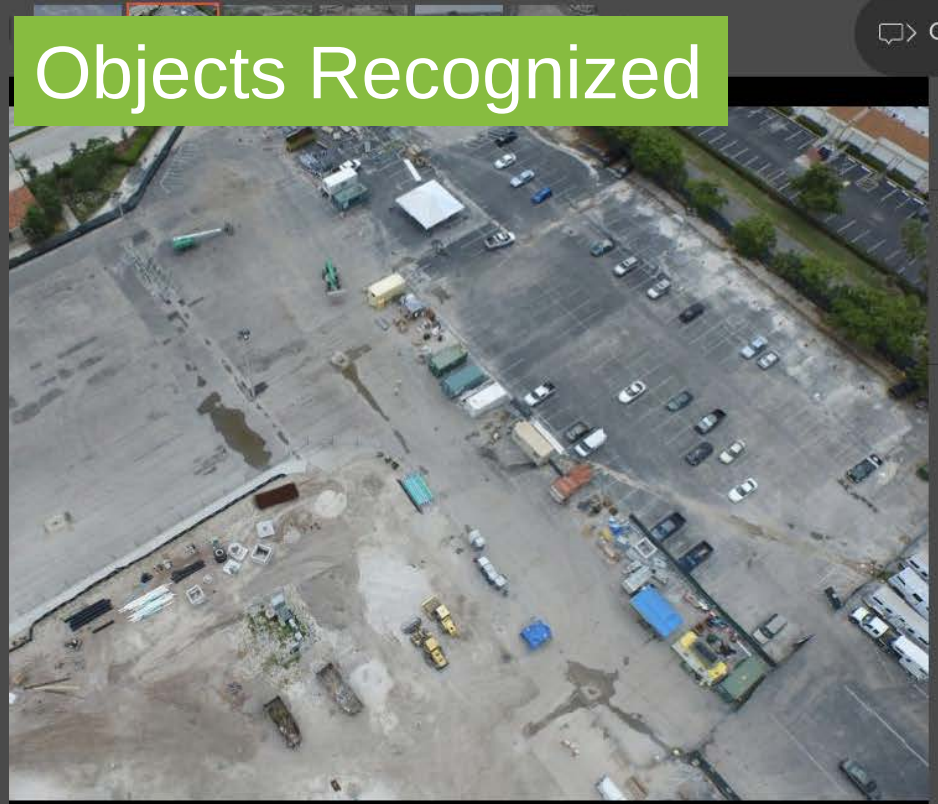
impersonate-app.smartvid.io/dashboard/viewer/4354a514-f31f-4110-9ef3-b943d17fb64d/bcc2bd91-ddb0-4aef-849e-92baed25d2ad

Pegasus Project - DJI_0067 (2).JPG

Oliver Smith OS

Objects Recognized

- Vehicle
- People
- Water
- Car
- Building
- Road



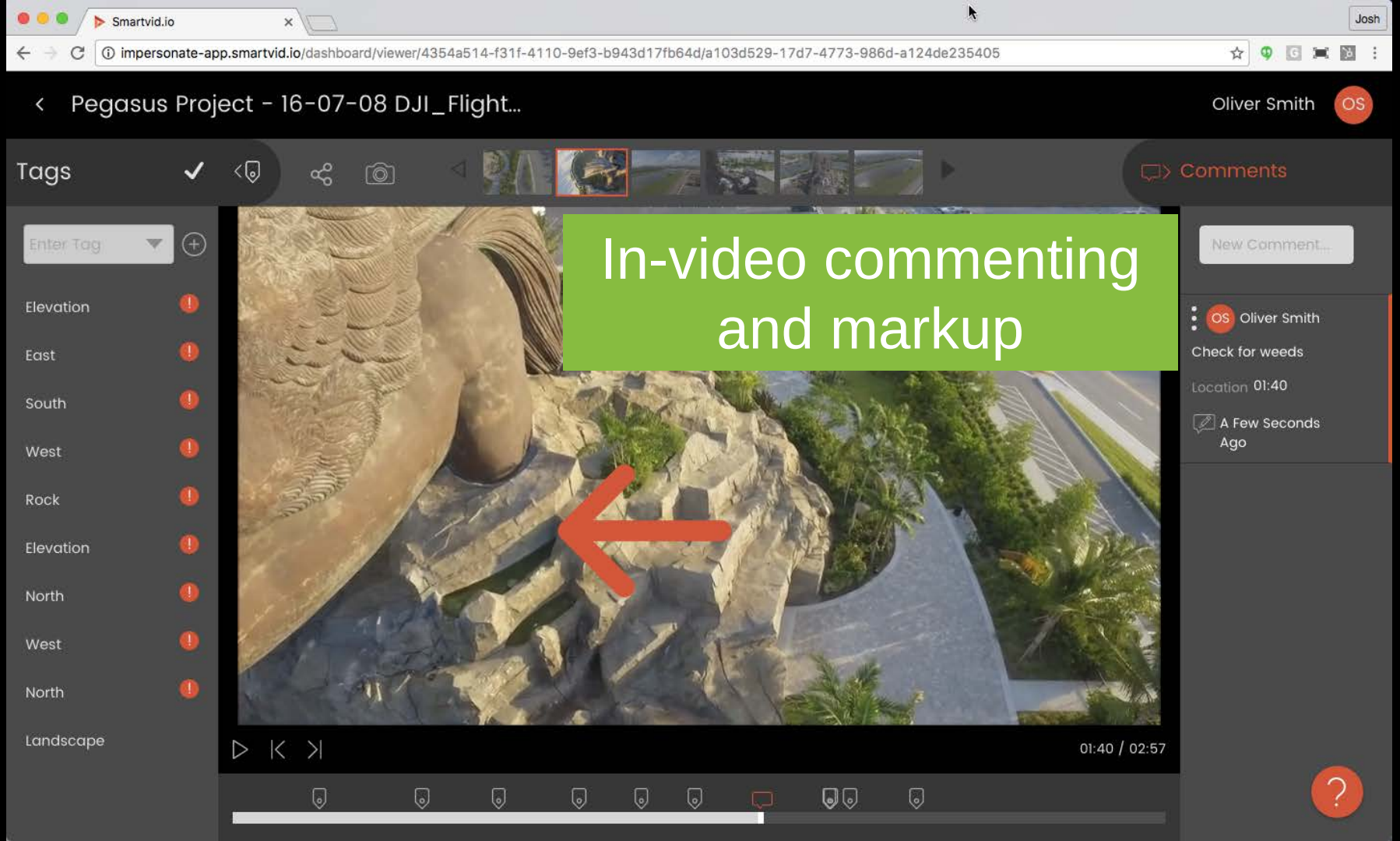
Comments

New Comment...

SA Smartvid Admin

Need to fix up housekeeping

2 Months Ago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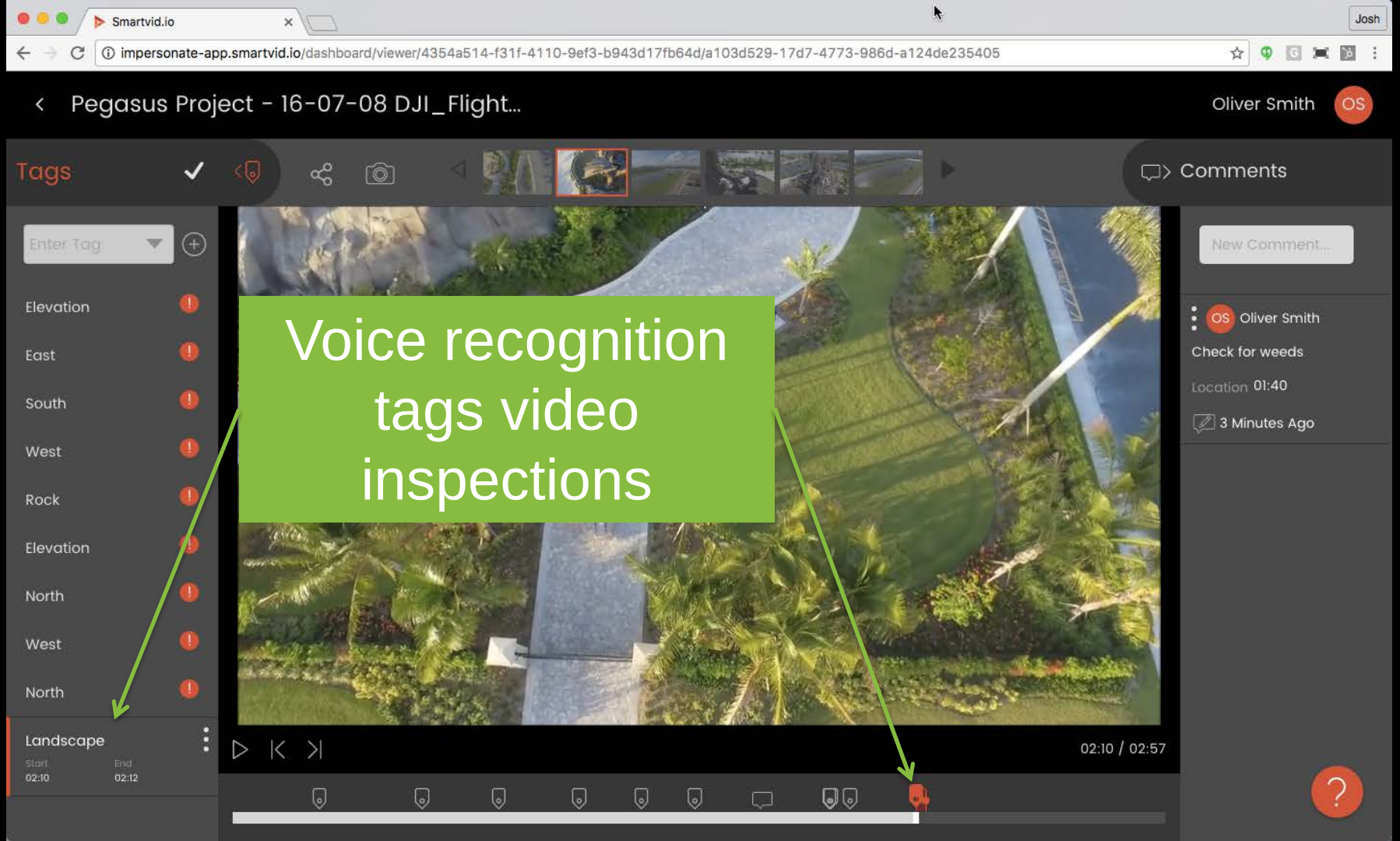
Pegasus Project - 16-07-08 DJI_Flight...
Oliver Smith
OS
Tags
Comments
Enter Tag
Elevation
East
South
West
Rock
Elevation
North
West
North
Landscape
In-video commenting and markup
New Comment...
OS
Oliver Smith
Check for weeds
Location 01:40
A Few Seconds Ago
01:40 / 02:57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Josh
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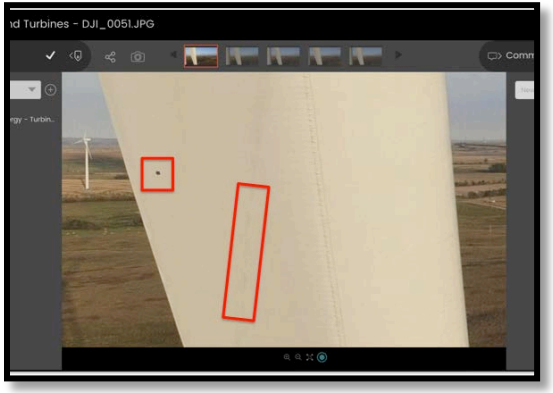
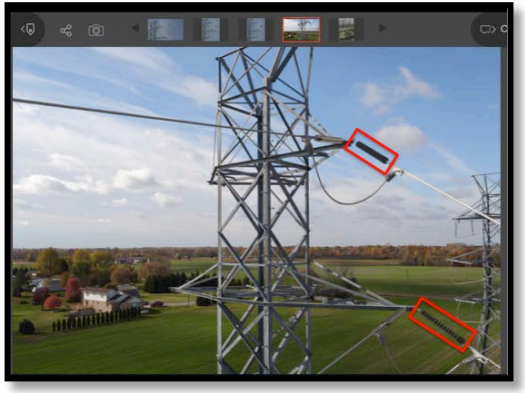
Pegasus Project - 16-07-08 DJI_Flight...
Oliver Smith
OS
Tags
Comments
Enter Tag
Elevation
East
South
West
Rock
Elevation
North
West
North
Landscape
Start
02:10
End
02:12
Voice recognition tags video inspections
New Comment...
OS
Oliver Smith
Check for weeds
Location 01:40
3 Minutes Ago
02:10 / 02:57

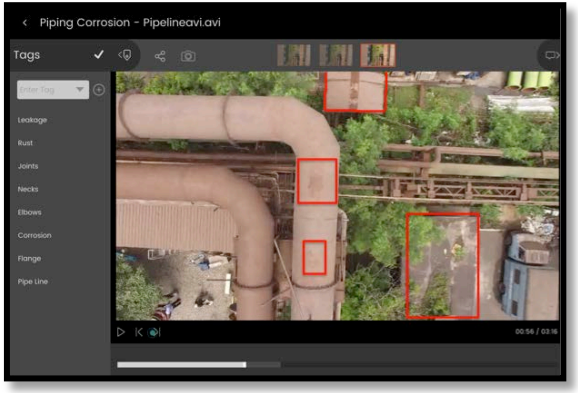
Advanced computer vision: Energy examples



Wind turbine blade inspection, defect detection and quantification

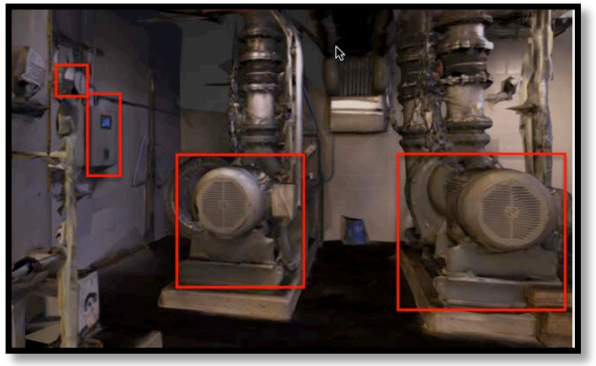


Transmission tower inspection, equipment identification and quantification

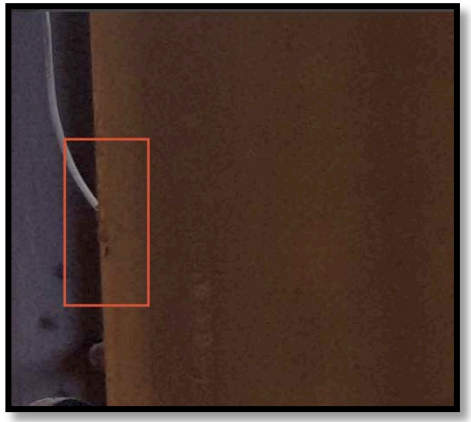


Pipeline equipment inventory, corrosion detection and quantification; High consequence area analysis, measurement of building density within proximity

Additional advanced computer vision examples



Asset counts from Scan data



Defect identification on conveyor belts

Cracks in manhole entry points

Smartvid.io's platform for classifier creation

Classifier Creation

Training Data

Training Data Markup

Classifier Creation & Iteration

Classifier Outputs
- Object present
- Object location in frame
- Object quantification (Count, Volume, Length)

Classifier Utilization

Uncategorized Data

Categorization & Quantification

Categorized & Quantified Data

Lessons Learned

- Data comes from various sources and technologies – How do we effectively manage all resources?
- Huge amounts of data and information at our finger tips – How do we leverage the right information?
- Skillsets and processes evolving – How do we as an industry go about changing the status quo?
- Privacy: Privacy rights and encroachment
- Project Team Utilization: Managing expectations and gathering support and resources

How did we do?

- Your class feedback is critical. Fill out a **class survey** now.
- Use the AU mobile app or fill out a class survey online.
- Give feedback after each session.
- AU speakers will get feedback in real-time.
- **Your feedback results in better classes and a better AU experience.**

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