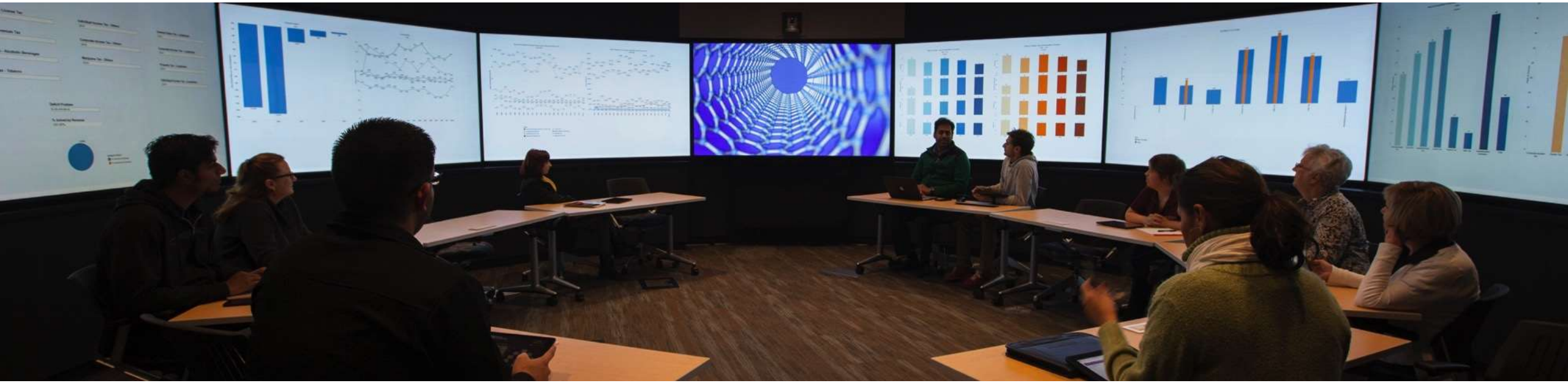
DESIGNING & VISUALIZING

prototypes for making decisions in the face of uncertainty



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Please Note: The views noted in the lessons learned section are my own based on experience with leading research teams and building research institutes. These views do not represent official views of Arizona State University. These views do not represent official views of any organization that funds or participates in any of my research projects.

Model Citizens

Visualization, modeling, and simulation technologies are immersing stakeholders in the planning process. By KEVIN C. DESOUZA and KENDRA L. SMITH

MAYBE THE TASK AHEAD OF YOU IS AS SIMPLE AS WORKING WITH COMMUNITY members to place a new left turn in a residential area. (Okay, that should be simple—in theory.) Or maybe it's as complex as siting a new factory, with all its attendant social and environmental implications, in the middle of a large, densely populated city. You might even be on a team evaluating the impacts of a national decision: opening oil and gas exploration in Mexico to foreign investors (more on that later). ¶Regardless of the project scope, emerging information technologies in visualization, simulation, and modeling are opening up new avenues for greater collaboration and citizen engagement in the planning process. These technologies allow users to conceptualize and weigh options on urban issues in a data-driven way—aiding both accuracy and efficiency. The end result is more informed decision making. ¶The vast amounts of data collected—from sensors, cameras, satellite images, and more—create opportunities for new modes of engagement. Take Chicago's Windygrid. It's a real-time, geospatial data dashboard that hosts about 600 datasets from sources such as the 911 and 311 services, building information, transit, and—importantly—public tweets, that gives access to real-time and historical data to help leaders gauge the overall health and function of the city. It can show sanitation, maintenance, and weather incident (think: storm damage) information, as well as highlight nonemergency events such as parades or sporting events.

Washington, D.C., provides another example. In 2014 officials offered three proposals for new elementary school boundaries. The switch would address overcrowded and underused schools, as well as travel and safety challenges, but the proposals would also change the traditional school assignment method. The *Washington Post* developed an interactive map (tinyurl.com/oddmdxs) with data from the Office of the Deputy Mayor of Education to help parents understand the proposed zone changes—which would affect how students were assigned to schools—as well as the current middle and high school feeder patterns, options for replacing feeder patterns with lottery admissions, and options for attending schools other than a family's neighborhood school. That data-driven approach provided early visualizations of the how the proposed changes would impact neighborhoods.

The technologies planners use today are sophisticated, but the idea of using visual technologies to solve challenging problems is not new. Back in 1854, Dr. John Snow used a dot map of cholera incidences by location in London that helped him discover that the disease was waterborne (not caused by poor air quality) but also that the outbreak could be traced to a water supply contaminated with sewage. That discovery not only provided solutions to the acute problem, it also established the basic principles of public health that are still present today and eventually led to a future focus on water sanitation.

Today, we have opportunities to move beyond static engagement—where we present the stakeholder with finished drafts of plans, designs, models, or prototypes—to more dynamic engagement where the stakeholders interact directly with our underlying data and models, allowing them to simulate for themselves various alternatives so that they can understand the intended and unintended consequences of decisions. (For more on leveraging data for planning, see "Data-Driven," *Planning*, April 2015.)

Visualization

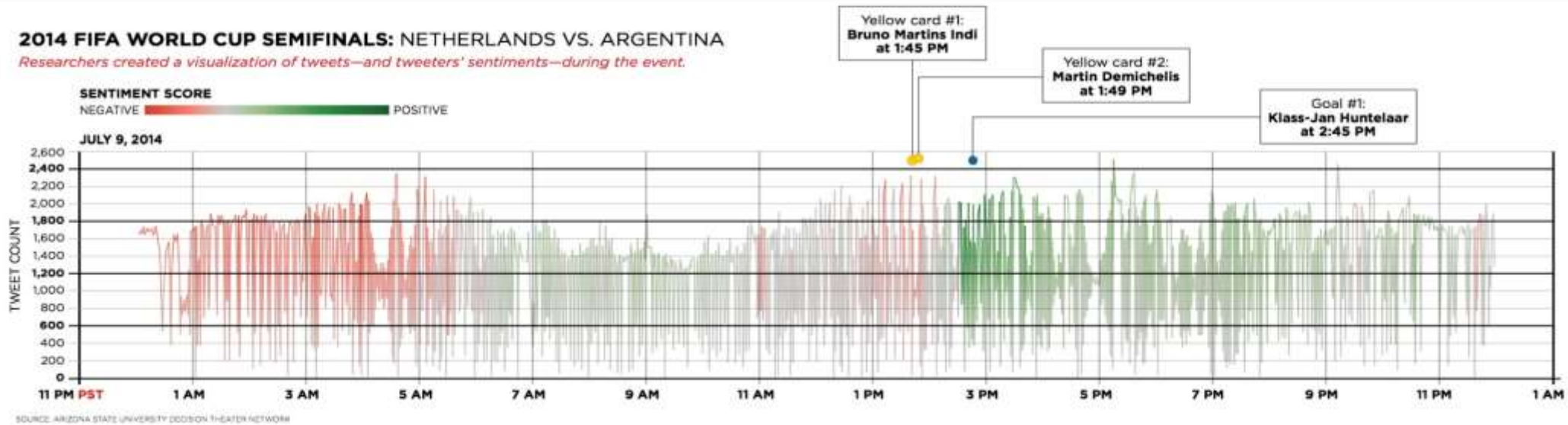
In the busy world of urban planning, important information and data can get buried in spreadsheets and reports. When conveyed visually, data delivers more powerful and meaningful messages.

In 2011, the *Guardian* newspaper's interactive team developed an interactive visualization (tinyurl.com/olltpbf) of rumors that proliferated during the UK riots that year. Unsubstantiated stories about various occurrences abounded, and people took to social media to show support, opposition, or skepticism regarding a particular occurrence. The interactive team created rumor timelines that showed key tweeters, information that was retweeted, and the associated sentiments, all of which were color-coded.

Each cluster of colors—green, red, or gold—reflected a specific tweet that was significantly retweeted. It allowed them to follow a rumor from its incep-

2014 FIFA WORLD CUP SEMIFINALS: NETHERLANDS VS. ARGENTINA

Researchers created a visualization of tweets—and tweeters' sentiments—during the event.



SOURCE: ARIZONA STATE UNIVERSITY DECISION THEATER NETWORK

THE INTELLIGENT CITY

KEVIN C. DESOUZA

Core city

LONDON

Secondary Cities

AMSTERDAM

TOKYO

NEW YORK

SINGAPORE

SEOUL

SAN FRANCISCO

CHICAGO

SYDNEY

Infrastructure

Smart infrastructure innovations can improve a city's capacity to meet the needs of the public. Examples of smart infrastructure are roads that monitor how congested they are and where accidents are most likely to occur, and can adjust the recommended traffic speed accordingly; bus systems that can run different-sized buses at different times of day to meet demand changes; and energy grids that have better real-time and predictive features to meet demand. For instance, real-time and predictive parking reduces the frustration of residents and improves the quality of life. Sensors placed in the roadway identify whether a parking place is vacant and drivers can access this information via an app on their smartphone. This opens up the city for many who might otherwise avoid visiting for fear of not finding parking and increases accessibility to local merchants, which can boost the local economy. The reduced occurrence of "circling the block" to find a parking space results in reduced CO2 emissions, reduced traffic, and fewer vehicle miles.

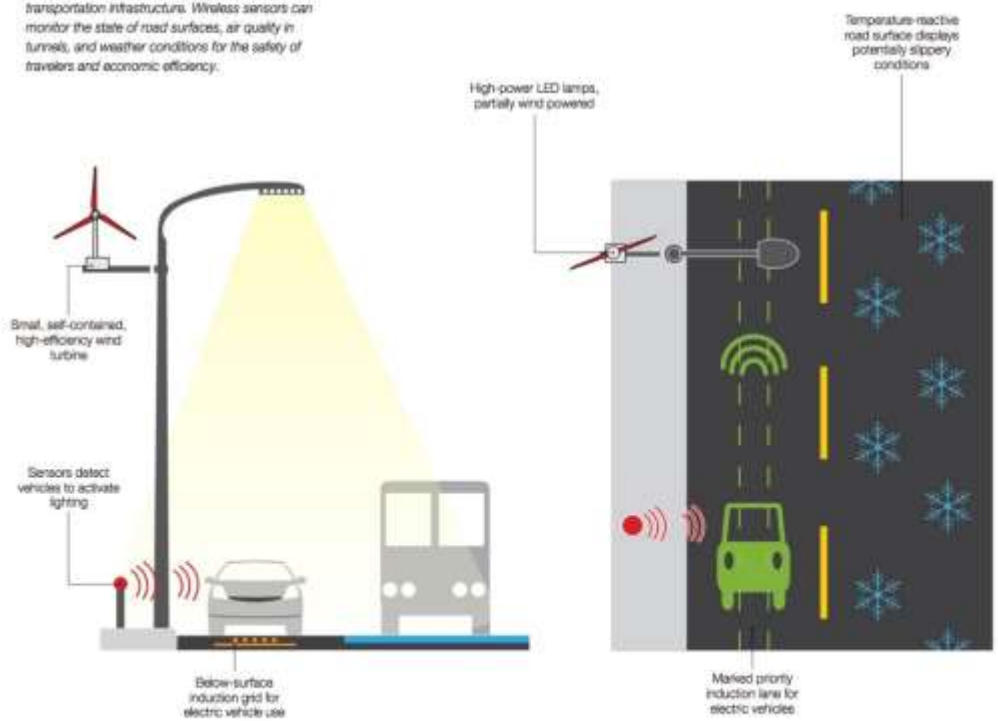
Smarter infrastructures have embedded information appliances which citizens can employ as they conduct their daily activities. An example of an information appliance that is embedding intelligence within a city is the next-generation telephone booth created by Telecom Italia. The prototype was deployed in Turin, just outside the Turin Politecnico. The telephone booth can be used to make traditional phone calls, but it also allows the user to find information about local attractions, shopping, public services, and even social networks. Visitors to Turin do not have to rely on static maps to navigate the city but can use these information kiosks to access dynamic, location-specific, and real-time information.

Financial institutions in Tokyo are developing smarter ATMs that enable customers to conduct transactions using fingerprint authentication rather than a traditional plastic card. Customers can access their finances by placing their hands on a scanner and entering an identifying code such as date of birth or a PIN. The technology matches a combination of three fingerprints with palm-vein data to filter millions of possible identities down to a few thousands in a matter of seconds, after which detailed pattern recognition takes places that relies on parallel processing using multiple servers. Given the fact that Tokyo is subject to natural disasters in which individuals may lose all of their personal belongings or face challenges accessing them, the use of fingerprints offers a more user-friendly and resilient way to access funds.

A critical aspect of designing intelligent infrastructures is the need to promote bottom-up designs and plans that originate from citizens, since urban development affects many aspects of citizens' everyday lives and impacts the lives of future generations. Helsinki chose to invest in a process that encouraged collaboration and idea development for more sustainable and innovative options for the future. In 2009, in collaboration with Sitra's Finnish Innovation Fund, Helsinki launched the Low2No competition, a sustainable development design competition. The competition directed teams to design buildings using four central principles: energy efficiency; low/no carbon emissions; high architectural, spatial, and social value; and sustainable materials and methods. This competition was not an architectural competition or a competition about ideas. It was to find the team that had the best sustainable development plan based on the four central principles to design a large building complex in Jätkäsaari, a precinct of the city.

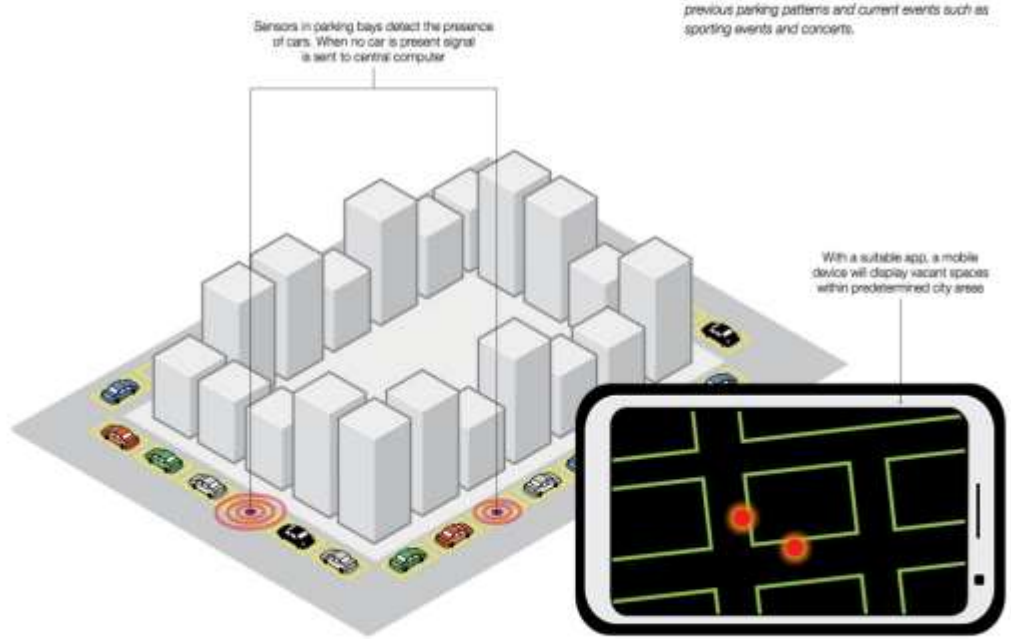
Smart roads

Wireless sensor networks in or near roads can help the maintenance and development of cities' transportation infrastructure. Wireless sensors can monitor the state of road surfaces, air quality in tunnels, and weather conditions for the safety of travelers and economic efficiency.



Predictive parking

Predictive parking systems count open spaces as well as predicting when lots will have free spaces. They use algorithms that combine historical data such as previous parking patterns and current events such as sporting events and concerts.



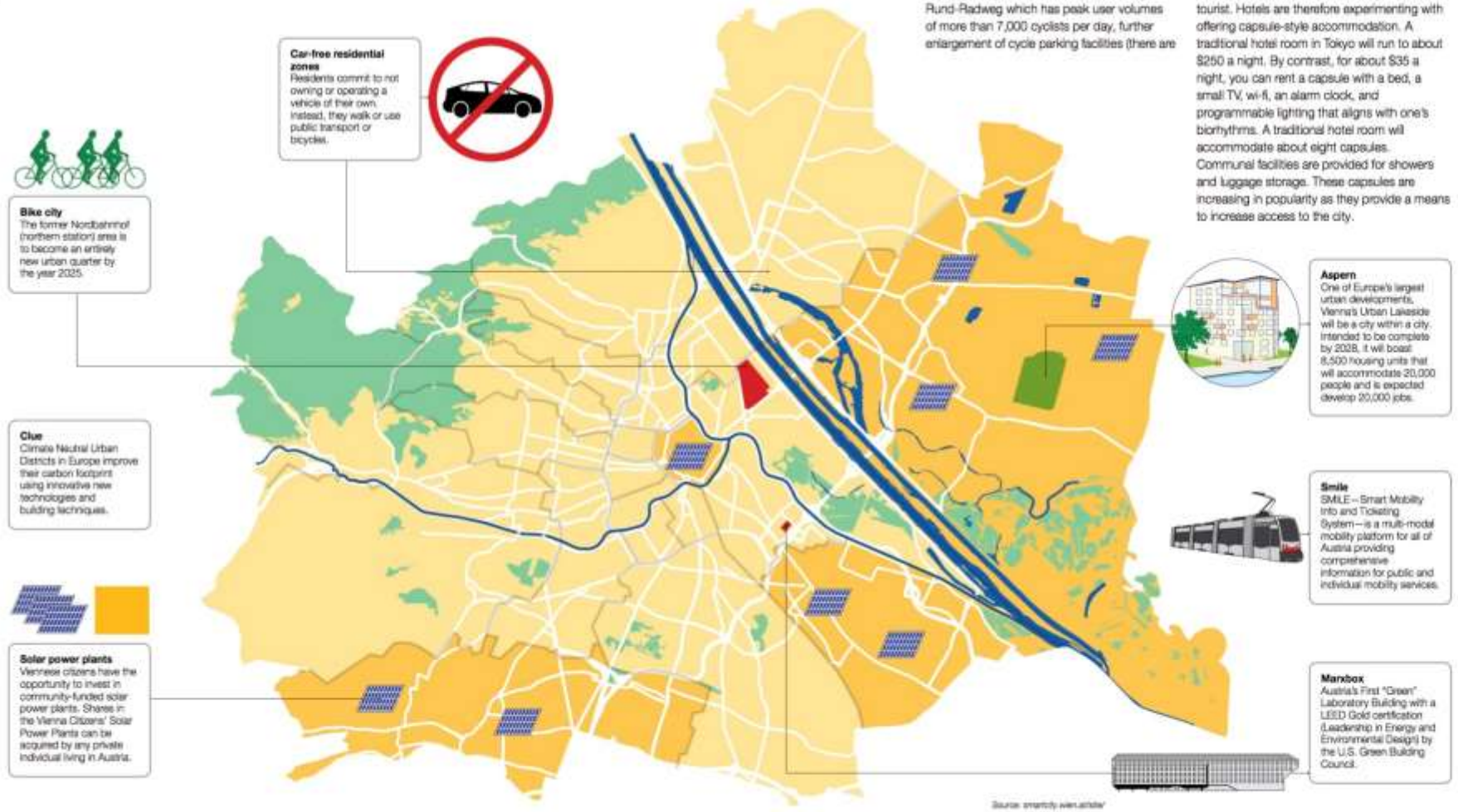
Quality of Life

Smart City Vienna
Vienna's city authorities are improving the design, development, and perception of their city. Vienna is looking to advance the quality of life for its citizens by making long-term infrastructure, energy, and mobility improvements.

Intelligent cities work creatively to ensure that their citizens enjoy a high standard of living. Critical to achieving this goal is the use of technologies to keep the city's infrastructure up to date. This requires a city to consider not only its present but also what it wants as its future. Transitional states—cities that are undergoing a period of change—are viewed as experiments where feedback is sought from citizens.

Consider the case of Vienna. Vienna is consistently ranked as having one of the best standards of living of any city in the world. By 2050 the city will have gone through a significant demographic shift from being one of the oldest regions in Austria to one of the youngest (currently, just over 20 percent of all Viennese are over 60). In keeping with this demographic shift, Vienna is already making itself more accessible and friendly to the younger generation. The "Smart City Wien" project focuses primarily on devising models to promote intelligent urbanity with a focus on reducing the city's impact on its environment and planning for rapidly changing population demographics. One major effort toward this goal is to make the city more bike friendly. The city government has committed Vienna to doubling cycling's overall transport share by 2015 from 5.5 percent to 10 percent. Vienna is focusing on creating "bicycle-friendly streets," the upgrading of main routes like the Ring-Rund-Radweg which has peak user volumes of more than 7,000 cyclists per day, further enlargement of cycle parking facilities (there are over 30,000 slots at the moment), and new solutions for the combination of cycling and public transport. Investments in cycle parking facilities, especially at railway stations, are also being made.

A critical aspect of maintaining good quality of life is ensuring that a city remains accessible to its residents and visitors. Tokyo leads all cities when it comes to creating innovative solutions to combat high real-estate prices. As with most cities, real estate is expensive in Tokyo, which makes it inaccessible to the average citizen or tourist. Hotels are therefore experimenting with offering capsule-style accommodation. A traditional hotel room in Tokyo will run to about $250 a night. By contrast, for about $35 a night, you can rent a capsule with a bed, a small TV, wi-fi, an alarm clock, and programmable lighting that aligns with one's biorhythms. A traditional hotel room will accommodate about eight capsules. Communal facilities are provided for showers and luggage storage. These capsules are increasing in popularity as they provide a means to increase access to the city.



Source: smartcity.wien.at/site/

THE TOP 50 LIVEABLE CITIES, 2012
From the Mercer Quality of Living Survey

1	**Vienna**	Austria
2	Zurich	Switzerland
3	Auckland	New Zealand
4	Munich	Germany
5	**Vancouver**	Canada
6	Düsseldorf	Germany
7	Frankfurt	Germany
8	Geneva	Switzerland
9	Copenhagen	Denmark
10	Bern	Switzerland
10	**Sydney**	Australia
12	**Amsterdam**	Netherlands
13	Wellington	New Zealand
14	Ottawa	Canada
15	Toronto	Canada
16	Berlin	Germany
17	Hamburg	Germany
17	Melbourne	Australia
19	Luxembourg	Luxembourg
19	Stockholm	Sweden
21	Perth	Australia
22	Brussels	Belgium
23	Montreal	Canada
24	Nurnberg	Germany
25	**Singapore**	Singapore
26	Canberra	Australia
27	Stuttgart	Germany
28	Honolulu	United States
29	Adelaide	Australia
29	Paris	France
29	**San Francisco**	United States
32	Calgary	Canada
32	Helsinki	Finland
32	Oslo	Norway
35	Boston	United States
35	Dublin	Ireland
37	Brisbane	Australia
38	**London**	United Kingdom
39	Lyon	France
40	Barcelona	Spain
41	Milan	Italy
42	**Chicago**	United States
43	Washington DC	United States
44	Lisbon	Portugal
44	**New York City**	United States
44	Seattle	United States
44	Tokyo	Japan
48	Kobe	Japan
49	Madrid	Spain
49	Pittsburgh	United States
49	Yokohama	Japan

The Intelligent City

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CORE COMPETENCIES

Complex Systems Framework

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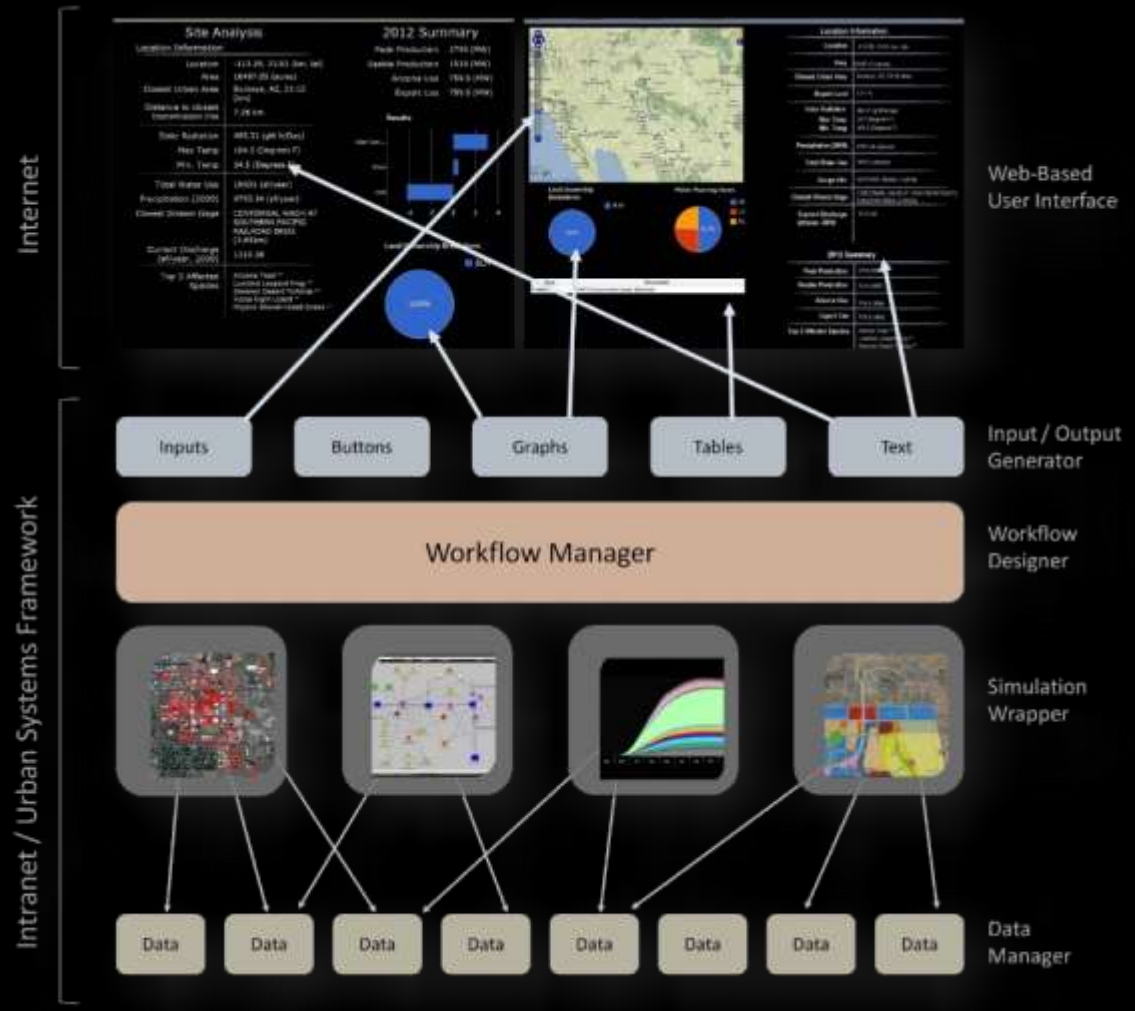

Data Mining, Analytics, Visualization

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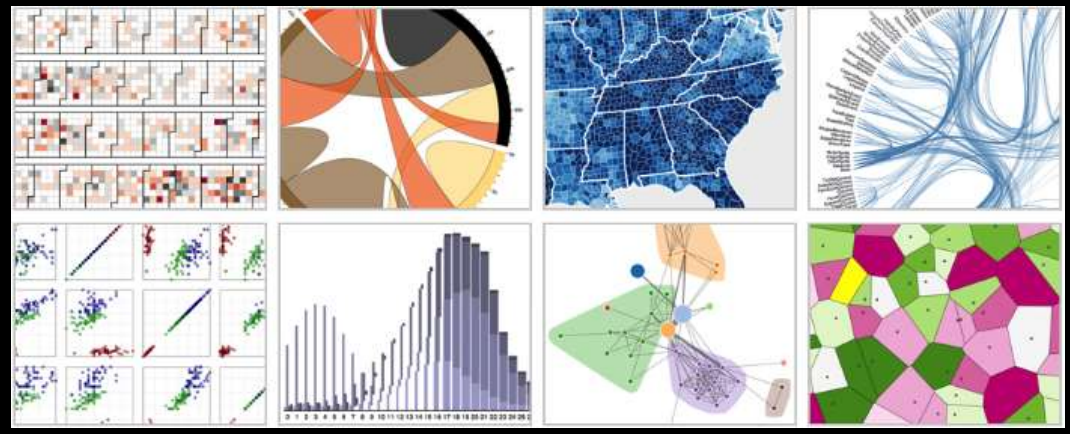

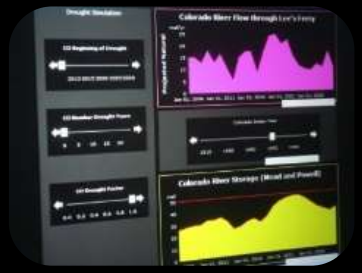

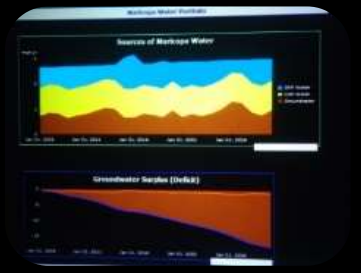

Geographic Information Systems

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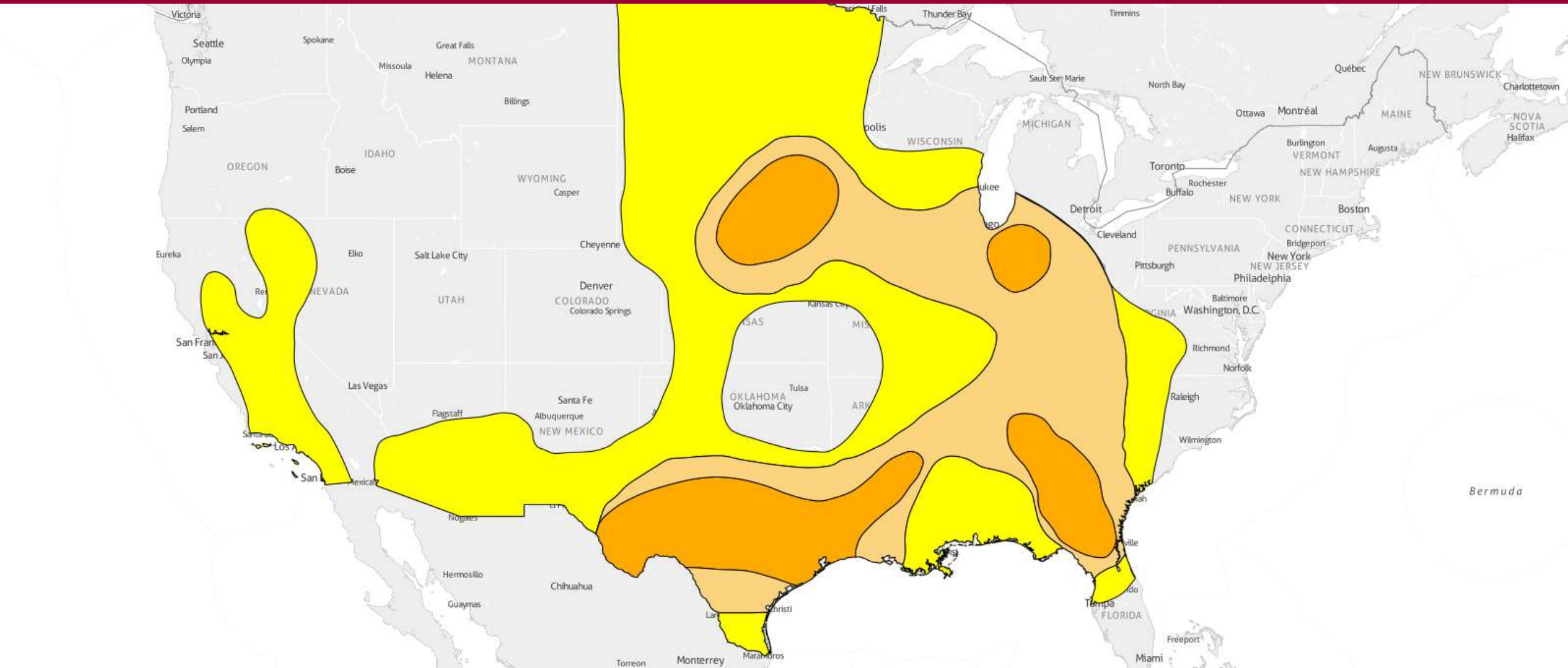

Advanced Computation

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Recent server addition added:

- **128GB Ram**
- **300TB storage**
- **256 virtual processing cores**

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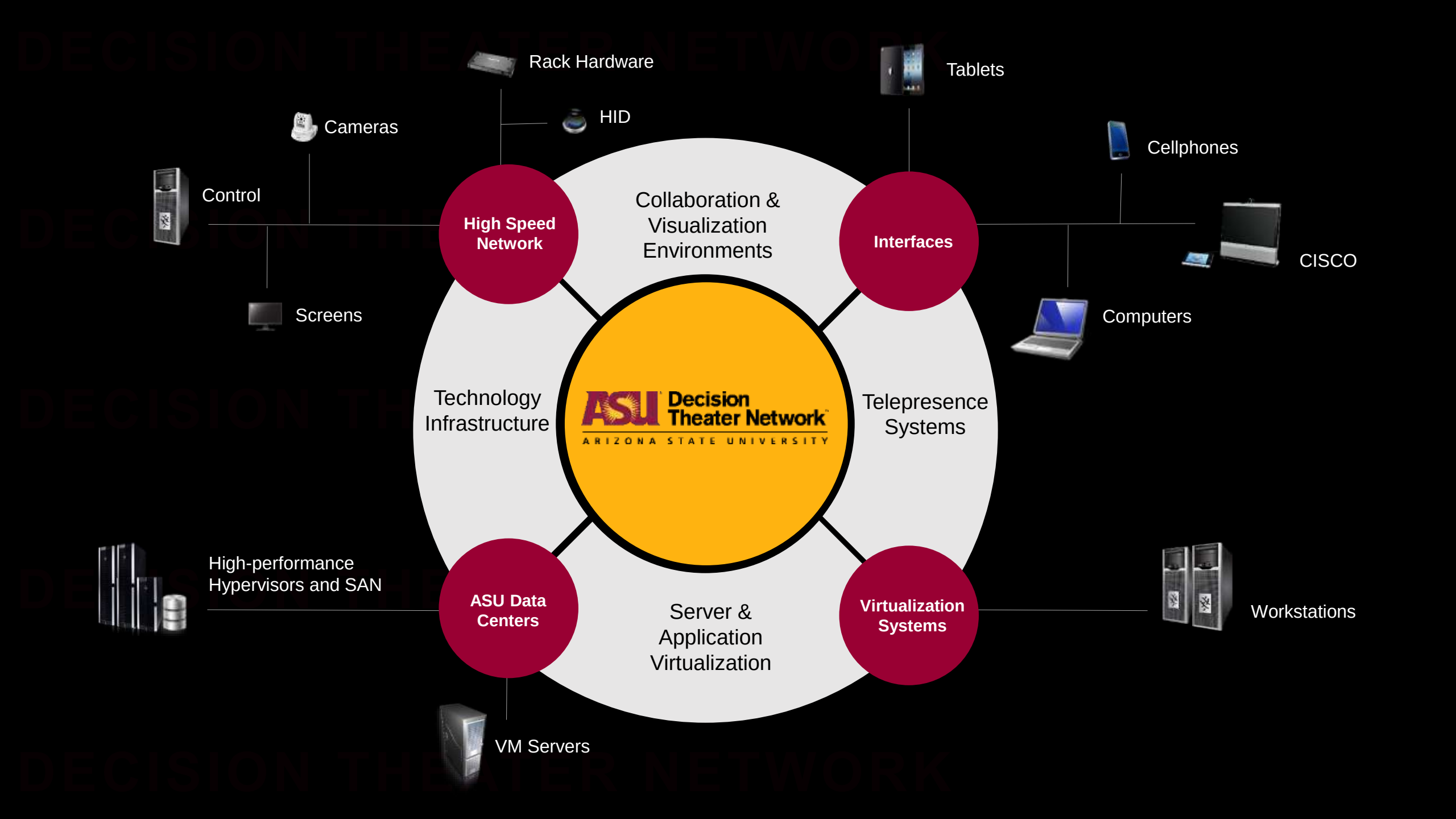
NETWORK & HARDWARE


Rack Hardware
Tablets
Cameras
HID
Cellphones
Control
High Speed Network
Collaboration & Visualization Environments
Interfaces
CISCO
Screens
Computers
Technology Infrastructure
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Telepresence Systems
High-performance Hypervisors and SAN
ASU Data Centers
Server & Application Virtualization
Virtualization Systems
Workstations
VM Servers

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ILLUSTRATIVE PROJECTS

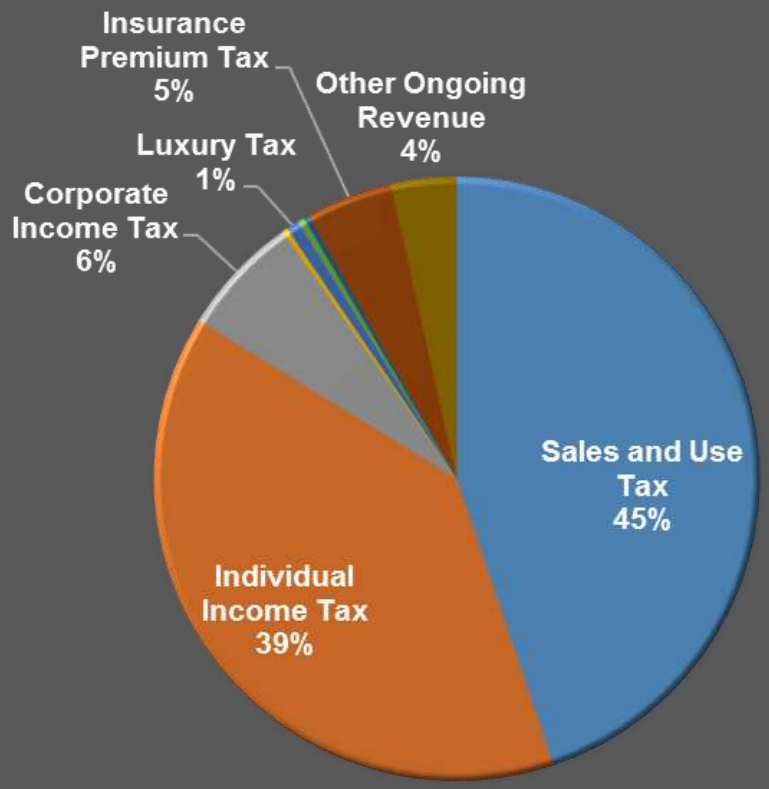
The Arizona Budget Analysis Tool (AzBAT) Education

Challenge

Enable lawmakers, economists, and the layperson to better understand the implications of the state's budgetary changes.

Solution

A Budget Analysis Tool that shows implication of minor changes on different aspects of employment, education, tax rates, national standing of the state, etc. as well as its comparison with the history of budgetary changes in the state.



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Mexican Energy Reform Sustainability

Challenge

Optimize energy investments and promote long-term prosperity.

Solution

A holistic model for real-time simulation of various investment scenarios, and their impact on socioeconomic variables such as GDP, job creation, and tax revenue.

Result

Decision Theater has built a strong relationship with Technológico de Monterrey, which recently constructed a 7-screen DT environment on site. Mexico's Minister of Energy has expressed interest in further collaborations.

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Mining Philanthropic Data

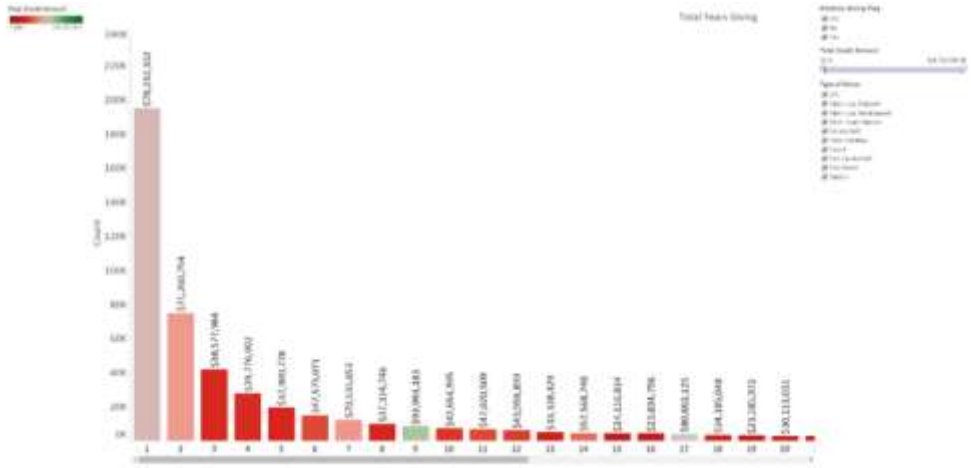
Entrepreneurship and Innovation

Challenge

Improve fundraising efficiency by understanding factors that trigger/increase prospective donors' propensity to give and the amount of donation.

Solution

A dashboard to visualize donor vs. non-donor groups and the programs donors support, preliminary data analysis to explore key indicators that could be used for donor profiles, and a statistical model to explain factors that help increase/decrease the amount of giving.



Finding

For those who donated $100,000+ in the past, total market value and the presence of children are two most statistically significant factors that influence the amount of giving.

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RAZA

Entrepreneurship and Innovation

Challenge

Understand Phoenix area residents' and businesses' concerns using survey data collected by Promise Arizona.

Solution

An interactive dashboard to visualize the survey results that helps community stakeholders make decisions on improving the standard of living.

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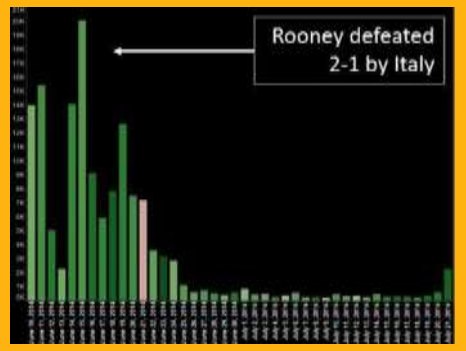
FIFA Education

Challenge

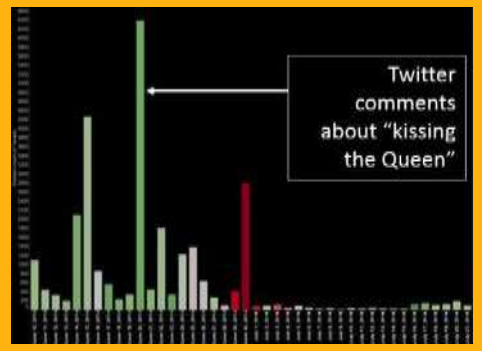
Analyze social media chatter during the FIFA World Cup 2014 to determine interesting aspects of online conversations.

Solution

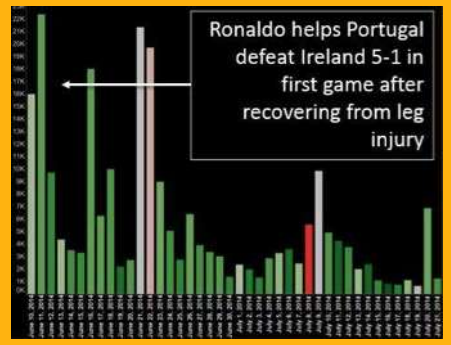
Construction of a social data pipeline that can quickly and efficiently analyze and visualize large data sets.



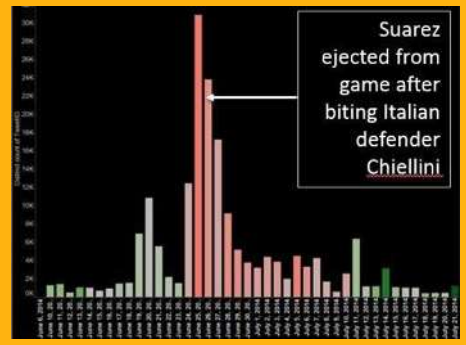
Rooney, England



Balotelli, Italy



Ronaldo, Portugal



Suarez, Uruguay

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LESSONS LEARNED

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1: Start with the Goal in Mind

evidence-based decision-making

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2: Explore Design Options

designing for the customer vs. designing with the customer

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3: Small, Medium…Big Data

synthetic data fusing techniques

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4: Rapid Prototype Dev.

open and frugal innovation

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5: Manage Scope Creep

bound the problem and hold

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6: Review Sessions

be prepared for anything

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7: Release in Beta

no such thing as a completed system

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8: Promote Intrapreneurship

develop competencies from within and promote innovation

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9: Outputs & Outcomes

communicate scientific and business ROIs

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10: Leadership Succession

think ahead and build a plan

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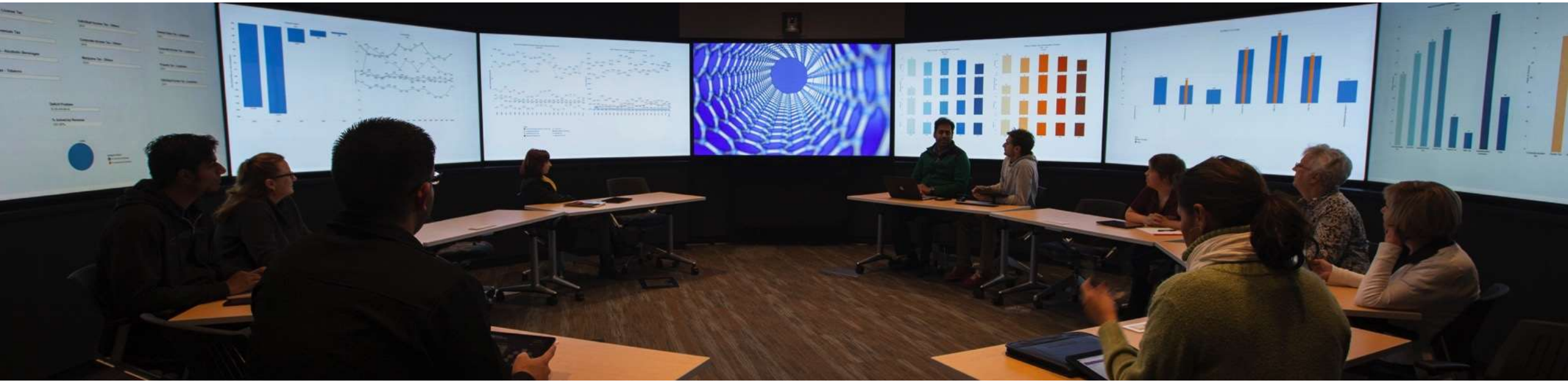

Questions or Comments

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