SERENDIPITY GRANT 2015
Minnesota Smart City/Infrastructure Stress Transparency Tool

Bradford Henry, P.E. U of M, PI

Rebecca Otto, Minnesota State Auditor
Thomas J Eggum, P.E. MN2050, Co-PI
Len Kne, Associate Director U of M
Andrew Owen, Director U of M
Bernadine Joselyn, Blandin Foundation
Craig Johnson, League of Minnesota Cities
Frank Douma, Humphrey School
Claudia Neuhauser, PhD, U of M
Mitch Rasmussen, P.E. MNDOT

Infrastructure   Asset management   Smart prioritization   Finance   Critical services
Total Funding Request: $30,000

Problem: Minnesota has a vast amount of infrastructure that is aging. This infrastructure protects public health and provides vital services to residents throughout the State of Minnesota. Maintaining, rehabilitating and replacing this infrastructure over the next few decades with limited resources will be challenging as they are expensive propositions. Many of our communities do not have the population base to spread the costs across. Currently there is single place that identifies location, value and the condition of infrastructure community by community. Yet the technology exists to integrate existing information, present it in understandable formats to better inform state policymakers and prioritization of funding around our most basic public facilities. A smart approach is required to address this problem.

Approach: Collect existing data from multiple separate sources in state government and create a statewide database with cleaned and formatted data. This data will then be used to create a living statewide map that identifies and quantifies civil infrastructure needs. The map will be housed and displayed on the Office of the State Auditor website, a neutral and known location for local government financial data. Mapping the data will create a visual experience for users. Maps can summarize complex datasets in a geographic manner which makes the data much more accessible and less intimidating to the public, media, lawmakers, and local leaders.

Goal: Create a comprehensive-transparency tool of our infrastructure needs in a simple manner using complex data sets to allow for smarter and more informed decisions. Using available data management and visualization technology, it is possible to 'see' the location, value, age, condition, etc. of the infrastructure for every governmental unit in Minnesota and use that information to better understand the capital spending and maintenance funding needs for infrastructure across Minnesota.

Outcomes: Improve state public policy/long-term financial planning and asset management planning for civil infrastructure throughout our 854 cities and other local governments. By improving transparency of our infrastructure needs, all residents, local elected officials, legislators and governors will have a more comprehensive understanding of the total need over the next few decades. This can accelerate better planning, lower costs for the users, and avoid major service disruptions caused by inaction. The dataset that is collected, cleaned and formatted will be a very valuable database for decision making and for ongoing research.

Potential Reviewers: Lee Munich, Dennis Martenson, Laurie McGinnis, Adeel Larri

Description of Issue

The societal challenge we face across the country is the significant amount of aging infrastructure we have and the lack of public awareness or political will to address how we will fund the growing needs over time. This infrastructure includes roads and bridges, traffic signs and signals, ports and dams, airports, drinking water, waste water and storm water infrastructure, as well as energy infrastructure. Much of it is "out of sight, out of mind". The general public pays little attention to civil infrastructure and it is often taken for granted. We are reminded periodically in a crisis situation of its role in providing for our safety, health and supporting our economy. These crises are usually due to either a failure of a system due to inaction or natural disasters that destroy or damage the infrastructure. These images are then plastered all over 24-7 news programs. The images are powerful and remind us momentarily that our survival depends on the availability of clean drinking water; that bridges must be maintained so that they stand up when we drive over them; and that mega storms wreak havoc on the economy as our much of our infrastructure is not sized to deal with these storms.

Many of our cities in Minnesota have small/declining populations. When embarking on rehabilitation and/or replacement of civil infrastructure the smaller entities do not have the economies of scale and the population base to spread these costs across. The state has limited resources to assist in funding these critical projects. Better planning statewide and funding prioritization is required to ensure that we meet our needs successfully as a state. There currently is no one place that succinctly identifies and quantifies the amount, value and condition of our civil infrastructure statewide in an easy to understand format.

Data does exist that could be collected from multiple existing sources, cleaned up, formatted and displayed on a statewide map to help us better understand our comprehensive infrastructure needs. Most people are intimidated by large government reports and spreadsheets. Our project will demonstrate that pictures are very powerful. A wise person once said, "I hear it and I forget; I see it and I understand." A simple visual presentation of our comprehensive needs will be very powerful to the user. Unlike the images of failed civil infrastructure that get our attention momentarily, this visual would be available in a neutral setting with the drama and politics stripped away. The users of this map will include the media who currently go to the Office of the State Auditor website when researching local government finances. Local leaders will begin to understand the scope of needs statewide and that better planning at the local level is imperative. Lawmakers will better understand the comprehensive needs, which can and will incent smart policies at the state level. These policies could include providing incentives for better planning at the local level, providing assistance to small cities to achieve better planning which could then be tied to financing programs. We have something like this for water infrastructure financing in Minnesota and it has proven to be effective. Extending it to other infrastructure would serve our interests well.

Through my service as State Auditor, I have had many conversations over the last several years with a variety of different stakeholders who think a tool like this would be very beneficial. We do not have the resources within the Office of the State Auditor to accomplish a project of this scale. The Colloquium on Smart Cities and Infrastructure was the first time I saw a way to accomplish this project. Collaboration on the part of the many different experts and stakeholders on our team is required to get this project off the ground and the first stage completed. The resources and expertise at the University of Minnesota will make this project work and is a perfect fit for all stakeholders.

Description of Team

Bradford Henry - P.E. Adjunct Professor, MS Infrastructure Systems Engineering Program U of M. Areas of expertise include working for the City of Minneapolis and URS directing design activities for city, county and state highway projects and coordinating GIS functions.

Rebecca Otto - State Auditor, statewide elected official, nationally recognized and respected. She will provide vision and leadership for project. The office has government accounting and auditing expertise. Auditor Otto will work with the state agency leads that handle the desired data. The final map will be published on OSA website which already houses all local government finances statewide.

Thomas Eggum – P.E. Senior Consultant TKDA, former city engineer, member MN2050. Areas of experience include organizing and managing complex programs at the local level and supporting infrastructure management through professional associations.

Len Kne – Associate Director, U-Spatial, U of M, specialty areas include GIS; Spatial Database Design; Web Visualization; Spatial Analysis. He will work to identify a graduate student to collect, clean and format the data. He will oversee the mapping tool creation.

Andrew Owen – Director, Accessibility Observatory and a research fellow in the Department of Civil Engineering, U of M. Areas of interest include transportation research, computer science, and network security. He also analyzes systems and will be a valuable team member as we build the tool, especially for future development of site.

Frank Douma – Research Fellow and Associate Director, Humphrey School of Public Affairs, Issue areas include telecommunications and information policy, transportation, planning, policy, finance, urban sprawl, privacy, non-motorized transportation, intelligent transportation systems. He will consult with the team on public policy and the usefulness of the tool.

Bernadine Joselyn – Blandin Foundation, Director of Public Policy and Outreach – focus on Greater Minnesota. Potential future funder of project and has a Greater Minnesota perspective where many of our small cities are located. Her focus will be to make sure that the tool we create will meet the need of Greater Minnesota cities.

Craig Johnson – League of Minnesota Cities, Intergovernmental Relations. Policy areas of interest include wastewater, drinking water, storm water and sustainable development. Can consult with our team around water infrastructure questions from a statewide perspective and provide us with connections to cities.

Mitch Rasmussen – P.E. MNDOT, Director County State Aid Program. Mr. Rasmussen has well-established relationships with cities and counties throughout the State of Minnesota. He has been an engineer for both counties and cities. He will use his expertise to identify appropriate data to collect and data analysis. http://belleplaineherald.com/Content/News/News/Article/Scott-County-Highway-Engineer-Heading-Up-the-Road-to-Mn-DOT/7/48/5393

Claudia Neuhauser, PhD, Director, Informatics Institute. Will help the team stay focused on ensuring that the tool we build will meet the needs of the users and the public.

Our team is new, diverse in disciplines and balanced between Greater Minnesota and the Metro Area.

Description and Timeline

The proposed project will bring together the computing, research and analysis capacity of the University of Minnesota with a team of nonprofit leaders, a statewide elected official and local government interests to address a pressing societal issue.

In terms of a timeline, I want to start the project in June of 2015. We would work with Len Kne to identify a graduate student who would be assigned to the project. We would then convene a meeting with key state agency contacts who collect and work with the infrastructure data needed for the project. June is a better month than May due to the Legislative session. I will also know if I received funding request from the legislature for this project. If I do not receive it, I will pursue other funding sources. The legislative appropriation would allow me to bring in extra help in the office to keep the project moving. So far, the Governor is supporting our request for funding. We would receive the state funds after June 30 of 2015.

We will need each team member's expertise to decide which data gets collected to build the tool. We will need to convene the experts on the team to determine the most appropriate presentation of the data that is currently collected. Once that is decided, the graduate student can start work on collecting; cleaning and formatting the data into a new database, possibly housed at the U of M. Len Kne estimated that this work would require a semester. Mr. Kne said the process of mapping the data is not difficult or time consuming. He stated the software is ESRI which the Office of the State Auditor has a license for currently. We do not have the latest version of the software, but upgrading the software will be a modest cost.

I anticipate that we will be lacking data that will leave our first map incomplete. We need to illustrate this for the policy makers so that they realize we have an incomplete picture of the needs. I envision enhancing the tool over time as better data is collected through surveys and/or reporting forms. I have had several stakeholders tell me that they can add strategic questions to surveys they currently conduct to assist with the project over time.

I am hoping to have the tool operational and published on the Office of the State Auditor website by next May. I plan on announcing the new tool through a variety of means. I plan to travel the state and demonstrate the tool to local leaders and media outlets. I will demonstrate it to legislative committees that are interested. I also plan on sharing the process of accomplishing this project and crediting the U of M and our excellent team to national associations. I have mentioned the project to my peers in other states and they are interested in having me give a presentation at a national conference on it in August. Our team members will share it with their peers in their respective groups and associations.

Many individuals have already communicated the value of the underlying database for future projects and research. The interest is both local and national. As a team we can show the rest of the county that we value smart government in Minnesota and can lead the way with this tool. I believe the project will have a ripple affect nationally in addressing civil infrastructure planning and funding. The U of M can be the catalyst to making this happen by awarding our project with a $30,000 Serendipity Grant.

Description of Outputs and Outcomes

One of the outputs of this project is a statewide map that will illustrate our civil infrastructure needs in a manner that is both comprehensive and easy to use. The outcome of this will be a smarter, better-informed approach to meet infrastructure needs throughout the state over the next decade. Another output of this project will be a large, high-quality database that will be useful for ongoing research by local, state and national groups who have a great interest in infrastructure. This project is nation-leading and can serve as the blueprint on how to get something of this size done in an efficient, effective manner. Another output may be that we find holes in the data for some communities, but this is important to know. These holes can be addressed through some simple means such as surveys that are already conducted on a regular basis.

There are many other smart outcomes that will result from this project. First, the potential to change statewide public policies and our approach to funding and planning is great. Another outcome is the potential for future research that can be done using the data that is collected and cleaned. Our entire team sees potential uses for this data that can be housed at the U of M. I see the team continuing to collaborate beyond this project. The data could also be used by cities that want to study a specific issue or question around prioritization of infrastructure. Funding for any of the above mentioned projects will almost certainly increase because maintaining/rehabilitating/replacing infrastructure is one of the societal issues we are going to have to address over time. Our goal is to create a tool that helps us to plan and create policies that will produce the most efficient and effective results for the citizens.

References

"Future Wastewater Infrastructure Needs and Capital Costs – FY2014 Biennial Survey of Wastewater Collection and Treatment", January 2014 http://www.pca.state.mn.us/index.php/view-document.html?gid=20506

"2013 Report Card for America's Infrastructure", American Society of Civil Engineers, http://www.infrastructurereportcard.org/grades/

"2013 Report Card for America's Infrastructure", American Society of Civil Engineers, Minnesota's Grade http://www.infrastructurereportcard.org/minnesota/minnesota-overview/

"Minnesota's Broken Bridges, Ruined Roads: All agree something must be done", January 4, 2015, http://www.startribune.com/politics/statelocal/287421581.html

"Minnesota's Broken Transportation System" Daily Planet, David Schultz December 29, 2014 http://www.tcdailyplanet.net/blog/david-schultz/minnesotas-broken-transportation-funding-system

Move MN http://movemn.org/move-mn-agenda/

"Drinking Water Infrastructure Needs Survey and Assessment", U.S. E.P.A., April 2013 http://water.epa.gov/grants_funding/dwsrf/upload/epa816r13006.pdf

"Minnesota Public Facilities Authority 2014 Annual Report", January 13, 2015 http://mn.gov/deed/images/PFA_Annual_Report.pdf

MN 2050 http://mn2050.org/

Strategic Directions Report US Water Industry Report, Key Insights for Building Critical Human Infrastructure, Black and Veatch http://bv.com/reports/water

BUDGET FOR PROPOSAL Minnesota Smart City/Infrastructure Stress Transparency Tool
2015 - 2016

ESTIMATED EXPENDITURES

ITEM	Cost
Personnel	
faculty salary and fringe	
P&A salary and fringe	
graduate research assistant salary and fringe	25,000
Consultant costs	
Materials and supplies	
Travel	
Software	5,000
Food and provisions	
Space rental	
Other	
Total Estimated Expenditures	
Total Grant Requested	30,000

Matching funds - contributors		
List each department	20,000	OSA
List each center		
List each College		
List non-UMN sources	10,000	Foundations
Total Matching	30,000	

Budget Justification
Len Kne thinks it will take one Graduate Student a semester to collect, clean up, and format the data. That is where the majority of costs will come in. He said the Office of the State Auditor will need a site license for ESRI for the mapping. We currently have a license, but will need to update the version. Estimates are about $5,000 to accomplish this. No one on the team has indicated that they will need any sort of compensation to accomplish the project. The League of Minnesota Cities approved Craig Johnson's time with the project as being in the best interests of their member cities. As the State Auditor, I can put time in with no extra costs to the project. My staff can consult as needed and I have requested $150,000 to assist with this project from the legislature. The Governor supports our request and the legislature is currently reviewing the request. As State Auditor, I am prepared to find funding to see this project through if unexpected costs arise. Sources will include state agencies who want to see this project happen, foundations in Minnesota, and other nonprofit organizations that have an interest in seeing this project happen.

Bio Sketches

Bradford Henry, P.E.

Experience Overview
Over 40 years of professional experience managing civil engineering and automation projects in the private and public sectors and teaching engineers how to bridge the gap between traditional engineering and innovative automation in a University of Minnesota civil engineering master's degree program.

MN2050
Currently on the MN2050 steering committee helping to shape the MN2050 mission and tools. The mission is to explain the value of infrastructure to Minnesota residents, politicians and professionals. The tools include Twin City Public television videos, for the public and politicians; STEM outreach, for future professionals; and asset management, to help current professionals demonstrate how to enhance infrastructure sustainability.

URS
Ten years at URS. Managed large engineering projects and statewide automation initiatives. The engineering projects included the MARQ2 Transit Corridor design and construction project in downtown Minneapolis; the MNDOT I-494/TH169 preliminary design in the west Metro; the MNDOT I-90 Mississippi River Crossing preliminary design in Dresbach, MN; the MNDOT ROC52 Design-Build project in Rochester, MN; and the MNDOT I-694/I-35E Unweave the Weave final design. Each of these projects featured techniques to expedite design and construction and 3D animation tools to improve public understanding and support. Mr. Henry also managed a MNDOT statewide hydraulic infrastructure structure project and a MNDOT 3D design implementation project.

City of Minneapolis
In 31 years at the Minneapolis Public Works Department, lead a large capital program and developed an enterprise GIS. The large capital program surveyed, designed and reconstructed over 700 miles of urban roadways over a dense Minneapolis infrastructure network. The public works team introduced automated CAD, mapping and design tools to expedite the capital program and improve asset management. The same team worked closely with Hennepin County to develop GIS within the City and County. The Minneapolis Enterprise GIS system was used by every City department; including Assessor, Planning, Police, Fire, Parks, Economic Development, Health and Public Works to improve their operations; and by Minneapolis citizens. Was a MetroGIS founder, which spread GIS data, tools and techniques across metro cities, counties, school districts and watersheds.

University of Minnesota
In 14 years at the University has taught in a civil engineering Master's Degree program at the Technological Leadership Institute (TLI). His classes help civil engineers manage and utilize innovative engineering automation concepts such as GIS, 3D Design, asset management, cloud computing and spatial apps.

Professional Affiliations and Community Involvement
MetroGIS; American Public Works Association (APWA); American Society of Photogrammetry Remote Sensing (ASPRS); Geospatial Information and Technology Association (GITA); International Highway Engineer Exchange Program (HEEP); MNDOT and APWA Conference Planning Committees; Minnesota Expo 2023; 2020 Partners; President Southwest Hockey and Baseball Associations

Education and Professional Certifications
Bachelor of Civil Engineering, University of Minnesota
Registered Professional Engineer Minnesota and California

Thomas J. Eggum, P.E.

Minnesota 2050 (MN2050)
Founding and present member of small volunteer steering team; Helped organize initiative; Prepared and delivered presentations; Supported work with Twin Cities Public Television creating infrastructure investment videos; Currently supporting initiative to survey Minnesota counties and cities on Asset Management practices.

Saint Paul Public Works
As Director of Public Works/City Engineer for Saint Paul, directed the planning, design, construction, operation and maintenance of infrastructure having a replacement value of over $2.5 billion; maintained these facilities with a mix of public and private services that included 500 Public Works employees (430 FTE's), and an annual operating budget of $100 million and an annual capital budget of $40 million. Supported and guided the following initiatives: Combined Sewer Separation Program, Snow Emergency improvements, sanitary sewer rehabilitation, downtown and neighborhood streetscape improvements, traffic calming, and computerized asset management. Established departmental mission and vision statements; reorganized to flatten the management structure; led or assisted with annual budget making processes for twenty-five years as first director of the Saint Paul on the Mississippi Design Center (instituted to promote and guide downtown and riverfront development), led the establishment of its ongoing work scope, organization, budget, and staffing.

Research and Best Practices
National Research Council's Infrastructure Research Agenda committee member; the American Public Works Association/Corps of Engineers Government Mandates Research Project team member; Minnesota Local Road Research Board's Traffic Calming Research Project advisory committee chair; Minnesota Public Works Association /City Engineers Association of Minnesota / League of Minnesota Cities creation of the "City Engineers' Transportation Primer" steering team member. Supported management practices analysis nationally through participation in the American Public Works Association's Management Practices Research & Validation Projects, as an Advisory Committee member, and as a Self-Assessment Clinic instructor; completed a self-assessment in Saint Paul. Conducted management peer review of government agencies for the American Society of Civil Engineers Committee on Peer Review and chaired the committee.

Past Professional & Community Leadership
Public Art Saint Paul board chair; Eureka Recycling, Inc. board chair; American Society of Civil Engineers national board director; Minnesota Section American Society of Civil Engineers president; Minnesota Guidestar Board director; Engineers Society of Saint Paul president.

Education
Bachelor of Civil Engineering, University of Minnesota
Master of Science in Civil Engineering, University of Pittsburgh
Master of Public Works Administration, University of Pittsburgh

MN 2050
Infrastructure planning, long term success

March 26, 2015

Ms.Rebecca Otto
State of Minnesota
Office of theState Auditor
525 Park St., Suite 500
St. Paul, MN 55103

RE: Serendipity Grant 2015: Minnesota Infrastructure Stress Transparency Tool

Dear Ms. Otto:

MN2050 is pleased to support the above referenced project that you are proposing. We will assist with organizing and delivering the project tasks. We will also feed the results of our upcoming (April-June 2015) statewide survey of Minnesota city and county Asset Management practices into the project and expect that the project will in turn support the follow-up work we are planning for the results of our survey.

MN2050 is a volunteer-run partnership of 18 professional societies and agencies with concern about and responsibility for the state's infrastructure. These partners include the Minnesota Chapter of the American Public Works Association (APWA), the American Water Works Association (AWWA), the Minnesota Section of the American Society of Civil Engineers (ASCE), the Minnesota Department of Transportation (MnDOT), and the Metropolitan Airports Commission.

MN2050 was organized in 2009 with the mission of educating Minnesota citizens about the importance of wisely investing in Minnesota infrastructure: roads, bridges, water and sewer facilities, airports, ports and waterways, and freight and passenger rail. Our basic infrastructure is aging and failing at a rate that exceeds maintenance, rehabilitation and replacement. The public

has not yet become aware of the importance of good infrastructure services to the state's economy, quality of life and public safety.

Pipes, pavement, and ports seem to not be of compelling interest as long faucets run, toilets flush, and pavement is halfway smooth on roads and airport runways. Yet as these all age, they increasingly deteriorate and eventually fail, mostly in small local ways -- but this may change. We'd like to keep Minnesota ahead of the failure curve.

Our initiatives include documenting infrastructure replacement needs, creating messages that will persuade the public of the importance of investment, and engaging the membership of our partner groups in getting the message out to the public. We have partnered with Twin Cities Public Television (TPT) to produce a series of videos highlighting the importance of infrastructure. We are supporting the STEM initiatives of TPT and the Minnesota High Technology Association. We are about to undertake a statewide survey of the asset management practices of Minnesota cities and counties, MnDOT, and the Metropolitan Council.

We are enthusiastic about partnering with you on this Serendipity Grant proposal because it will leverage our current efforts beyond our many partners already on-board. Gathering basic needs data from cities and counties and presenting it in understandable maps and graphics will raise public consciousness about the importance of improved stewardship better than almost anything short of catastrophic or widespread infrastructure failure. The output of this project, combined with the results of our asset management survey, will provide Minnesotans and their elected decision makers with collective needs data from all levels of government. We know of no other state which has gathered basic infrastructure information this comprehensively.

This project will expand our public education efforts immensely and significantly beyond what we are capable of doing on our own. We expect that the national offices of our participating partners, (e.g., APWA, ASCE, and AWWA) will be very interested

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in this comprehensive needs gathering project. Both the proposed Principal Investigator Brad Henry, and the Co-principal Investigator Tom Eggum are members of MN2050's steering committee.

Sincerely,

Dan Gage
Chair, MN2050

May 15, 2015

Len Kne
Associate Director, U-Spatial
University of Minnesota
Room 50 Willey Hall
Minneapolis, MN 55455

Dear Mr. Kne,

Congratulations! We have completed the review of the Smart Cities – Serendipity Grant proposals and your proposal was selected for funding. The Smart Cities and Infrastructure Convergence Colloquium generated seven high quality proposals that outlined creative ways to advance transdisciplinary and engaged research at the University of Minnesota.

The selection process was rigorous with each proposal being read by several different reviewers. Yours was viewed by the panel as one of the best submitted. Comments on your proposal from our reviewers are enclosed. Please note the particular recommendation to enhance the research objective component of this proposal. It is recommended by the reviewers that your team explore potential research questions and pursue the engagement of faculty formally or informally in this effort. I would welcome the opportunity to meet with your team and explore potential opportunities and facilitate connections with faculty who might be interested in getting involved.

We are excited about the potential your proposal "Minnesota Smart City/Infrastructure Stress Transparency Tool" has for contributing to the University and the public. We appreciate your effort in drawing on the serendipitous interactions offered by the Colloquium to advance research and engagement objectives.

Your proposal is funded at $20,000 over one year, from May 15, 2015 through May 14, 2016. The funds will be awarded in one lump sum payment. This award is subject to completion of all of the University of Minnesota's requirements for Responsible Conduct of Research. The Office of the Vice President for Research budget officer will transfer your award as soon as possible. You may begin to spend the grant funds as of May 15, 2015. Expenditures must be consistent with the budget that you submitted as part of your proposal.

A progress report and a final report of impact survey are required to be completed by the PI. Guidelines concerning reporting and budget management are enclosed. As the principal investigator for this award, you are responsible for adhering to these guidelines as well as

judicious stewardship of the monies entrusted to you. Please contact your departmental budget officer if you have questions regarding accounting procedures. Other general questions regarding your award may be directed to the Office of the Vice President for Research at facgrant@umn.edu or at (612) 625-7585. Please reference "Serendipity Grant" in the subject line.

Once again, congratulations on an excellent proposal.

Sincerely,

Brian Herman
Vice President for Research

Carissa Slotterback
Director of Research Engagement

Enclosures

cc: Steve Manson, Director, U-Spatial
       Steve Ruggles, Minnesota Population Center
       Anujani Aluwihare, Director of Finance, OVPR
       Julie Parker, Senior Accountant & Cluster Director, OVPR
       Glen Powell, Administrator, Department of Geography
       Lisa Jahr, Accountant, Department of Geography