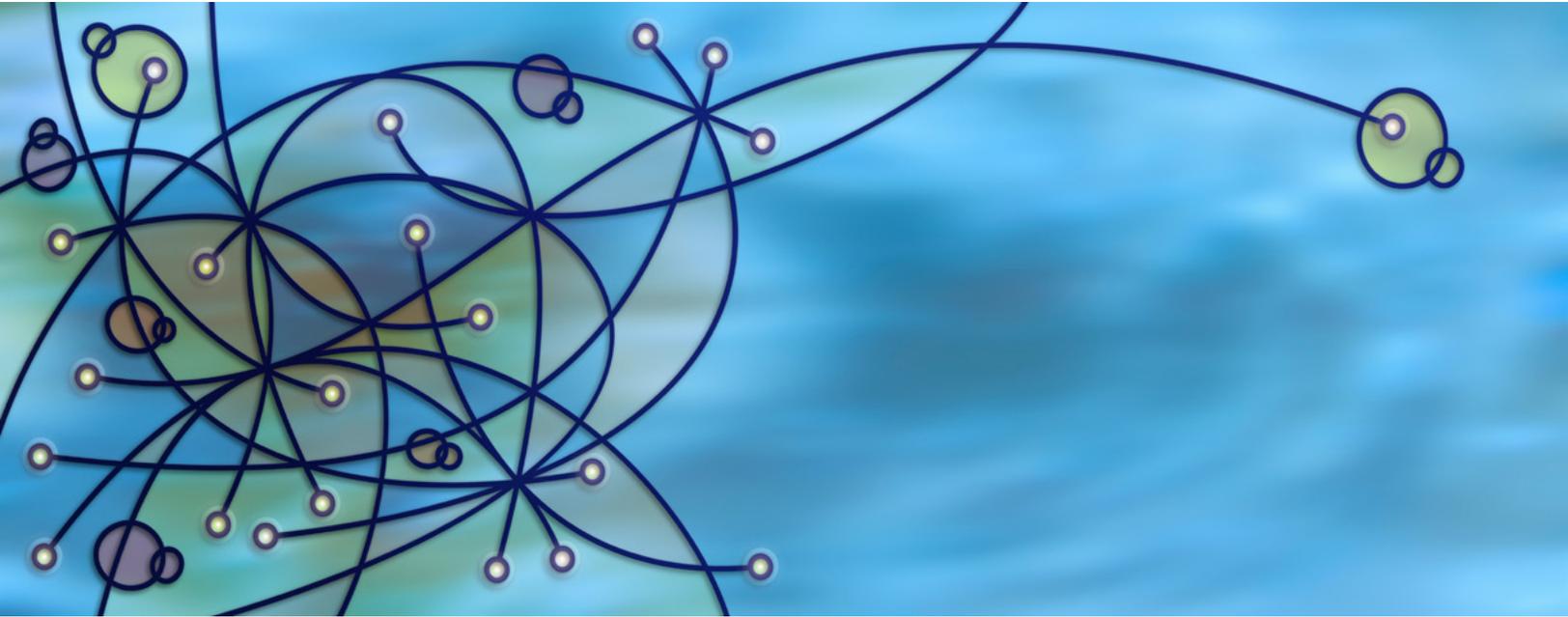


# CONVERGENCE COLLOQUIA

Cultivating Serendipity for Action



## Smart Cities & Infrastructure

February 28, 2015



Office of the Vice President for Research

UNIVERSITY OF MINNESOTA  
Driven to Discover<sup>SM</sup>

# Convergence Colloquia: Cultivating Serendipity for Action

On February 28, 2015, the University of Minnesota’s Office of the Vice President for Research (OVPR) convened the first colloquium on the topic of smart cities and infrastructure. The Convergence Colloquia are a new series of multi-disciplinary gatherings that advance cutting-edge research to develop innovative solutions and build long term partnerships that improve our world.

The colloquia serve as action-oriented think tanks focusing on critical issues for our communities, from building smarter cities to exploring alternative energy sources to improving water quality to securing our food supply, that bring together U of M researchers with private, public and nonprofit stakeholders to identify strategic collaboration opportunities that can lead to significant impact at the local, state, national and global scales.

The colloquia grew out of recommendations from the U of M’s research strategic plan, Five Years Forward, to promote a culture of serendipity that advances scientific discovery through collaborative thinking and action. Embedded in a strategic vision and action plan, the colloquia are grounded in a results-oriented approach that includes ongoing evaluation and reflection to ensure accountability and results.

## FIVE YEARS FORWARD - Vision and Cornerstones



Each workshop is intended to engage approximately 50-100 participants from a variety of disciplines and fields. Through facilitated sessions and focused dialogue, participants work to identify a set of strategic research priorities and explore opportunities for collaboration. Serendipity Grants are available to support follow on collaborative research efforts that engage U of M researchers, along with public, private and nonprofit participants.

The smart cities and infrastructure colloquium engaged over 80 participants from the U of M, and public, private and nonprofit organizations. Participants represented seven U of M colleges, as well as university-wide centers including the Center for Transportation Studies, Center for Urban and Regional Affairs, Informatics Institute, Institute on the Environment and Minnesota Population Center. Experts from outside of the U of M included 10 representatives from nonprofit organizations, more than a dozen private companies including those working locally to internationally, and more than a dozen public sector participants working in cities, counties, regional government and at the state level in Minnesota. A list of participants is included in Appendix A.

Attendees explored opportunities for collaborative research connected to the growing availability of data and the deployment of technologies in cities and regions that facilitate smart urban decision making and integration of multiple infrastructure systems. The event offered an opportunity to consider how smarter cities connect people and information in new ways to enhance governance and social networks. In addition, the event engaged experts from across a variety of topic areas to explore smart approaches that can be applied across transportation, health, natural resources, energy, safety and other systems.

## Converging on Smart Cities and Infrastructure

While there are many definitions of smart cities being advanced, the event was framed broadly with a definition noting that a city is smart when “investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and high quality of life, with a wise management of natural resources, through participatory governance.”<sup>1</sup> In this definition ICT refers to information and communication technology. With this focus, participants were encouraged to explore not just emerging data and technologies, but also the broader context and impacts. Participants considered how to connect their knowledge and resources to create communities that are not just more intelligent and efficient, but also more livable.

<sup>1</sup>Caragliu, A., C. Del Bo, and P. Nijkamp. 2011. Smart cities in Europe. *Journal of Urban Technology* 18(2): 65-82.

Smart cities and infrastructure offered a prime topic for the first colloquium. The topic has not been addressed in any direct way at the U of M, yet is an emerging topic in the US and even more established in European and Asian contexts. While U of M expertise on smart cities and infrastructure is extensive (e.g. big data, spatial science, social media analytics, visualization, mobile application development, wearable technologies, infrastructure system modeling, sensors, robotics, user interface design), it is has not been explicitly applied to this topic. A list of key U of M centers and programs with relevant expertise on smart cities and infrastructure is available in Appendix B.

Further, Minnesota and the Twin Cities offer a history of innovation related to the development and application of technology, as well as the production and sharing of data. Illustrative of this innovation is the MetroGIS program, a voluntary collaboration of local and regional governments to promote and facilitate widespread sharing of geospatial data. In the private sector, the local MyMeter Company has built an interactive platform and tool for energy use visualization that provides residential and commercial customers with information on energy usage patterns and trends that link to temperature, occupancy, appliance use and other factors. The local nonprofit E-Democracy.org works nationally and internationally to advance online engagement tools that promote participation in public life and foster community. These serve only as samples of the relevant innovations.



Colloquium participants discuss smart cities and infrastructure research opportunities.

## Directions in Smart Cities Research

Research funding is emerging in support of smart cities and infrastructure focused scholarship. Recent funding programs from the National Science Foundation (NSF) include, but are not limited to, the Partnerships for Innovation: Building Innovation Capacity program supports academic-industry partnerships related to the integration of technologies into human-center smart service systems. Smart cities, smart infrastructure and on-demand transportation are noted as specific smart service applications that might be pursued under this program. NSF is also sponsoring a 2015 Early-Career Investigators Workshop on Cyber-Physical Systems in Smart Cities. This workshop will identify research opportunities related to topics such as smart technologies, social impacts of smart technologies, computing for sustainable and green urban living, human interfaces with smart city systems and urban analytics. NSF's recent Critical Resilient Interdependent Infrastructure Systems and Processes program is focused on interdisciplinary research focused on critical and interdependent infrastructure systems (e.g. electrical power grids, transportation services, emergency services). This program places particular emphasis on interactions among physical, cyber, and social, behavior and economic components of systems.

In Europe, the European Union's Horizon 2020 program has provided funding for a number of years related to smart cities and infrastructure, with additional national level funding supporting innovation across various European countries. In 2015, the Horizon 2020 program issued a call for proposals for Smart Cities and Communities demonstration projects that integrate energy, transportation and information and communications technology. An additional call is focused on developing standards for smart cities components such as smart meters, smart grids and information and communications technology. Acknowledging the progress and diffusion of innovation that has already occurred in the European context around smart cities and infrastructure, this effort is intended promote connections among existing systems, ensuring open data access, and maintaining Europe's status as a leader on smart cities.

Finally, a number of universities are positioning and highlighting their expertise on smart cities. For example, the University of Alabama at Birmingham's Smart Cities Research Center positions itself as promoting collaboration to develop smart technologies and information systems, improve transportation models and promote green construction and renewable energy. The University of California, Berkeley also has a Smart Cities Research Center initiated out of its Civil and Environmental Engineering Department, but draws on interdisciplinary expertise focused on quantitative modeling of urban systems. Key areas of expertise include urban data analytics, distributed control systems, smart transportation, computational social science and location-based social

networks. Columbia University’s Data Science Institute includes a Smart Cities Center focused on developing and monitoring sustainable urban infrastructure and buildings. Additional areas of focus include smart grid, transportation system modeling and sensing devices in urban environments. The list above offers just a sampling of research centers, but university smart cities initiatives also include courses and degree programs that are positioning expertise on smart cities.



Participants share insights from small group discussions.

## Exploring Opportunities for Collaborative Research

The primary focus in organizing the colloquium was to advance conversations and networking among attendees. The discussion was informed by a series of “catalyst presentations” that highlighted big ideas and new technologies related to smart cities and infrastructure. Each presenter also highlighted key needs and potential collaborators needed to move the work forward. The presentations are briefly summarized on the opposite page. Presenter bios are included in Appendix C.



Convergence Colloquium participants network around shared interests in smart cities and infrastructure.

## Catalyst Presentations

### ***Access across America: Measuring What Matters about Transportation***

**Andrew Owen**, Director, Accessibility Observatory, Department of Civil, Environmental, and Geo- Engineering, University of Minnesota

Drawing on work with the U of M's Accessibility Observatory, Mr. Owen explored the "Cumulative Opportunities of Accessibility." He highlighted an emerging approach to transportation data and modeling that quantifies the varying levels of access to "valued destinations" (e.g. jobs, healthcare, and education) by way of automobile, bus/rail and pedestrian modes within a certain radial range.

### ***Making the City Visible: Translating Use Data into Decision Making***

**Jon Commers**, Principal, Donjek, Inc.; Lead, Visible City

Behavioral data, which integrates and layers physical, relational and behavioral data sets, is a product of the explosion of data collection, data decentralization and its visualization. Mr. Commers builds on the physical elements and relationships that make up a framework for the city to derive where the highest value contributions can be made for planning, investment and building resilience.

### ***Minneapolis Intelligent Operations Platform***

**Otto Doll**, Chief Information Officer, City of Minneapolis

Mr. Doll aspires to establish an "Event Horizon Picture" by meshing historic, recent and real time data. Such a picture will be created by unifying data and analytics around all City of Minneapolis department permits and trends to create an "Analyst Palette," which will allow officials and citizens to think and plan descriptively, diagnostically, predictively, and ultimately, prescriptively.

### ***The Human in the Smart City: Leveraging Wearable Technologies to Inform Infrastructure***

**Lucy Dunne**, Associate Professor, Department of Design, Housing and Apparel, University of Minnesota

By developing capacity for ubiquitous computing between clothing data and infrastructure data, Dr. Dunne is advancing the potential to convert casual clothing into a data and knowledge source that is reflective of true human nature, movement and decisions. If the potential is fully realized she foresees the ability for personal information, portable environments and public services to interact fluidly.

### ***Smarter Buildings Creating Smarter Cities***

**Ed Stogenson**, General Manager, Siemens Building Technologies

Mr. Stogenson posits that Smarter Cities start with Smarter Buildings, which move from a reactive service to a proactive one aligned with business goals. Through his work with Siemens, he seeks to leverage the latest technologies (e.g. IT/Building Convergence, Big Data, Data Analytics, Cloud Delivery, User Experience) to meet tenant and owner needs with better Monitoring Forecasts, Smart Building Products and Building Management Systems.

### ***Great Cities: A Traveling Exhibit about the Past, Present and Future of Cities***

**Patrick Hamilton**, Director of Global Change Initiatives, Science Museum of Minnesota

Mr. Hamilton is developing an adaptive model of a "Great City" traveling exhibit at the Science Museum of Minnesota, which can act as a catalyst for change and possibility. In the end, this model would be able to adapt to the unique current and projected factors and constraints of each city it travels to. By doing so the model can reveal current trends and ways in which a city can alter its current course.

### ***Thinking Spatially – Tools for Smart Cities***

**Len Kne**, Associate Director, U-Spatial, University of Minnesota

Through his work with U-Spatial, Mr. Kne is working to create a framework for "Collaborative Geodesign," which will consist of the people of the place in question, various design professions, the geographic sciences and information technologies. Within such a framework he foresees the ability to create and develop the new tools needed to realize Smarter Cities. Relevant tools include visualization, collaborative geodesign and spatial analysis.

## Key Questions and Potential Collaborations

Following the catalyst presentations, participants were invited to identify questions about smart cities and infrastructure that they would like to explore with others. Participants proposed questions, which were then used to organize two rounds of table discussions. Participants had the opportunity to self-select to table discussions that interested them. For their table question, they were asked to explore three issues: (1) *information needed or desired to address the question*; (2) *relevant data, technology, areas of expertise, and/or capacities*; and (3) *prospects for collaboration among those at the colloquium, as well as additional stakeholders and organizations*. Key insights from the table discussions are highlighted below:

- 1** ***How do we merge data and existing infrastructure?***

Participants highlighted a need for methods to measure and monitor existing infrastructure conditions. They were also seeking mechanisms to anticipate and manage how different types of infrastructure affect each other, such as in situations where street reconstruction has implications for water, energy and fiber optic infrastructure. Approaches to sharing data and the prospects for incentives to merge data across infrastructure systems were also prioritized. Participants encouraged the identification and consideration of best practices from across the world.
- 2** ***How do we ensure equal utilization and distribution of technology for everyone?***

This discussion focused on the importance of equitable access and distribution of data and technology across people, communities and the state of Minnesota. Participants noted a need for informed decision making about data and technology investments and their impacts. The group identified the need for and inquired about the prospect of more open source tools and crowd-sourced data. As with the previous question, the participants considered what might be learned from other sectors, institutions, states and countries.
- 3** ***How do we use design to make technology accessible and usable for all people?***

Participants expressed a desire to facilitate a better match between technology and users expectations and needs. They emphasized the importance of achieving a balance between meeting needs and adding burden to others. The group highlighted expertise in technology/data usability, human factors and psychology as important to making technology accessible and usable. Approaches such as single sign-on and payment systems were noted as relevant technologies for enhancing access and usability.
- 4** ***How do we be good stewards of data?***

The discussion pointed to the need for data to be more visible, more accessible and at the same time more secure. The participants noted that the sources of data are not always clear and that metadata (i.e. data about the data) are often lacking and not uniform. The group called for methods and protocols for anonymizing data to protect sensitive information that still retain its utility. It was recommended that new opportunities for uniform data collection across the Twin Cities region be explored.

**5** ***How do we build trust in our models, data, and systems?***

Participants in the discussion noted a need for stakeholder engagement that includes diverse communities, is cognizant of cultural norms, and draws on the global community. It was emphasized that engagement be grounded in an understanding of what is needed to create trust and with attention to listening skills. Psychology, humanities, arts and human behavior expertise were all noted as critical capacities in this regard. Also noted was the importance of embracing failure, and acknowledging that those imperfect efforts are important for learning. Finally, data sharing policies were again noted as a potential barrier to expanding capacity.

**6** ***What will drive implementation of smart cities, besides technology?***

Central to this discussion was an emphasis on the need for changes in legal and regulatory framework that will drive smart cities implementation. Participants noted a need for insights on how to change rules, regulations, and laws that they see as impeding the implementation of smart cities. The group called for a “transformational model” that motivates behavior change, uses relevant data to inform users, and uses financial incentives to drive investments in new technology. It was also noted the focus should shift to performance rather the prescriptive metrics to more effectively drive implementation.

**7** ***How can we predict the technology that will transform smart cities?***

The group prioritized tracking trends at multiple levels. They noted a need to track efforts of the White House office of Science and Technology Policy and those emerging from Silicon Valley, as well as trends in how various age groups are using technology. Millennials were specifically noted, with an emphasis on understanding how they do tasks and what they prioritize. Also important is the need to understand how previous technologies (e.g. smart phones, cloud computing, sensor networks, social computing) have impacted cities. Expertise is needed relative to transportation, land use, computer science, security, and data, as well as insights that come from both the public and private sectors (e.g. Google, Apple).

**8** ***How do we engage local leaders to lead the change process around smart cities and infrastructure?***

Discussion participants prioritized the need for financial data and mapping of infrastructure to inform local leaders. Even as the information becomes available, it is acknowledged that leadership and a new focus on competitiveness is needed. Additional considerations include the fact that elected officials and community staff are already stretched thin and that the solutions for small communities might be different than those for larger ones. In identifying and developing new data and information, it must be presented in a timely, succinct and digestible manner. Examples and successes from other communities are particularly useful. Potential collaborators on this question include the U of M, Metropolitan Council, large cities and the State Auditor’s Office. The group prioritized building connections among academics, communities, and local leaders.

**9** ***How does Minnesota import and improve on the best ideas (and use social media)?***

Participants acknowledged that it is not always necessary to start from scratch. Looking at efforts coming from other states and across the globe is essential, taking the best ideas and applying them to the Minnesota context. Key needs include an effectively facilitated knowledge exchange that would identify issues, collaborators and information.

**10** ***How do we measure the impact of smart cities and infrastructure on human well-being?***

Central to this discussion was an exploration of what well-being means, including considering how you feel, how you behave, how present you are, how absent you are and how healthy you are. Equity and public health were also highlighted as key concerns within well-being. Both individual and societal well-being were seen as important. Creating environments that are not work-centric were also emphasized.

**11** ***How do we plan for the technology life cycle?***

In the discussion, the authoritativeness and actionability of data were questioned. The group explored the resilience of data and importance of identifying both durable and transient data and figuring out how to use both. On the technology side, participants considered the ripeness of technology and the importance of ongoing evaluation and maintenance.

**12** ***What can we do to promote connectivity?***

The discussion started with a query as to whether Minnesota is competitively positioned in terms of Internet access and connectivity and how our efforts compare to those being pursued in other states. It was acknowledged that there might be barriers to investment and collaboration that should be more proactively identified. Planning and goal setting for connectivity were prioritized by participants, including recommending the development of a master plan that identifies where fiber optic cable is available and where there are gaps in the system. Planning for future connectivity should also include understanding the current and future needs of residents and businesses for level of service and speed. Competitiveness now and in the future was seen as essential and was used to justify participants' call for local and state, as well as private, funding to extend existing networks. Future collaborative research on this topic might engage the public, private and nonprofit sectors, as well as the Minnesota Task Force on Broadband Development and Minnesota Office of Broadband Development.

**13** ***How can we increase transportation resiliency?***

The participants identified resiliency through technology and resiliency through sharing as two key issues. Natural and technological disasters, as well as cybersecurity were noted as key threats. On the technology side, concerns were raised as to the use of systems that are traditionally guarded by personal choice. Relative to sharing, participants noted the importance of sharing Minnesota's knowledge about resiliency, such as how we address snow. Sharing and the "teaching" that goes along with it was acknowledged as making us even more knowledgeable and resilient.

**14** *How do we think about systems in a systems way?*

This high-level discussion offered a conceptual discussion of the need to understand all of the pieces of key systems (e.g. data, infrastructure). Identifying both good and poor systems is seen as important for enhancing learning, as well as identifying system-scale fixes. Data can also be helpful in identifying things that are not working. A systems perspective also requires defining the problem in a unified manner that ensures that solutions do not precede the problem they are intended to solve. Further, it is essential to understand how systems intersect with fiscal, political and interpersonal relationships. Building trust among stakeholders and developing networks that reveal and promote reuse of previous work is also important.

**15** *How can there be better collaboration between government and the university?*

While this topic is broader than the focus on smart cities and infrastructure, participants did note a potential role for the university in developing visual tools to support better decision making, offering support for data analytics, and providing capacity relative to Geographic Information Systems (GIS). More generally, the participants noted a need for a “one-stop shop” for information, which could better match available information to the relevant context and facilitate collaboration to improve government projects. Multiple sources of data, technology and expertise were identified, including from a variety of colleges at the U of M and cities, counties and school districts. At the same time, data sharing policies were noted as a limitation, as well as concerns that the U of M has not consistently shared its high research and expertise.



Colloquium participants discuss research needs.

## Research Needs

Looking across these discussions, it is clear that best practices from relevant local, state, and international contexts are needed. Participants would like to see more examples from other communities and organizations, and at the same time participants highlight the prospect of sharing innovations emerging from Minnesota. It is acknowledged that future innovations must be responsive to changes in how people work, live, socialize, and travel in our communities and have an overall goal of improving quality of life.

As we consider opportunities for future research, participants emphasized the need for more collaboration across levels of government and across the public, private and nonprofit sectors. Participants also prioritized collaboration with the U of M in pursuing research to address smart cities and infrastructure. Priority research questions that emerged from these colloquium discussions are listed below.

### Priority Research Questions:

1. How can we effectively share and ensure equitable access to data from across multiple systems and jurisdictions?
2. How can we ensure that the increasing amount and availability of data are managed in a manner that protects sensitive information and is also usable?
3. How can we be responsive to stakeholder perceptions, cultural norms and organizational capacities as we develop new technologies, enhanced user interfaces and smarter decision-making tools and processes?

Minnesota's unique characteristics and capacities were noted by participants as making the state and our communities poised to pursue research and innovation in smart cities and infrastructure. The Twin Cities' status as a major metropolitan area is seen as an asset, creating opportunities to serve as an urban lab. The U of M's capacities, with multiple disciplines and campuses across the state, offer relevant expertise and prospects for collaboration.

## Colloquium Outcomes and Next Steps

The colloquium provided a valuable opportunity for networking and sharing information, laying the groundwork for future collaboration across disciplines and across sectors. A post event survey, completed by about one-third of the participants, revealed highly favorable reactions to the Smart Cities and Infrastructure event. Over 95 percent of survey respondents strongly agreed or agreed that the Colloquium provided opportunities to meet people outside of their discipline and 100 percent meet people from both within and outside of the U of M. Over 65 percent of respondents noted that they met more than five new people at the event and an additional 35 percent met three to four new people.

Over 93 percent agreed that the colloquium provided productive opportunities for interaction among participants and over 90 percent noted that the Colloquium revealed new prospects for engaging U of M and external partners. Nearly three-quarters of survey respondents noted that they met one or more people at the event that they expect to collaborate with in the future. Almost 90 percent showed a definite interest in participating in a follow up event and about two-thirds expressed interest in engaging via an online group.

As noted earlier, participants in each of the Convergence Colloquia are eligible to apply for Serendipity Grants to support the formation of and capacity building for new collaborative research teams. Teams are required to engage diverse disciplinary perspectives and integrate UMN experts with those from the public, private and nonprofit sectors. Seven proposals, engaging 46 participants, were submitted following the Smart Cities and Infrastructure Colloquium. Proposal participants represent five U of M-wide centers and six colleges, two private companies, two state agencies, one regional agency, one county, three local governments, and 10 nonprofits. Participating U of M researchers come from 15 different disciplines.

Serendipity Grant proposals outlined needs for new data and databases, analytical and mapping tools, and visualization and interactive software to enhance decision making. The proposals engage with an array of topics including climate change, public infrastructure, mental health benefits of nature, housing access and policy, transportation accessibility and the intersection of human behavior and the built environment. Funding decisions will be announced in May 2015.

The convergence colloquium brought together a diverse group of participants and fostered networking that will advance future collaborative research and support a community of practice around smart cities and infrastructure.

## Appendix A: List of Registered Participants

<b>Last Name</b>	<b>First Name</b>	<b>UMN Department</b>	<b>Employer</b>
Anderson	Ellen	Energy Transition Lab	University of Minnesota
Beaulieu	Michelle		City of Saint Paul
Borgen	Janelle		WSB & Associates, Inc.
Brisk	Debra		Hennepin County
Clift	Steven		E-Democracy.org
Commers	Jon		Visible City
Convertino	Matteo	Division of Environmental Health Sciences, School of Public Health	University of Minnesota
Doll	Otto		City of Minneapolis
Doll	Jenifer	Department of Educational Psychology	University of Minnesota
Donahue	Marie	Institute on the Environment	University of Minnesota
Douma	Frank	State and Local Policy Program, Humphrey School of Public Affairs	University of Minnesota
Dunne	Lucy	Department of Design, Housing, and Apparel	University of Minnesota
Edwards	Jenny		Center for Energy and Environment
Eftelioglu	Emre	Department of Computer Science and Engineering	University of Minnesota
Eggum	Tom		TKDA
Engel	Sabine	Office of University Economic Development	University of Minnesota
Erickson	Thomas		IBM T. J. Watson Research Center
Falbo	Dan		ESRI
Fan	Yingling	Urban and Regional Planning Program, Humphrey School of Public Affairs	University of Minnesota
Giannakis	Georgios	Digital Technology Center, Department of Electrical and Computer Engineering	University of Minnesota
Graham	Todd		Metropolitan Council
Gulliver	John	Department of Civil, Environmental, and Geo- Engineering	University of Minnesota
Hamilton	Patrick		Science Museum of Minnesota
Harvey	Brian		Zipcar
Headlee	Josh		Accelerated Innovations
Hecht	Brent	Department of Computer Science and Engineering	University of Minnesota
Henry	Bradford	Technological Leadership Institute, Department of Civil, Environmental, and Geo- Engineering	University of Minnesota
Herman	Brian	Office of the Vice President for Research	University of Minnesota
Hosmer	Grant		University of Minnesota City of Minneapolis Office of Emergency Management
Hourdos	John	Department of Civil, Environmental, and Geo- Engineering	University of Minnesota
Johnson	Josh		car2go
Joselyn	Bernadine		Blandin Foundation
Keeler	Bonnie	Institute on the Environment	University of Minnesota

<b>Last Name</b>	<b>First Name</b>	<b>UMN Department</b>	<b>Employer</b>
Kne	Len	U-Spatial, Minnesota Population Center	University of Minnesota
Konstan	Joseph	Department of Computer Science and Engineering	University of Minnesota
Kraikul	Evva		GLITCH
Kristen	Murray	Center for Urban and Regional Affairs	University of Minnesota
Levin	John		Metro Transit
Levinson	David	Accessibility Observatory, Department of Civil, Environmental, and Geo- Engineering	University of Minnesota
Li	Yanhua	Department of Computer Science and Engineering	University of Minnesota
Linderman	Lauren	Department of Civil, Environmental, and Geo- Engineering	University of Minnesota
Lund	Bob		THOR Construction, Inc.
Maas	Geoffrey		Metropolitan Council
Malmquist	Jerome	Facilities Management	University of Minnesota
Manore	Michael		MasterGraphics, Inc.
Manson	Steven	U-Spatial, Department of Geography	University of Minnesota
Martenson	Dennis		Independent Consultant
Martin	Pieter	University of Minnesota Press	University of Minnesot
Matzek	Kelli		Washington County,
McGeveran	William	Law School	University of Minnesota
McGinnis	Laurie	Center for Transportation Studies	University of Minnesota
Munnich	Lee	State and Local Policy Program, Humphrey School of Public Affairs	
Nadav	Amir		University of Minnesota
Neuhauser	Claudia	Informatics Institute, Office of Vice President for Research	Great Plains Institute
Norman	Ravi		University of Minnesota
Otto	Rebecca		THOR Construction, Inc.
Owen	Andrew	Accessibility Observatory, Department of Civil, Environmental, and Geo- Engineering	Minnesota Office of the State Auditor
Przybilla	Paul		University of Minnesota
Ramaswami	Anu	Science, Technology, and Environmental Policy Program, Humphrey School of Public Affairs	Hennepin County
Reddy	Abraham	School of Physics and Astronomy	University of Minnesota
Riemenschneider	Nora		University of Minnesota
Risse	William		City of St. Paul
Ritchie	Mark		Visible City
Schaffner	Philip		Expo 2023
Schmit	Matt		Minnesota Department of Transportation
Scott	Brian		Minnesota State Senate
Sheehy	Lee		SRF Consulting Group, Inc.
Shekhar	Shashi	Department of Computer Science and Engineering	The McKnight Foundation
Smith	Ken		University of Minnesota
Stogenson	Ed		Ever-Green Energy
Stroebel	Jay		Siemens
			City of Minneapolis

Tang	Xun	Department of Computer Science and Engineering	University of Minnesota
VanMeerten	Nicolaas	Department of Educational Psychology	University of Minnesota
Vars	Mitch		Nice Ride Minnesota
Wilson	Elizabeth	Science, Technology, and Environmental Policy Program, Humphrey School of Public Affairs	University of Minnesota
Xie	Xiqun	Department of Computer Science and Engineering	University of Minnesota
Yang	KwangSoo	Department of Computer Science and Engineering	University of Minnesota
Zhe	Jiang	Department of Computer Science and Engineering	University of Minnesota

## Appendix B: University of Minnesota Resources on Smart Cities and Infrastructure

The list below offers a sampling of U of M programs and centers that have the potential to connect to research on smart cities and infrastructure. The list is not comprehensive, but offers valuable insights into the range of expertise and capacities for collaboration.

### **Accessibility Observatory**

<http://access.umn.edu/about/>

The Accessibility Observatory is focused on the research and application of accessibility-based transportation system evaluation. The Observatory is guided by a threefold mission:

1. To advance the field of transportation system evaluation through research of new data sources and methods for accessibility evaluation
2. To develop standards and tools to facilitate the use and communication of accessibility-based metrics in transportation planning, engineering, and evaluation
3. To apply our tools and expertise in support of continual improvements in the planning, design, engineering, and analysis of transportation systems

The Accessibility Observatory is a program of the Center for Transportation Studies and the Department of Civil, Environmental, and Geo-Engineering. The program builds on earlier work conducted at the U of M, including the Access to Destinations and first Access Across America series report.

### **Center for Science, Technology, and Public Policy**

<http://www.hhh.umn.edu/centers/stpp/about.html>

The Center for Science, Technology, and Public Policy in the Humphrey School of Public Affairs transforms policy and action to address society's grand challenges at the intersection of science, technology, environment, and society through thought-leadership, systems thinking, and public discourse. Research in the Center is focused on infrastructure for future cities, climate change, sustainable energy transitions, governance of emerging and/or disruptive technologies and food and water security. Current projects include research on smart grids, sustainable electricity and sustainable infrastructure and cities.

### **Center for Transportation Studies**

<http://www.cts.umn.edu/>

The Center for Transportation Studies solves old transportation problems in innovative new ways. It convenes diverse communities to brainstorm, debate, share, learn and act. CTS partners with local and global transportation professionals, stakeholders, businesses and leaders to move new ideas from research to reality. The Center engages faculty expertise from across the U of M and facilitates ongoing engagement with transportation agencies and other stakeholders. Recent research projects focus on a variety of topics, including measuring accessibility, supporting statewide economic vitality, developing a "super hybrid" bus, warning drivers about safety hazards, spurring transit-oriented development and improving Minnesota's transportation system.

### **HumanFIRST Laboratory**

<http://www.humanfirst.umn.edu/>

The HumanFIRST (Human Factors Interdisciplinary Research in Simulation and Transportation) Laboratory employs tools and methods of psychology and human factors in engineering to improve scientific understanding of driver performance and cognitive functions. The Laboratory is a facility of the Department of Mechanical Engineering and is affiliated with the Roadway Safety Institute and the Region 5 University Transportation Center. Key capacities of HumanFIRST Laboratory include an advanced driving environment simulation system, driver data collection systems and instrumented roadways and vehicles.

### **Informatics Institute**

[http://www.research.umn.edu/umii/#.VRHH\\_vnF98F](http://www.research.umn.edu/umii/#.VRHH_vnF98F)

The U of M's Informatics Institute is an institute in the Office of the Vice President for Research. UMII is responsive to the needs of the University community and shaped by the University community in partnership with public and private organizations. The UMII fosters and accelerates data-intensive research across the University system in agriculture, arts, design, engineering, environment, health, humanities and social sciences through informatics services, competitive grants and consultation. UMII serves as the link to connect the research community to the services related to managing data across the data life cycle.

### **Roadway Safety Institute**

<http://www.roadwaysafety.umn.edu/about/>

The Roadway Safety Institute is the US Region 5 University Transportation Center funded by the US Department of Transportation. The Institute conducts activities that further the mission of the UTC program of the USDOT—to advance U.S. technology and expertise in the many disciplines that make up transportation through education, research, and technology transfer activities at university-based centers of excellence. Driven by the goal of preventing crashes to reduce fatalities and life-changing injuries, the Institute's research is focused on user-centered transportation safety systems. The Institute, previously known as the Intelligent Transportation Systems Institute, represents a consortium led by the U of M and including four other universities.

### **Social Media & Business Analytics Collaborative**

<http://sobaco.umn.edu/about>

Social Media and Business Analytics Collaborative builds on two decades of work in social computing. With top rated programs in computer science, engineering, management, and decision sciences, SOBACO combines these University strengths with the real-world business challenges, domain expertise, and unique data sets of our industry partners. The Collaborative sparks new thinking, creates a place for innovative ideas to incubate, and co-creates new knowledge and business value for today's data-rich, socially networked world. SOBACO is a University-wide research initiative, supported by the Carlson School of Management, the College of Science and Engineering, the President's Office, and Office of Academic Affairs and Provost.

### **Spatial Computing Research Group**

<http://www.spatial.cs.umn.edu/>

The research group's work is focused on the storage, management and analysis of scientific and geographic data, information and knowledge. The research is motivated by and has been applied to application areas such as transportation, virtual environments, earth science, epidemiology, and cartography. Recent projects focus on data mining and spatial data analytics related to weather, climate change, transportation, and public safety. The Spatial Computing Research Group is a research laboratory in the Department of Computer Science and Engineering.

### **State and Local Policy Program**

<http://www.hhh.umn.edu/centers/slp/>

The State and Local Policy Program helps policy leaders and citizens understand how changes in the global economy, technology, and the workplace affect communities by: convening to increase discussion and awareness of policy issues; contributing to produce and integrate new information, ideas, and approaches; and changing to enhance and apply public policy that addresses community needs. SLPP undertakes projects in four major policy areas: (1) Transportation and the Community, (2) Economic Development & Human Capital, (3) Rural Safety, and (4) Telecommunication.

### **U-Spatial**

<https://uspatial.umn.edu/summary>

U-Spatial, a program of the U of M's Minnesota Population Center provides support for spatial research, helps to eliminate duplication and fragmentation of scientific resources, and provides a framework of data, equipment, expertise, and resources that benefits all researchers working with spatial related sciences and creative activities. U-Spatial is providing broad-based infrastructure across traditional disciplinary and college boundaries has come much more recently. It provides support via four Cores:

1. Central Core services include technical assistance, training, resource coordination, and development of the spatial science community
2. Imaging Core infrastructure focuses on data and analysis of aerial and satellite imagery of the earth
3. Data Core services include data archiving and discovery and development of shared computing infrastructure
4. Analysis Core infrastructure centers on spatiotemporal modeling, geodesign, and mapping

### **Wearable Technology Lab**

<http://faculty.design.umn.edu/dunne/about.html>

The Wearable Technology Lab (WTL) focuses on the intersection between apparel and new technology: for instance, in expanding garment functionality through dynamic aesthetics and new sensing functions; in improving the way we use, manage, and consume clothing; and in streamlining the design and manufacturing processes of smart clothing. Many projects deal with translating technological potential into the real, everyday world: understanding human physical and emotional comfort and balancing these variables with tradeoffs of performance variables in a smart system design. The WTL is part of the Wearable Product Design Center in the U of M's College of Design.

## Appendix C: Catalyst Presenter Biographies

### ***Access across America: Measuring What Matters about Transportation***

**Andrew Owen**, Director, Accessibility Observatory, Department of Civil, Environmental, and Geo- Engineering, University of Minnesota

Andrew Owen is the director of the Accessibility Observatory and a research fellow in the Department of Civil, Environmental and Geo- Engineering at the University of Minnesota. He leads the Observatory's development and maintenance of tools to calculate nationwide, multimodal accessibility to a variety of destination types. Owen holds master's degrees in civil engineering and in urban and regional planning, and he has joined the field of transportation research following a career in computer science and network security.

### ***Making the City Visible: Translating Use Data into Decision Making***

**Jon Commers**, Principal, Donjek, Inc.; Lead, Visible City

Jon Commers is principal at Donjek, Inc., where he combines public finance, economics, planning and urban design concepts to provide effective project management and redevelopment strategy. As lead of Visible City, Jon has been developing an approach to identify and harness data that documents patterns of urban experience, for decision making by public, private and philanthropic parties. In his civic work, Jon has represented Saint Paul on the Metropolitan Council since 2011, where he chairs the Land Use Advisory Committee and is a member of the Transportation and Community Development Committees. Previously, Jon served on the Saint Paul Planning Commission for six years, where he was elected chair. Jon is also a co-founder of Strong Towns, a virtual nonprofit organization focused on improving the fiscal health of communities through productive land use. Jon joined the University of Minnesota in 2014 as an adjunct instructor in Urban Studies. He lives in Saint Paul with his family.

### ***Minneapolis Intelligent Operations Platform***

**Otto Doll**, Chief Information Officer, City of Minneapolis

Otto Doll was appointed the City of Minneapolis Chief Information Officer (CIO) in February 2011, responsible for all IT operations. Formally South Dakota's CIO for 15 years with responsibility for all state government computing, telecommunications, state radio and public broadcasting. Mr. Doll received his Bachelors in Computer Science from Virginia Tech and graduated from the Senior Executive Fellows program of the Kennedy School of Government, Harvard University. He is a past President of NASCIO- a national organization of state CIOs. Mr. Doll was named to Government Technology's Top 25 Doers, Dreamers and Drivers.

### ***The Human in the Smart City: Leveraging Wearable Technologies to Inform Infrastructure***

**Lucy Dunne**, Associate Professor, Department of Design, Housing and Apparel, University of Minnesota

Lucy E. Dunne is an Associate Professor in the Department of Design, Housing and Apparel, and sits on the faculty of Apparel Design, Product Design and Human Factors and Ergonomics, as well as holding affiliate membership in the graduate faculties of Computer Science and Engineering, Electrical and Computer Engineering, and the Institute for Health Informatics. She holds BS and MA degrees from Cornell University in Textiles and Apparel, an AAS in Electronic Technology from Tompkins-Cortland Community College, and a PhD in Computer Science from University College Dublin. Her research is focused on wearability and textile-based wearable technology and explores new functionality in apparel, human-device interface, production and manufacture and human factors of wearable products. Dr. Dunne has received the National Science Foundation's CAREER award and the NASA Silver Achievement Medal for her work with functional clothing and wearable technology.

### ***Smarter Buildings Creating Smarter Cities***

**Ed Stogenson**, General Manager, Siemens Building Technologies

Ed Stogenson is the General Manager for Siemens Building Technologies in Minnesota. He moved from Chicago to the Twin Cities about 8 years ago. He's been with Siemens for 18 years and has over 30 years of experience regarding construction infrastructure and facilities management. He has previously presented at the 7x24 International Conference regarding integration of building systems and at the University of Minnesota regarding sustainability. He is an active member of Winona State University Alumni and Friends, the Minnesota Chamber of Commerce, and was in the 2012 group of Leadership Twin Cities.

### ***Great Cities: A Traveling Exhibit about the Past, Present and Future of Cities***

**Patrick Hamilton**, Director of Global Change Initiatives, Science Museum of Minnesota

As Director of Global Change Initiatives at the Science Museum of Minnesota, Patrick Hamilton develops projects that explore the challenges and opportunities of humanity as the dominant agent of global change. Patrick also is a Fellow of the University of Minnesota's Institute on the Environment, a Board Member of District Energy St. Paul, and a Co-PI with the University of Minnesota's Urban Heat Island Network. Away from the museum, Patrick and his wife J. like to kayak and grow organic, blue-ribbon-winning pears, peaches and plums in Saint Paul.

### ***Thinking Spatially – Tools for Smart Cities***

**Len Kne**, Associate Director, U-Spatial, University of Minnesota

Len Kne, GISP, brings extensive experience with GIS and Information Technologies in higher education, construction, government and non-profit organizations to his work at U-Spatial, a center at the University of Minnesota providing support for spatial research. He is an alum of the University of Minnesota with a BS in Recreation Resource Management (2005) and Master of Geographic Information Science (2009). He is on the faculty of the Master of Geographic Information Science program and teaches project management, spatial databases and a variety of graduate seminar classes focusing on the use of technology in GIS. He is looking forward to the day when everyone is thinking spatially.

**For more information, visit: [research.umn.edu/convergence](http://research.umn.edu/convergence)**

Produced by the Office of the Vice President for Research.

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