

CONSTRUCTION TECHNOLOGY FUTURE FORECAST

How Drones, Sensors and Integrated
Apps are Rewriting all the Rules

James M. Benham

Twitter: @JamesMBenham, #JBTechTalk

Twitter
@JamesMBenham
#JBTechTalk

ABOUT





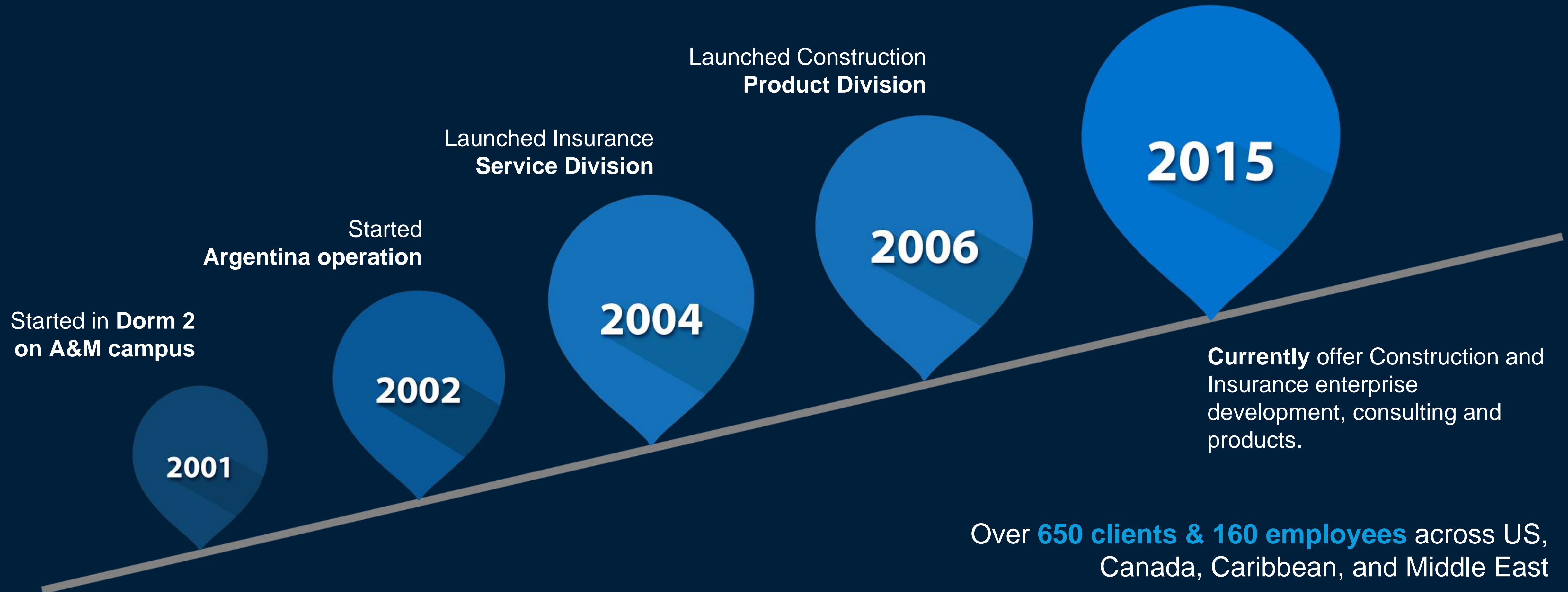
JAMES
BENHAM



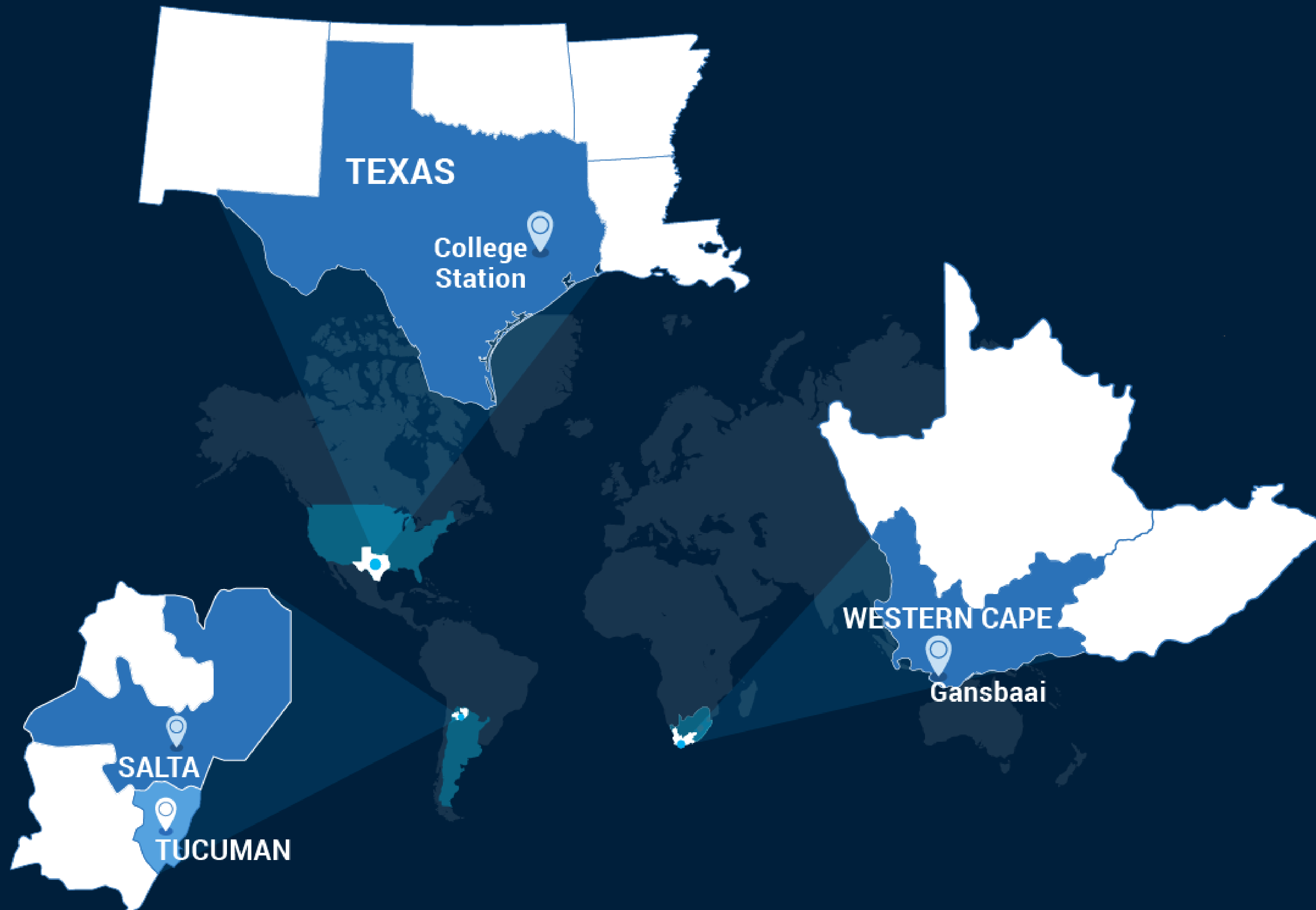
JIM
BENHAM



SEBASTIAN
COSTA







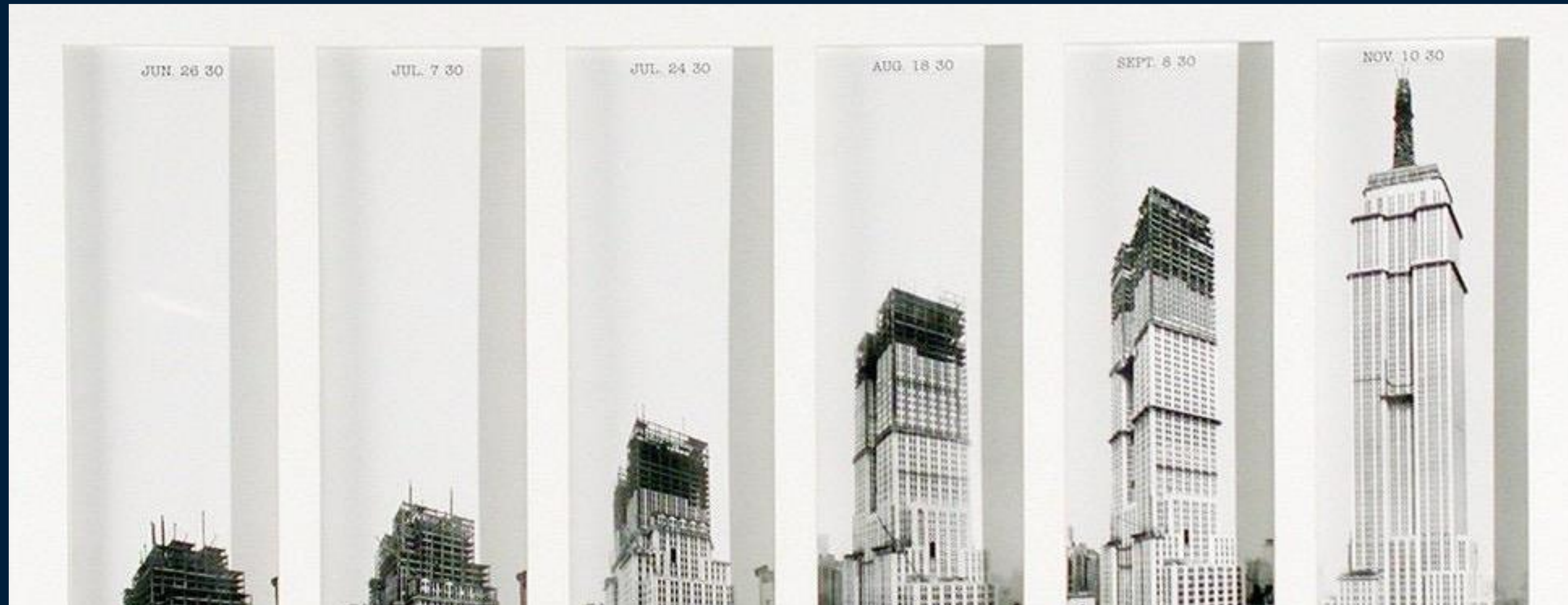
Why Do We Bother?



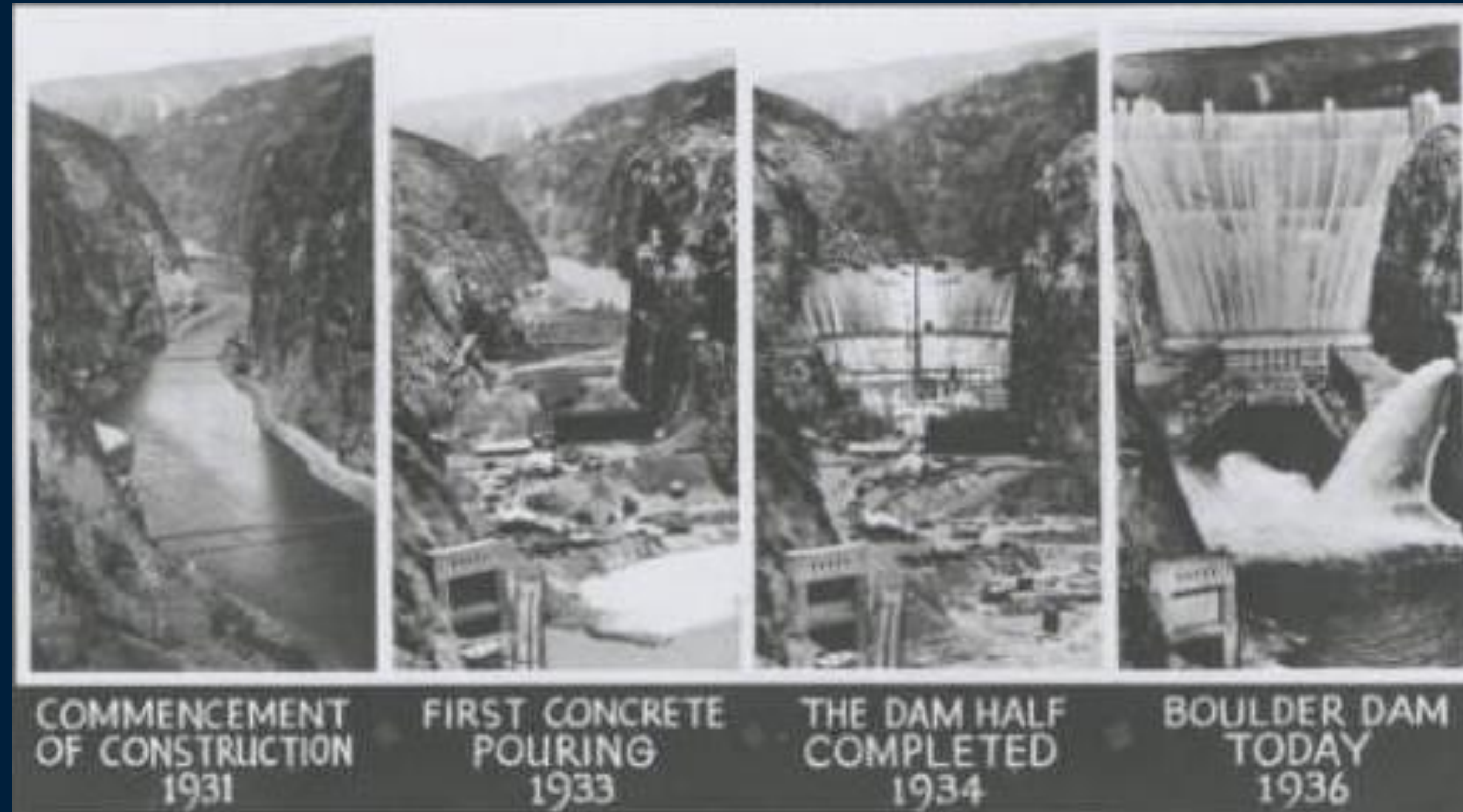
The Pyramids At Giza - 2560 BC



The Great Wall of China - Over 4,000 miles in 1,700
years



The Empire State Building - 1930



The Hoover Dam - 1936



Big Inch (350 Days) And Little Big Inch - 1942

So Why Do We Bother?

**Forbes**
com

Technology

Building A Hospital Out Of Bits And Bricks

Kerry A. Dolan, 09.27.10, 12:00 AM ET

Atul Khanzode is a building contractor navigating his way through the complex ductwork of a new \$1.5 billion medical center a couple of blocks from San Francisco Bay. He hits a snag. A large air duct he is following has mysteriously disappeared into the side of a sprinkler pipe and reappeared on the other side. This is impossible, the building designers have to be informed. This has to be fixed immediately.

That's easily enough done, because the duct doesn't exist. Nor does the hospital. Khanzode is sitting at a computer terminal inside a double-wide trailer on the edge of the hospital construction site, which is currently bulldozed earth. The building and all its ductwork are merely bits of data in a 14-gigabyte file stored on a server. Khanzode homes in on the image of the air duct running into the pipe, clicks through the software, rotates the view and zooms in, as if playing a videogame. "In a normal process it would have taken a week to solve it," he says. "Now we can do it in two minutes."

Khanzode, the director of virtual construction for general contractor DPR Construction of Redwood City, Calif., is one of 120 people from 30 different companies who have spent the past 16 months virtually building a new 878,000-square-foot medical center for the University of California, San Francisco. Physical construction of the project won't begin until December. Completion is slated for June 2014.

By building the medical center first in detailed 3-D graphic computer files, the designer and builders can discover problems when they're easier and cheaper to solve. Already DPR and its collaborators say they have shaved five months off the schedule and \$100 million from the budget.



DPR BIM ROI

Total Station

Greater Margins



Crystal Bridges



Burj Khalifa

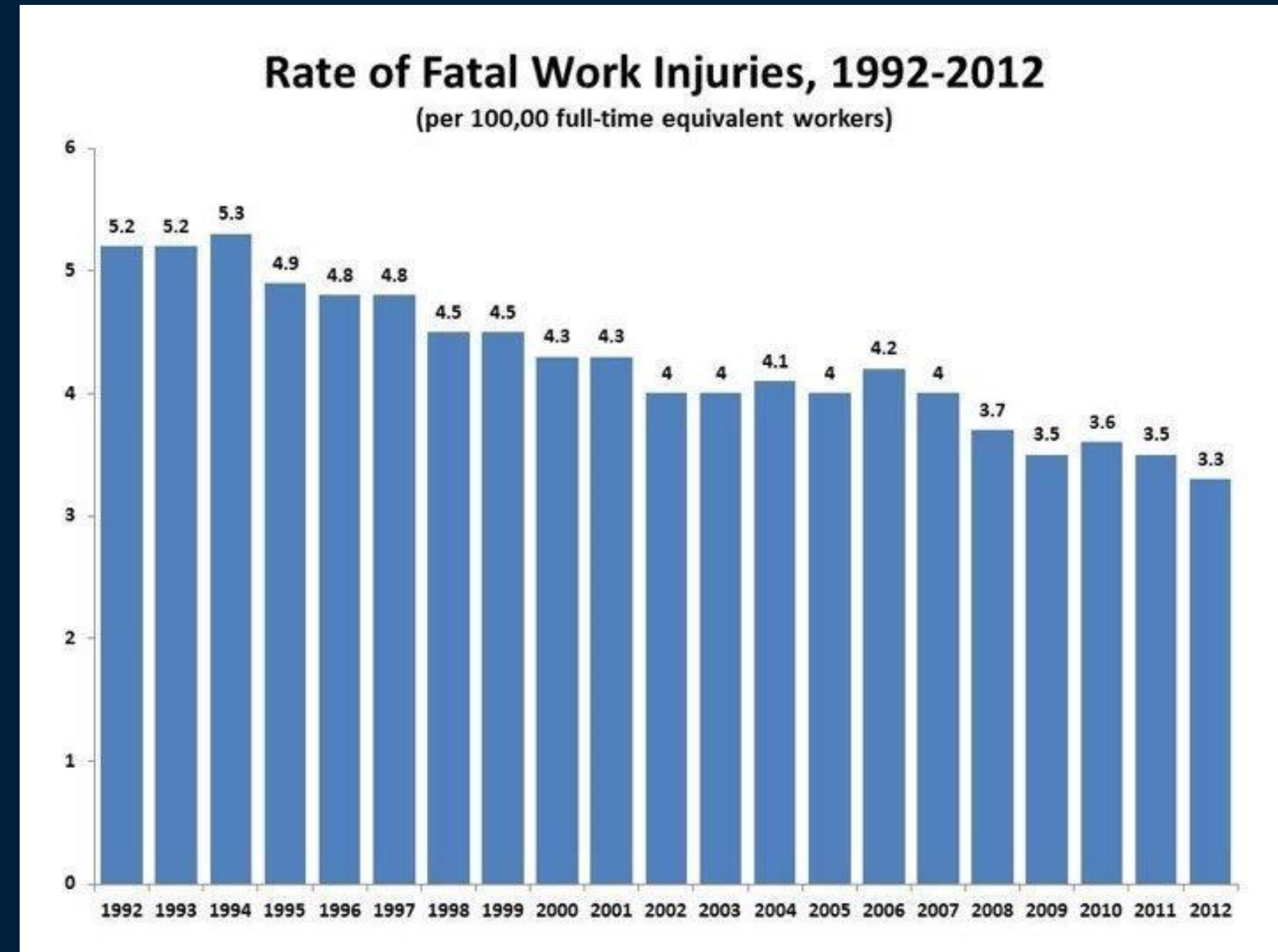


Bird's Nest



Palm Jumeirah

Greater Complexity



Safety

Deadly crane collapse at Saudi Arabia's Grand Mosque

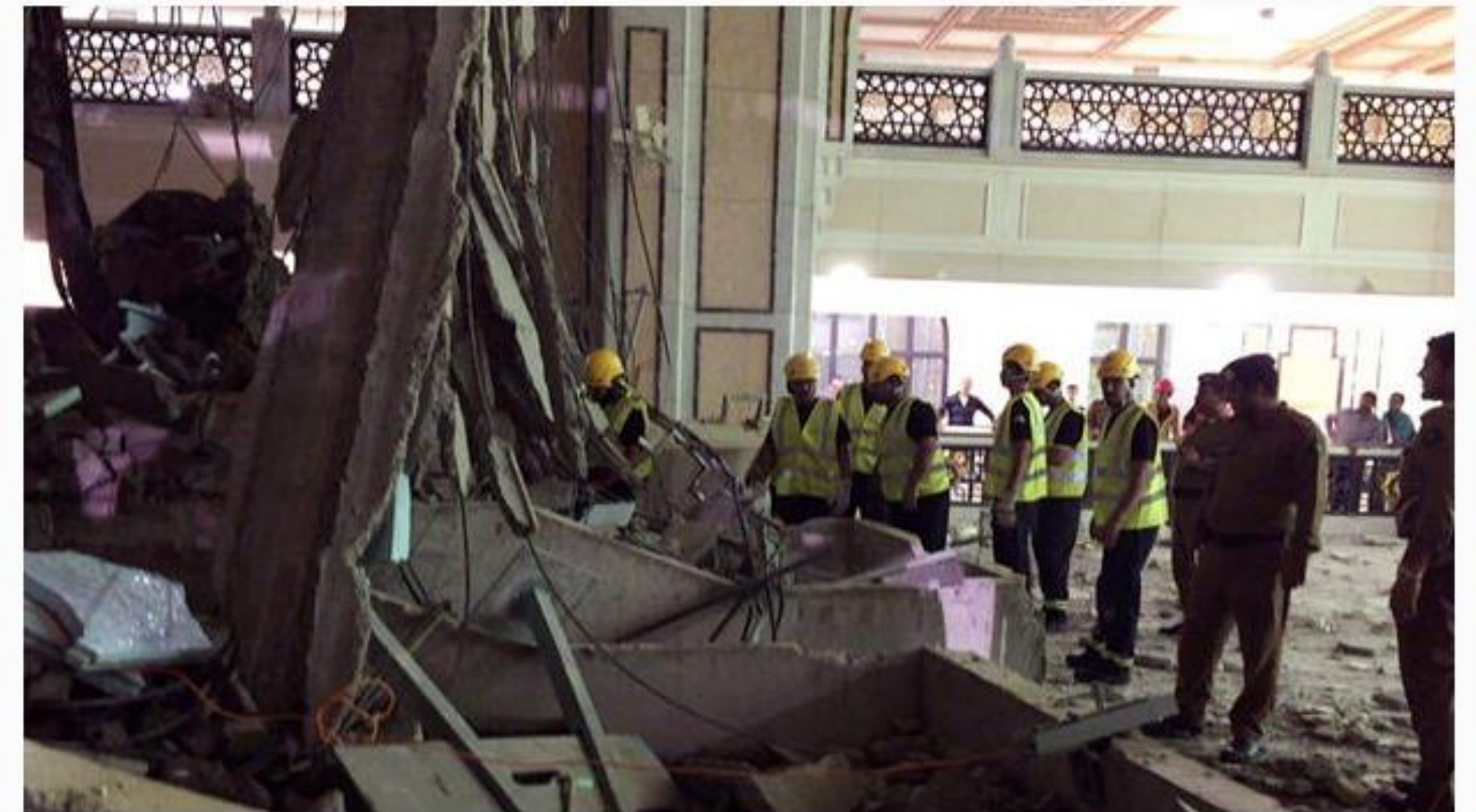
Last Updated Sep 11, 2015 10:39 PM EDT

RIYADH, Saudi Arabia -- A towering construction crane collapsed on Friday during a violent rainstorm in Saudi Arabia's city of Mecca, Islam's holiest site, crashing into the Grand Mosque and killing at least 107 people ahead of the start of the annual hajj pilgrimage later this month.

Videos and photos posted by social media users and Arab news outlets showed a grisly scene, with police and onlookers attending to bloodied bodies on the polished mosque floors.

Saudi Arabia's civil defense authority provided a series of rising casualty numbers on its official Twitter account. As of late Friday, it said those injured in the disaster numbered 238.

A photo posted online by the authority showed police and workers in hardhats inspecting a pile of collapsed concrete slabs inside a part of the sprawling, ornately decorated mosque.



In this image released by the Saudi Interior Ministry's General Directorate of Civil Defense, Civil Defense personnel inspect the damage at the Grand Mosque in Mecca after a crane collapsed, killing dozens, Sept. 11, 2015.

Safety



Worker Quality Of Life



“I got into construction decades ago because you didn’t have to be a rocket scientist, only to find out that now, you have to be a rocket scientist to be in construction.”

"The only constant is change."

"To improve is to change, so to be perfect is to
have changed often."

Winston Churchill

"We don't have to be way ahead, we have to be a
year ahead."

Some Quick Definitions

What is the Cloud? It's (NIST Definition):

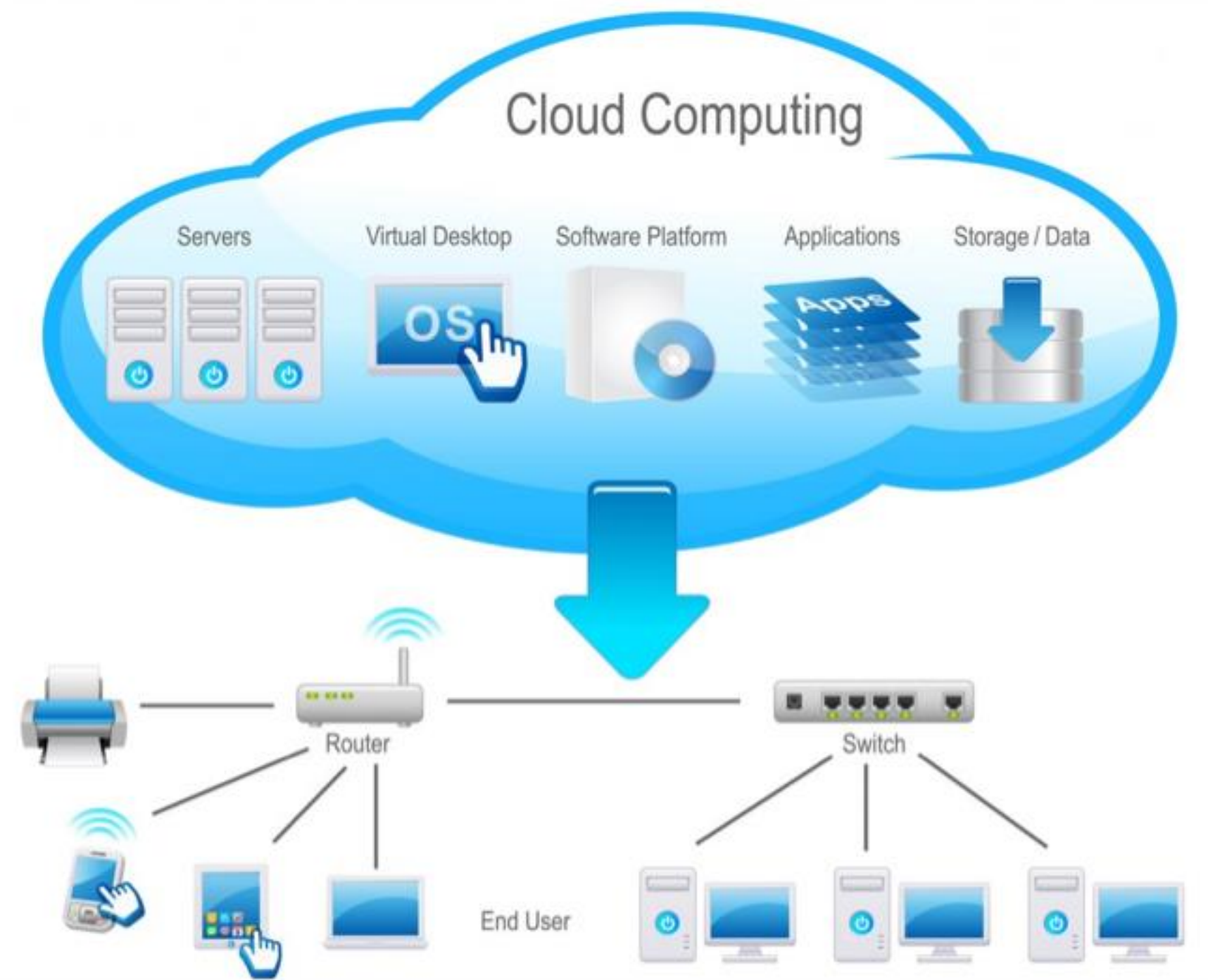


Image from rubiconn.com

Windows Azure™

amazon
web services™

the
rackspace cloud

Google Compute Engine

- Self Service
 - Resource Pooling
 - Scalable
 - Programmable
 - Broad Access
- Public/Private/Hybrid**

Big Data (from Michael Stonebraker @ MIT)



- **Big Volume**
(Simple SQL analytics,
Complex non-SQL)
- **Big Velocity**
(Drink from a fire hose)
- **Big Variety**
(Large # of diverse data
sources for integration)

Machine Learning (from WhatIs)



A type of artificial intelligence (AI) that provides computers with the ability to learn without being explicitly programmed.

Arthur Lee Samuel

Two Types of Construction Tech



Management Tech



Building Tech

What changed in the
last 12 months?

Mobile Devices, Apps and Connectivity Dramatically Improve Again



Google fiber (up to 1Gbps)

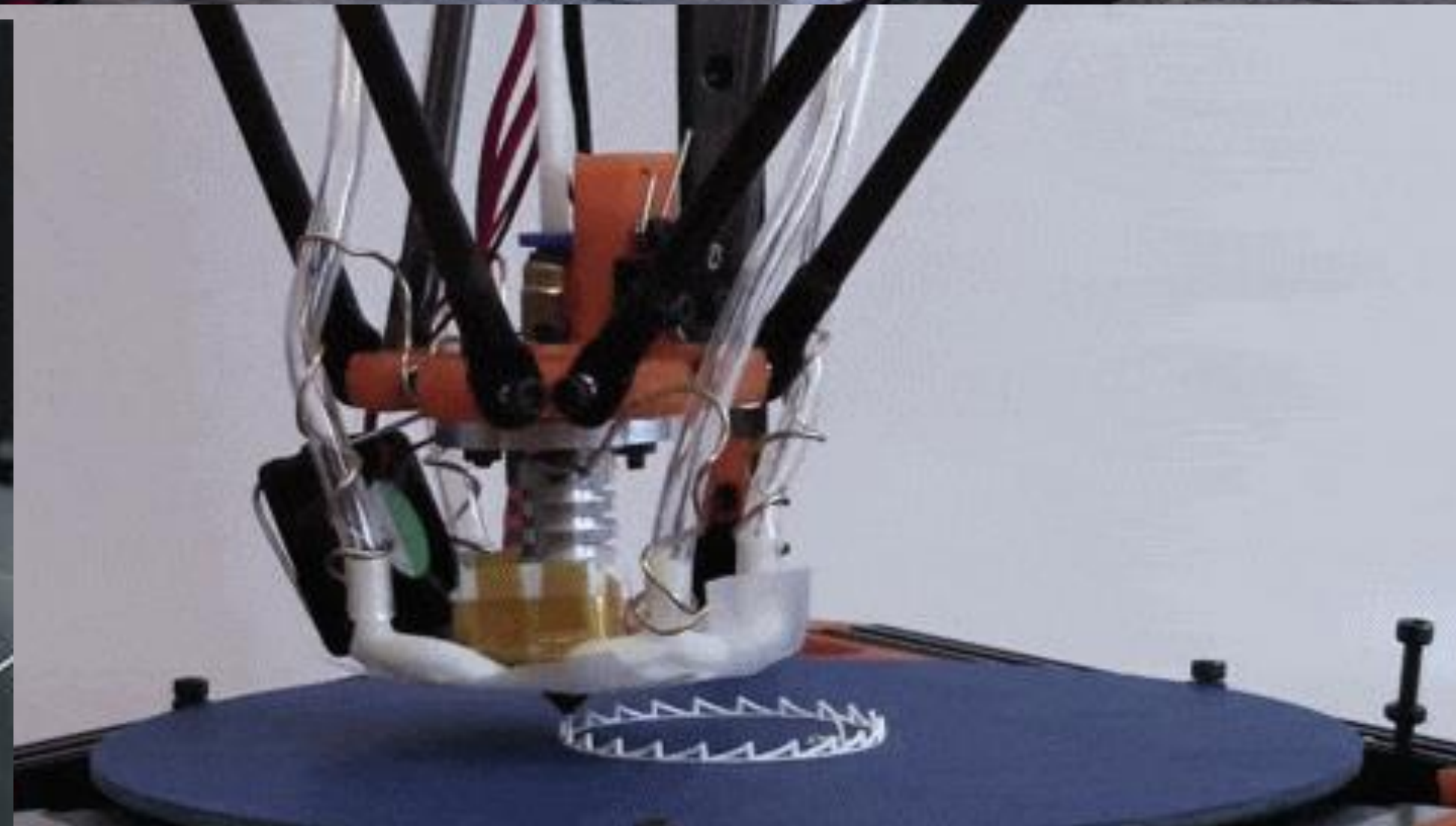
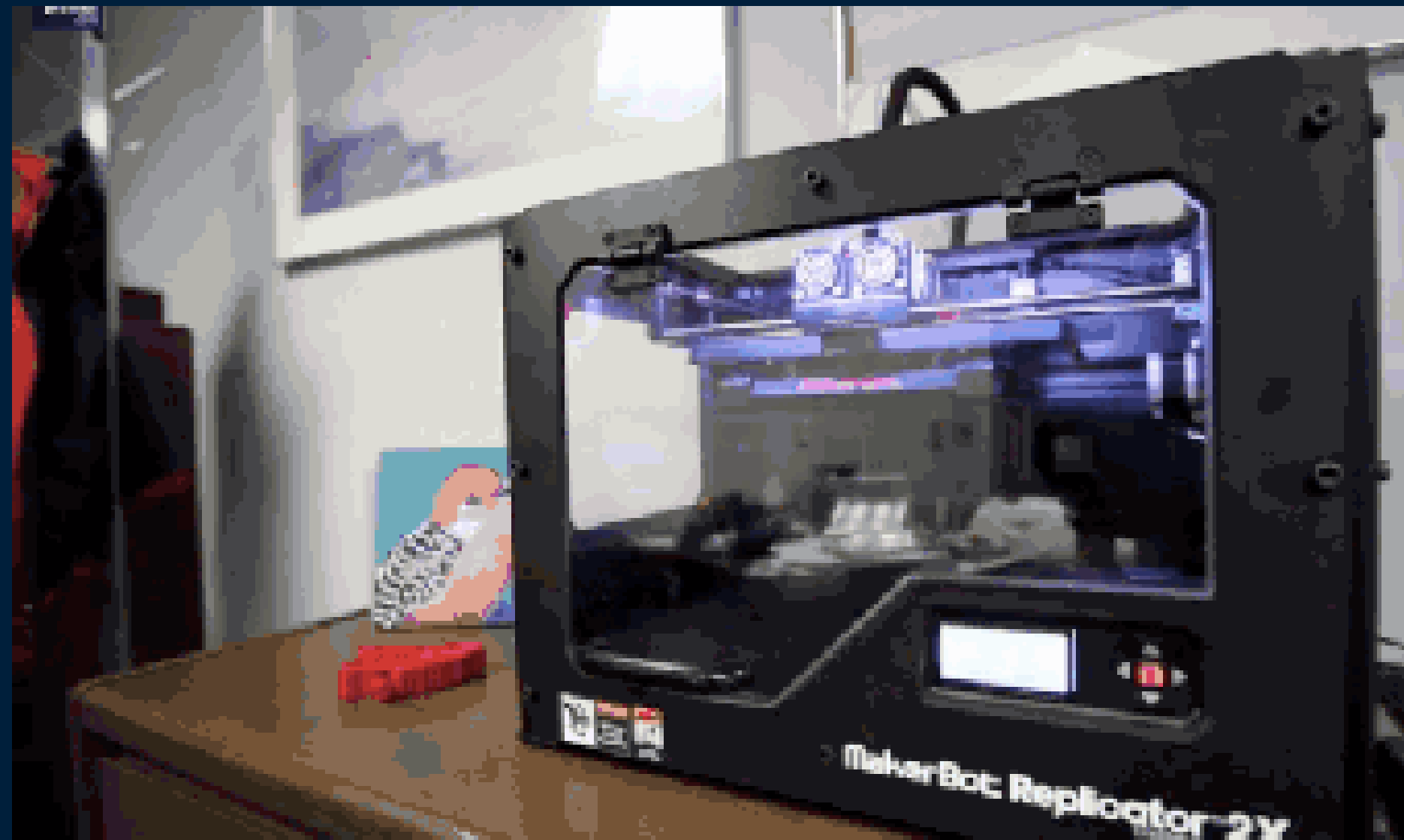


(up to 80Mbps)



5G (up to 1Gbps)

3D Printing is Taking Off



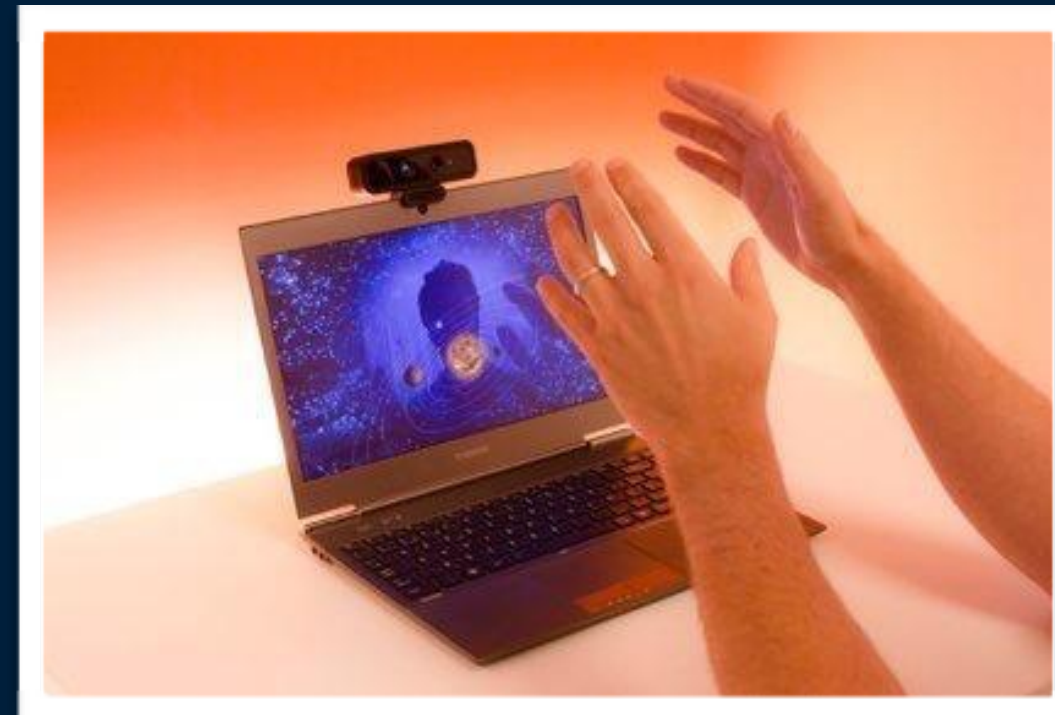
Wearables are in Popular Use Now



Your Computers Can See You Now... No Really, They Can.



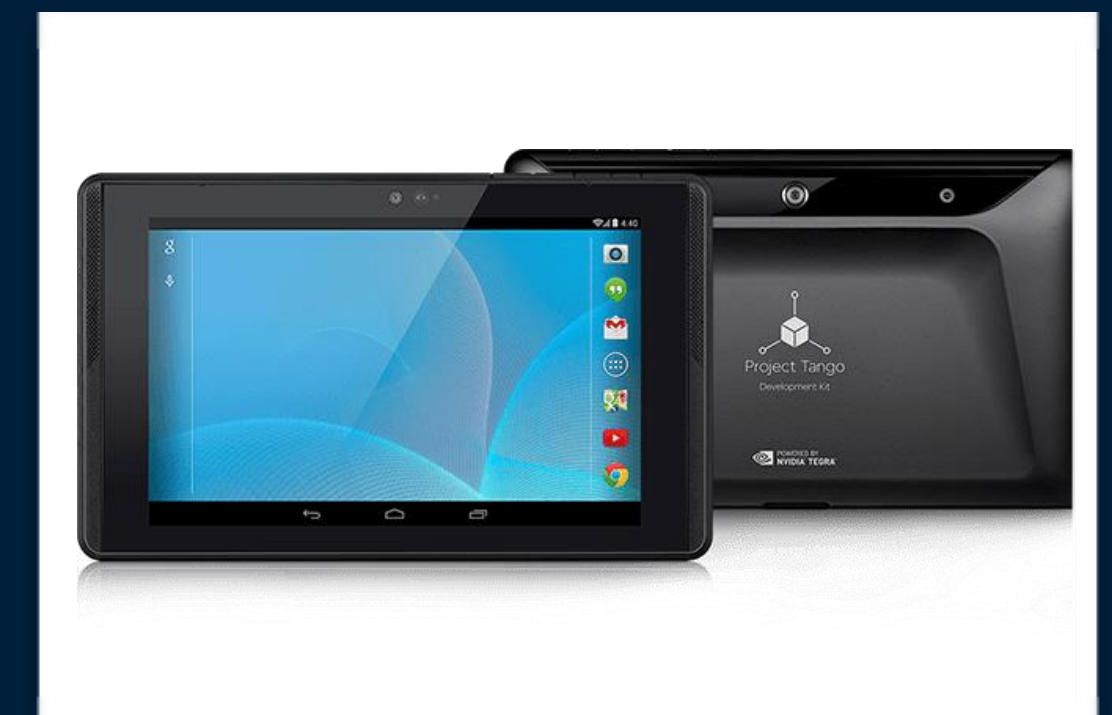
Leap Motion



SoftKinetic



Structure
Sensor



Project Tango

Drone Battles are a Reality, Not Just a Movie

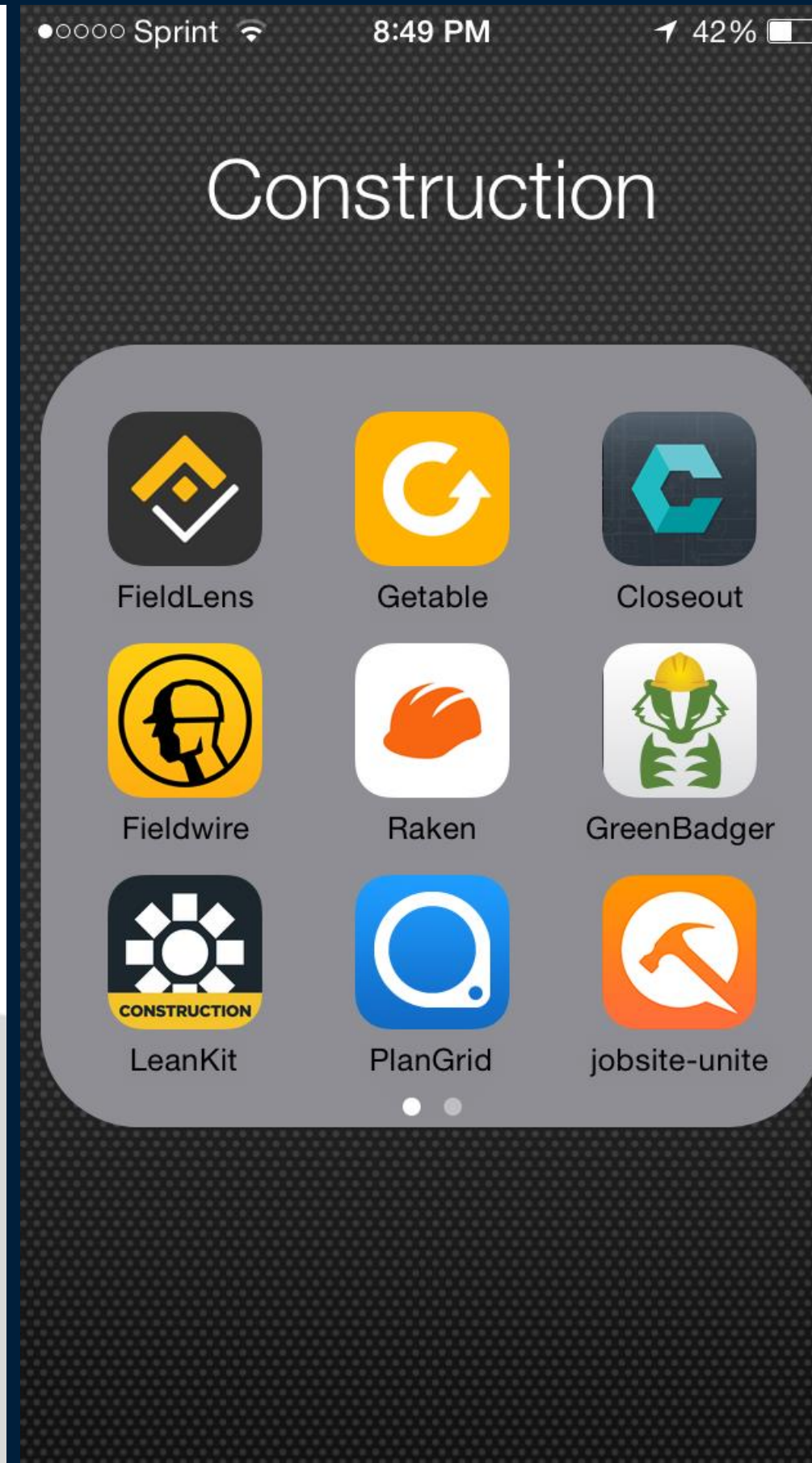


Aerial Sports League

Hacking & The AEC Industry are Taking Off



More Construction Apps than Ever



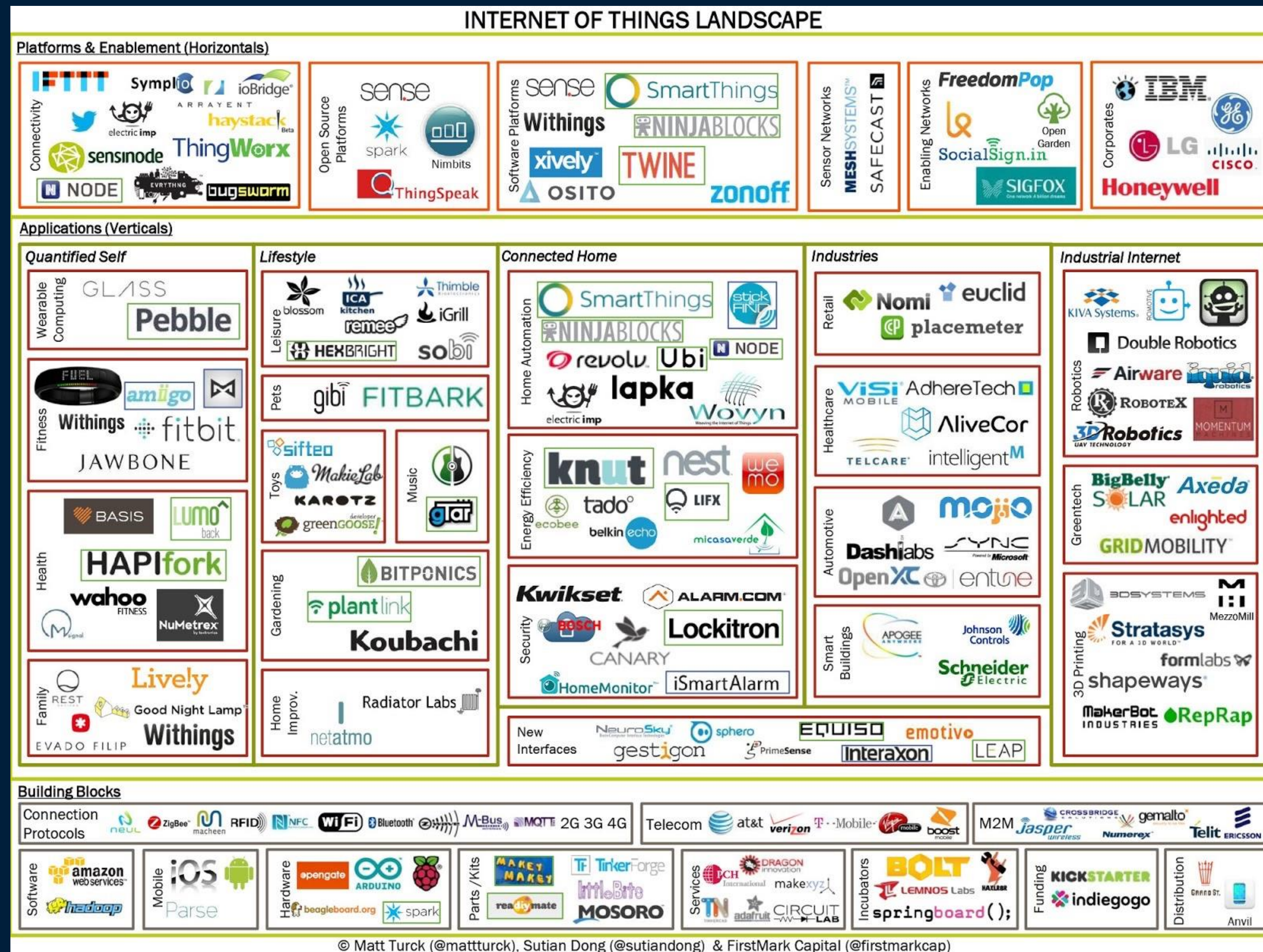
The Universal Translator is Here - in 27 Languages



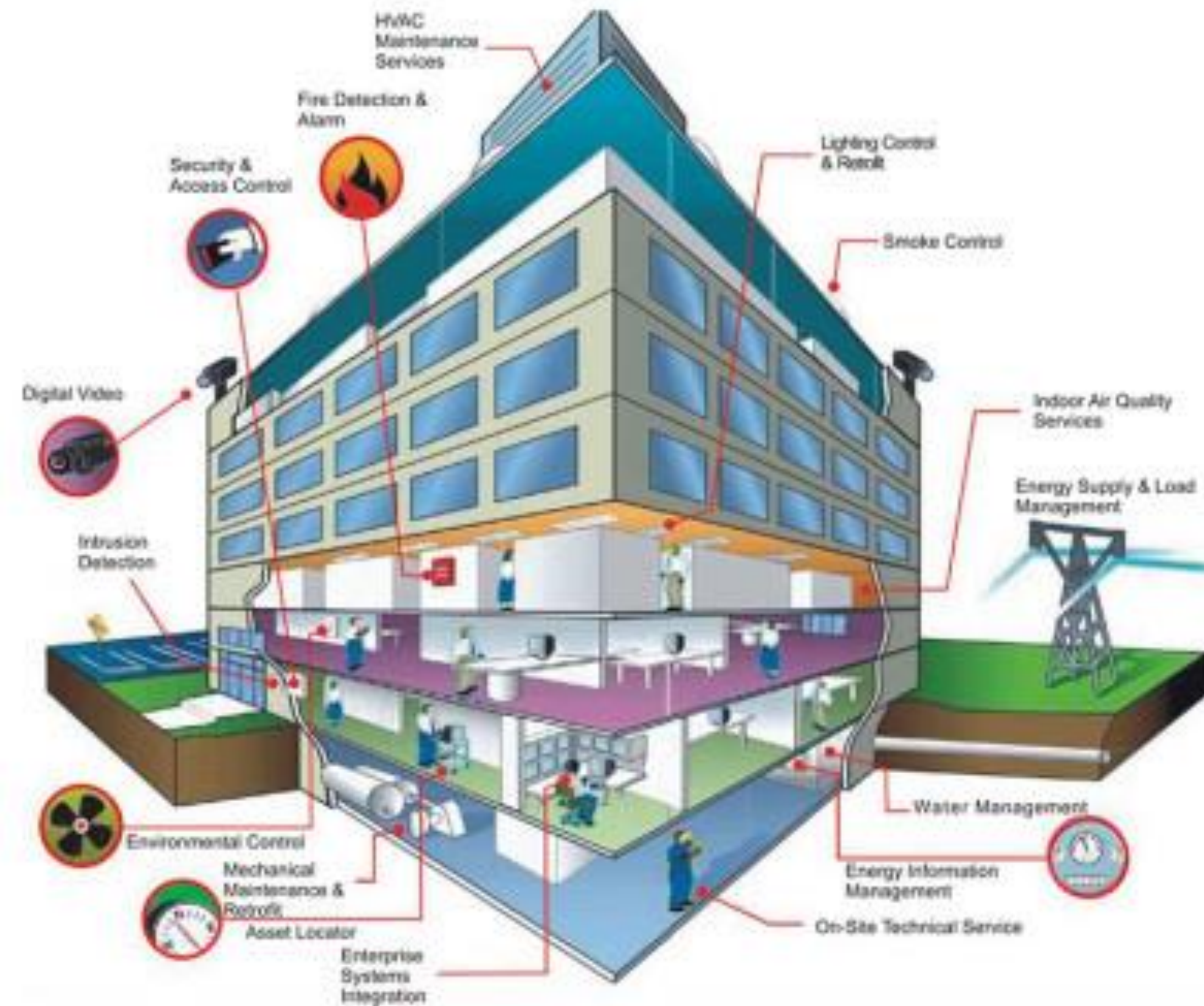
The Internet Of Things Has Accelerated...



Forming a huge landscape...



...And Has Become Internet Of Buildings



Images © SynapseAV.com

Telsa Model P85D Gets Ludicrous and Auto Pilot Mode



Does 0-60 in 2.8 Seconds 762 brake horsepower total

Back to the Future II is Actually Happening



Back to the Future II is Actually Happening

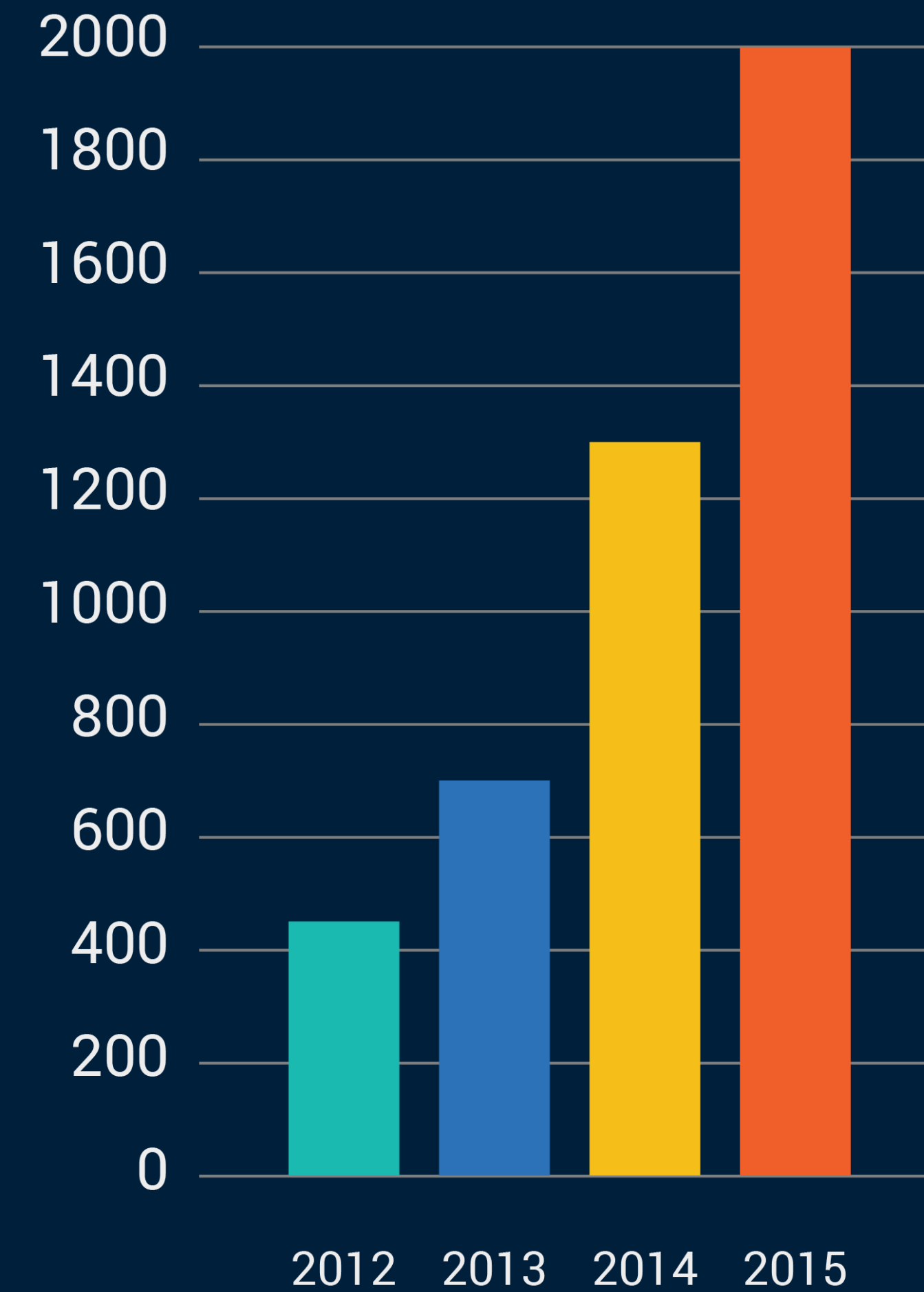


Big Data and machine learning are intersecting.

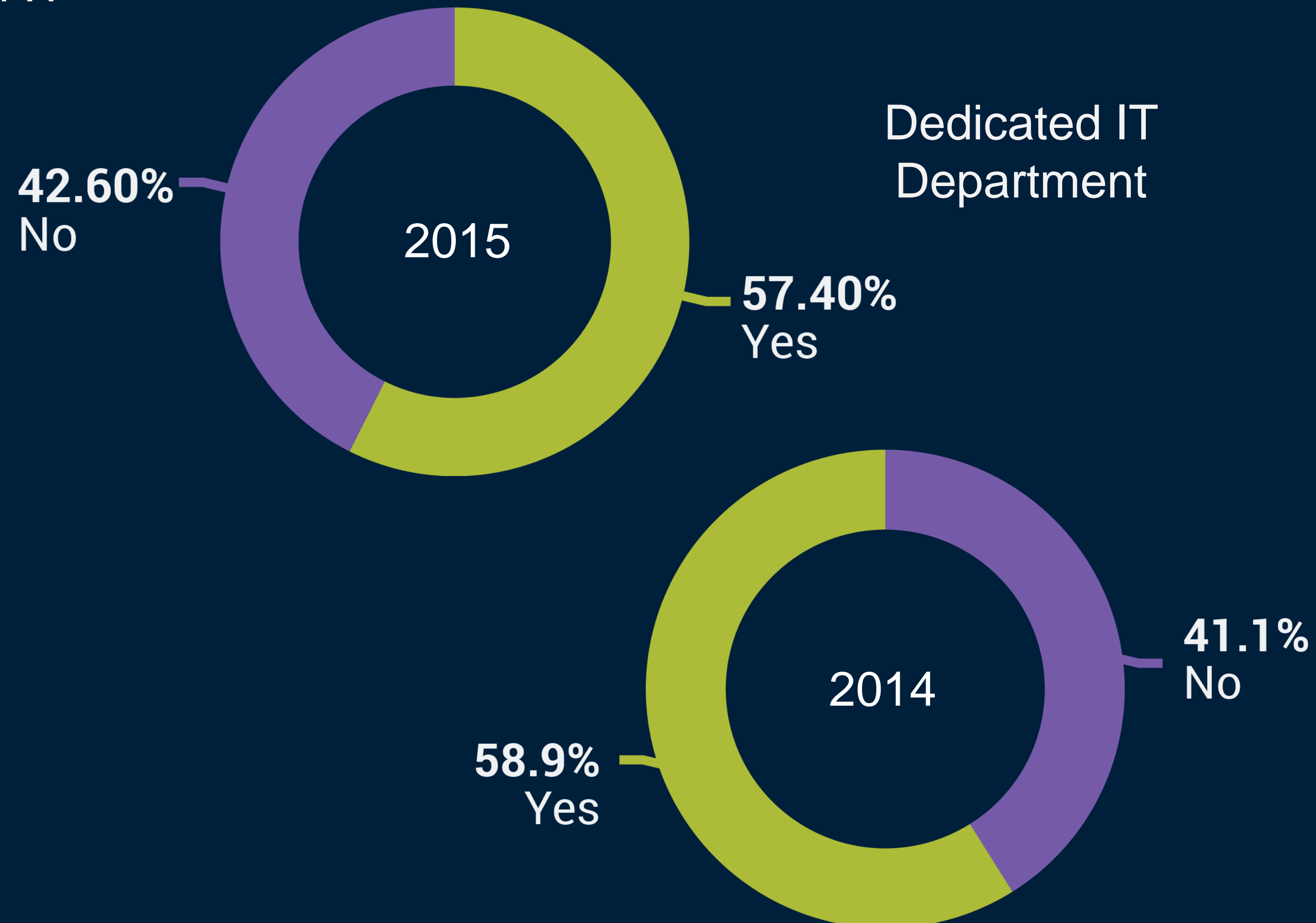
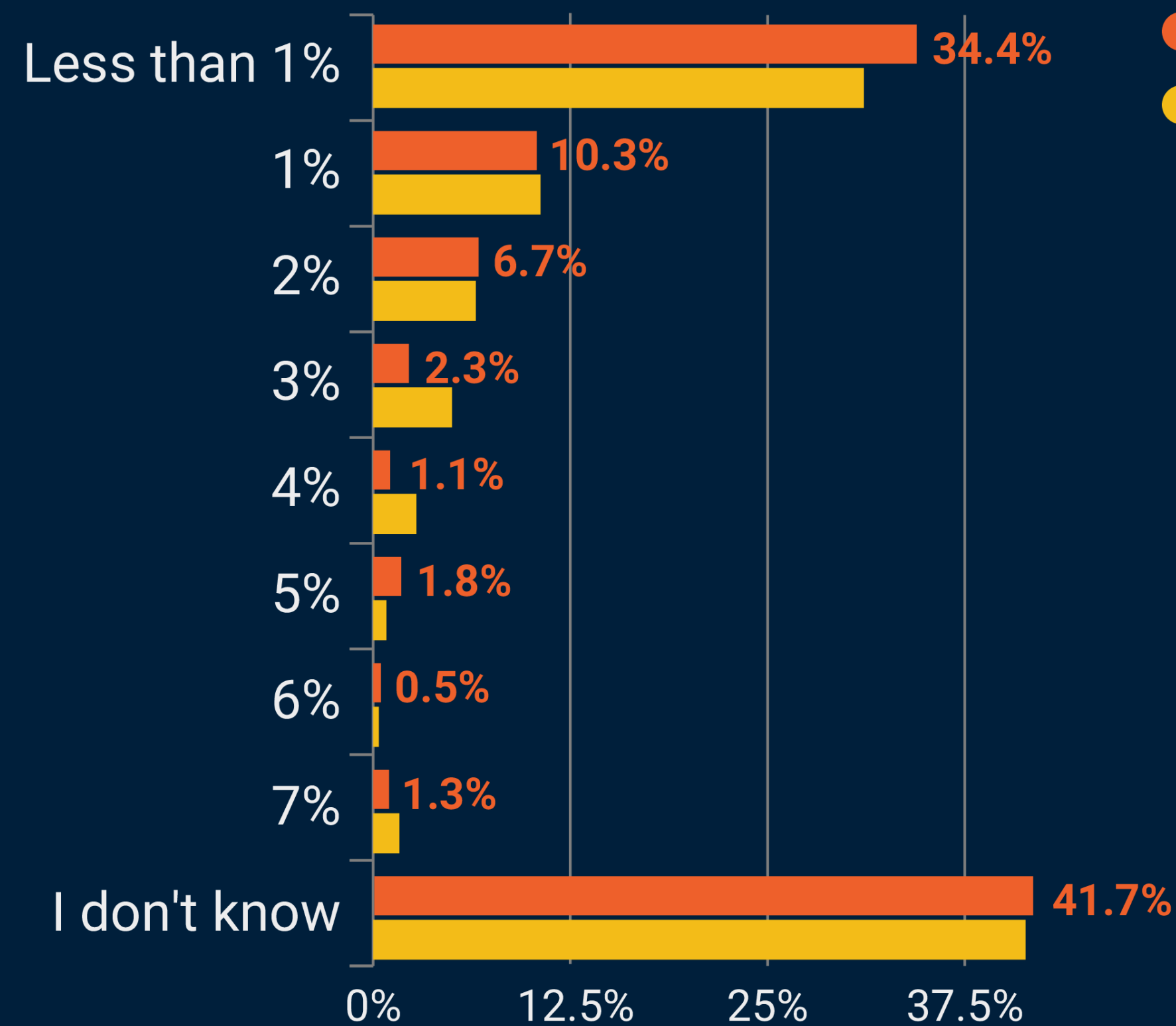


Annual Construction Technology Survey

Survey Participants



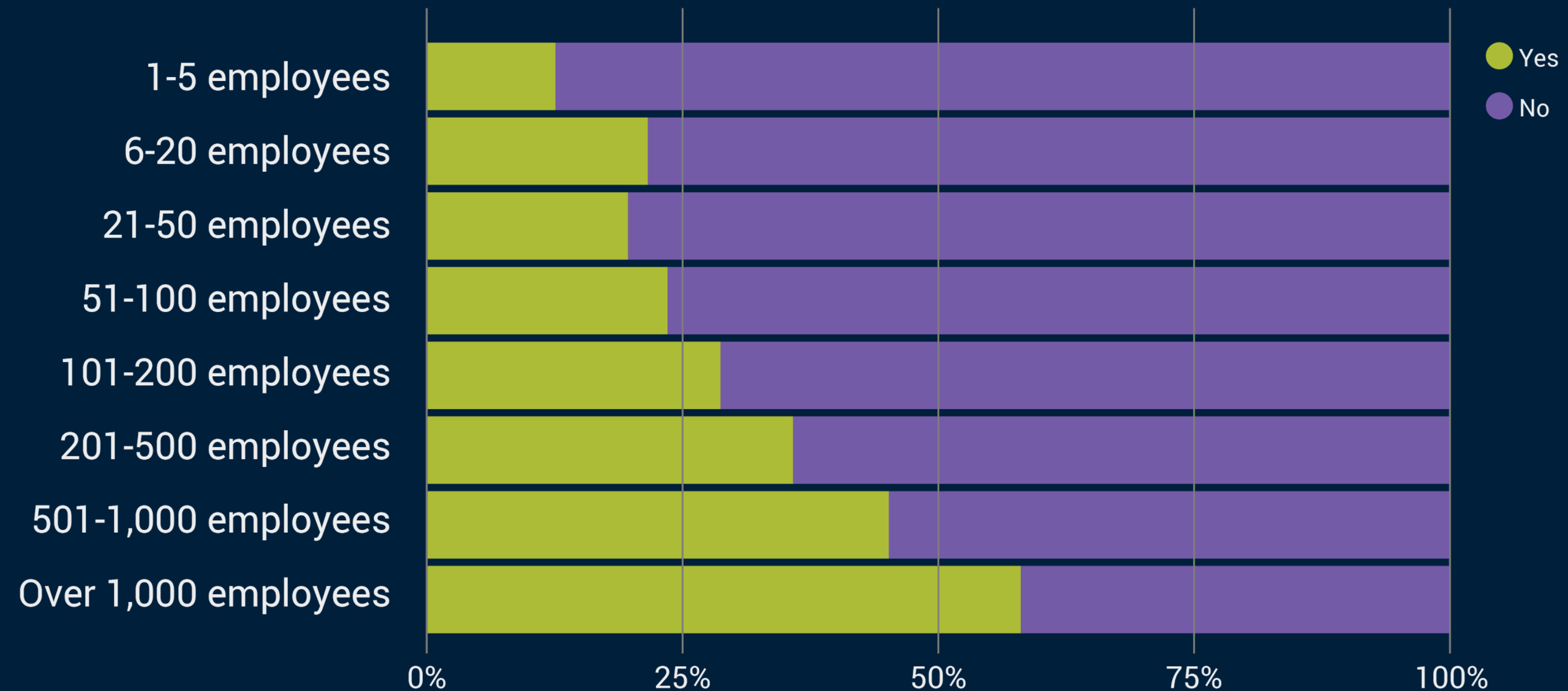
Percentage of Corporate Revenue Spent on IT



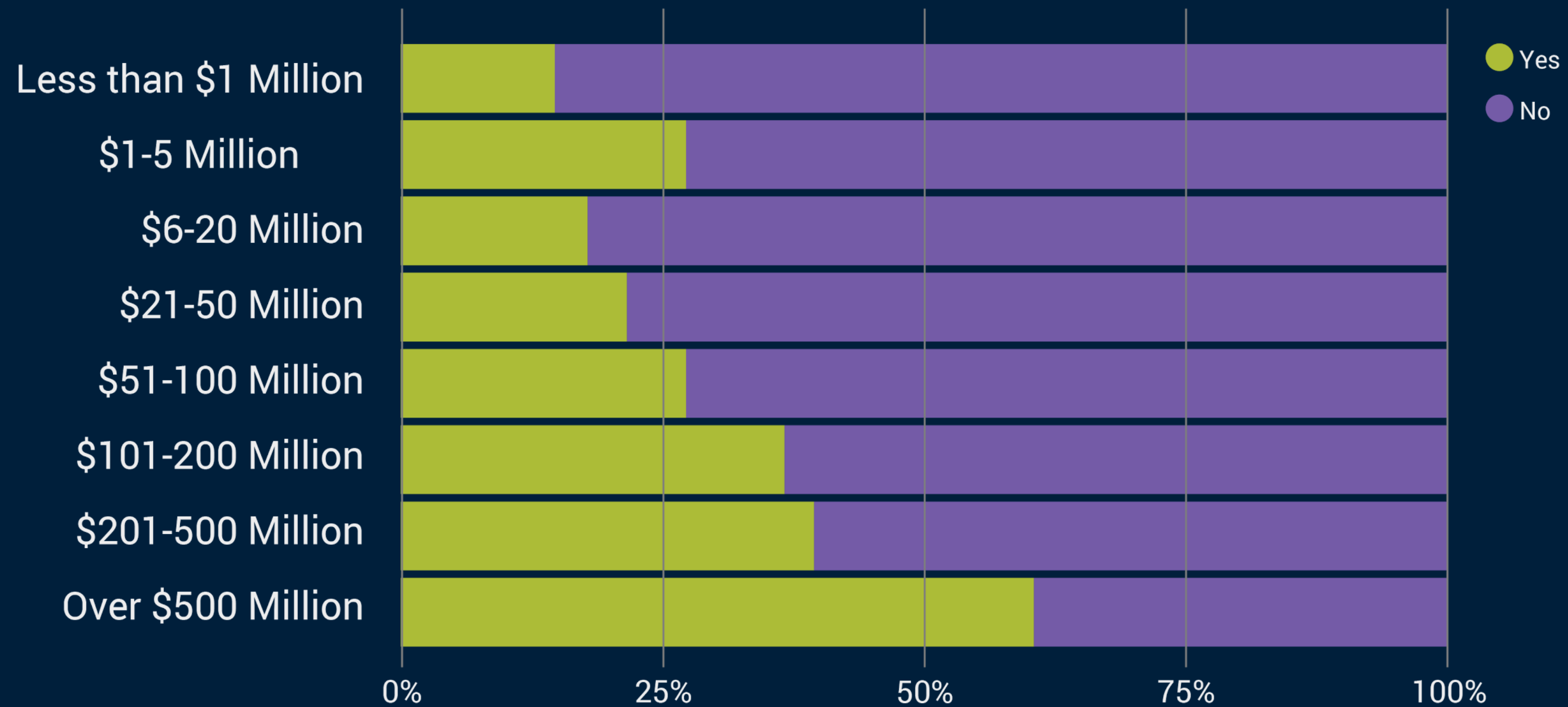
Does your company have a R&D Department?



R&D Departments vs Number of Employees



R&D Departments vs Revenue

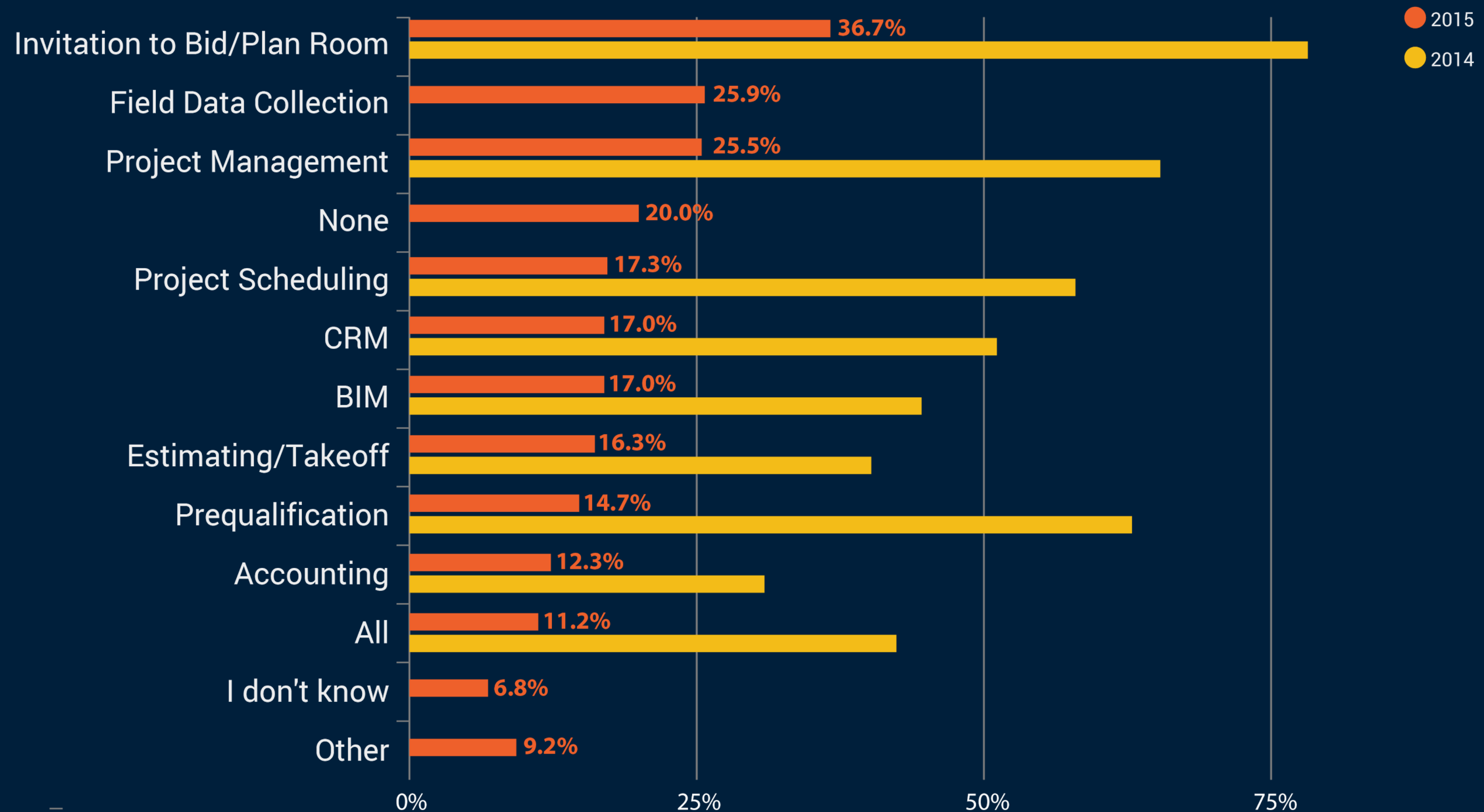


Many famous companies have run their own R&D labs - you should, too.

The logo for Google X, featuring the word "Google" in its standard grey font, followed by a small trademark symbol and an orange "[x]" in a bold, sans-serif font.

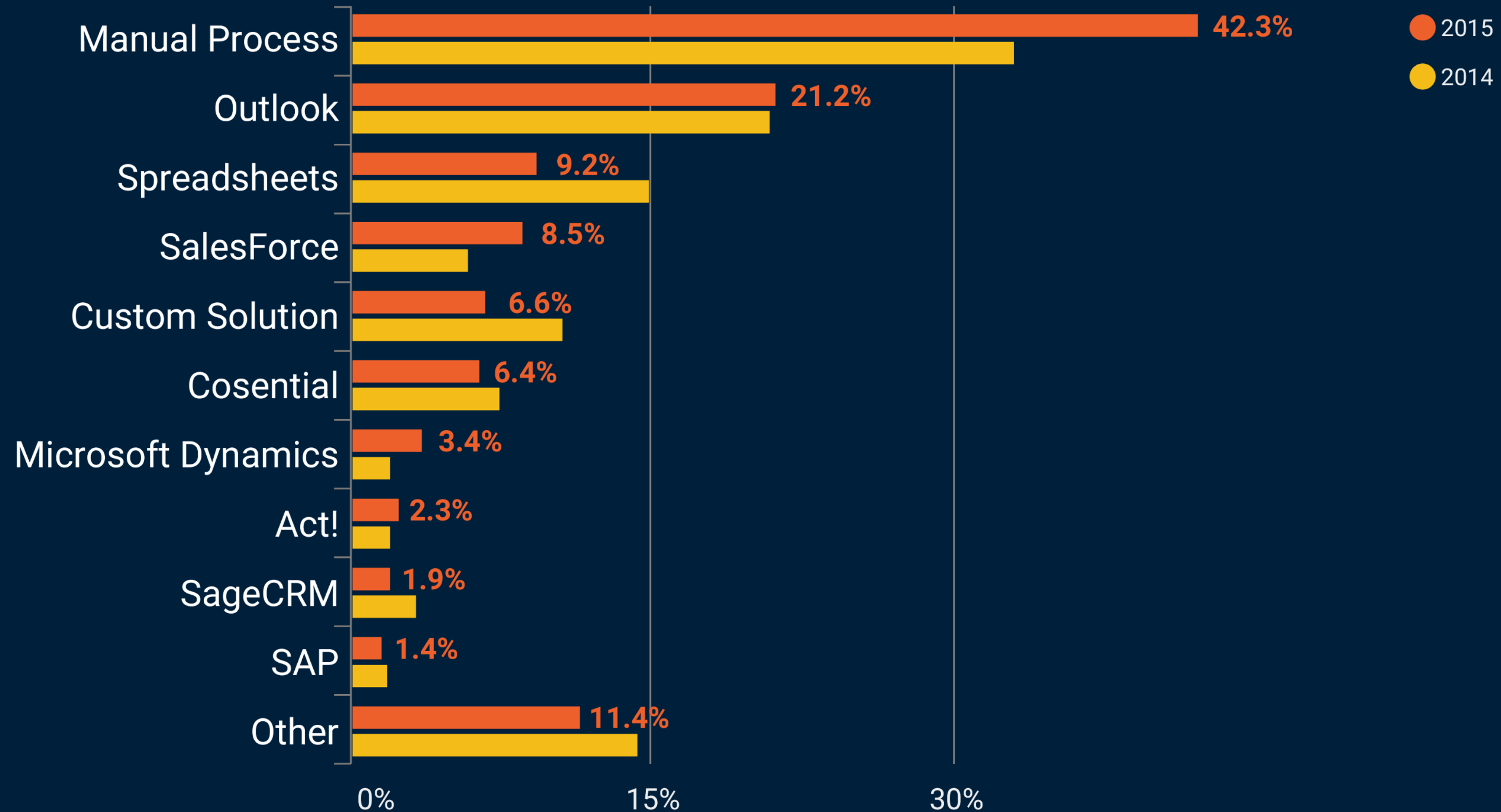
Bell Laboratories

What Software Can Be Cloud Based?



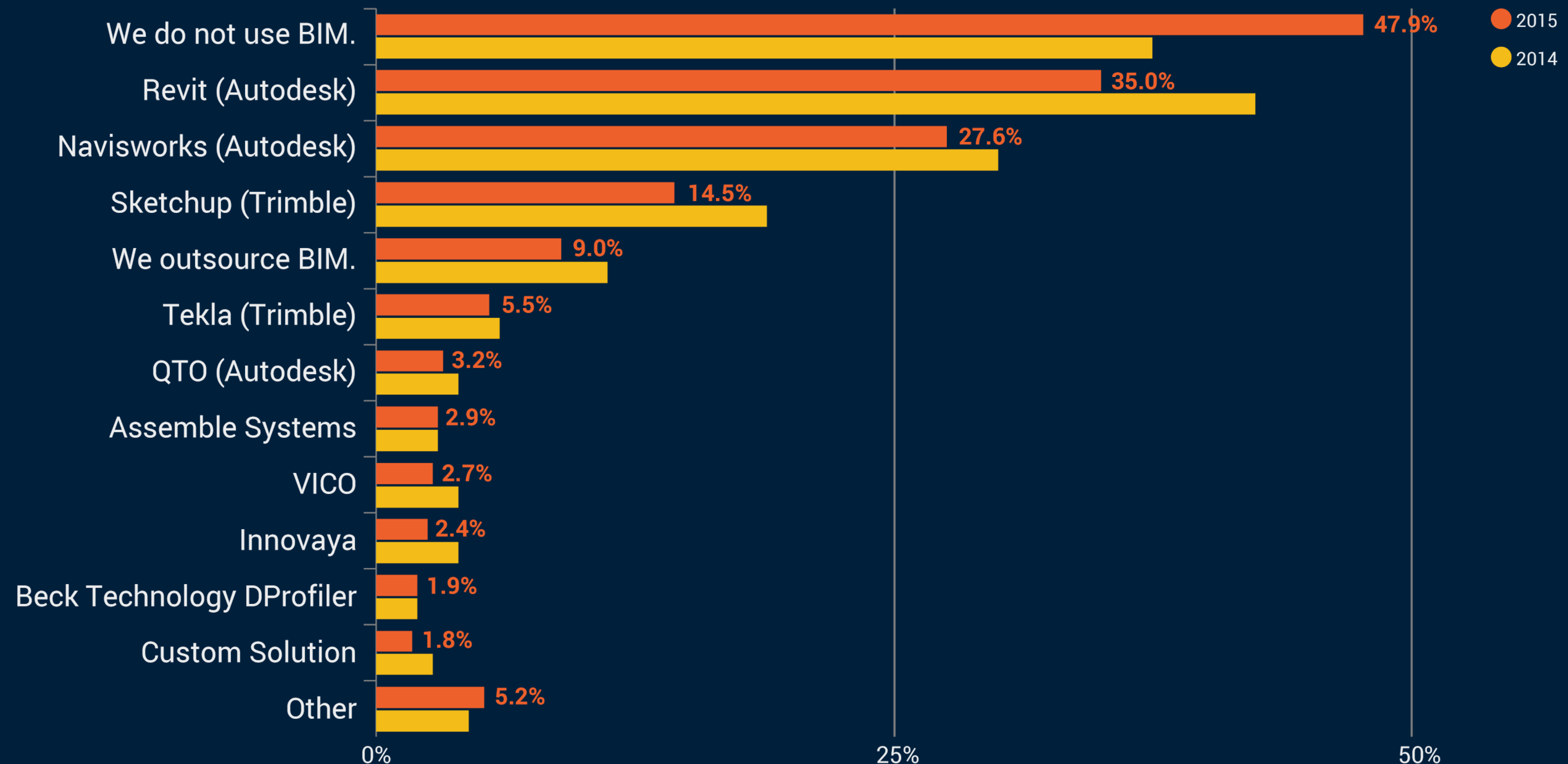
There is an irrational fear
of cloud-based solutions.

Client Relationship Management (CRM) Software



There is a huge opportunity
to improve business development
with CRM technology.

Building Information Modeling (BIM) Software



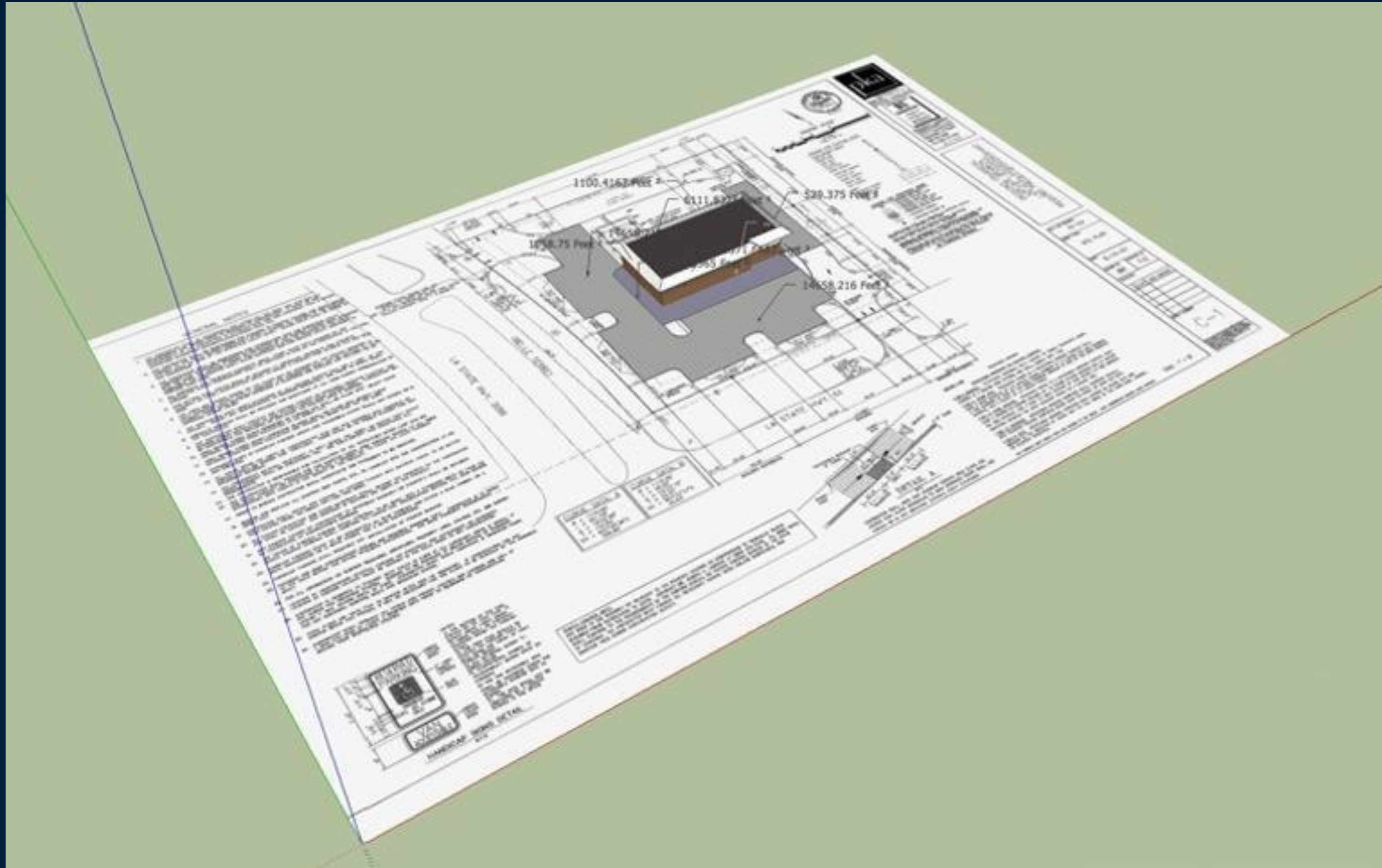
4D, 5D & 6D BIM adoption
is happening now.

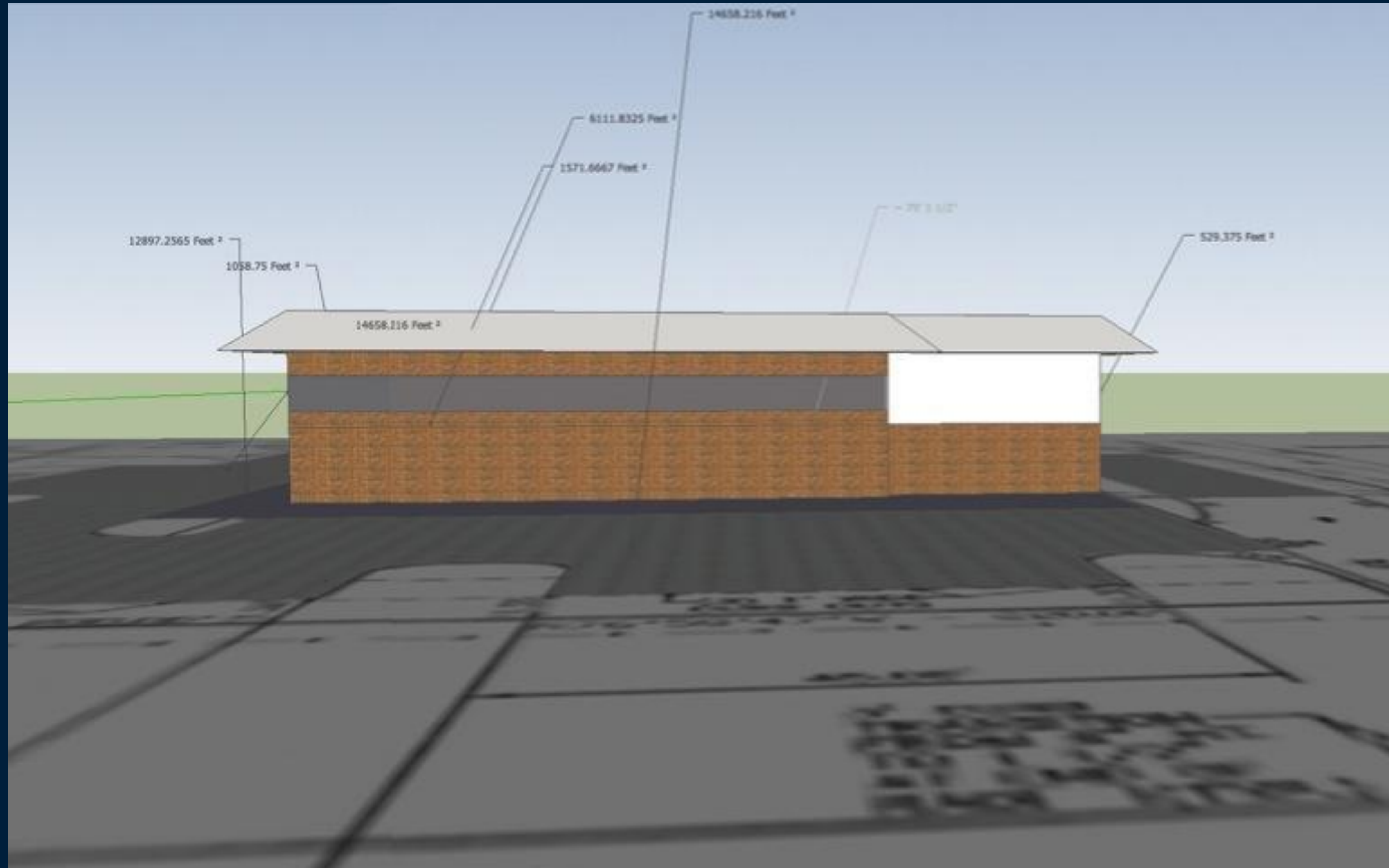


Providers like Sysque are
bringing intelligent data
and live costing to BIM

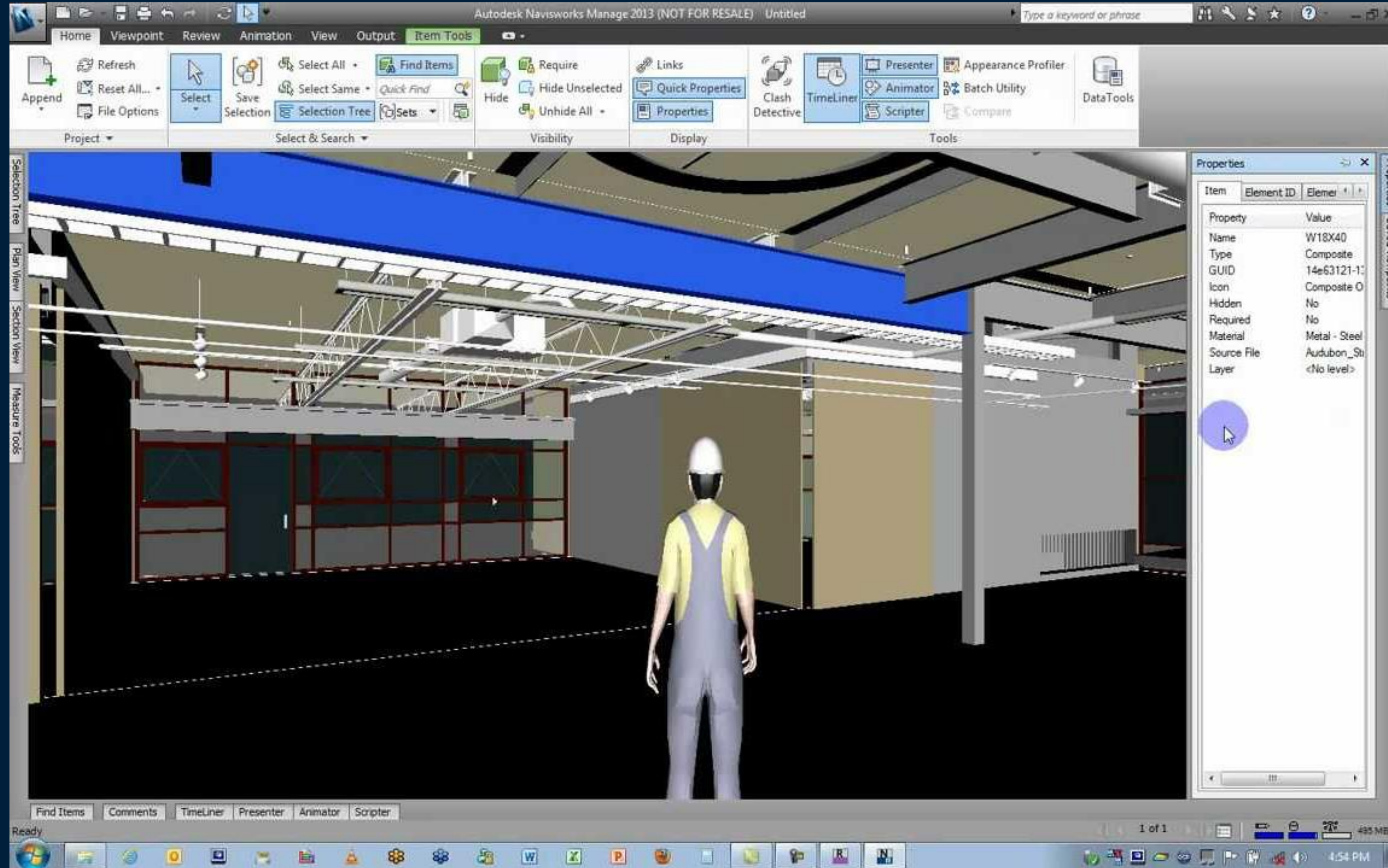
Life Safety Leads the Way



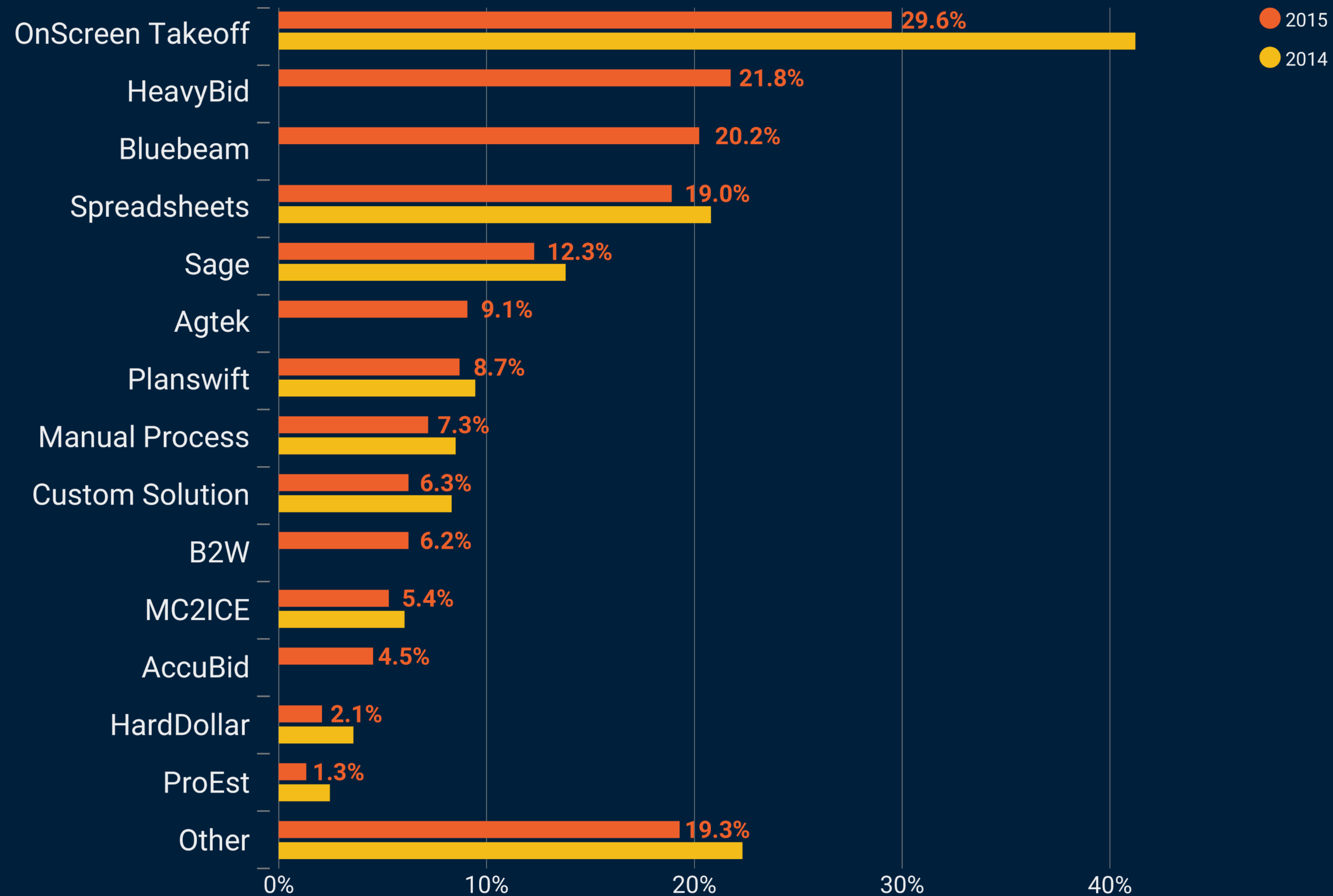






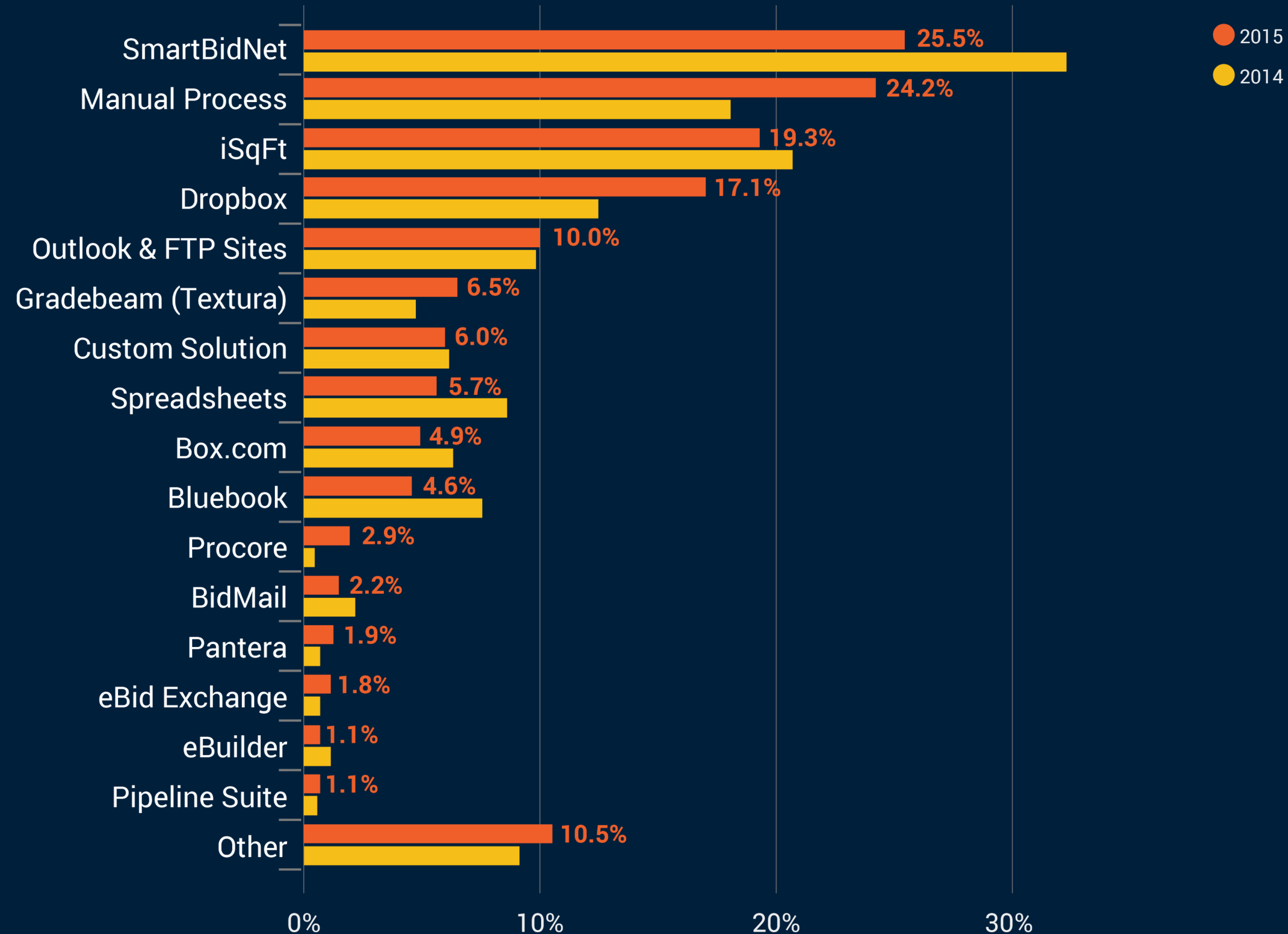


Estimating/Takeoff Software



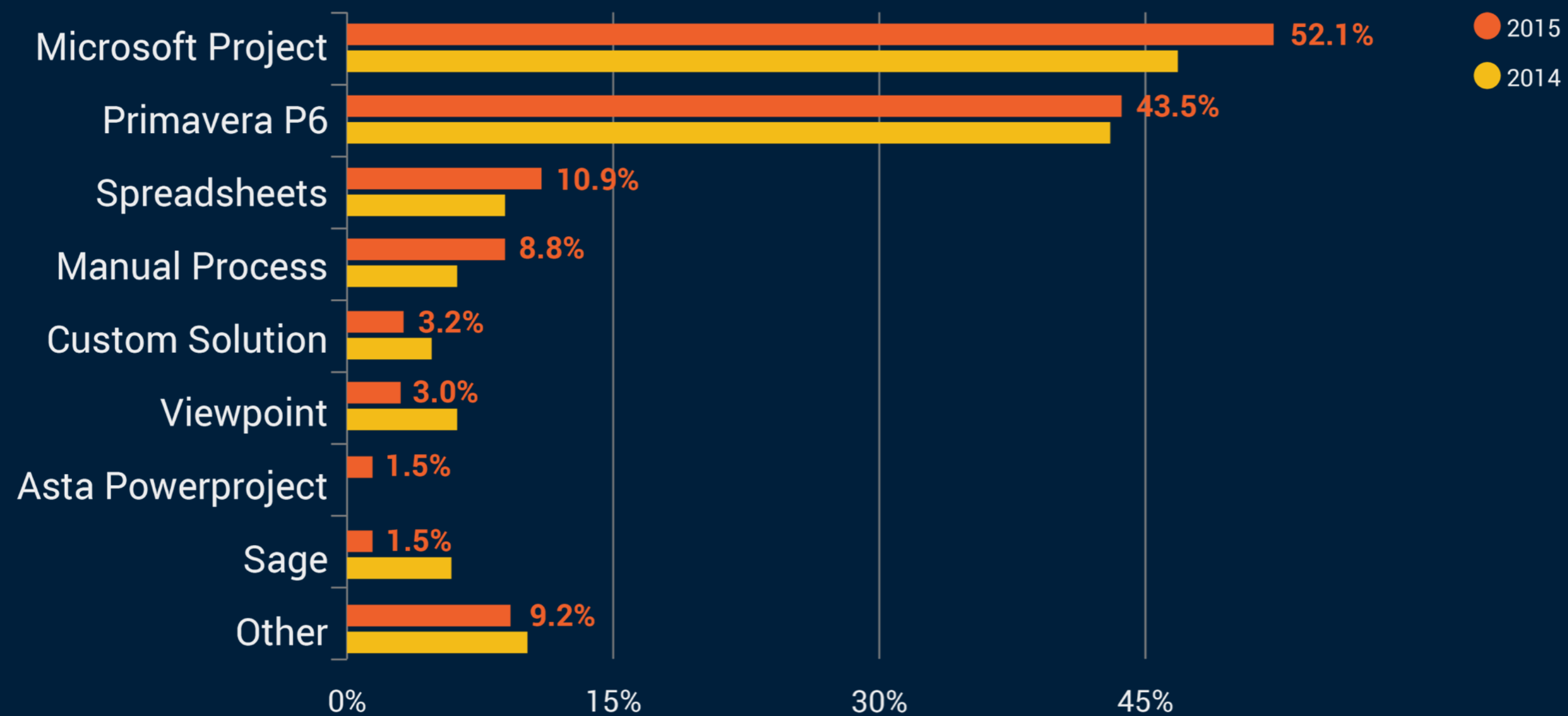
Estimating is undergoing
a fundamental change.

Invitation to Bid Software

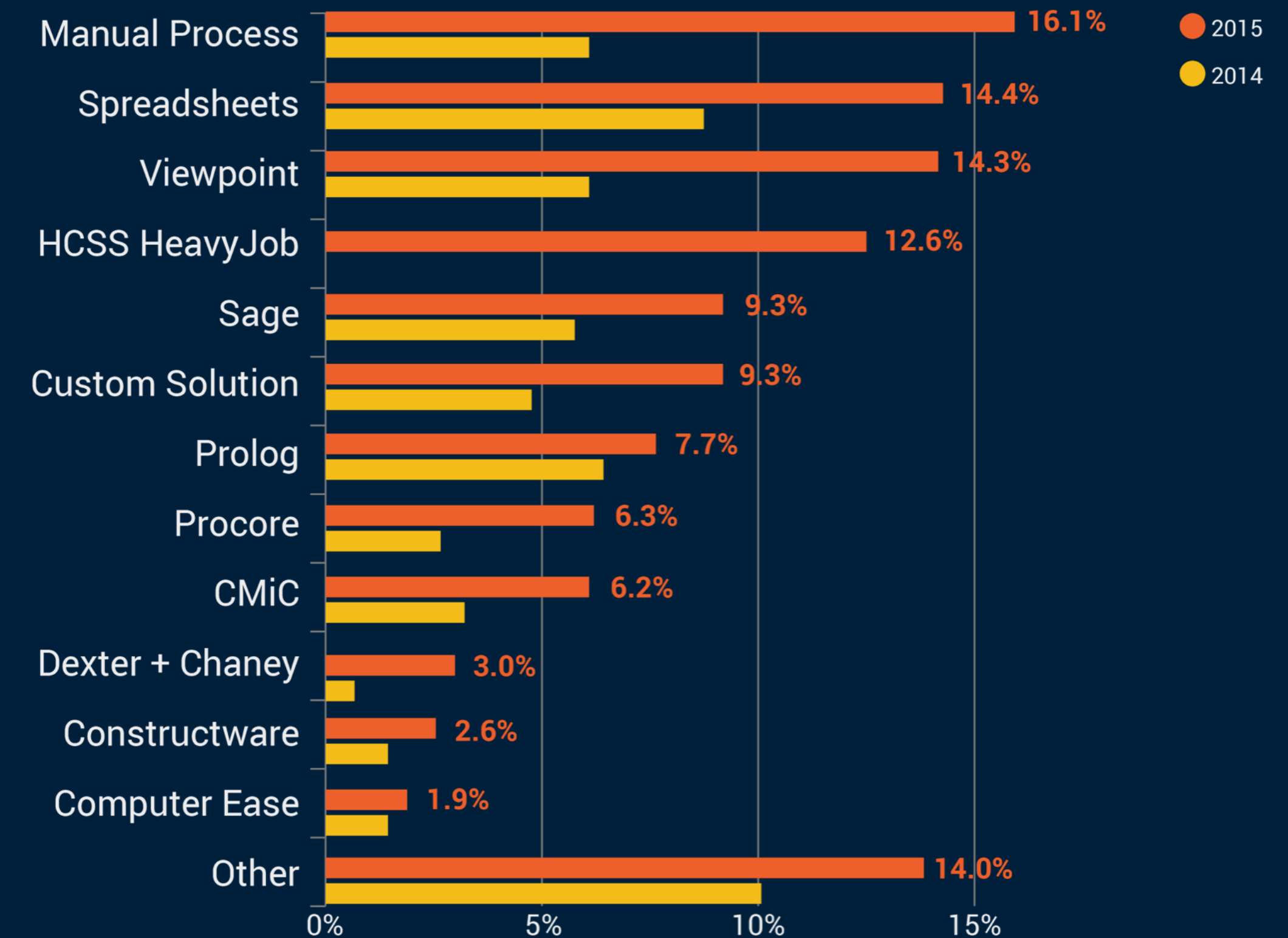


Project Scheduling & Management Software

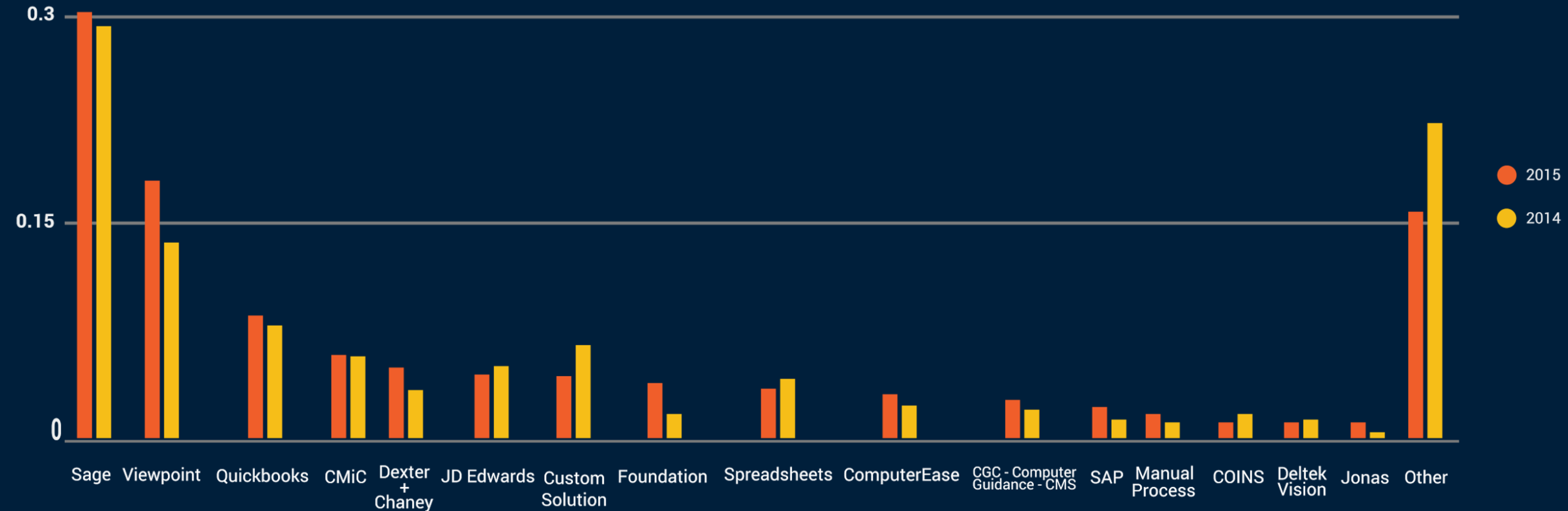
Project Scheduling



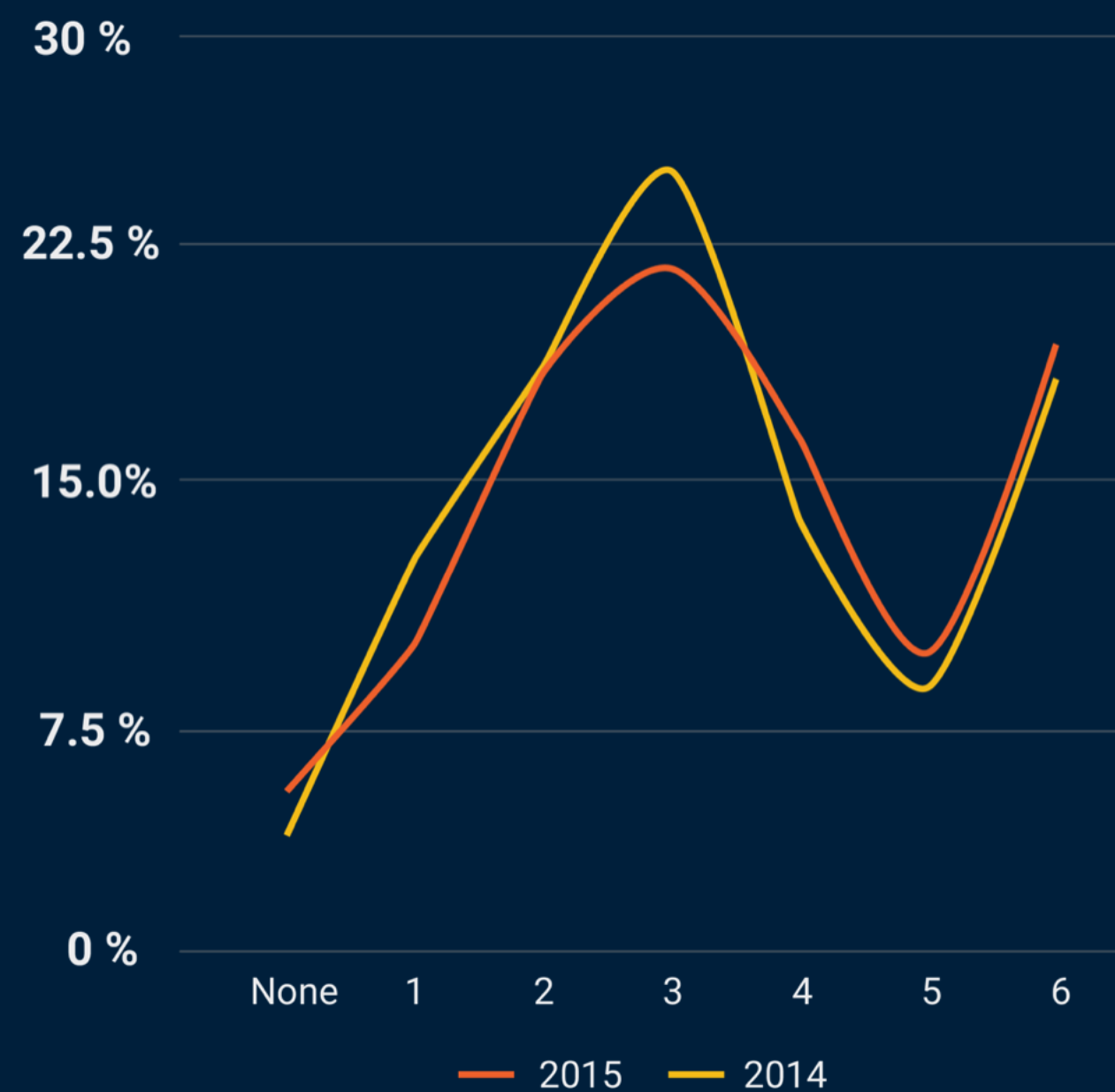
Project Management



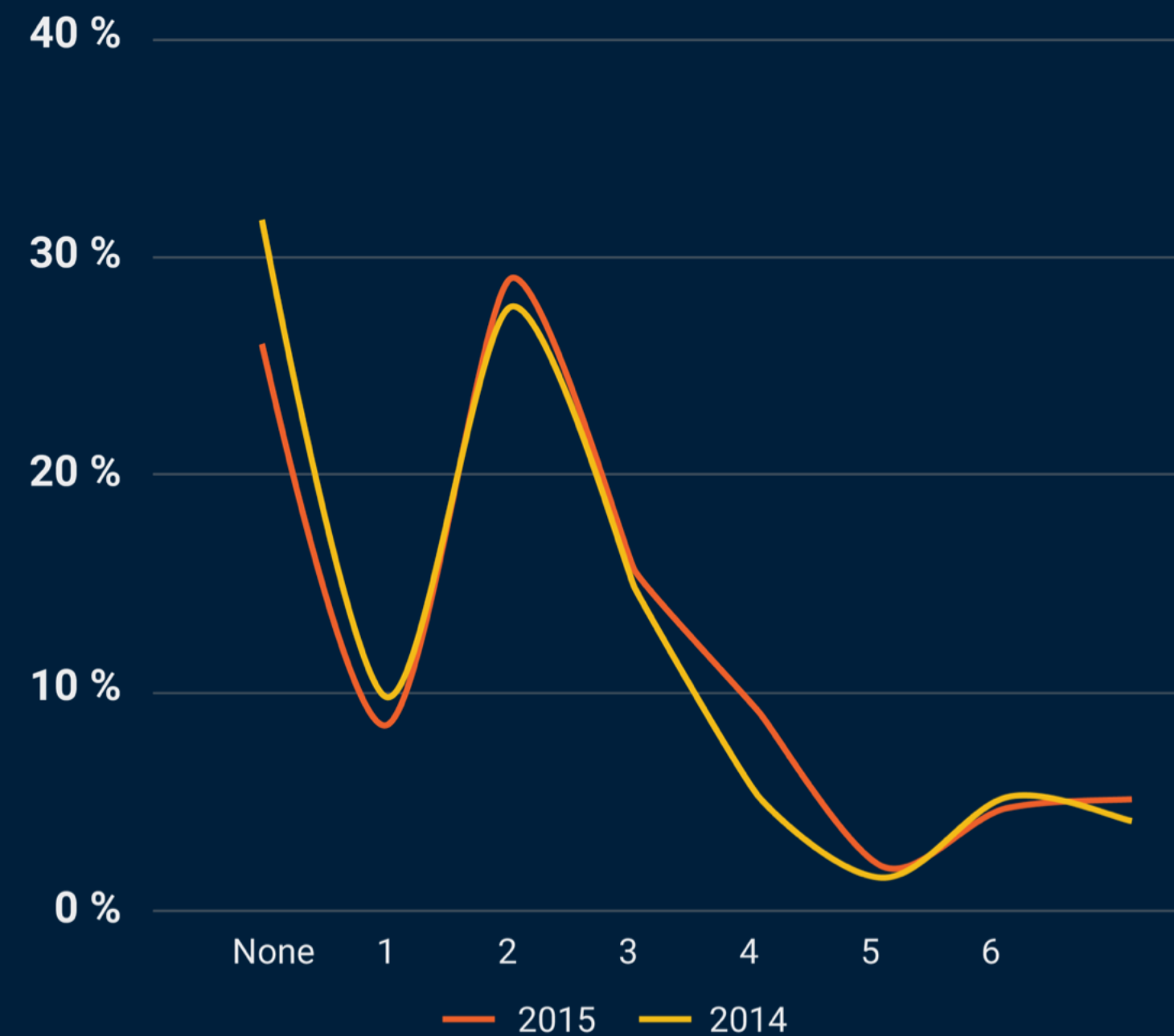
Accounting Software



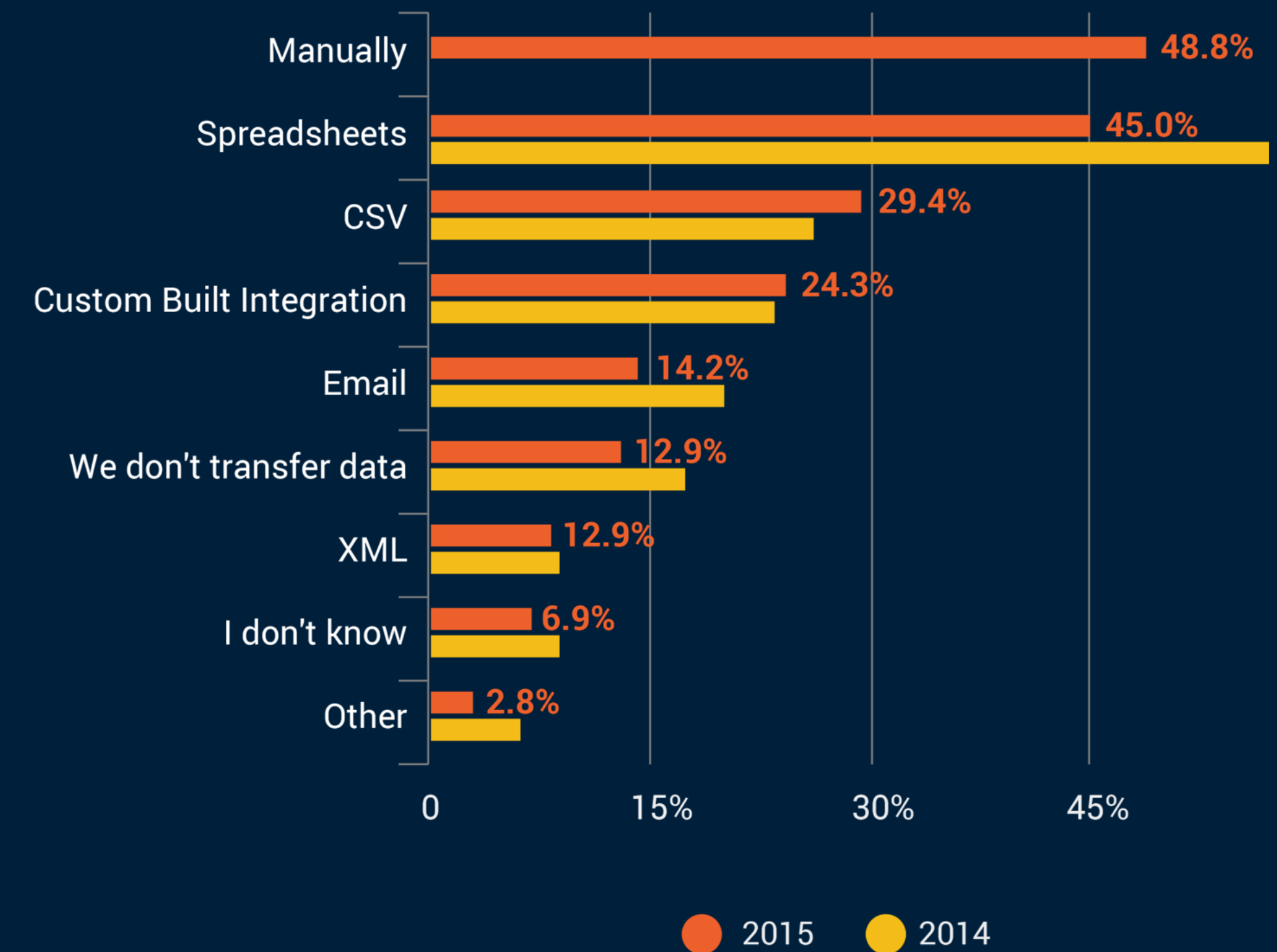
Number of Software Applications Used Daily



How many of their applications integrate?



How do they transfer data if applications don't integrate?



People and companies still depend far
too much on spreadsheets.

What are spreadsheets good for?

Ad Hoc Computation

Basic Report Analytics

Some Data Entry (let's rethink)

Why should we escape spreadsheets?

Severe Data Duplication and Validation Issues

Weak or Non Existent Version Control

Weak or Non Existent Audit Trails

Current Data Only - No good way to mine historical data

Limited Reporting and BI Capability

Weak or Non Existent Web Services for Integration

Row and Column Limitations

Weak or Non Existent Source Code and Version Control for Macros and Embedde Code

Deployment and Staging Schemes are Weak

Non Relation Flat File Storage with lack of primary and foreign keys

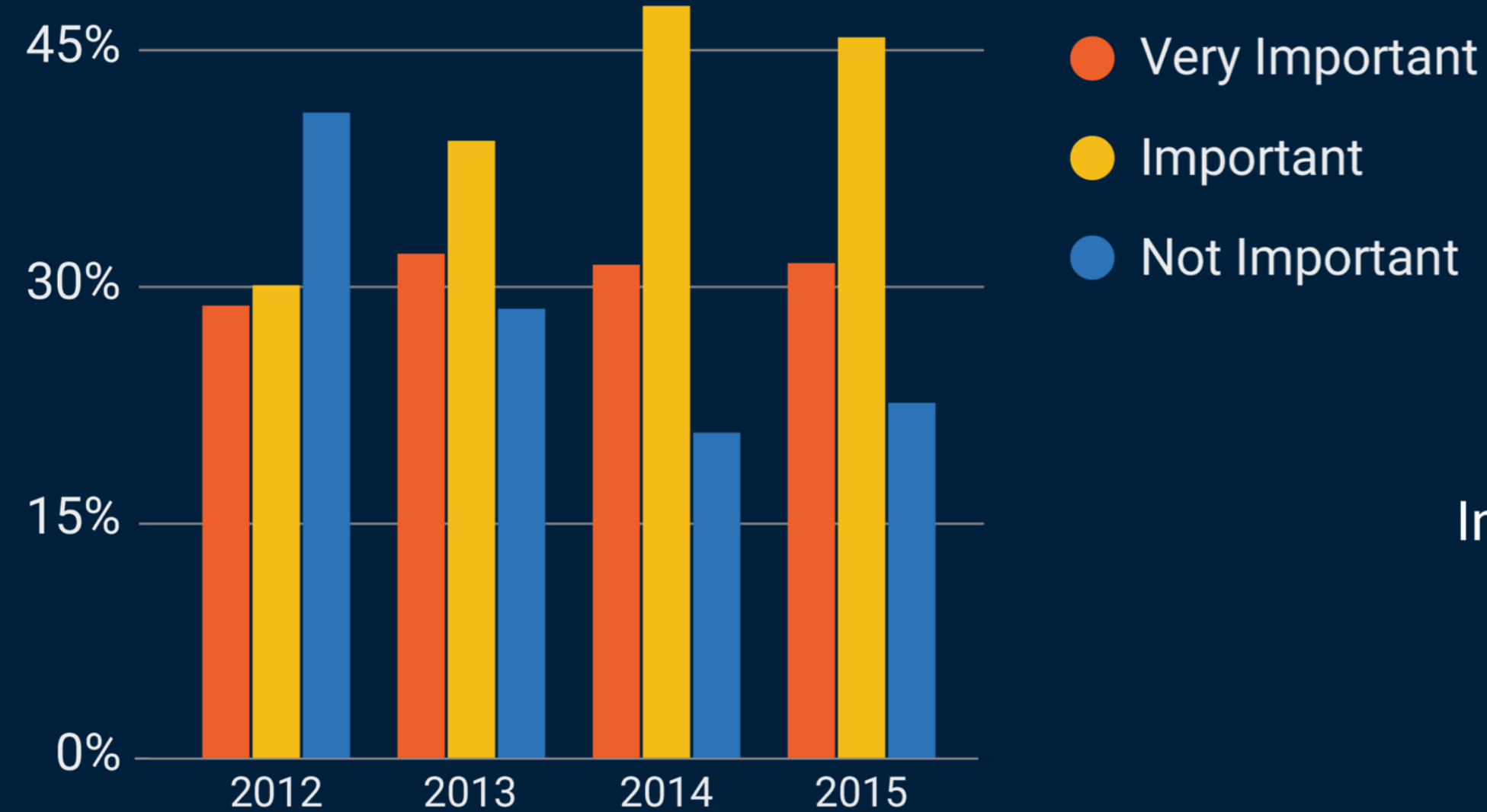
How do you start escaping spreadsheets?



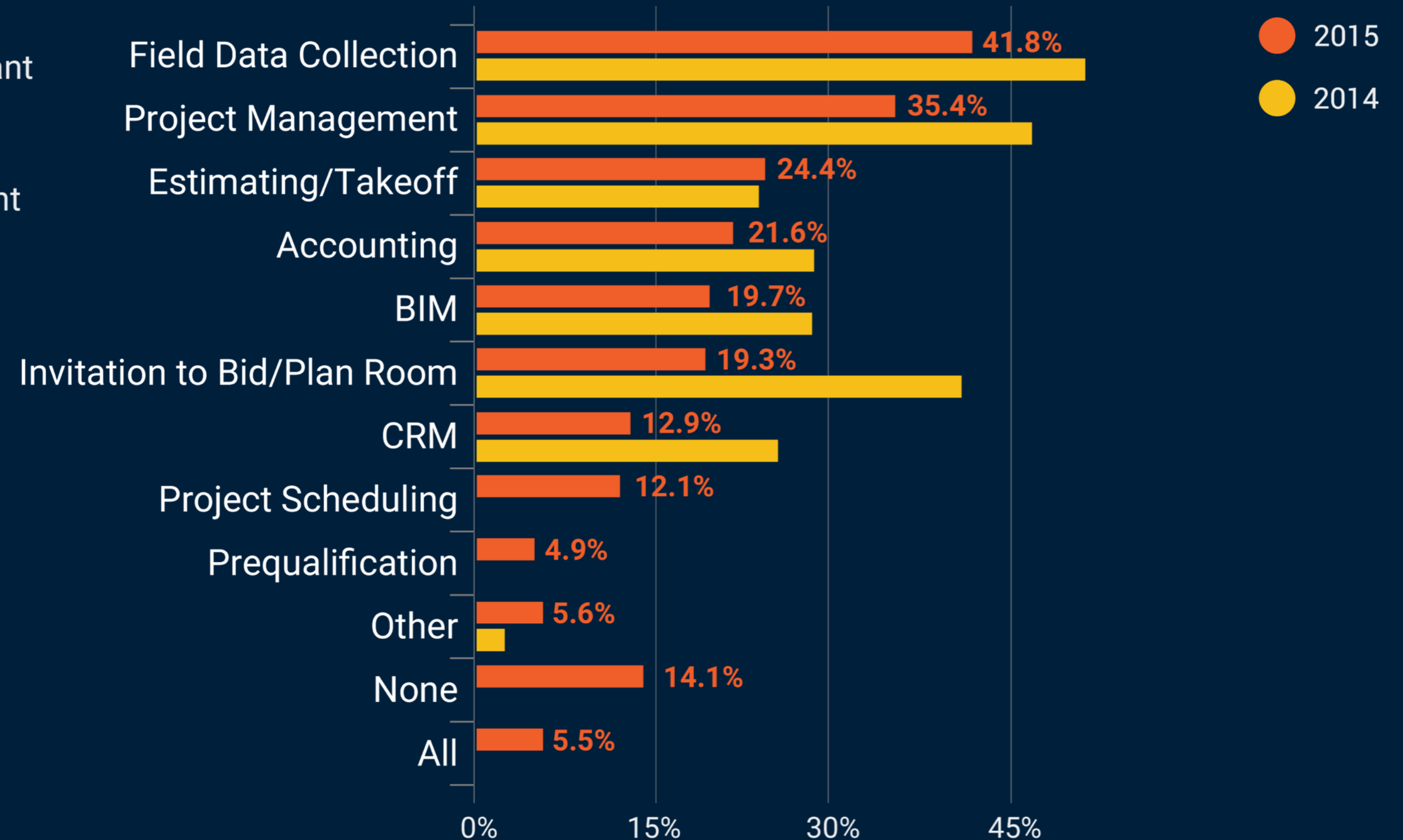
AppSheet



How important are mobile capabilities?



Software Providers That Offer Mobile Apps





2001



Mitsubishi Trium Mondo

2001



HTC Wallaby

2004



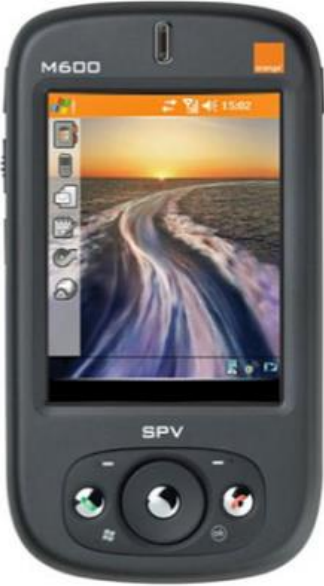
HTC Blueangel

2005



Apple-Motorola ROKR

2006



HTC Wizard

2006







LG Prada

2007



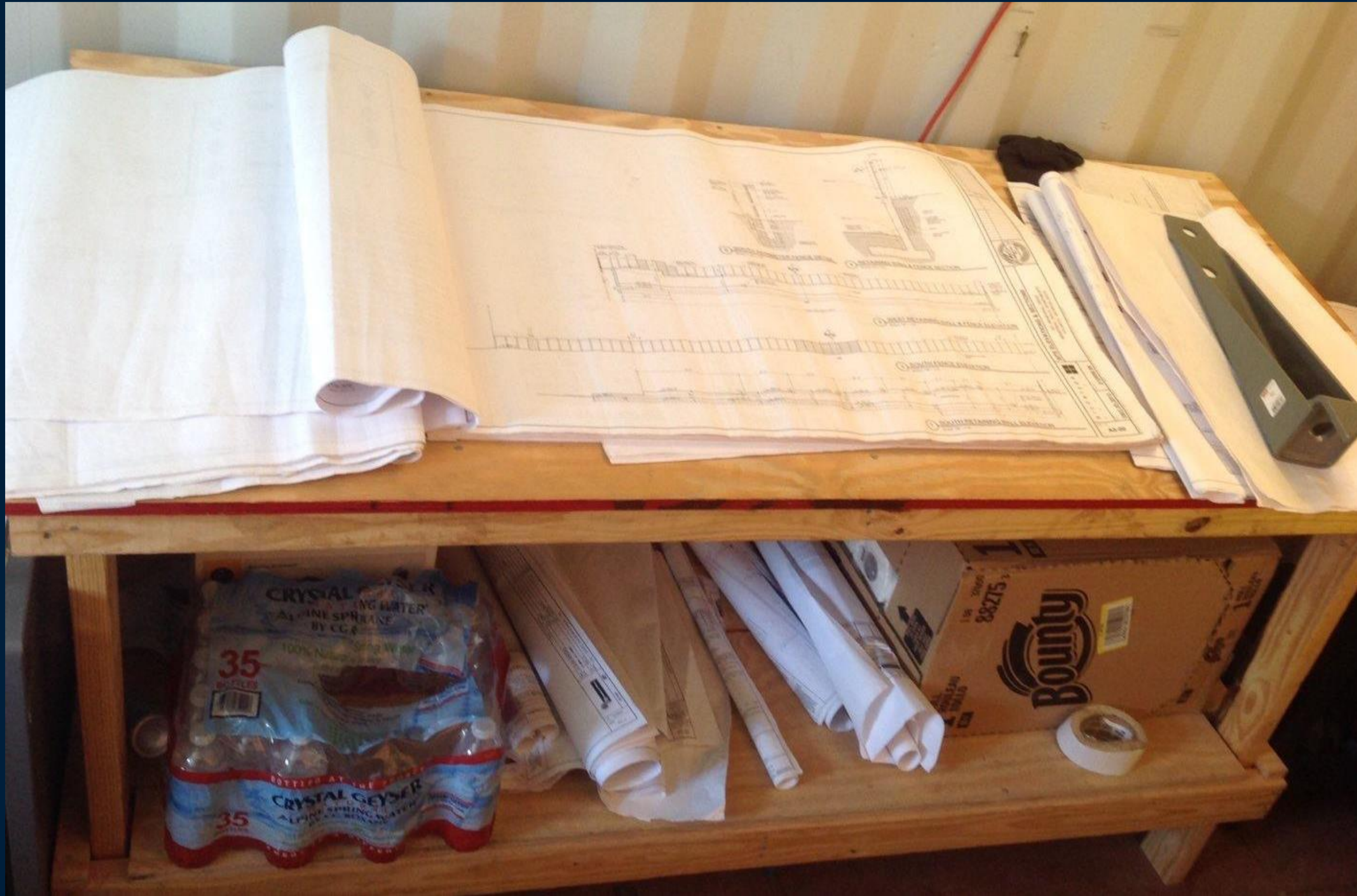
Apple iPhone 2G

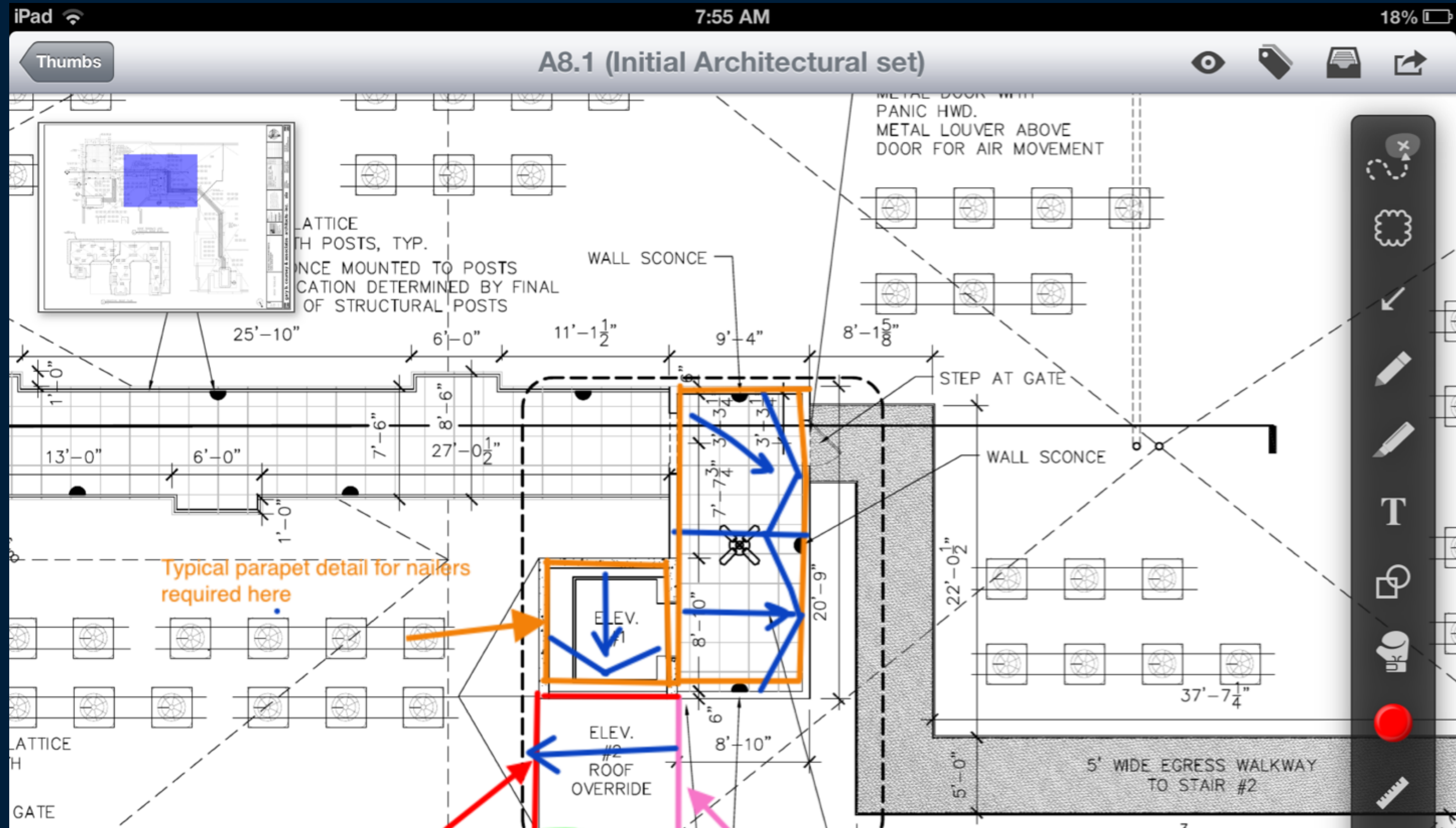
Daily Device Usage & BYOD

					
		LAPTOP	TABLET	SMARTPHONE	WEARABLE
2015	Total Personal Company	85.6% 23.3% 91%	69.4% 38.9% 74.5%	97.6% 35.9% 81.1%	9.2% 71.4% 33.3%
2014	Total Personal Company	63.9% 27.4% 86.3%	50.1% 48.8% 60.1%	72% 41.6% 72.3%	
2013	Total Personal Company	83.3% 40.6 79.2%%	53.1% 62.7% 52.2%	91.4% 48.6% 71.5%	



1. Plans (sharing, viewing, and marking up):
2. Safety (inspections, tool box talks, accident reports):
3. Photos (progress, safety, and RFI's):
4. Daily Reports (manpower, delays, and deliveries):
5. Notes (job notes, mark ups, etc):
6. Time Entry (employee hours and equipment hours):
7. Scheduling (Creating, Distributing and Updating):
8. RFI (Creating, Distributing and Updating):
9. Punch List(Creating, Distributing and Updating):
10. BIM (Creation, Collaboration and Distribution):





PRELIMINARY
Internal review
This drawing is not to be used for construction or other purposes without the written approval of the architect.

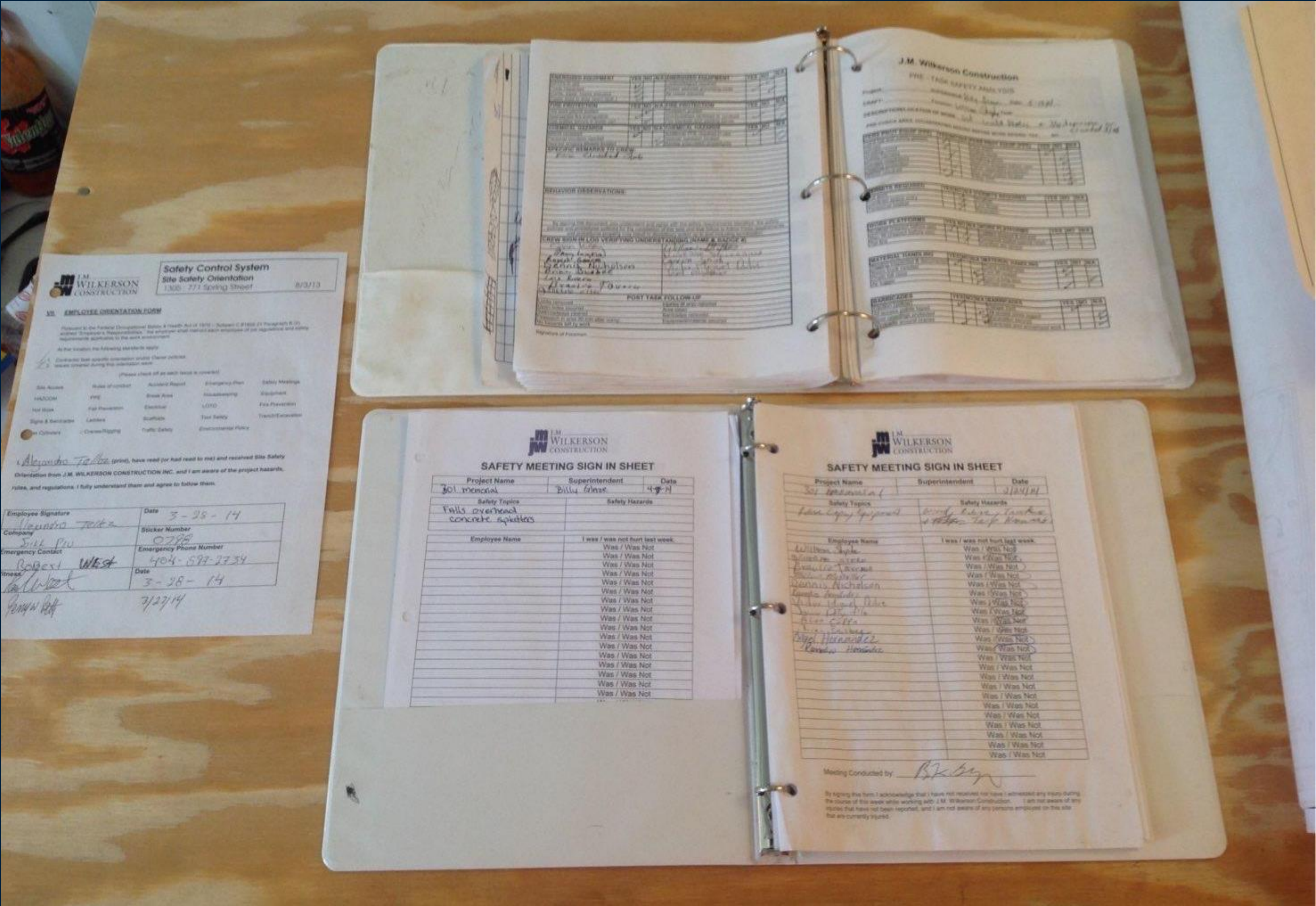
Texas A&M University Soil and Crop Science
Scott's Miracle-Gro Facility
For Lawn and Garden Research

NOTES
1. See "Notes" section of the drawing for details.
2. See "Notes" section of the drawing for details.
3. See "Notes" section of the drawing for details.

Layers:
demo 5
+ ADD LAYER
John Smith
demo 1
internal
shared

Toolbar:
Undo Redo Shapes Measure Insert

Bottom Bar:
Workspace View Info Settings Help














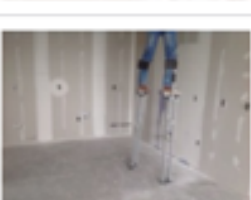








iPad 2:49 PM 66%

Gallery

Gallery > Device > Rob McKinney iPad



1316_675 North Ave_Rob McKinney iPad_2014-02-25

1311_301-399 Harden St SE, Atlanta_Rob McKinney iPad_2014-02-20

1311_301-399 Harden St SE, Atlanta_Rob McKinney iPad_2014-02-20

1311_301-399 Harden St SE, Atlanta_Rob McKinney iPad_2014-02-20

1311_301-399 Harden St SE, Atlanta_Rob McKinney iPad_2014-02-18

1311_301-399 Harden St SE, Atlanta_Rob McKinney iPad_2014-02-18

1311_301-399 Harden St SE, Atlanta_Rob McKinney iPad_2014-01-31

1302-66_575 Ponce de Leon Ave NE, Atlanta_Rob McKinney iPad_2014-01-28

Sync all

Start a Report

Import a Photo

Delete Photo

Settings

Send Feedback

Help

Everything's up to date.

WILKERSON CONSTRUCTION

Quality Control System Form QCS-F-4
Subcontractor Daily Report

Company Name		Weather		Employee Name	Date
Job		Foreman	Journeyman		
Crew Size					
Accidents Reported?					
Yes / No					
Actions Today:					
Materials Received:					
Equipment Rented:					
Things that impacted your job today:					
Things that helped your job today:					
Print Name		Title			
Sign Name		Date			





BLANK DAILY FORMS

iPad

1:45 PM

60%

← Kyle Slager is talking



Chrome

File Edit View History Bookmarks Window Help

11

100%

Fri 10:45 AM

Kyle Slager

Dashboard - Whiting-Turner

Preview Mode - InVision

JMWilkerson.com - current

Rob McKinney, LEED AP BD

whiting-turner.rakenapp.com

Apps Amex Chase WF HSA BCBS sdge cox USAir Geico TDA Mint Surf FB Twit Fin TBP WIMBIO Yahoo Flurry

Whiting-Turner Demo User Support

WT

News Feed Projects

Search


Accidents2


Delays1


Missed Reports59


Open Tasks2


Activity Feed

 Demo User 01/03/2014 10:46 AM added subcontractor for La Jolla Commons 01/03/2014
4 workers from ARB - "Continued Miscellaneous cleanup and punchlist items."


 Demo User 01/03/2014 10:46 AM added subcontractor for La Jolla Commons 01/03/2014
6 workers from C&I Roofing - "Continued to load roof pavers to the roof and roofing of the penthouse."

 Demo User 01/03/2014 10:46 AM added subcontractor for La Jolla Commons 01/03/2014
0 workers from American Stair - "No work today"

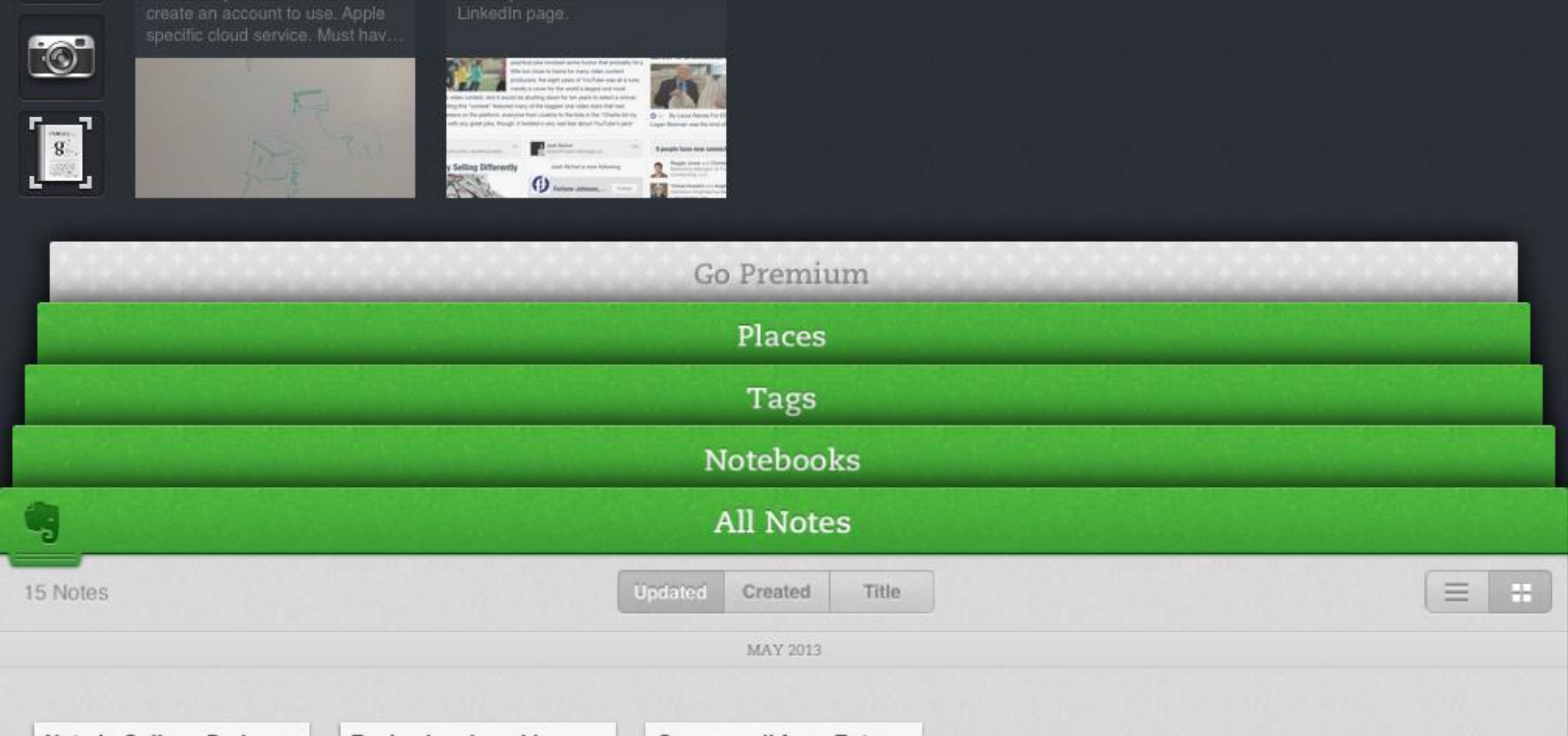
 Demo User 01/03/2014 10:46 AM added subcontractor for La Jolla Commons 01/03/2014
2 workers from Courtney - "Installed vertical and horizontal water tops on 8 line."

 Demo User 01/03/2014 10:46 AM added subcontractor for La Jolla Commons 01/03/2014
3 workers from Diggin It - "Exported spoils and installed irrigation sleeves at executive."

You have successfully logged into your Raken account at whiting-turner.rakenapp.com and can start managing your projects.







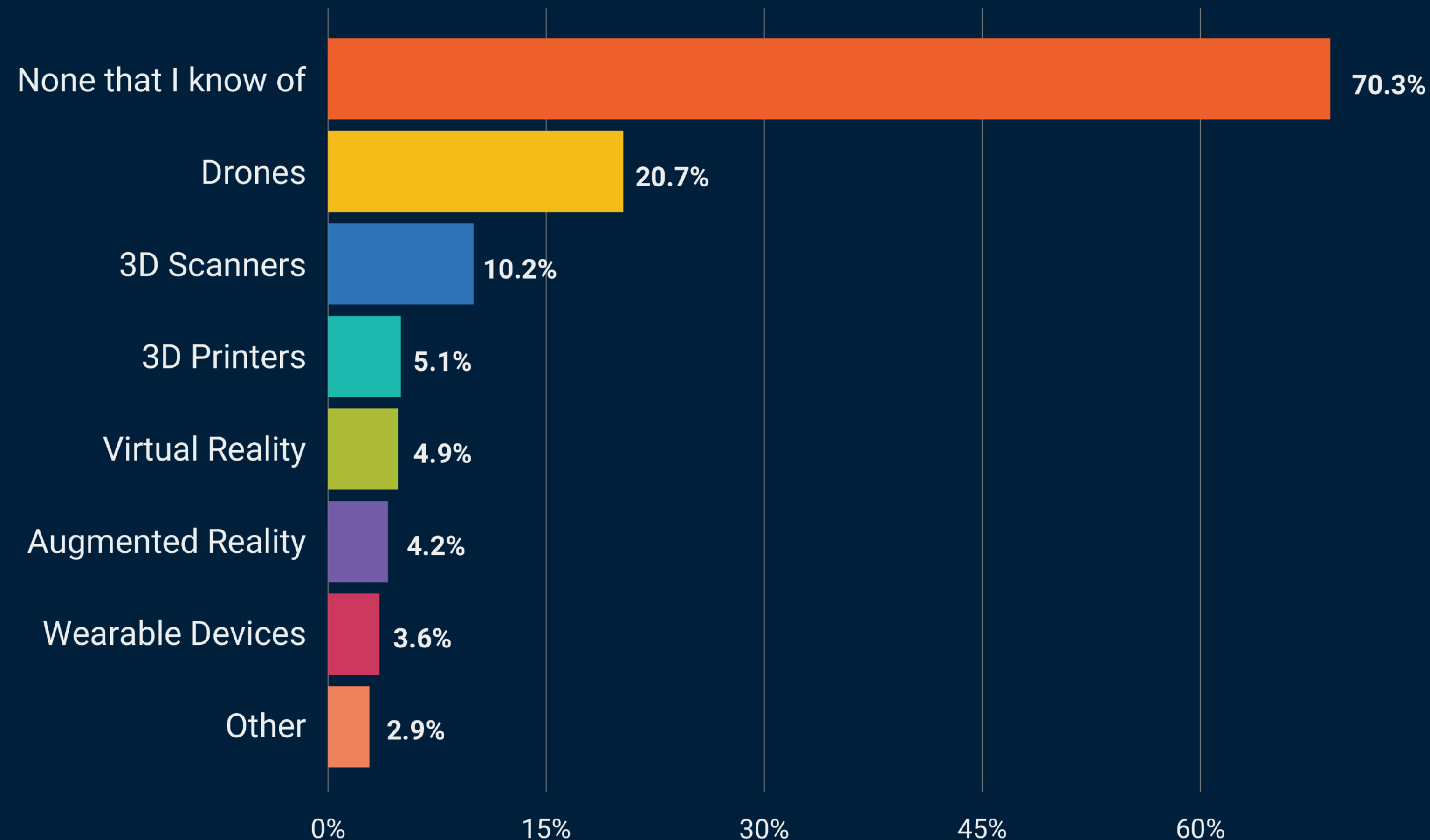


@ConAppGuru Top Mobile Apps



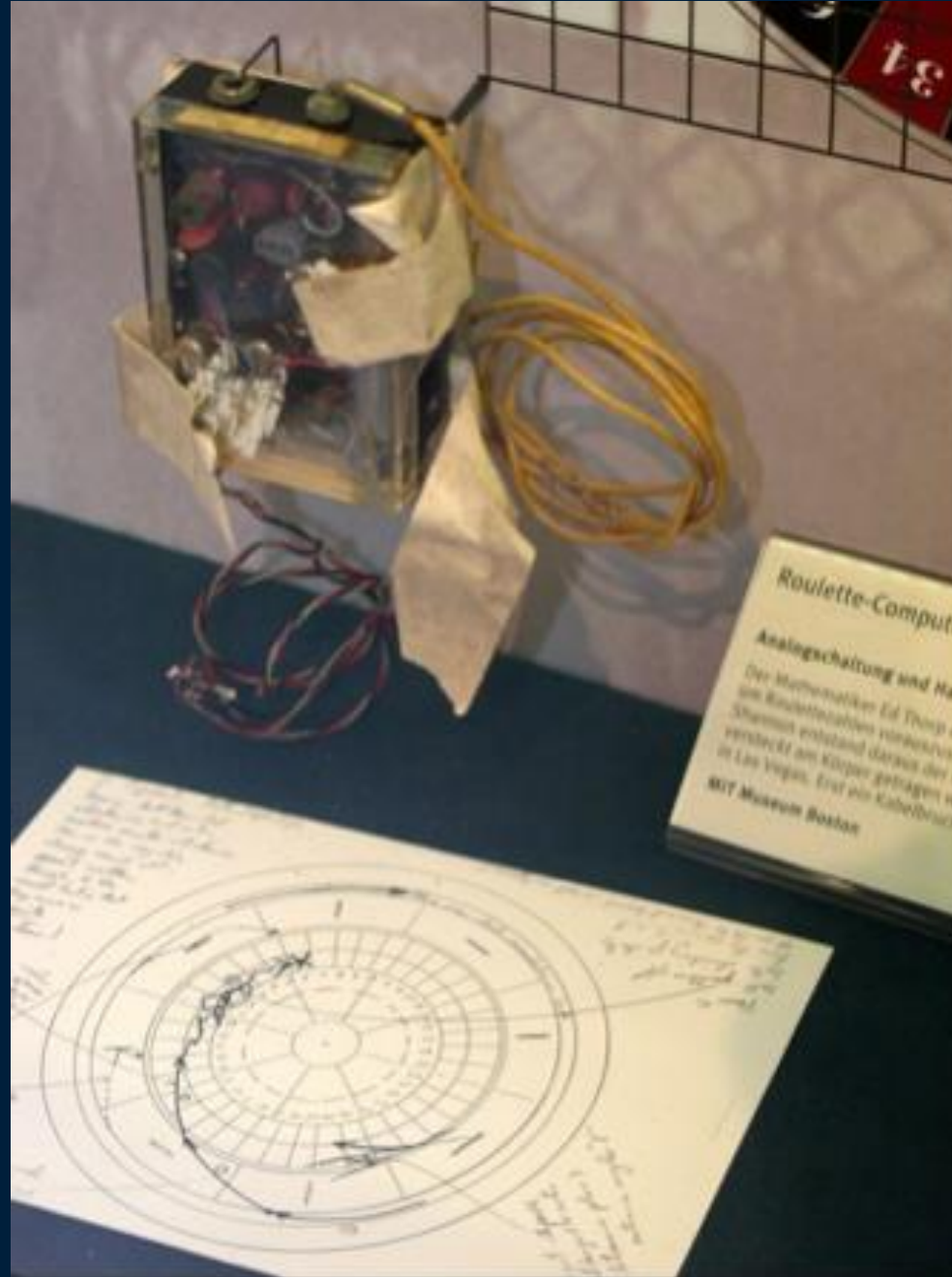
Mobile adoption is happening
now and very quickly.

What technologies are builders experimenting with?





(Brief) History of Wearable Technology



Edward Thorp
Roulette Computer
1960s

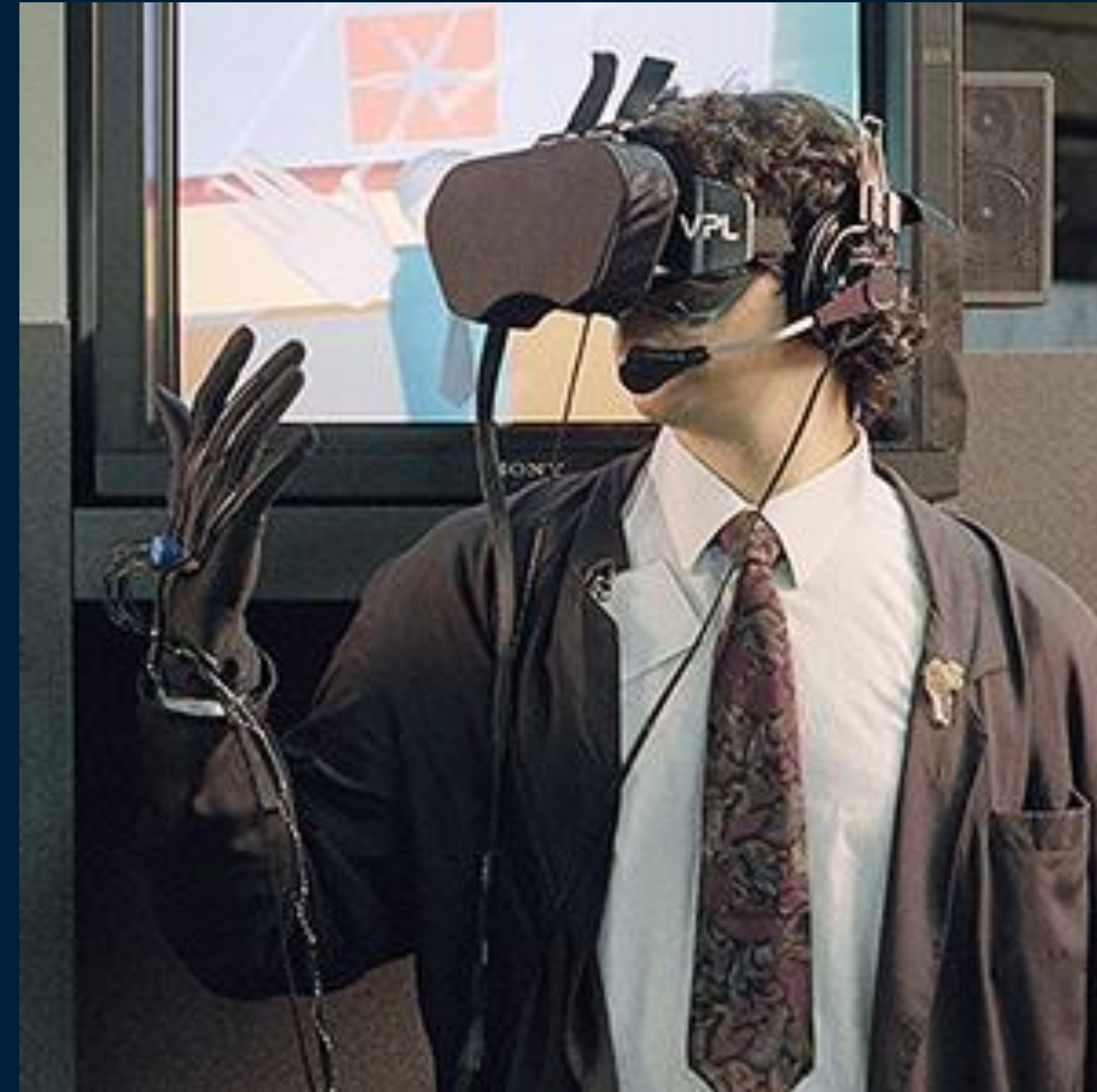
Steve Mann's "wearable computer" and "reality mediator" inventions of the 1970s have evolved into what looks like ordinary eyeglasses.



Steve Mann's Wearable Computer
wearcam.org



Calculator Watches
1980s



The EyePhone (\$100,000)
Jaron Lanier VPL 1989

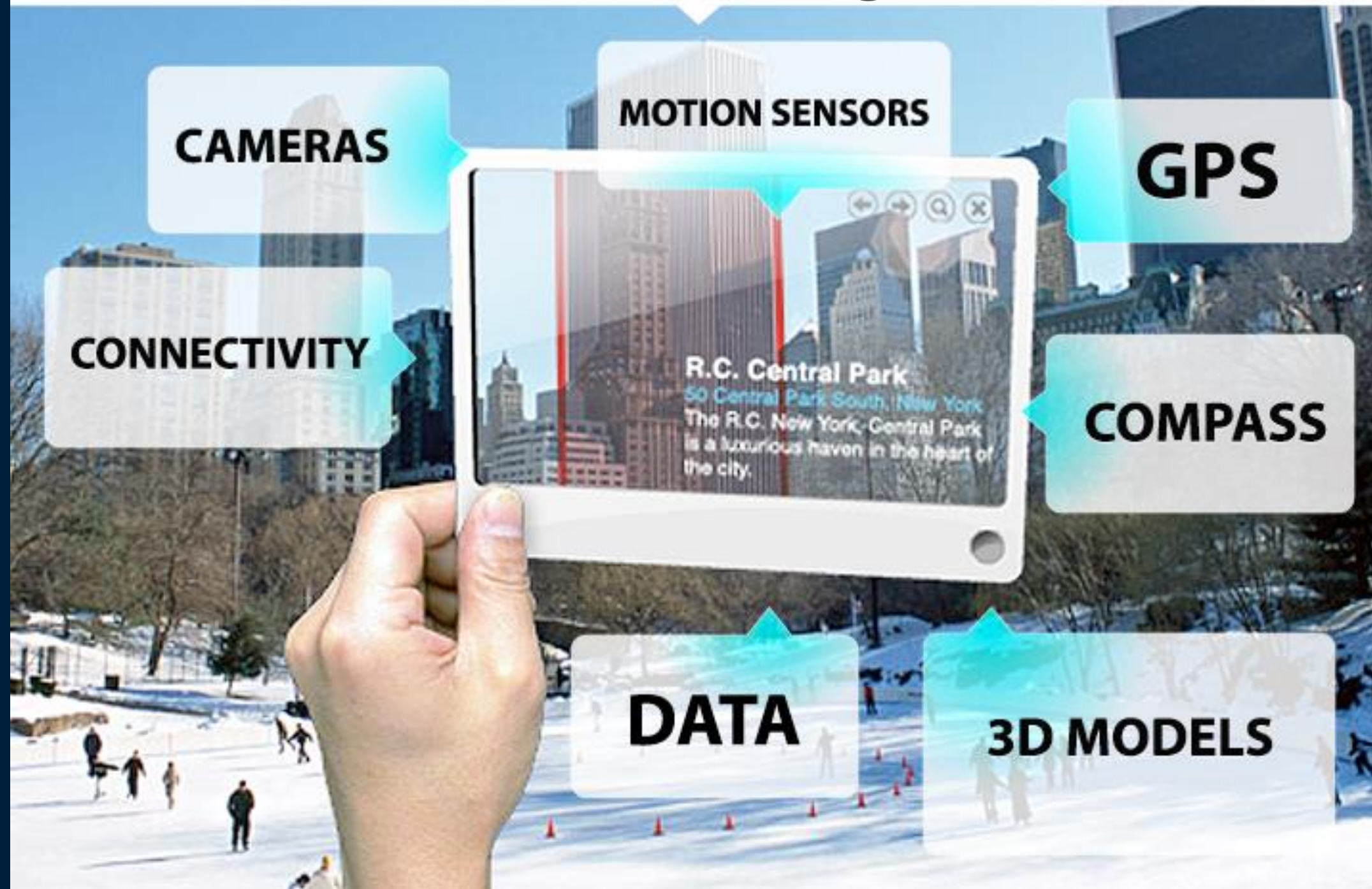


Visual

Sensing

Tactical

What is enabling this?

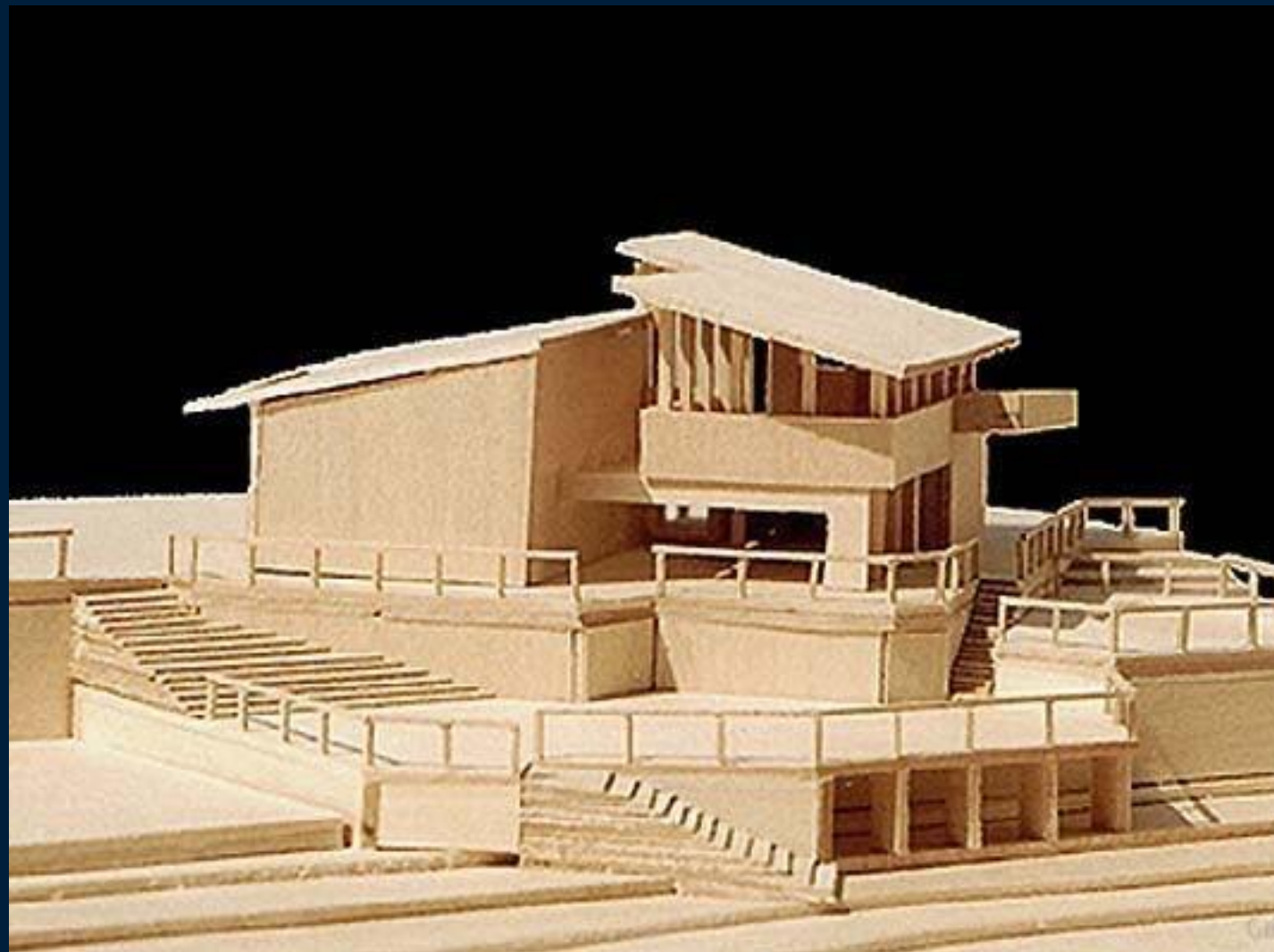


AR = Visual Overlay

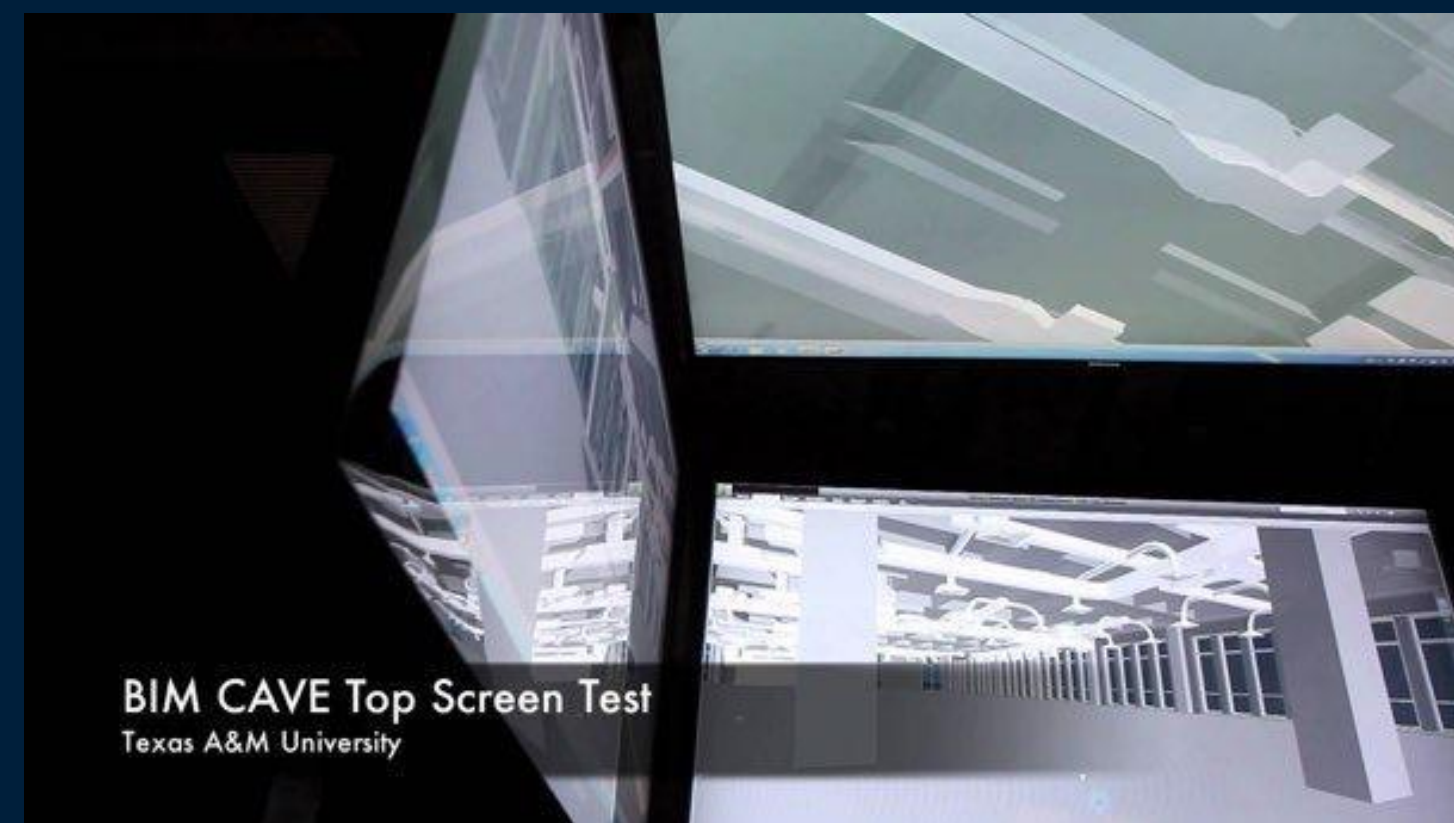
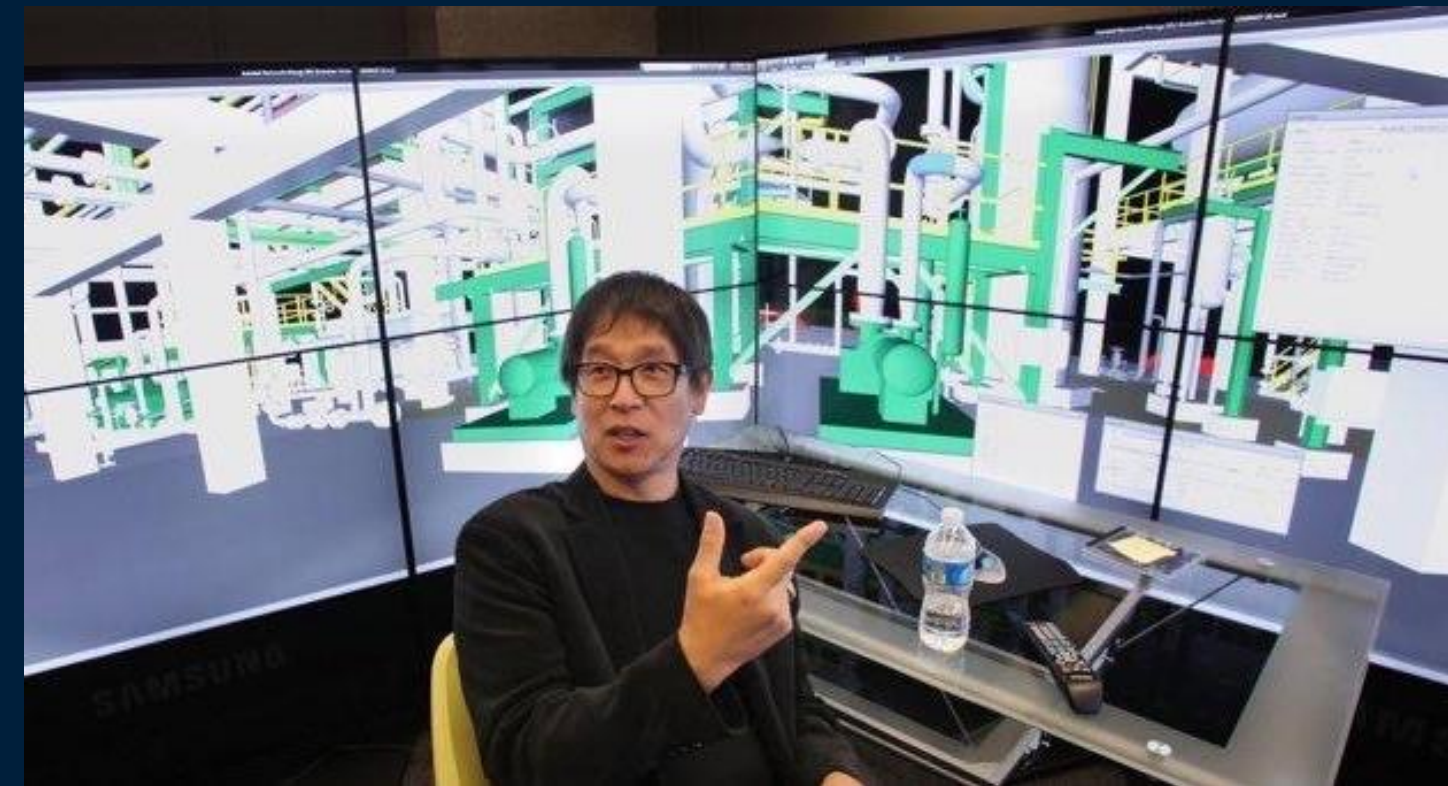
VR = Presence

Mixed Reality = Both

Life Before AR, VR, Wearables - Balsa Wood Models



Life Before AR, VR, Wearables - BIM Caves



Are augmented and virtual reality solutions in search of a problem?



USE CASE 1

AEC professionals use AR and VR to show how things should be built.

USE CASE 2

Contractors, developers and architects use AR to more easily pitch new projects.



USE CASE 3

AEC professionals take schedules to the field to find problems much earlier



LEAP
MOTION



Oculus

EPSON®



Google Glass



Google Glass, Myo & Bridgit



Julian Kang - Texas A&M

DAQRI Smart Helmet

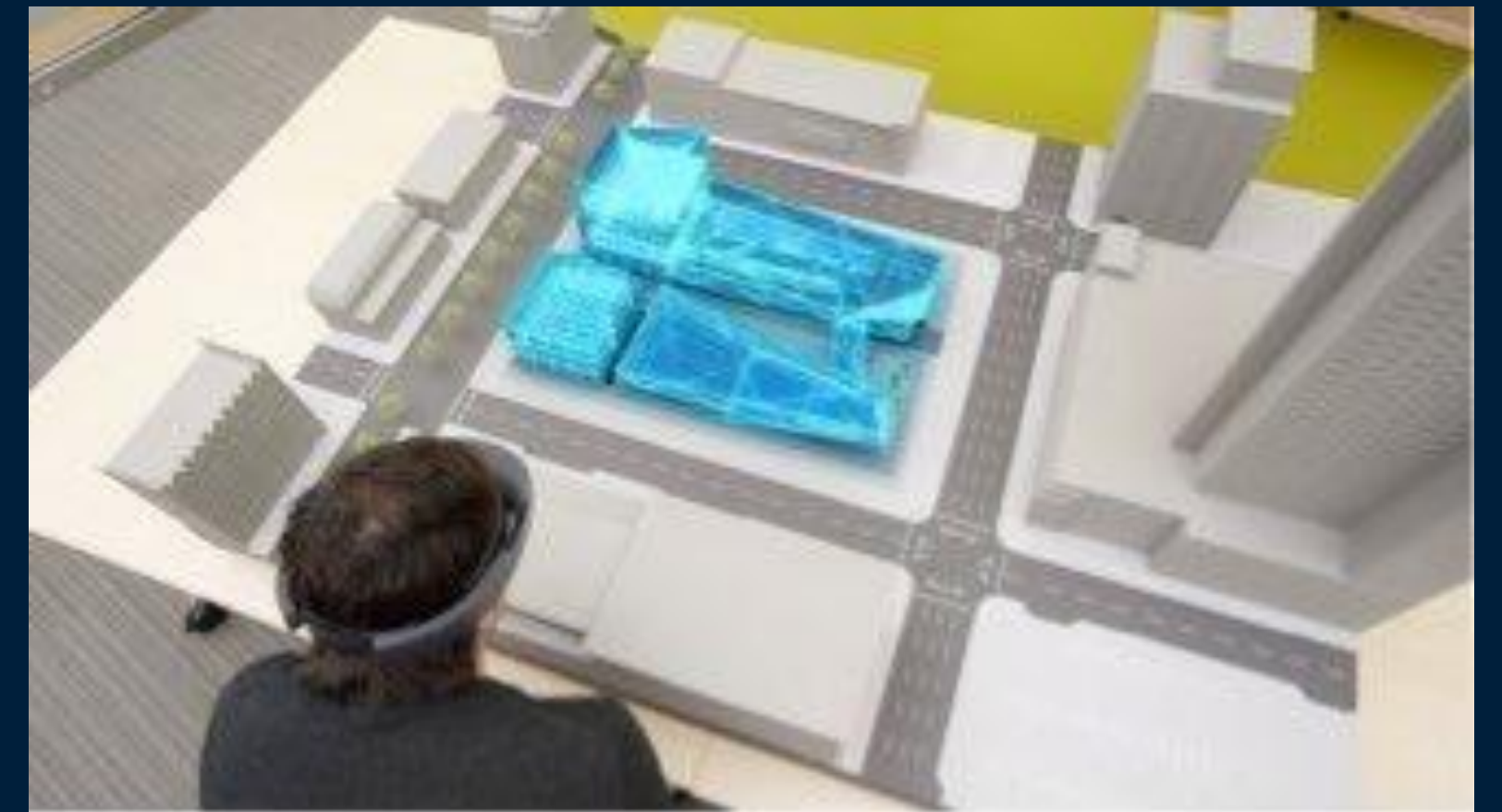


DAQRI Smart Helmet

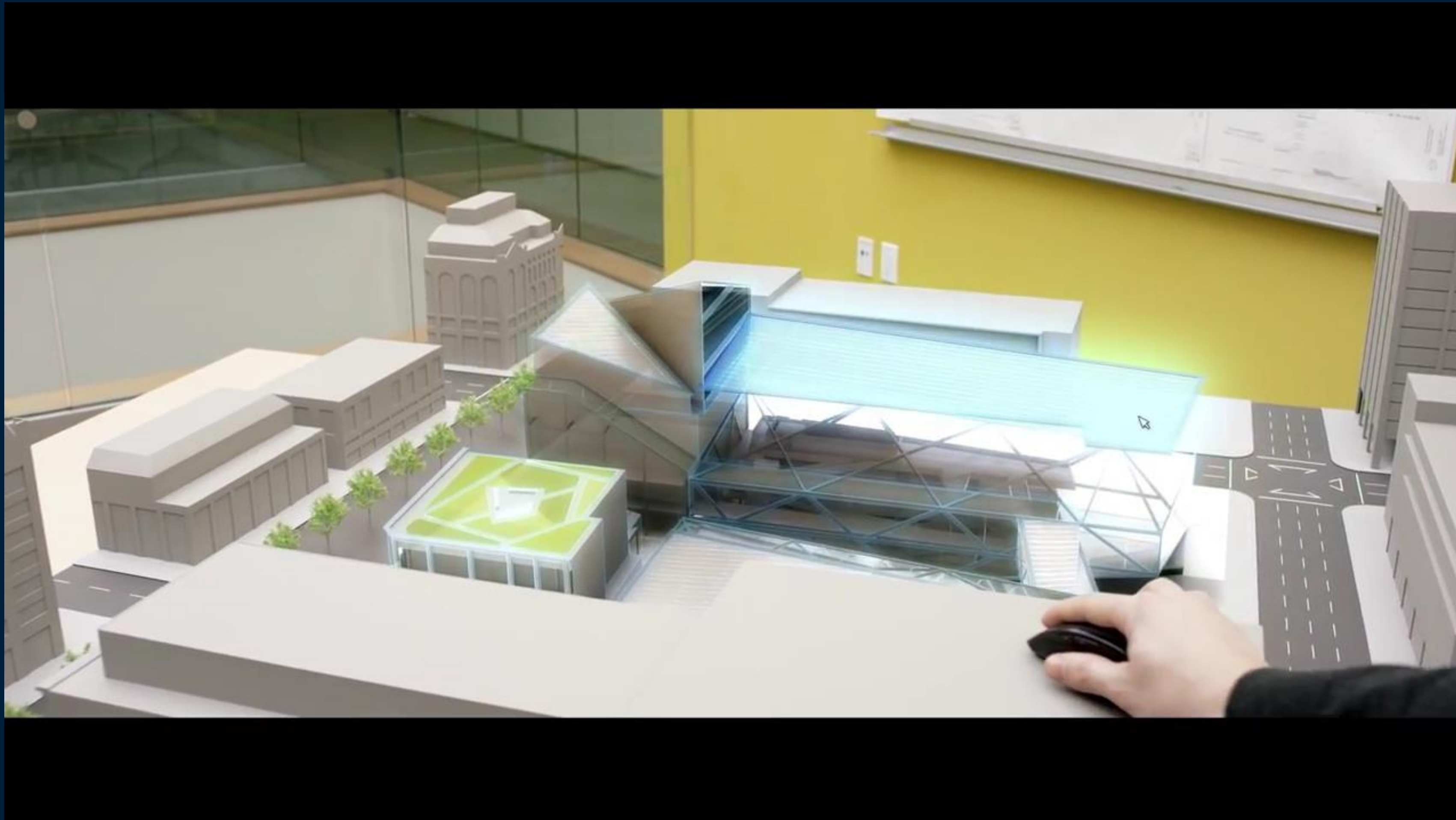
True 4D™ display:
Make the world
your screen



Microsoft Hololens



Trimble & Microsoft Hololens



Magic Leap



How do we build, scan and track these environments?

FARO



Project Tango From ATAP



Project Tango

Project Tango by MatterPort

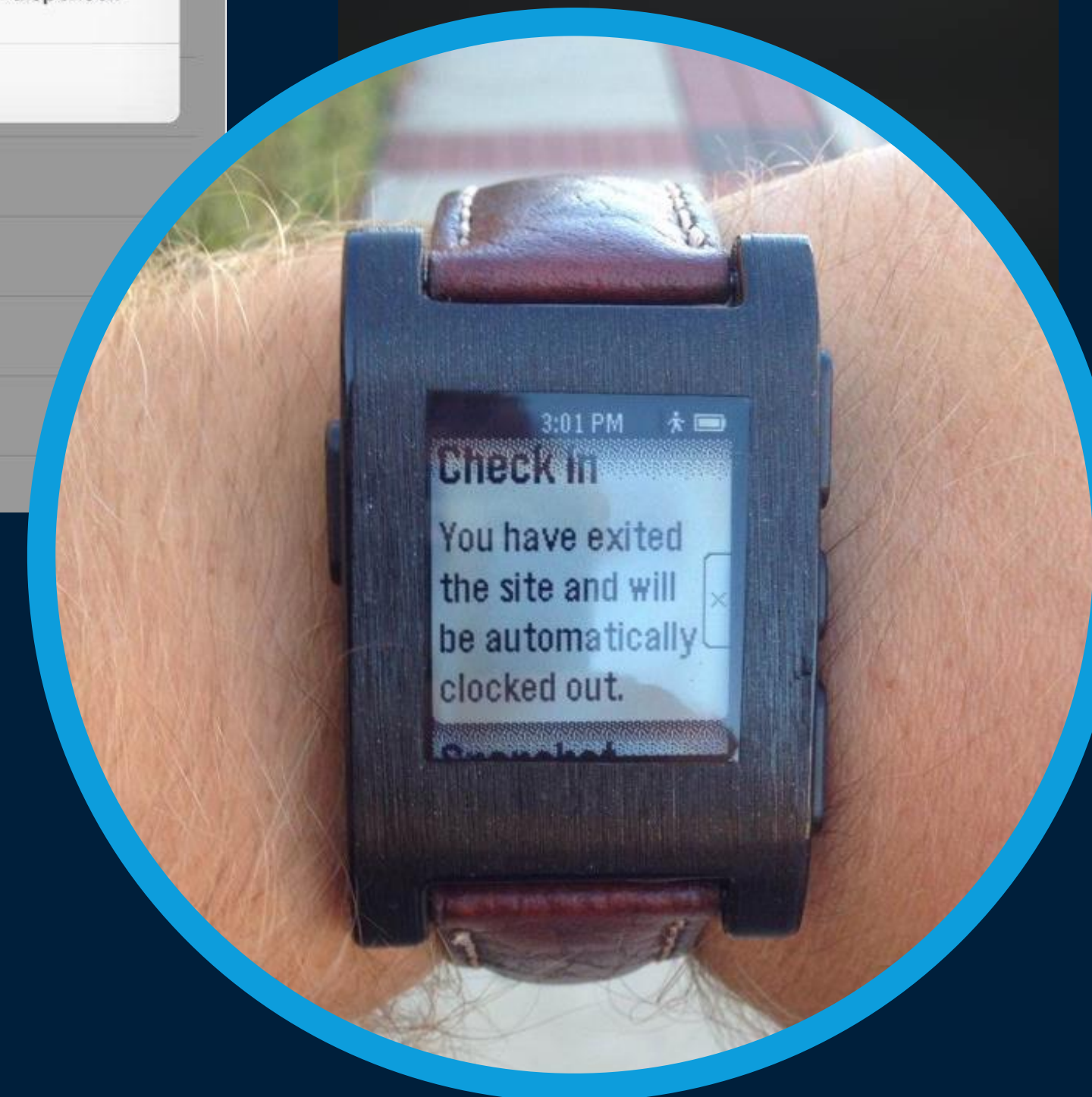
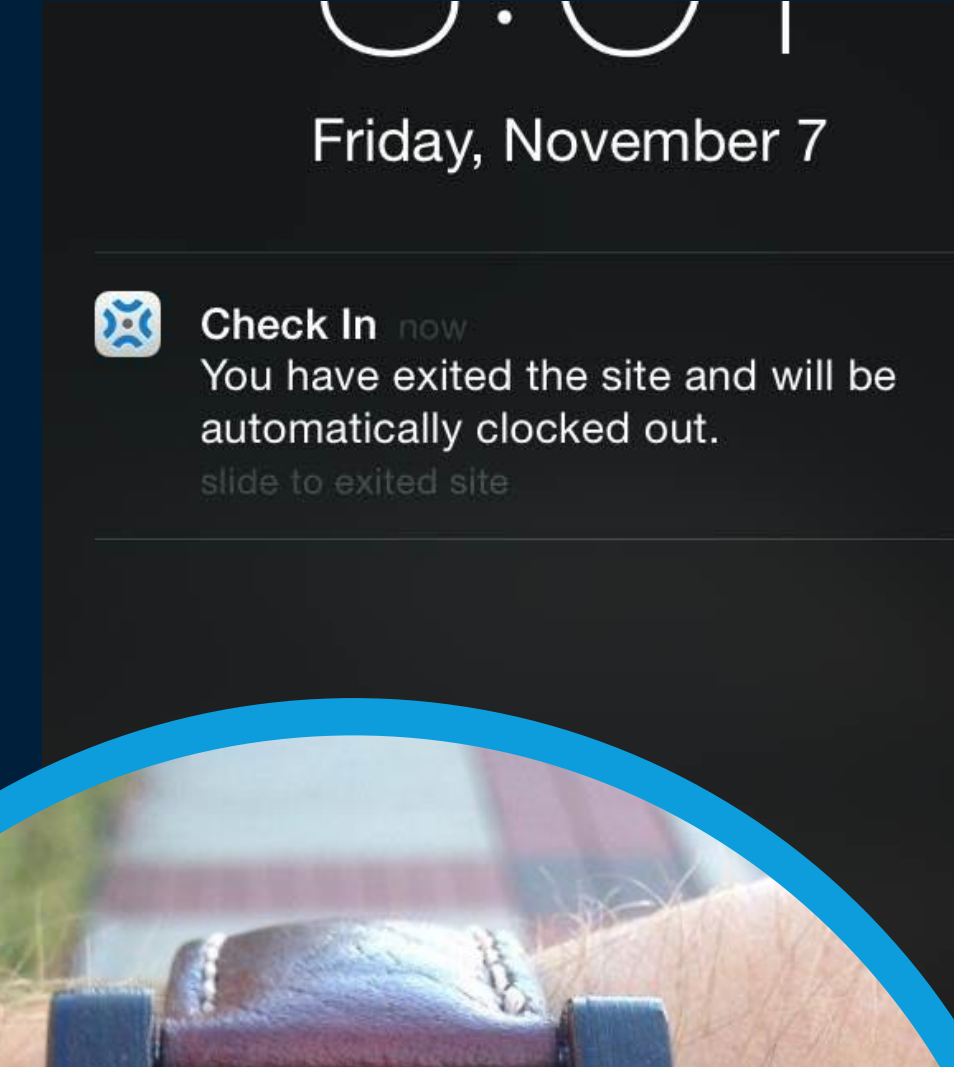
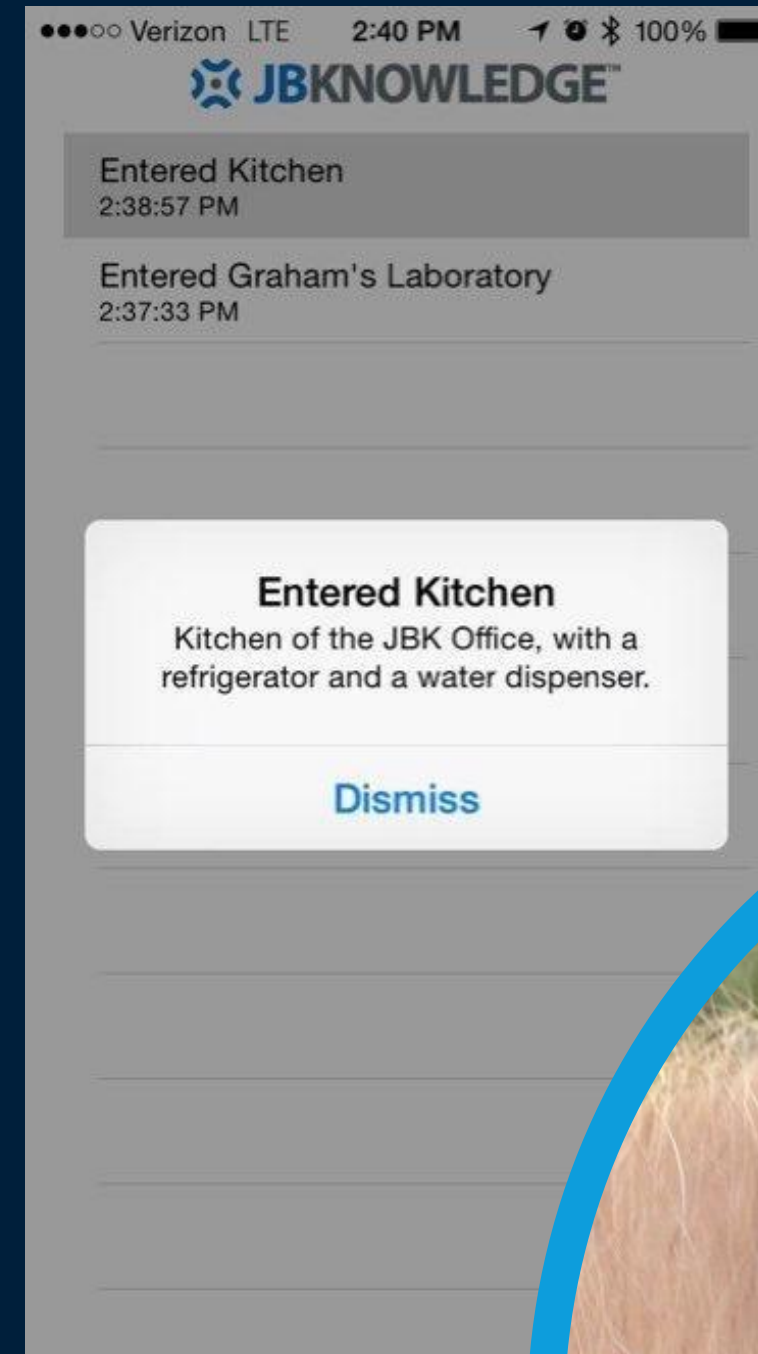
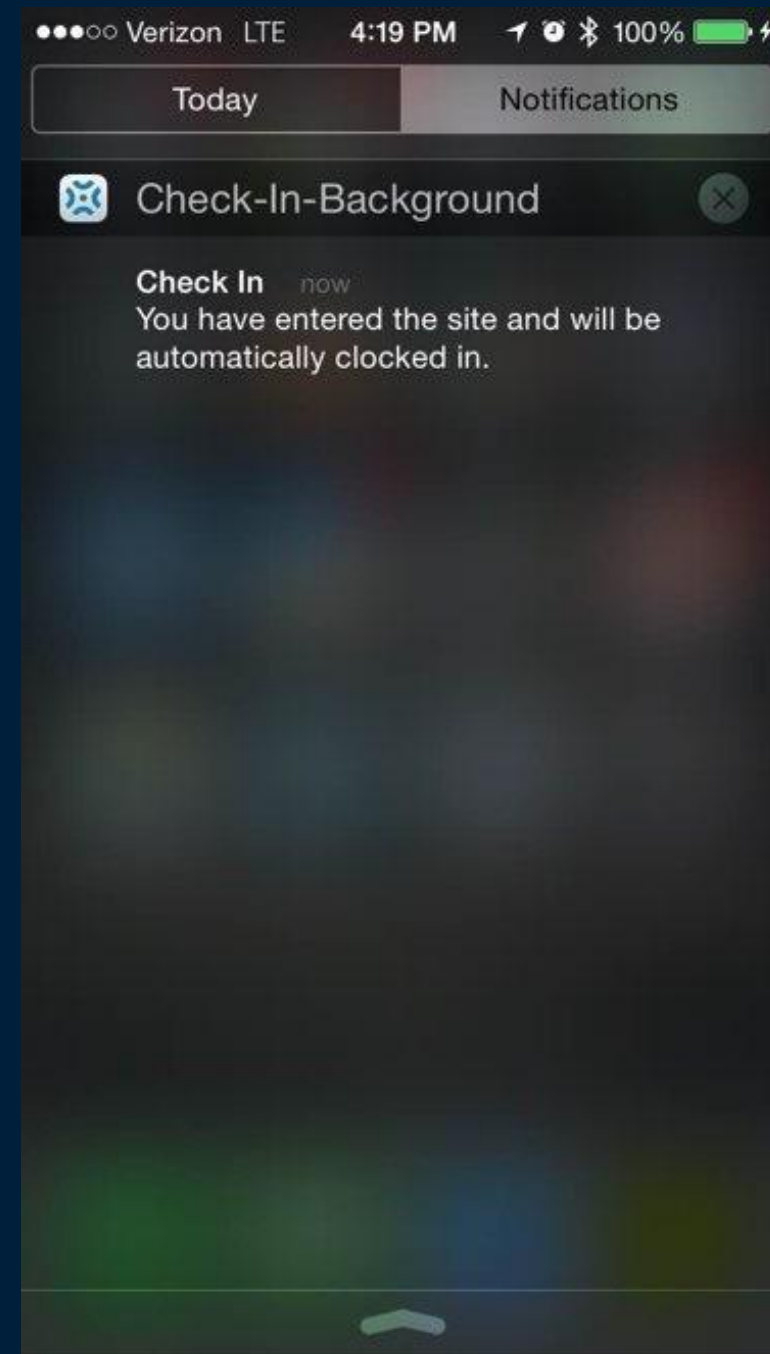


Structure Sensor Structure.IO



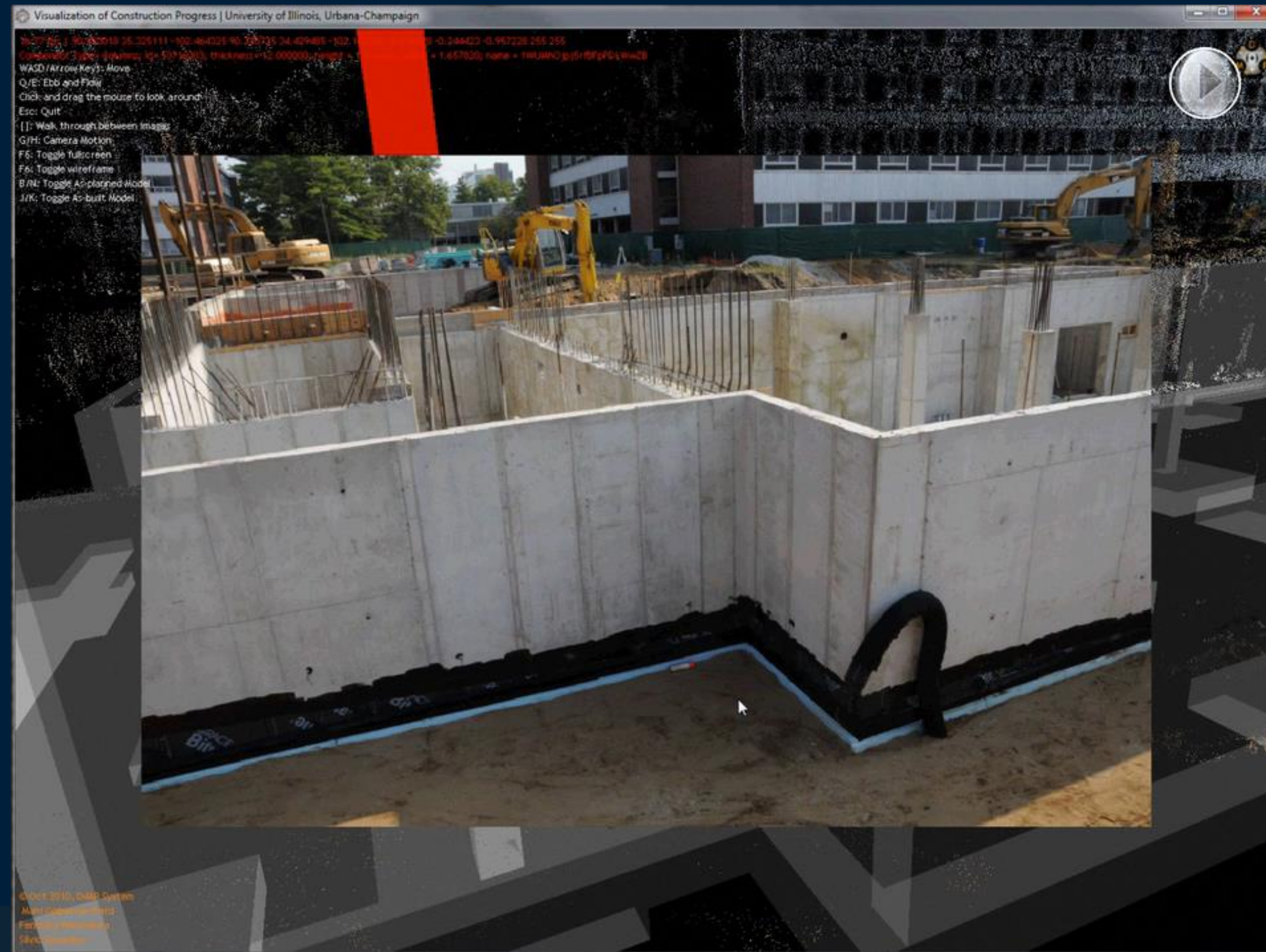
iBeacons for: Location Tracking Environmental Measurements Layout





Photogrammetry & Machine Learning with BIM

MANI GOLPARVAR-FARD, Ph.D., NCSA Faculty
Fellow and Assistant Professor
 University of Illinois at Urbana-Champaign

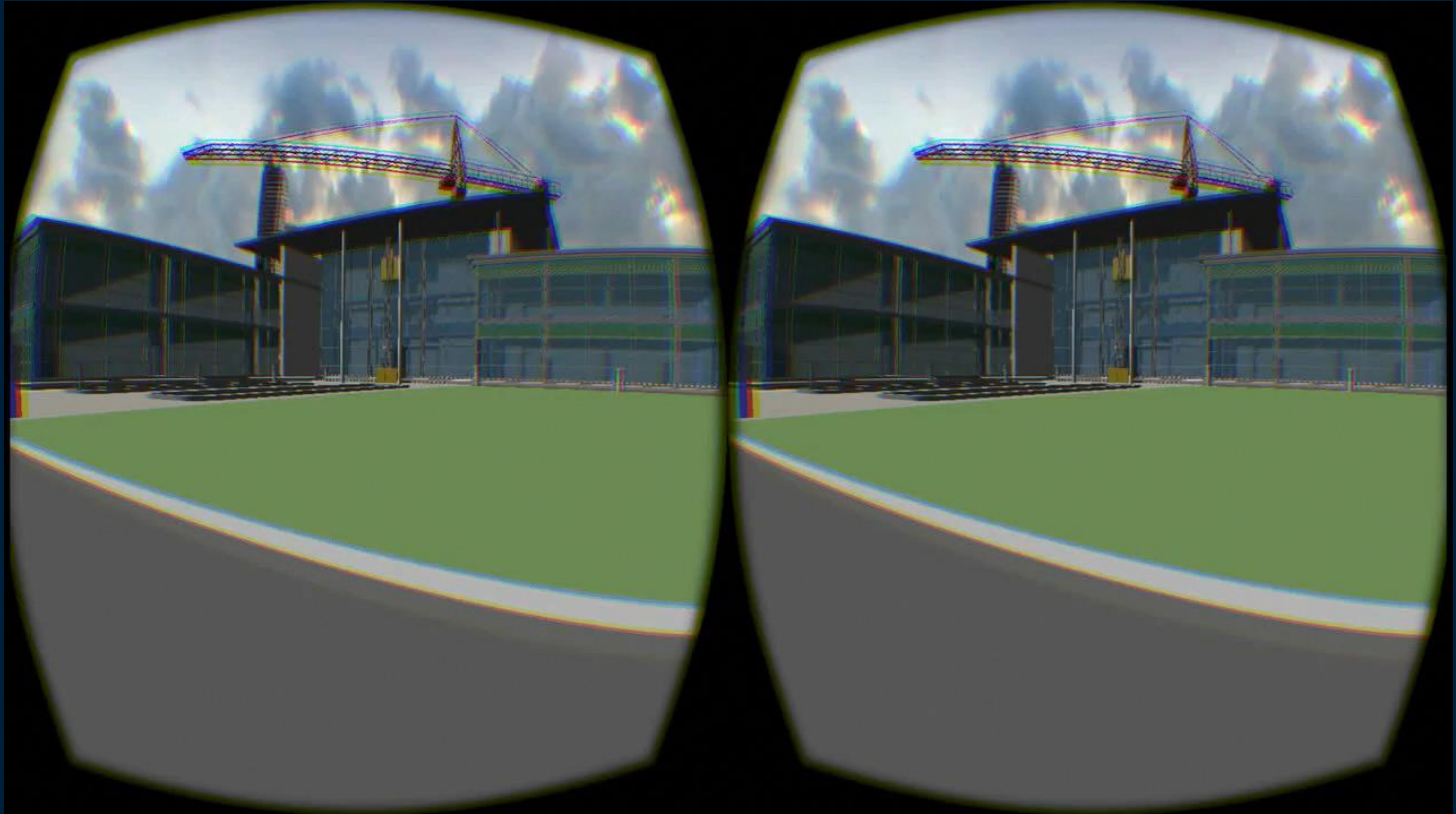


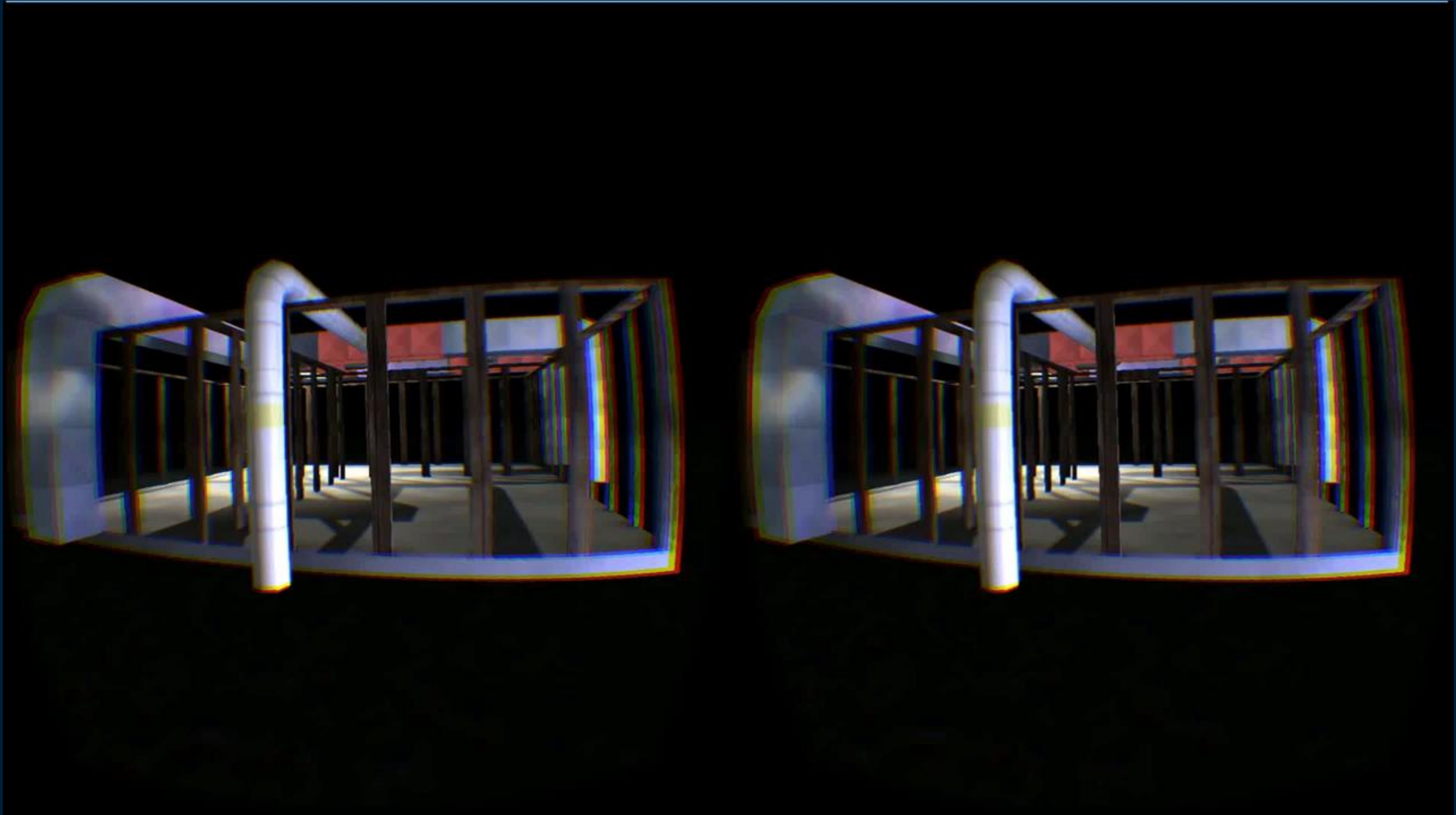
VR - The Pursuit of Presence & Mobility

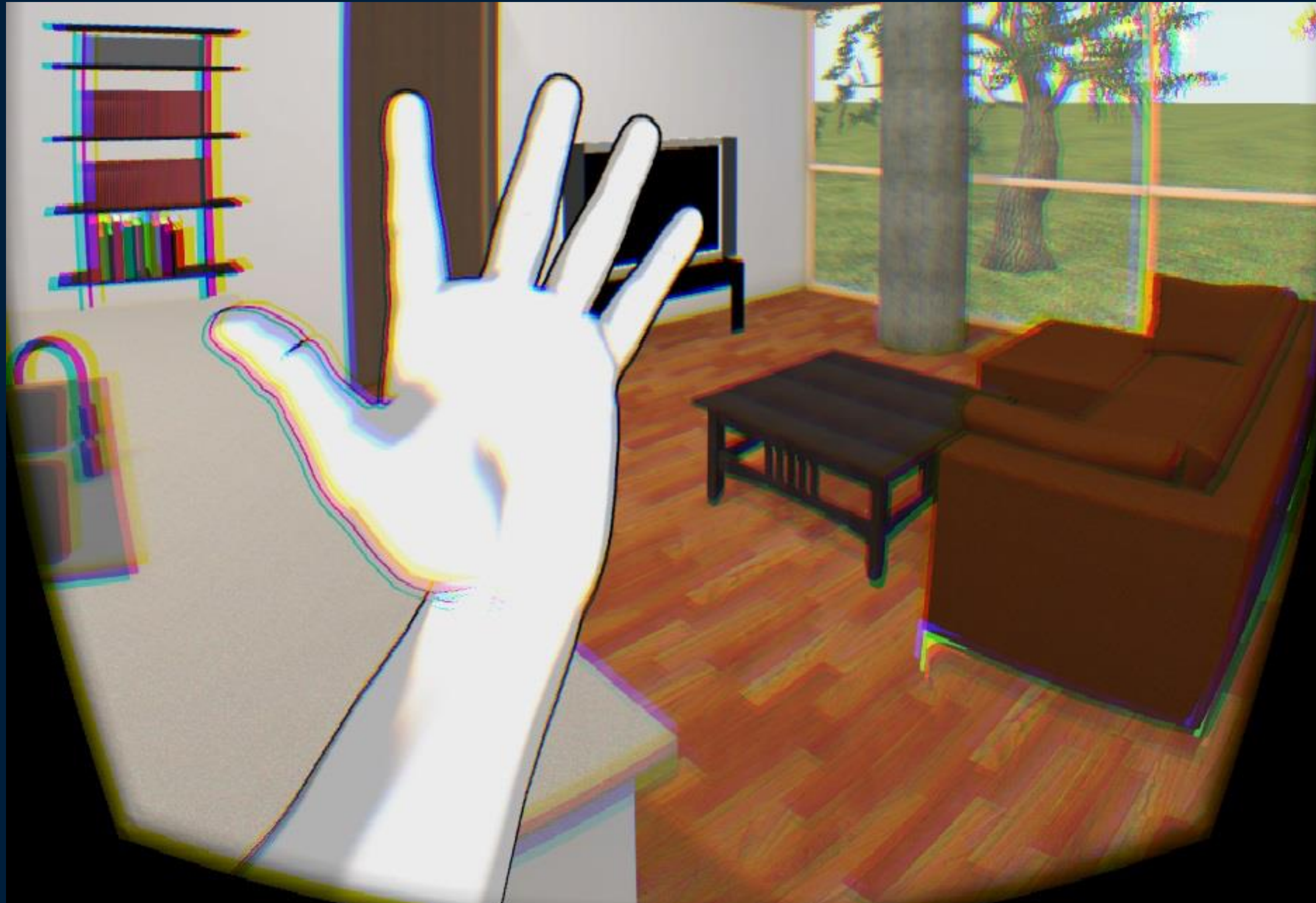


VR - The Pursuit of Presence & Mobility

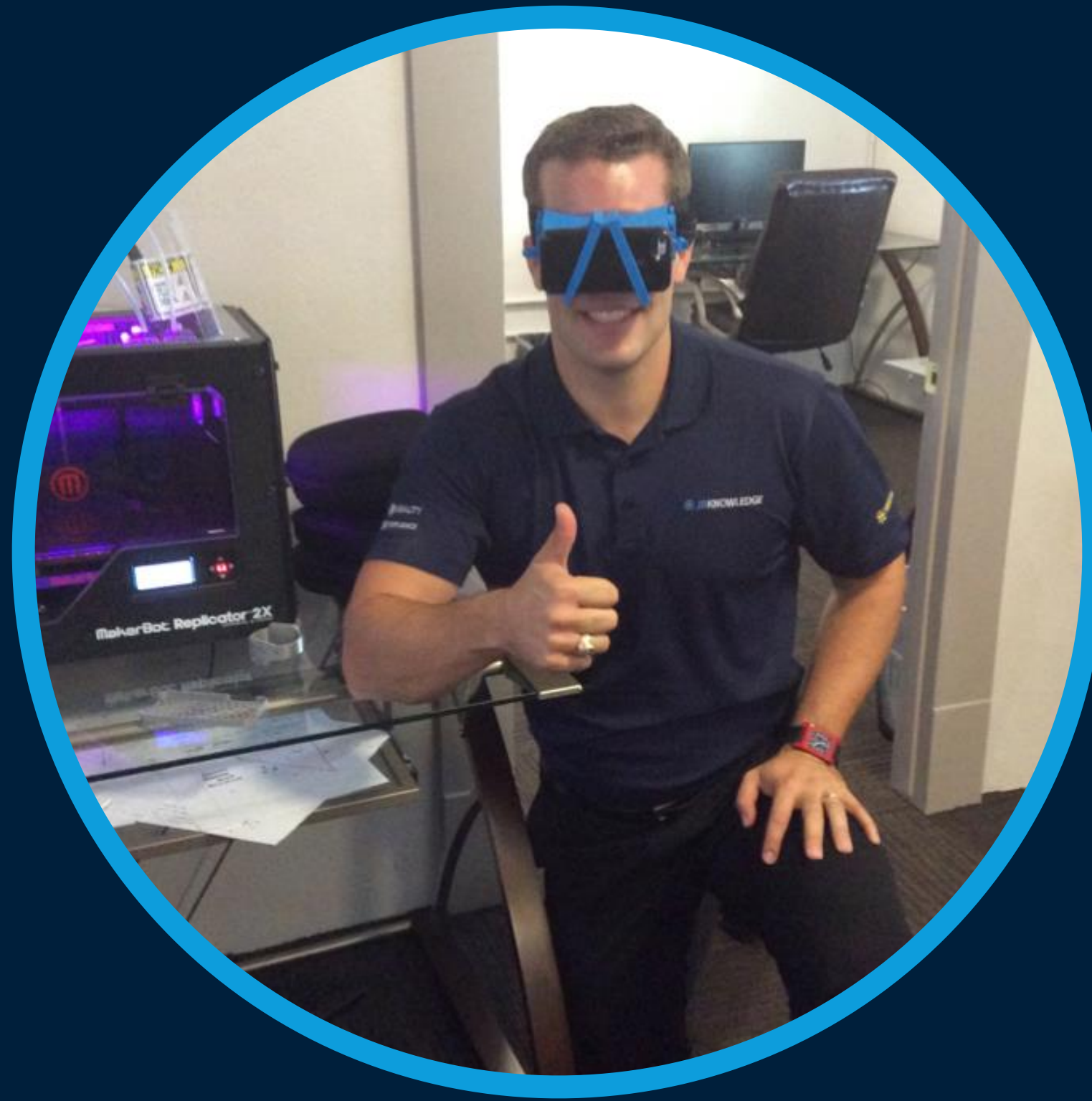






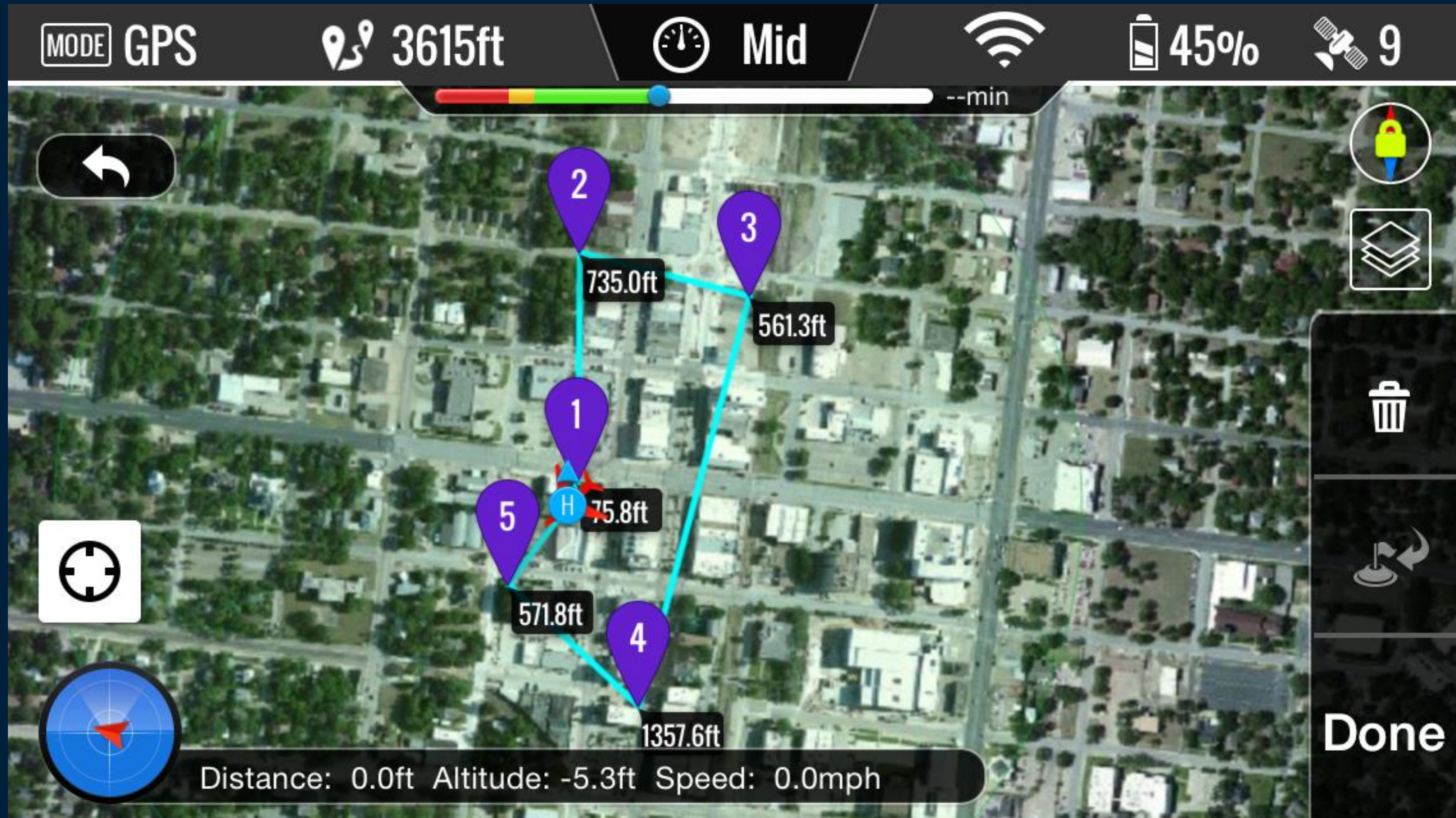


Ultra Portable VR



Drones are already here.

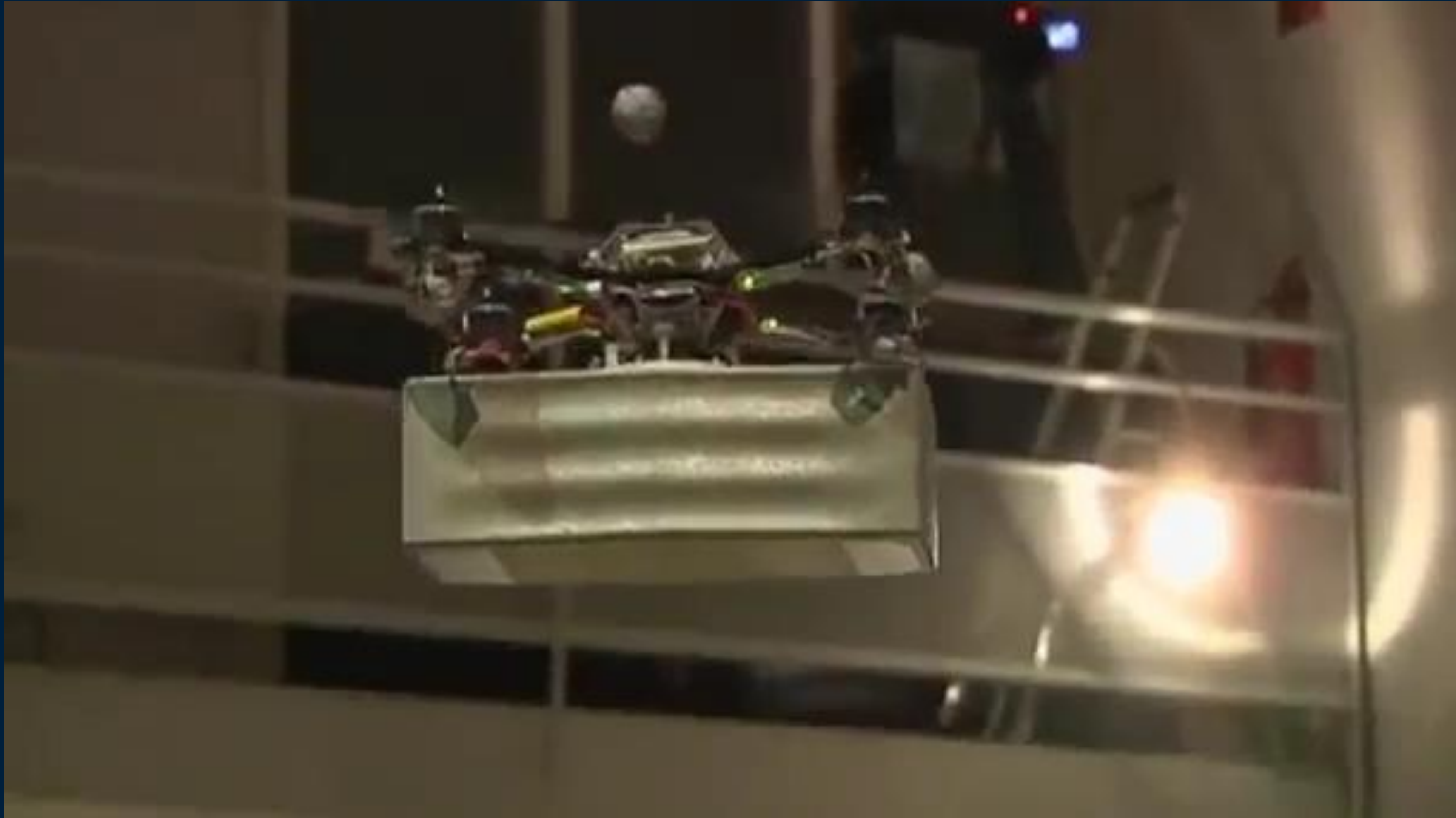






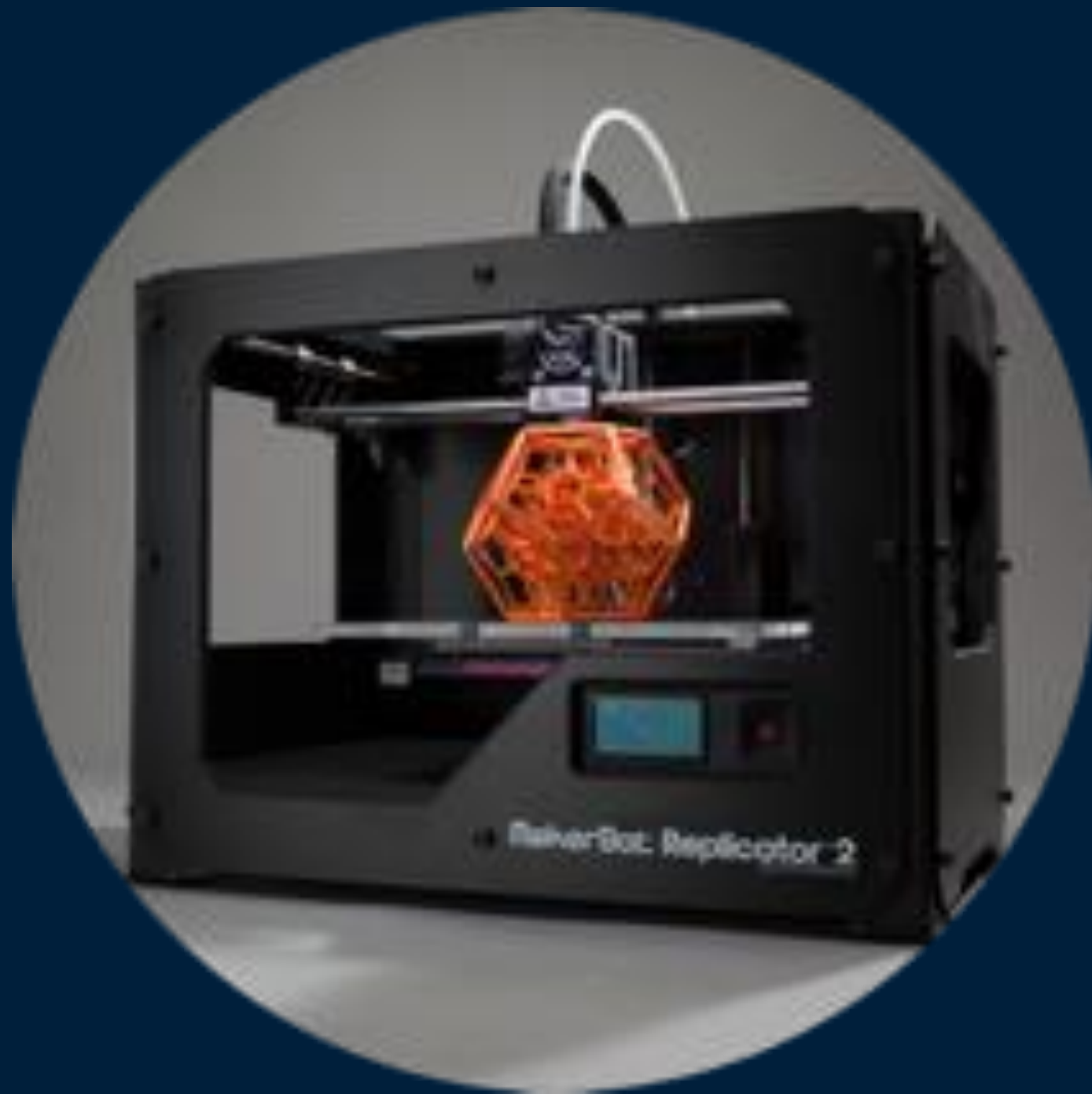


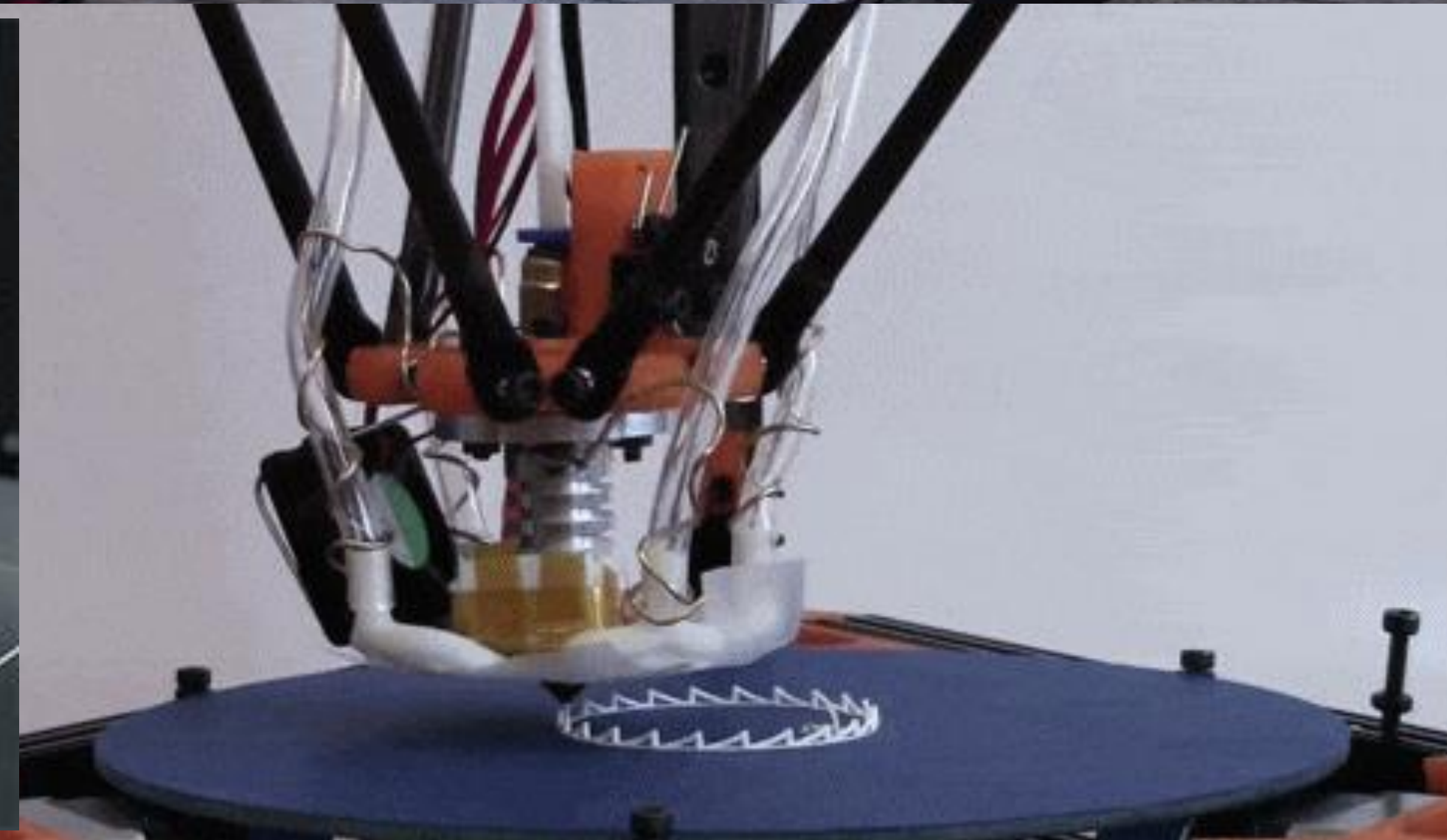




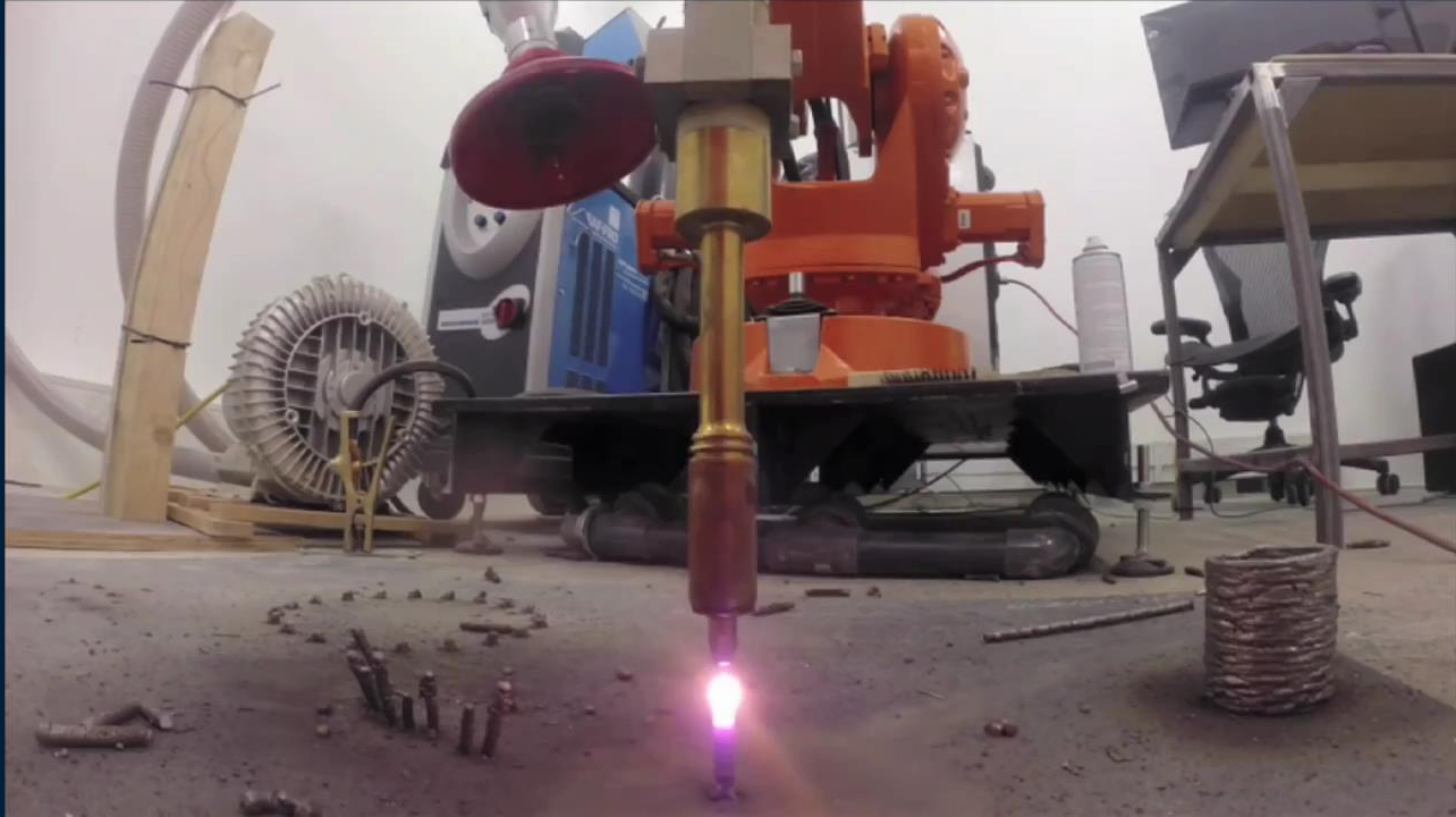
Review regulations at
knowbeforeyoufly.org

Printing Tools, Parts And Buildings











OUR PRODUCTS & RESEARCH



Invitation To Bid Software For Commercial General Contractors

Over 10,000 GC users

(throughout the U.S., Canada, Caribbean and Middle East)

- **Invitations to Bid**
- **Plan Distribution**
- **Subcontractor Data**
- **Prequalification**
- **Project Communication**



Certificate Of Insurance, Contract & Compliance Management Software for Risk Managers

150 users (Including the Largest Independent TPA in the US)

- **Certificate & contract collection**
- **Certificate issuance**
- **Vendor management**
- **Compliance management**
- **Optical Character Recognition (OCR)**

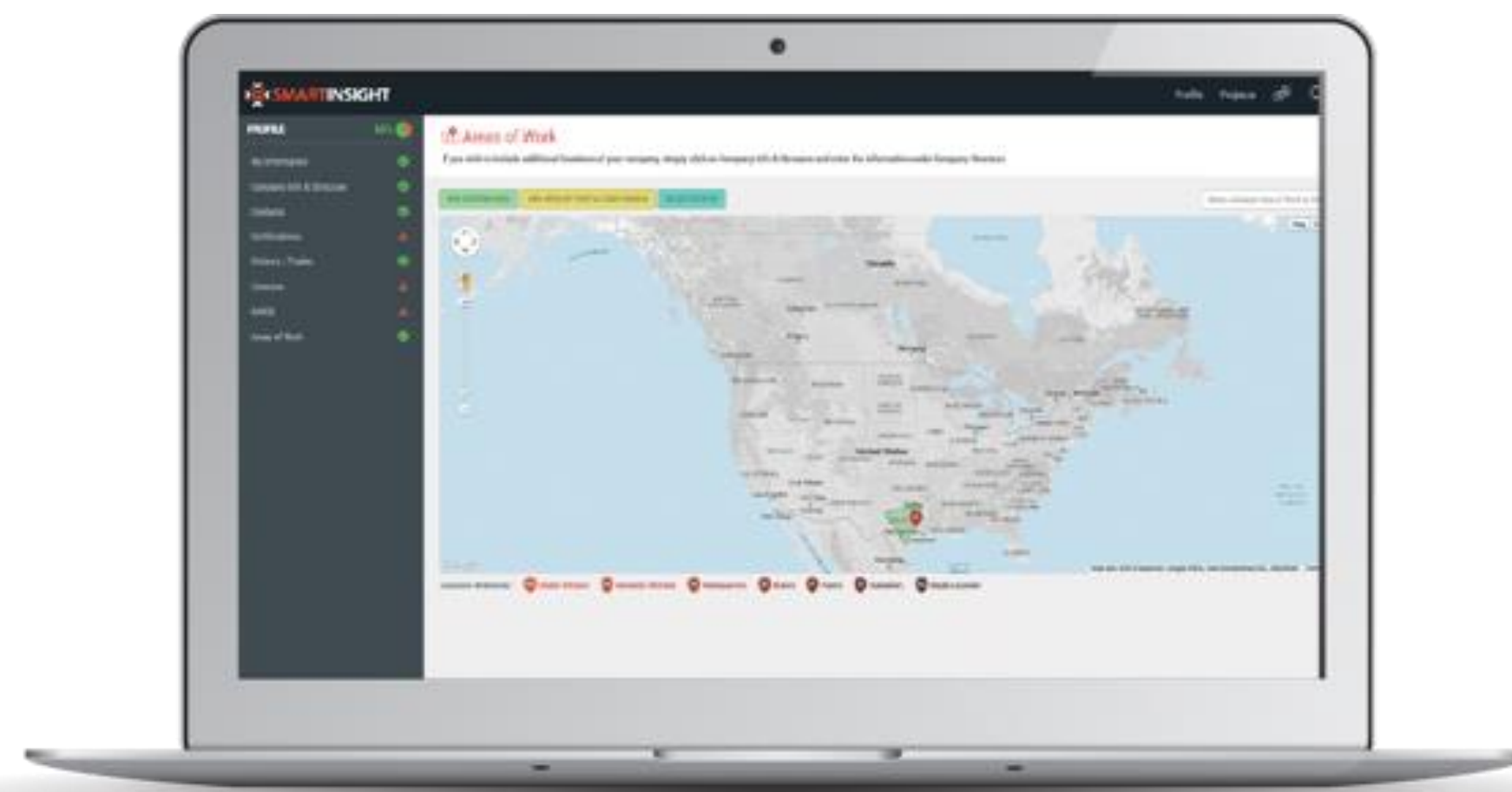


Online Construction Network for Searching, Selecting & Verifying Contractors

Over **130,000** member companies.

Over **500,000** public agency records.

- Centralize company financial, operational, project history, qualification data and more
- Request and share prequalification data for construction projects
- Connect with potential project partners

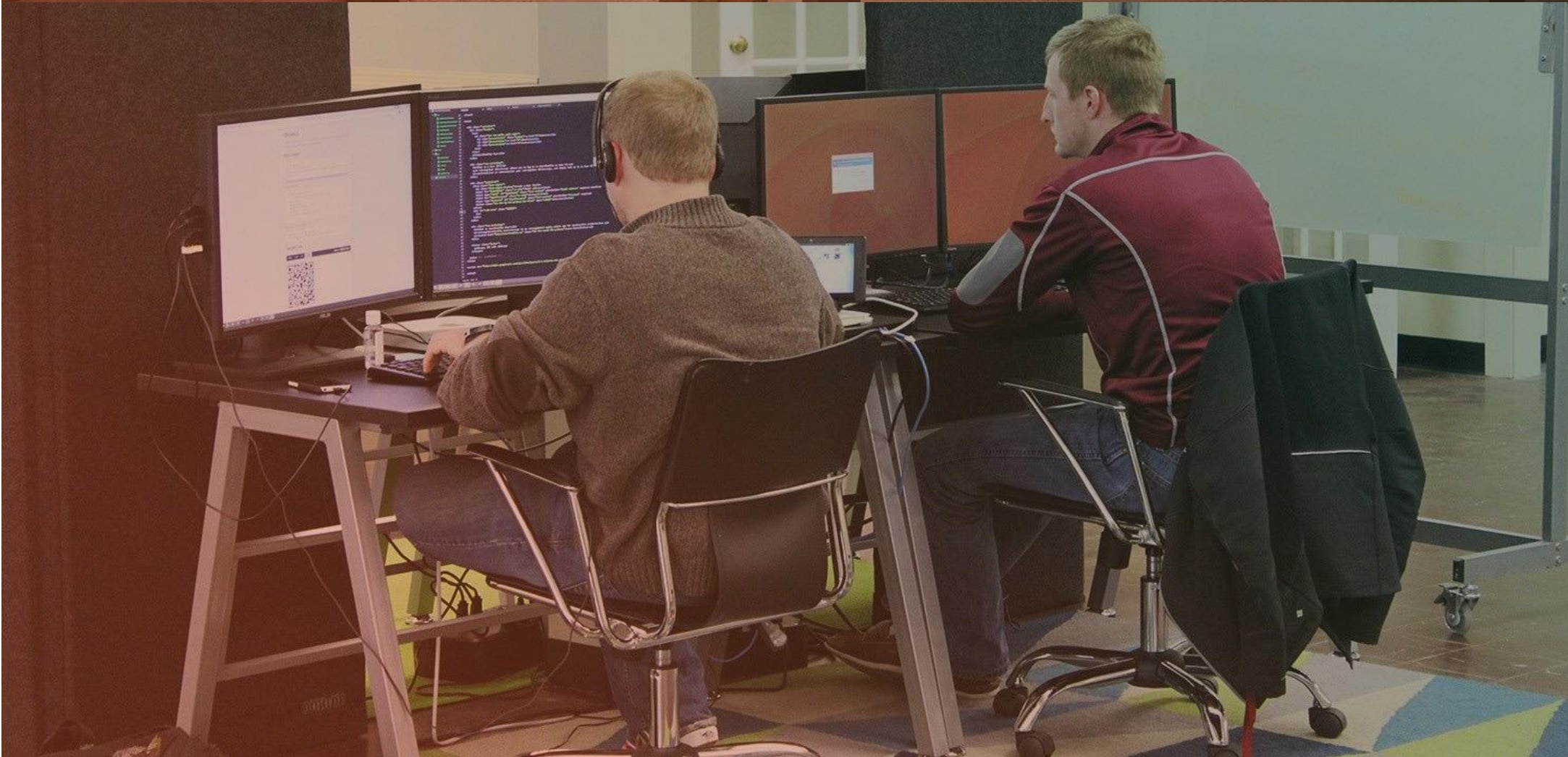


Augmented Reality Mobile App for Construction Project Visualization

2,074 users in over 20 countries.

- Enables 3D animated visualizations of 2D blueprints
- Bridges the gap between construction project conception and visualization





jbknowledge.com/labs
Current Research:

- **iBeacons & Micro Positioning**
- **Job Site Photography & Data Collection**
- **Virtual and Augmented Reality**
- **3D Scanning**
- **3D Printing/CNC**

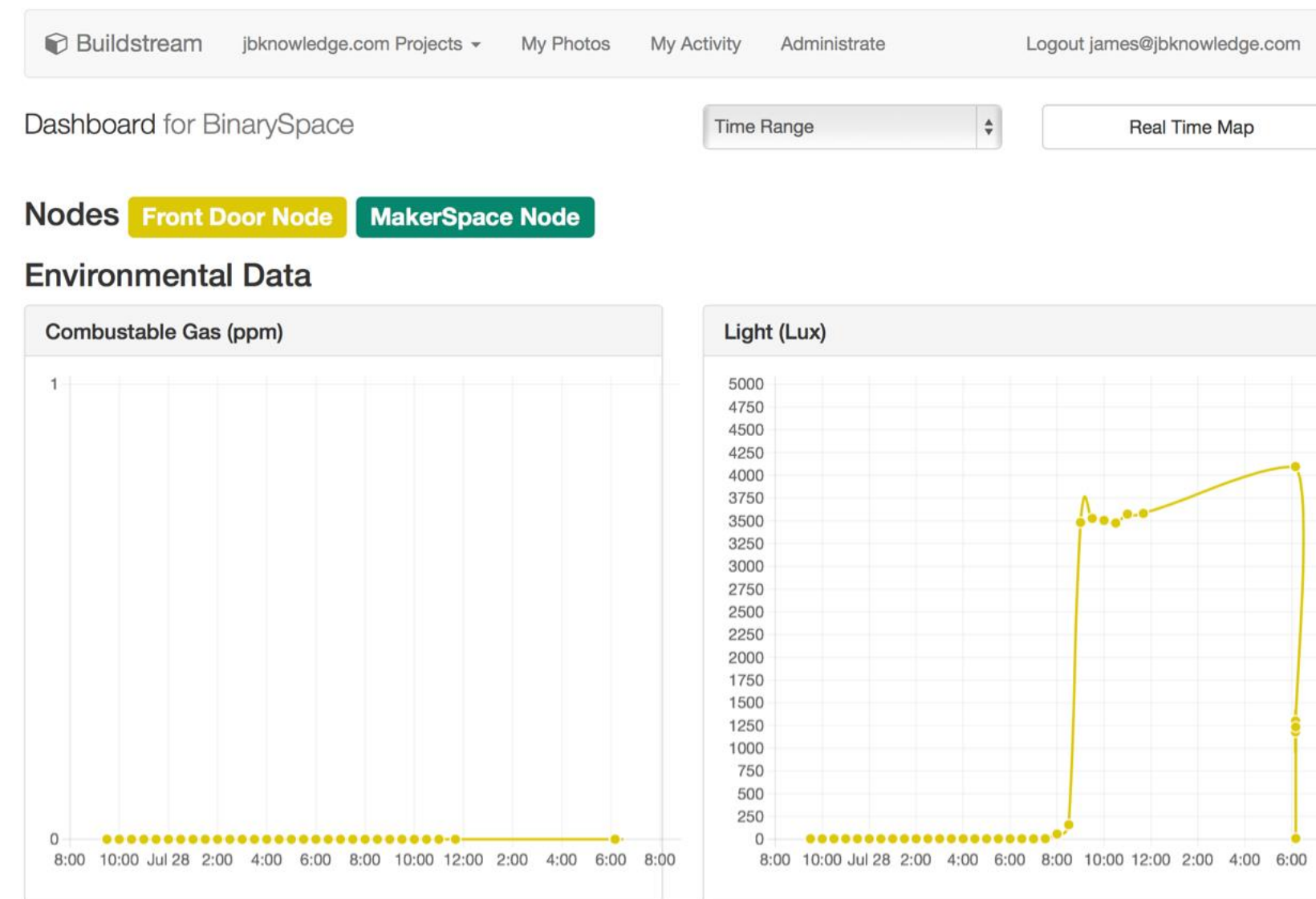


Today, we are releasing apps for :

- Oculus Rift DK2 with Leap Motion
- Oculus Gear VR
- Google Project Tango

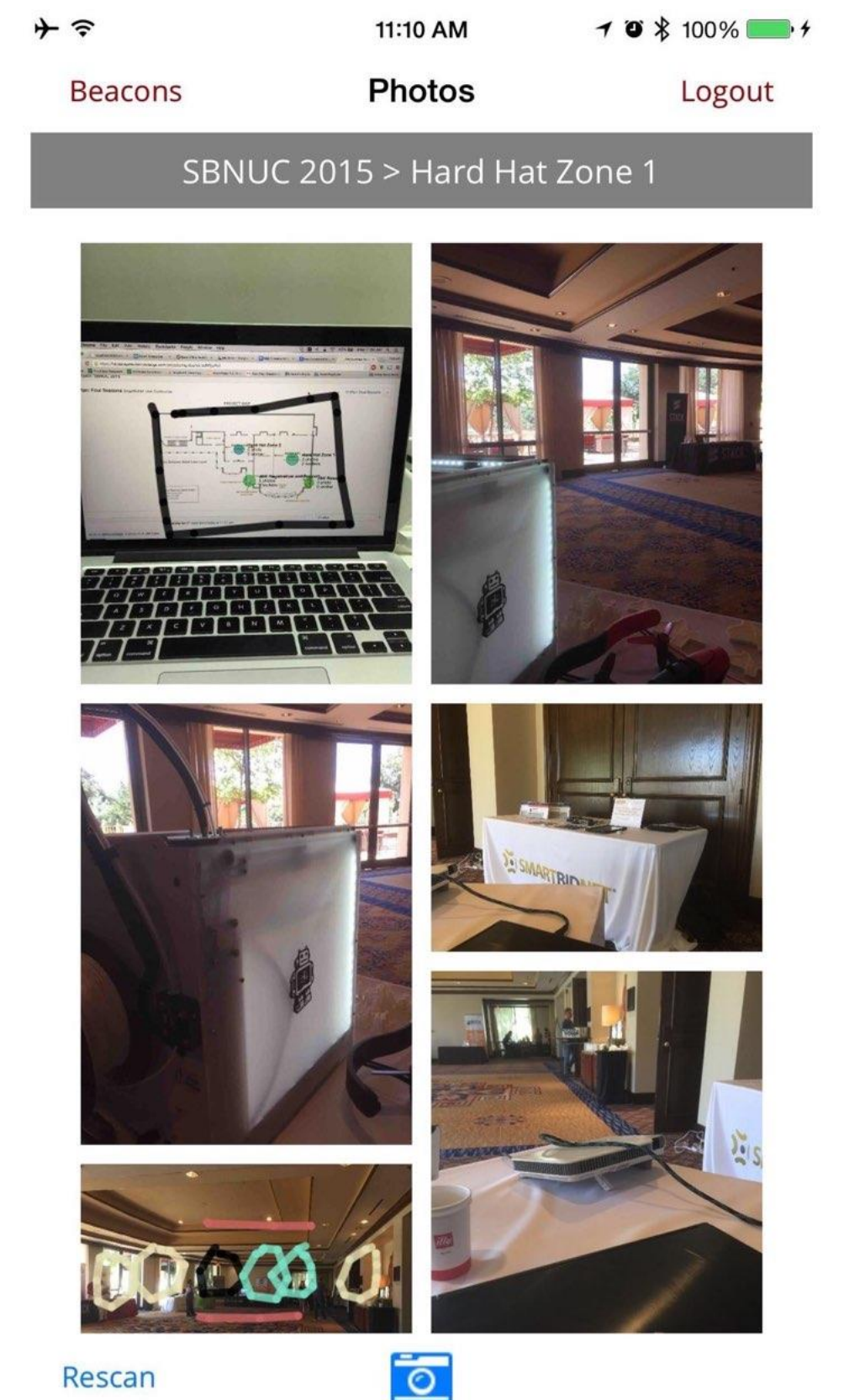


BUILDSTREAM NODE

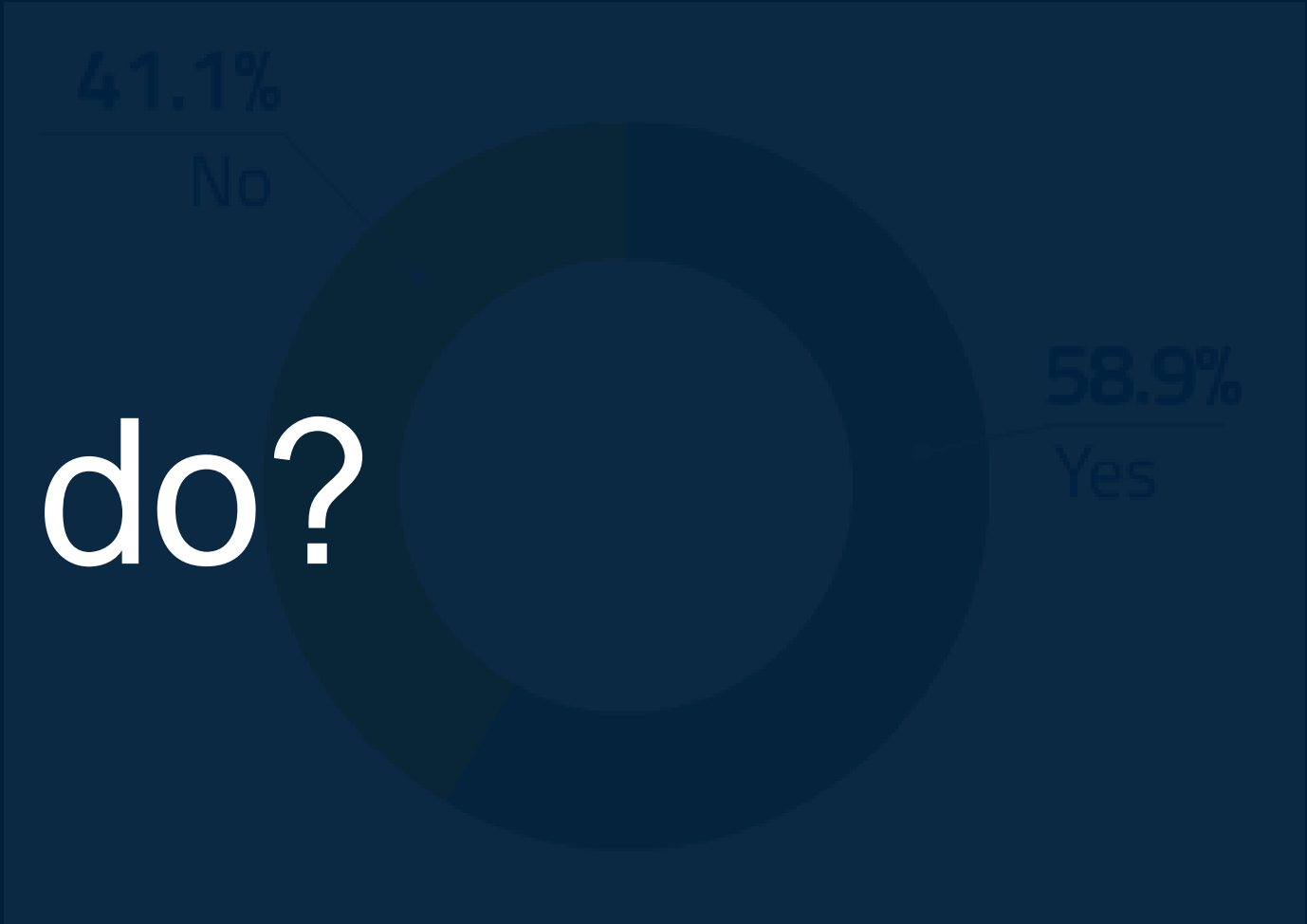


BUILDSTREAM PORTAL

BUILDSTREAM MOBILE



What can you do?



Address your budget.

Do you have dedicated Tech staff?

Are you underspending?

Do you have a proactive or reactive budget?

Do you have an R&D budget?

Can you bill to projects?

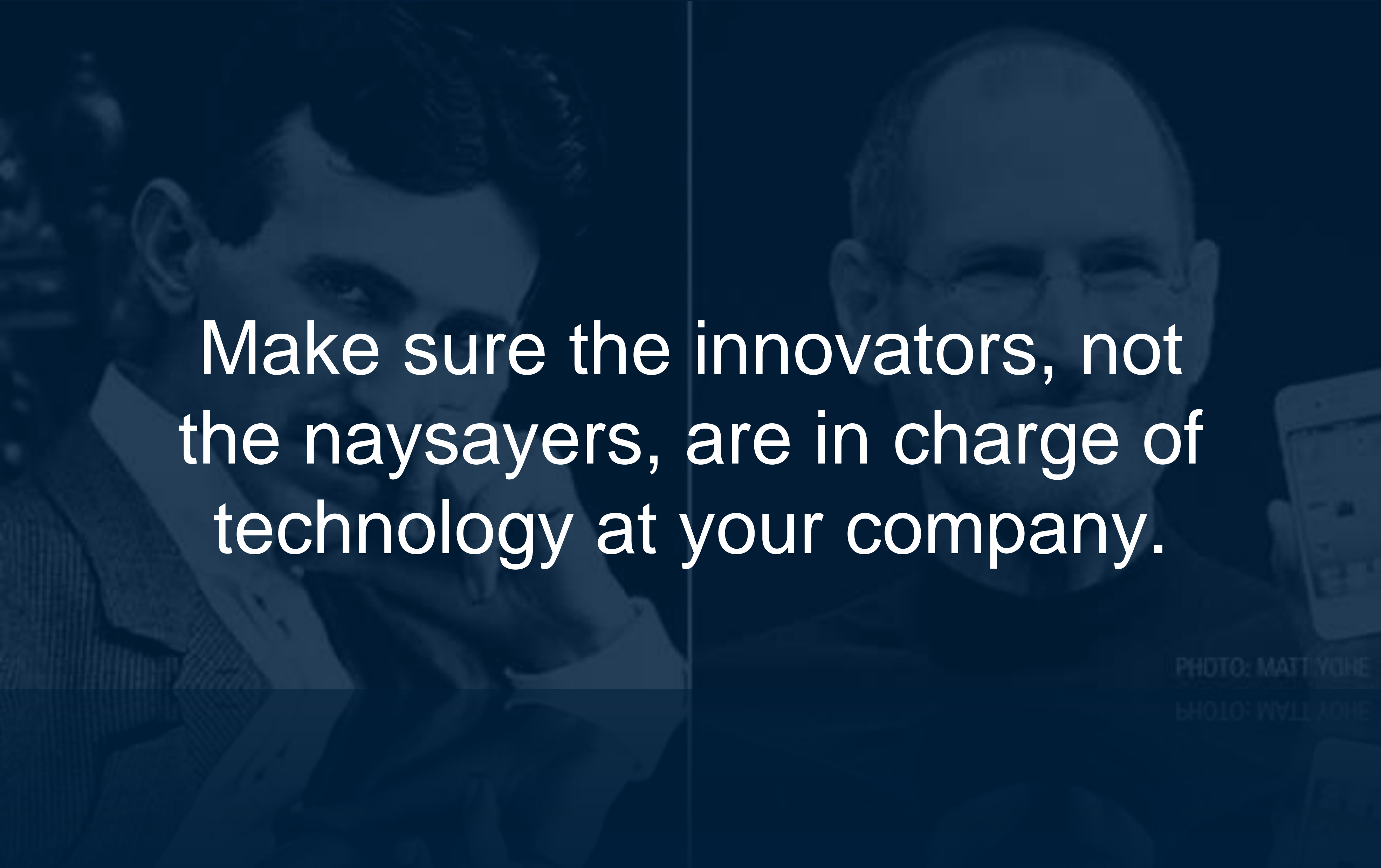
A Note About “Free” Software:

“When an online service is free, you’re not the customer. You’re the product.”

- Tim Cook

Conduct periodic tech reviews.
Look for paper and excel utilization.
Automate these processes.

QuickBase, AppSheet, Google Docs



Make sure the innovators, not the naysayers, are in charge of technology at your company.



Become a tinkerer.

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Makers of

