

Visual Insights | Sentient Architectures

Katy Börner @katycns

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Indiana University Network Science Institute
Indiana University, USA

ISE Undergraduate Student Orientation

November 2, 2017

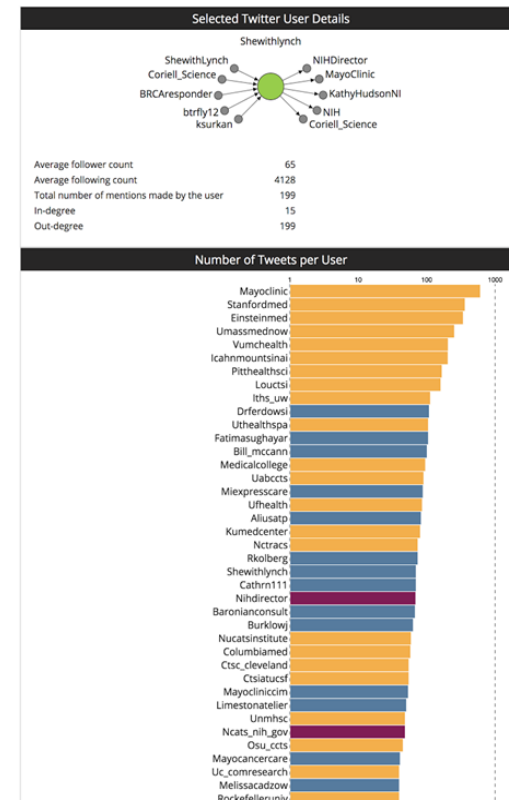
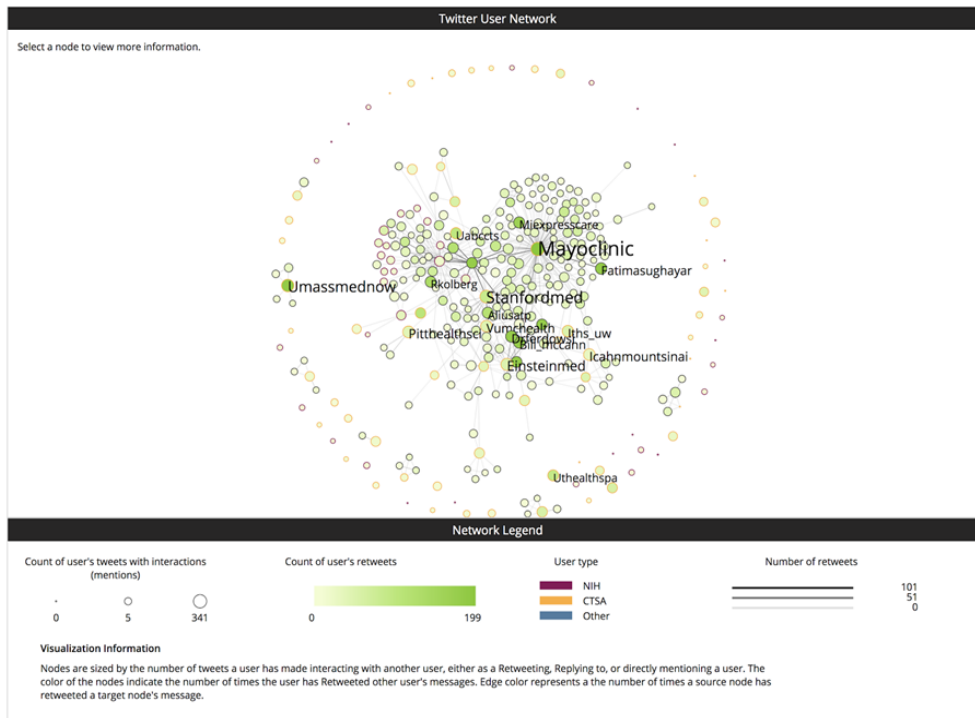
Research

Interactive Visualizations using CNS WebVis Framework

Visualization: Twitter Network

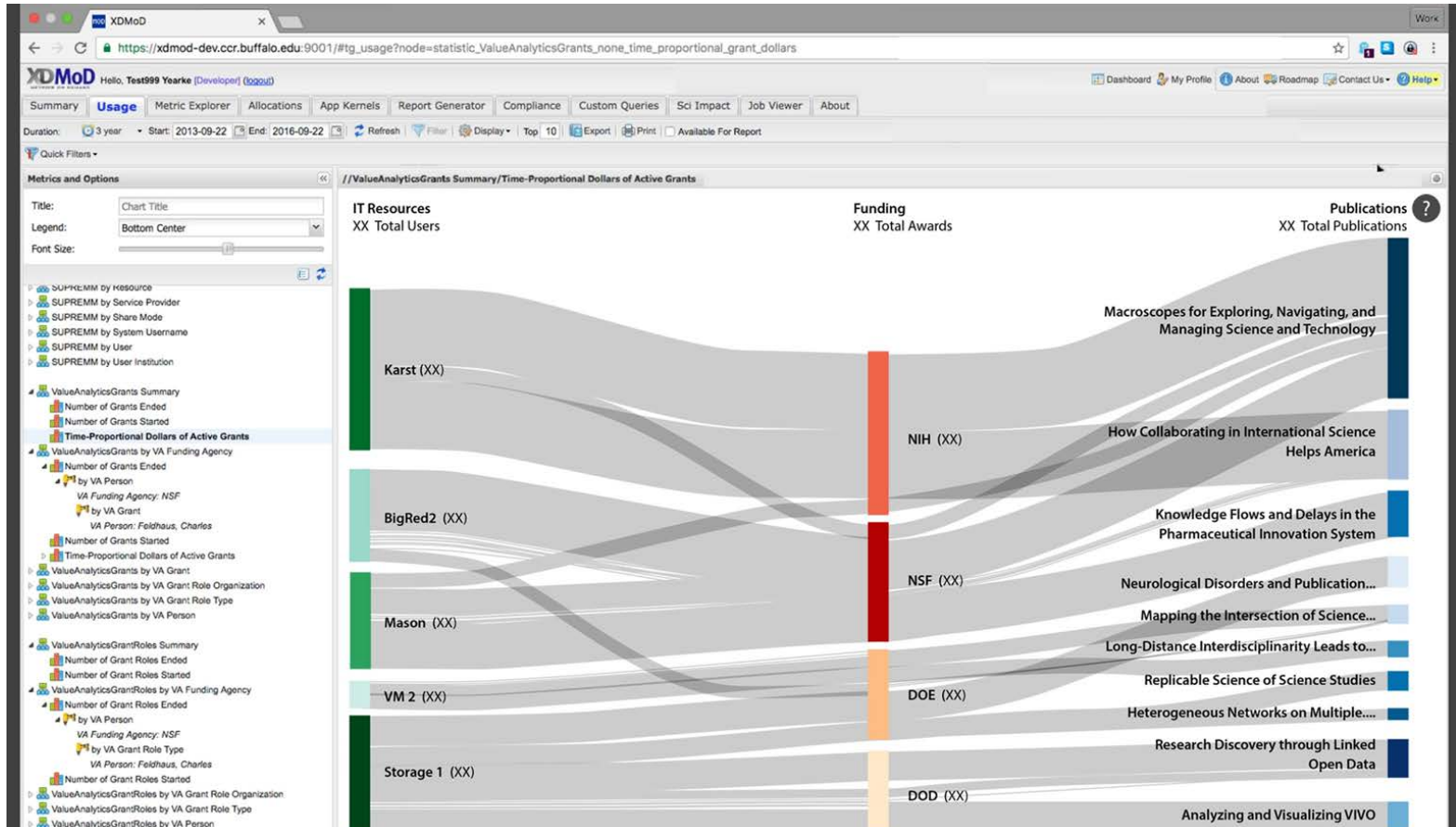
Project: IAI

demo.cns.iu.edu/client/iai/twitter.html



Visualization: Sankey Diagram

Project: XDMoD



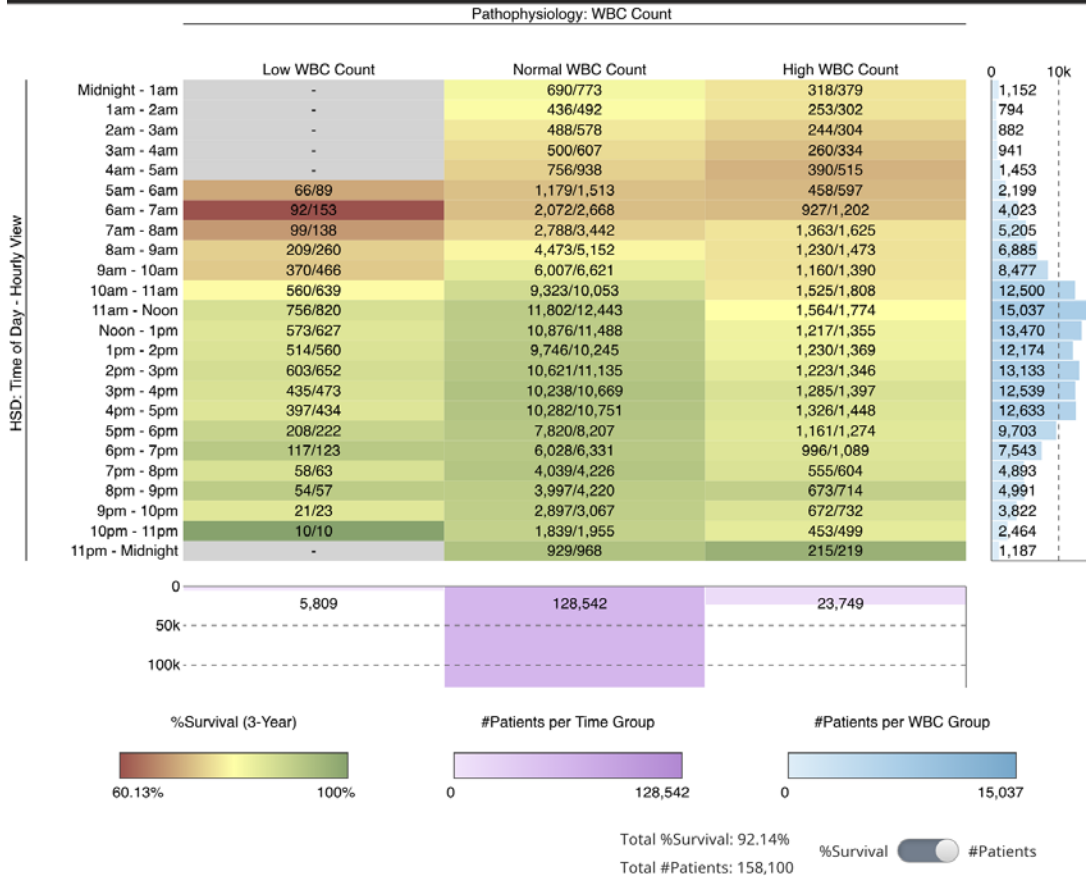
This Sankey diagram displays a multivariate analysis of the relationship between IT resources, funding agencies, and publications. The width of each line represents grant dollars awarded to researchers. The configuration model allows for easy metric switching.

Visualization: Heatmap

Project: HSD

demo.cns.iu.edu/client/hsd/static/heatmap_hour.html

Patient Survival by White Blood Cell (WBC) Count and Time of Day



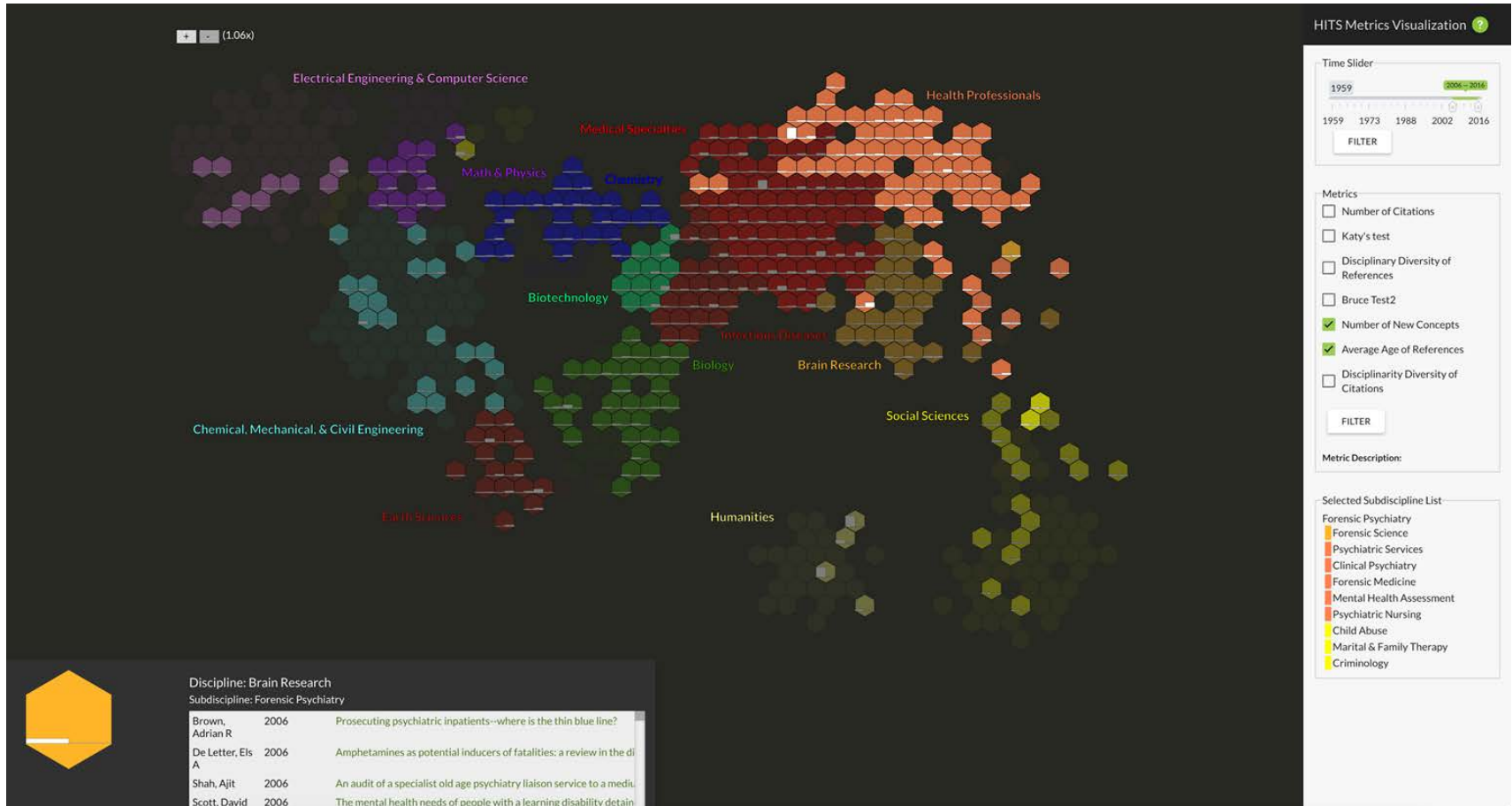
This visualization shows how white blood cell (WBC) laboratory tests correlate with three-year survival rates. The HSD dimension of the data (rows) is the time of the day of the test; and three-year survival rate (numbers and colors in the boxes) is an outcome variable. **Aggregation level for the HSD time of day are shown— 24 hourly blocks on the right..** The lowest survival rates are for patients with a low WBC value in the morning (specifically at 6am).

In this project, we created data visualizations to explain HSD to users and to help them incorporate it into their research.

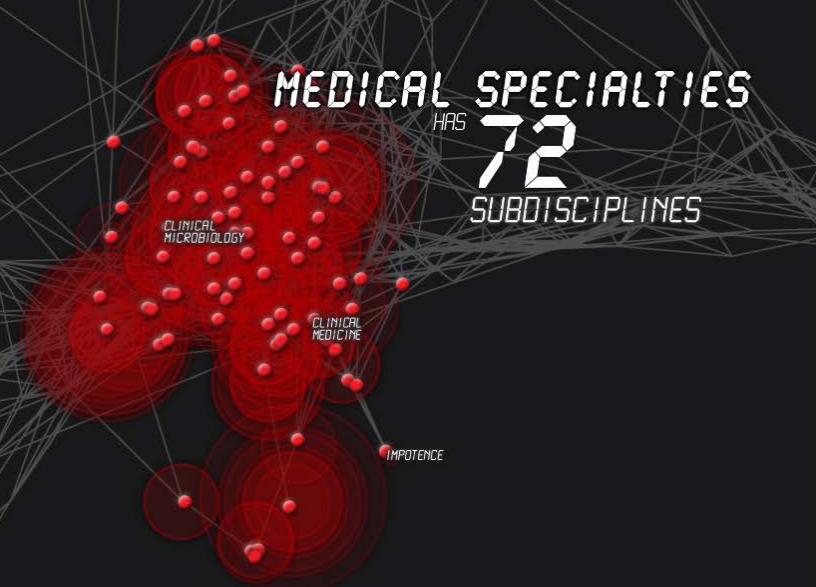
Visualization: Hex Map of Science

Project: ECON

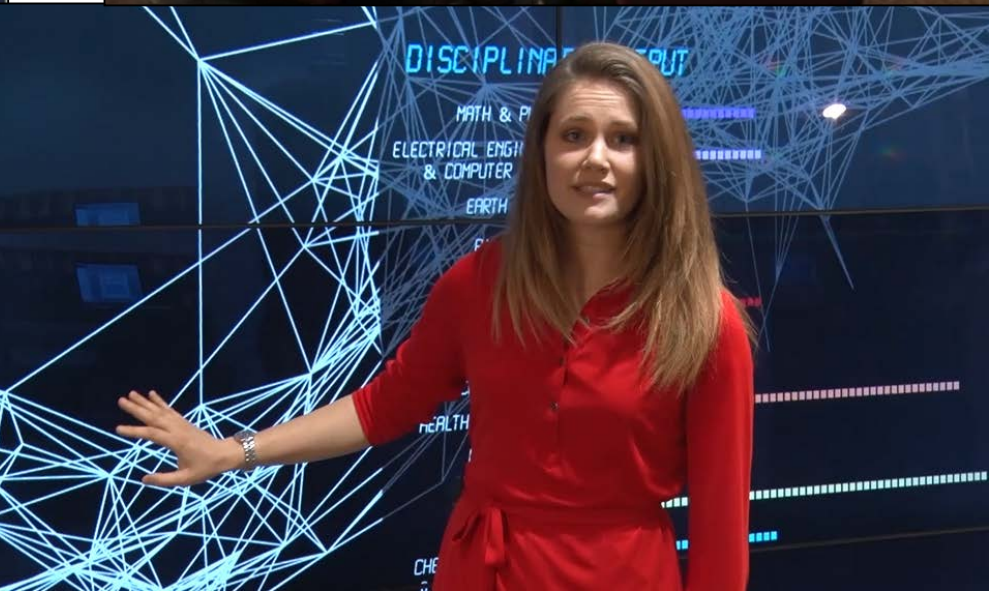
demo.cns.iu.edu/client/econ-hexmap



Hex-style rendering of the UCSD map of science allows for easier investigation of metric bars within each hexagon node. This Interactive map allows the user to hover over a discipline label to highlight all its subdisciplines, and also hover over a subdiscipline to see all subdisciplines it is connected to.



Science Forecast S1:E1, 2015







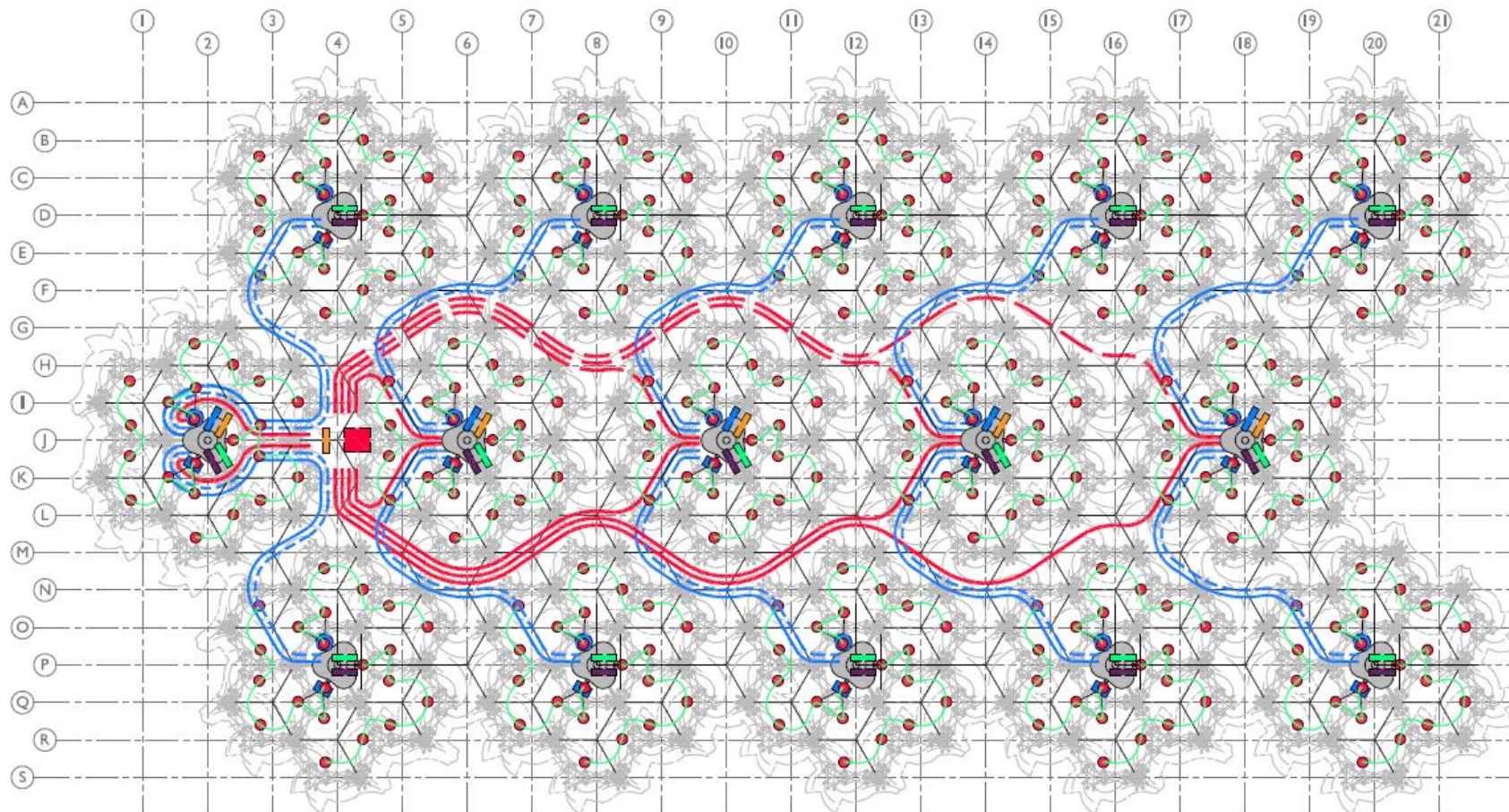
Sentient Veil, Isabella Stewart Gardner Museum, Boston, MA (2017)




Sentient Veil, Isabella Stewart Gardner Museum, Boston, MA (2017)







Sentient Veil, Isabella Stewart Gardner Museum, Boston, MA (2017)



PCBs

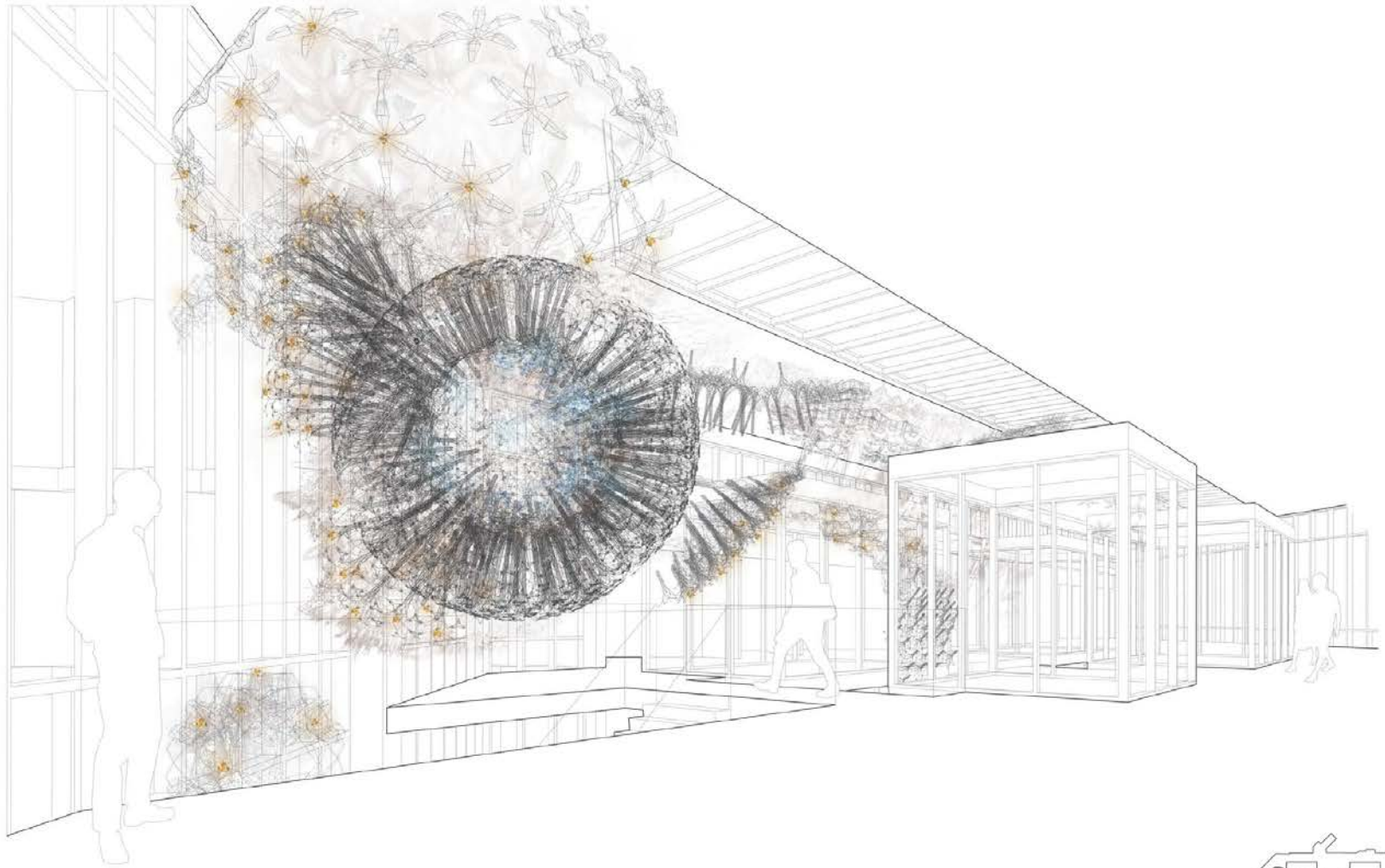
-  Raspberry Pi 3.0 B
-  3.1 Control Node
-  3.1 Device Module
-  Power Distribution board
-  Mp3 Trigger board

Interactive Devices

-  Light Module Cluster
-  Sound Unit
-  Short Range IR Proximity Sensor
-  Microphone Sensor

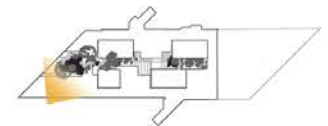
Mechanisms

-  Main Power Trunk
-  Main Communications Trunk
-  Node to Device Module Power
-  Node to Device Module Communications
-  Neo Pixel Chain

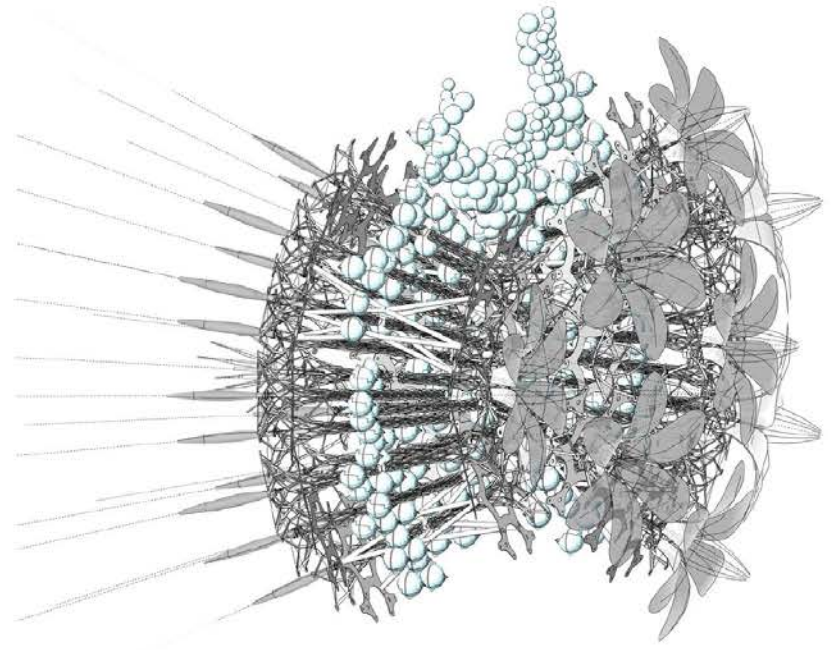
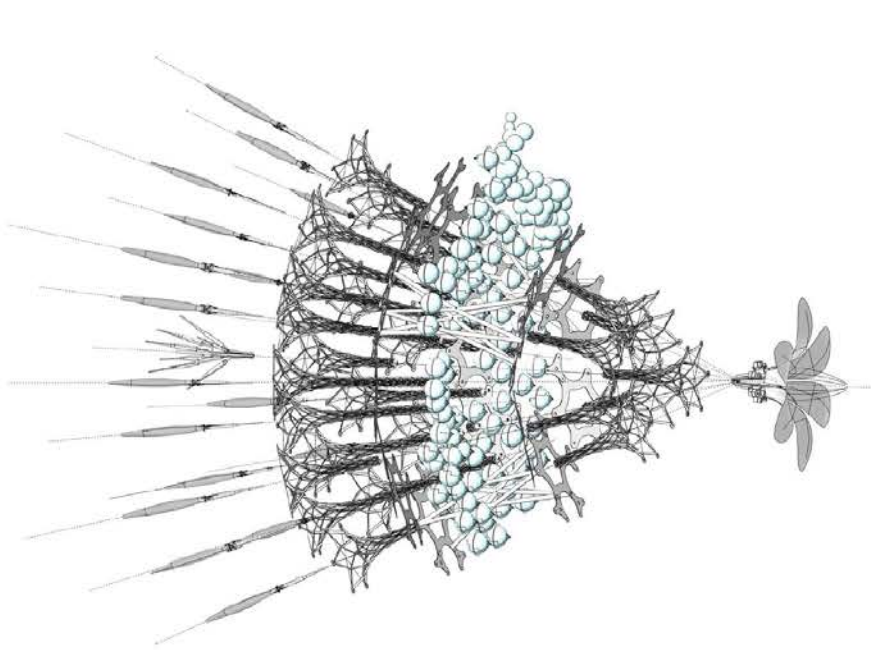


Luddy Hall Installation
Indiana University Bloomington
April 29 2017

UPPER ATRIUM



Philip Beesley • Living Architecture Systems



Luddy Hall Installation
Indiana University Bloomington
April 29 2017

ASSEMBLY SAMPLE

Philip Beesley • Living Architecture Systems

[Faculty + Student Work](#)[Learning Facilities](#)[Grunwald Gallery](#)[Centers](#)[Sage Collection](#)[McKinney Visiting Artist Series](#)[Archive](#)[Home](#) / [Creative Activity + Spaces](#) / [McKinney Visiting Artist Series](#) / [Upcoming Events](#)

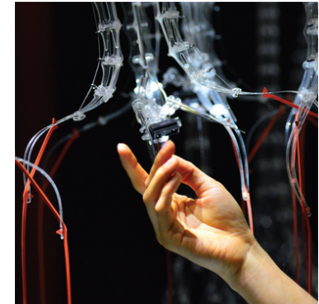
Philip Beesley: Digital Arts

Friday, November 3, 2017

5:00 P.M. – 6:00 P.M.

This lecture will take place in Fine Arts 015.

Philip Beesley's (FRAIC OAA RCA, visual artist, architect) research focuses on next-generation architecture that asks fundamental questions: can architecture feel, and care? Can new digital fabrication, artificial intelligence, and synthetic biology combine in architecture that comes close to life itself? Beesley's practice includes multiple crafts of architecture, sculpture, industrial design, instrument making, and mechatronics. He often collaborates with artists, including couture designer Iris van Herpen and futurist Rachel Armstrong. He is a Professor at the University of Waterloo and European Graduate School, and serves as the Director for the 40-partner Living Architecture Systems Group and Riverside Architectural Press. He has authored and edited sixteen books and proceedings, and has appeared on the cover of *Artificial Life* (MIT), *LEONARDO* and *AD* journals. Features include *Vogue*, *WIRED*, and a series of TED talks. His work has received multiple distinctions, and was selected to represent Canada at the 2010 Venice Biennale for Architecture.



Data Visualization Literacy: Research and Tools that Advance Public Understanding of Scientific Data

NSF Org: [DRL](#)
[Division Of Research On Learning](#)

Initial Amendment Date: June 13, 2017

Latest Amendment Date: June 13, 2017

Award Number: 1713567

Award Instrument: Standard Grant

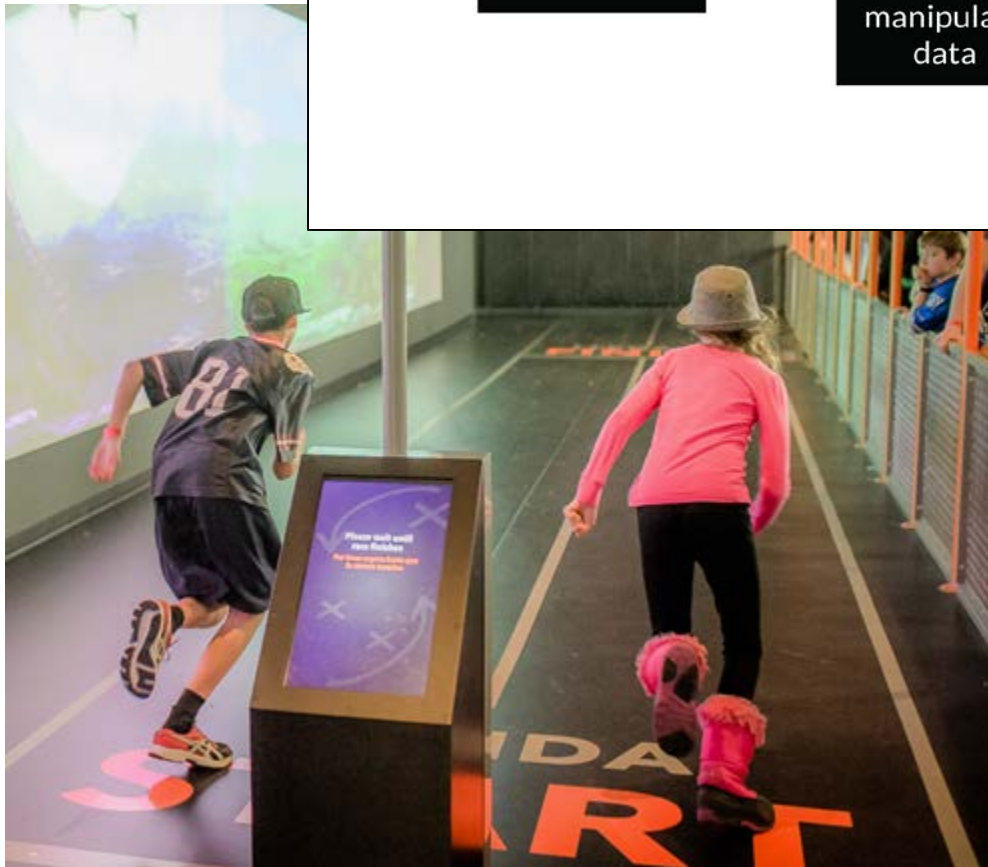
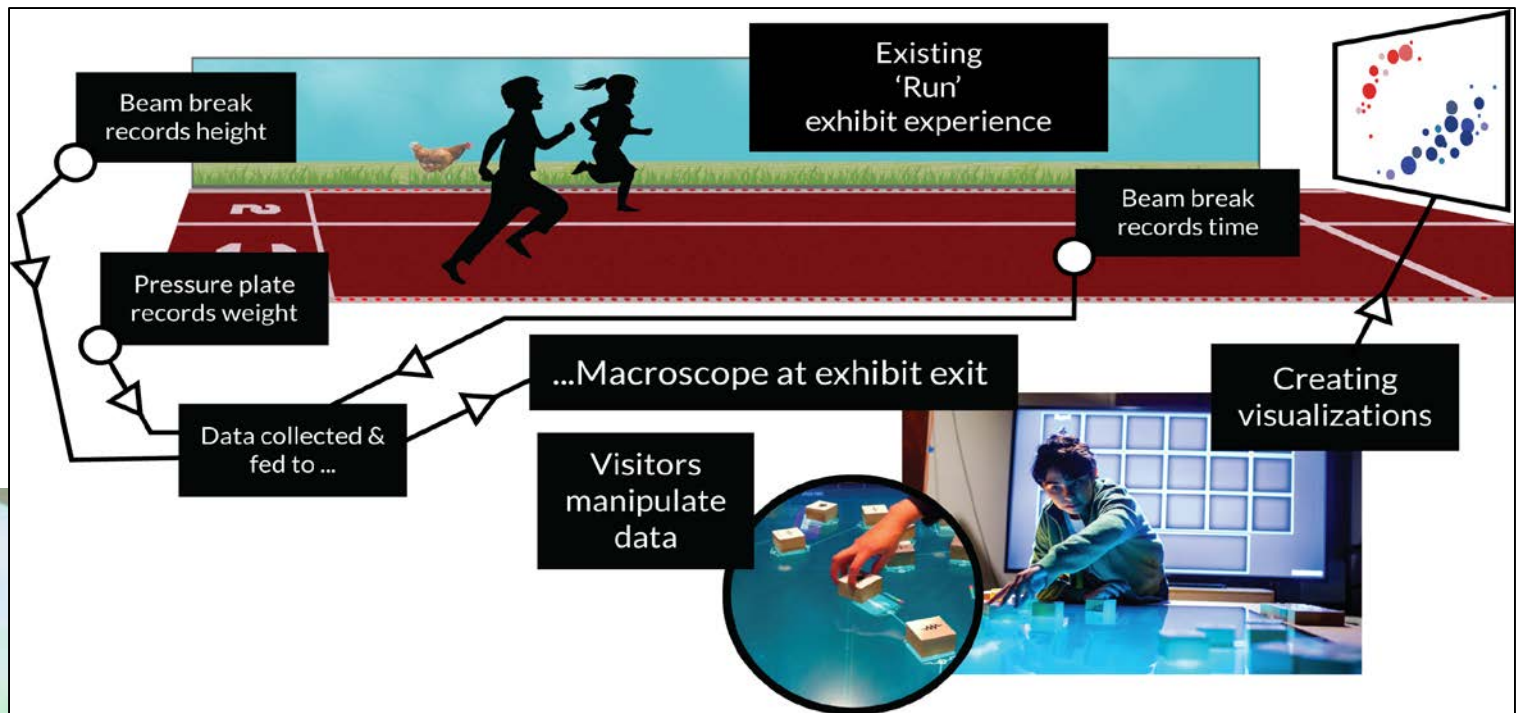
Program Manager: Arlene M. de Strulle
DRL Division Of Research On Learning
EHR Direct For Education and Human Resources

Start Date: August 1, 2017

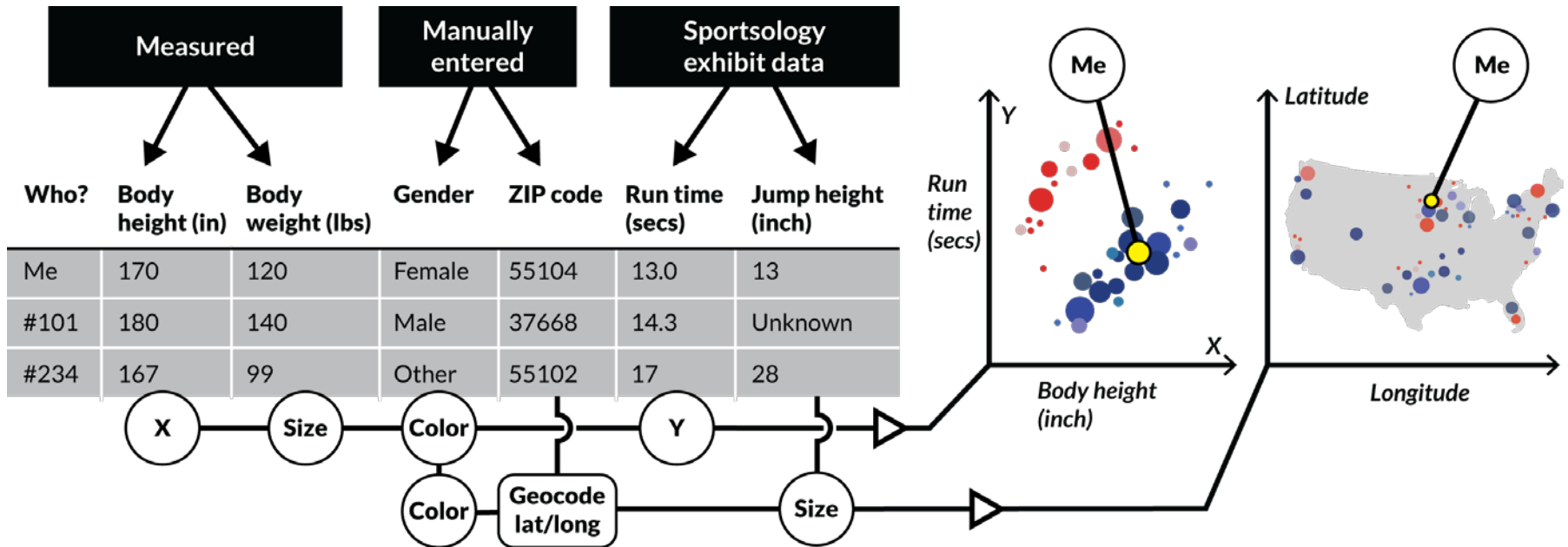
End Date: July 31, 2021 (Estimated)

Awarded Amount to Date: \$1,355,236.00

Investigator(s): Katy Borner katy@indiana.edu (Principal Investigator)
Kylie Pepler (Co-Principal Investigator)
Bryan Kennedy (Co-Principal Investigator)
Stephen Uzzo (Co-Principal Investigator)
Joe Heimlich (Co-Principal Investigator)



Sketch of the *Run* exhibit including data collection (top) and macroscope add-on that lets interested visitors explore more complex data visualizations using table-top displays.



xMacroscope general setup and activity—Raw data on left is converted to visualization on right by dragging and dropping (or connecting) column headers to axes, paint buckets, size, and shape.

2017 Conference

EnCon features talks, demos, and tours on the cutting-edge of technical innovation. Practicing engineers, academic researchers, students, and retired engineers will all find something of interest. This is an excellent opportunity for networking, knowledge sharing and professional development.

📍 BLOOMINGTON, IN

📅 NOVEMBER 10 - 11, 2017

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Program Committee

- **Katy Börner**, Indiana University
- **Gerhard Klimeck**, Purdue University
- Bob Evanich, Duke Energy
- **Oscar Moralez**, Vision Tech
- **Chris Foreman**, Purdue University
- David Peter, Borg Warner
- **Brian King**, IUPUI
- **Lisel Record**, Indiana University

<http://www.cis-ieee.org/encon2017>



SCWS 2017

Connecting the World
for a Sustainable Future

15th.Nov.-17th.Nov.2017

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Science Centre World Summit 2017 IN TOKYO

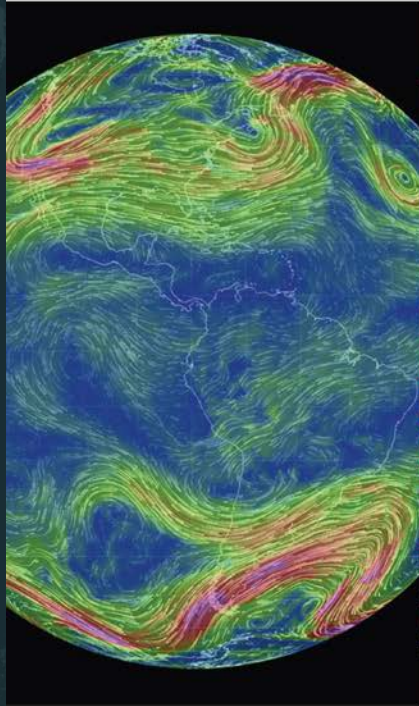
National Museum of Emerging Science and Innovation (Miraikan)

CSWS Session: Visualizing STEAM Data in Support of Smart Decision Making
November 15-17, 2017, Tokyo, Japan. <http://scws2017.org>

Teaching



i MACROSCOPES FOR INTERACTING WITH SCIENCE



Earth

Weather on a worldwide scale



AcademyScope

Exploring the scientific landscape



Mapping Global Society

Local news from a global perspective



Charting Culture

2,600 years of human history in 5 minutes

Iteration XI (2015): Macroscopes for Interacting with Science

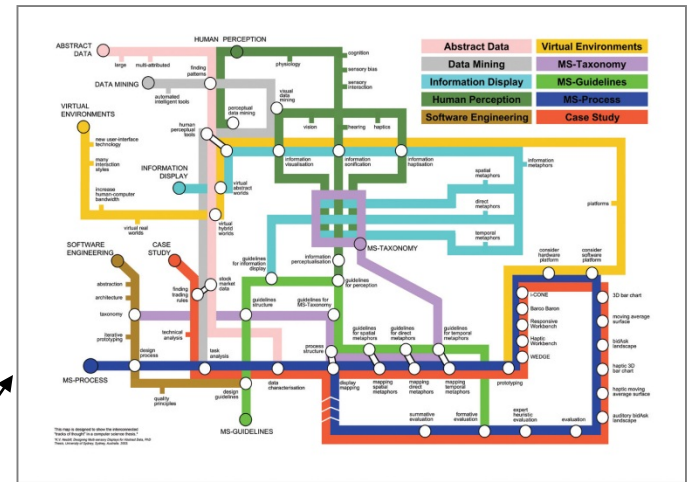
<http://scimaps.org/iteration/11>

Different Question Types



Terabytes of data

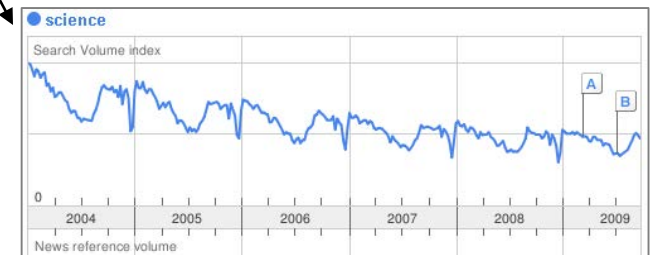
Descriptive & Predictive Models



Find your way



Find collaborators, friends

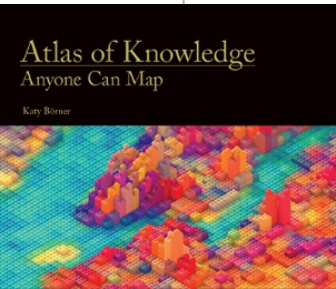


Identify trends

Tasks

LEVELS

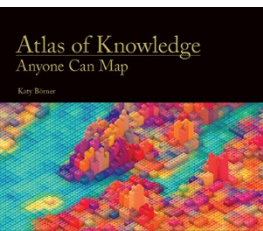
	MICRO: Individual Level about 1–1,000 records page 6	MESO: Local Level about 1,001–100,000 records page 8	MACRO: Global Level more than 100,000 records page 10
TYPES			
Statistical Analysis page 44	 Knowledge Cartography page 135	 Productivity of Russian life sciences research teams page 105	 Science and Society in Equilibrium Number of scientists versus population and R&D costs versus GNP. page 103
WHEN: Temporal Analysis page 48	 Visualizing decision-making processes page 95	 Key events in the development of the video tape recorder page 85	 Increased travel and communication speeds page 83
WHERE: Geospatial Analysis page 52	 Cell phone usage in Milan, Italy page 109	 Victorian poetry in Europe page 137	 Ecological footprint of countries page 99
WHAT: Topical Analysis page 56	 Evolving patent holdings of Apple Computer, Inc. and Jerome Lemelson page 89	 Evolving journal networks in nanotechnology page 139	 Product space showing co-export patterns of countries page 93
WITH WHOM: Network Analysis page 60	 World Finance Corporation network page 87	 Electronic and new media art networks page 133	 World-wide scholarly collaboration networks page 157



See *Atlas of Science: Anyone Can Map*, page 5

Visualization Framework

Insight Need Types page 26	Data Scale Types page 28	Visualization Types page 30	Graphic Symbol Types page 32	Graphic Variable Types page 34	Interaction Types page 26
<ul style="list-style-type: none"> • categorize/cluster • order/rank/sort • distributions (also outliers, gaps) • comparisons • trends (process and time) • geospatial • compositions (also of text) • correlations/relationships 	<ul style="list-style-type: none"> • nominal • ordinal • interval • ratio 	<ul style="list-style-type: none"> • table • chart • graph • map • network layout 	<ul style="list-style-type: none"> • geometric symbols <ul style="list-style-type: none"> point line area surface volume • linguistic symbols <ul style="list-style-type: none"> text numerals punctuation marks • pictorial symbols <ul style="list-style-type: none"> images icons statistical glyphs 	<ul style="list-style-type: none"> • spatial <ul style="list-style-type: none"> position • retinal <ul style="list-style-type: none"> form color optics motion 	<ul style="list-style-type: none"> • overview • zoom • search and locate • filter • details-on-demand • history • extract • link and brush • projection • distortion



See page 24

Graphic Variable Types Versus Graphic Symbol Types

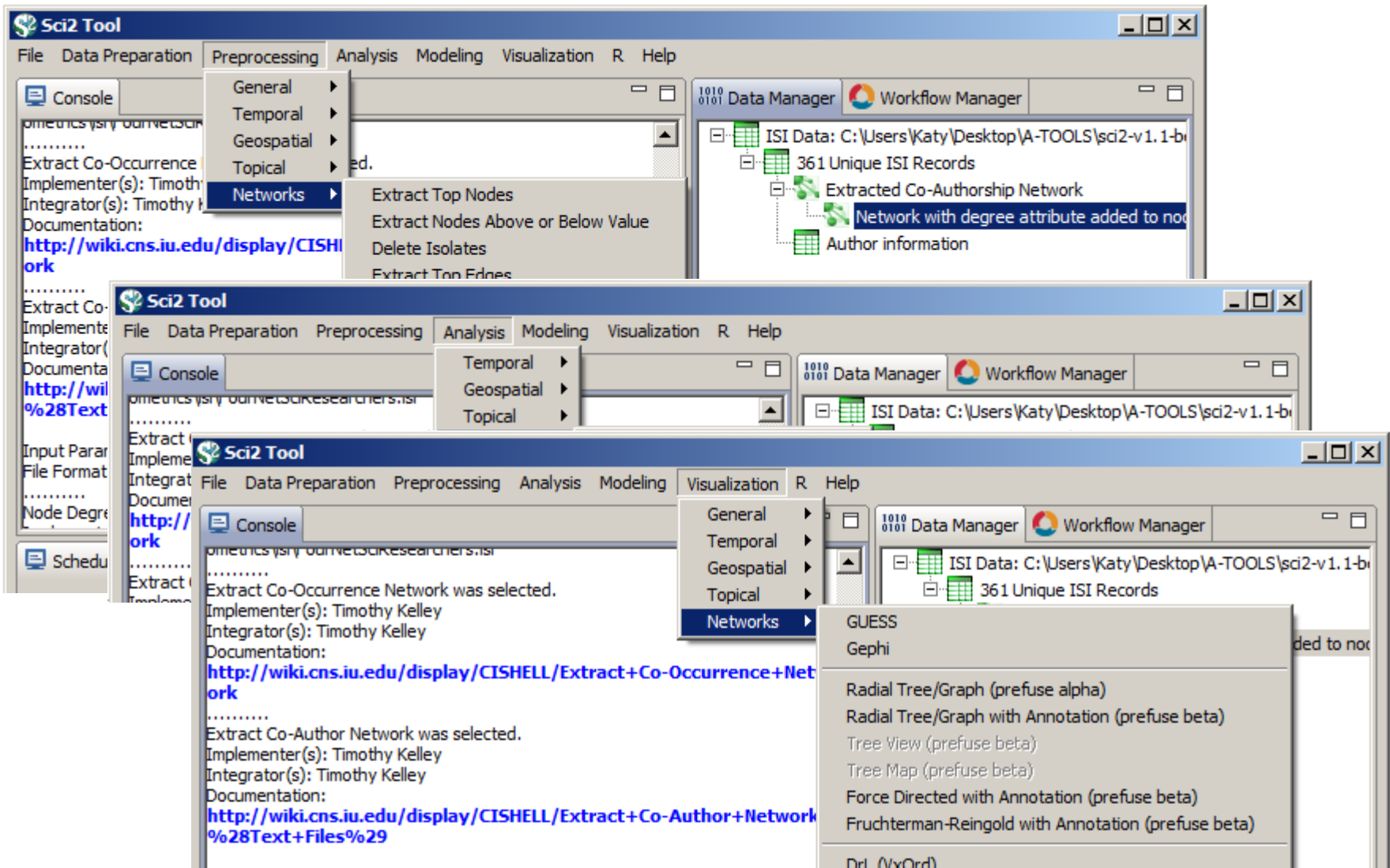
			Geometric Symbols					
			Point		Line		Area	
Spatial	x	quantitative						
	y	quantitative						
	z	quantitative						
Retinal	Form	Size	quantitative	NA (Not Applicable)				
		Shape	qualitative	NA				
		Rotation	quantitative	NA				
		Curvature	quantitative	NA				
		Angle	quantitative	NA				
		Closure	quantitative	NA				
	Color	Value	quantitative					
Hue		qualitative						
Saturation		quantitative						

Graphic Variable Types Versus Graphic Symbol Types

		Geometric Symbols					Linguistic Symbols Text, Numerals, Punctuation Marks		Pictorial Symbols Images, Icons, Statistical Graphs	
		point	line	area	surface	volume				
Symbol	1									
	2									
	3									
Form	size	NA (Not applicable)								
	shape	NA								
	orientation	NA								
	curvature	NA								
	angle	NA								
	closure	NA								
	value									
	hue									
	saturation									
Texture	spacing									
	complexity									
	pattern									
	orientation	NA								
	accent									
	blur									
	transparency									
	shading									
	stereoscopic depth	Point in foreground - background	Line in foreground - background	Area in foreground - background	Surface in foreground - background	Volume in foreground - background	Text in foreground - background	Text in foreground - background	Image in foreground - background	Image in foreground - background
	speed									
Motion	velocity									
	strobium	Blinking point slow - fast	Blinking line slow - fast	Blinking area slow - fast	Blinking surface slow - fast	Blinking volume slow - fast	Blinking text slow - fast	Blinking text slow - fast	Blinking icons slow - fast	Blinking icons slow - fast

Sci2 Tool Interface Components Implement Vis Framework

Download tool for free at <http://sci2.cns.iu.edu>



Load **One** File and Run **Many** Analyses and Visualizations

Times Cited	Publication Year	City of Publisher	Country	Journal Title (Full)	Title	Subject Category	Authors
12	2011	NEW YORK	USA	COMMUNICATIONS OF THE ACM	Plug-and-Play Microscopes	Computer Science	Borner, K
18	2010	MALDEN	USA	CTS-CLINICAL AND TRANSLATIONAL SCIENCE	Advancing the Science of Team Science	Research & Experimental Medicine	Falk-Krzesinski, HJ Borner, K Contractor, N Fiore, SM Hall, KL Keyton, J Spring, B Stokols, D Trochim, W Uzzi, B
13	2010	WASHINGTON	USA	SCIENCE TRANSLATIONAL MEDICINE	A Multi-Level Systems Perspective for the Science of Team Science	Cell Biology Research & Experimental Medicine	Borner, K Contractor, N Falk-Krzesinski, HJ Fiore, SM Hall, KL Keyton, J Spring, B Stokols, D Trochim, W Uzzi, B

Statistical Analysis—p. 44

Location	Count	# Citations
Netherlands	13	292
United States	9	318
Germany	11	36
United Kingdom	1	2

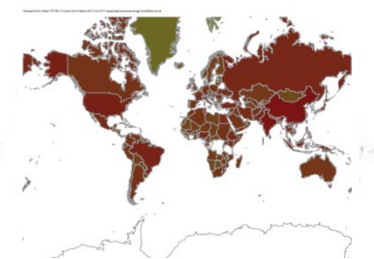
Temporal Burst Analysis—p. 48



Geospatial Analysis—p. 52



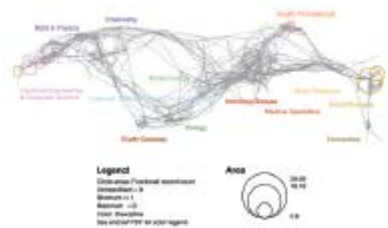
Geospatial Analysis—p. 52



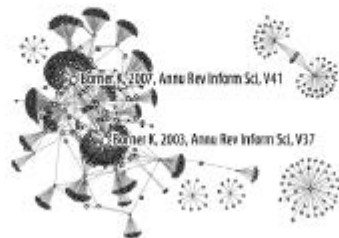
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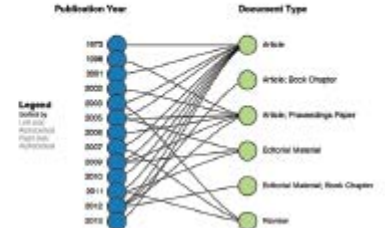
Topical Analysis—p. 56



Paper Citation Network—p. 60



Bi-Modal Network—p. 60



Co-author and many other bi-modal networks.



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**INTELLIGENT SYSTEMS
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Epiphyte Grove, Trondheim, Norway, 2012. ©PBAI

Sentient Architecture — Sculptures that Listen and Talk

As the built environment becomes increasingly more complex and integrated with new technologies—including the emerging Internet of Things (IoT)—there is an urgent need to understand how embedded technologies affect the experience of individuals that inhabit these spaces.

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- OCT 1** Katy Börner attends PIUG 2013 Northeast Conference
- 10.13** Katy Börner presents Mapping Science Exhibit at WSSF
- 10.15** Ted Polley & Google Team present IVMOOC at EDUCAUSE
- 10.22** Katy Börner presents at the SciELO 15 Years Conference

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These slides are at <http://cns.iu.edu/presentations.html>

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Mapping Science Exhibit Facebook: <http://www.facebook.com/mappingscience>