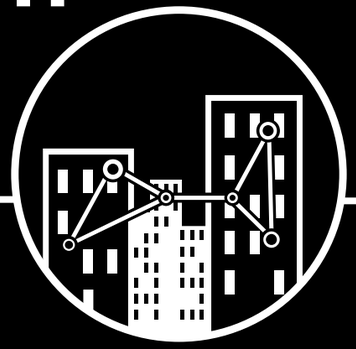
Interactive Simulation



Ira Winder

ira.mit.edu
T: @jamesira

Novel interfaces for collaborative decision-making

Prague City Data Congress
May 30, 2019

Interactive Simulation

Ira Winder

ira.mit.edu

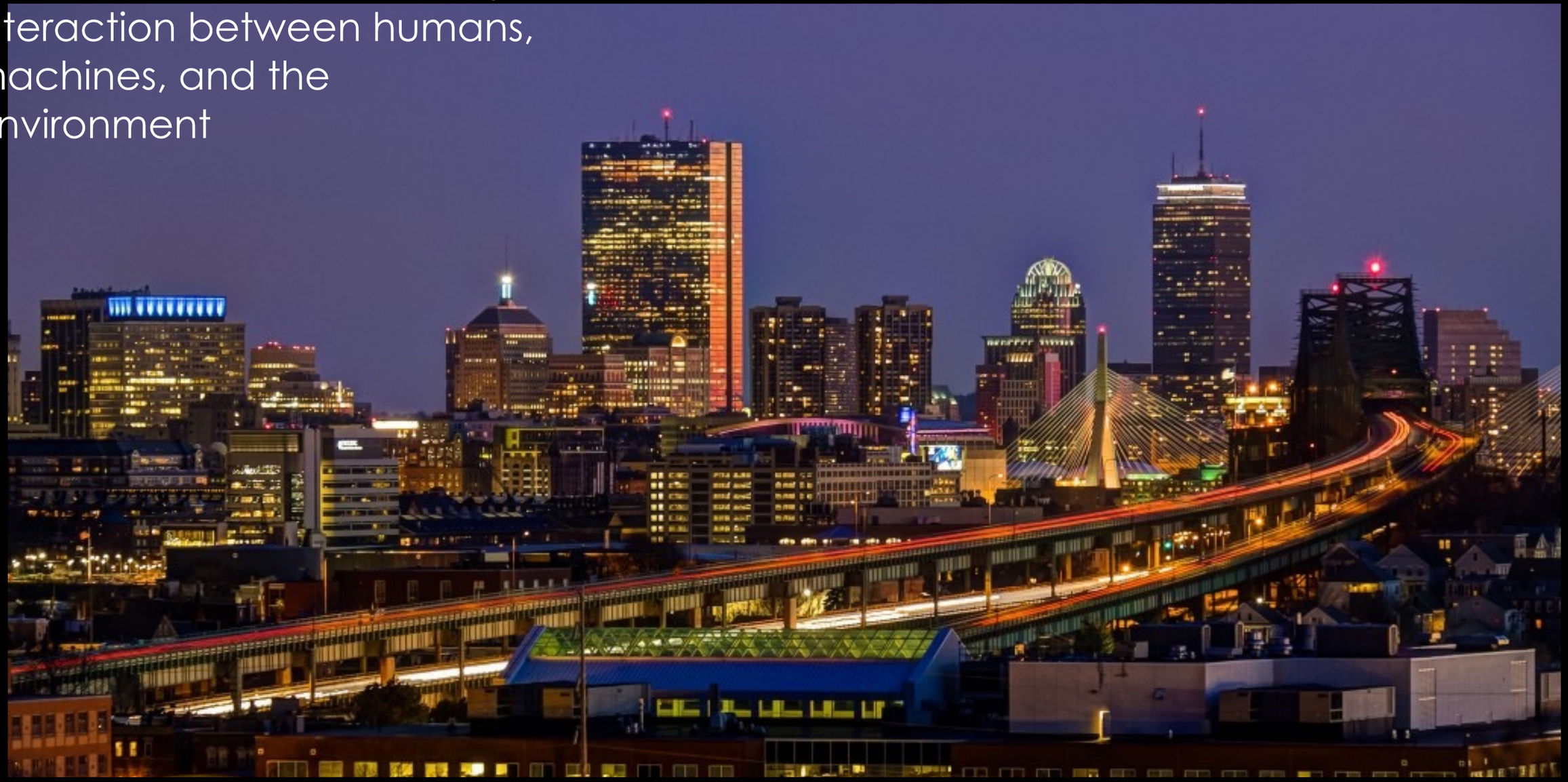
T: @jamesira

Novel interfaces for collaborative decision-making

Prague City Data Congress
May 30, 2019

Ira Winder

System that involves a complex interaction between humans, machines, and the environment



Sociotechnical System (STS)

Ira Winder

System that involves a complex interaction between humans, machines, and the environment

"Cities are for people, not technology."
- Kent Larson, MIT

Sociotechnical System (STS)

Ira Winder

System that involves a complex interaction between humans, machines, and the environment

"The only thing harder than launching a rocket is designing a city."
- Oli de Weck, MIT AeroAstro

Sociotechnical System (STS)

Ira Winder

A description of a *system* using tangible and/or mathematical concepts and language

Systems Model

Ira Winder
Michael Lin

Models can be optimized
for efficiency.

In cities we must ask:
"for whom are
we optimizing?"

Urban "Efficiency" and "Optimization"

Ira Winder

Navigation Apps Are Turning Quiet Neighborhoods Into Traffic Nightmares

The corner of Fort Lee Road and Broad Avenue in Leonia, N.J. With traffic apps suggesting shortcuts for commuters through the borough, officials have decided to take a stand. Bryan Anselm for The New York Times

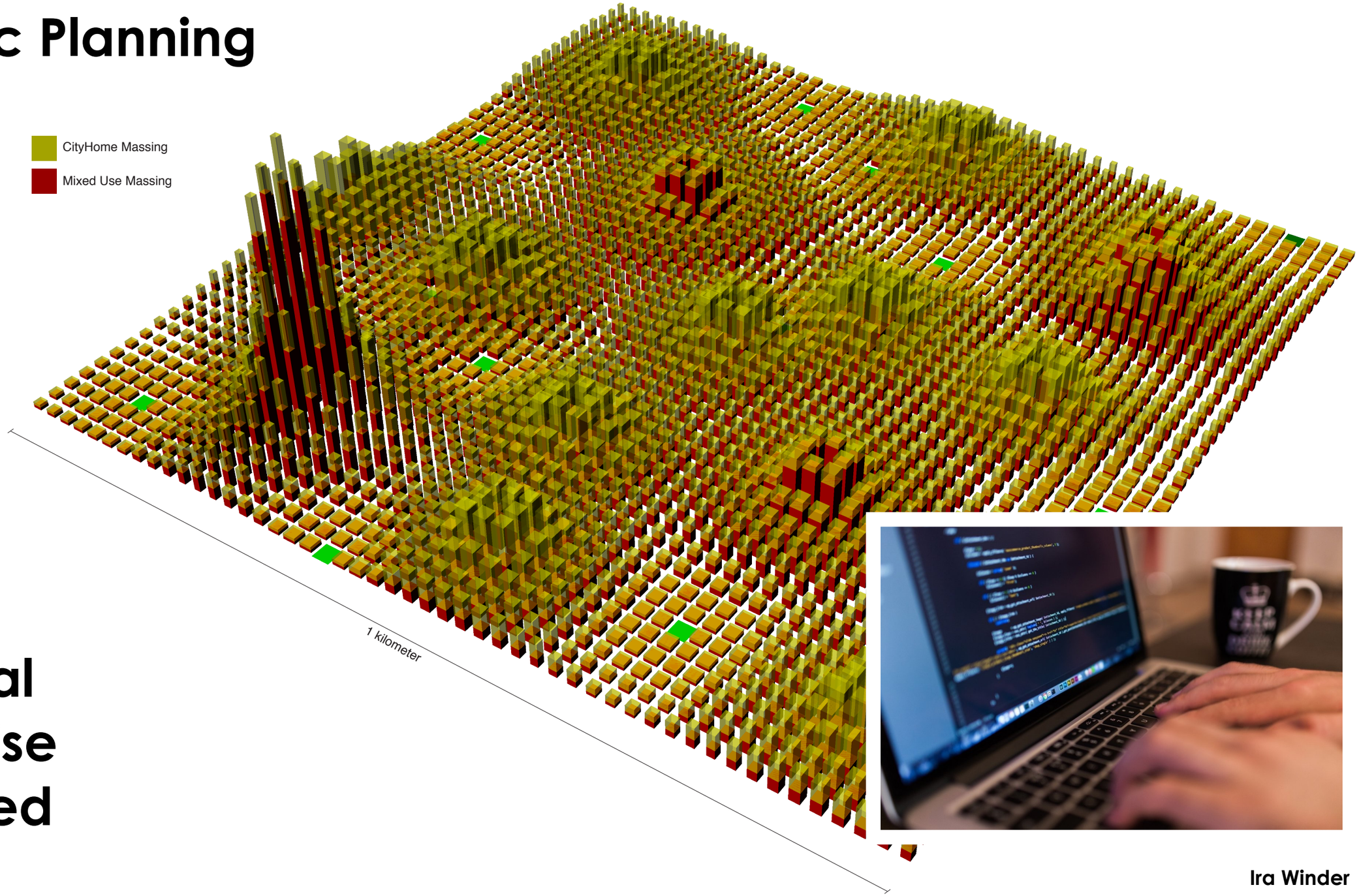
Lisa Foderaro, NY Times

“Traditional” Planning Engagement

- Social
- Analogue
- Adaptive
- Open

Ira Winder

Algorithmic Planning



¥

- Solo
- Digital
- Precise
- Closed

Ira Winder

Algorithmic Planning (Shanghai Case Study)

Site Condition

Ira Winder

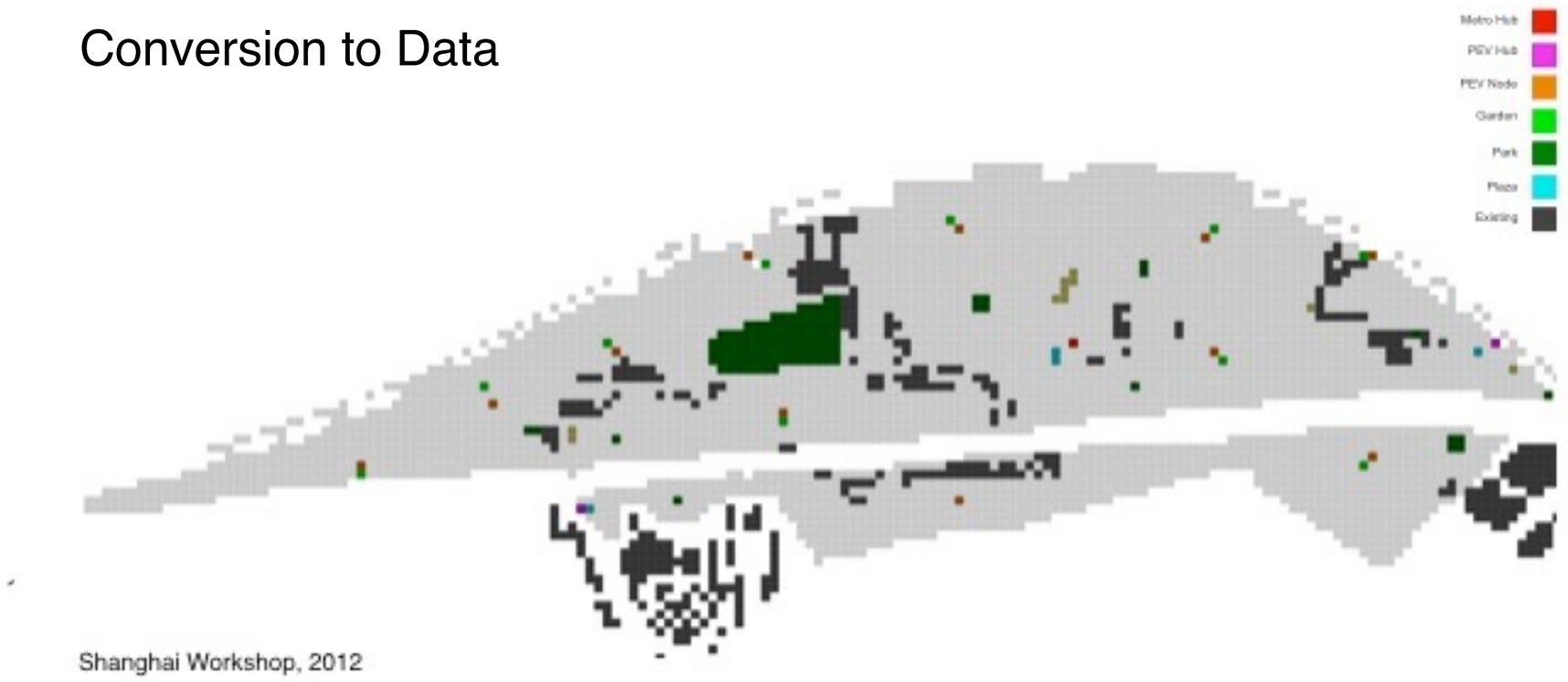
Algorithmic Planning

Conversion to Model

Shanghai Workshop, 2012

Algorithmic Planning

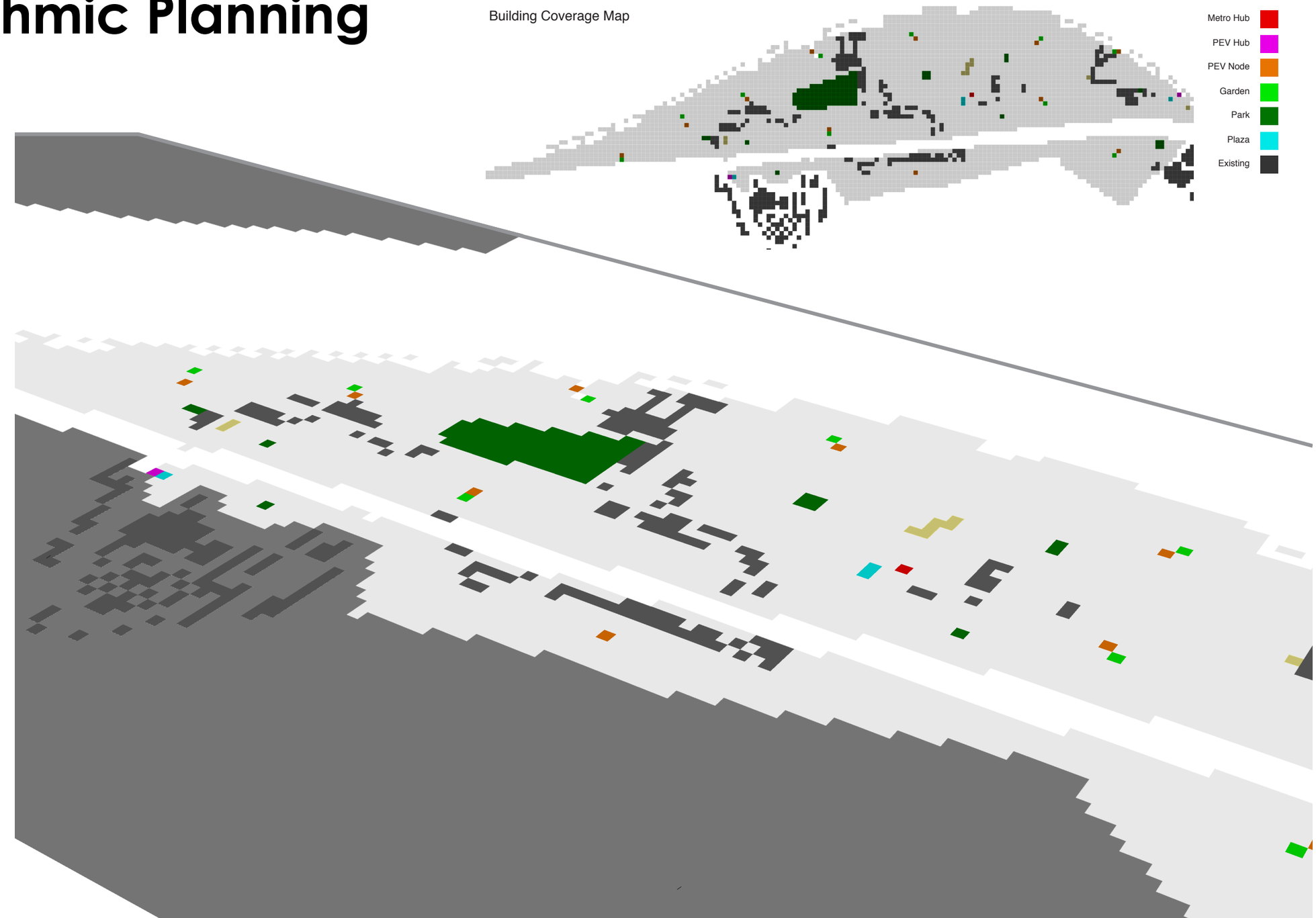
Conversion to Data



Shanghai Workshop, 2012

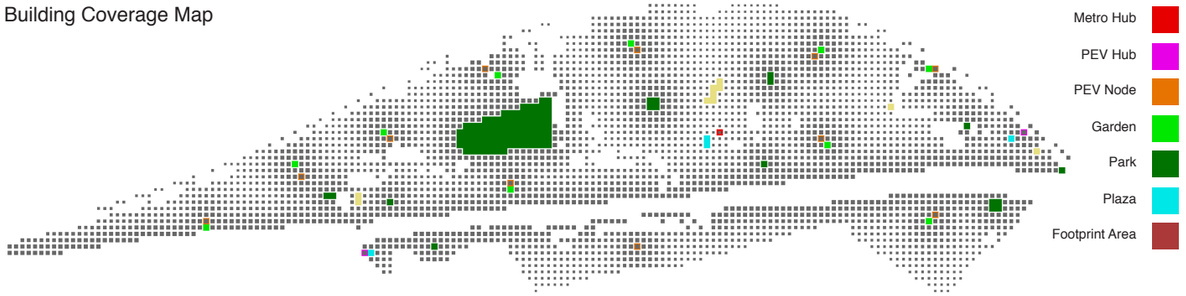
Ira Winder

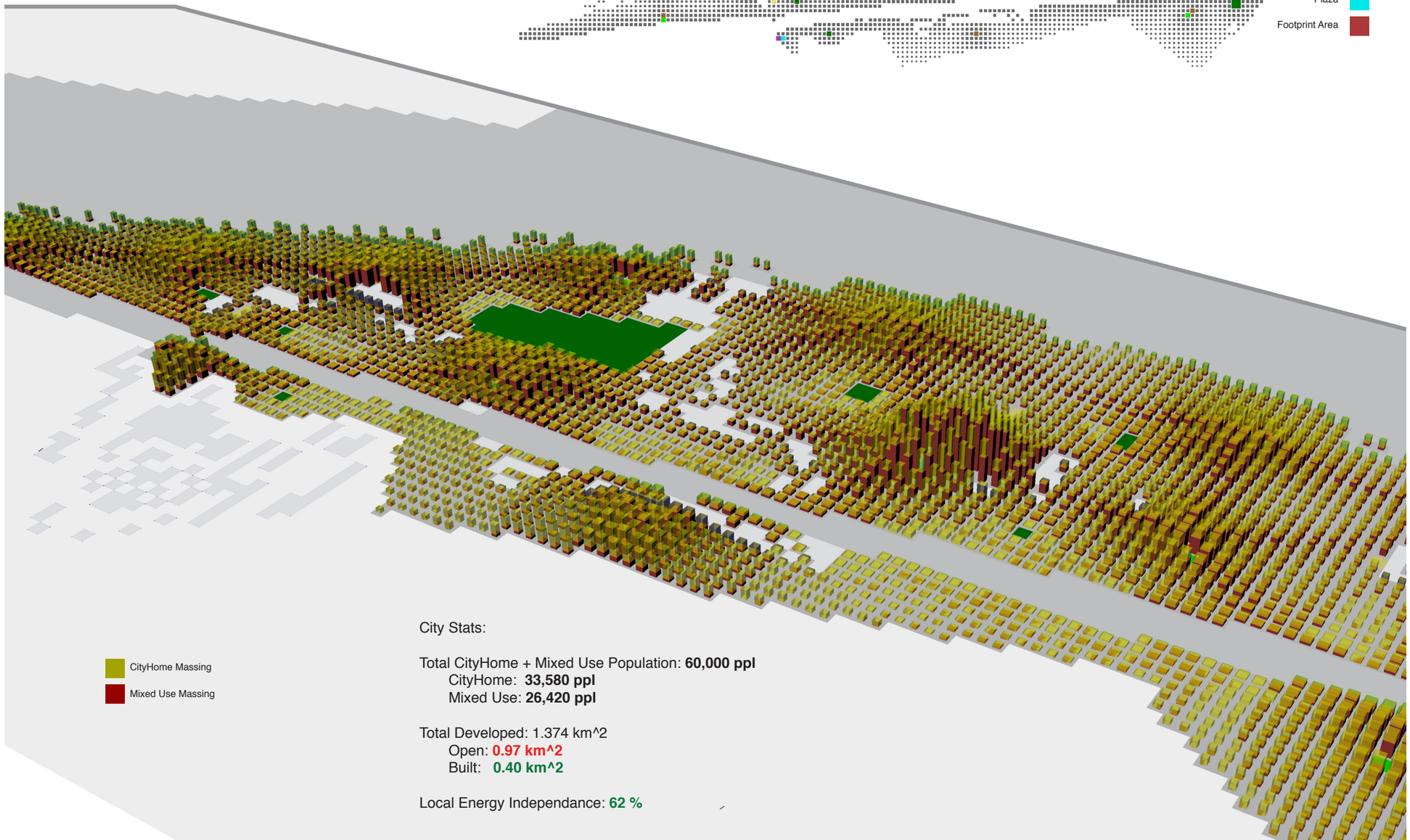
Algorithmic Planning



Ira Winder

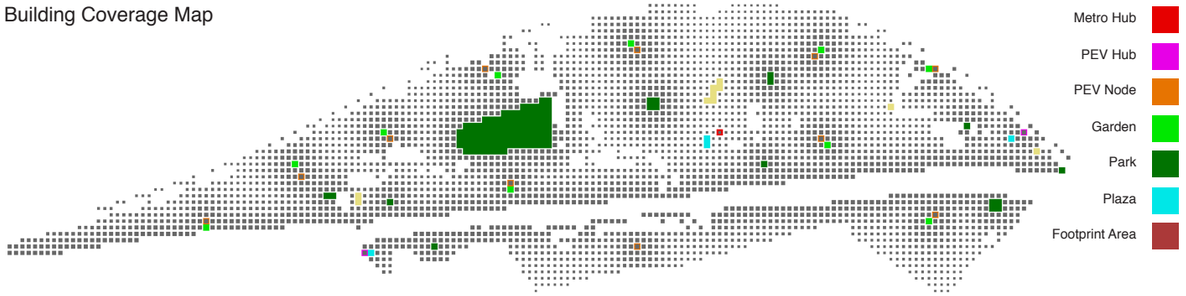
Moderate Waterfront Demand

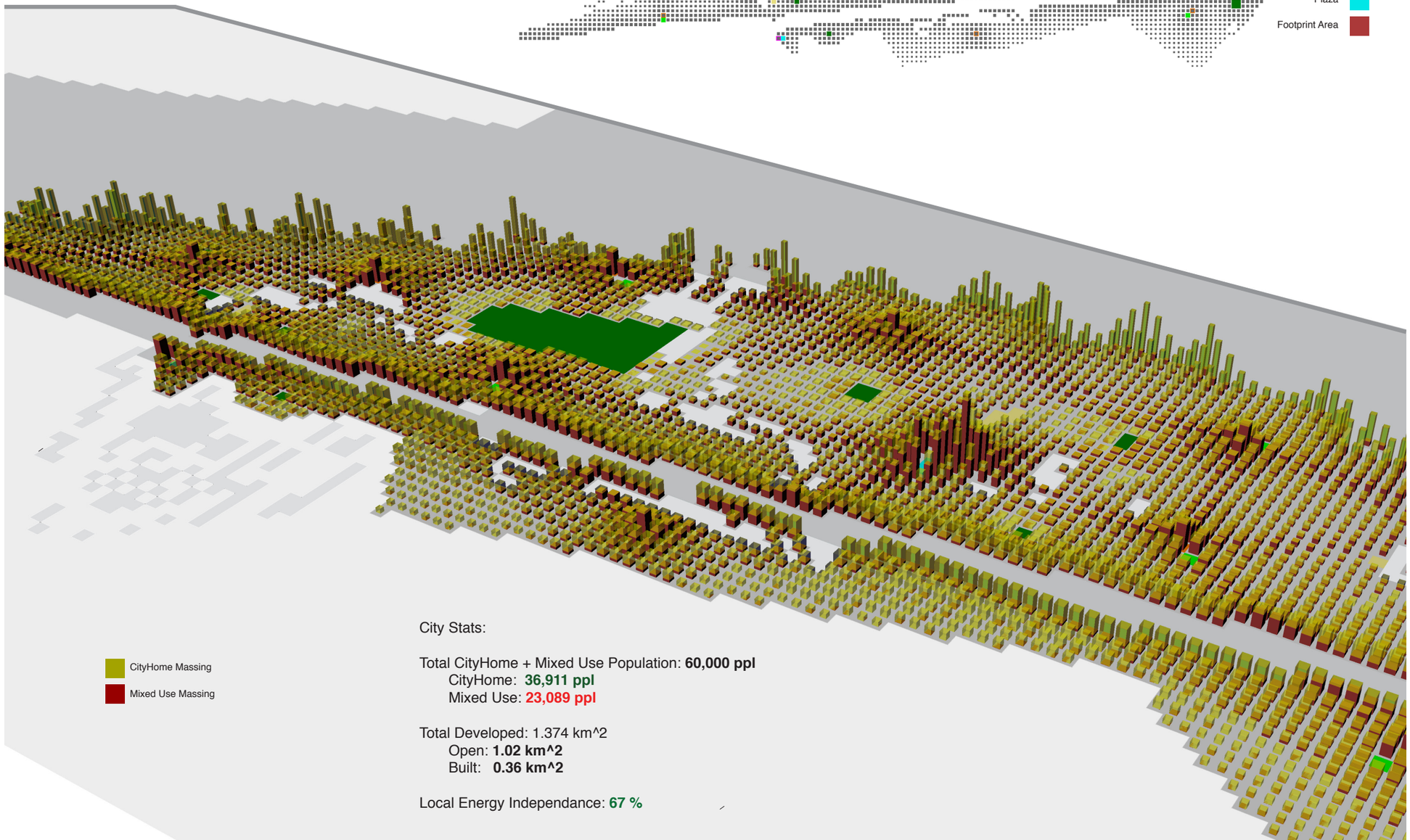




Ira Winder

Exceptional Waterfront Demand





City Stats:

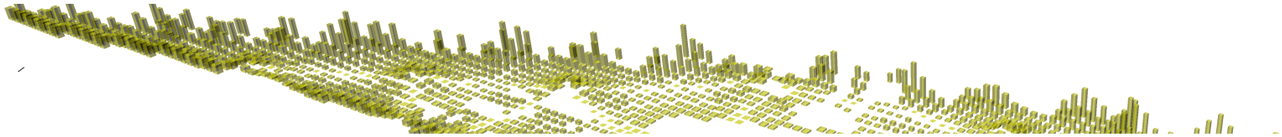
Total CityHome + Mixed Use Population: **60,000 ppl**
CityHome: **36,911 ppl**
Mixed Use: **23,089 ppl**

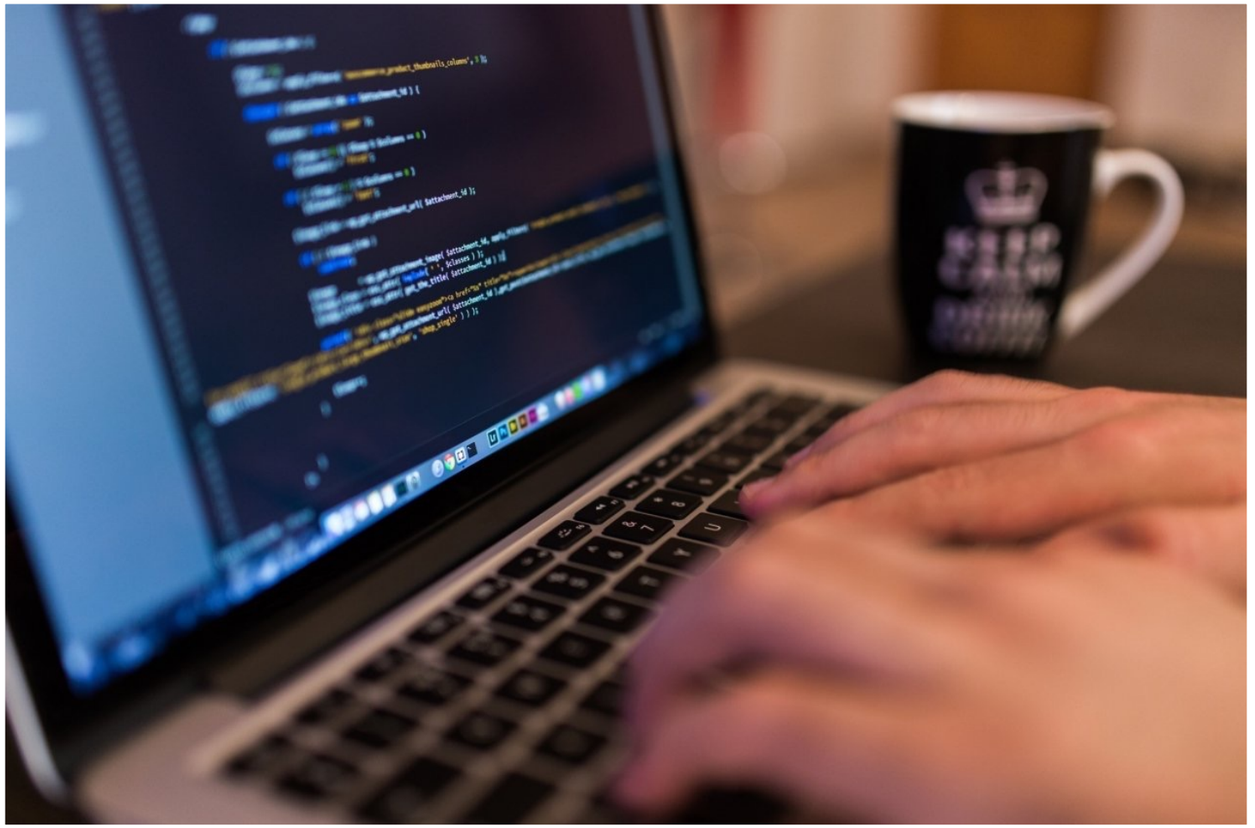
Total Developed: 1.374 km^2
Open: **1.02 km^2**
Built: **0.36 km^2**

Local Energy Independance: **67 %**

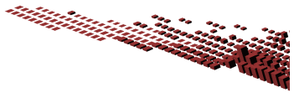
Ira Winder

Algorithmic techniques are fun but tend to be exclusive …

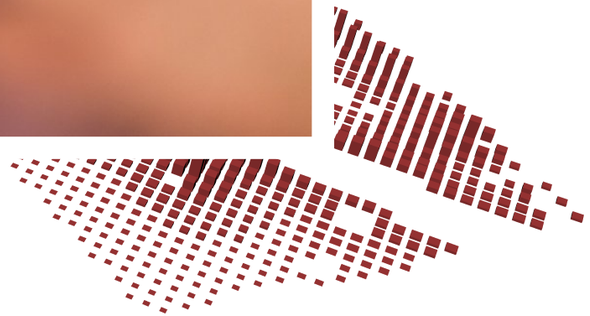




CityHome Massing

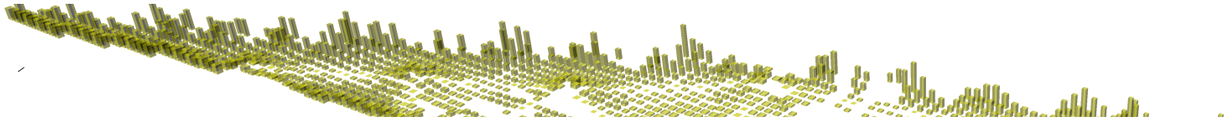


Mixed Use Massing

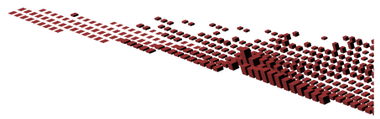


Ira Winder

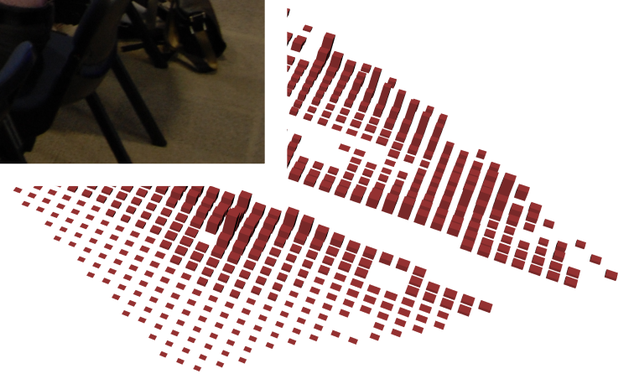
How to Empower Non-Expert Stakeholders with Model-based Thinking?



CityHome Massing



Mixed Use Massing

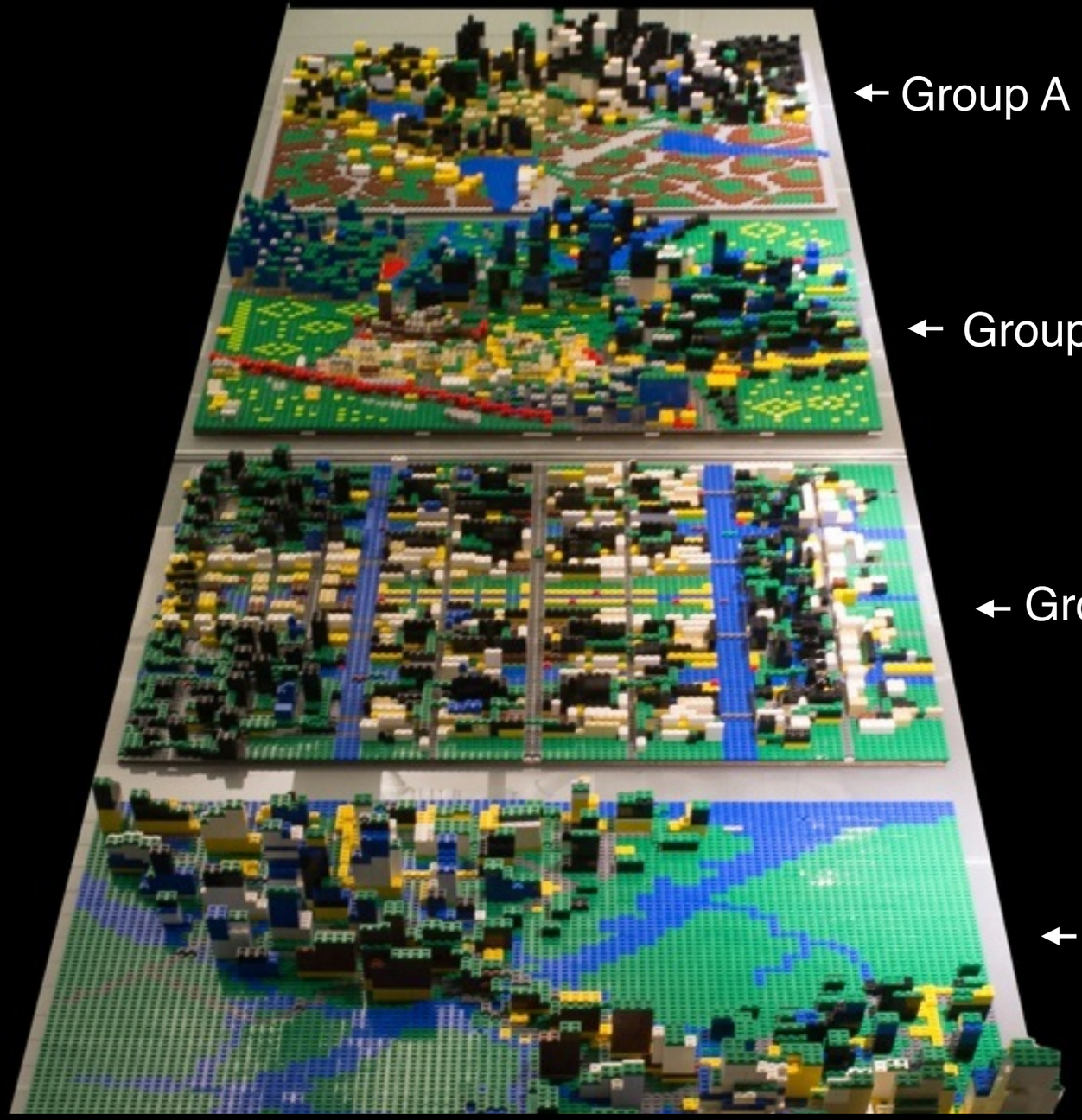


Ira Winder

Human-in-the-Loop Model

Ira Winder
Ryan Chin

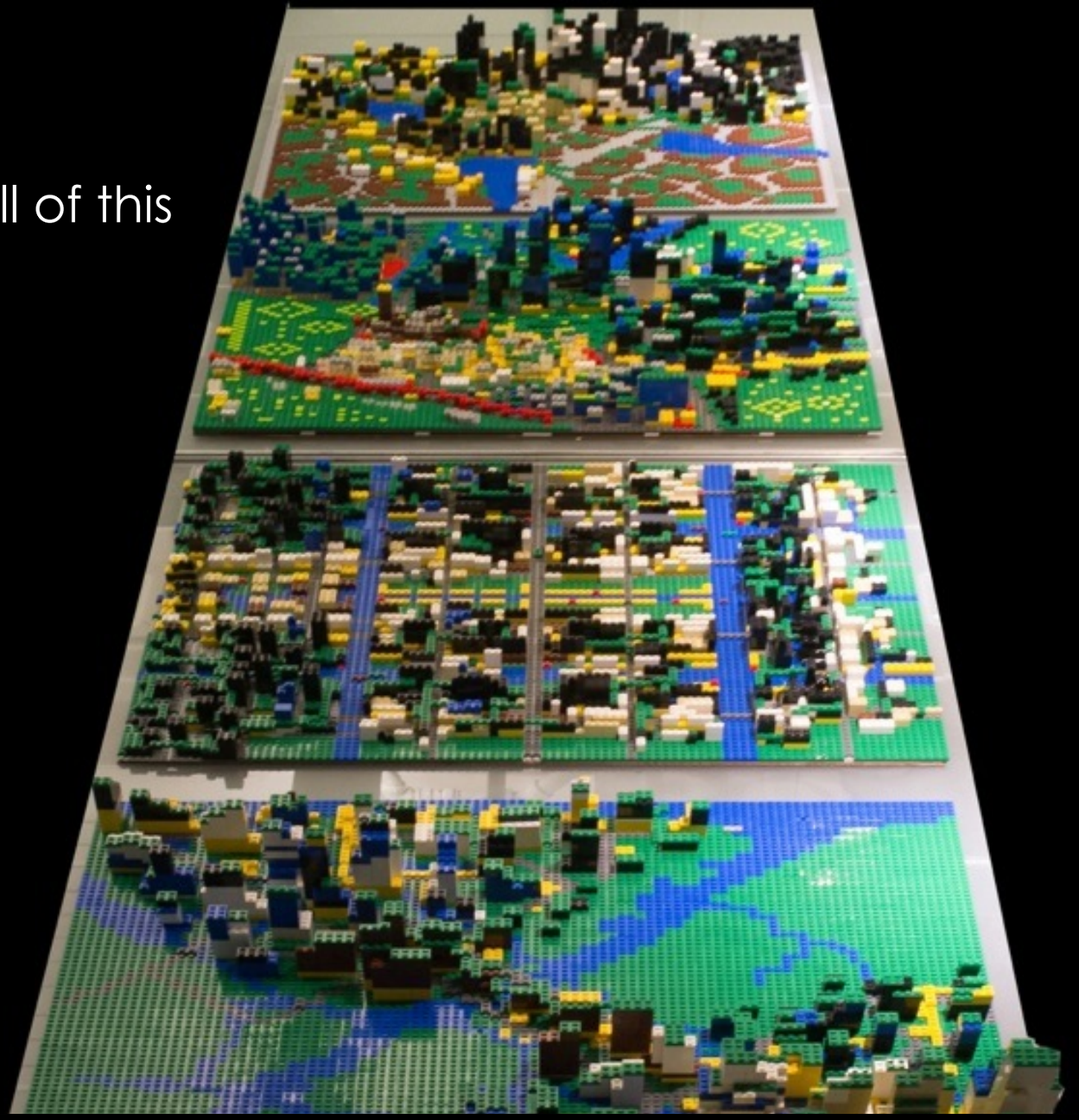
Outcome
Enabled diverse, non-convergent, solutions with a standard kit.



Human-in-the-Loop Model

Ira Winder

Problem
How do we **digitize** all of this rich **user input** data?



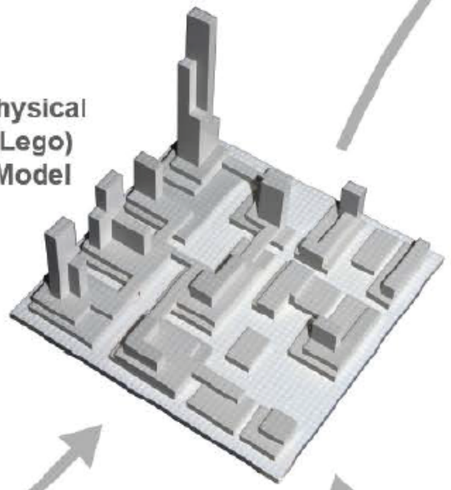
Ira Winder

CityScope

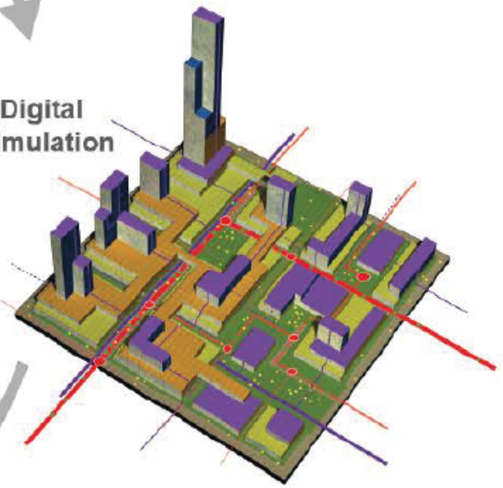
A Tangible Urban
Simulation Platform

3D Scanning

Physical
(Lego)
Model

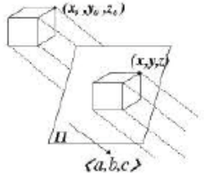


Digital
Simulation



Interaction/
Tangible Editing

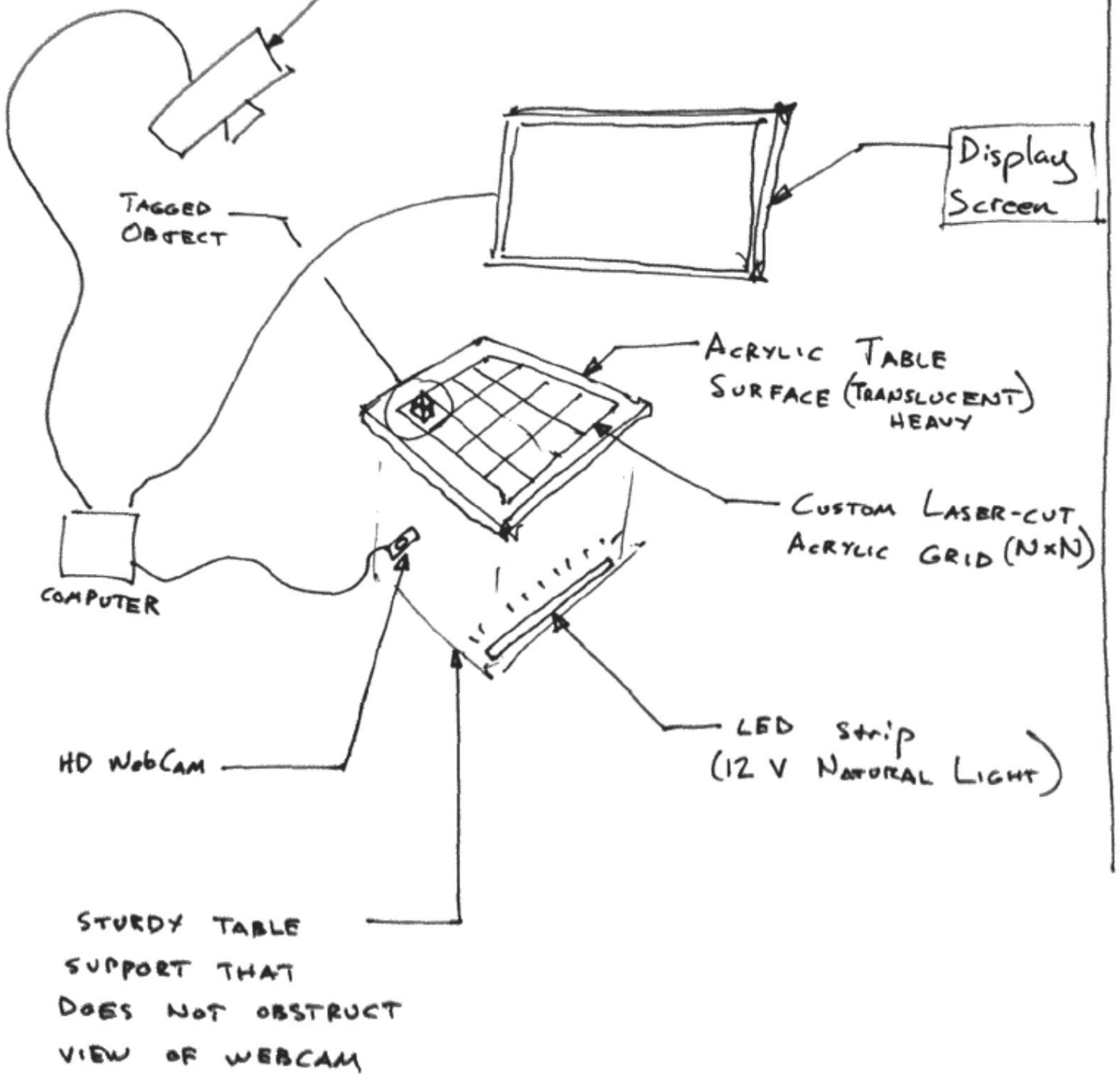
Projection Mapping



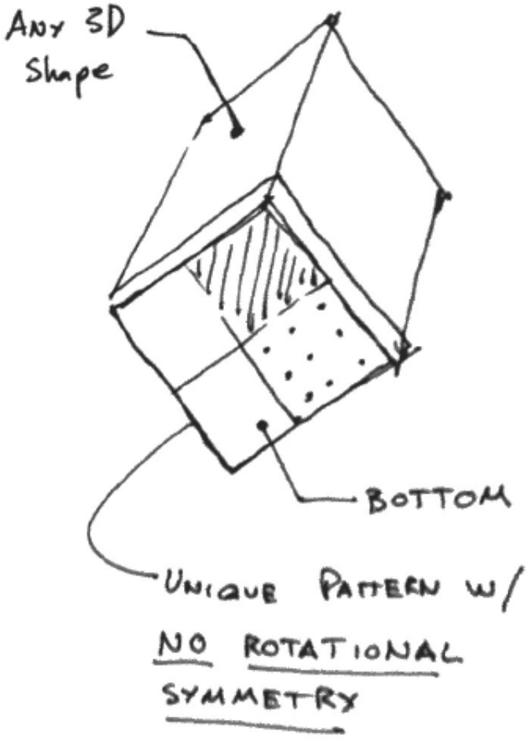
Observational/
Streaming Data

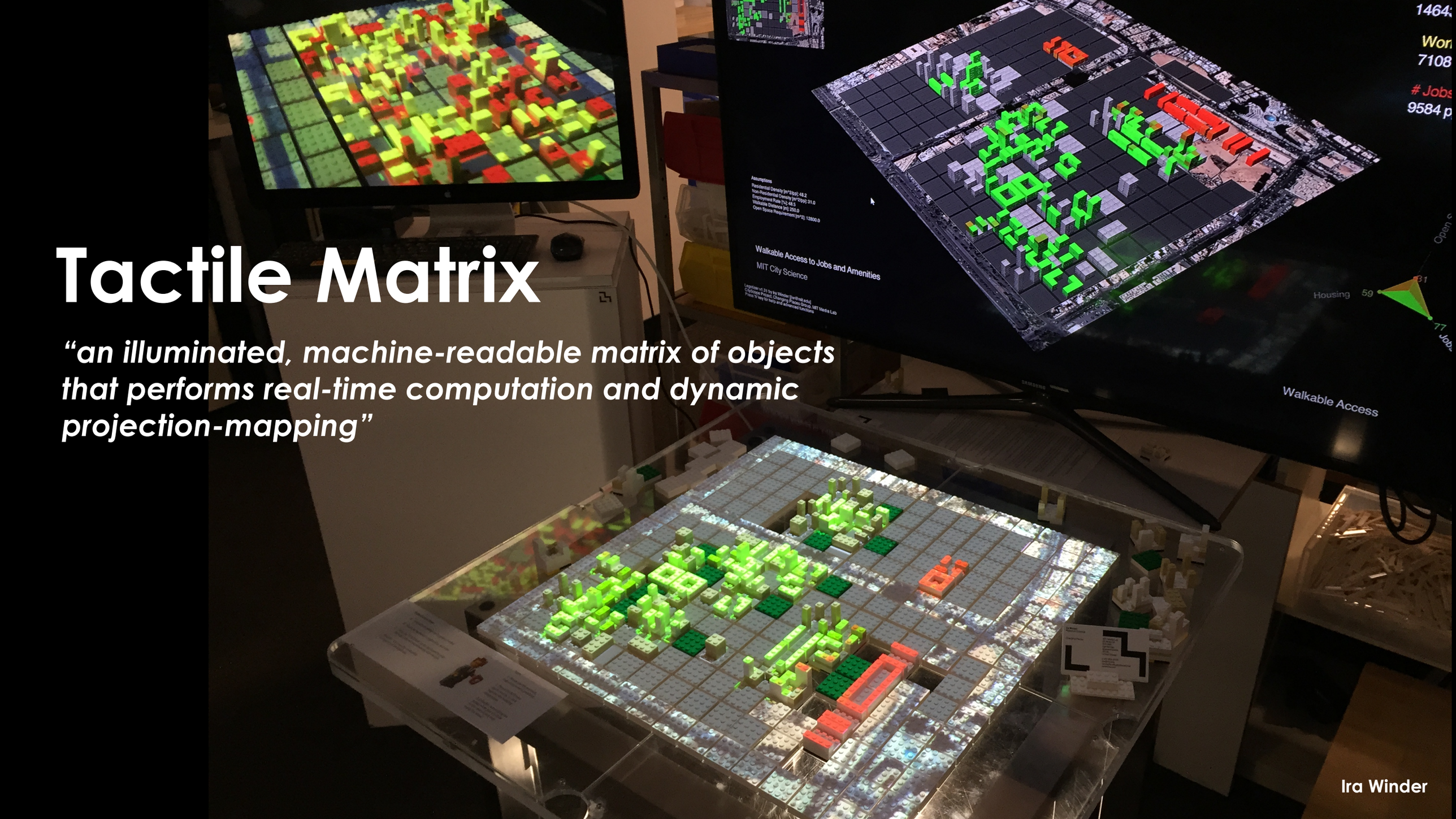
2015.04.08 IRA WINDER | SYSTEM FOR REALTIME DIGITAL RECONSTRUCTION + 3D PROJECTION-MAPPING OF TAGGED PHYSICAL 3D ENVIRONMENT USING COMPUTER VISION

HARDWARE



TAGGED OBJECT (EXAMPLE)





Tactile Matrix

“an illuminated, machine-readable matrix of objects that performs real-time computation and dynamic projection-mapping”

Ira Winder

Tactile Matrix

Ira Winder

Tactile Matrix

Real-Time Computation - Open Sourced at ira.mit.edu

Ira Winder

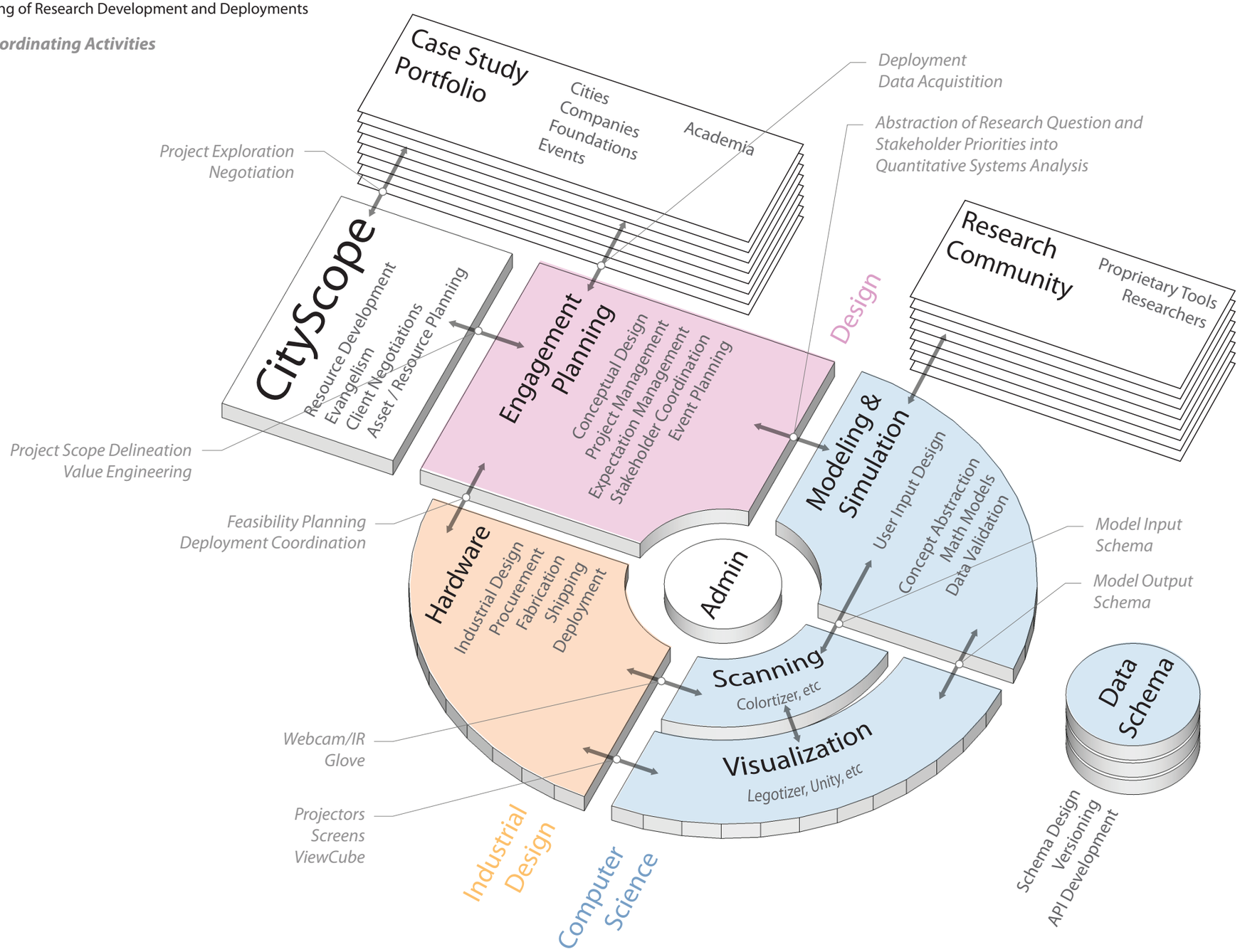

MIT / Kendall Square
FLOOR PLAN
SHOULD BE AT
Retail
Office
Academic

2015.06.18 Ira Winder

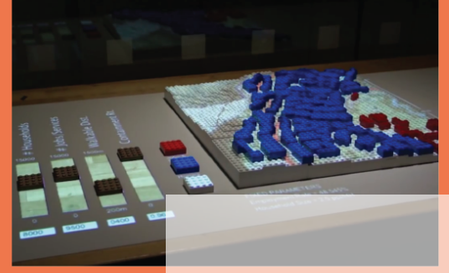
CityScope Strategic Organization Plan

for Efficient Scaling of Research Development and Deployments

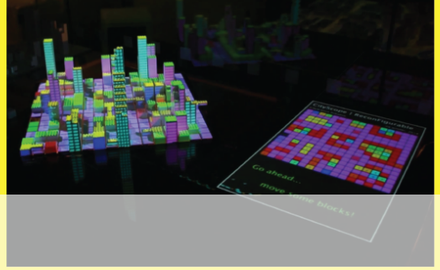
Task Group Coordinating Activities



Case Studies

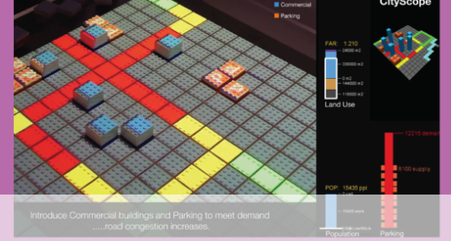


Town Planning in Flind… Queensland, Au… 2014
MIT Media Lab: Ira W… Joshua Fabian



Reconfigurable Cityscape, MIT Media Lab, Cambridge, MA 2014
Media La… Grad…

City Planning for Daylight, Energy, and… in Riyadh
…udi A… 2015
MIT M… Lab: Moha…
… Kent Larso…



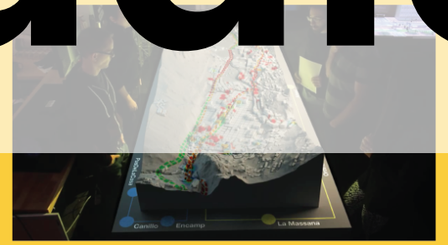
Land Use and Transportation (LUT) Mo… g, Toronto, Ca… 2015
M… edia … Car… Smut…

"CityMatrix" Model, MIT Media Lab, Cambridge, MA 2016
MIT Media Lab: Yan (Ryan) Zhang, Arna… …d, Luis Alonso Pas… …ent L… …n, Ira Winder

Bus Rapid Transit Planning and Community Engagement in Boston, MA, USA 2015
MIT Media Lab: Ariel Noyman, Kent Larson, Phil Tinn, Ira Winder, Ryan CC Chin

Kendall Square Algorithmic Zoning "Playground", Cambridge, MA, USA 2015
MIT Media Lab: Ira Winder, Ariel Noyman, Lezhi Li, Wei Lin

Hafencity University Workshop, Hamburg, Germany 2015
HCU: Tobias Holtz, Nina Haelker, Katrin Hovy, Gesa Ziemer
MIT Media Lab: Ira Winder, Yan (Ryan) Zhang, Ariel Noyman, Kent Larson



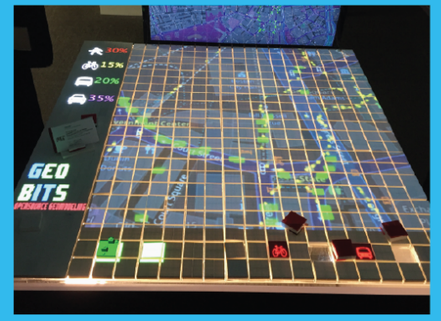
Andorra Living Lab, Andorra La Vella 2015
MIT Media Lab: Kent Larson, Luis Alonso Pastor, Arnaud Grignard, Yan (Ryan) Zhang, Juanita Devis, Ronano Doorley, Carson Smuts, Nai Chun Chen, Yan Leng, Ira Winder

Philips Lighting Research, Cambridge, MA 2017
MIT Media Lab: Ira Winder, Anthony Cheng, Nina Lutz

Distribution and Logistics Planning, MIT CTL, San Jose, CA & Denver, CO 2016
MIT Media Lab: Ira Winder, Mike Winder
MIT CTL: Matthias Winkenbach

Singapore Pedestrian Accessibility, World Cities Summit, Singapore 2016
MIT Media Lab: Ira Winder, Nina Lutz
Singapore CLC: Yimin Zhou

"Finding Places" Refugee Planning, Hamburg, Germany 2016
HCU: Tobias Holtz, Nina Haelker, Katrin Hovy, Gesa Ziemer
MIT Media Lab: Ira Winder, Yan (Ryan) Zhang, Ariel Noyman, Kent Larson

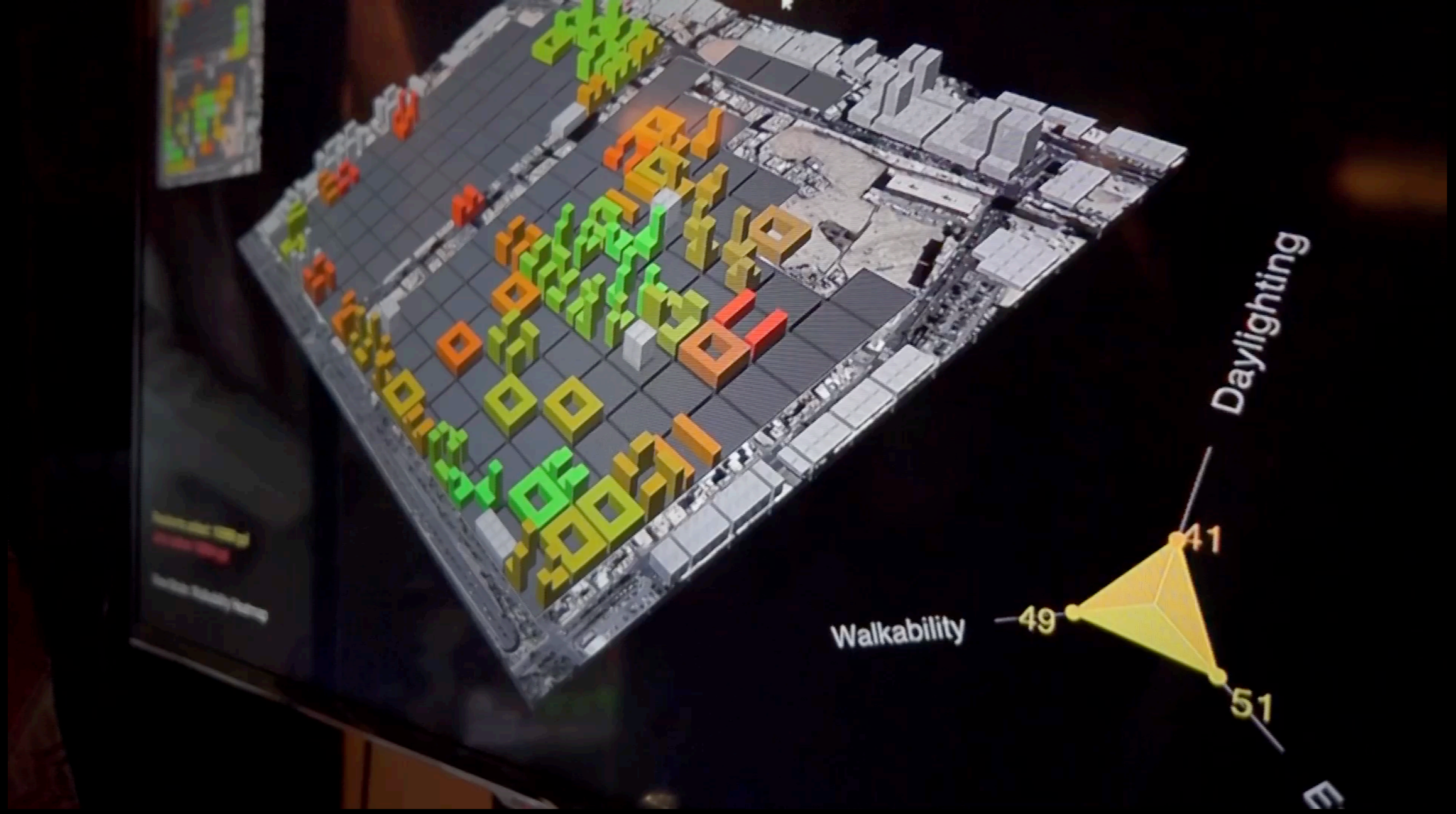


GeoBits, MIT Media Lab, Cambridge, MA 2016
MIT Media Lab: Nina Lutz, Ira Winder

PharmaScope, GSK, Stevenage, UK 2018
MIT Media Lab: Ira Winder, Nina Lutz, Joyce Chen
GSK: Giovanni Giorgio, Joana Gomes, Mason Briner, Andrew Rutter, John Dyson

Riyadh - King Abdullah University of Science and Technology

MIT / KACST
Ira Winder



Tactile Matrix - Analyzing User Interventions

MIT / KACST
Ira Winder

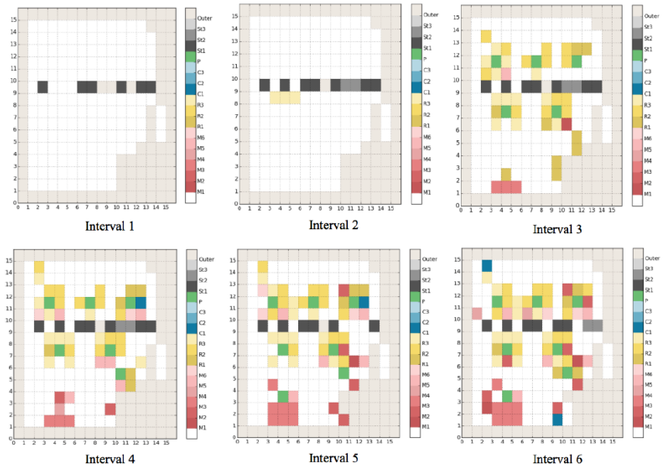


Figure 16. Recreated Snapshots of the grid at the end of each 5-minute interval for game session 2

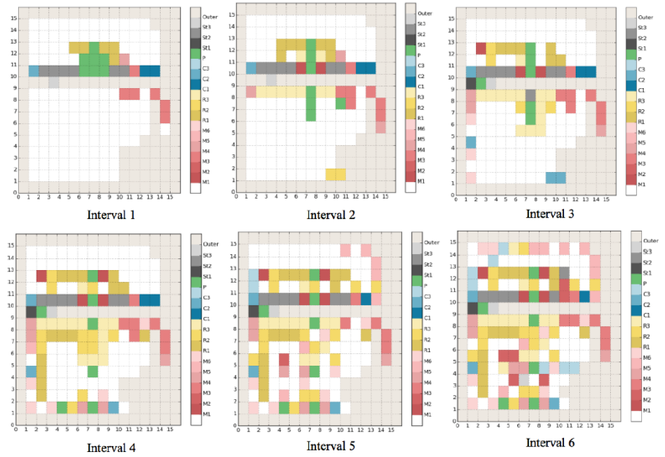


Figure 17. Recreated Snapshots of the grid at the end of each 5-minute interval for game session 3

Source: Tariq Alhindi, Tarfah Alrashed, Almaha Almalki, Faisal Aleissa, Cody Rose, Ira Winder, Anas Alfaris, Areej Al-Wabil

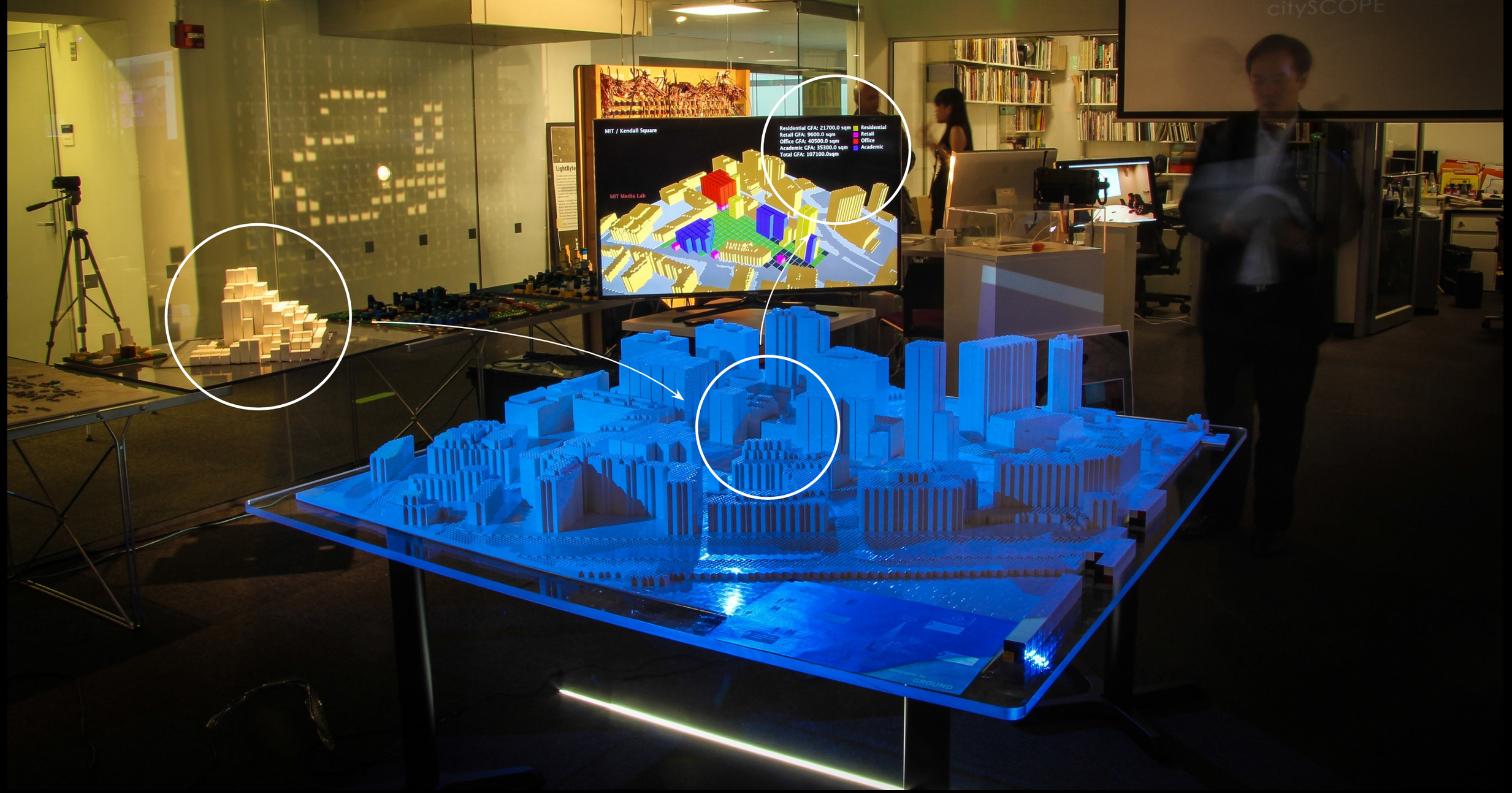
Source: Ira Winder

Case Study: City Block Envelope Designer

CityScope Playground:
Ira Winder
Ariel Noyman
Lezhi Li

Case Study: City Block Envelope Designer

CityScope Playground:
Ira Winder
Ariel Noyman
Lezhi Li

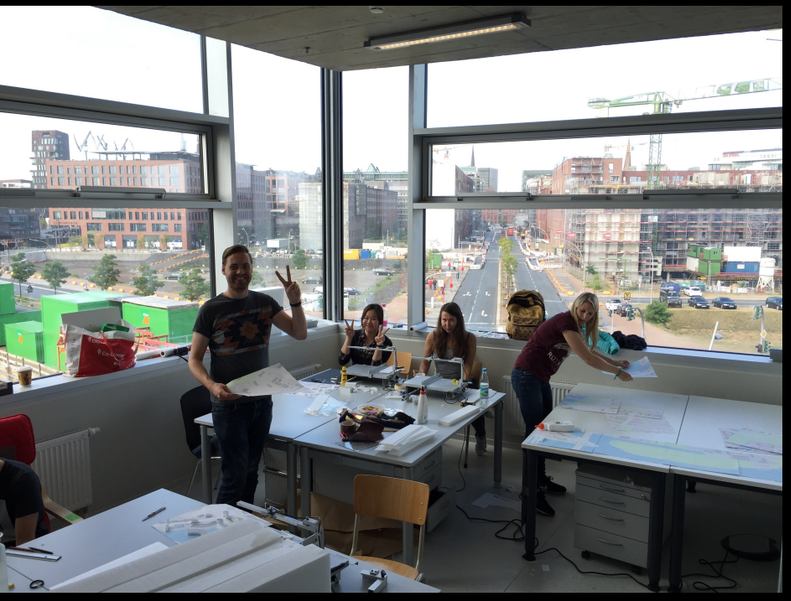


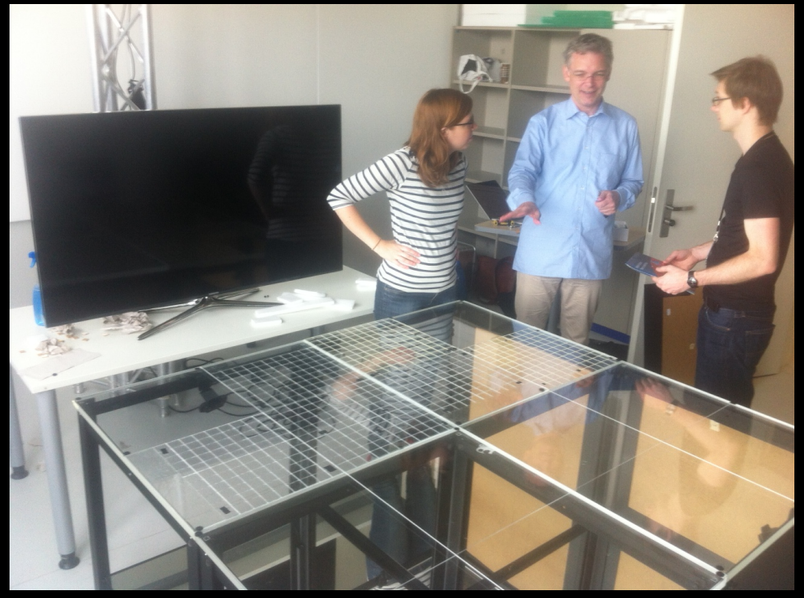
Case Study: City Block Envelope Designer

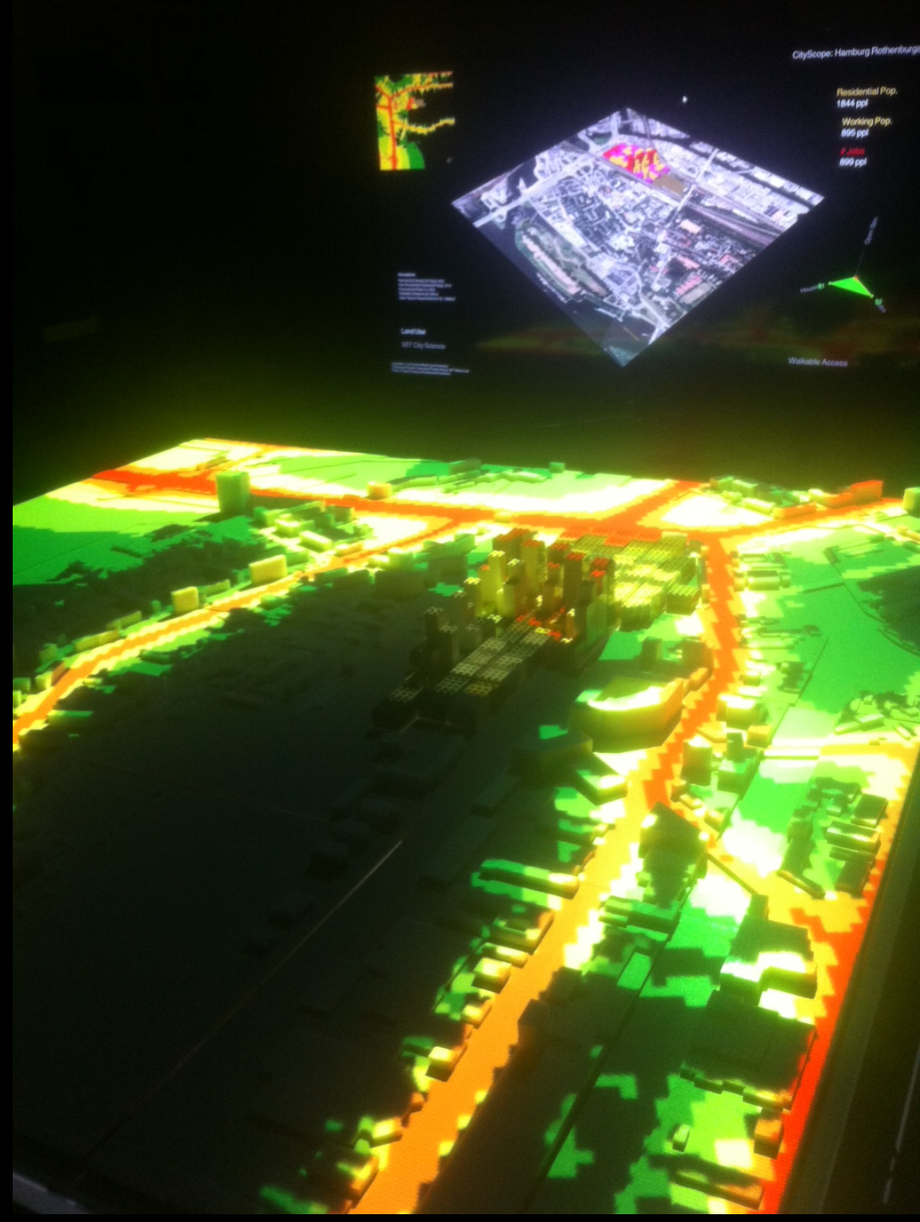
CityScope Playground:

Ira Winder
Ariel Noyman
Lezhi Li

Case Study: Hamburg Living Lab - Hafencity University

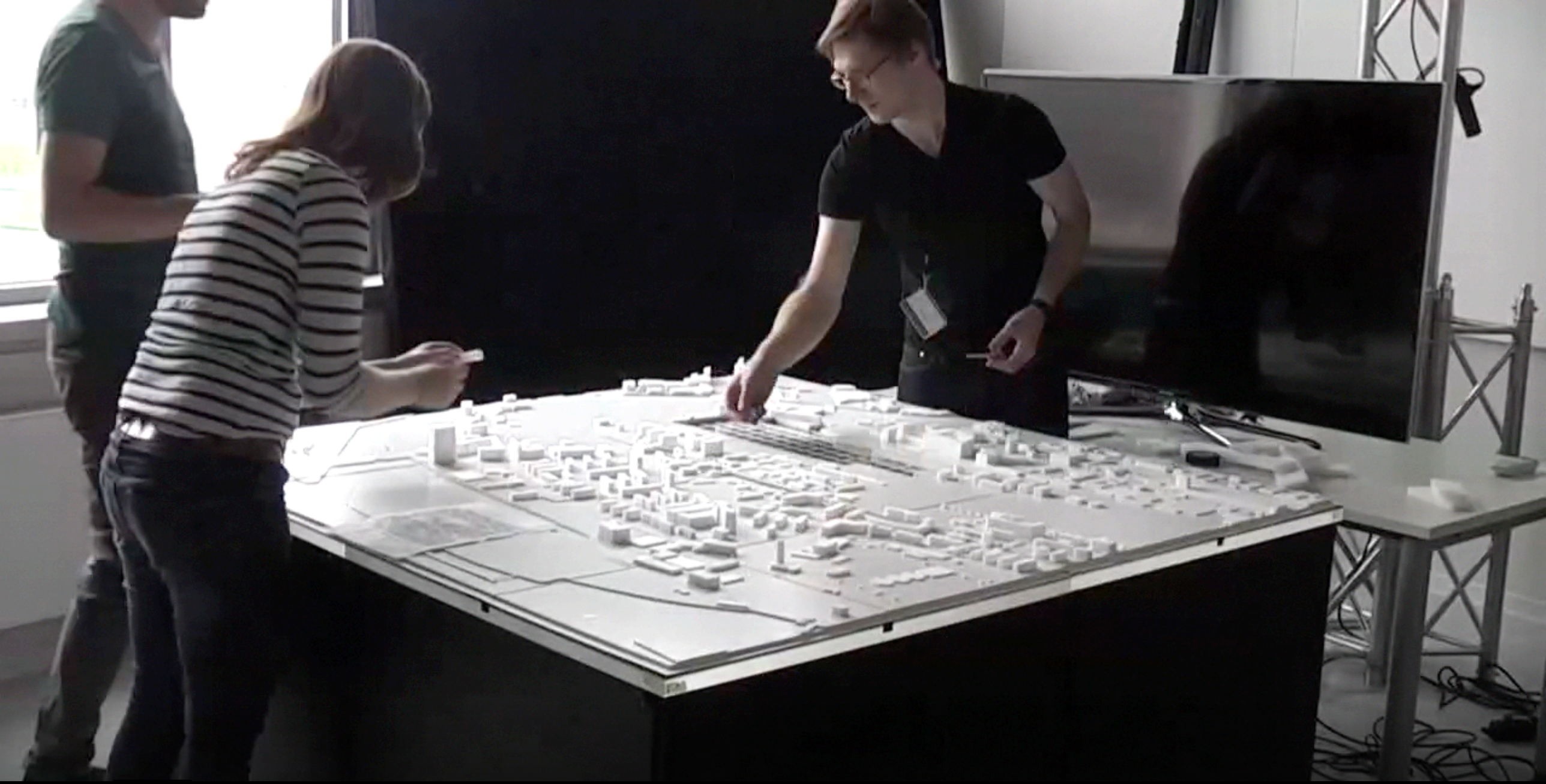






Case Study: Hamburg Living Lab - Hafencity University

Hafencity University
Ira Winder

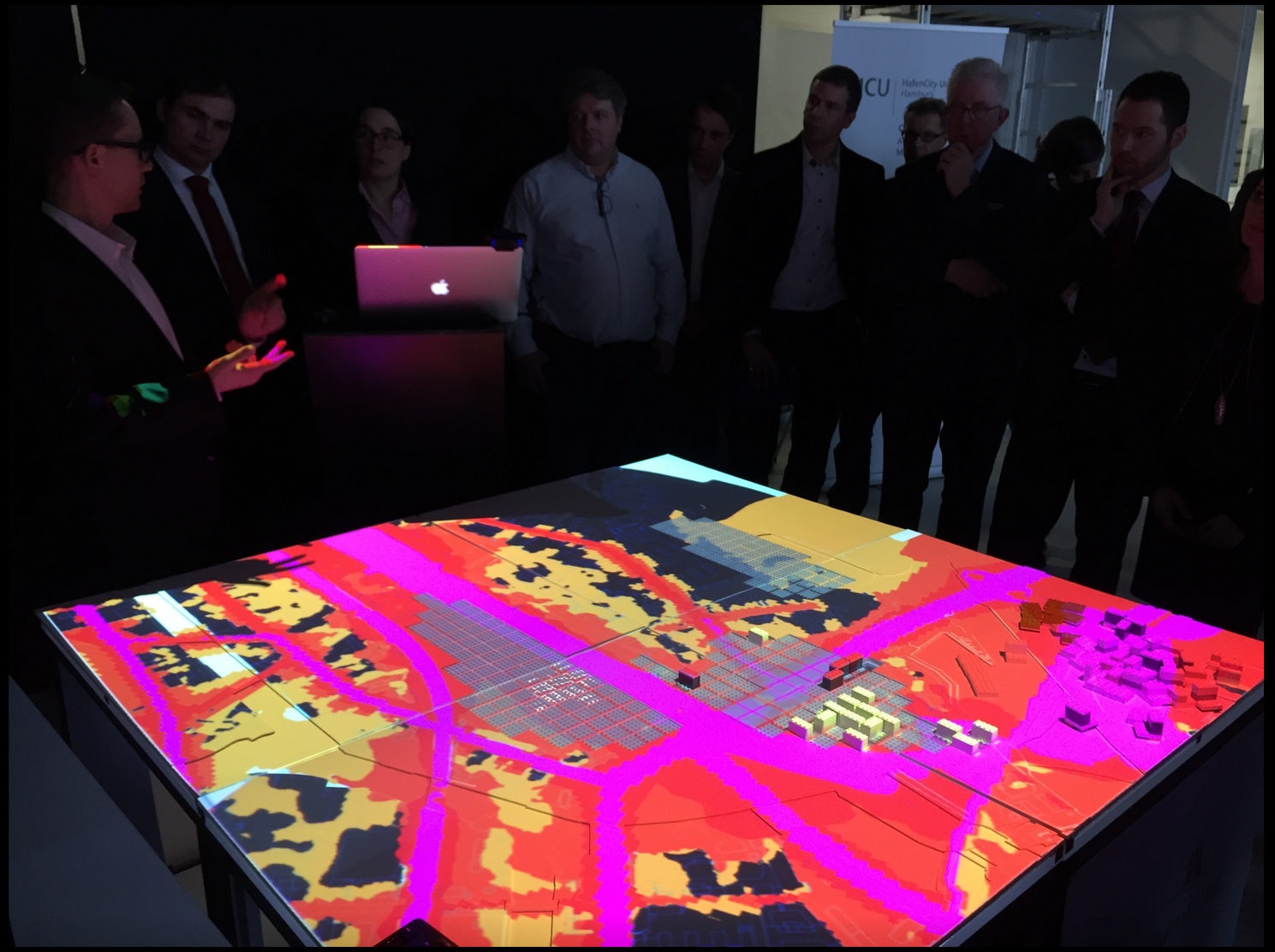


Case Study: Hamburg Living Lab - Hafencity University

Hafencity University
Ira Winder

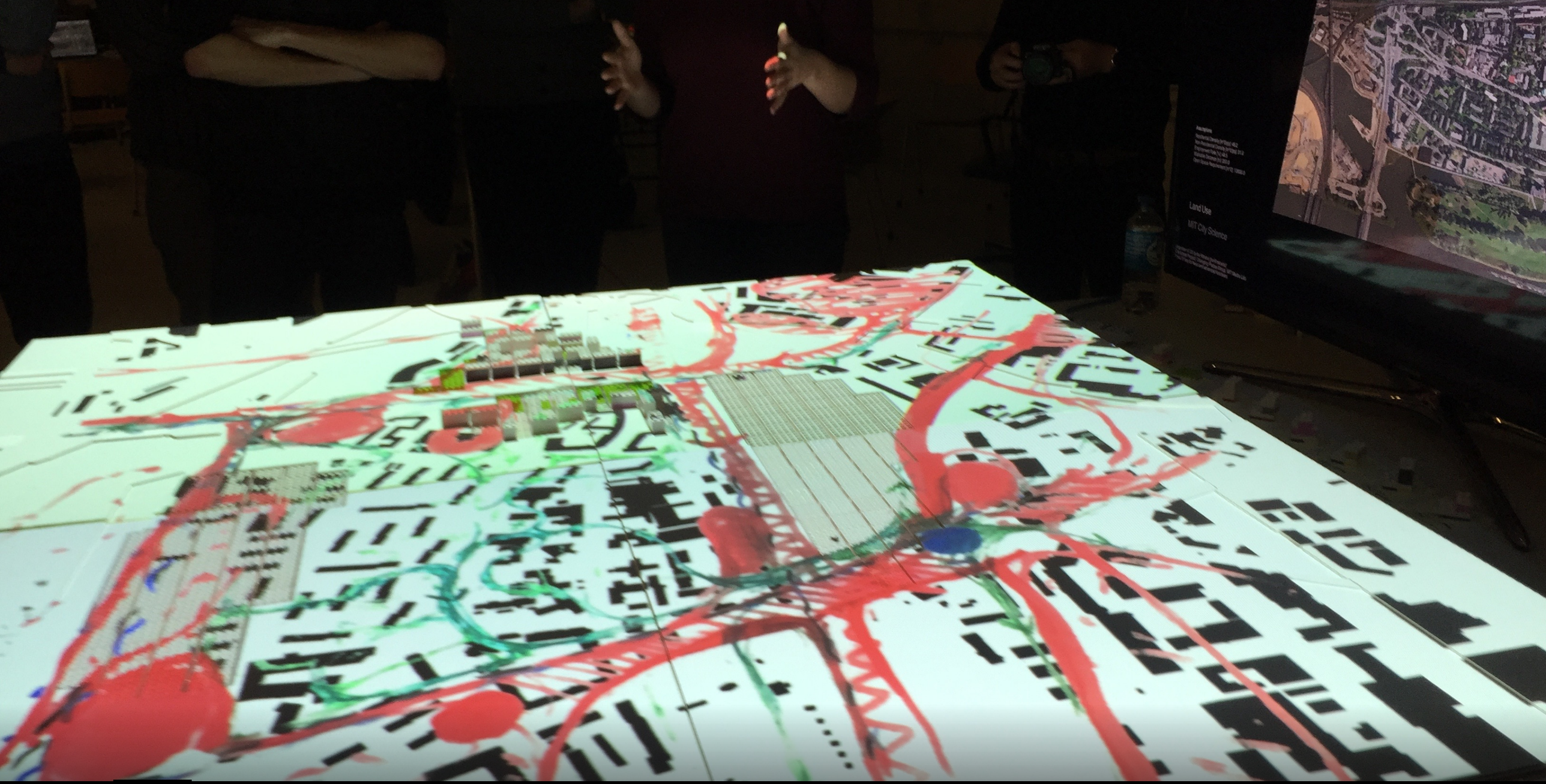
Case Study: Hamburg Living Lab - Solutions Conference

Hafencity University
Ira Winder



Case Study: Hamburg Living Lab - Traffic Noise

Hafencity University
Ira Winder



Case Study: Hamburg Living Lab - Student Surveys

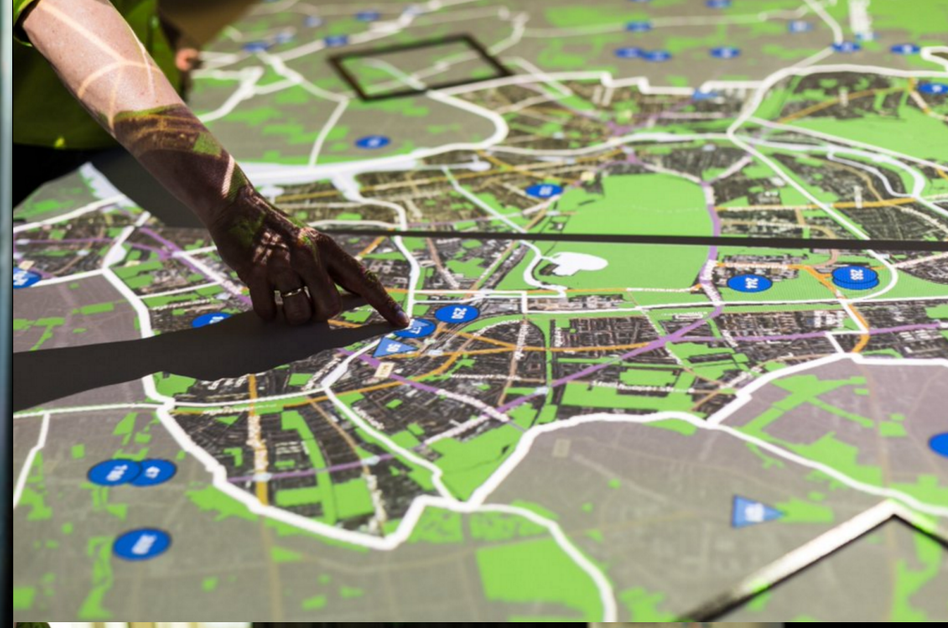
Hafencity University
Ira Winder

Case Study: Hamburg Finding Places - Refugee Crisis

Hafencity University
Ira Winder

Case Study: Hamburg Finding Places - Refugee Crisis

Hafencity University
Ira Winder



Case Study: Finding Places Workshop

Hafencity University

iSoftStone

iSoftStone
Ira Winder

iSoftStone

iSoftStone
Ira Winder

iSoftStone

iSoftStone
Ira Winder

iSoftStone

iSoftStone
Ira Winder

iSoftStone

iSoftStone
Ira Winder

iSoftStone

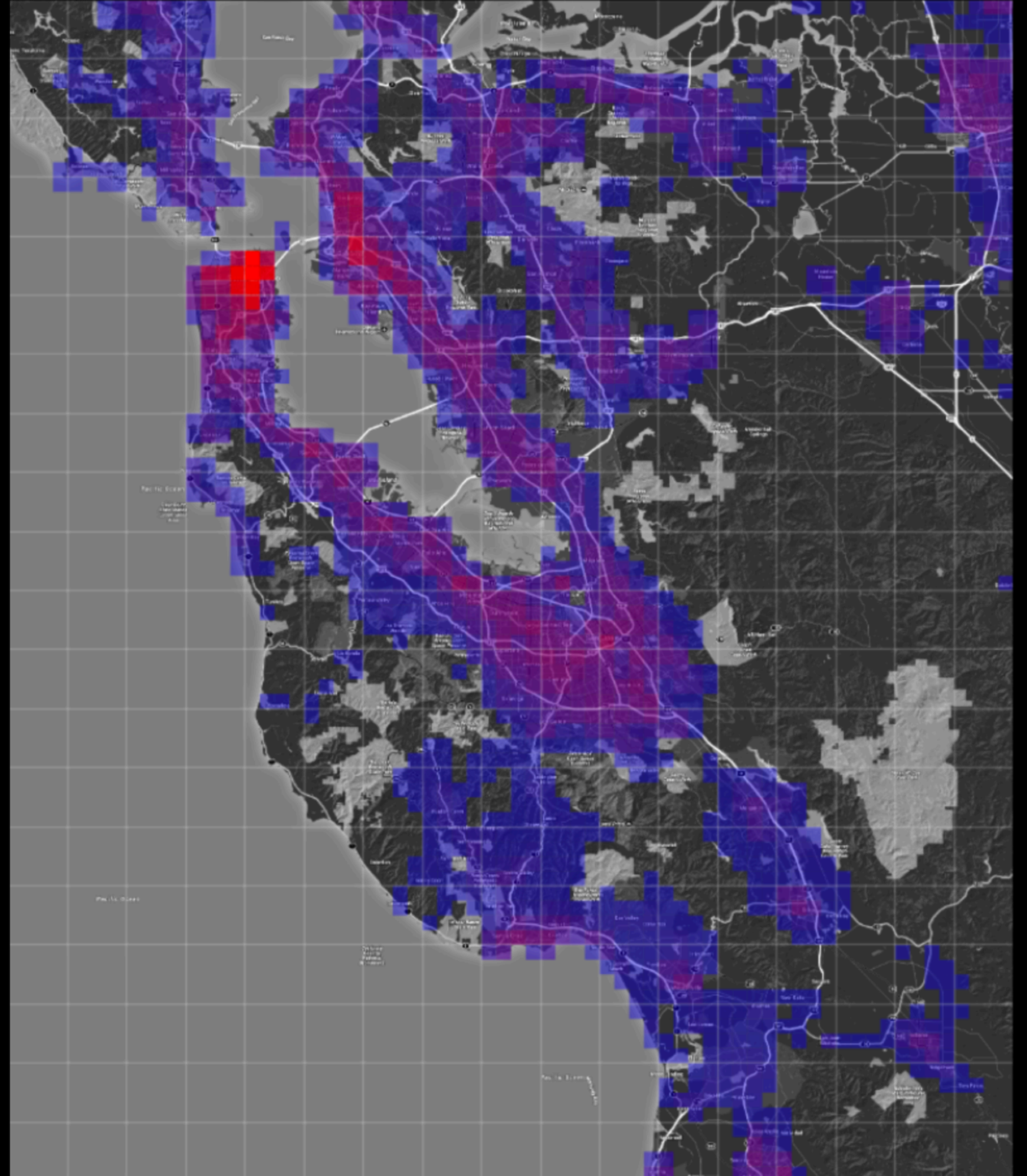
iSoftStone
Ira Winder

Last Mile Logistics

Image: Michael Lin, MIT Media Lab

Home Delivery Demand:

- Based on Population



Demand Potential
Source: 2010 U.S. Census

142 deliv./day

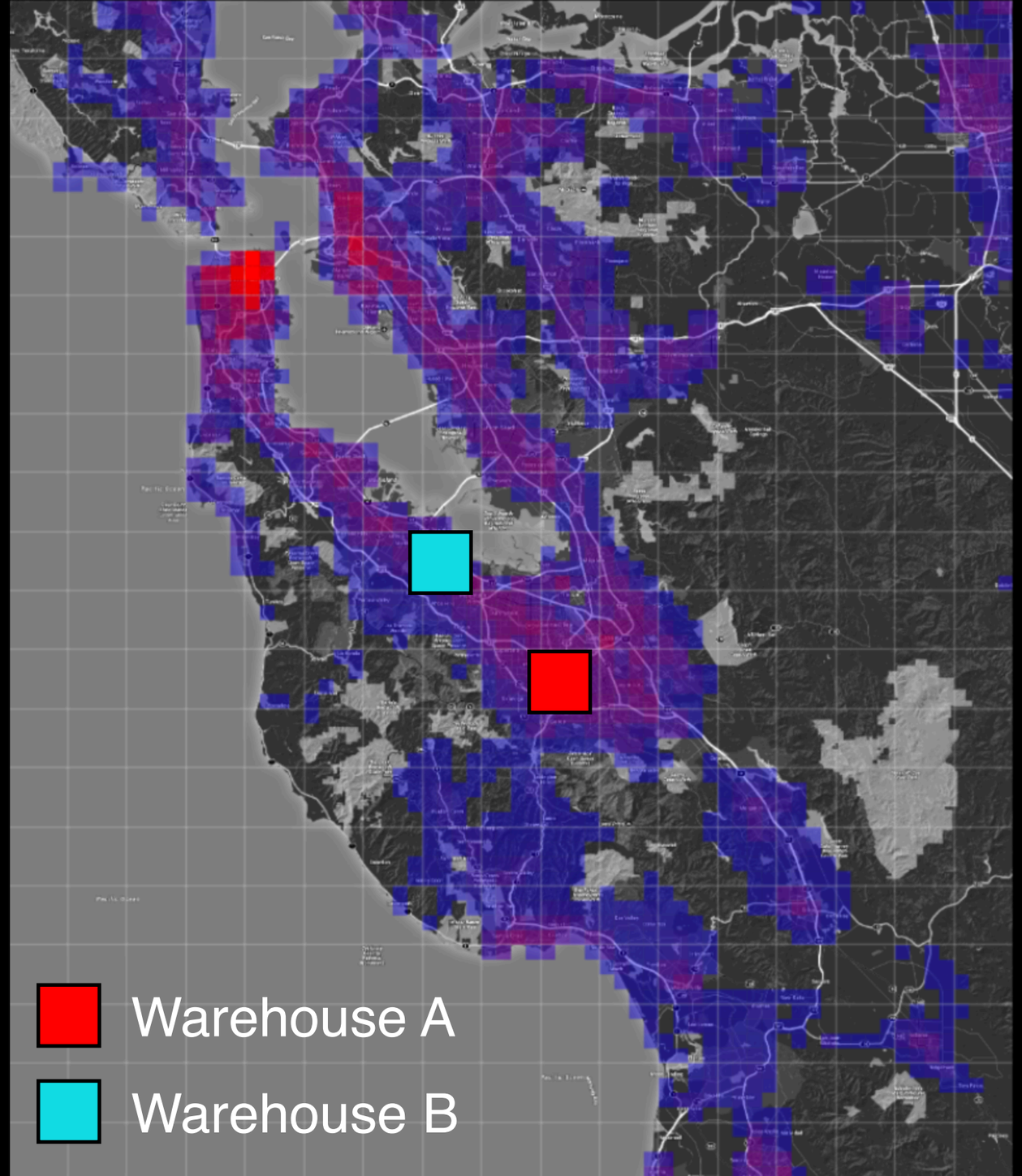
10 deliv./day

8.0 km

Total Demand Potential
8175 deliveries

Warehouse Placement:

How shall we allocate service areas for 4,000 daily deliveries to homes?



Demand Potential
Source: 2010 U.S. Census

142 deliv./day

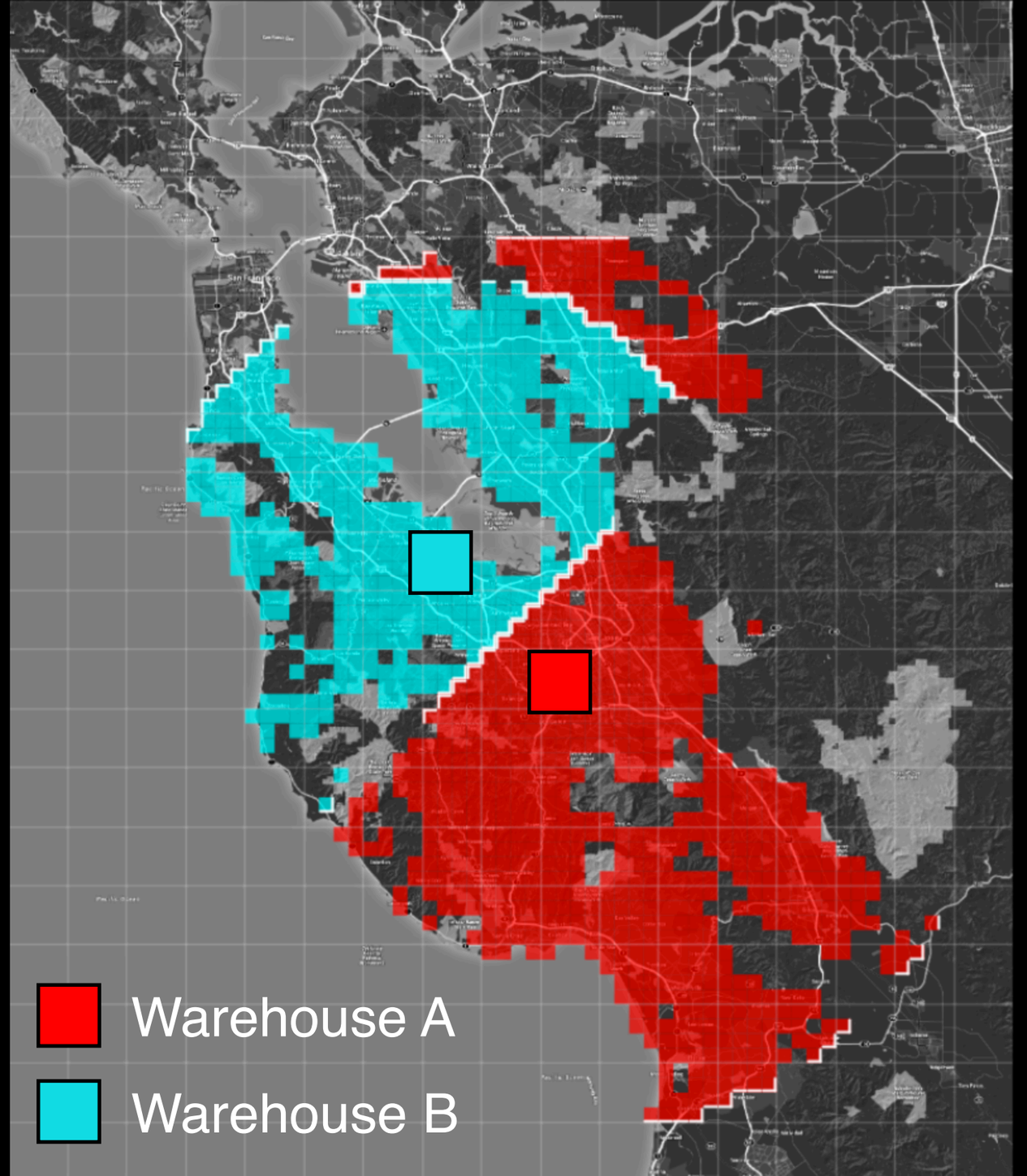
10 deliv./day

8.0 km

Total Demand Potential
8175 deliveries

Optimize Service Areas for Distance?

- Most Simple to Draw

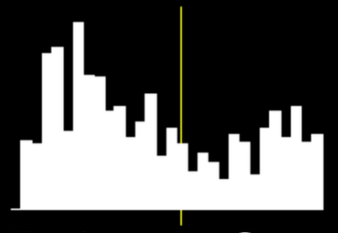


Demand Potential
Source: 2010 U.S. Census

142 deliv./day

10 deliv./day

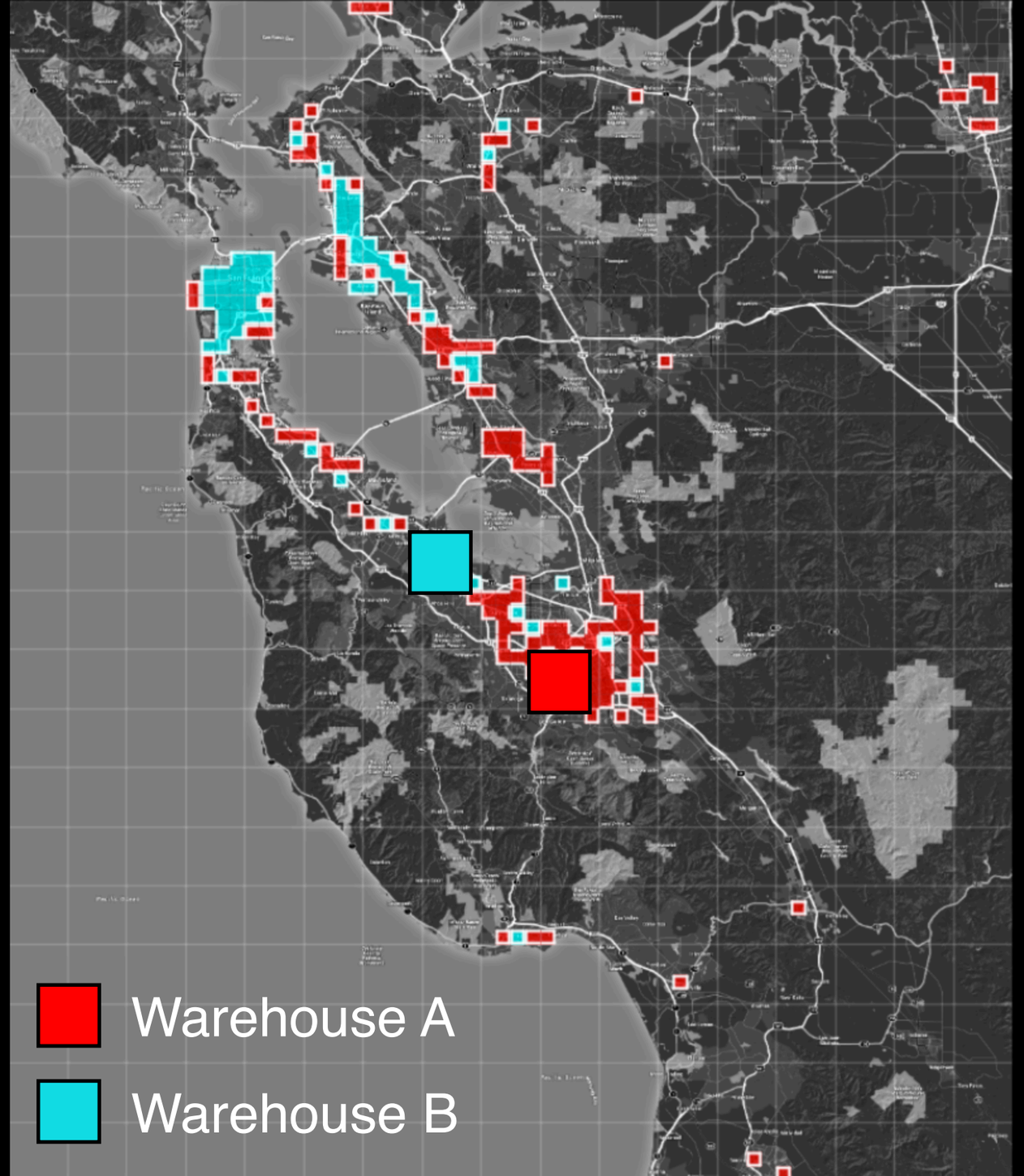
8.0 km

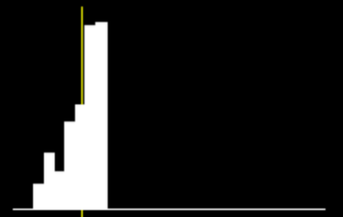


Delivery Cost

Optimize Service Areas for Urban-ness:

- Most service to Dense, Urban Areas





Delivery Cost

Total Demand Potential
8175 deliveries

Daily Demand Supplied
4014 deliveries

Demand Potential
Source: 2010 U.S. Census

142 deliv./day

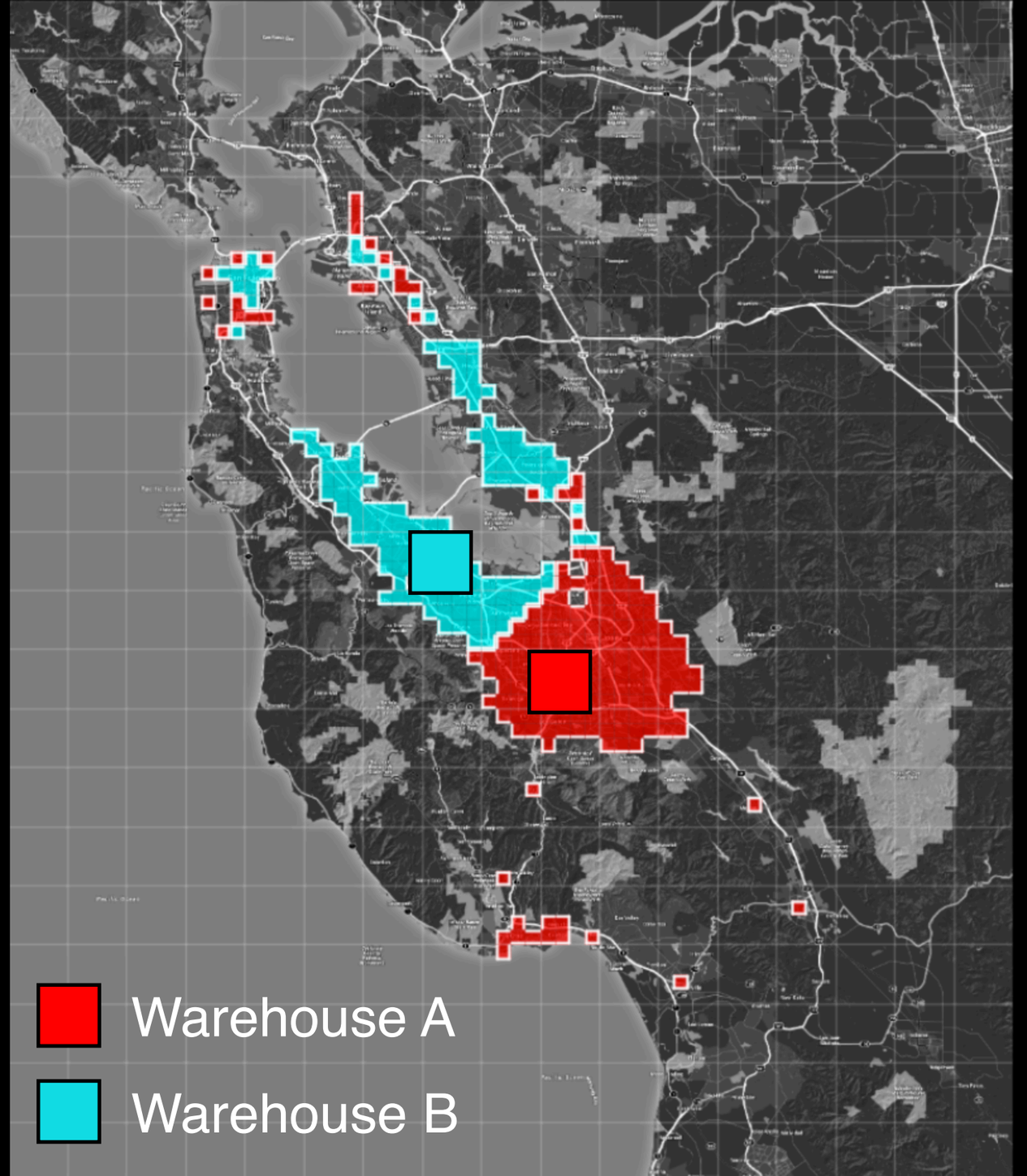
10 deliv./day

8.0 km

Optimize Service Areas for Delivery Cost:

- Most Cost-Efficient Service Area

- Cost = density / distance



Demand Potential
Source: 2010 U.S. Census

142 deliv./day

10 deliv./day

8.0 km

Delivery Cost

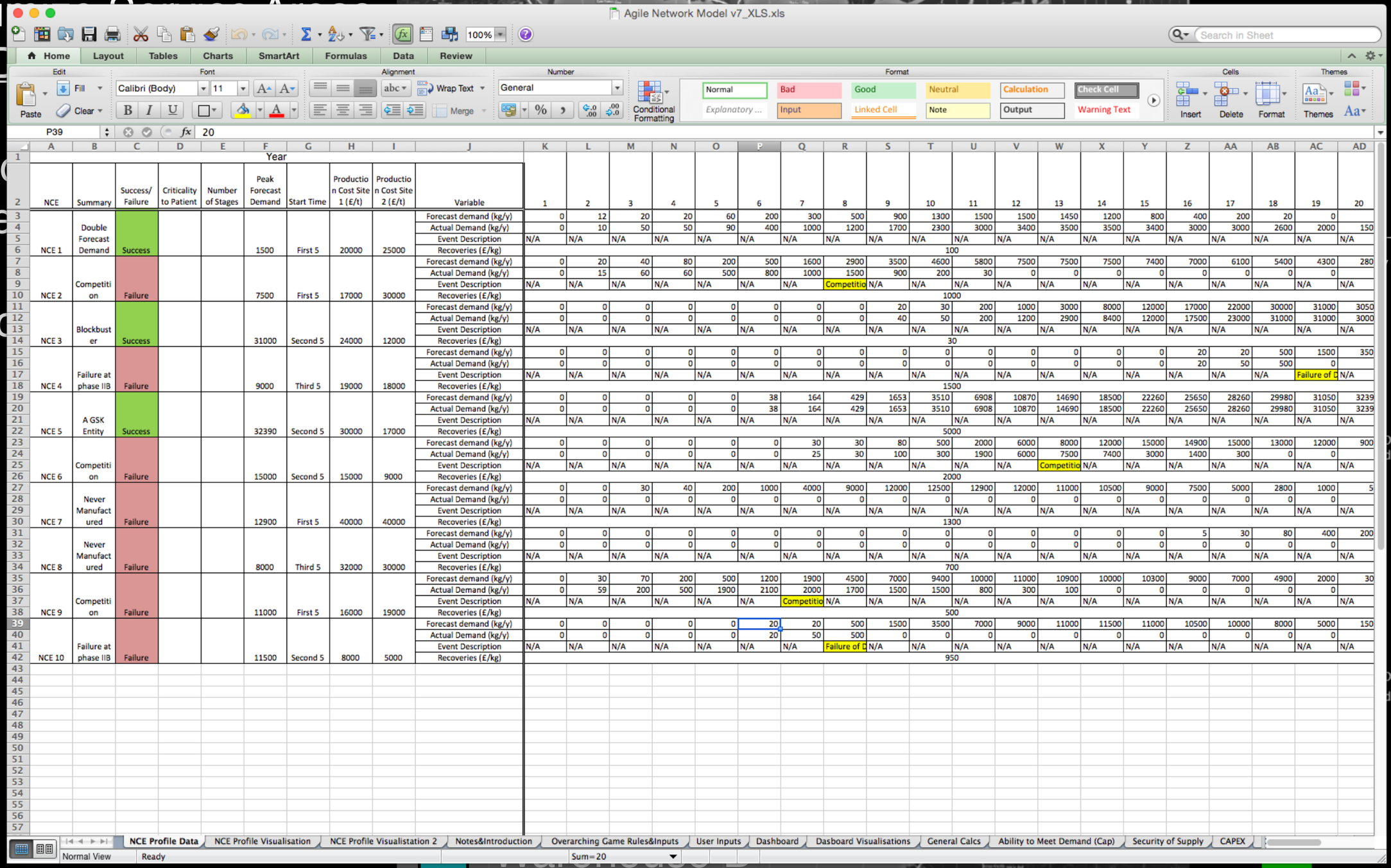
Opti
for D

- Mo
  Se
- Co

Cost

Demand Potential
deliveries

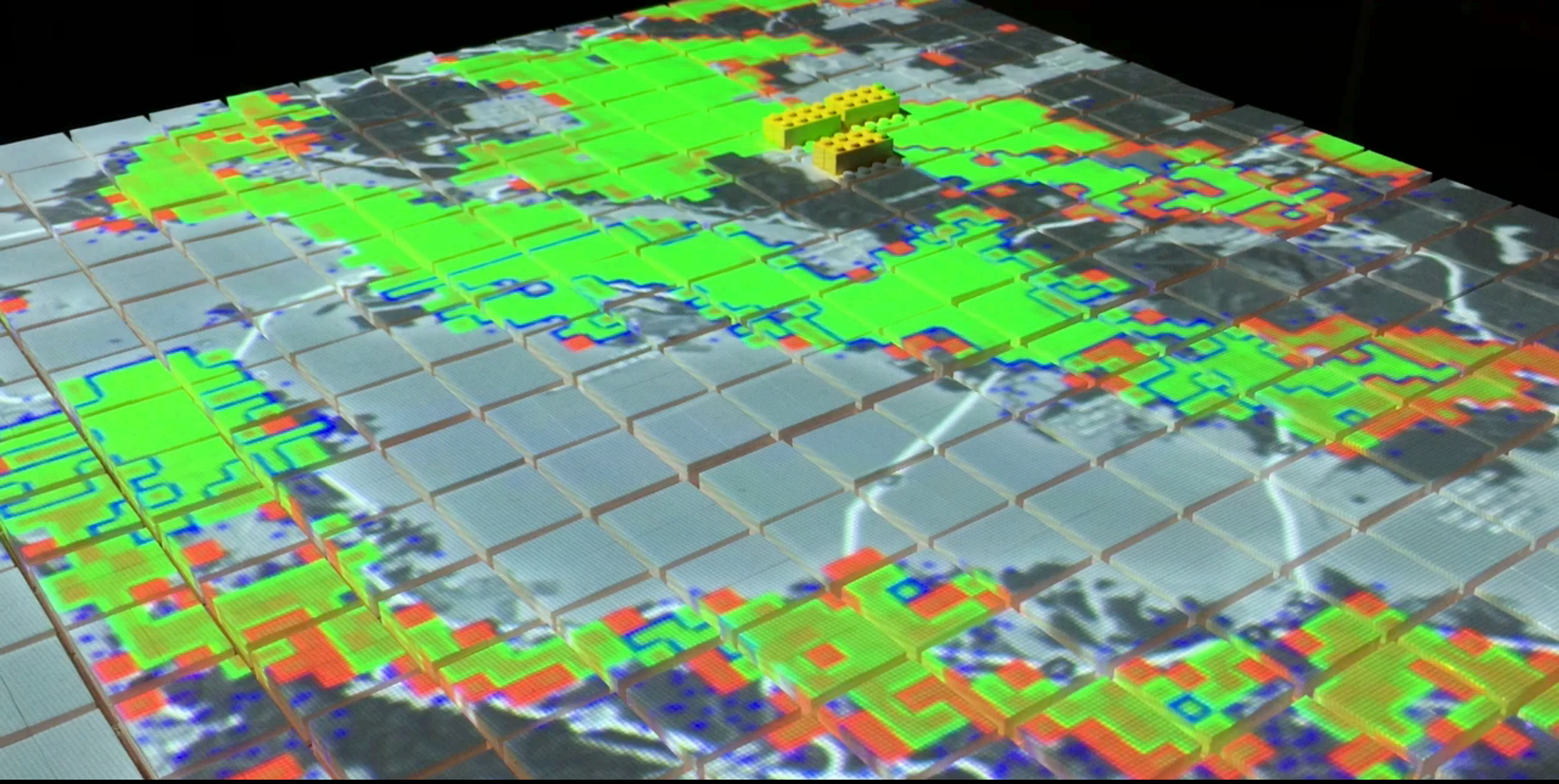
Demand Supplied
deliveries



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
1						Year																								
2	NCE	Summary	Success/ Failure	Criticality to Patient	Number of Stages	Peak Forecast Demand	Start Time	Production Cost Site 1 (£/t)	Production Cost Site 2 (£/t)	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
3		Double Forecast Demand	Success			1500	First 5	20000	25000	Forecast demand (kg/y)	0	12	20	20	60	200	300	500	900	1300	1500	1500	1450	1200	800	400	200	20	0	
4										Actual Demand (kg/y)	0	10	50	50	90	400	1000	1200	1700	2300	3000	3400	3500	3500	3400	3000	3000	2600	2000	150
5										Event Description	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	NCE 1									Recoveries (£/kg)	100																			
7		Competition	Failure			7500	First 5	17000	30000	Forecast demand (kg/y)	0	20	40	80	200	500	1600	2900	3500	4600	5800	7500	7500	7500	7400	7000	6100	5400	4300	280
8										Actual Demand (kg/y)	0	15	60	60	500	800	1000	1500	900	200	30	0	0	0	0	0	0	0	0	
9										Event Description	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Competitio	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	NCE 2									Recoveries (£/kg)	1000																			
11		Blockbuster	Success			31000	Second 5	24000	12000	Forecast demand (kg/y)	0	0	0	0	0	0	0	0	20	30	200	1000	3000	8000	12000	17000	22000	30000	31000	3050
12										Actual Demand (kg/y)	0	0	0	0	0	0	0	0	40	50	200	1200	2900	8400	12000	17500	23000	31000	31000	3000
13										Event Description	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	NCE 3									Recoveries (£/kg)	30																			
15		Failure at phase IIB	Failure			9000	Third 5	19000	18000	Forecast demand (kg/y)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	20	500	1500	350
16										Actual Demand (kg/y)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	50	500	0	
17										Event Description	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Failure of D	N/A
18	NCE 4									Recoveries (£/kg)	1500																			
19		A GSK Entity	Success			32390	Second 5	30000	17000	Forecast demand (kg/y)	0	0	0	0	0	38	164	429	1653	3510	6908	10870	14690	18500	22260	25650	28260	29980	31050	3239
20										Actual Demand (kg/y)	0	0	0	0	0	38	164	429	1653	3510	6908	10870	14690	18500	22260	25650	28260	29980	31050	3239
21										Event Description	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22	NCE 5									Recoveries (£/kg)	5000																			
23		Competition	Failure			15000	Second 5	15000	9000	Forecast demand (kg/y)	0	0	0	0	0	0	30	30	80	500	2000	6000	8000	12000	15000	14900	15000	13000	12000	900
24										Actual Demand (kg/y)	0	0	0	0	0	0	25	30	100	300	1900	6000	7500	7400	3000	1400	300	0	0	
25										Event Description	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Competitio	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26	NCE 6									Recoveries (£/kg)	2000																			
27		Never Manufactured	Failure			12900	First 5	40000	40000	Forecast demand (kg/y)	0	0	30	40	200	1000	4000	9000	12000	12500	12900	12000	11000	10500	9000	7500	5000	2800	1000	5
28										Actual Demand (kg/y)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
29										Event Description	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	NCE 7									Recoveries (£/kg)	1300																			
31		Never Manufactured	Failure			8000	Third 5	32000	30000	Forecast demand (kg/y)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	30	80	400	200
32										Actual Demand (kg/y)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
33										Event Description	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
34	NCE 8									Recoveries (£/kg)	700																			
35		Competition	Failure			11000	First 5	16000	19000	Forecast demand (kg/y)	0	30	70	200	500	1200	1900	4500	7000	9400	10000	11000	10900	10000	10300	9000	7000	4900	2000	30
36										Actual Demand (kg/y)	0	59	200	500	1900	2100	2000	1700	1500	1500	800	300	100	0	0	0	0	0	0	
37										Event Description	N/A	N/A	N/A	N/A	N/A	N/A	Competitio	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
38	NCE 9									Recoveries (£/kg)	500																			
39		Failure at phase IIB	Failure			11500	Second 5	8000	5000	Forecast demand (kg/y)	0	0	0	0	0	20	20	500	1500	3500	7000	9000	11000	11500	11000	10500	10000	8000	5000	150
40										Actual Demand (kg/y)	0	0	0	0	0	20	50	500	0	0	0	0	0	0	0	0	0	0	0	
41										Event Description	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Failure of D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
42	NCE 10									Recoveries (£/kg)	950																			

Case Study: Last Mile Logistics (Walmart)

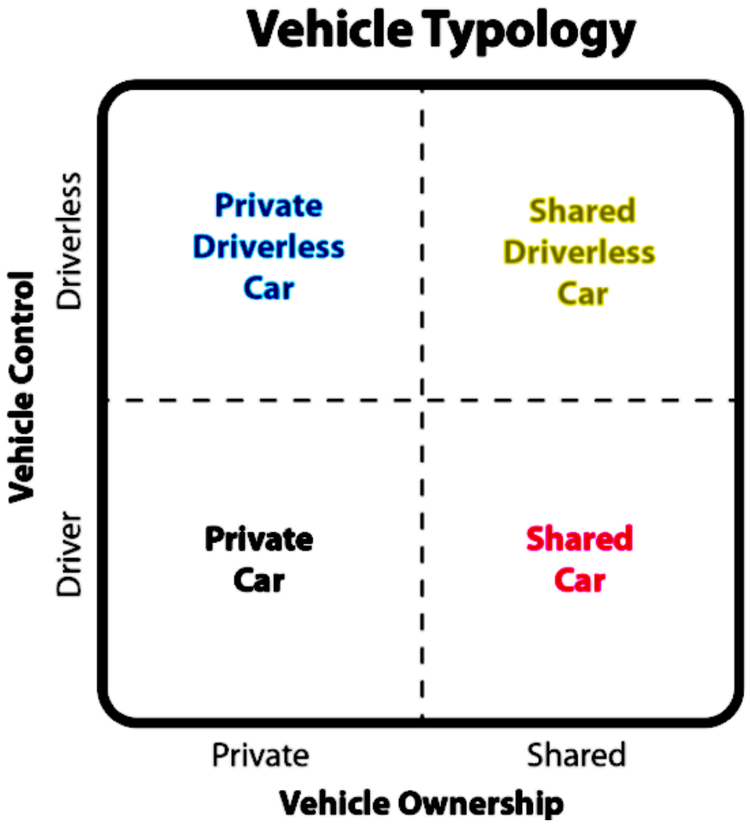
Ira Winder

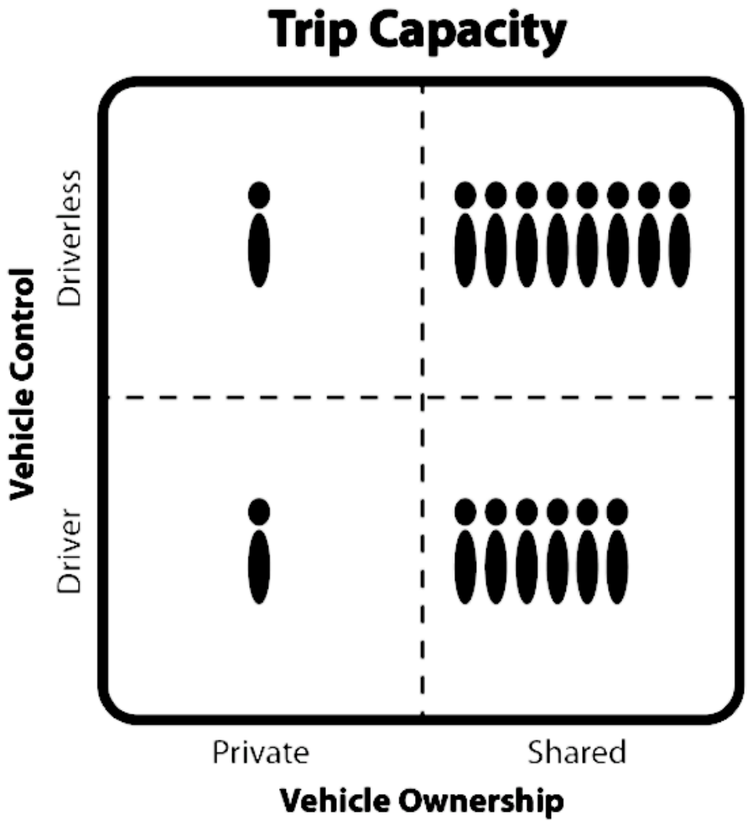


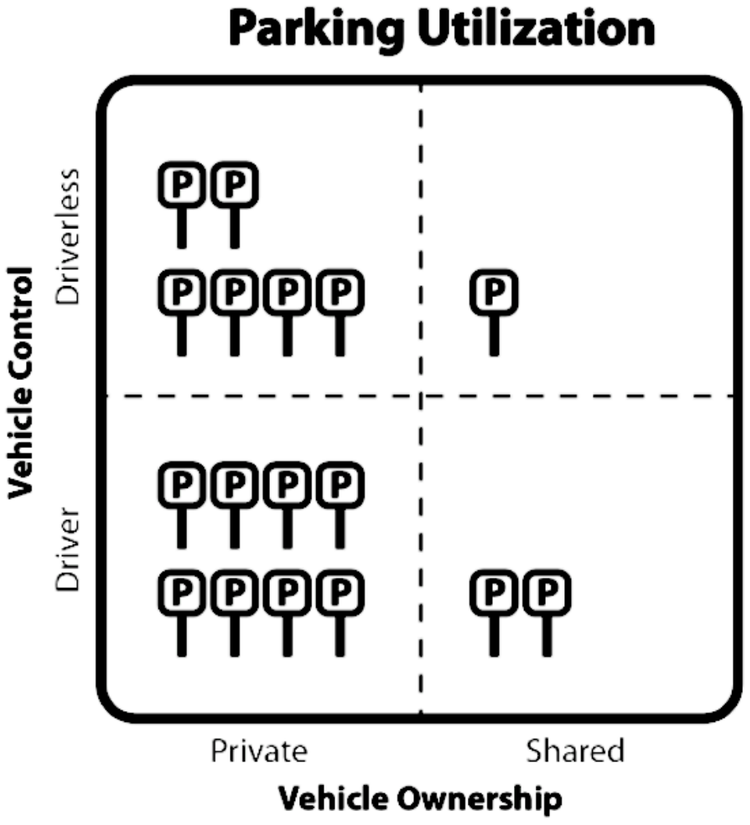
Last Mile Logistics Platform

“What is the future of traffic and parking in Boston?”

Ira Winder
Gensler

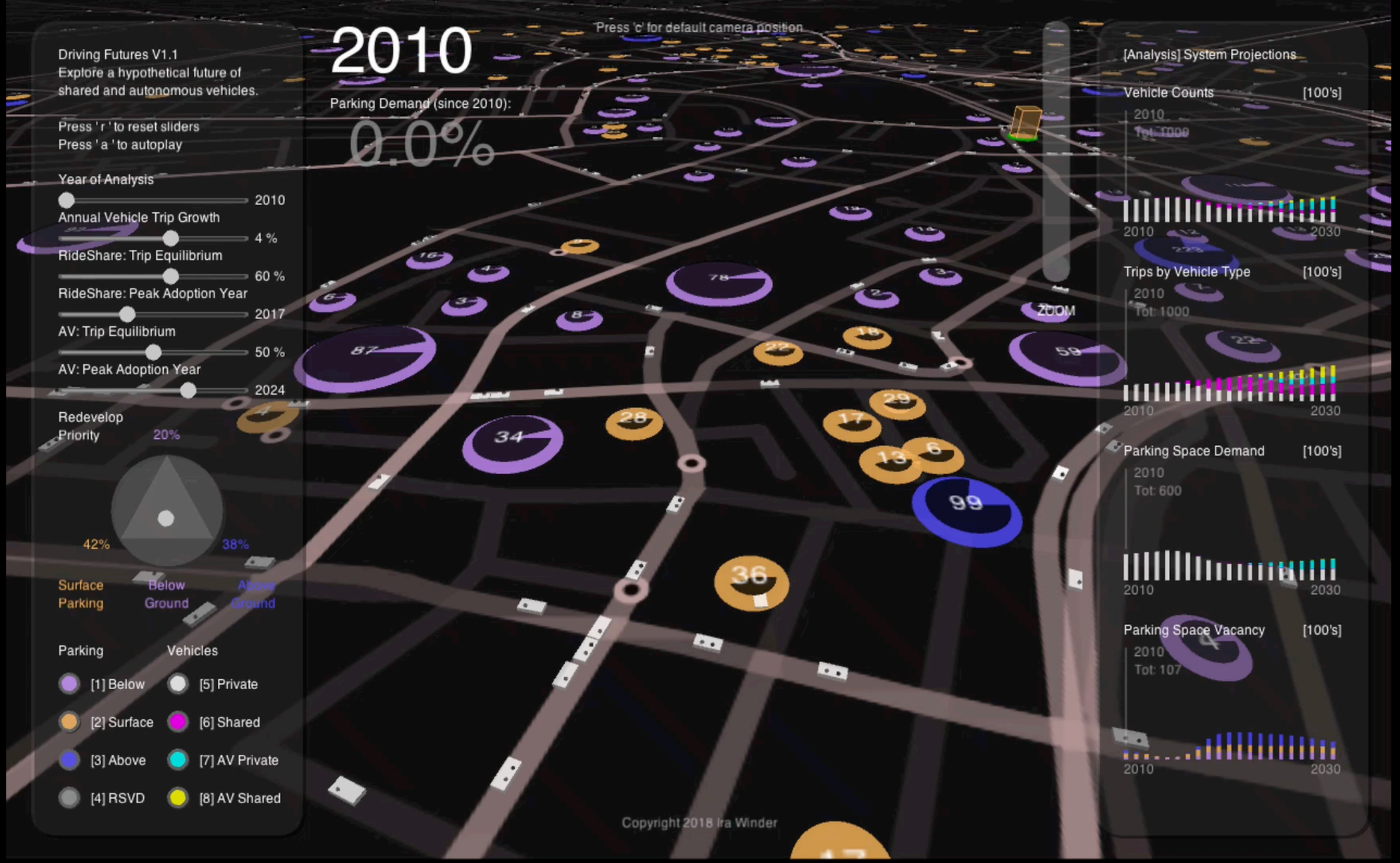






Driving Futures | Passenger Vehicle Typologies

Ira Winder
Gensler



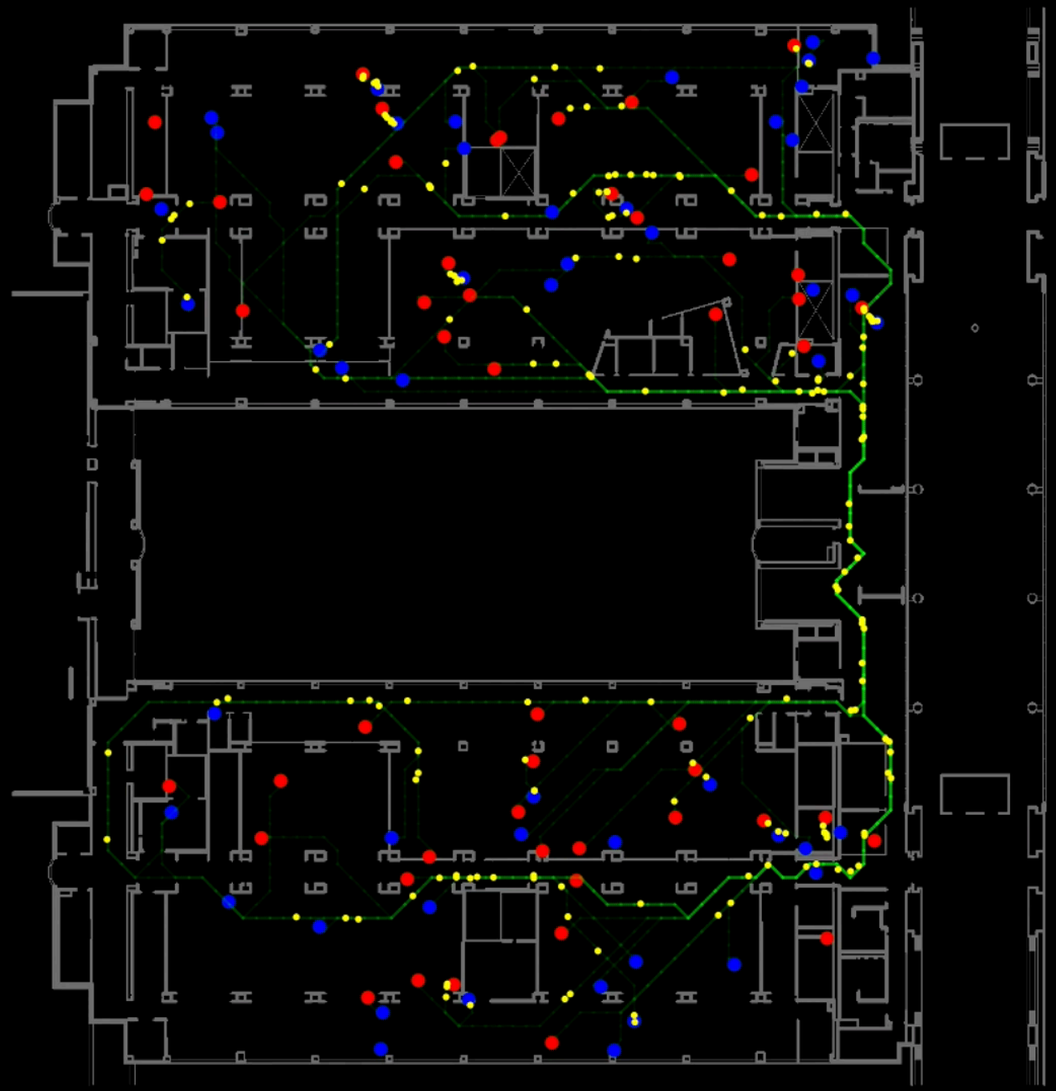
Driving Futures

Driving Futures

Ira Winder

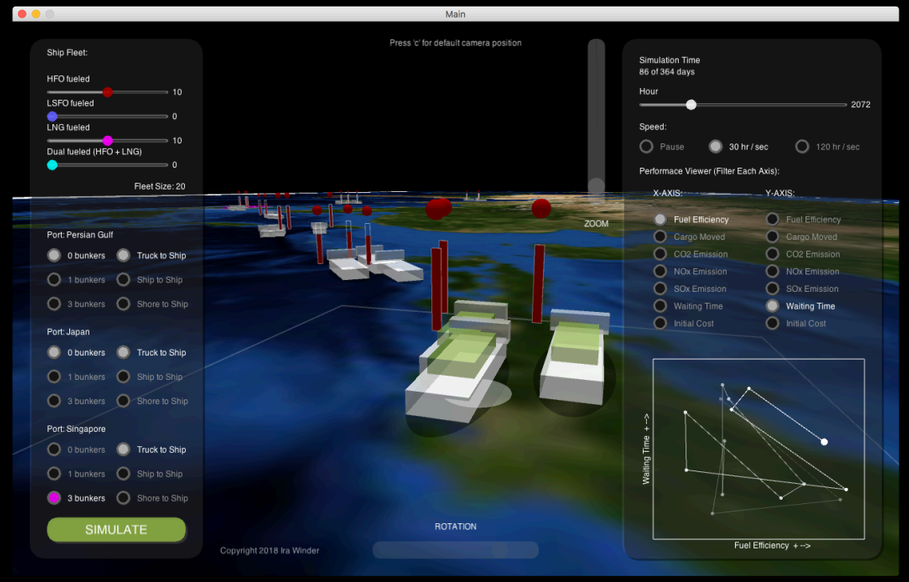
Pedestrian Simulation

Ira Winder



Laboratory Occupant Simulation

Ira Winder



Beyond Cities

Ira Winder

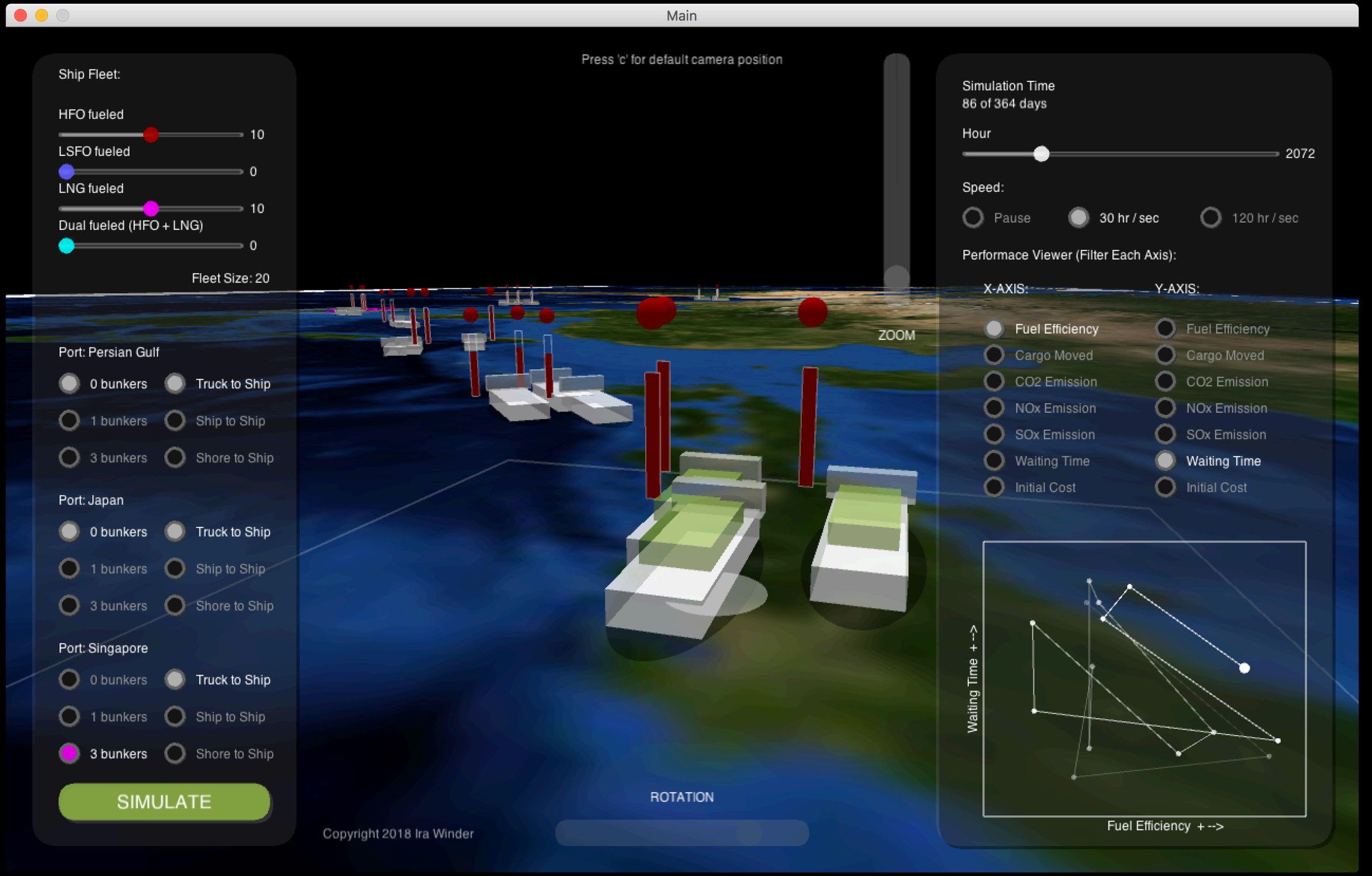
MaritimeDSS V1.0

Ira Winder
ira.mit.edu

GLOBAL TEAMWORK LAB

MIT

東京大学
THE UNIVERSITY OF TOKYO


Main
Press 'c' for default camera position
Ship Fleet:
HFO fueled
10
LSFO fueled
0
LNG fueled
10
Dual fueled (HFO + LNG)
0
Fleet Size: 20
Port: Persian Gulf
0 bunkers
1 bunkers
3 bunkers
Truck to Ship
Ship to Ship
Shore to Ship
Port: Japan
0 bunkers
1 bunkers
3 bunkers
Truck to Ship
Ship to Ship
Shore to Ship
Port: Singapore
0 bunkers
1 bunkers
3 bunkers
Truck to Ship
Ship to Ship
Shore to Ship
SIMULATE
ZOOM
ROTATION
Copyright 2018 Ira Winder
Simulation Time
86 of 364 days
Hour
2072
Speed:
Pause
30 hr / sec
120 hr / sec
Performace Viewer (Filter Each Axis):
X-AXIS:
Y-AXIS:
Fuel Efficiency
Cargo Moved
CO2 Emission
NOx Emission
SOx Emission
Waiting Time
Initial Cost
Waiting Time + -->
Fuel Efficiency + -->

Experimental Framework

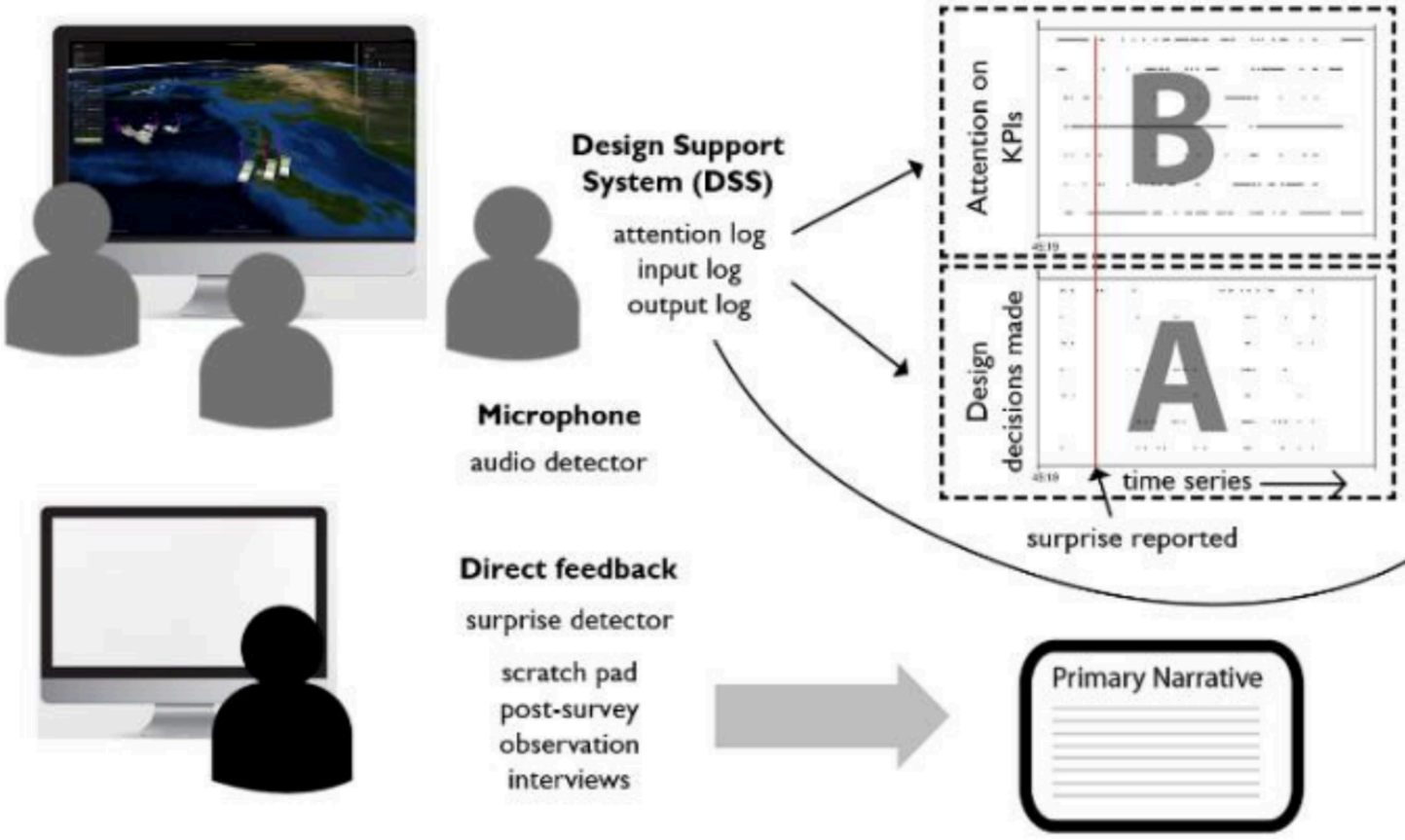


Fig. 2. A conceptual diagram of the experiment setup and research flow. During design experiments, sensors consist of DSS logs & microphones and "direct feedback" by human participants or observers. Sensor data is displayed, & both are interpreted into narratives.

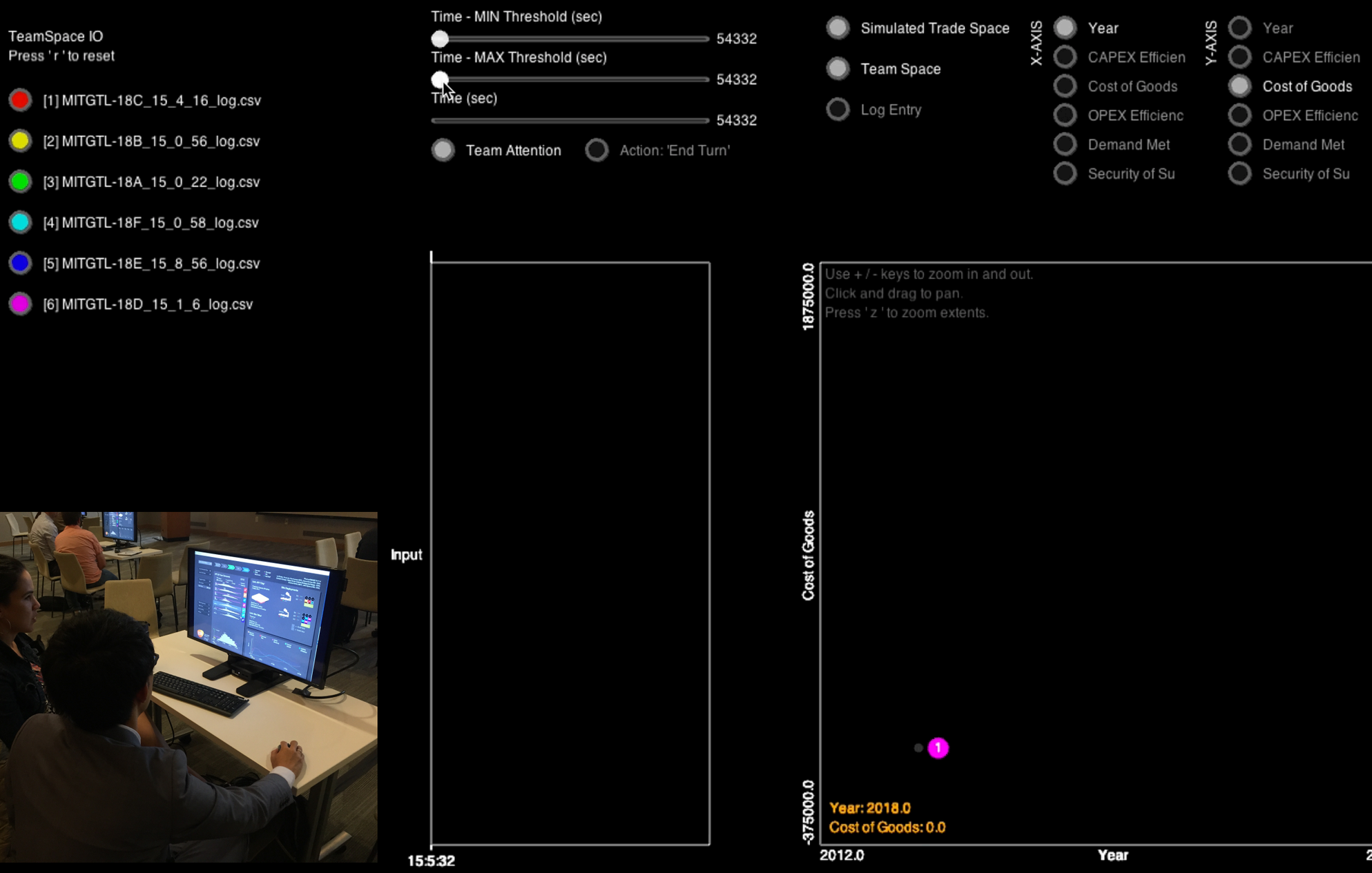
Macdonald, Ira Winder, "**Field Guide for Interpreting Engineering Team Behavior with Sensor Data**", *Complex Systems Design & Management (CSD&M) conference, December 2018. Paris, France*

Case Study: Pharma Manufacturing (GSK)

Ira Winder

Case Study: Pharma Manufacturing (GSK)

Ira Winder



Pharma Capital Strategy Exercise (6 Teams)

Ira Winder

11.S195 Computational Urban Science Workshop

"I have a secret goal, which is to encourage you to use mathematical play in a computational setting ... to make things that make people think and interact with ideas. In other words, to make art."
- Brandon Martin-Anderson

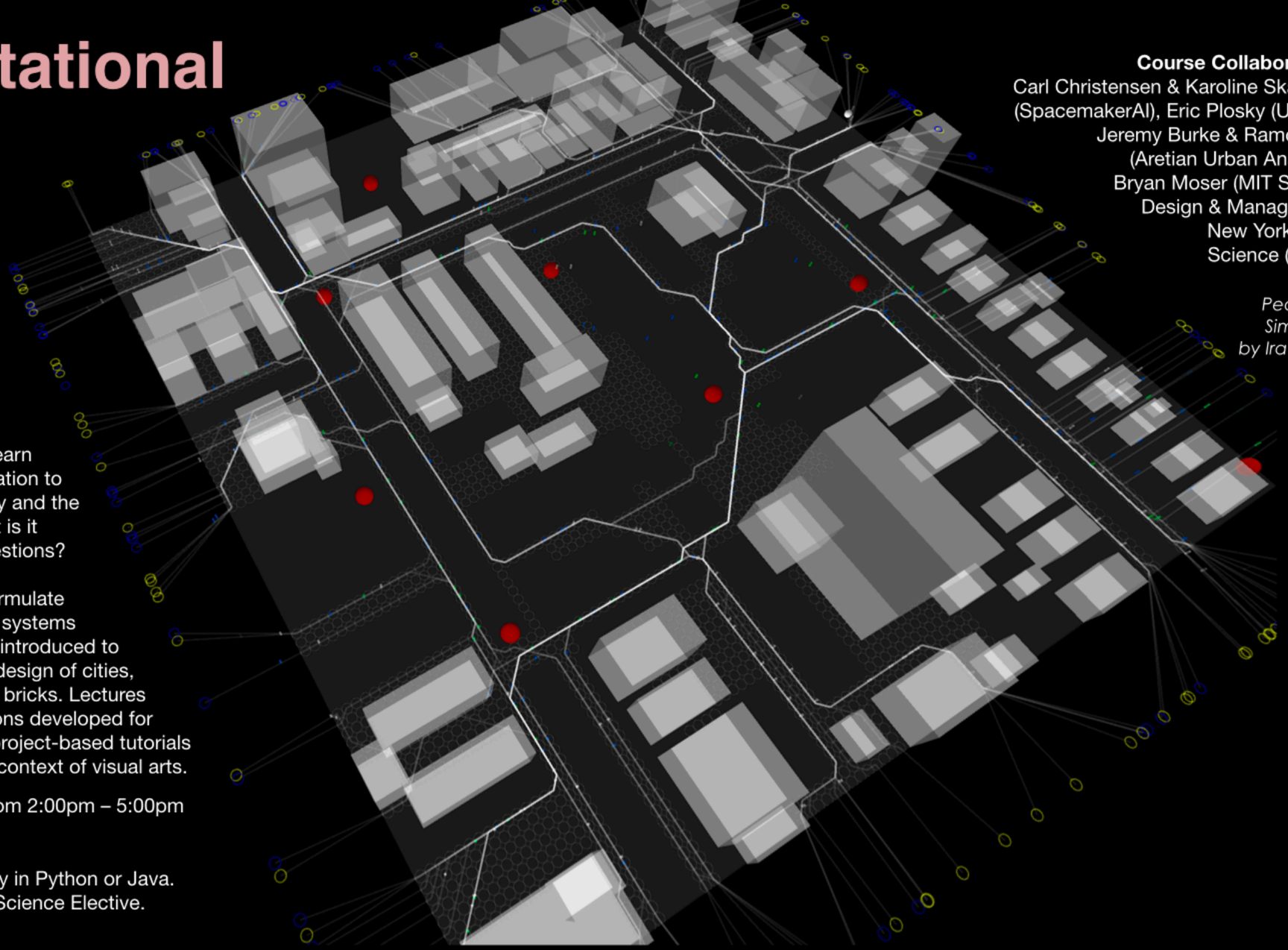
Class Description - Computation permeates nearly every course at MIT. Urban Scientists must uniquely learn to responsibly and playfully wield the tools of computation to solve complex problems at the convergence of society and the built environment. Your algorithm may be efficient, but is it Ethical? Is it Just? Are you even asking the -right- questions?

In this project-based course, students learn how to formulate and develop interactive simulations of complex urban systems representing a diversity of stakeholders. Students are introduced to novel interactive engagement tools for the study and design of cities, blending software with playful mediums such as Lego bricks. Lectures include case studies of real-world interactive simulations developed for research and practice. Seasoned professionals offer project-based tutorials in Processing, a flexible sketchbook for coding in the context of visual arts.

Schedule - The workshop will meet each Thursday from 2:00pm – 5:00pm in Room 9-451 (4th Floor, MIT DUSP).

Requisites - 6.0001 & 6.0002 or equivalent proficiency in Python or Java. Units (3-0-6) Contributes Toward Course 11-6 Urban Science Elective. Preference given to students declared Course 11-6.

Reference Websites -
dusp.mit.edu/subject/spring-2019-11s195
ira.mit.edu & ninalutz.github.io



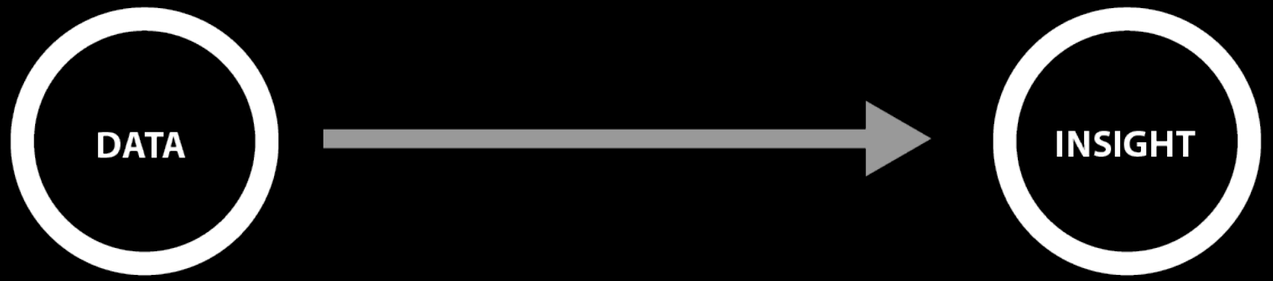
Pedestrian Simulation by Ira Winder

Course Collaborators -
Carl Christensen & Karoline Skatteboe (SpacemakerAI), Eric Plosky (USDOT), Jeremy Burke & Ramos Gras (Aretian Urban Analytics), Bryan Moser (MIT Systems Design & Management), New York Hall of Science (NYSCI)

First Class: Thursday, February 7th at 2:00pm, Room 9-451

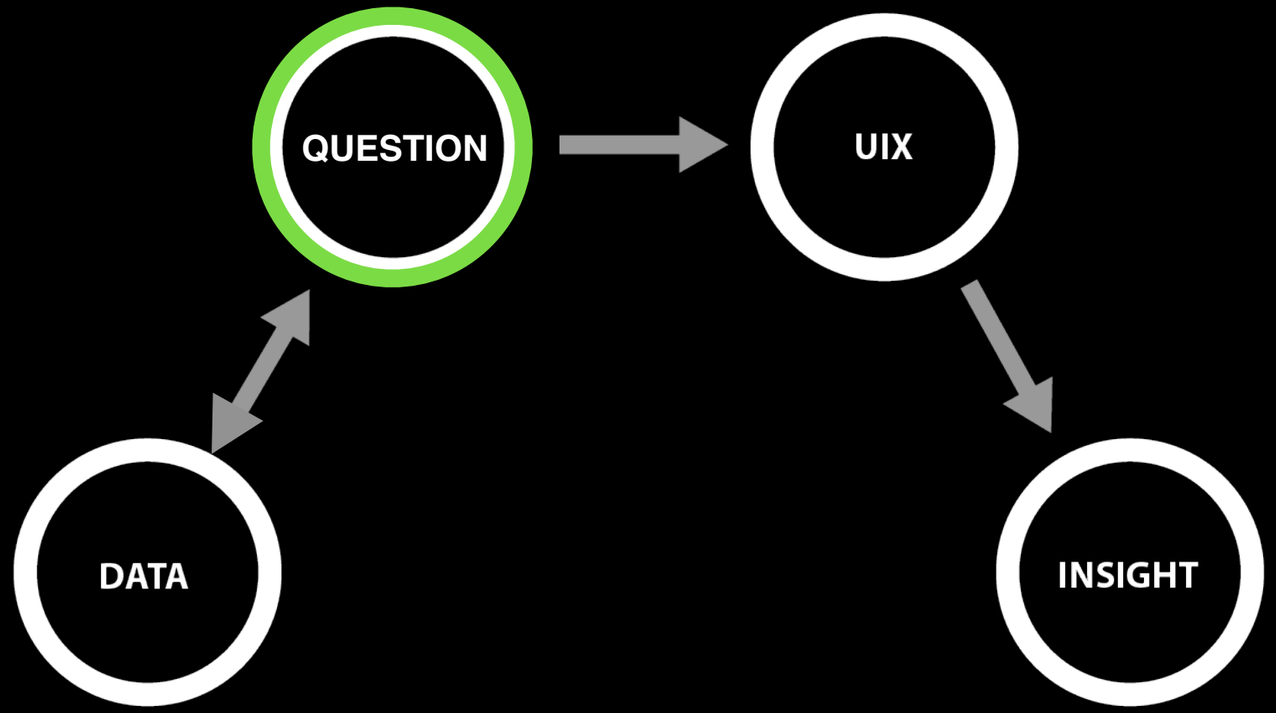
Instructors
Ira Winder, jiw@mit.edu
Nina Lutz, nlutz@mit.edu

Research Method



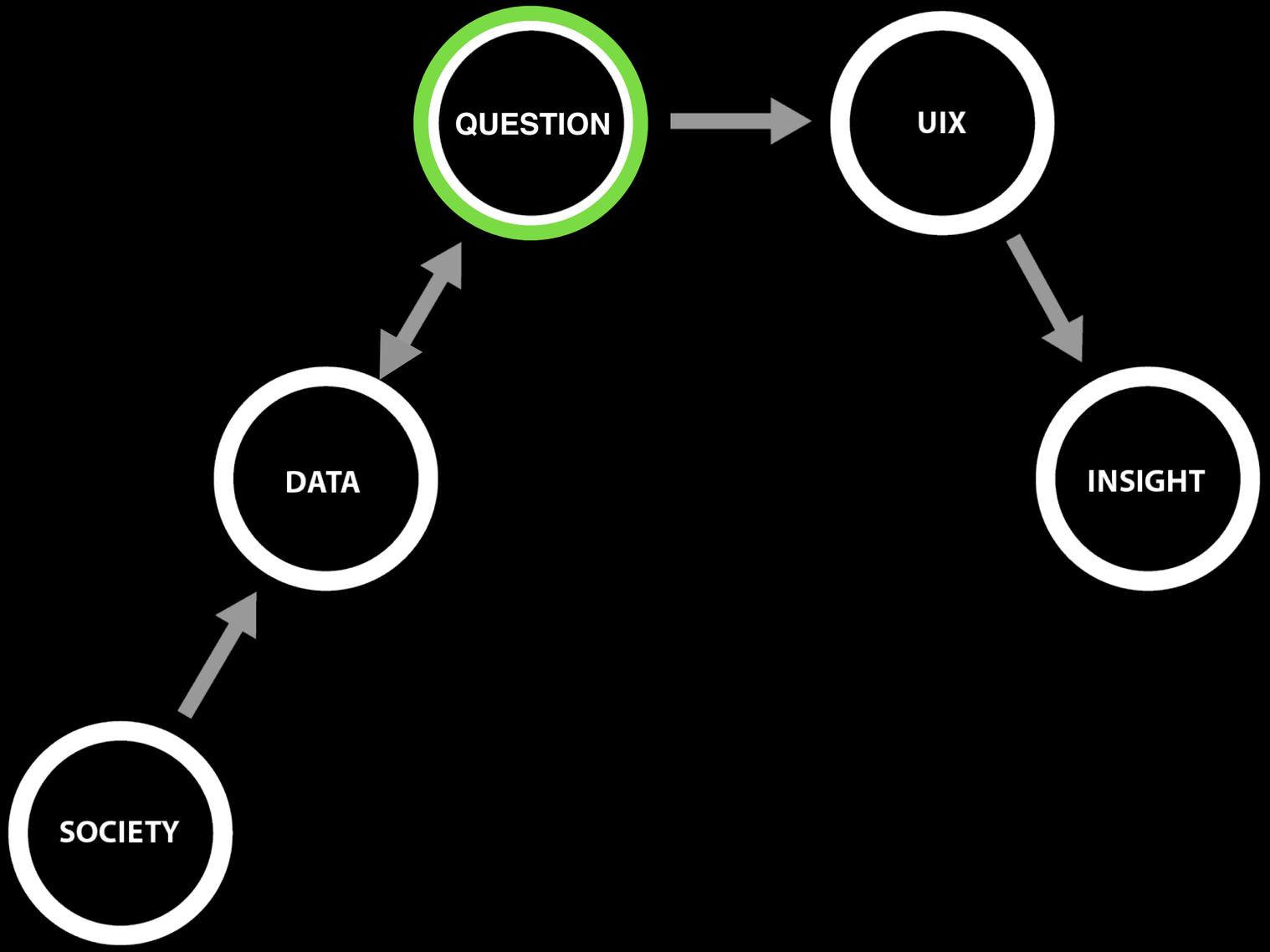
Ira Winder
Bryan Moser

Ira Winder
Bryan Moser



GLOBAL TEAMWORK LAB

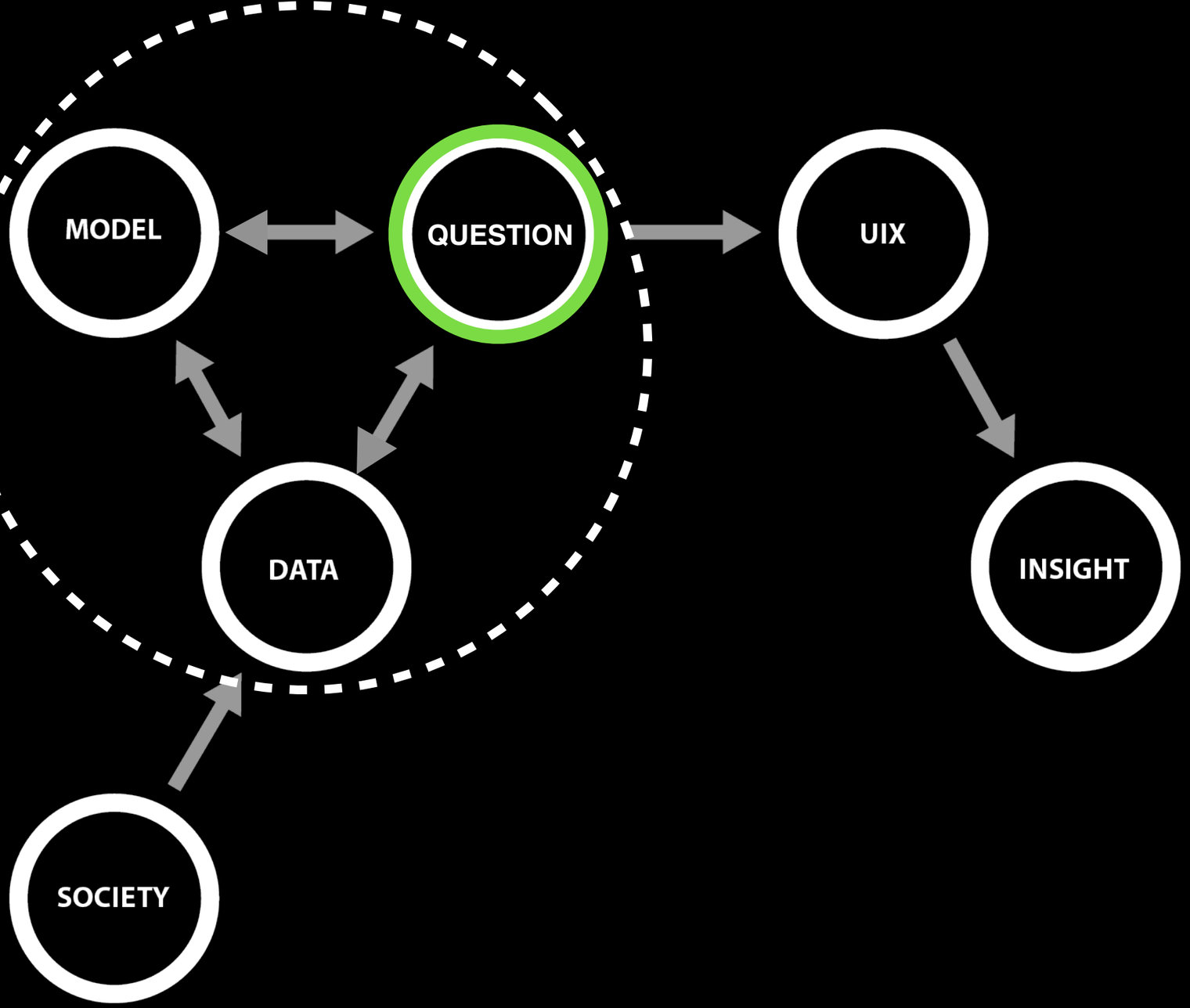
Ira Winder



Research Method

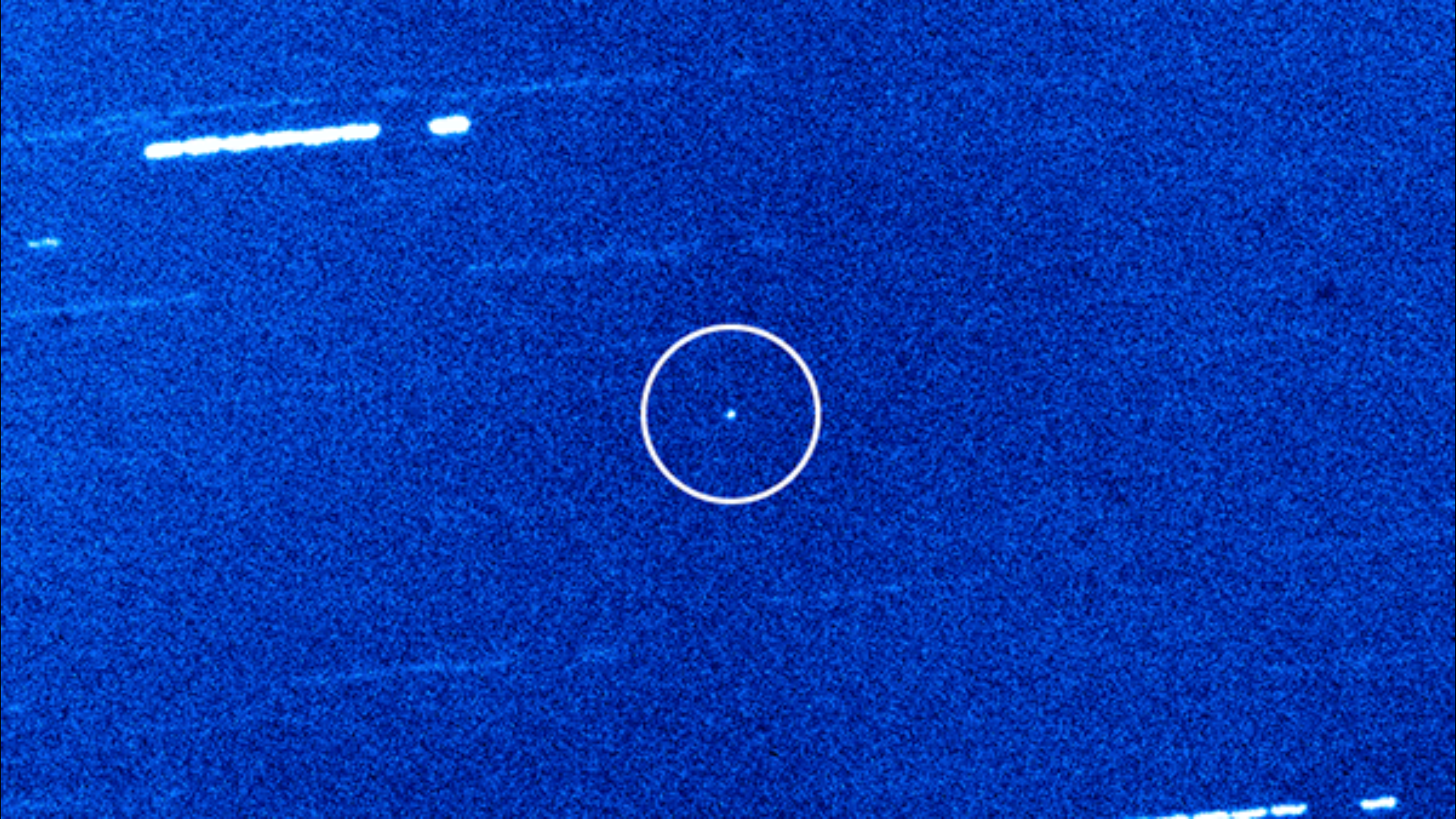
Ira Winder
Bryan Moser

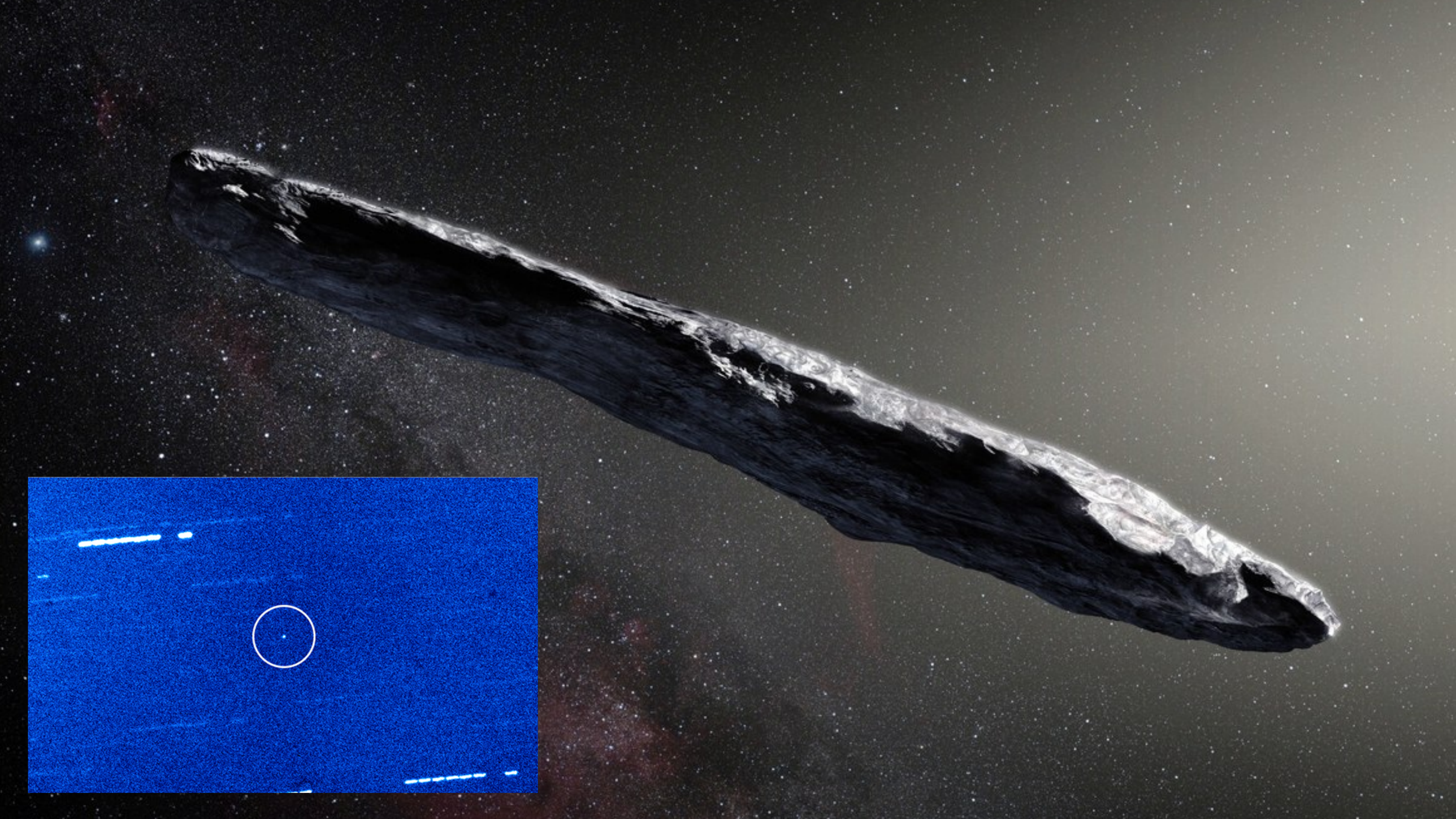
Traditional
Research
Scope



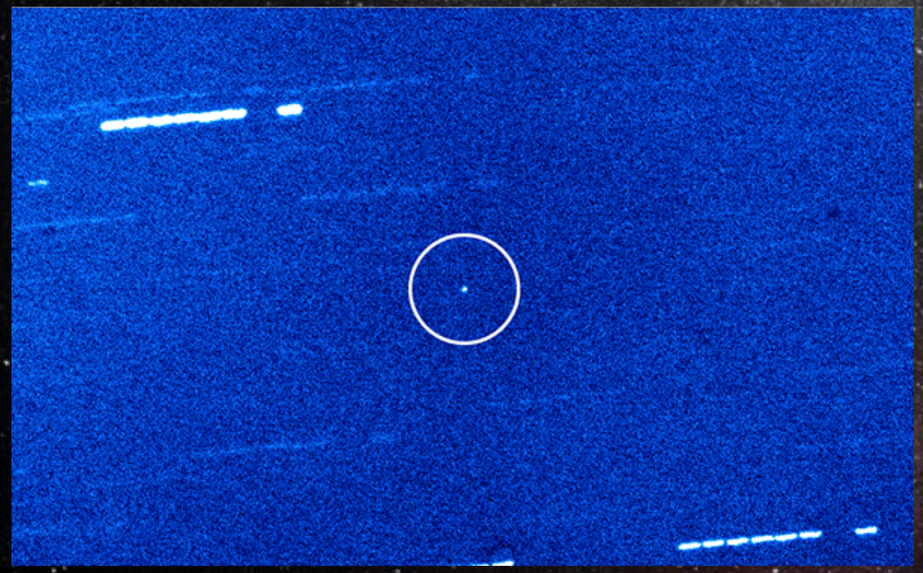
Research Method

Ira Winder
Bryan Moser

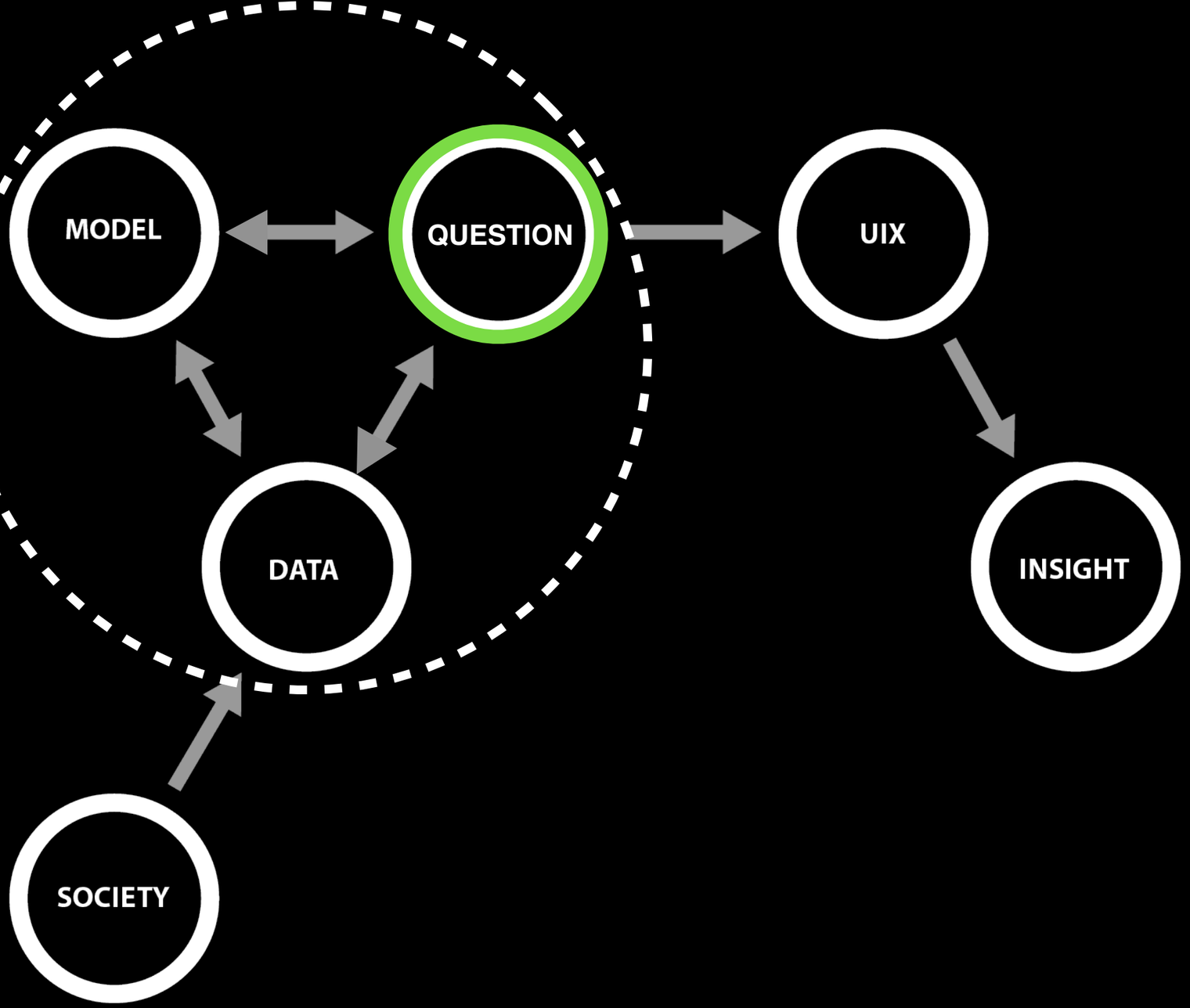




Yes, we need data. But we owe our knowledge of the cosmos to the sophisticated use of models!

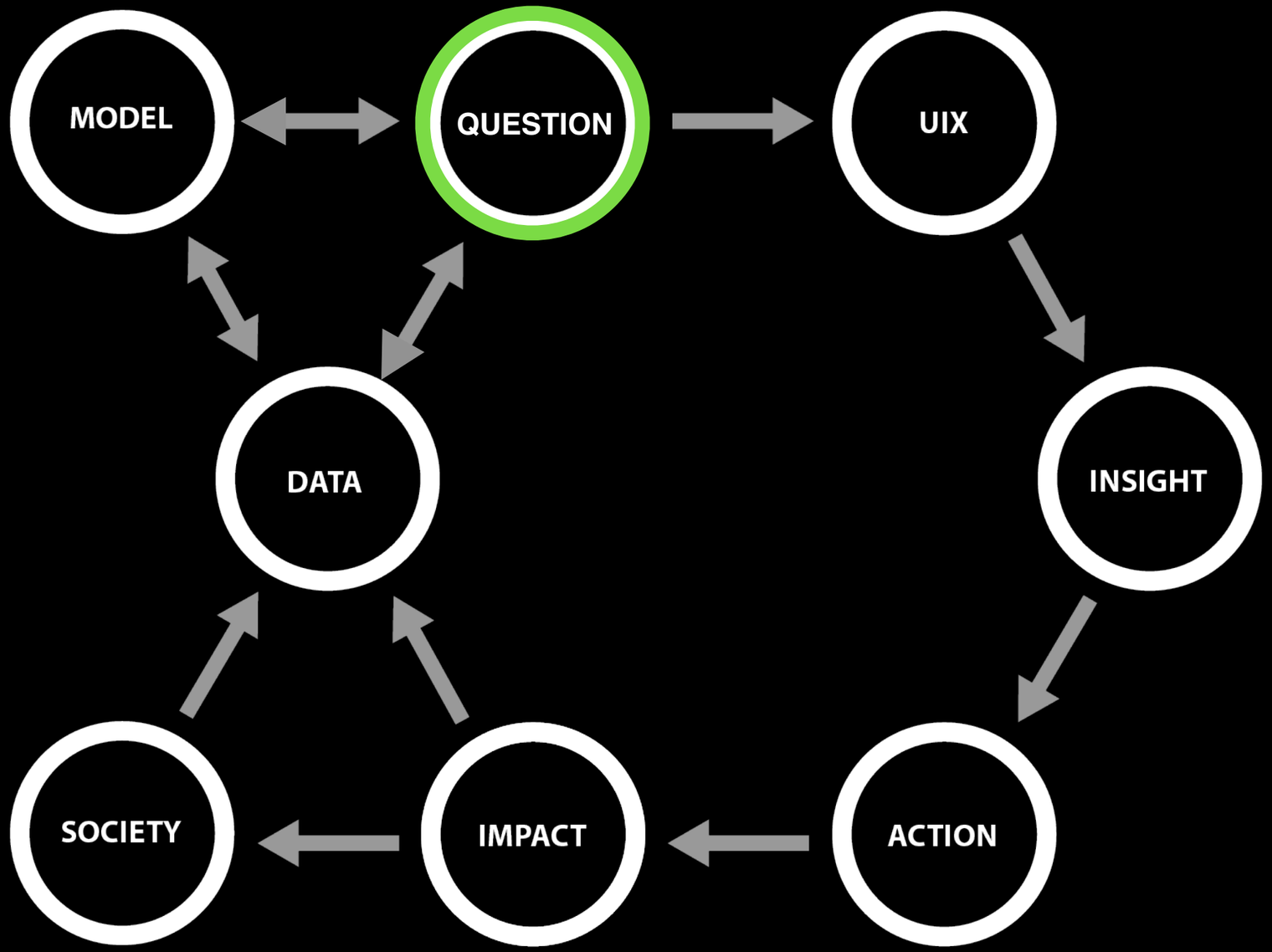


Traditional
Research
Scope



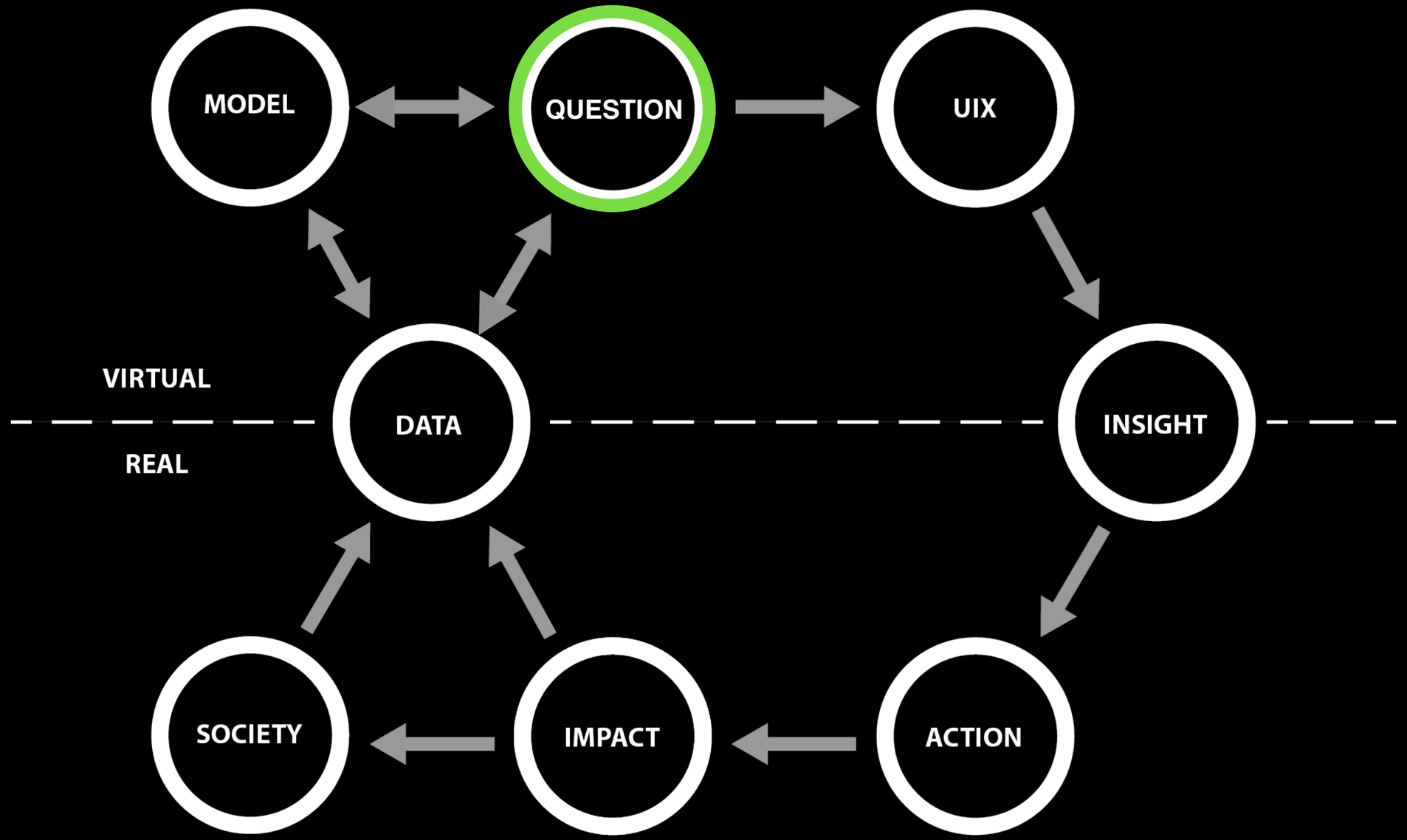
Research Method

Ira Winder
Bryan Moser



Research Method

Ira Winder
Bryan Moser



Research Method

Ira Winder
Bryan Moser

"I have a secret goal, which is to encourage you to use mathematical play in a computational setting ... to make things that make people think and interact with ideas. In other words, to make art."
- Brandon Martin-Anderson

Interactive Simulation

Ira Winder

ira.mit.edu

T: @jamesira

Novel interfaces for collaborative decision-making