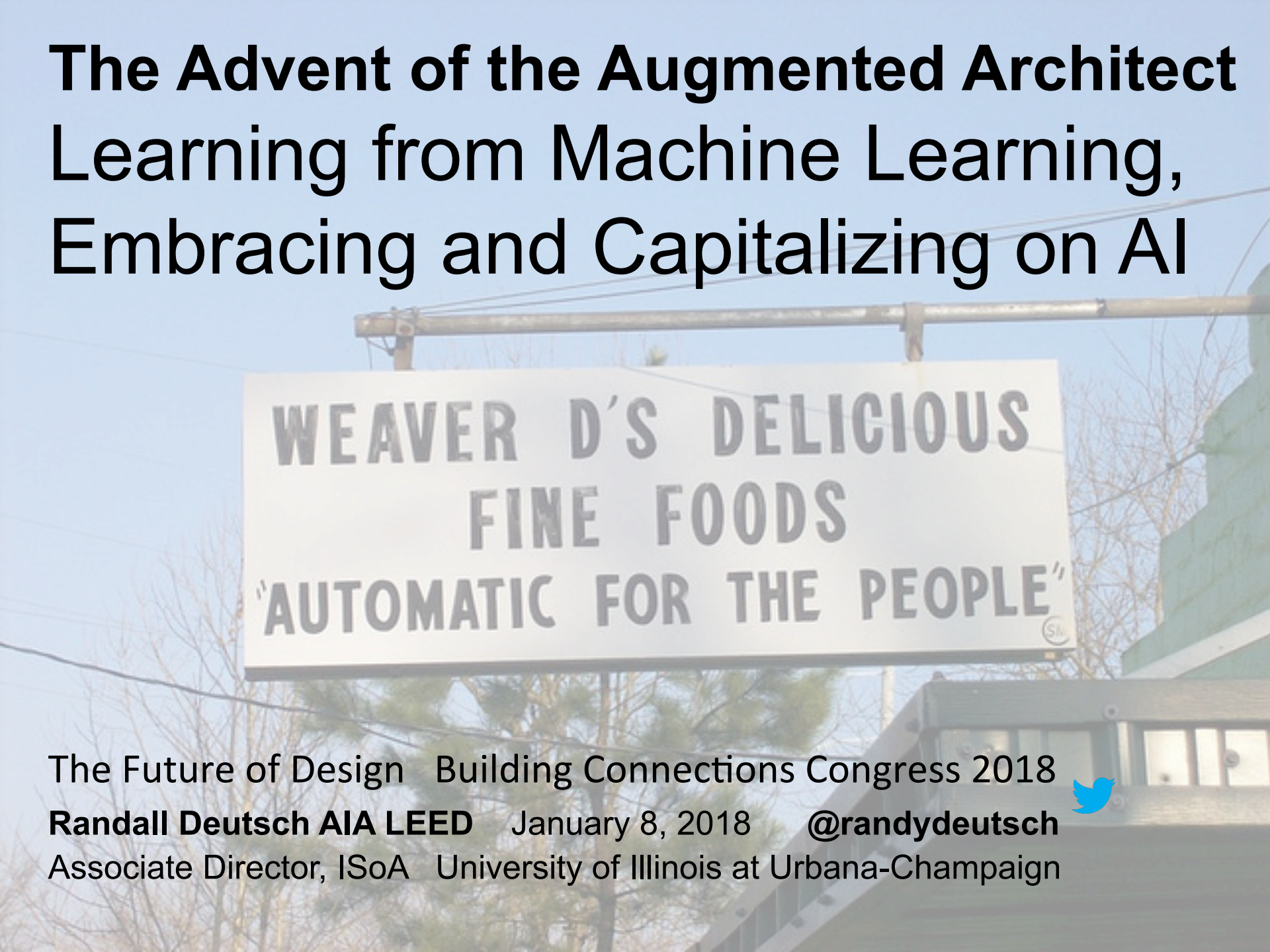
The Advent of the Augmented Architect

Learning from Machine Learning, Embracing and Capitalizing on AI

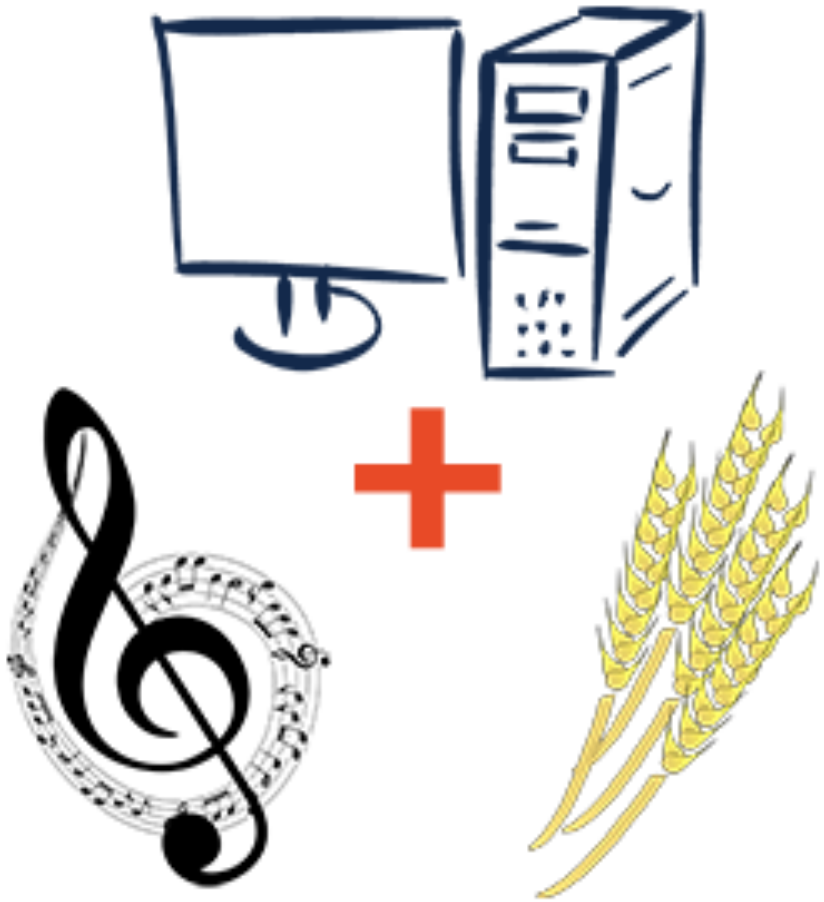


The Future of Design Building Connections Congress 2018

Randall Deutsch AIA LEED January 8, 2018 **@randydeutsch**

Associate Director, ISoA University of Illinois at Urbana-Champaign

I am actually an Architecture major with a minor in Informatics with a concentration in Human Computer Interaction. I am actually currently taking an virtual reality class with Professor Lavalle who is the founder of Oculus!! I am hoping to pursue a degree in Human Computer Interaction(HCI) in the future like in Grad School or Phd. Architecture really benefits me with my 3D modeling and Adobe Suite skills and I know there are people who were architecture major go into HCI field and do User Interface or User Experience design!




CS + CROP SCIENCES
NEW CS + X DEGREES
CS + MUSIC


FOLLOW
YOUR
PASSION


UNIVERSITY OF
OXFORD
Department of
Computer Science
→ (Entrance on Parks Road)

DEEP LEARNING FROM LAS VEGAS

Revised Edition

Robert Venturi Denise Scott Brown Steven Izenour

MACHINE LEARNING FROM LAS VEGAS

Revised Edition

Robert Venturi Denise Scott Brown Steven Izenour

As the next generation of practitioners with next generation solutions:

What role do you want to play?

SITE ACQUISITION \ FINANCING \ ARCHITECTURAL DESIGN \ CONSTRUCTION \ ASSET MANAGEMENT

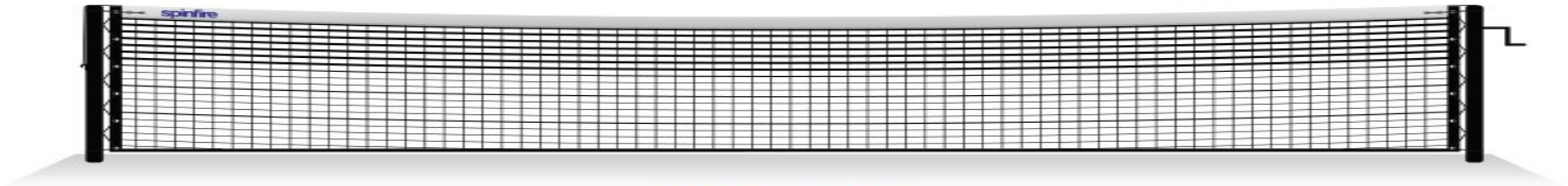
The Firm of Everything

WeWork
ShopArchitects
KieranTimberlake
BeckGroup
AECOM
Stantec

Speakers

Module 1: Teach machines to think like us

- Natasha Luthra, 2018 Chair, Technology and Practice Knowledge Community
- Michael Schrage, MIT
- Patrick Hebron, Foil Software
- Brok Howard, dRofus
- Randy Deutsch, University of Illinois Urbana-Champaign
- Zig Rubel, Aditazz

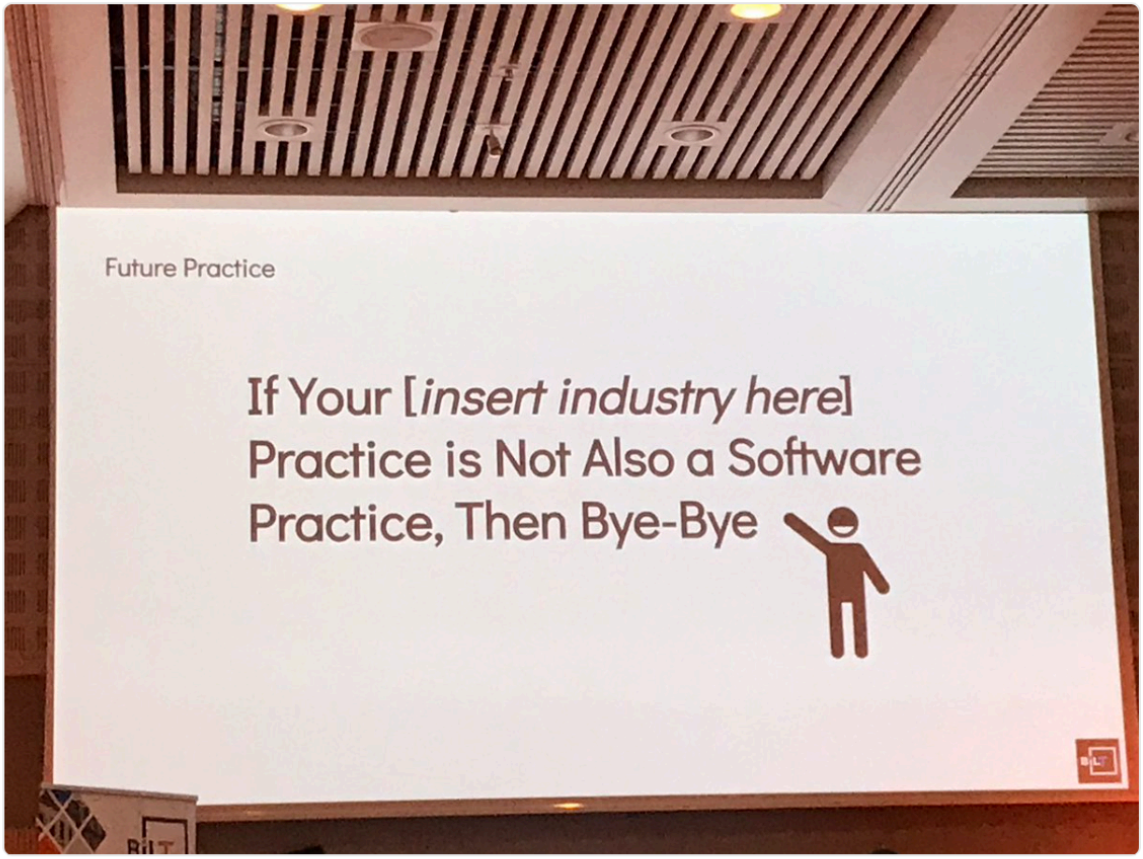


Module II: Have machines do things for us:

- Josh Kanner, Smartvid.io
- Mani Golparvar, ReConstruct
- Pat Keaney, Autodesk
- Brian Ringley, WeWork
- Christopher Connock, Kiernan Timberlake
- Paul Kassabian, Simpson Gumpertz & Heger

BIMinions
@BIMinions

#BiLTEUR @brianringley - great slide!



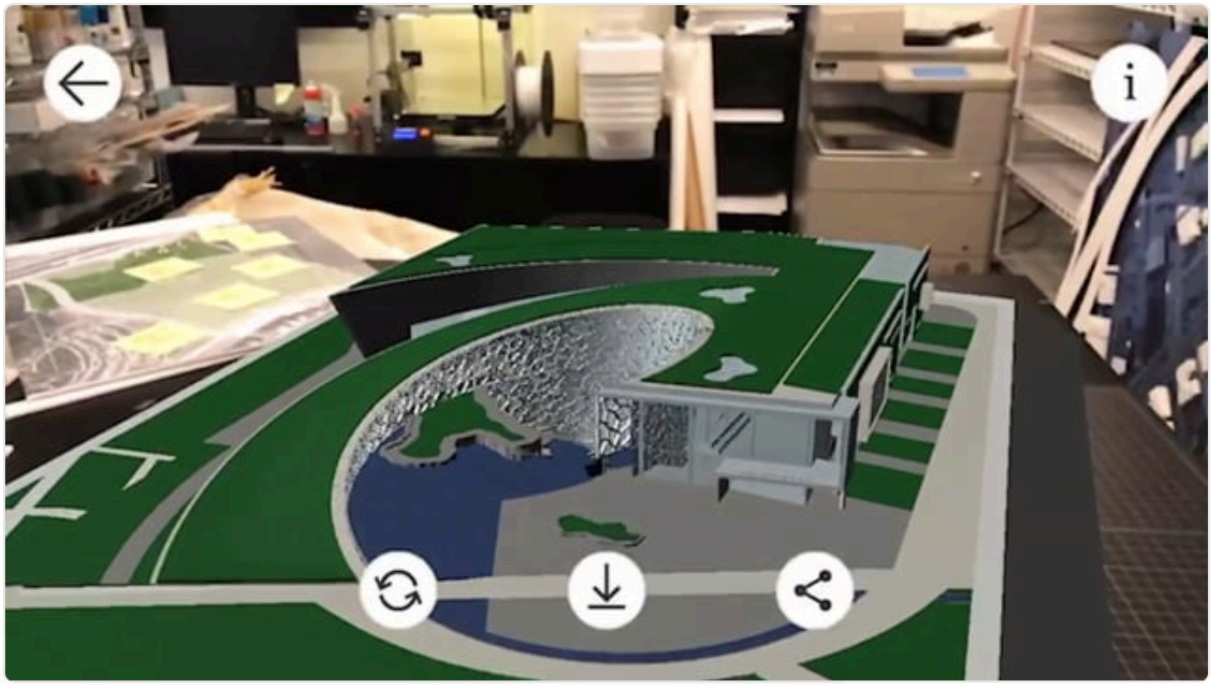
1:28 AM - 7 Oct 2017

11 Retweets **25** Likes

Randy Deutsch
@randydeutsch

'Every company is a technology company'

Some #architecture firms take this more seriously than others > @perkinswill adds new #VirtualReality app to their growing portfolio of digital experience tools perkinswill.com/news/perkinswi… #AEC #AR #VR



Brian Ringley @brianringley · 11m

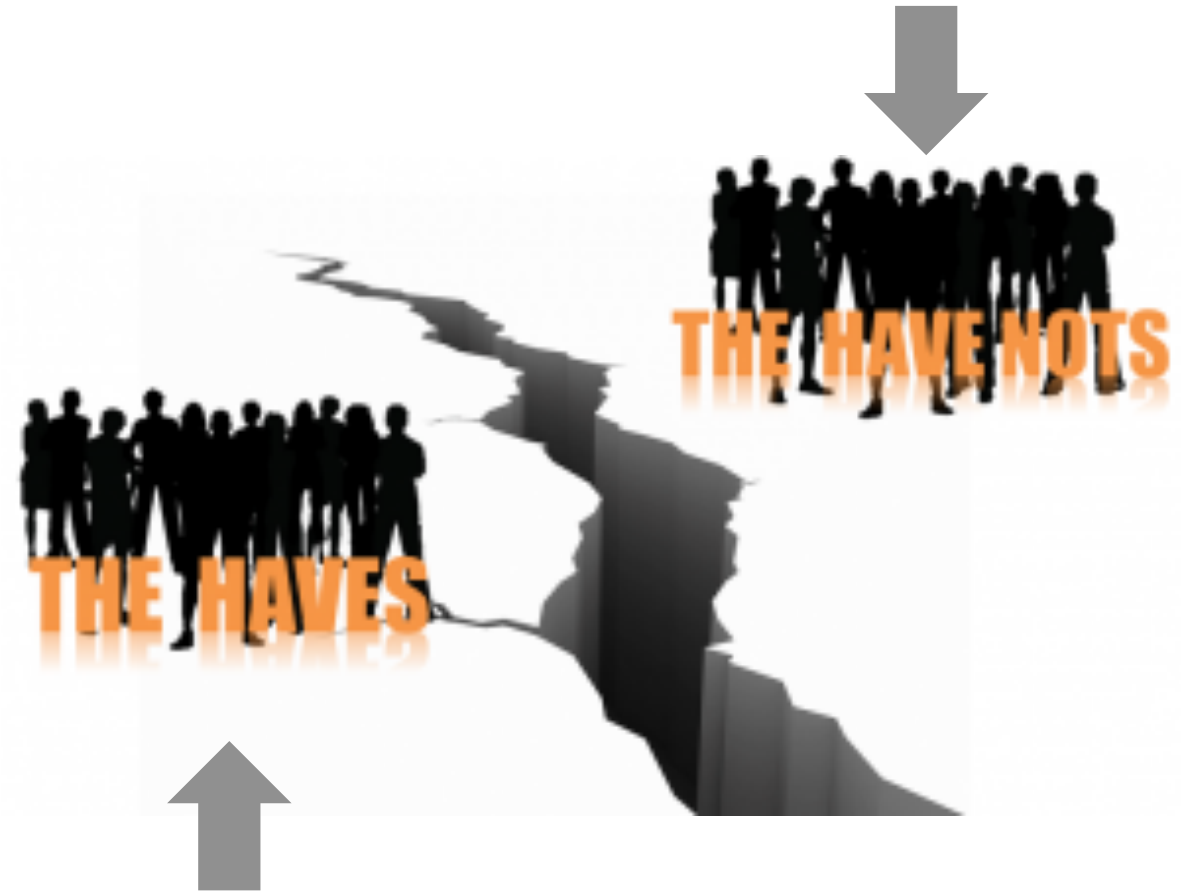
nearly every architect, regardless of tech inclination, speaking casually of scripts/algorithms as integral to their process #facadesplusAM

1 1


THE HAVE NOTS
THE HAVES

the future is here

not evenly distributed



the future is here

VIATechnik
@VIATechnik

Follow

We're taking a poll: which of the following #AEC technologies do you think will impact #construction the most over the next 5 to 10 years?

2:27 PM - Jun 21, 2017

30% VDC tech (VR, AR, BIM)

20% Drones

20% Artificial Intelligence

30% 3D Printing

81 votes • Final results

7 8

Randy Deutsch
@randydeutsch

Tweets	Following	Followers
54.2K	10	8,039

Who to follow · Refresh · View all

Followed by Brian Ringley

Richard Garber @rich_ga…

Follow

Followed by Brian Ringley

Nicholas Kramer @krame…

Follow

designalyze @designalyze

Follow

Find people you know

Trends for you · Change

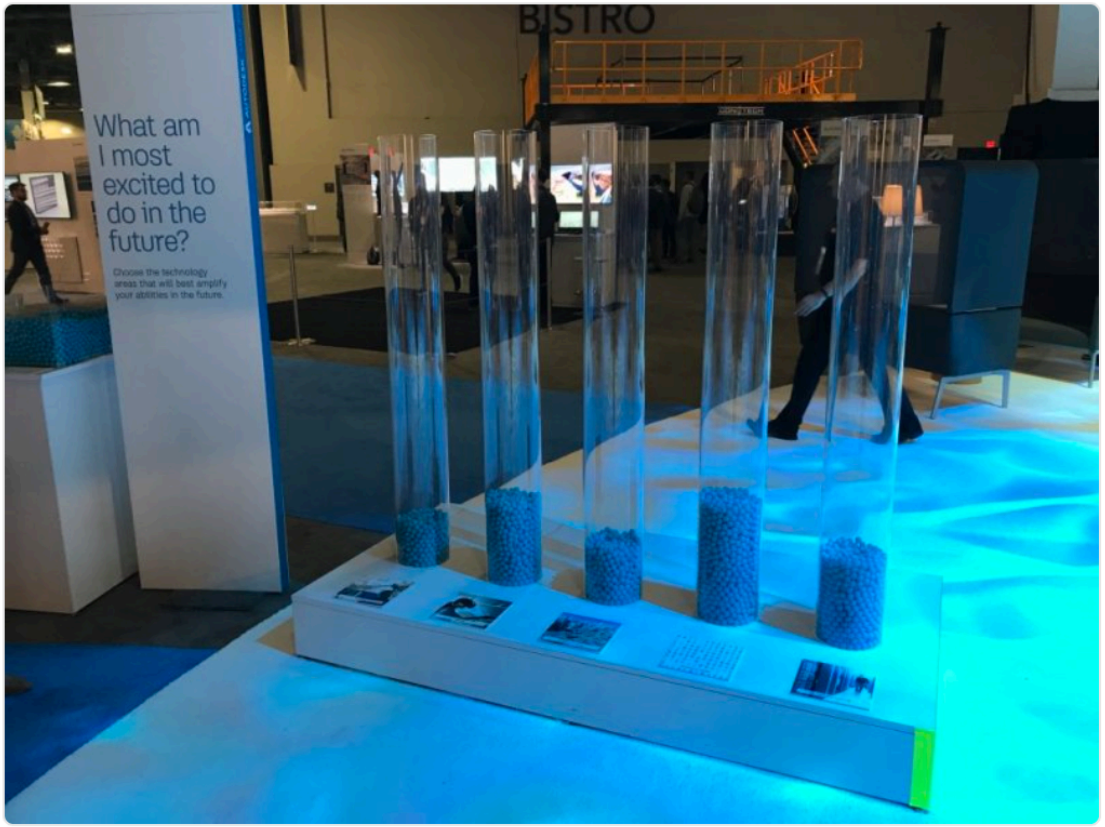
#NetNeutrality

Randy Deutsch @randydeutsch · 3s

What technologies are Autodesk customers excited about for the future of work? The people have spoken

From left to right: #Robotics, #AugmentReality/#VirtualReality, #InternetOfThings, #Generative Design, #ArtificialIntelligence/#MachineLearning

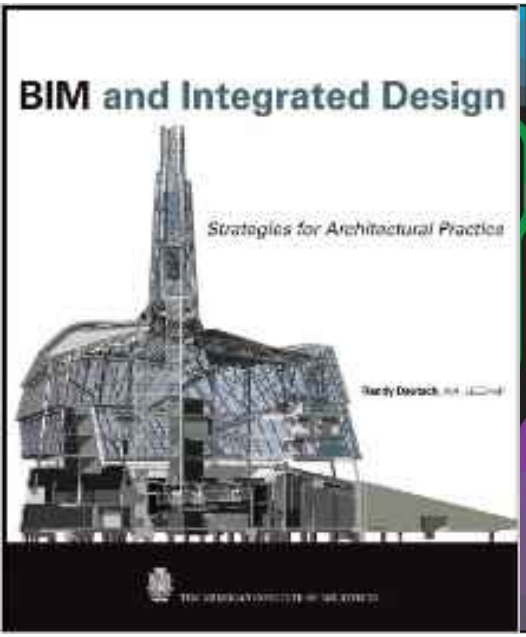
labs.blogs.com/its_alive_in_t… #IoT

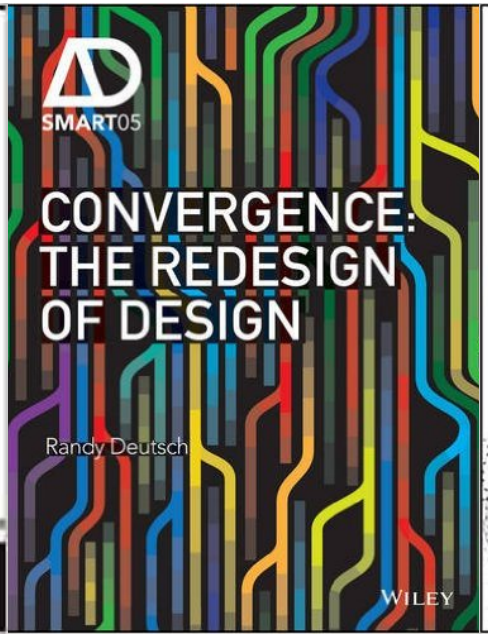


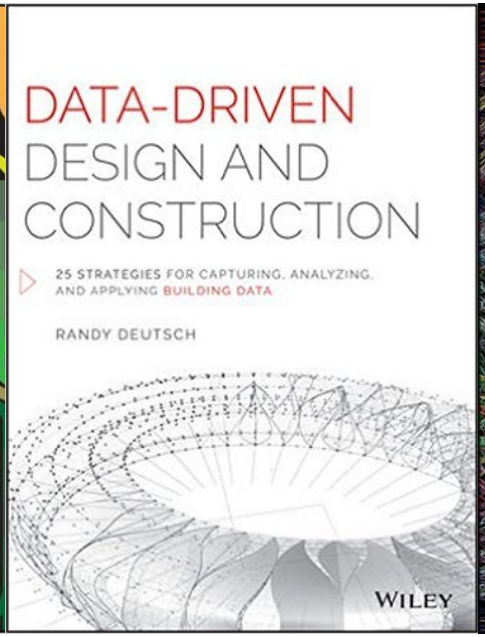
What are the most significant changes in course offerings in the past three years?

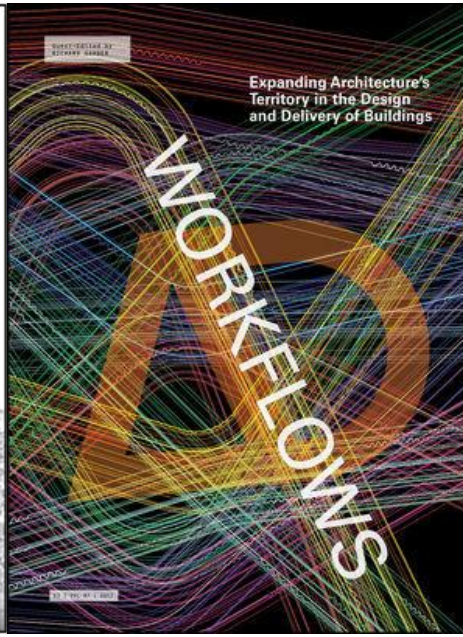
Top ten listed

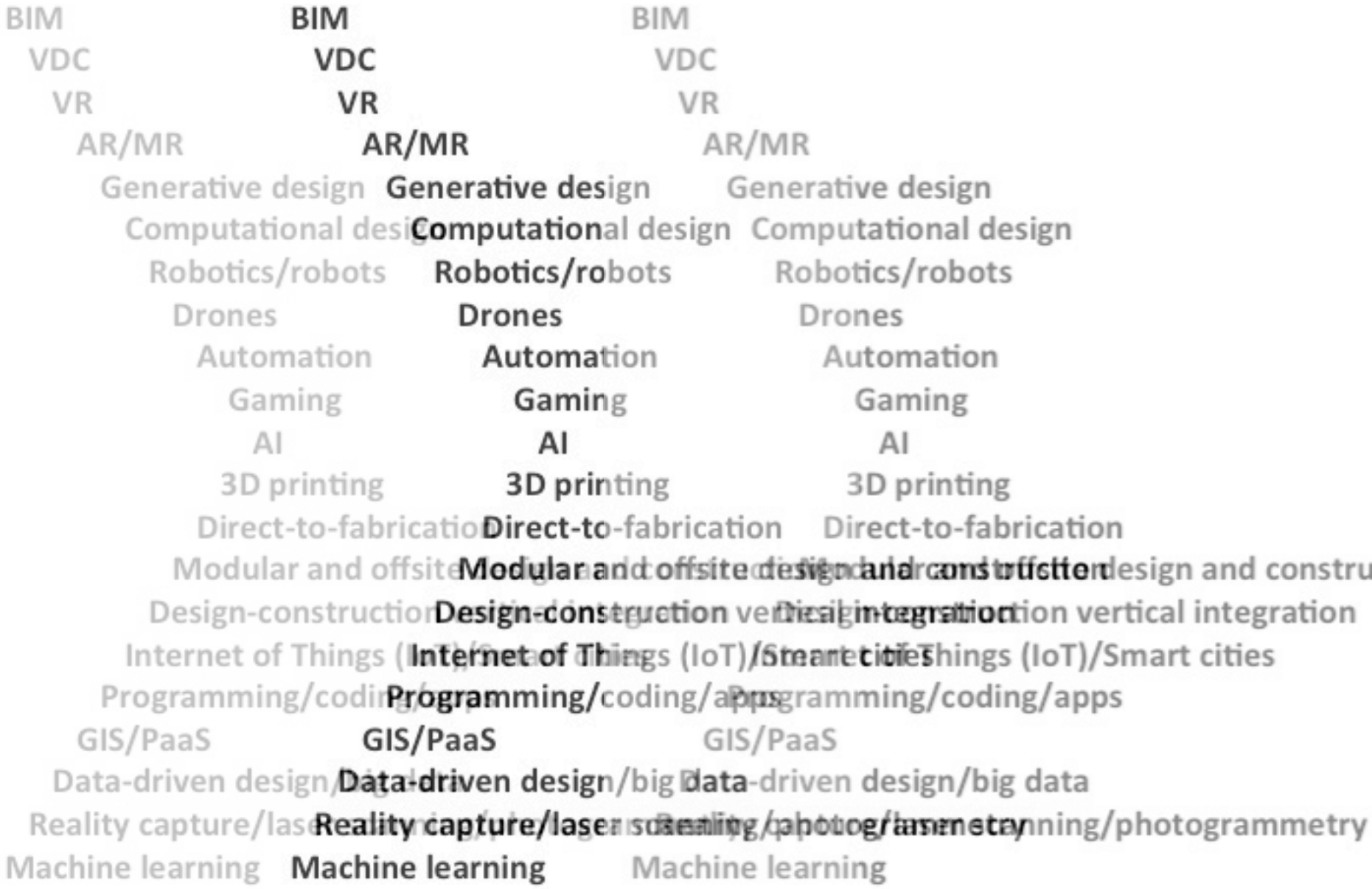
Greater concentration on interdisciplinary studies (awareness of, and collaboration with, multiple disciplines impacting the built environment)	60%
Increased focus on community involvement - e.g. mentorship programs, volunteering, civic opportunities, etc.	57%
Increased focus on design technologies - e.g. BIM, AI, VR, AR, etc.	49%
Expanded focus on global issues/international practice	40%
Deeper concentration on research methodologies	39%
Increased emphasis on sustainable/healthy design	39%
Greater emphasis on construction materials, means and methods	36%
Greater emphasis on communication and presentation skills	35%
Expanded opportunities for study abroad	35%
Greater concentration on design theory and practice	25%


BIM and Integrated Design
Strategies for Architectural Practice


SMART05
CONVERGENCE:
THE REDESIGN
OF DESIGN
Randy Deutsch
WILEY


DATA-DRIVEN
DESIGN AND
CONSTRUCTION
25 STRATEGIES FOR CAPTURING, ANALYZING,
AND APPLYING BUILDING DATA
RANDY DEUTSCH
WILEY


Expanding Architecture's
Territory in the Design
and Delivery of Buildings
WORKFLOWS


BIM
VDC
VR
AR/MR
Generative design
Computational design
Robotics/robots
Drones
Automation
Gaming
AI
3D printing
Direct-to-fabrication
Modular and offsite design and construction
Design-construction vertical integration
Internet of Things (IoT)/Smart cities
Programming/coding/apps
GIS/PaaS
Data-driven design/big data
Reality capture/laser scanning/photogrammetry
Machine learning
BIM
VDC
VR
AR/MR
Generative design
Computational design
Robotics/robots
Drones
Automation
Gaming
AI
3D printing
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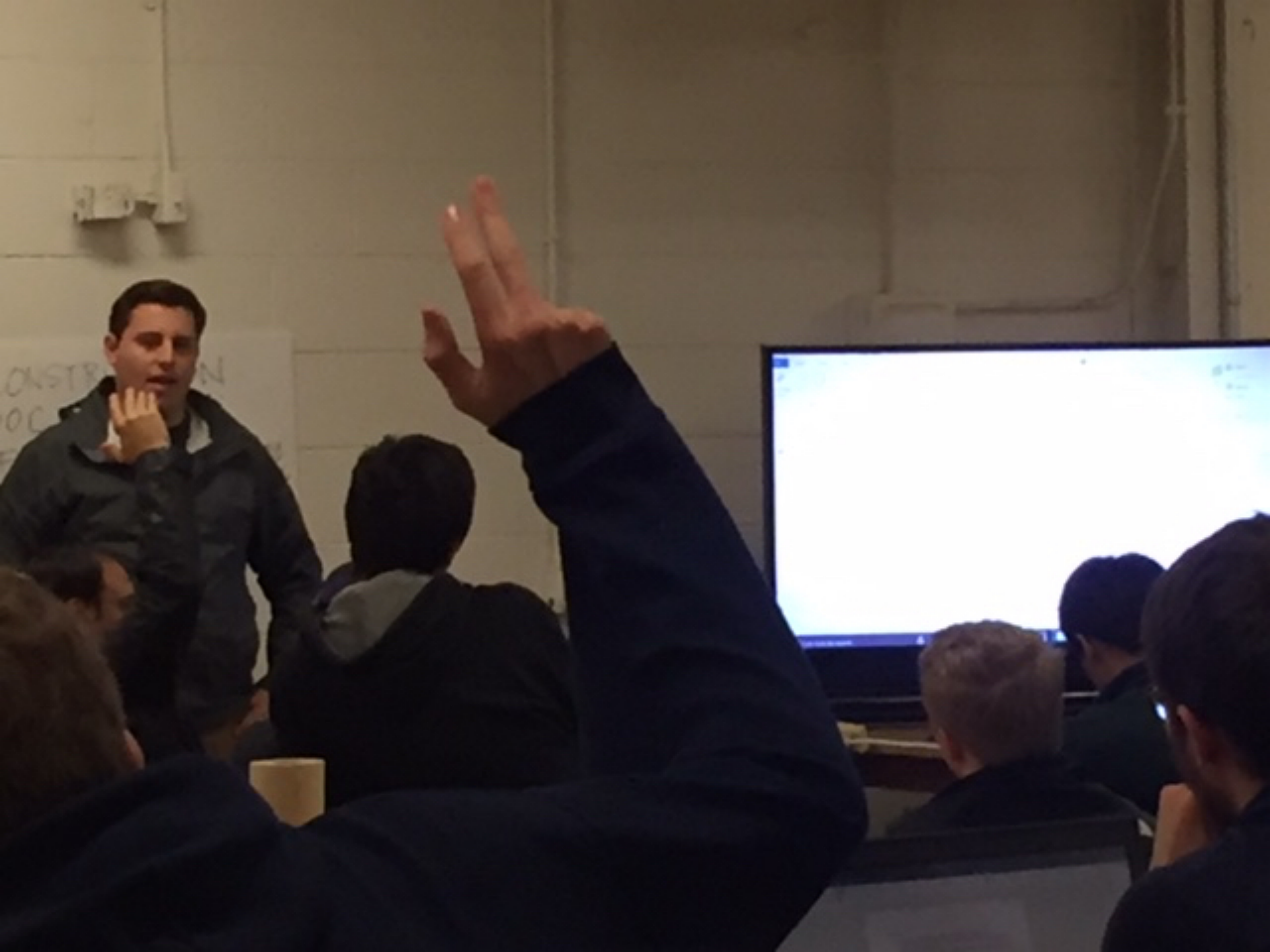
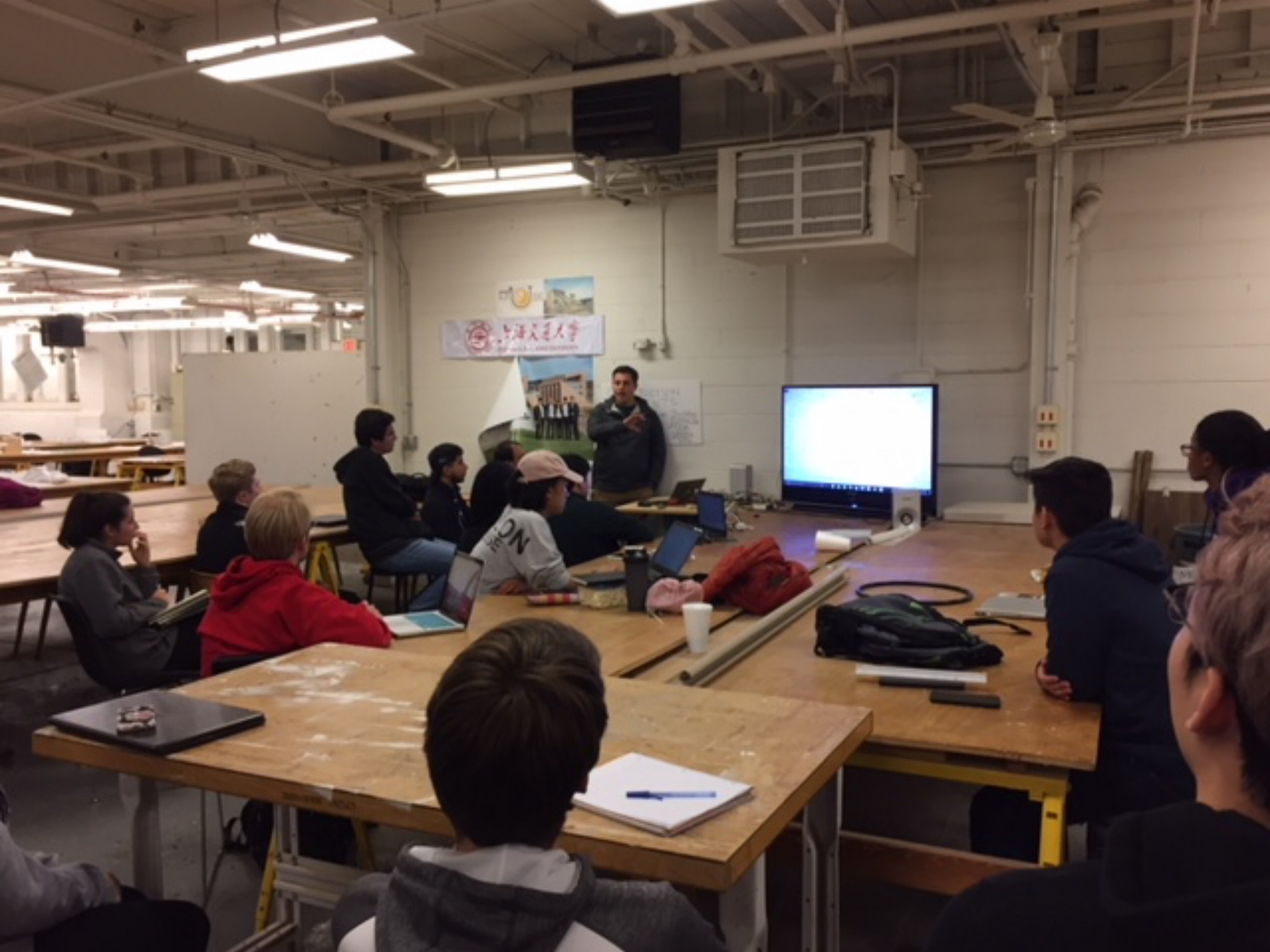
Machine learning
BIM
VDC
VR
AR/MR
Generative design
Computational design
Robotics/robots
Drones
Automation
Gaming
AI
3D printing
Direct-to-fabrication
Design-construction vertical integration
Internet of Things (IoT)/Smart cities
Programming/coding/apps
GIS/PaaS
Data-driven design/big data
Reality capture/laser scanning/photogrammetry
Machine learning

Human UI

- **Architectural implications:**
  - It makes Grasshopper more accessible to designers
  - NBBJ uses it for a wide range of purposes from designing forms to estimating facility space needed for future growth to calculating views, to daylight computation/ simulation.
  - NBBJ implemented Human UI in their design proposal for 2 towers in London that would leverage the sun path to minimize shadows on the ground level public spaces

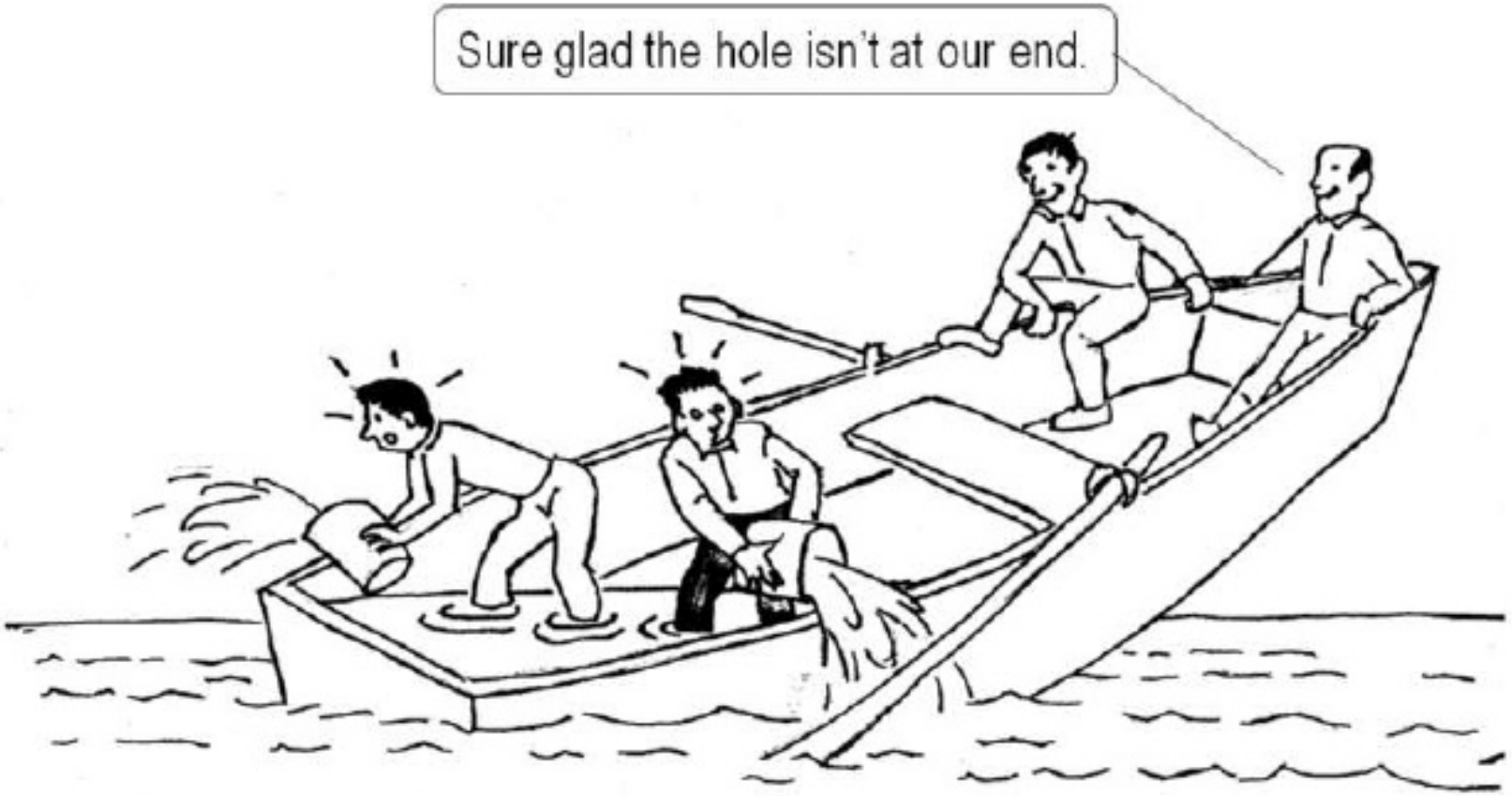




Having the

- wherewithal to recognize a tool
- curiosity to inquire into a tool
- confidence to mess with a tool
- capacity to learn a tool
- instinct to combine tools

These are more important

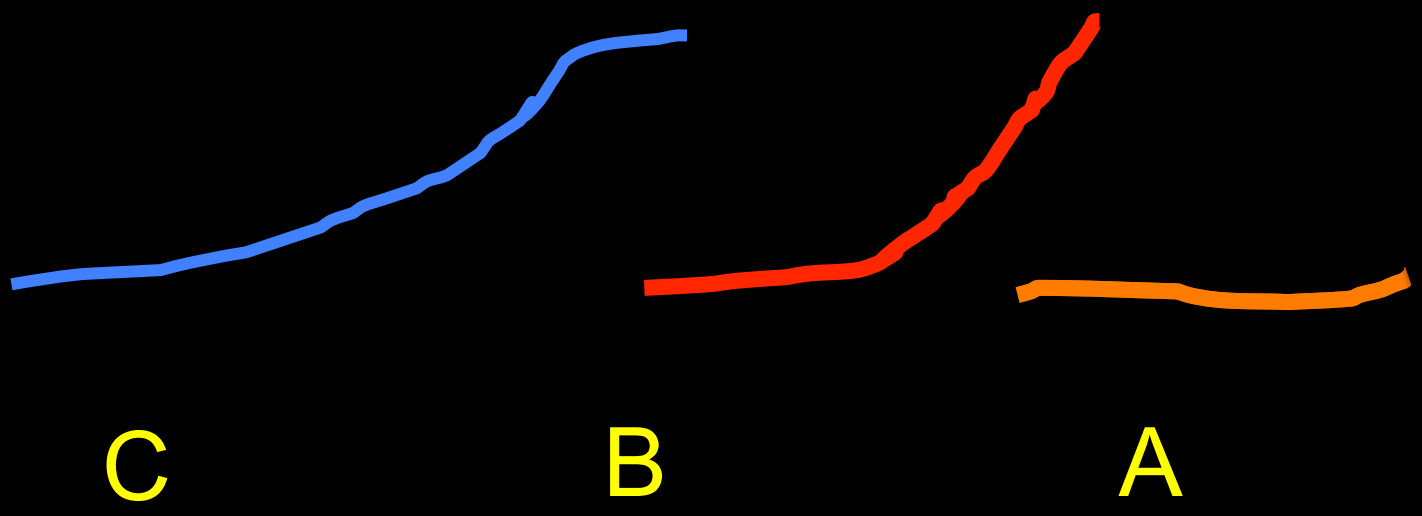

Sure glad the hole isn't at our end.

Both #architects & #highereducation:

- Divide between the haves and the have-nots
- Are trying to justify & explain themselves, better articulate and prove what they do
- Are experiencing Americans' intensifying resentment of anything that smacks of elitism
- Have maintained too aloof a posture
- Once great aspirations — now polarizing question marks

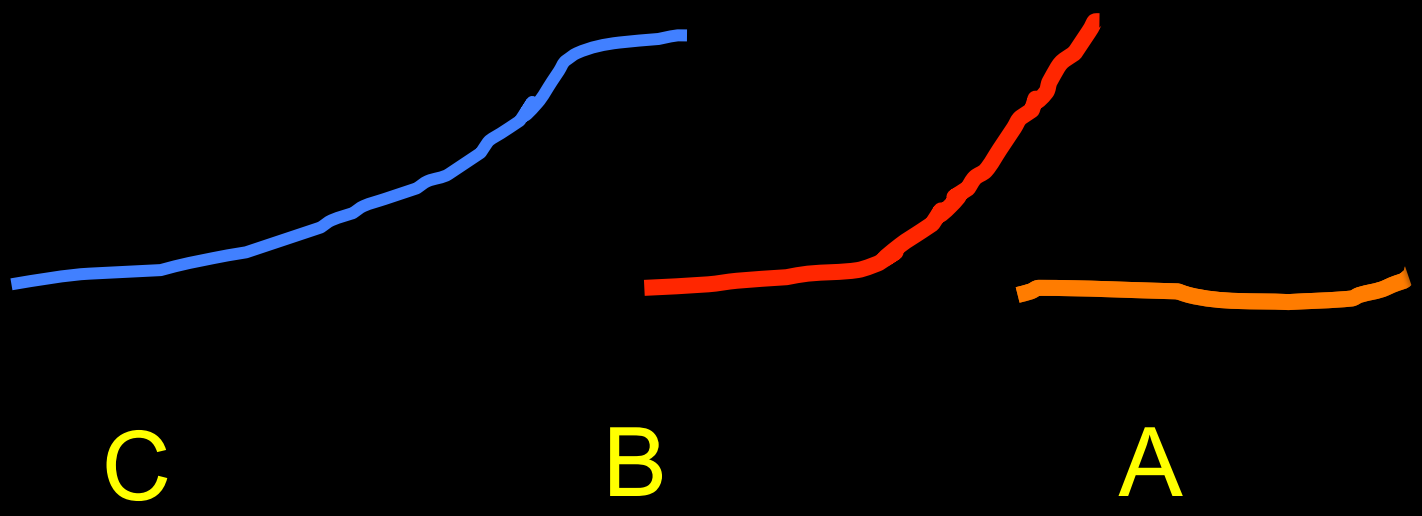
Not all accept on faith their value

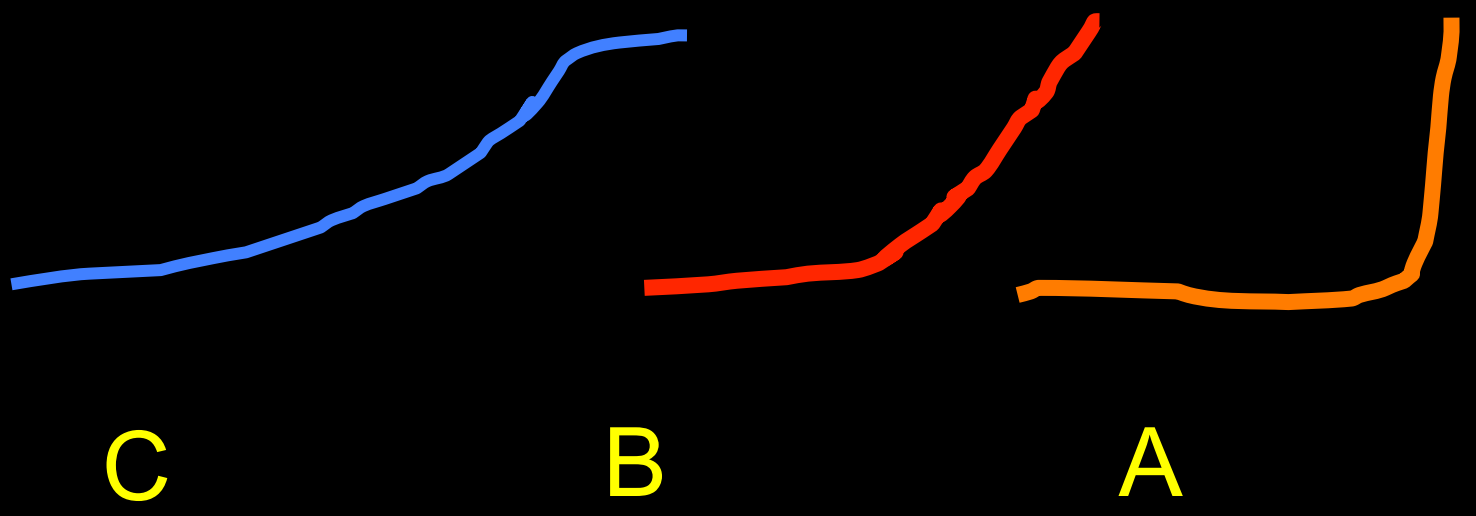
You will be graduating into a field experiencing technology disruption

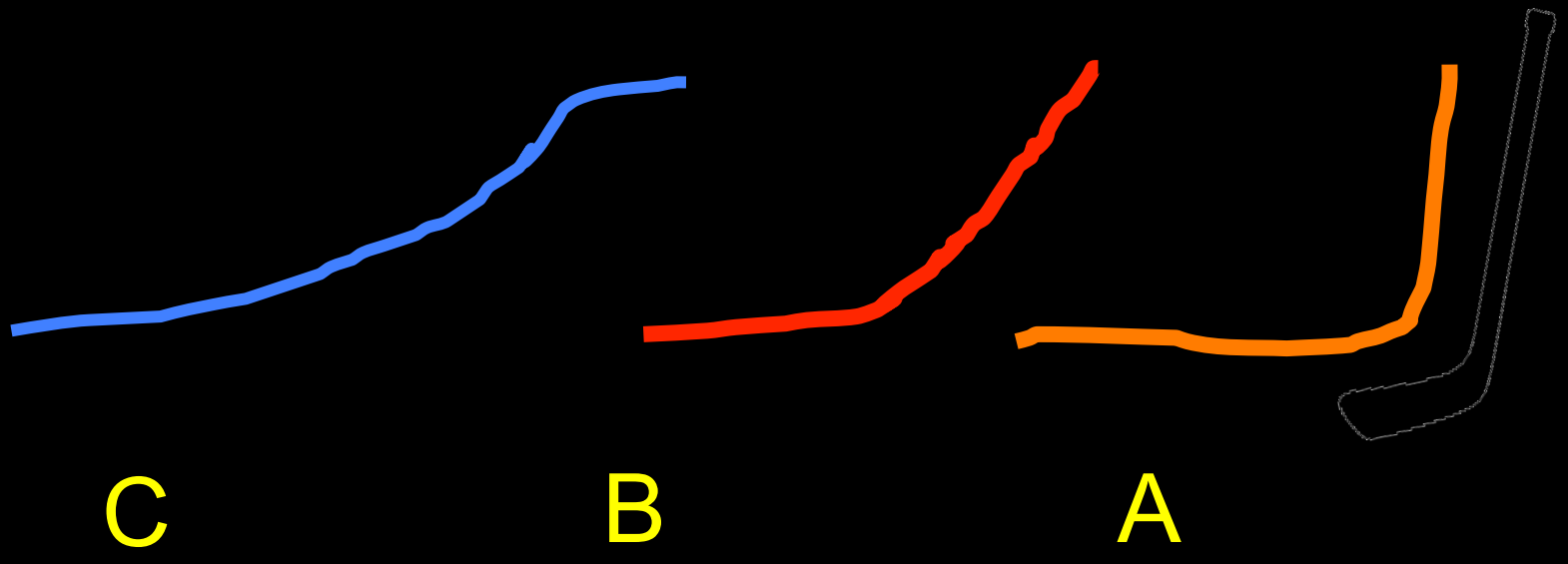

C
B
A

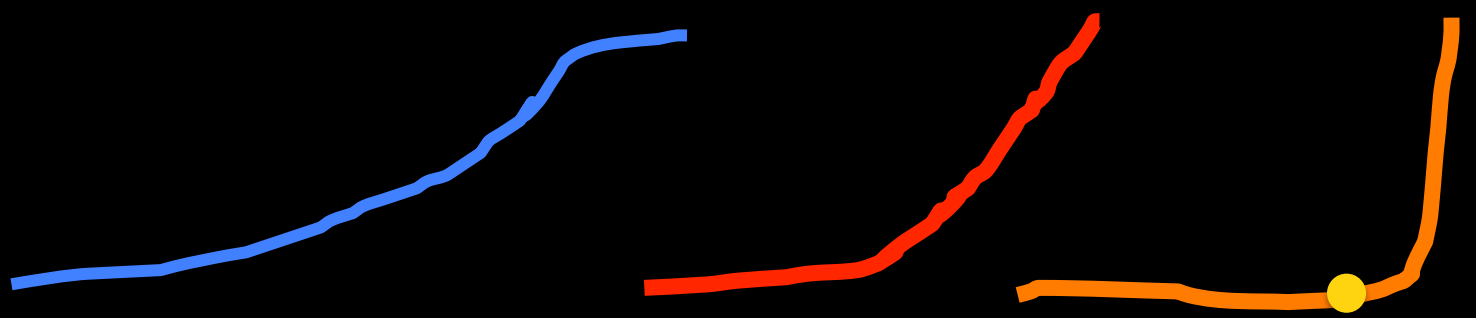

3
2
1


CAD
BIM
AI


C
B
A


C
B
A


C
B
A



C B A

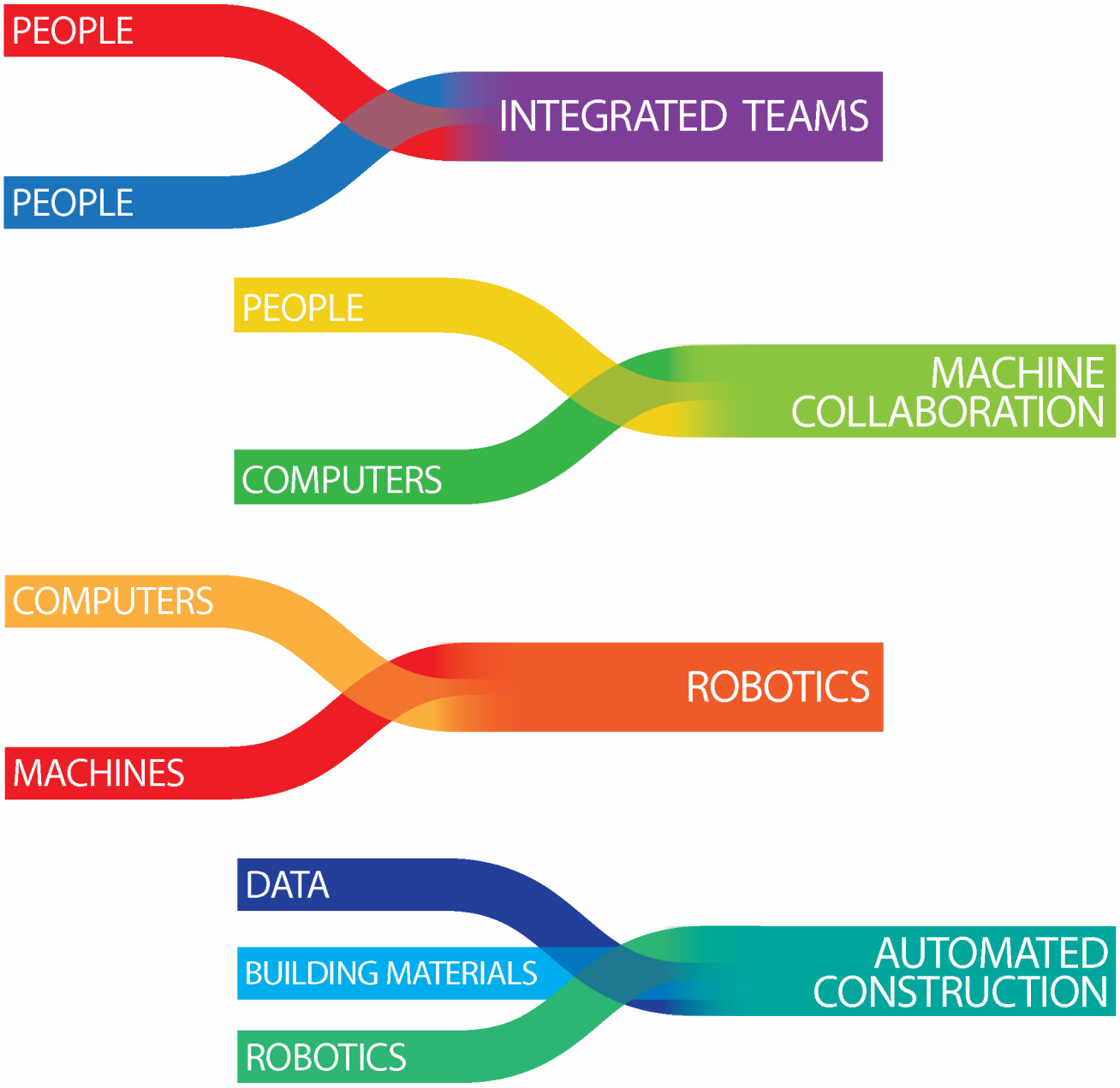

URBAN SEARCH & RESCUE TYPE 3

al dean
@alistardean

Follow

“What’s innovative today will soon be expected”. Nicely sums up how quickly these tools are advancing and converging into a new set of tools #AU2017

9:38 AM - 15 Nov 2017

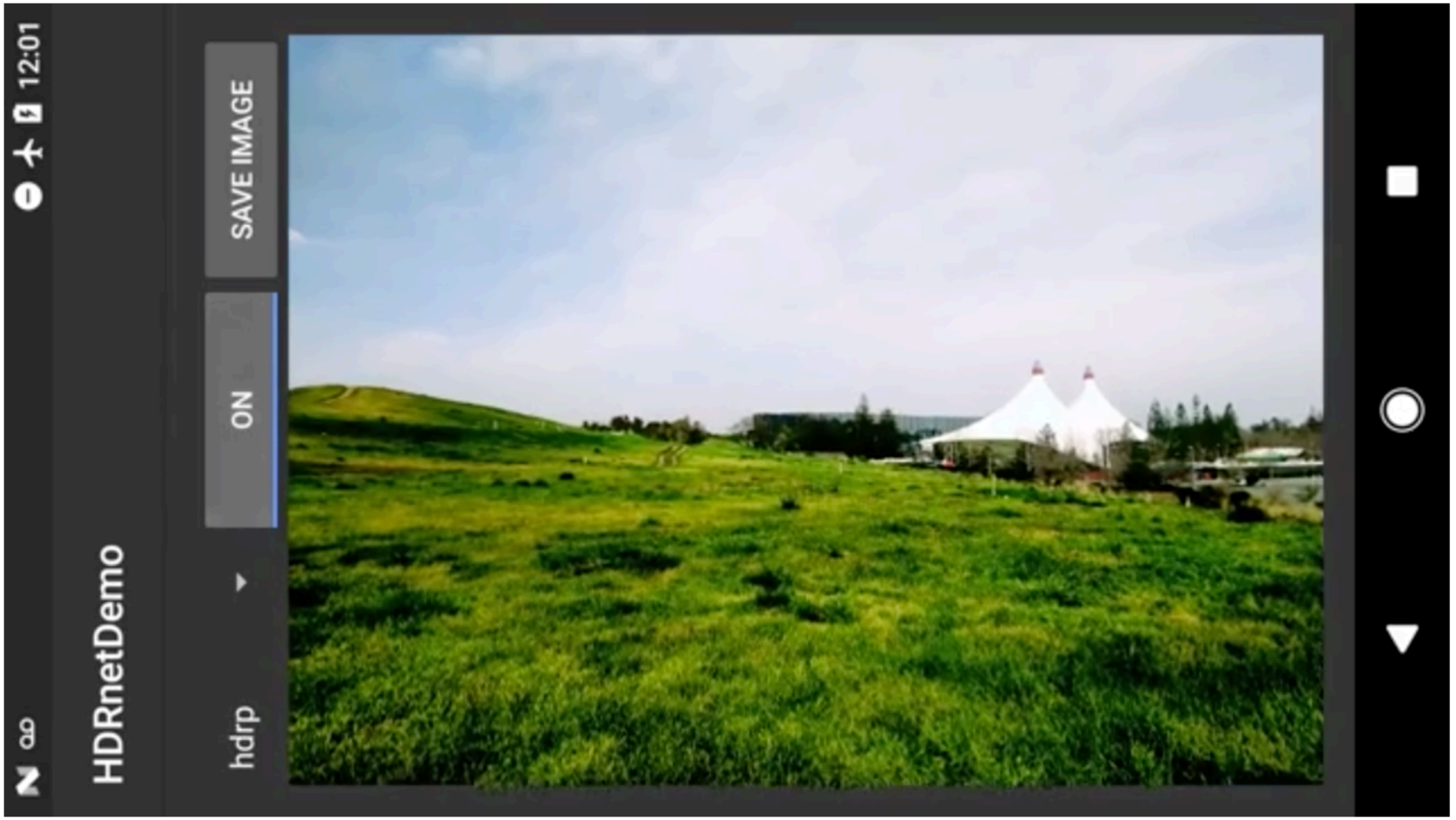

PEOPLE
PEOPLE
INTEGRATED TEAMS
PEOPLE
COMPUTERS
MACHINE COLLABORATION
COMPUTERS
MACHINES
ROBOTICS
DATA
BUILDING MATERIALS
ROBOTICS
AUTOMATED CONSTRUCTION

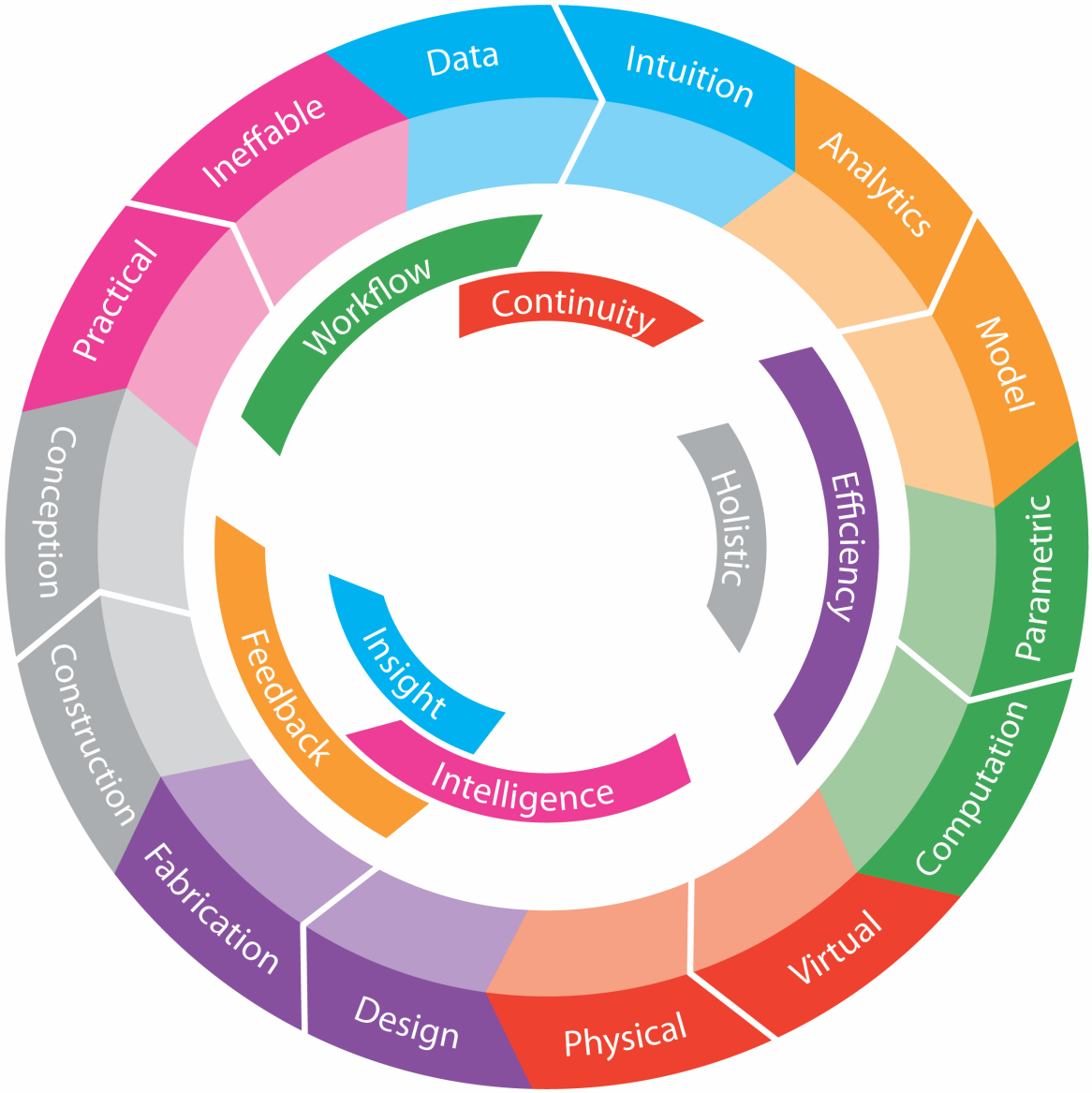

Pre-
Analysis
Design
Build
Post-
Analysis
Convergence

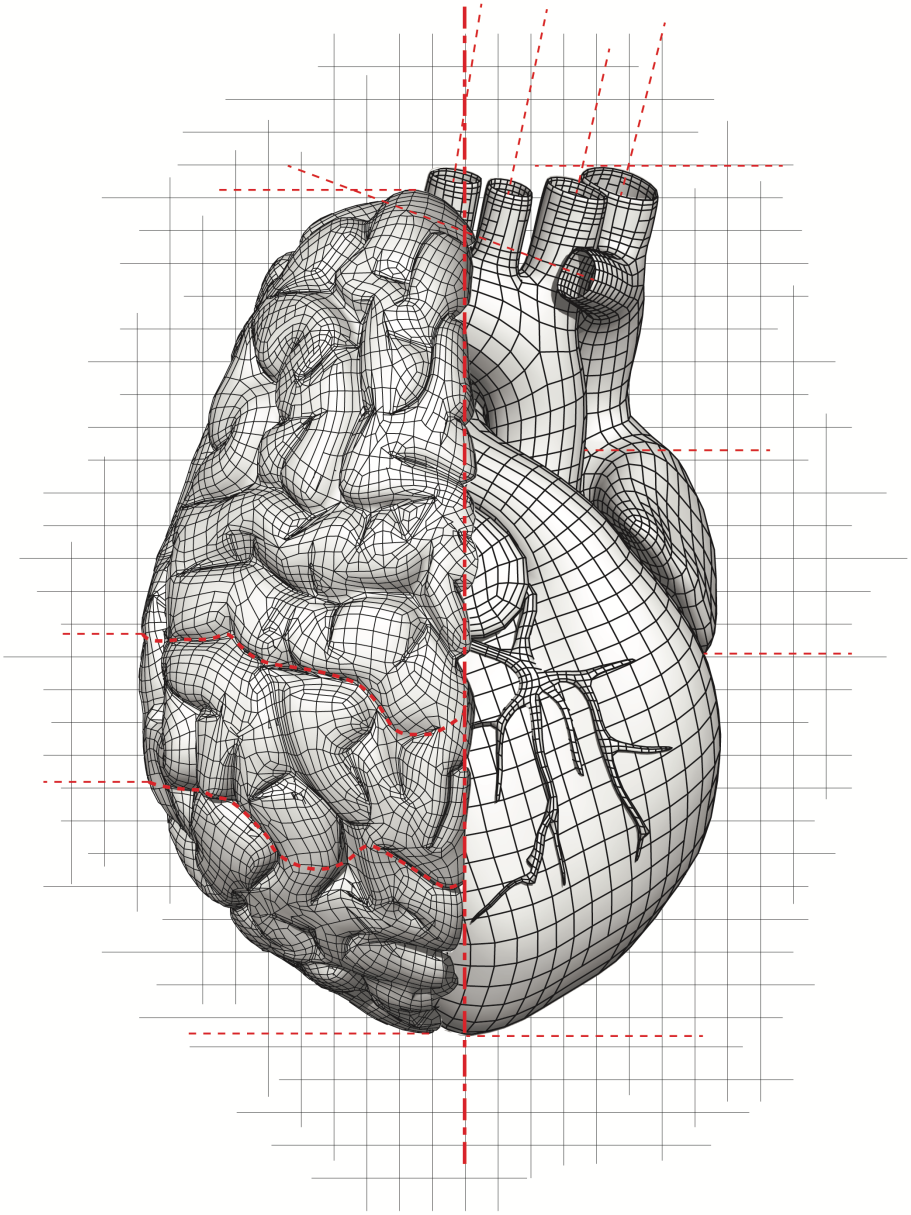
This Super Fast Algorithm Edits Photographs Like a Professional - Before You Take Them

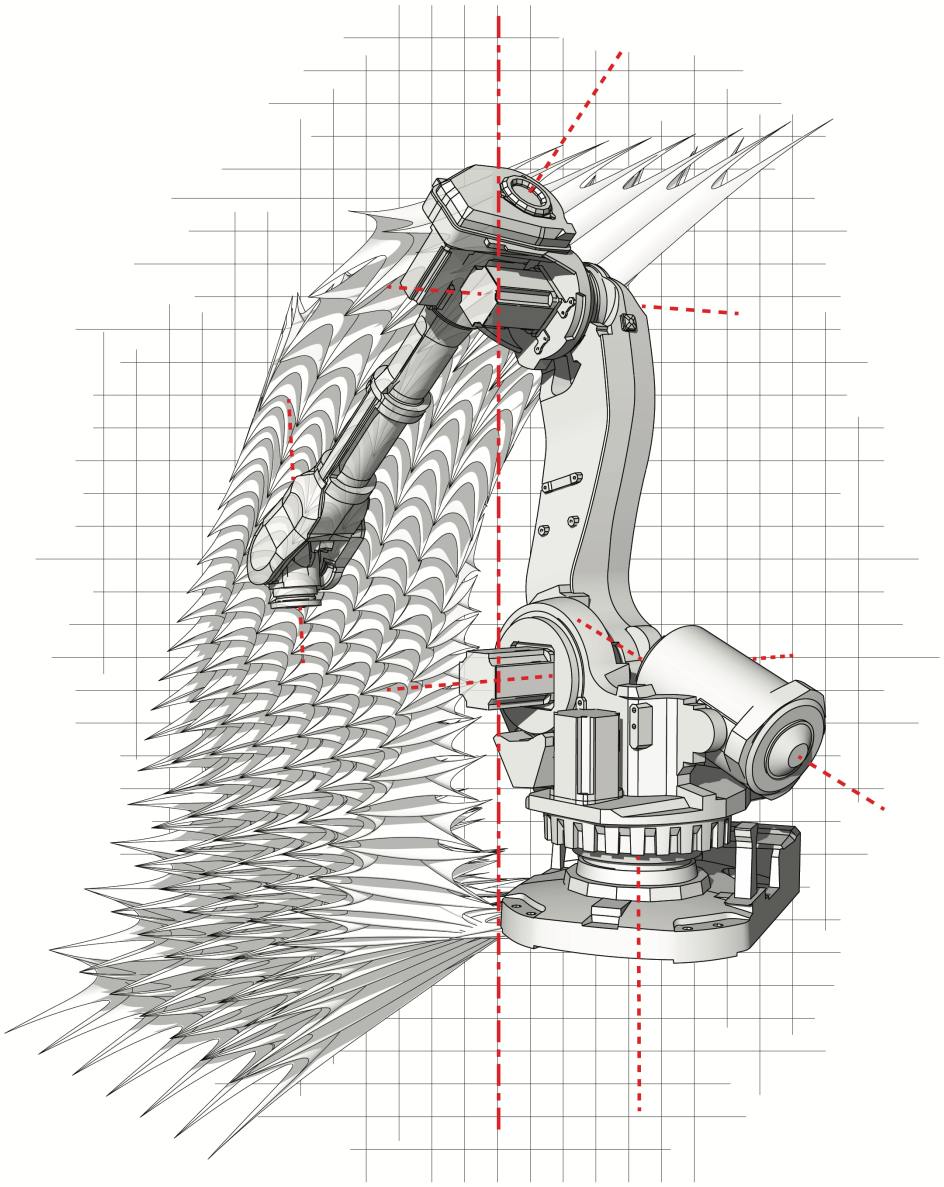
6:00 - 7 August, 2017 | by **Rory Stott**

Share in Whatsapp



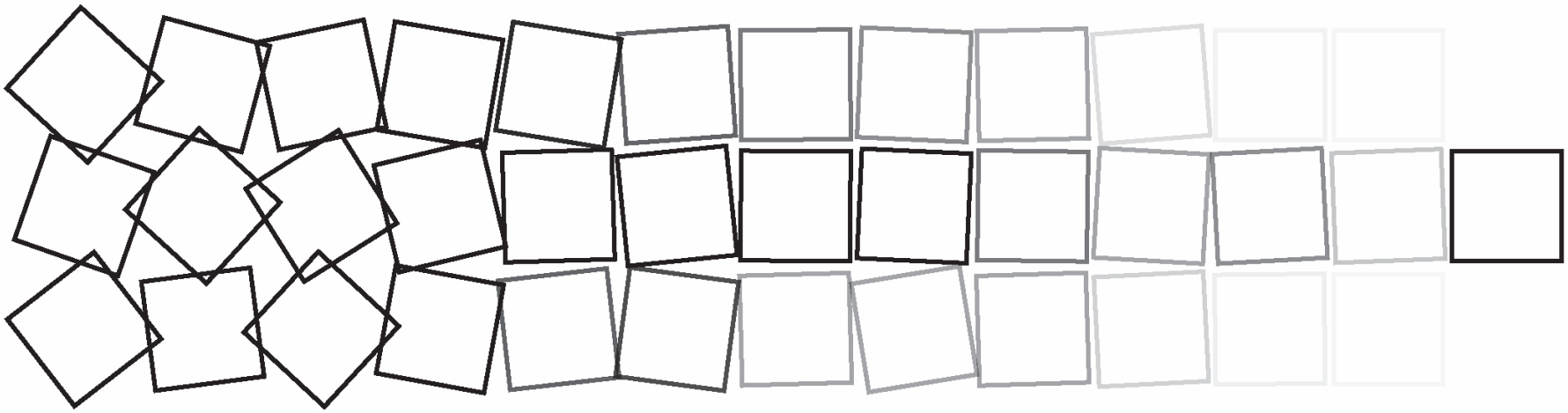

Data
Intuition
Analytics
Model
Parametric
Computation
Virtual
Physical
Design
Fabrication
Construction
Conception
Practical
Ineffable
Workflow
Continuity
Efficiency
Holistic
Intelligence
Insight
Feedback





AMBIGUITY

CLARITY



UNCERTAINTY

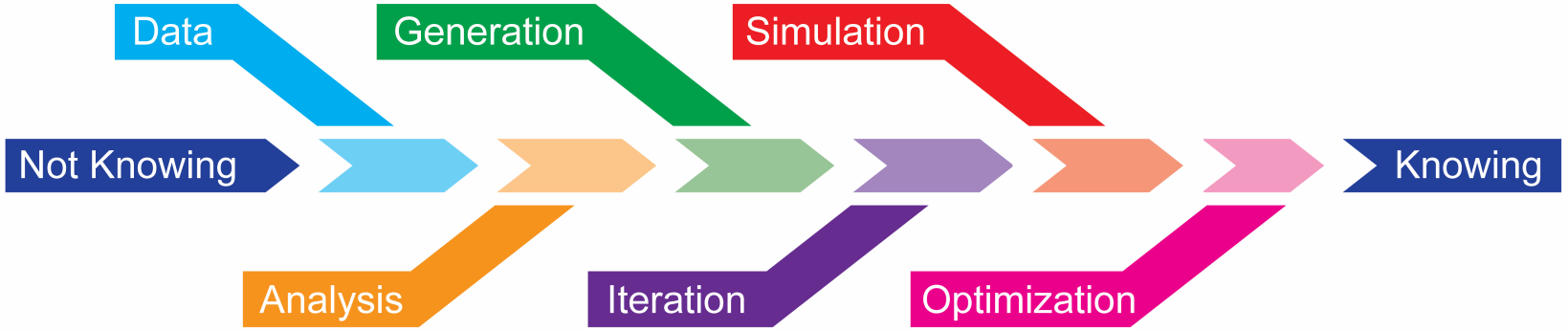
CERTAINTY

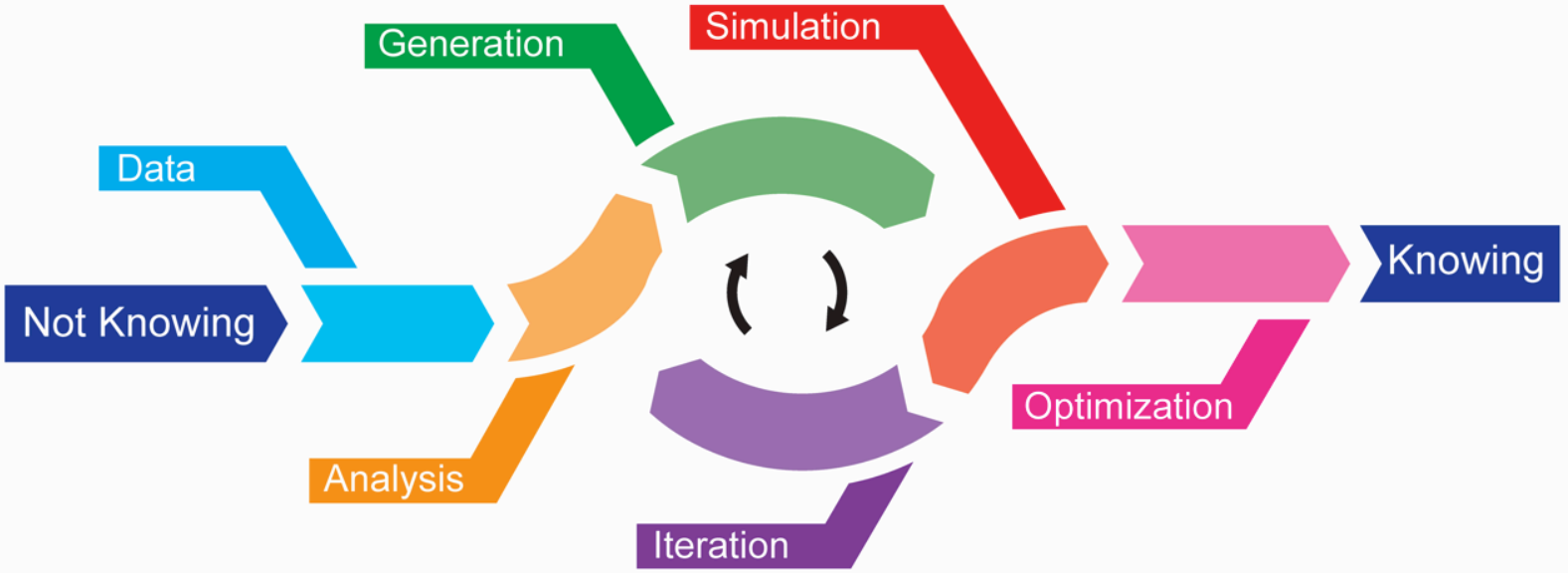
COMPLEX

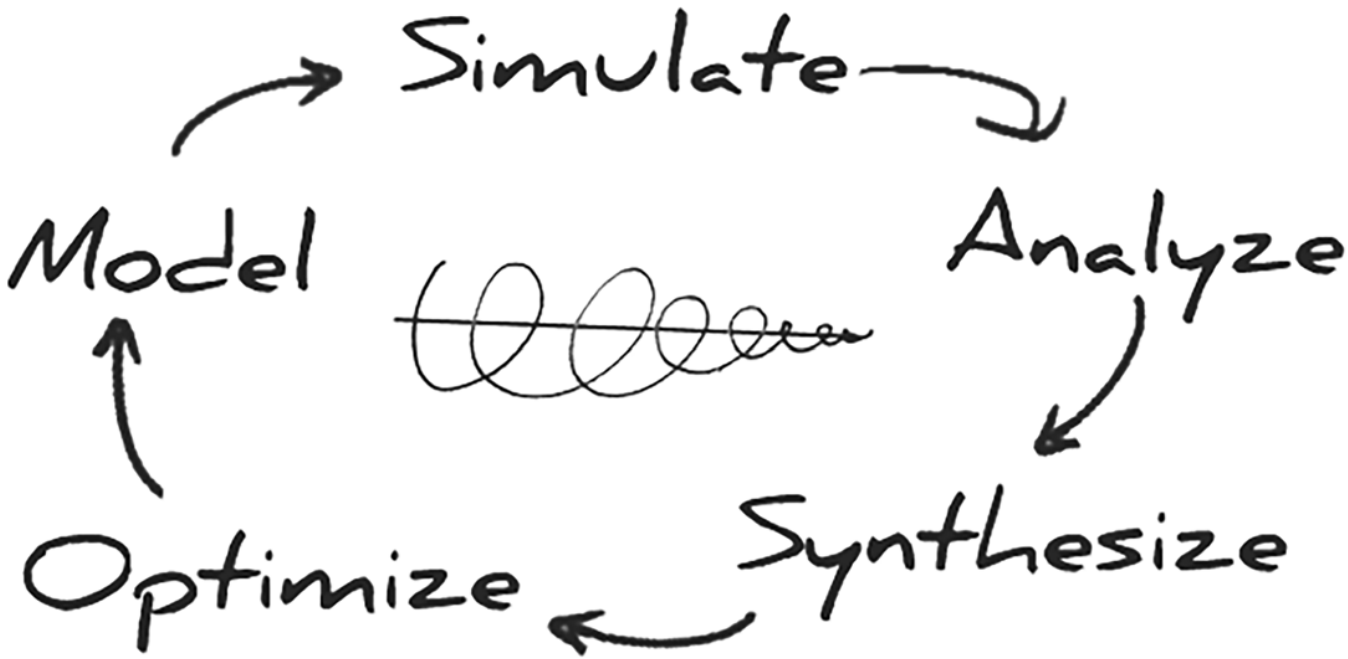
SIMPLE

TIME INTENSIVE

INSTANTANEOUS

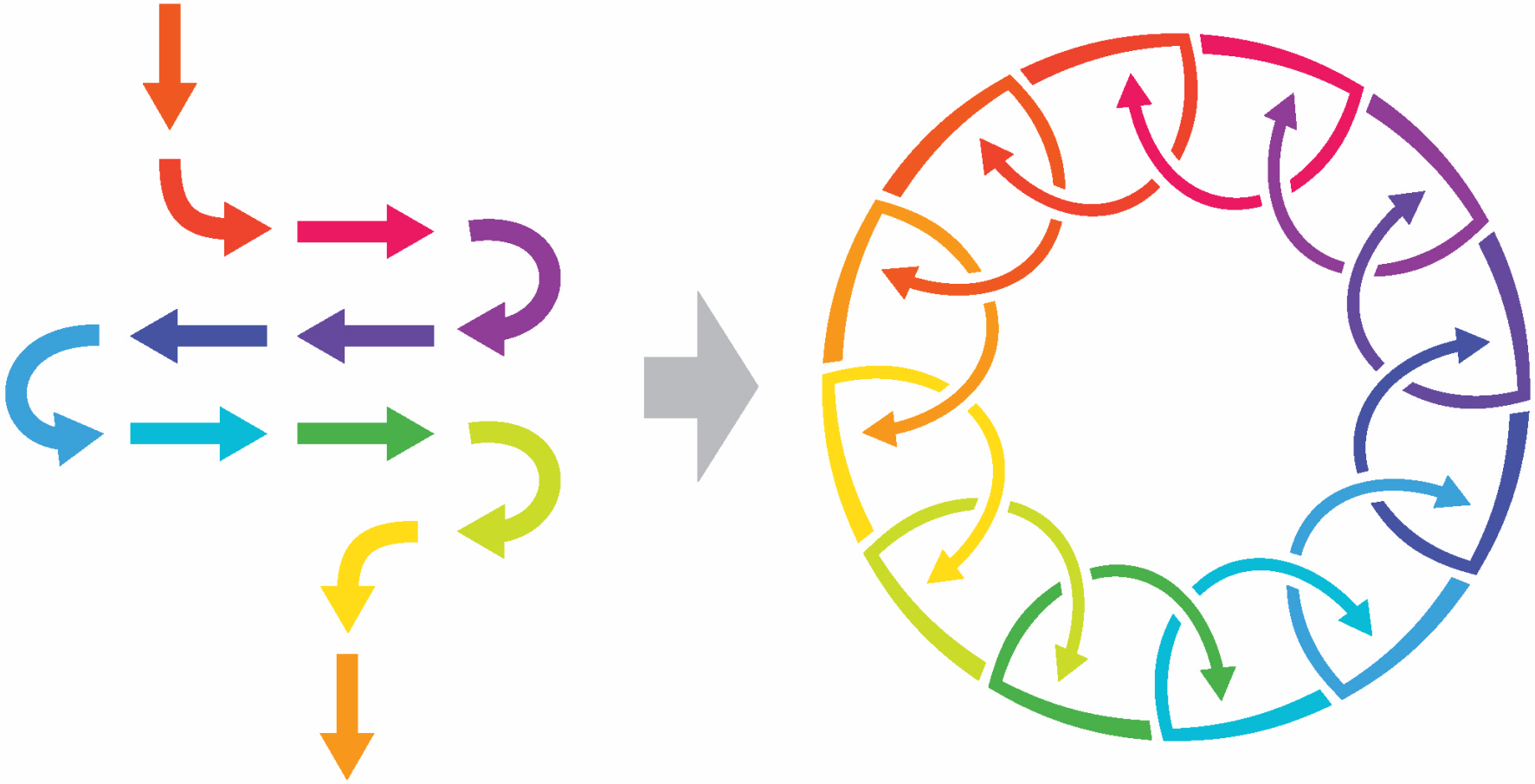

Data
Generation
Simulation
Not Knowing
Knowing
Analysis
Iteration
Optimization


Generation
Simulation
Data
Not Knowing
Knowing
Analysis
Optimization
Iteration

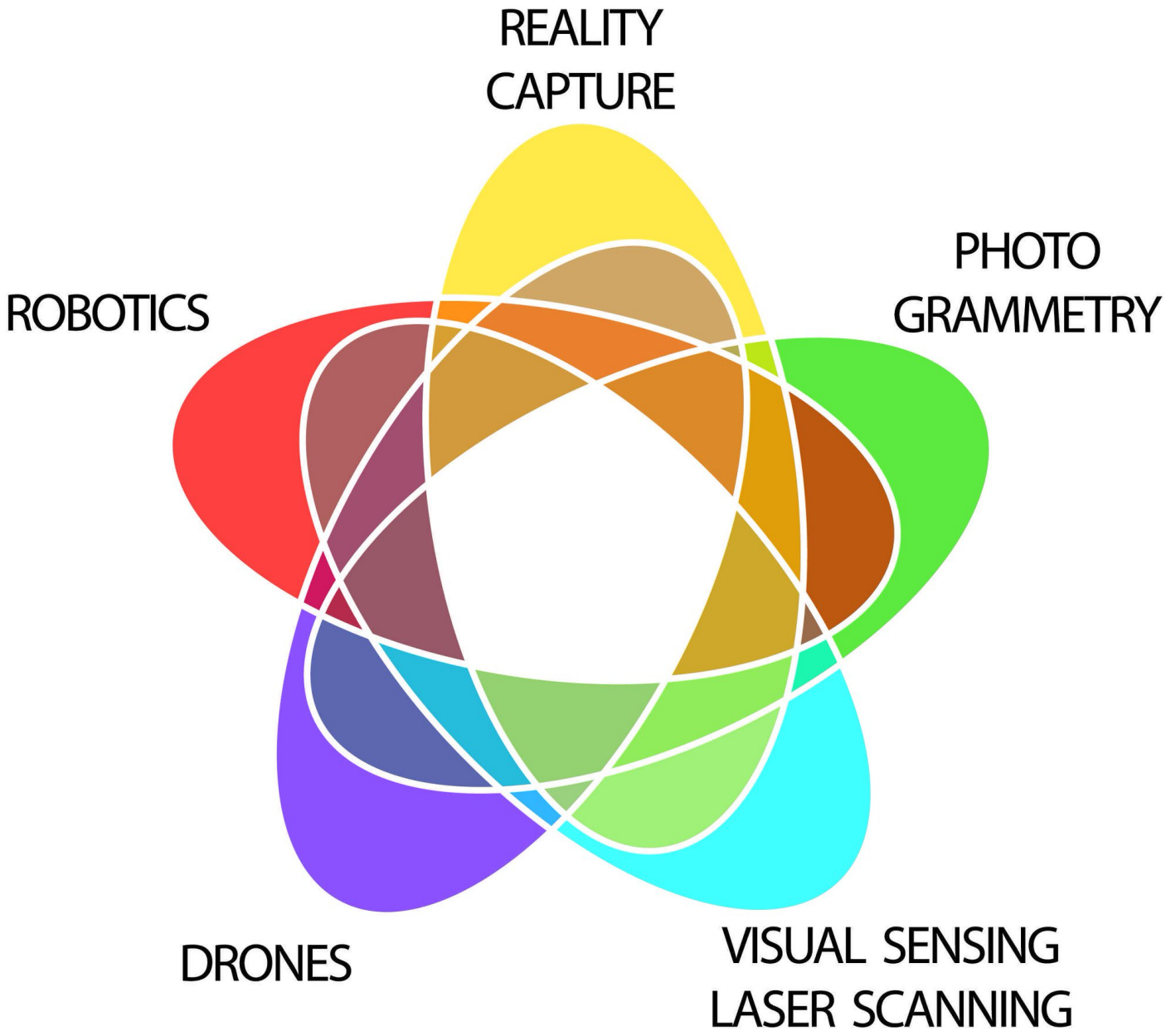

Simulate
Analyze
Synthesize
Optimize
Model

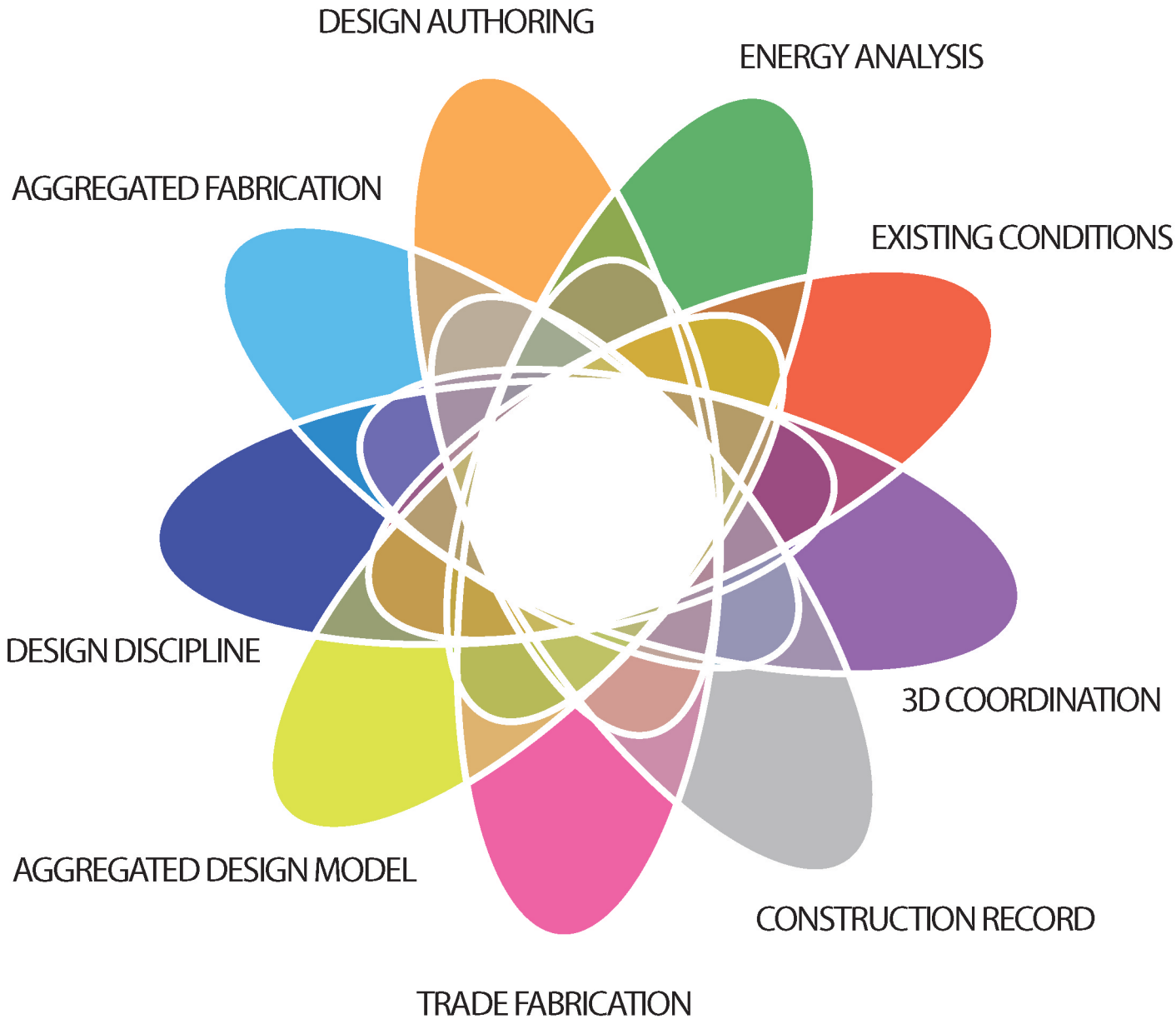
LINEAR STEPS

FEEDBACK LOOP

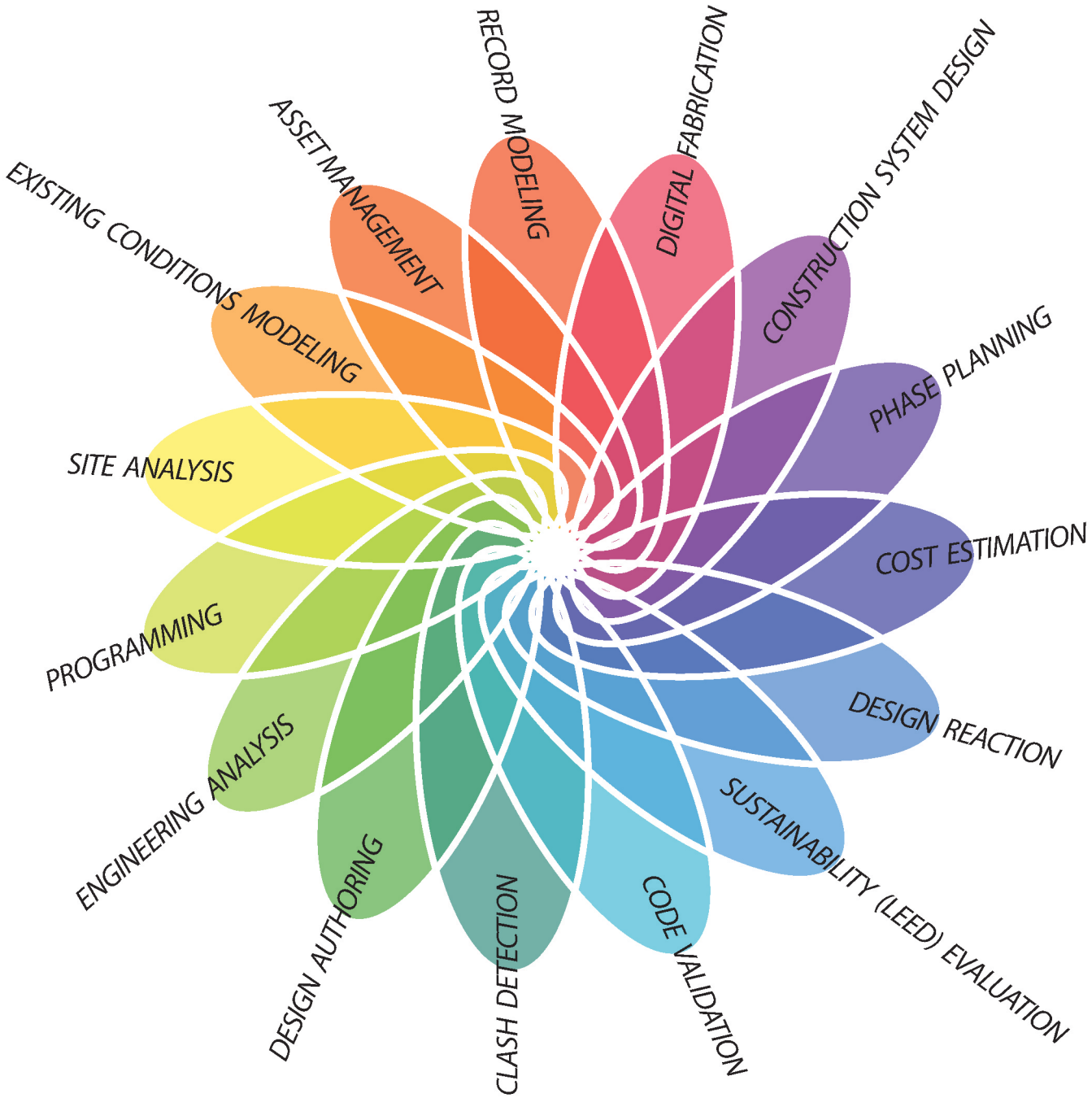


TECHNOLOGY ENABLES SIMULTANEOUS WORKFLOW


REALITY
CAPTURE
PHOTO
GRAMMETRY
ROBOTICS
DRONES
VISUAL SENSING
LASER SCANNING


DESIGN AUTHORING
ENERGY ANALYSIS
AGGREGATED FABRICATION
EXISTING CONDITIONS
DESIGN DISCIPLINE
3D COORDINATION
AGGREGATED DESIGN MODEL
CONSTRUCTION RECORD
TRADE FABRICATION


DESIGN AUTHORING
ENERGY ANALYSIS
EXISTING CONDITIONS
3D COORDINATION
CONSTRUCTION RECORD
AGGREGATED DESIGN MODEL
DESIGN DISCIPLINE
TRADE FABRICATION
AGGREGATED FABRICATION


RECORD MODELING
DIGITAL FABRICATION
CONSTRUCTION SYSTEM DESIGN
ASSET MANAGEMENT
EXISTING CONDITIONS MODELING
PHASE PLANNING
SITE ANALYSIS
COST ESTIMATION
PROGRAMMING
DESIGN REACTION
ENGINEERING ANALYSIS
SUSTAINABILITY (LEED) EVALUATION
DESIGN AUTHORING
CLASH DETECTION
CODE VALIDATION


HYBRID

Super-Strength Operator

Augmented Operator

Virtual Operator

Healthy Operator

Smarter Operator

Collaborative Operator

Social Operator

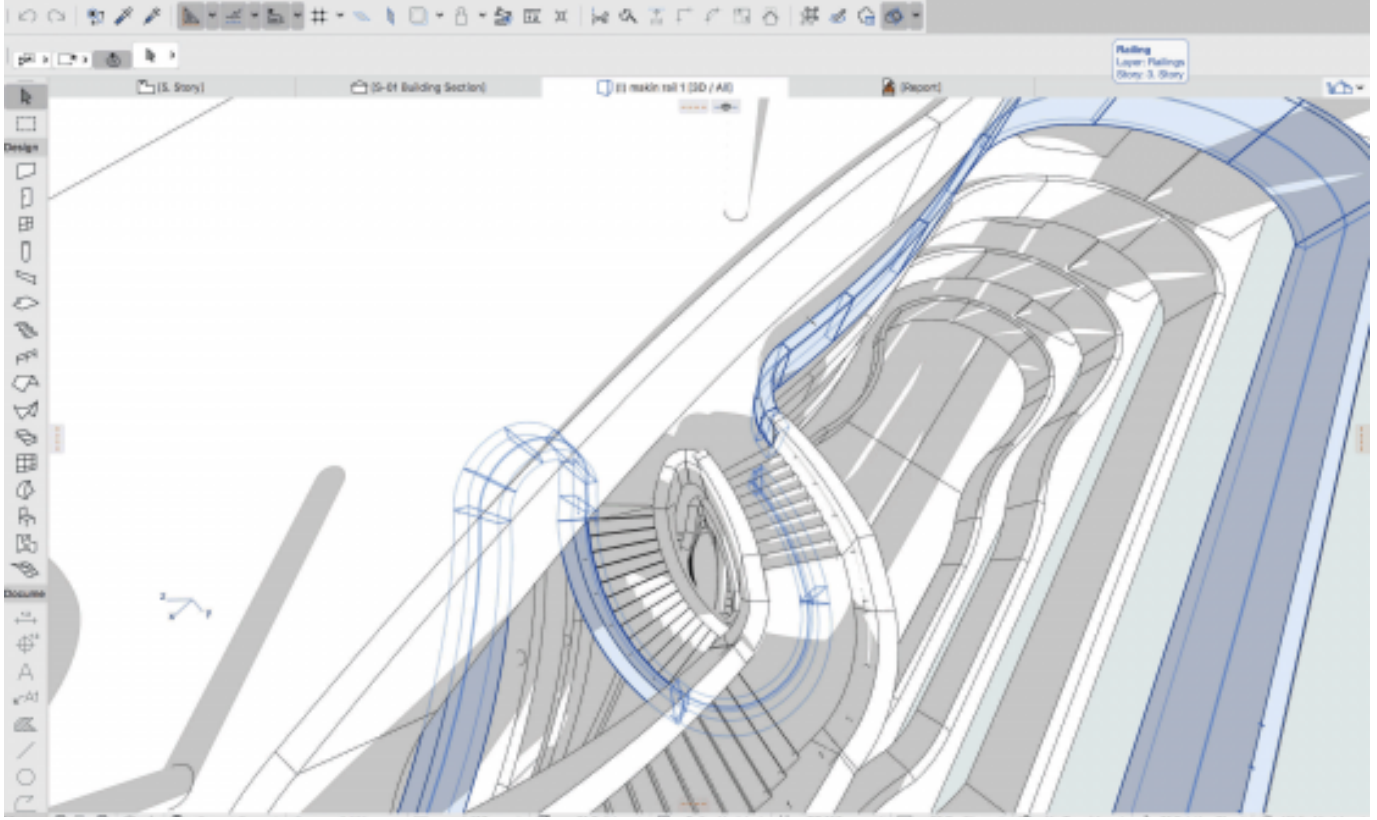
Analytical Operator


45% of today's work
can be automated, leaving more time
for what really matters.
Augmented human labour is an
inclusive opportunity, not a threat.

AI: Fake, Weak and Narrow

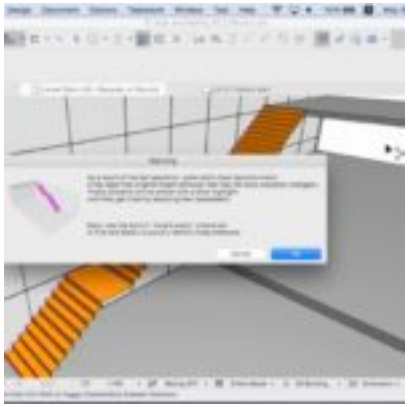
Beijing Is Getting a $2.1 Billion AI District

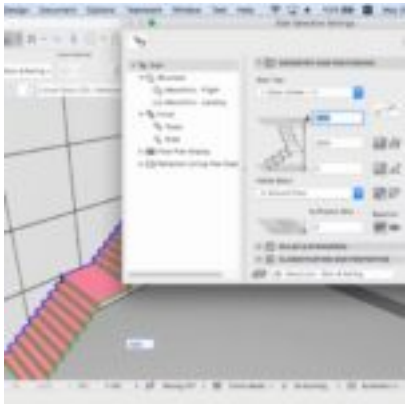
China is gearing up to build a technology park in Beijing entirely dedicated to the development of artificial intelligence, news first reported by Xinhua, the country's official press agency.

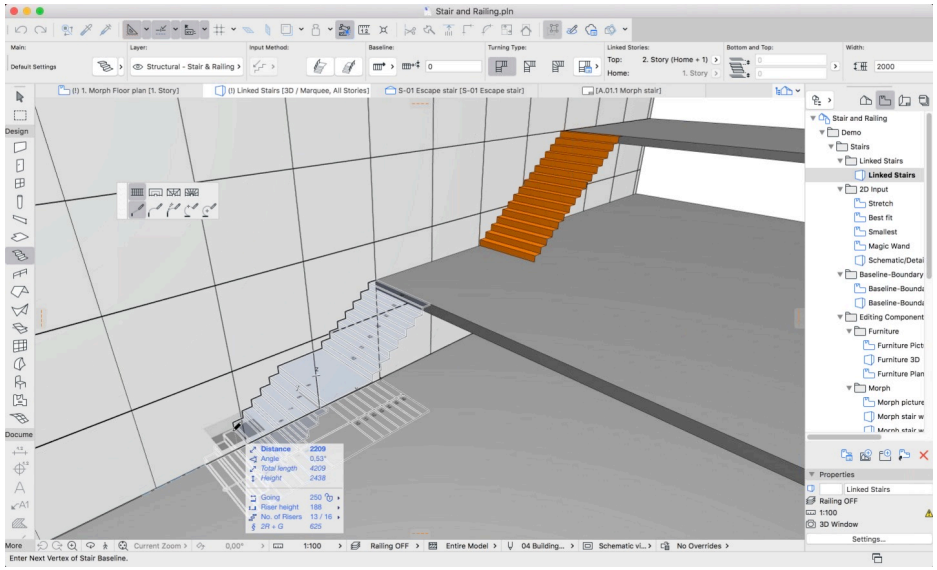


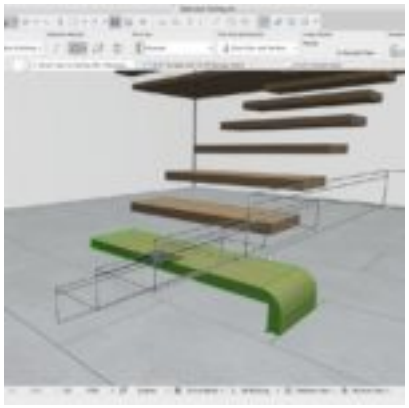
"The company believes this is the first practical application of AI (artificial intelligence) in design by a BIM software package, and hence they are protecting it with a patent application."

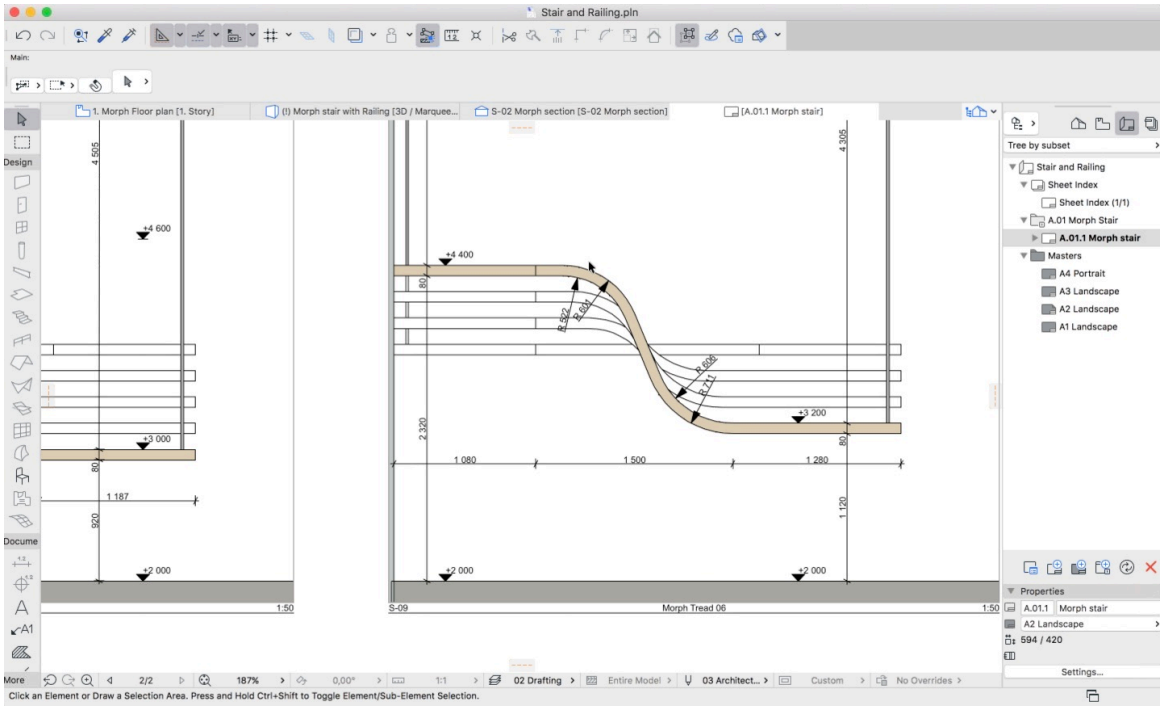
--- Eniko Pauko, Senior BIM Consultant, GRAPHISOFT SE

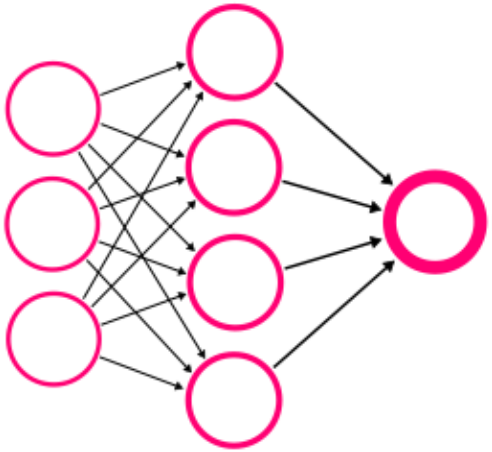




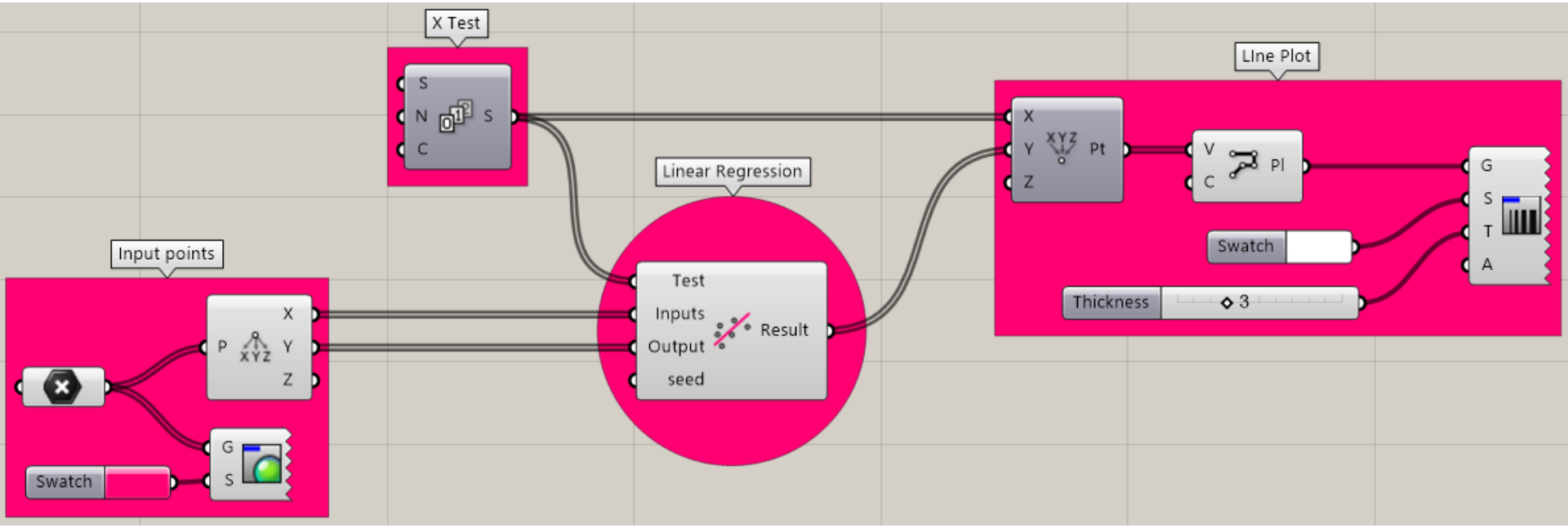

Stair and Railing.pln
Main:
Default Settings
Layer:
Structural - Stair & Railing
Input Method:
Baseline:
Turning Type:
Linked Stories:
Top: 2. Story (Home + 1)
Home: 1. Story
Bottom and Top:
Width:
2000
(I) 1. Morph Floor plan [1. Story]
(I) Linked Stairs [3D / Marquee, All Stories]
S-01 Escape stair [S-01 Escape stair]
[A.01.1 Morph stair]
Design
Docume
Distance 2209
Angle 0,53°
Total length 4209
Height 2438
Going 250
Riser height 188
No. of Risers 13 / 16
2R + G 625
Stair and Railing
Demo
Stairs
Linked Stairs
Linked Stairs
2D Input
Stretch
Best fit
Smallest
Magic Wand
Baseline-Boundary
Editing Component
Furniture
Morph
Properties
Linked Stairs
Railing OFF
1:100
3D Window
Settings...
More
Current Zoom
1:100
Railing OFF
Entire Model
04 Building...
Schematic vi...
No Overrides
Enter Next Vertex of Stair Baseline.




Stair and Railing.pln
1. Morph Floor plan [1. Story]
(I) Morph stair with Railing [3D / Marquee...
S-02 Morph section [S-02 Morph section]
[A.01.1 Morph stair]
Tree by subset
Stair and Railing
Sheet Index
Sheet Index (1/1)
A.01 Morph Stair
A.01.1 Morph stair
Masters
A4 Portrait
A3 Landscape
A2 Landscape
A1 Landscape
+4 600
+3 000
+2 000
+4 400
+3 200
+2 000
+2 000
4 505
4 305
2 320
1 187
920
1 080
1 500
1 280
1 120
80
S-09
Morph Tread 06
1:50
1:50
Properties
A.01.1
Morph stair
A2 Landscape
594 / 420
Settings...
02 Drafting
Entire Model
03 Architect...
Custom
No Overrides
Click an Element or Draw a Selection Area. Press and Hold Ctrl+Shift to Toggle Element/Sub-Element Selection.

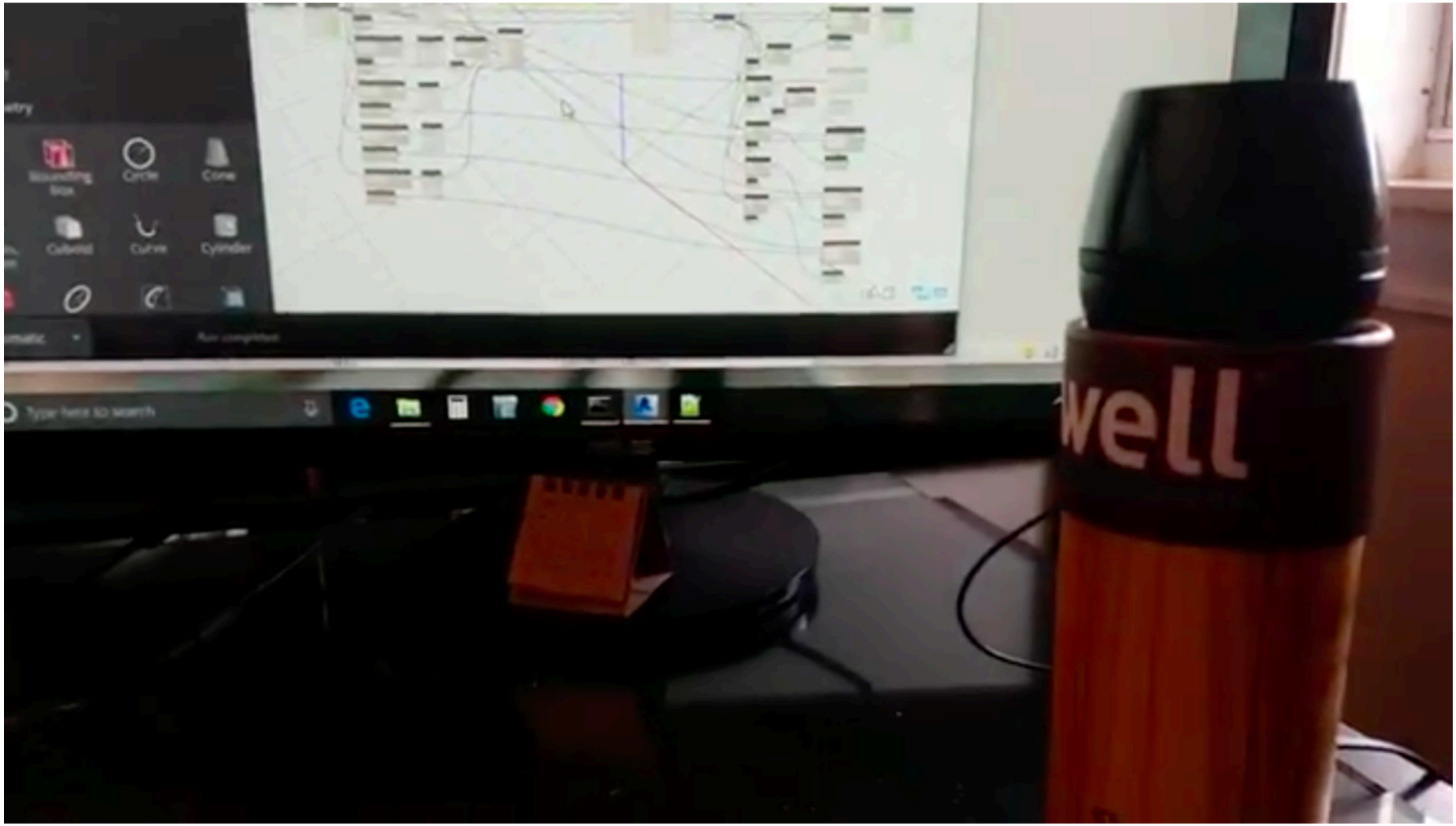


LunchBoxML


X Test
S
N
C
S
Linear Regression
Test
Inputs
Output
seed
Result
Input points
P
X
Y
Z
XYZ
Swatch
G
S
LIne Plot
X
Y
Z
XYZ
Pt
V
C
Pl
Swatch
Thickness
3
G
S
T
A

YouTube

Search



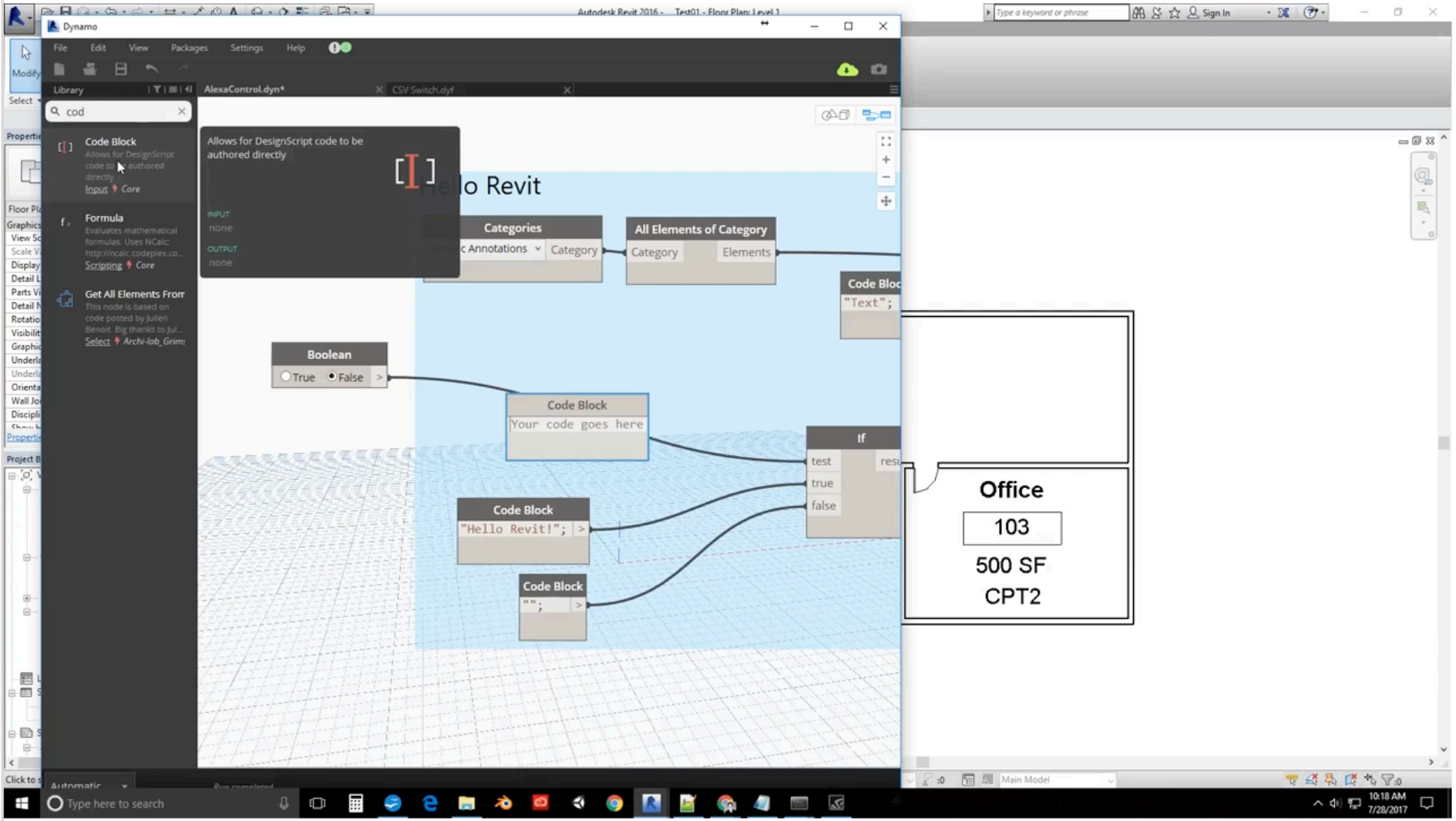
Alexa talks to Revit

3,772 views

67 1 SHARE

YouTube

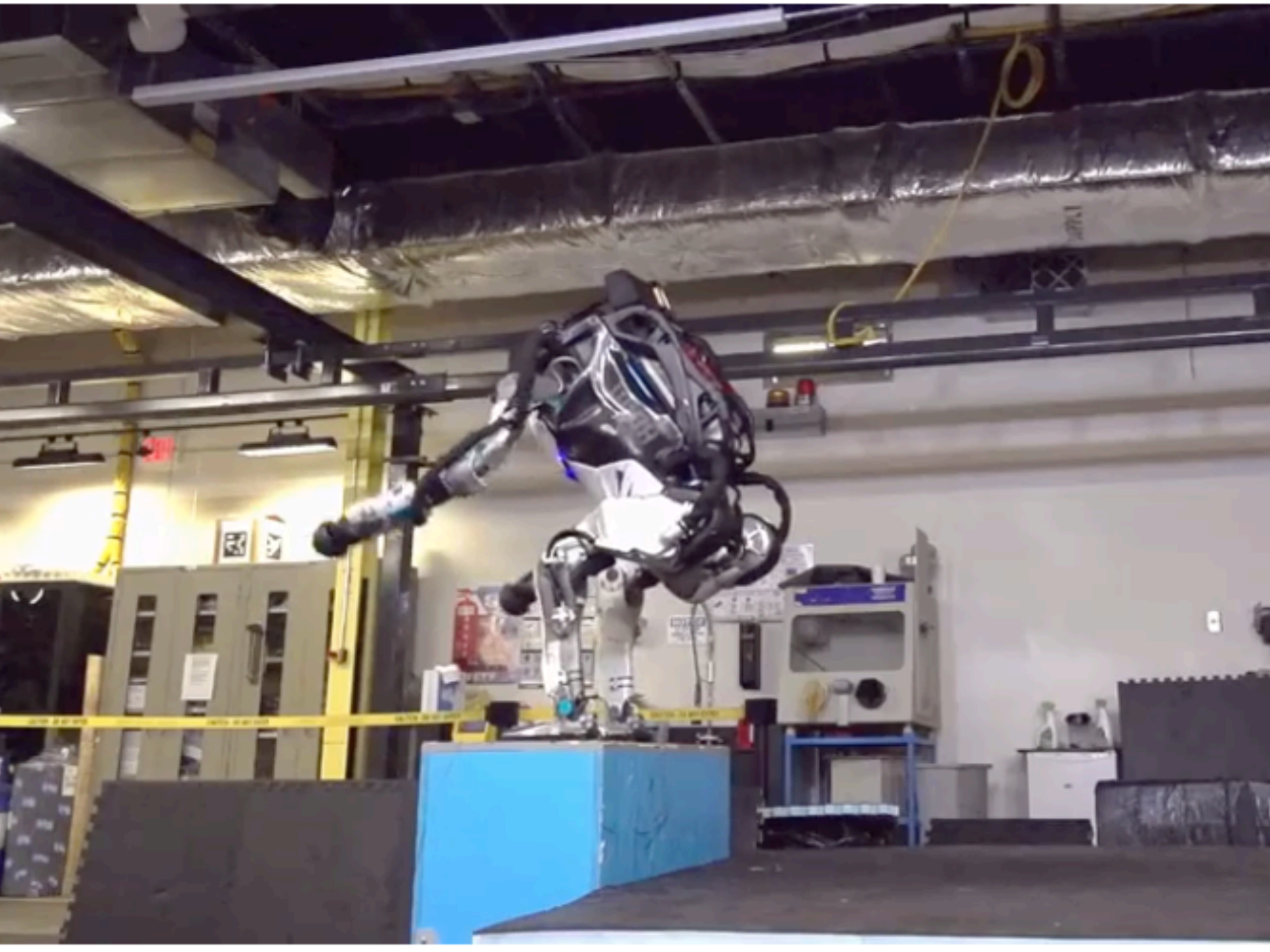
Search

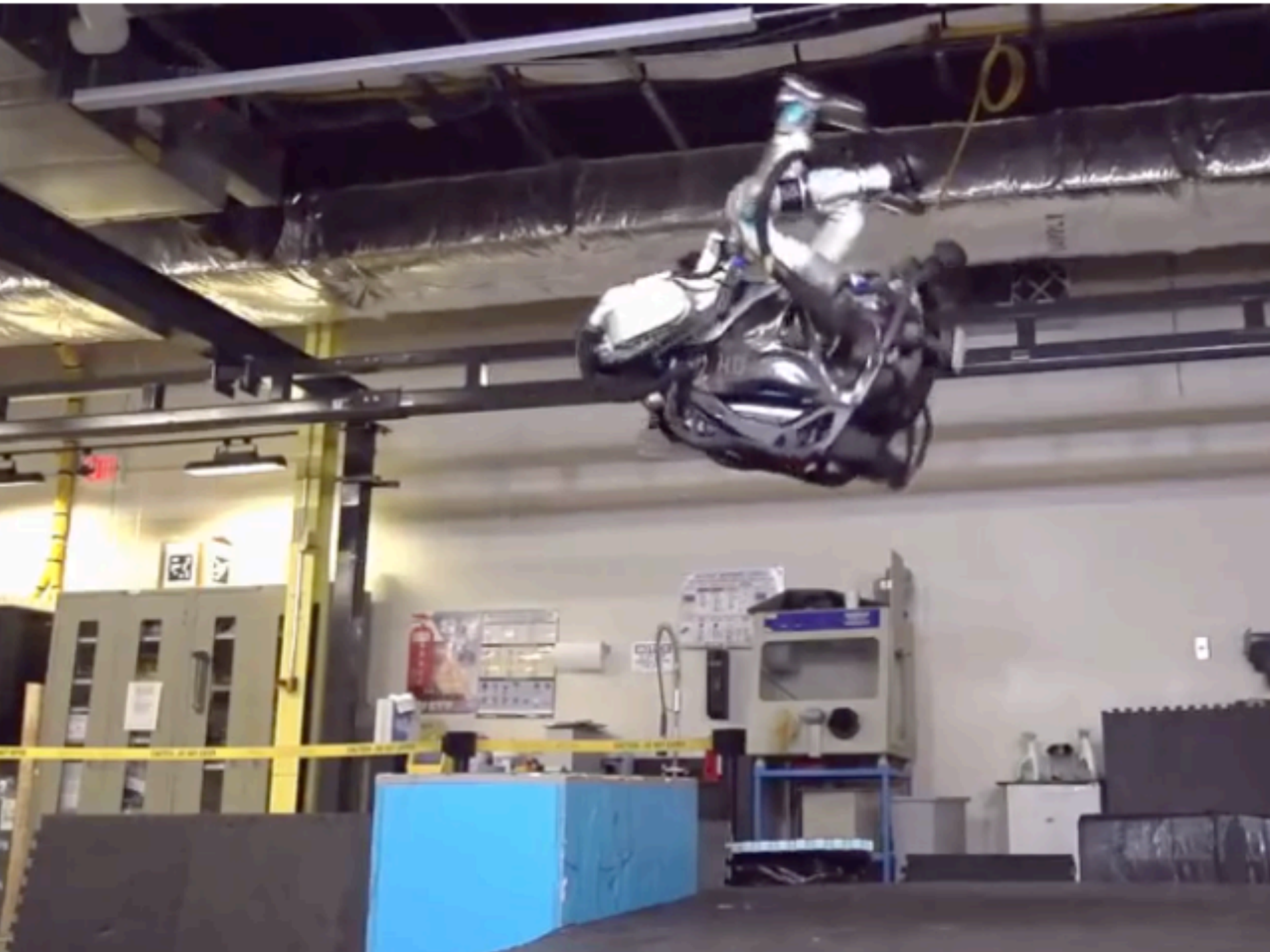


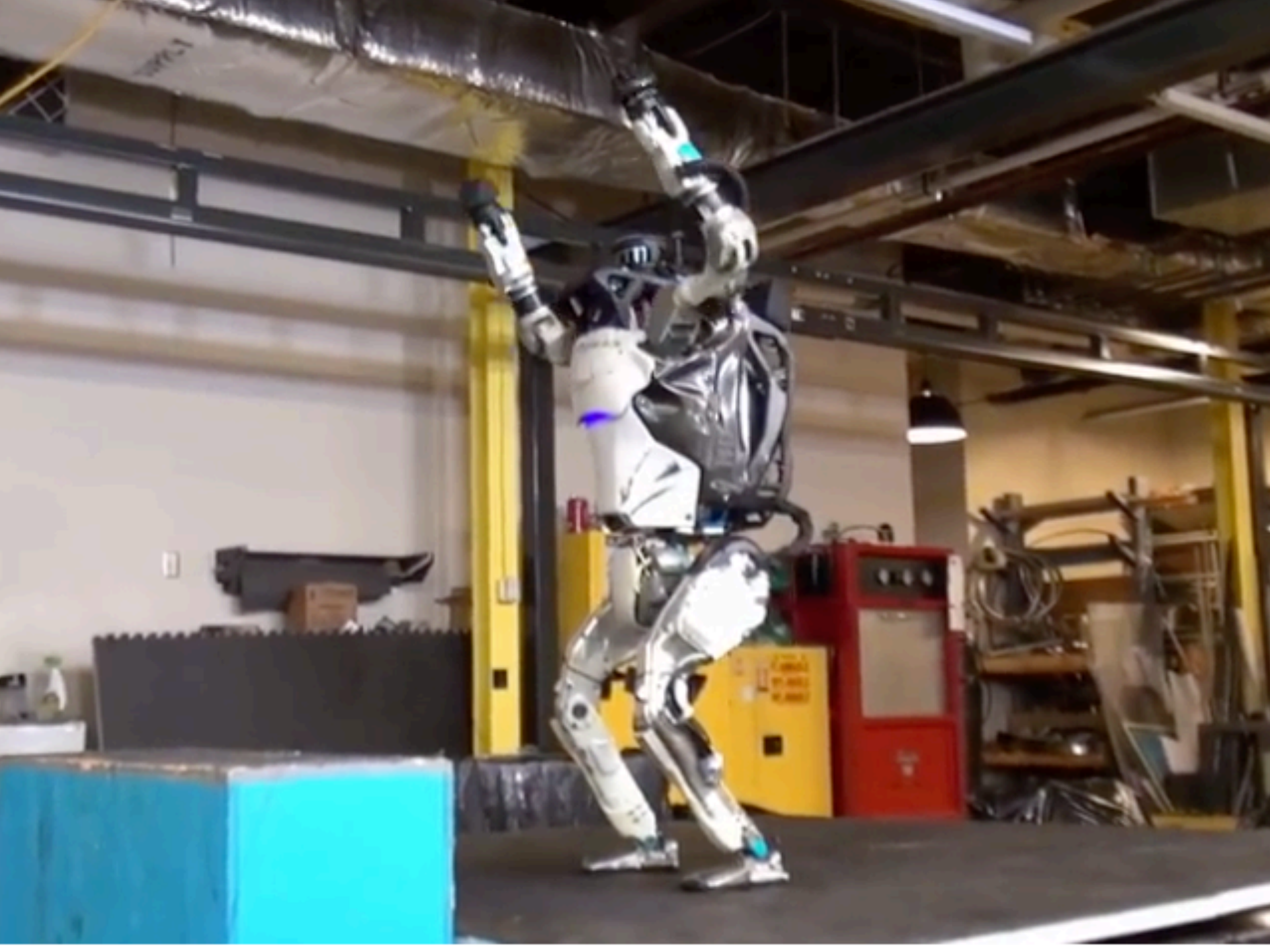
Alexa Talks to Revit: Episode 2, Revit Talks Back!

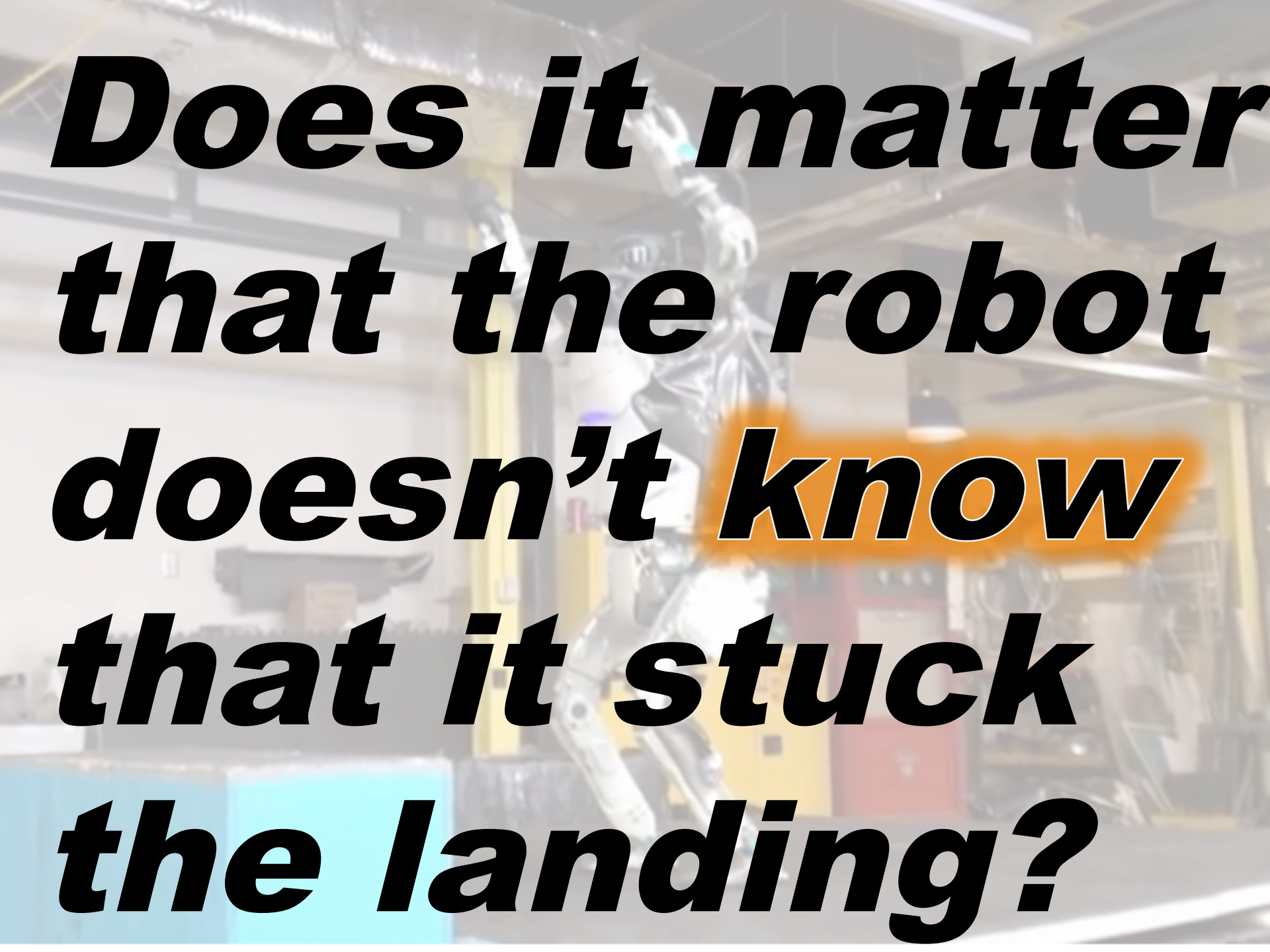
1,066 views

36 0 SHARE








Does it matter
that the robot
doesn't know
that it stuck
the landing?

AI breaks professions down into tasks

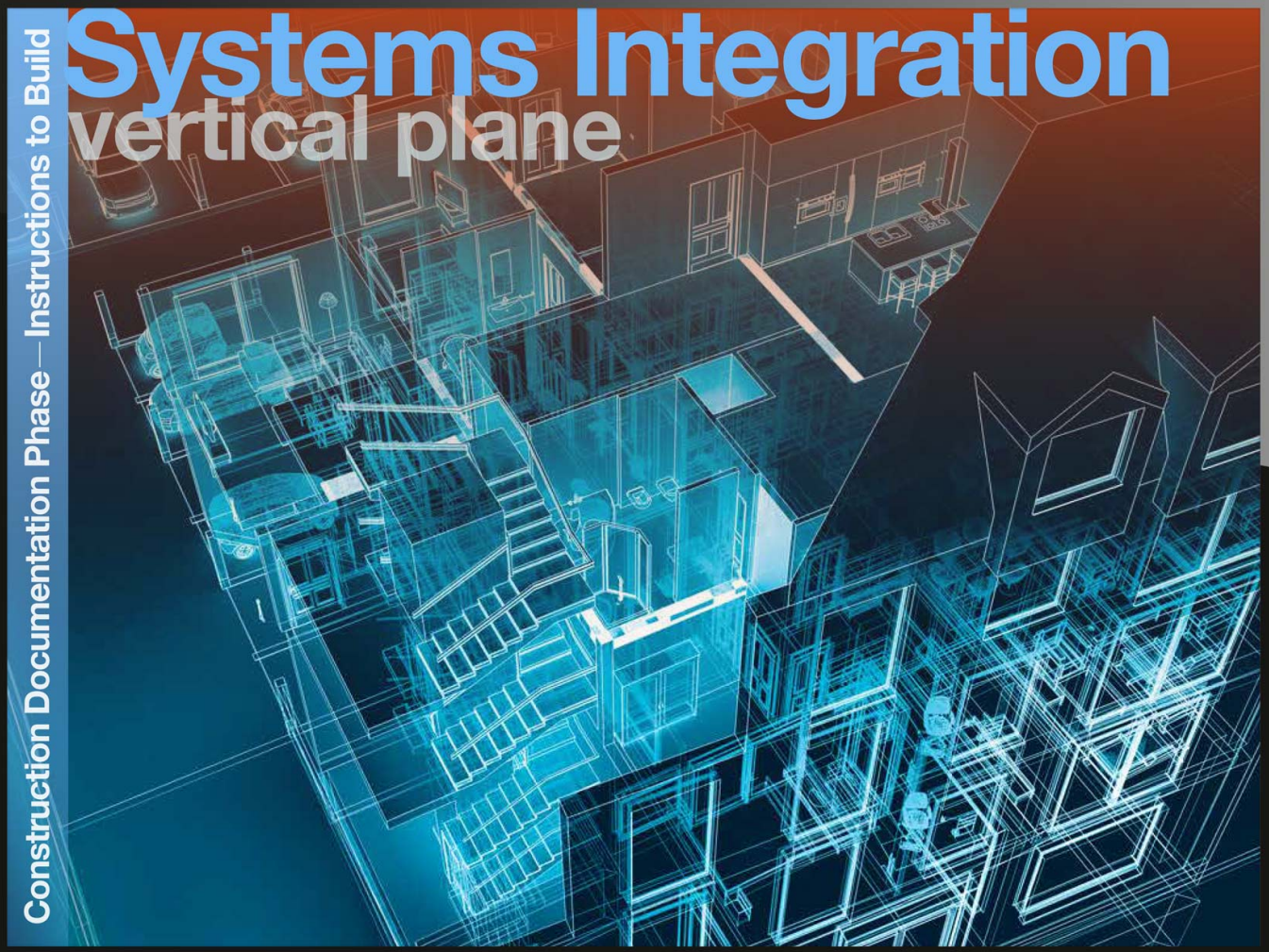
AIA does the same,

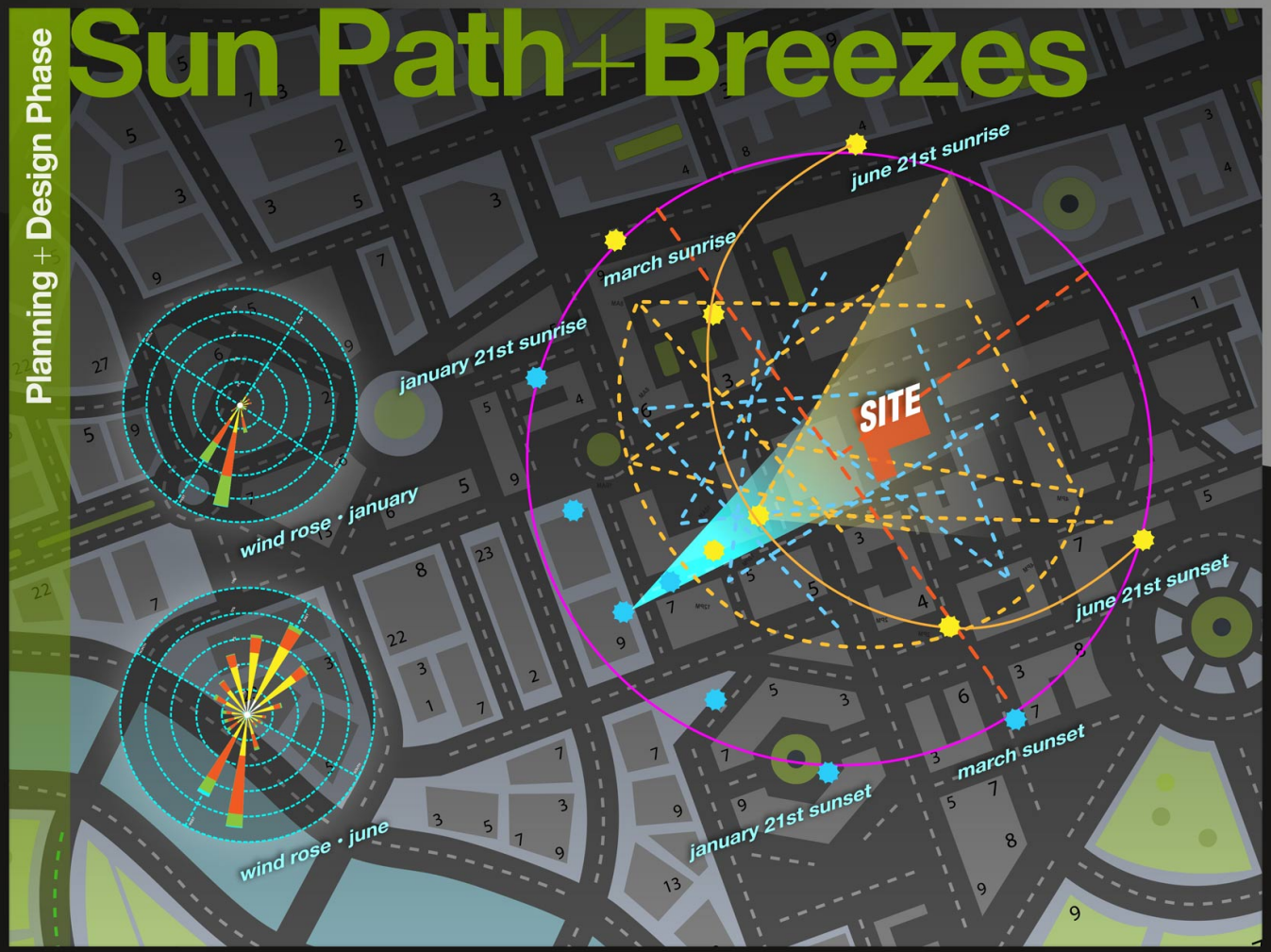
highlighting the essential value architects bring to projects

Construction Documentation Phase — Instructions to Build

Systems Integration

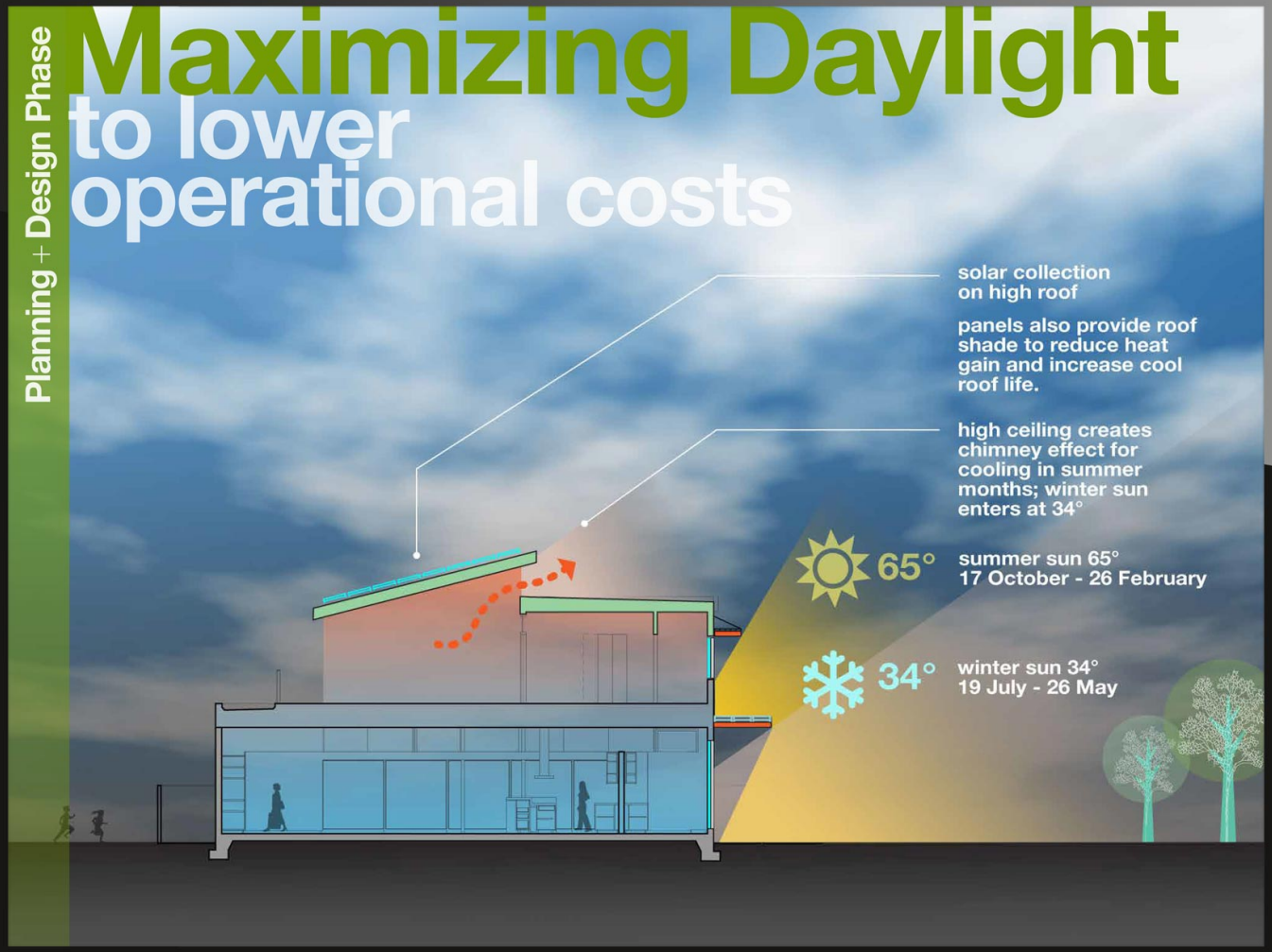
vertical plane




Planning + Design Phase
Sun Path+Breezes
january 21st sunrise
march sunrise
june 21st sunrise
SITE
wind rose · january
wind rose · june
june 21st sunset
march sunset
january 21st sunset

Massing

Planning + Design Phase

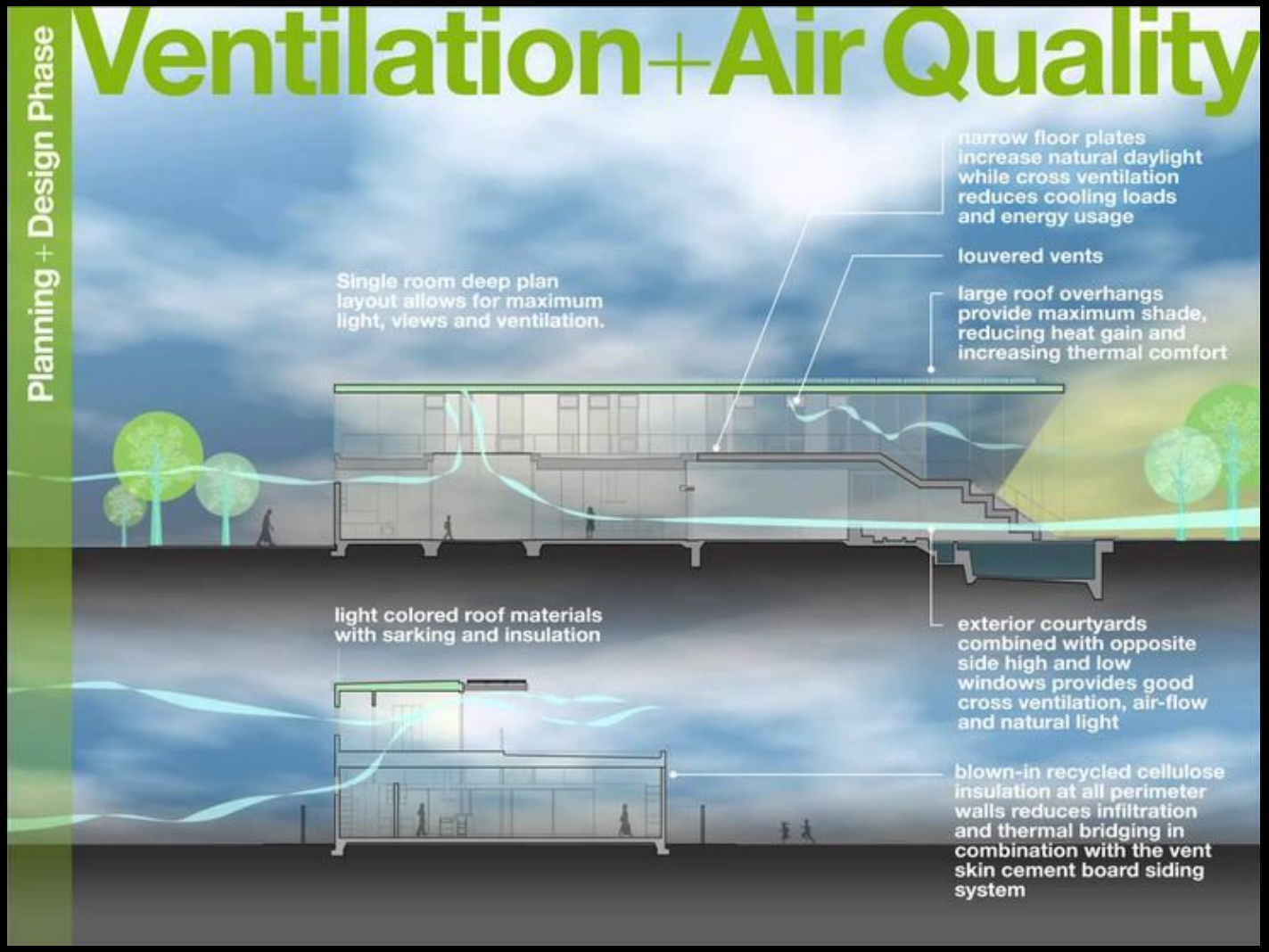

Planning + Design Phase
Maximizing Daylight
to lower
operational costs
solar collection
on high roof
panels also provide roof
shade to reduce heat
gain and increase cool
roof life.
high ceiling creates
chimney effect for
cooling in summer
months; winter sun
enters at 34°
65°
summer sun 65°
17 October - 26 February
34°
winter sun 34°
19 July - 26 May

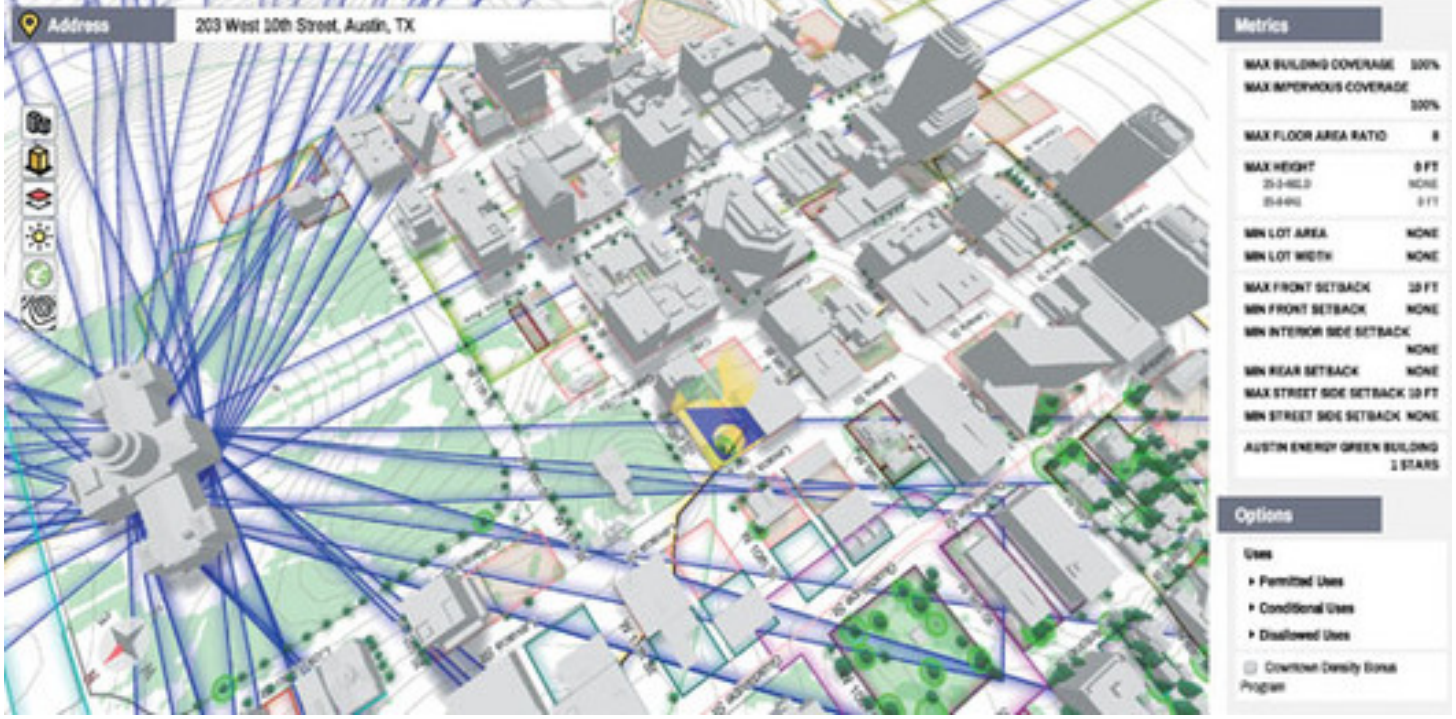

modern
SITE
romantic
eclectic
colonial
post-modern
victorian

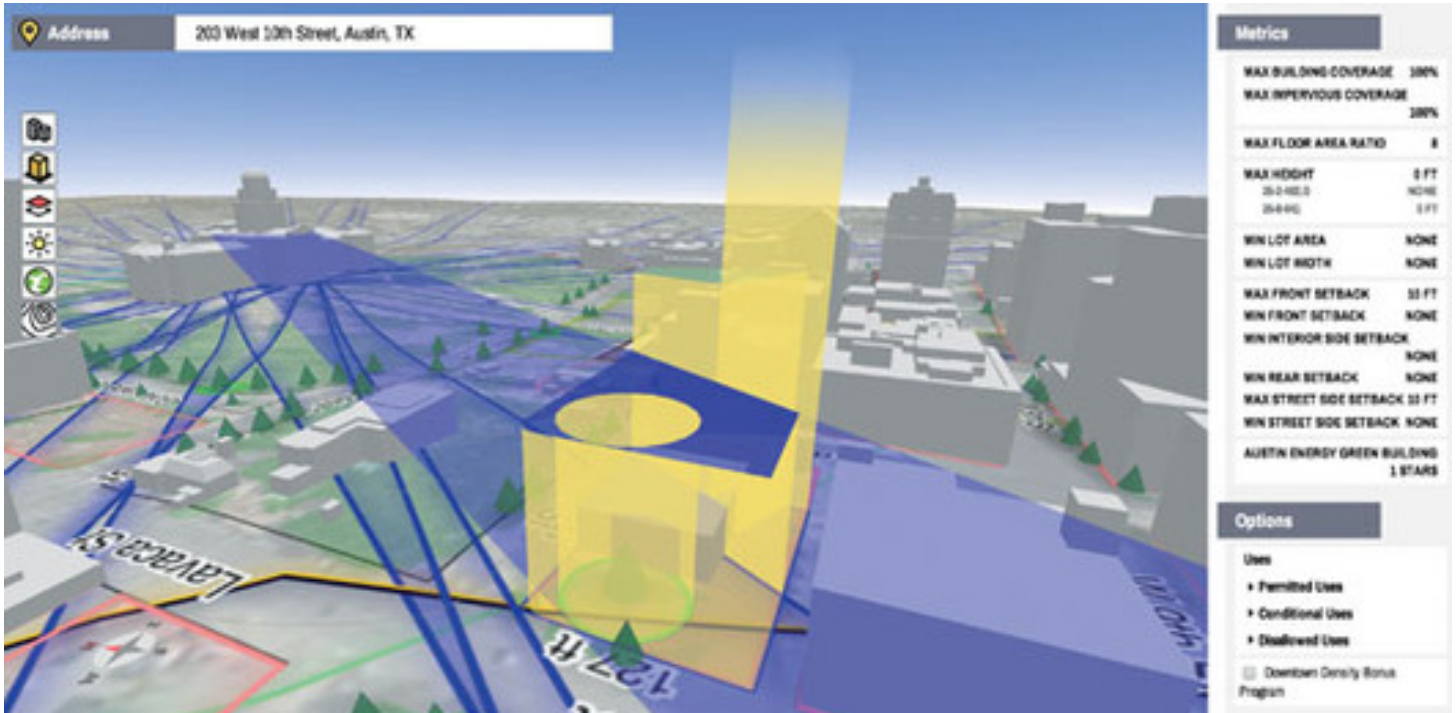

Programming
Planning + Design Phase
Function
People
Activities
Relationships
Goals
Facts
Concepts
Needs
Problem
Form
People
Activities
Relationships
Economy
Initial Budget
Operating Costs
Life cycle Costs
Time
Past
Present
Future
Cost parameters
Maximum budget
Time-use factors
market analysis
Energy source costs
Activities and climate factors
Economic data
LEED rating system
IGCC & other code
Area requirements—
by organization
by space type
by time
by location
Parking requirements
Outdoor space requirements
Functional alternatives
Building cost/SF
Building overall efficiency factor
Adaptability
Tolerance
Convertibility
Expansibility
Linear/concurrent scheduling
Phasing
Cost control
Efficient allocation
Multifunction/versatility
Merchandising
Energy conservation
Recycling
Significance
Space parameters
Activities
Projections
Durations
Escalation factors
Escalation
Time schedule
Implications of changes and growth on long-range performance
Change
Growth
Occupancy data
Reduction of life cycle costs
Sustainability

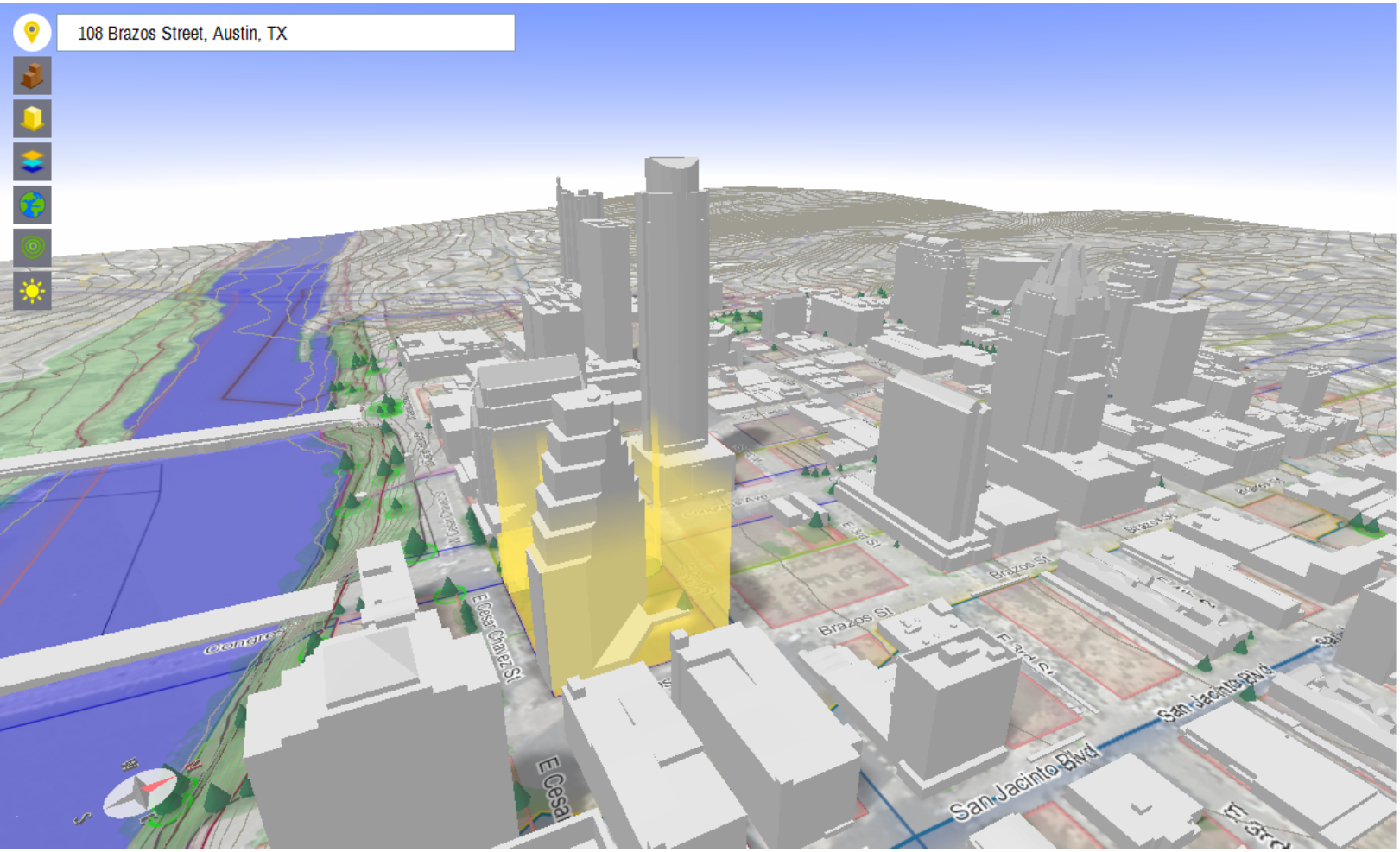
Planning + Design Phase

Ventilation+Air Quality




Address
203 West 10th Street, Austin, TX
Metrics
MAX BUILDING COVERAGE 100%
MAX IMPERVIOUS COVERAGE 100%
MAX FLOOR AREA RATIO 8
MAX HEIGHT 0 FT
MIN LOT AREA NONE
MIN LOT WIDTH NONE
MAX FRONT SETBACK 10 FT
MIN FRONT SETBACK NONE
MIN INTERIOR SIDE SETBACK NONE
MIN REAR SETBACK NONE
MAX STREET SIDE SETBACK 10 FT
MIN STREET SIDE SETBACK NONE
AUSTIN ENERGY GREEN BUILDING 1 STARS
Options
Uses
Permitted Uses
Conditional Uses
Disallowed Uses
Downtown Density Bonus Program


Address
203 West 10th Street, Austin, TX
Metrics
MAX BUILDING COVERAGE 100%
MAX IMPERVIOUS COVERAGE 100%
MAX FLOOR AREA RATIO 8
MAX HEIGHT 0 FT
MIN LOT AREA NONE
MIN LOT WIDTH NONE
MAX FRONT SETBACK 10 FT
MIN FRONT SETBACK NONE
MIN INTERIOR SIDE SETBACK NONE
MIN REAR SETBACK NONE
MAX STREET SIDE SETBACK 10 FT
MIN STREET SIDE SETBACK NONE
AUSTIN ENERGY GREEN BUILDING 1 STARS
Options
Uses
Permitted Uses
Conditional Uses
Disallowed Uses
Downtown Density Bonus Program
Lavaca St
127 ft



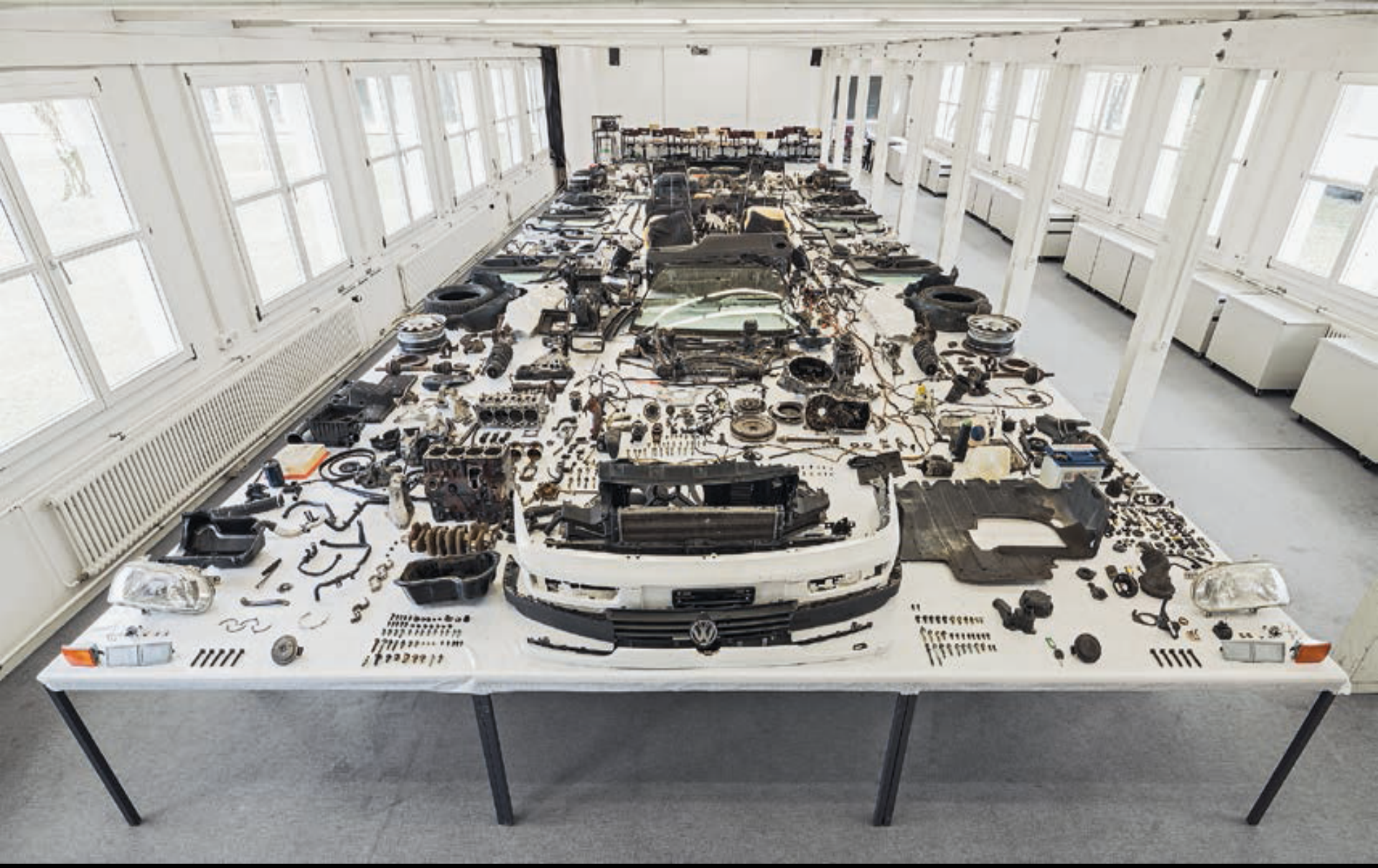
Summary

Parcel ID	0205020408
Addresses	108 Brazos Street 111 Congress Avenue 103 East 2nd Street 107 East 2nd Street 105 East 2nd Street
Area	93,148 ft²
Max Dimensions	277 ft x 340 ft

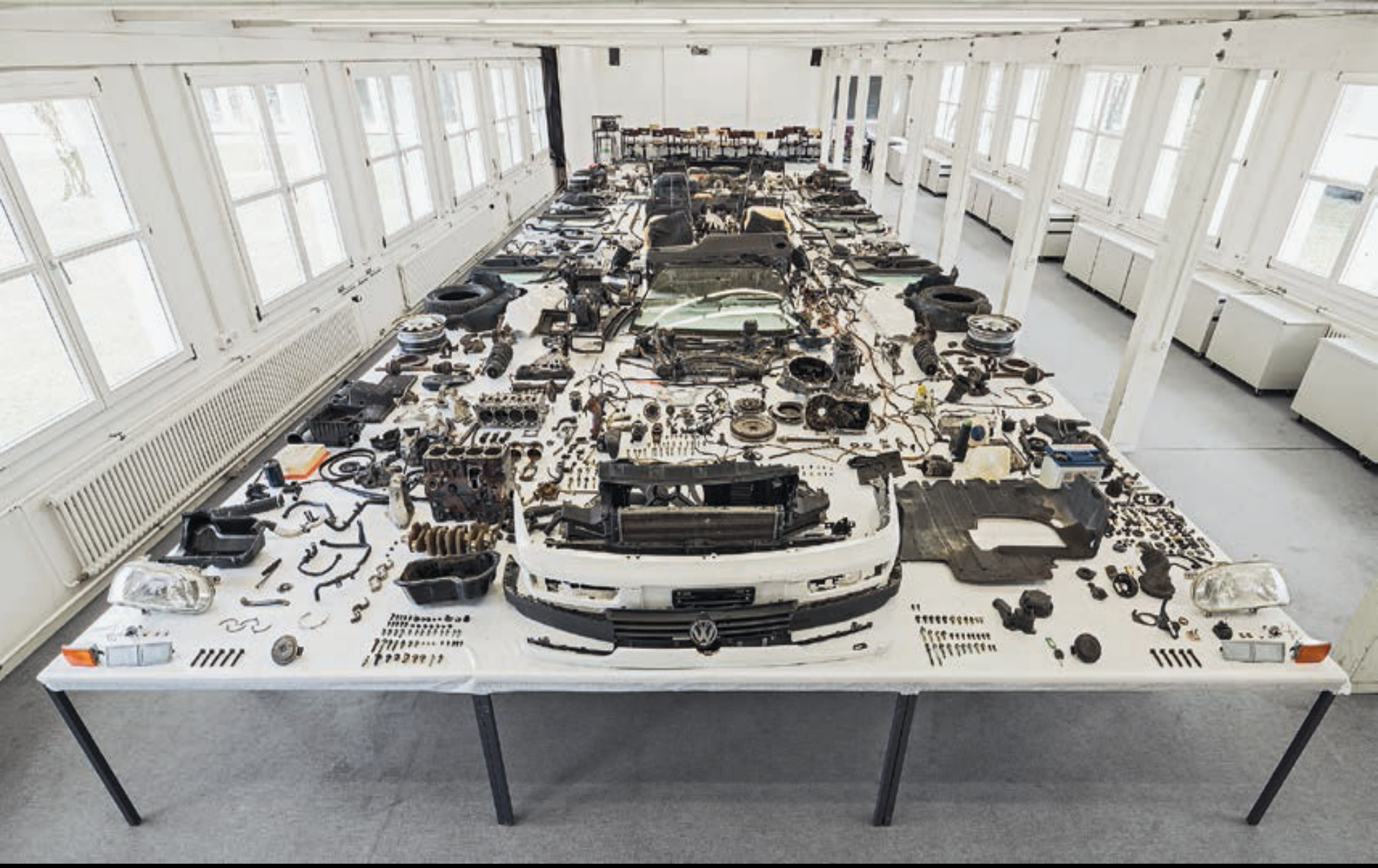
Zones & Overlays

- Central Business District
- Heritage Trees
- Capitol View Corridor Combining District
- Congress Avenue Combining District
- Convention Center Overlay District
- Waterfront Overlay: North Shore Central
- National Register Historic District
- Lady Bird Lake Watershed
- Residential Design and Compatibility Standards

Options



Architects are more than the sum of their parts



(Architects aren’t cars)

9 Recommendations

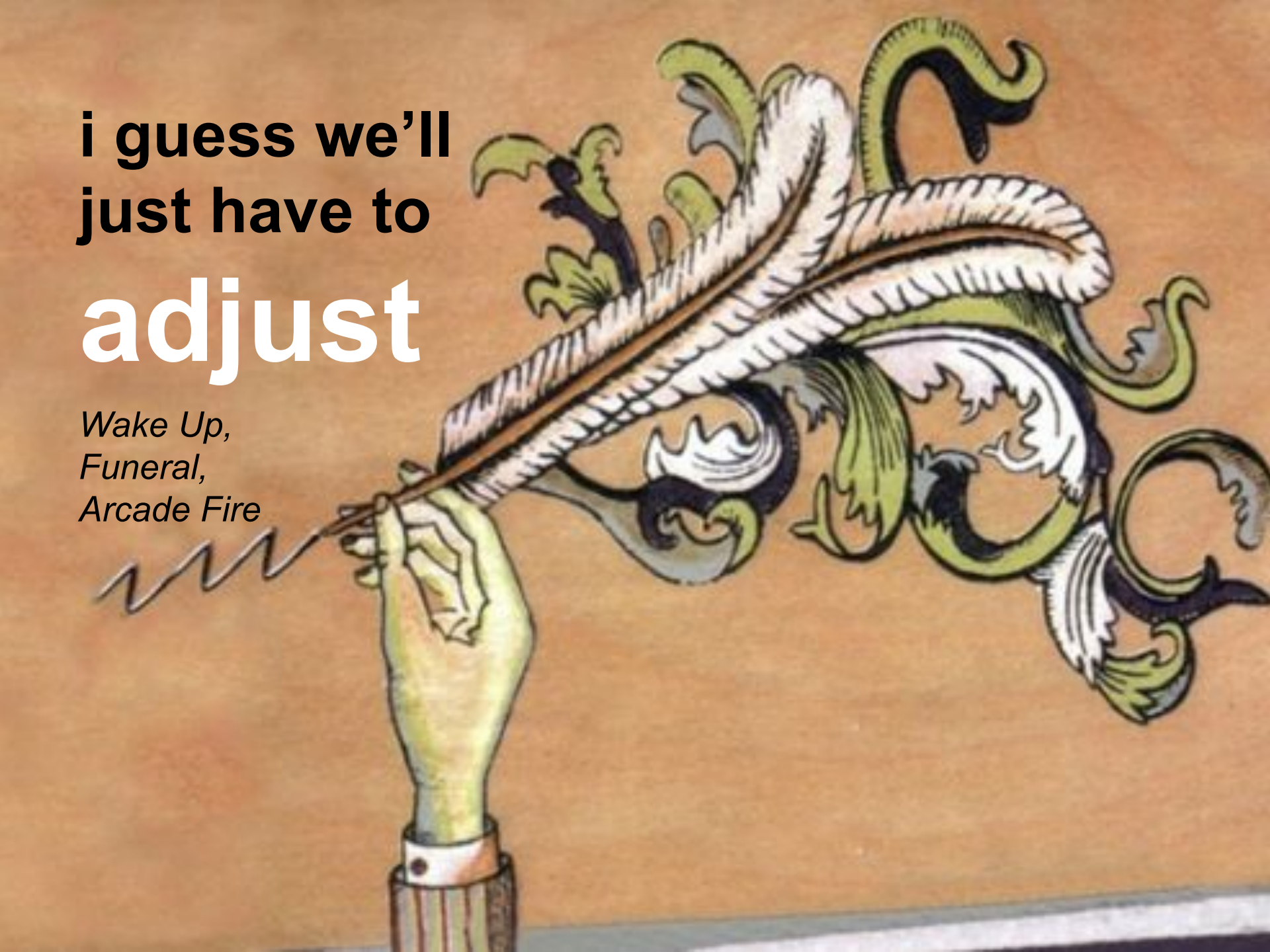
The Future of Design Building Connections Congress 2018

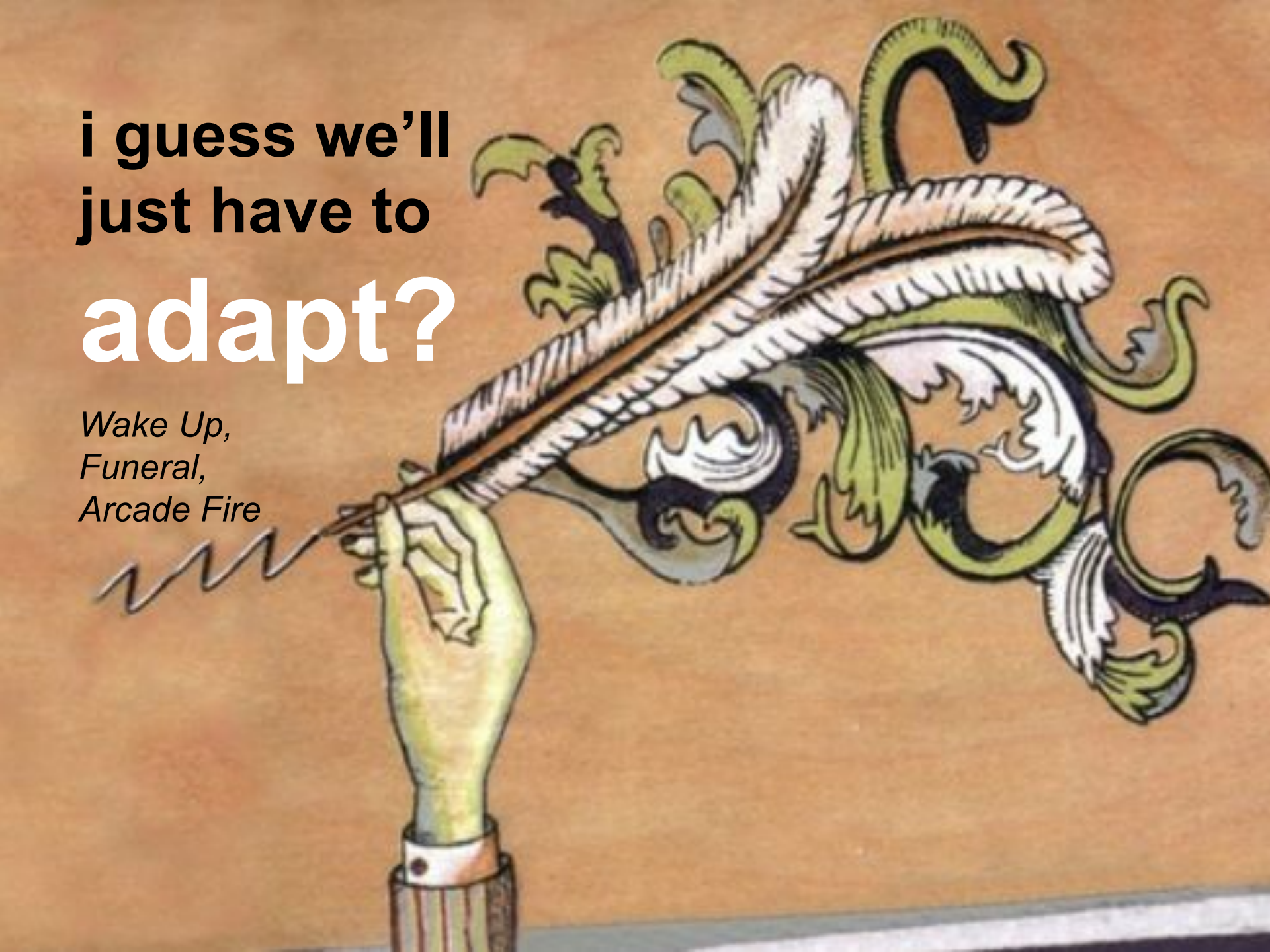
Randall Deutsch AIA LEED January 8, 2018 **@randydeutsch**

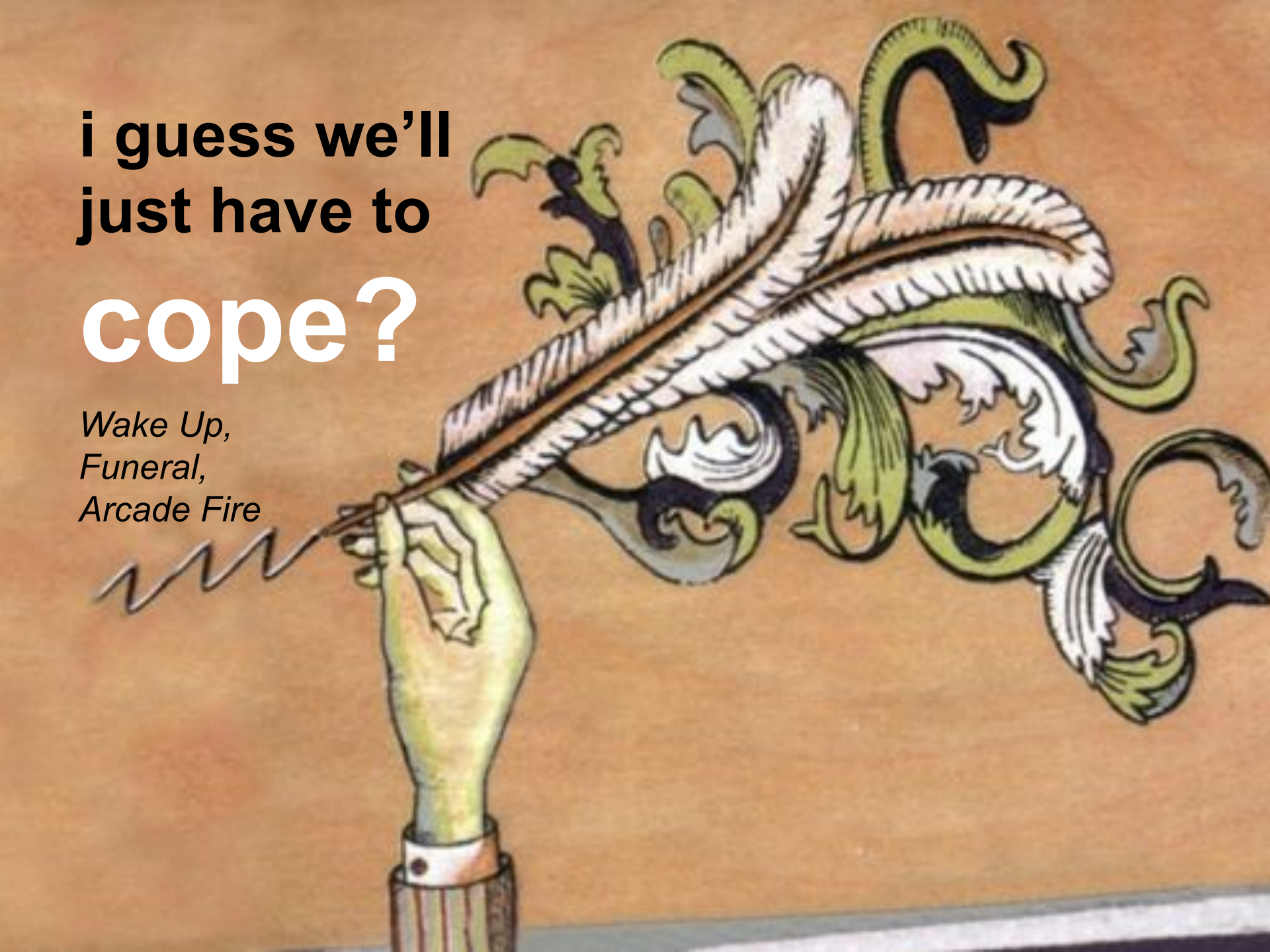
Associate Director, ISoA University of Illinois at Urbana-Champaign


URBAN SEARCH & RESCUE TYPE 3

1. Be concerned, be *vigilant*
but not fearful

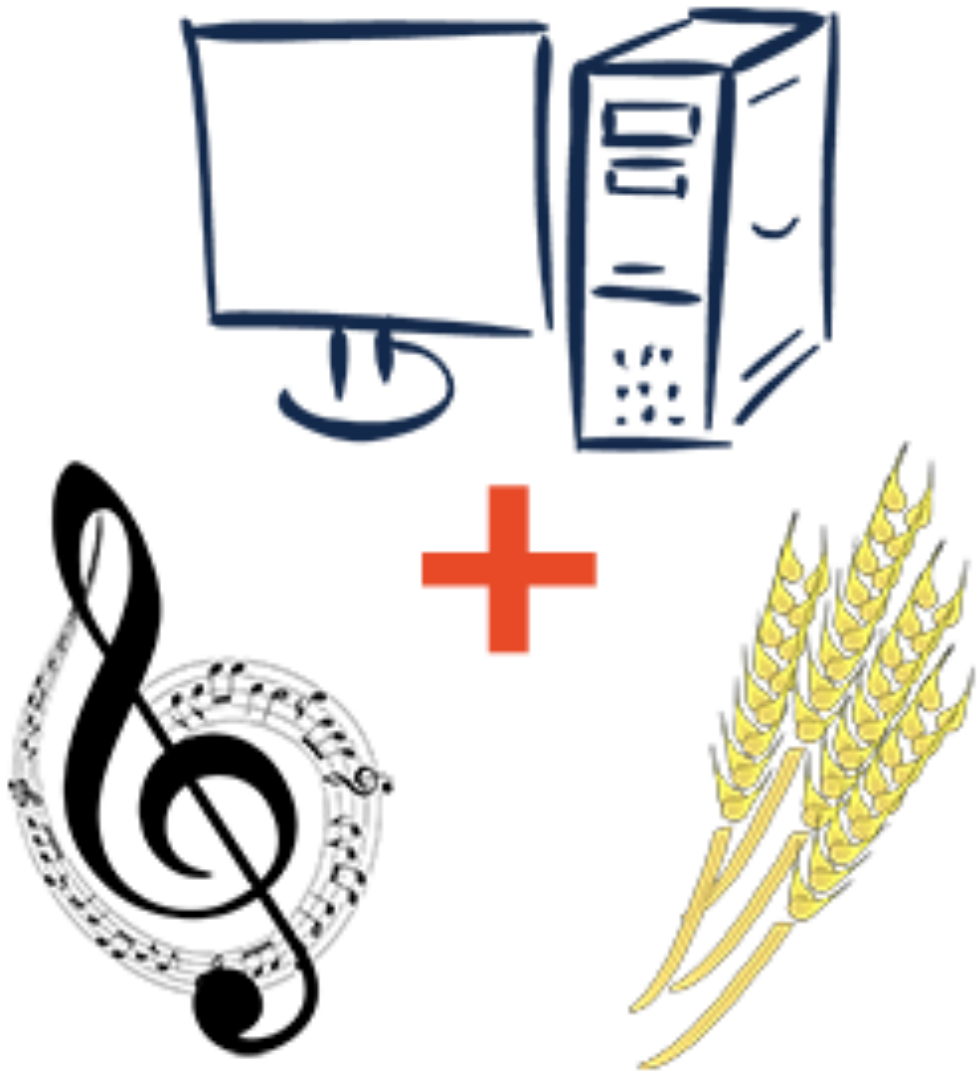

i guess we'll
just have to
adjust
Wake Up,
Funeral,
Arcade Fire


i guess we'll just have to
adapt?
Wake Up, Funeral, Arcade Fire


i guess we'll just have to
cope?
Wake Up, Funeral, Arcade Fire


i guess we'll just have to
leverage, thrive, exploit, embrace, capitalize on!
Wake Up,
Funeral,
Arcade Fire

2. Design buildings, but also processes & algorithms



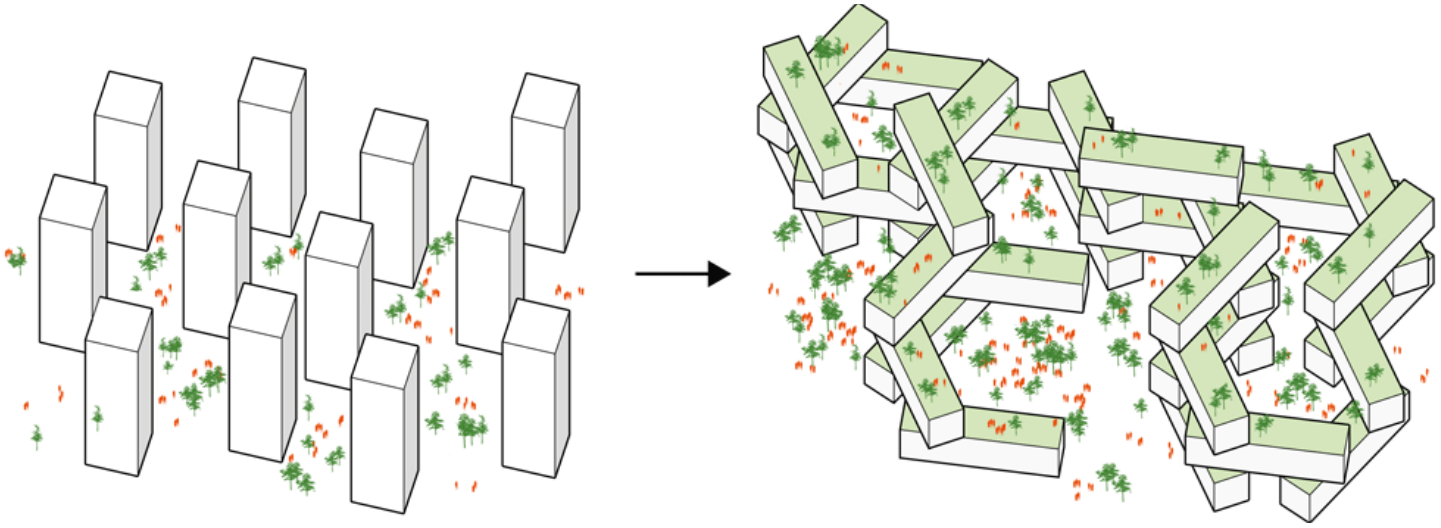
Always have a **minor** to go along with your **major**

3. Emphasize synthesis

You will never out-analyze a computer


Central
Central
Central


PRESS
PIZZA EXPRESS
LOGAN
IMAX
MARCH 1



4. Identify opportunities for automation

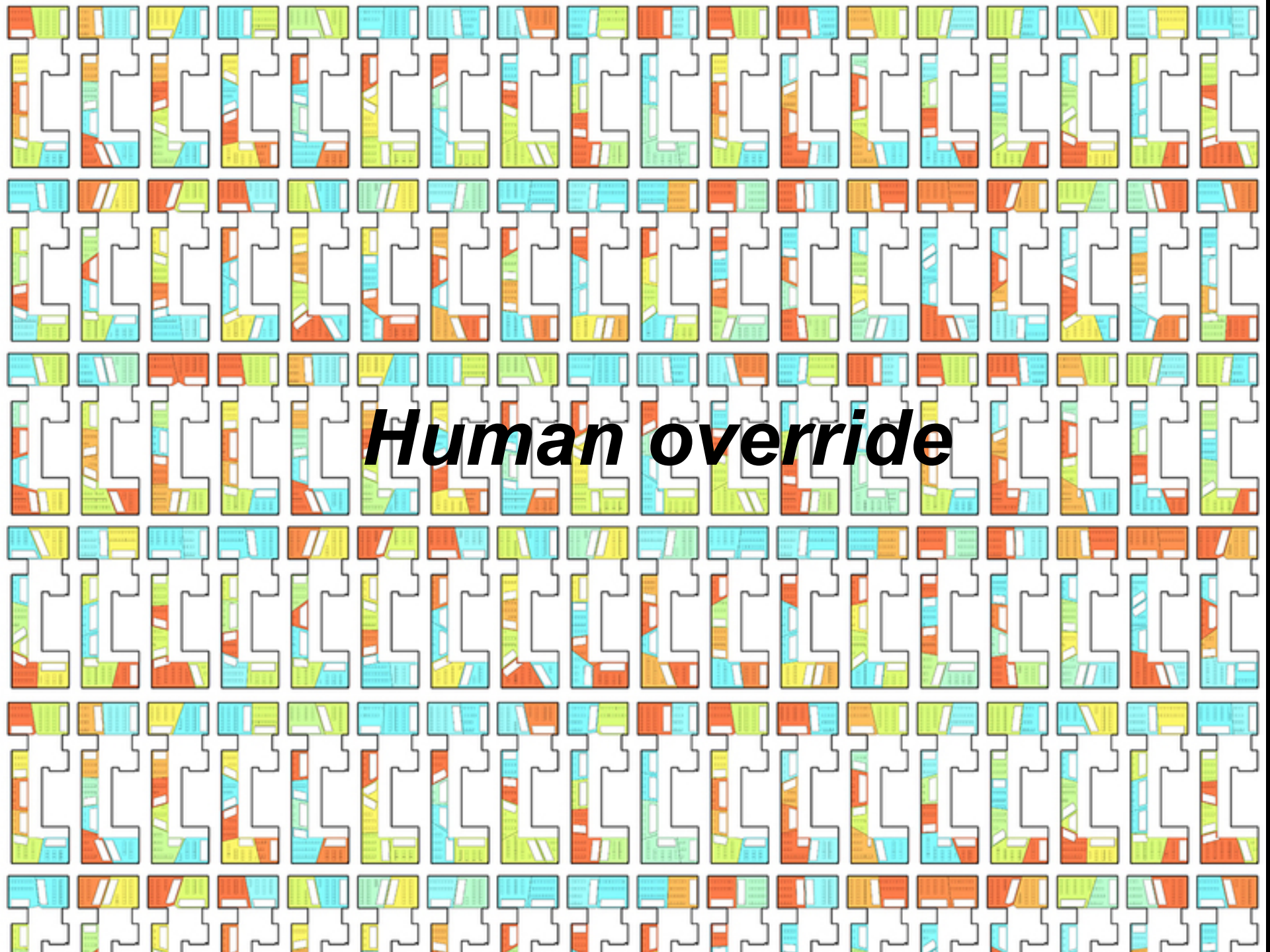
Don’t just focus on what cannot be automated

5. Work at being meaning makers

Deliver insight

Human override

you (still, for now) have the final say


Human override

6. Focus on creating exceptional experiences

Make moments that are unique and memorable

Tell narratives that encapsulate information

If you tell a story and the computer doesn't, you win

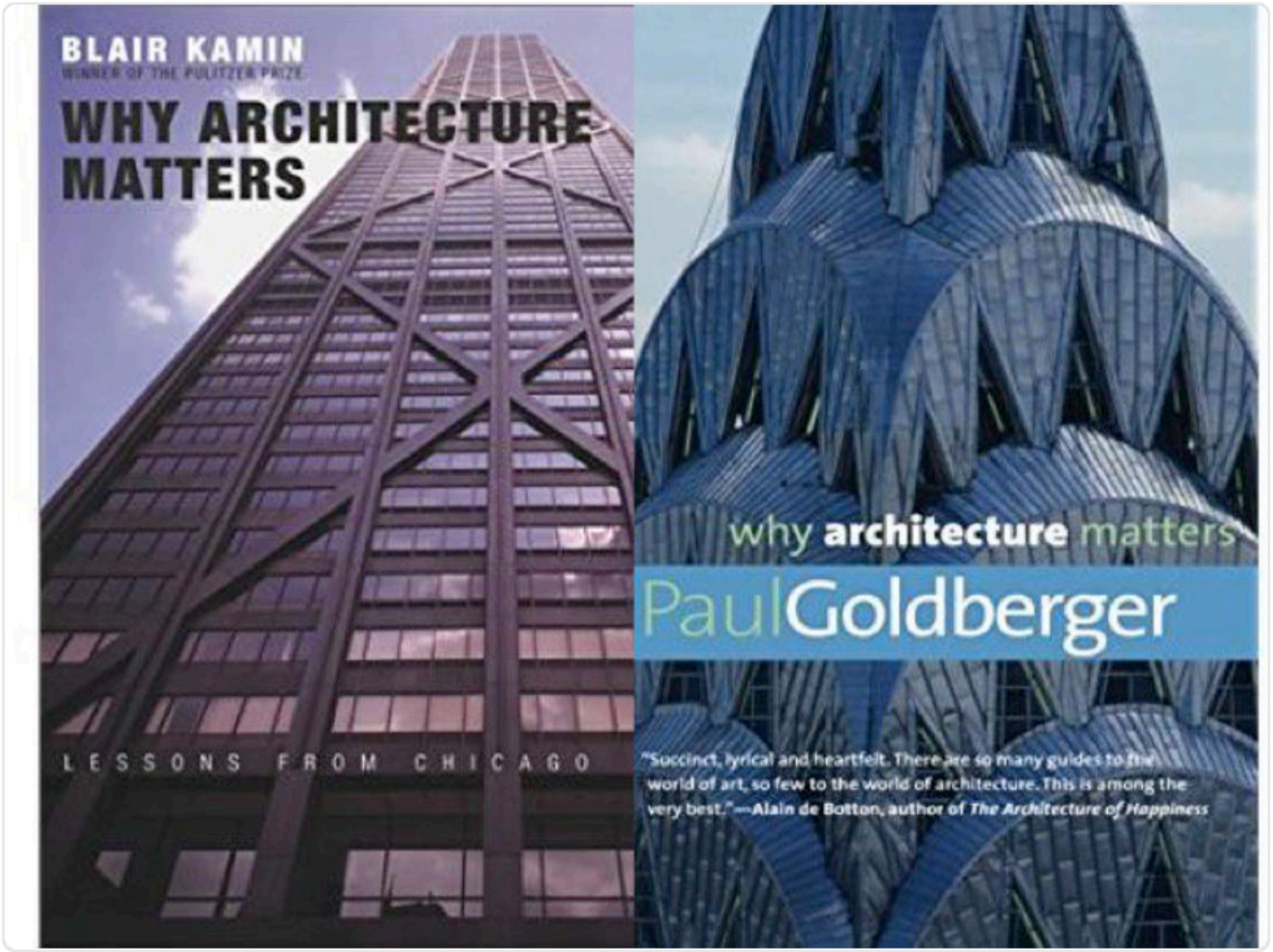
7. Paint a picture of the world *without* architects


祥國陳醫牙

8. Make architecture that matters

Randy Deutsch @randydeutsch · 16 Dec 2017

If we spent more time making #architecture that matters we wouldn't have to spend so much time convincing everybody that it matters



5 68 140

9. Collaborate with technology

Man-Machine Collaboration

You Retweeted

Derek Kinsman @derekkinsman · 20h

Replying to @joannekcheung @blprnt and 2 others

Myself, along with Hammer and Tablesaw built a house. I'd also like to give a shoutout to lumber. We nailed it.

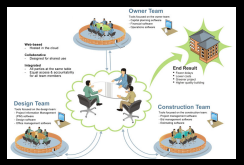
1 1 6


the rematch

Risk aversion is no longer optional

AEC is risk-averse. *Get over it.*

Augment, don’t replace, architects



NO ONE DESIGNS

SOMEONE DESIGNS

EVERYONE DESIGNS

DESIGNING NOTHING

DESIGNING SOMETHING

DESIGNING EVERYTHING

NO ONE DESIGNS

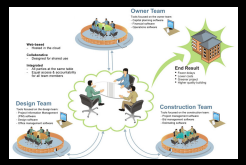
DESIGNING NOTHING

GENERATIVE DESIGN

SOMEONE DESIGNS

DESIGNING SOMETHING

AUGMENTED ARCHITECTS



EVERYONE DESIGNS

DESIGNING EVERYTHING

CROWDSOURCED DESIGN

NO ONE DESIGNS

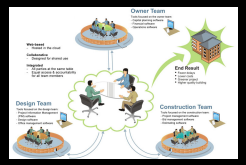
DESIGNING NOTHING

GENERATIVE DESIGN

SOMEONE DESIGNS

DESIGNING SOMETHING

AUGMENTED ARCHITECTS



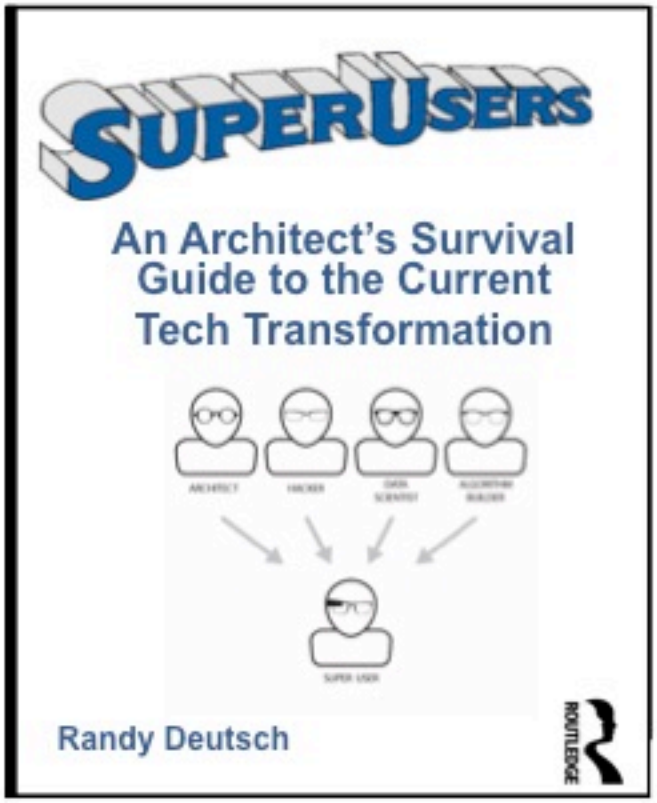
EVERYONE DESIGNS

DESIGNING EVERYTHING

GENERATIVE DESIGN


KOPIN
IBM Watson IoT
SONY


KOPIN
IBM Watson IoT


SUPERUSERS
An Architect's Survival Guide to the Current Tech Transformation
Randy Deutsch
ROUTLEDGE

In conclusion….

Teach machines to think like us?
We're still working on teaching *us* to think like us.

Machines will think any which way they damn please.

Teach machines to think like us?
We're still working on teaching *us* to think like us.

Machines will think any which way they damn please.

Do we even *want* machines to think like us?
Is that a good idea?

Let machines do what they are best at.

Instead, learn how to think like machines

Instead, learn how to think like machines

(*and everybody else for that matter*)

Ask…

Will our clients/users be better off if the machine decides this?

or

Will people be better off if the machine decides this in collaboration with an architect?

Ask…

Will our clients/users be better off if the machine decides this?

or

Will people be better off if the machine decides this in collaboration with an architect?

Ask…

Will our clients/users be better off if the machine decides this?

or

Will people be better off if the machine decides this in collaboration with an architect?

not

Will architects be better off if the machine decides this?

Randy Deutsch @randydeutsch · 2h

AIA has a Directory of Public Policies & Position Statements that was amended by the Board of Directors as recently as December 2017 but doesn't include a statement on #AI in #architecture. It ought to aia.org/resources/9156… #AEC #ArtificialIntelligence

AIA

Directory of
Public Policies
and
Position Statements

Where architects stand: A statement of our values

Where we stand

Climate change

Infrastructure

Immigration and visa restrictions

Sustainability

Related pages

Directory of Public Policies and Position Statements

2016-2020 Strategic Plan

AIA's two core missions:

to stimulate demand for architecture everywhere in society
&
to improve the architect's capacity to deliver.

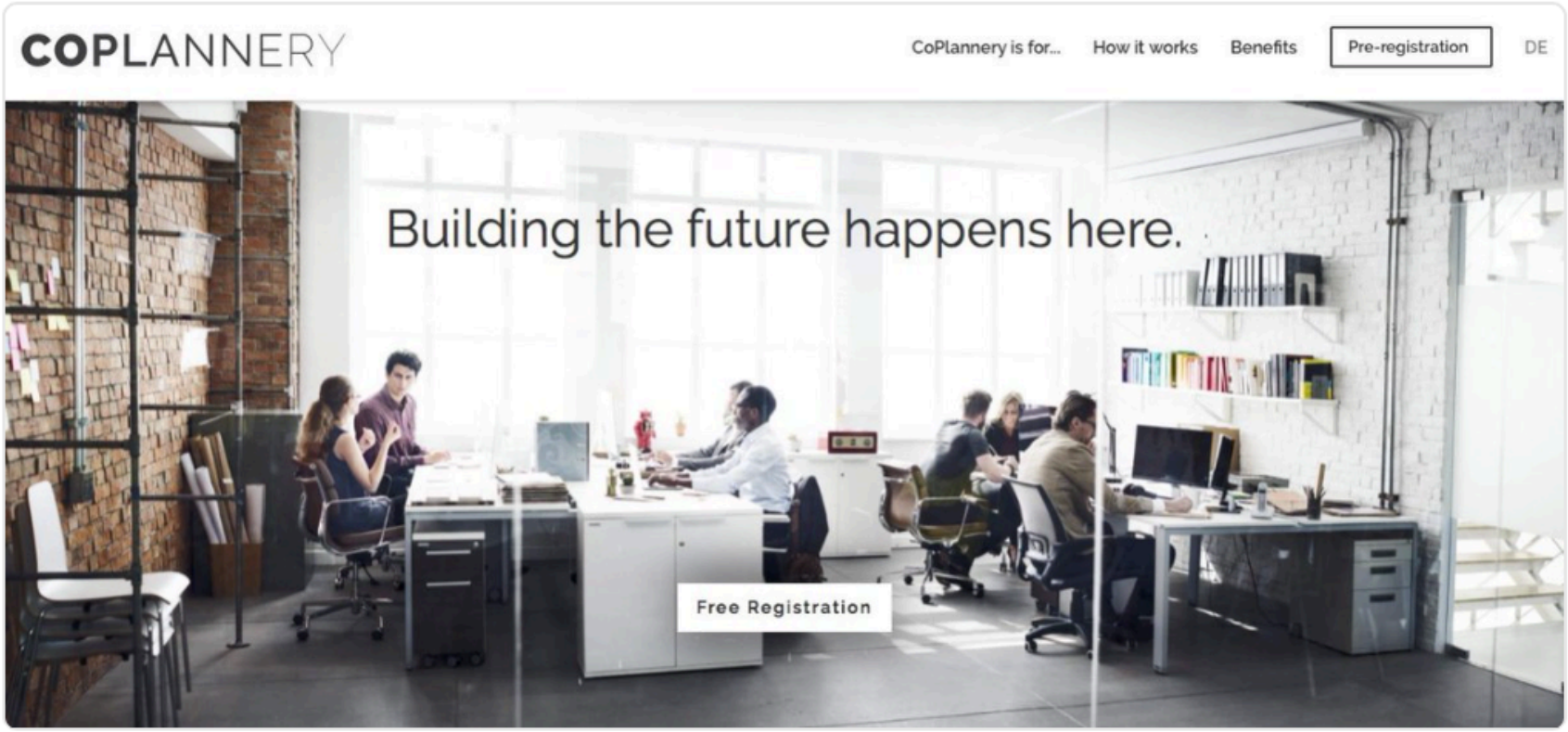
AIA's two core missions:

to stimulate demand for architecture everywhere in society
&
to improve the architect's capacity to deliver.

Randy Deutsch @randydeutsch · 35s

In 2018, #architecture will offer clients two experiences: work with augmented architects, or work with #AI #architects

#AEC #ArtificialIntelligence



AIA >>> AIA

AIA >>> AI A

AIA >>> AI A

AIA >>> AI A

AIA >>> AI A

AIA >>> AI A

YOU are in a field experiencing technology disruption

BRING IT.

YOU are in a field experiencing technology disruption

There's a transformation that's coming that's poorly understood, and we're all trying to understand it.

– Dan Anthony, Design Computation Leader, NBBJ

The Advent of the Augmented Architect

Learning from Machine Learning, Embracing and Capitalizing on AI

THANK YOU

The Future of Design Building Connections Congress 2018

Randall Deutsch AIA LEED January 8, 2018 **@randydeutsch**

Associate Director, ISoA University of Illinois at Urbana-Champaign