

# Mobility21

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Carnegie Mellon University



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## Synthesis of Research Results and Technology Trends to Inform Policies for Smart Mobility of People and Goods Phase 2

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June 30, 2020

Final Research Report  
Contract # 69A3551747111

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# **Synthesis of Research Results and Technology Trends to Inform Policies for Smart Mobility of People and Goods Phase 2**

Mobility 21 UTC Project #288 - Final Research Report  
June 30, 2020

## **Project Details:**

Stan Caldwell, PI                    <https://orcid.org/0000-0002-8564-220X>  
Chris Hendrickson, Co-PI       <https://orcid.org/0000-0002-9812-3580>

Period of Performance July 1, 2019 through June 30, 2020

Federal Funding: \$90,000

## **Research Description**

This research project is intended to track disruptive technologies impacting transportation including automated and connected vehicles, big data analytics, shared vehicles, electric vehicles and novel modes of transportation. The researchers follow industry and technology trends, synthesize research results from the full range of CMU and partner research efforts and assess a variety of policy alternatives. The researchers work closely with local, state and federal transportation officials to frame policy issues and provide policy solution to improve the mobility of people and goods. This work is also intended to identify new research opportunities for smart mobility work for faculty throughout this center's academic consortium.

## **Personnel**

The project involves effort by Stan Caldwell and Chris Hendrickson:

- Stan Caldwell is an Adjunct Associate Professor for Transportation and Policy and serves as Executive Director of Carnegie Mellon's [Traffic21 Institute](#) which is housed in the Heinz College and Executive Director of the Mobility21 National University Transportation Center (UTC) which is housed in the College of Engineering. Both Traffic21 and the UTC are co-housed and co-staffed, and Stan manages the day-to-day operations of the two research centers. These centers fund and coordinate faculty from across the University in interdisciplinary transportation research. The research centers maintain a primary focus on deploying transportation research and technology in the community and work with public and private partners to use Pittsburgh, Pennsylvania, and the region as a smart transportation test bed. Through the work of these centers Stan has taken a nationally active role in the emerging intelligent transportation industry and serves on the Leadership Circle of the Intelligent Transportation Society of America and curates the industry recognized Traffic21 Smart Transportation Dispatch. He is a founding member of the Smart Belt Coalition, Pennsylvania Autonomous Vehicle Policy Tasks Force and the Pennsylvania State Transportation Innovation Council. He teaches courses in Intelligent Transportation Systems.

- Chris Hendrickson is the Hamerschlag University Professor Emeritus, Director of the [Traffic 21 Institute](#) at Carnegie Mellon University, member of the National Academy of Engineering, Chair of the National Research Council's Transportation Research Board Division Committee, and Editor-in-Chief of the ASCE Journal of Transportation Engineering Part A (Systems). His research, teaching and consulting are in the general area of engineering planning and management, including design for the environment, system performance, construction project management, finance and computer applications.

### **Expected Impacts**

This project is intended to influence transportation decision making and policies with regard to new technology implementation and the improvement in mobility of people and goods both in Pennsylvania and nationally. Progress is assessed from activities such as meetings, presentations and publications as well as policy changes, technology implementations and new research projects.

### **Matching Funds**

The Traffic21 sponsored Smart Mobility Challenge is a direct complement to this research activity and the Hillman Foundation funding for the challenge can be used as matching funds.

Carnegie Mellon University's [Traffic21 Institute](#) and its affiliated US DOT Mobility21 National University Transportation Center have sponsored a challenge to demonstrate how innovative technology can improve mobility using southwestern Pennsylvania as a test bed.

This challenge is inspired by Traffic21's years of successful collaboration with the City of Pittsburgh to become a globally recognized smart city test bed and the desire to demonstrate how suburban and rural communities can also benefit from innovative transportation.

### **Data Management Plan**

This project does not involve extensive original data resources. The primary data involves text and presentation. These documents will be managed and updated in accordance with overall Mobility21 center data management plan.

### **Problem**

New disruptive technologies such as vehicle automation, connected vehicles, alternative fuels and data analytics are rapidly developing and impacting society in both positive and negative ways. Federal, state, regional and local officials along with community organizations are challenged by a lack of technical capacity and information to assess these disruptive technologies and develop policies to manage these disruptive transportation technologies. Effective public policies have the potential to apply new technology to improve safety and efficiency of transportation systems and these policies can also mitigate unintended consequences of disruptive technology.

### **Approach**

Carnegie Mellon University's Traffic21 Institute and Mobility21 National University Transportation Center have developed a proven model of Research, Development and Deployment through community partnerships. Traffic21 and Mobility21 maintain a Deployment Partner Consortium of over 100 public, private and non-profit members who collaborate with researchers to identify real-world transportation needs.

## Deployment Partner Consortium

- [412 Food Rescue](#)
- [Allegheny General Hospital](#)
- [American Association of Retired Persons](#)
- [American Association of State Highway and Transportation Officials](#)
- [Access Transportation Systems](#)
- [Airport Corridor Transportation Association](#)
- [Alliance for Transportation Working in Communities](#)
- [Architecture, Engineering, Consulting, Operations, and Maintenance](#)
- [ALCO Parking](#)
- [Allegheny Conference on Community Development](#)
- [Allegheny County](#)
- [Allegheny County Airport Authority](#)
- [Allegheny County Office of Children, Youth and Families](#)
- [Allies for Children](#)
- [American Public Transportation Association](#)
- [ARGO AI](#)
- [Association of American Railroads](#)
- [Aurora Innovation](#)
- [Automatic Labs \(a SiriusXM company\)](#)
- [Azuga](#)
- [Babst Calland Law Firm](#)
- [Bentley Systems](#)
- [Bike Pittsburgh](#)
- [Bombardier](#)
- [Booz Allen Hamilton](#)
- [Bosch Research and Technology Center, North America](#)
- [The Breathe Project](#)
- [Carnegie Mellon University Campus Development and Facilities Design Department](#)
- [Carnegie Mellon University Center for Air Particle Studies](#)
- [Caterpillar](#)
- [Children's Hospital of Philadelphia](#)
- [Cisco](#)
- [CITA – International Motor Vehicle Inspection Committee](#)
- [City of Philadelphia](#)
- [City of Pittsburgh](#)
- [City of Seattle](#)
- [Comcast](#)
- [Community College of Allegheny County](#)
- [Conference of Minority Transportation Officials](#)
- [Cranberry Township](#)
- [Crown Castle](#)
- [Dalian University of Technology](#)
- [Delaware River Port Authority](#)
- [Delaware Valley Regional Planning Commission](#)
- [Borough of Dormont](#)
- [Economic Development South](#)
- [Ericsson](#)
- [Federal Highway Administration](#)
- [Ford Motor Company](#)
- [Freedom Transit](#)
- [GAI Consultants](#)
- [General Motors Global Research & Development](#)
- [Healthy Ride](#)
- [Hulton Arbors](#)
- [Hillman Family Foundations](#)
- [Imperial College in London](#)
- [iNetworks Advisors](#)
- [Indiana University](#)
- [Innovation Works](#)
- [Intel](#)
- [Intelligent Transportation Society of America](#)
- [Jackson/Clark Partners](#)
- [JITSIK](#)
- [Lawrence County](#)
- [League of American Bicyclists](#)
- [Marshall Township](#)
- [Masite](#)
- [Meter Feeder](#)
- [Mid-Ohio Regional Planning Commission](#)
- [Mileage-Based User Fee Alliance](#)
- [Miovision](#)
- [Near Earth Autonomy](#)

- [North Huntingdon Township](#)
- [Northrop Grumman Corporation](#)
- [Oakland Transportation Management Association](#)
- [OSHER](#)
- [PathVu](#)
- [Partner4Work](#)
- [Peloton Technologies](#)
- [PennDOT](#)
- [Pennsylvania Motor Truck Association \(PMTA\)](#)
- [Pennsylvania Rural Robotics Initiative](#)
- [Pennsylvania Turnpike](#)
- [Philadelphia Port Authority](#)
- [Pi-Lit](#)
- [PITT OHIO](#)
- [Pittsburgh Community Reinvestment Group](#)
- [Pittsburgh Downtown Partnership](#)
- [Pittsburgh Parking Authority](#)
- [Pittsburgh Technology Council](#)
- [Port Authority of Allegheny County](#)
- [Port of Pittsburgh Commission](#)
- [PPG Industries Inc.](#)
- [Precision Neuroscopics LLC](#)
- [Propel IT, Inc.](#)
- [Quaker Valley Council of Governments](#)
- [Rapid Flow Technologies](#)
- [Regional Industrial Development Corporation](#)
- [Richard King Mellon Foundation](#)
- [Roadbotics](#)
- [RobotWits](#)
- [SORTERIA Moonshot Program at CMU](#)
- [Southeastern Pennsylvania Transportation Authority](#)
- [Southwestern Pennsylvania Commission](#)
- [Sustainable Pittsburgh](#)
- [TJKP Corporation](#)
- [The Heinz Endowments](#)
- [The Ohio State University](#)
- [Tiramisu Transit Inc](#)
- [Toyota](#)
- [Tsinghua University](#)
- [Uber](#)
- [University of Pittsburgh](#)
- [University of Pittsburgh Medical Center](#)
- [Uptown Partners](#)
- [Venium](#)
- [Wade Trim](#)
- [Western Pennsylvania Regional Data Center](#)
- [Western Pennsylvania School for Blind Children](#)
- [Women's Transportation Seminar](#)
- [Zensors](#)

Over the past ten years Traffic21 has developed a reputation as an objective third-party advisor to government agencies and community organizations for technology and policy issues related to new developments and trends in transportation. Traffic21 also funds and manages cutting edge research in new transportation technology and interfaces with corporate partners to transfer that technology through pilot deployments and commercialization.

This positioned Traffic21 well to synthesize research results and technology trends to inform policies for smart mobility of people and goods. As Director of Traffic21, Chris Hendrickson, and Executive Director of Traffic21, Stan Caldwell the approach of the researchers in this project was to leverage Traffic21 model and partnerships to advance this synthesis research.

## **Methodology**

The research work for this project was conducted through a variety of activities highlighted below. Under each category are specific outputs by the researchers:

- Meetings with civic and business leaders and government policy makers to discuss transportation challenges and advise on applicable smart mobility policies. These meetings include southwestern Pennsylvania, state, regional, national and international corporate and civic leaders and policy makers.
- Presentations and publications providing policy analyses of smart mobility alternatives, such as connected and automated vehicle policies or multi-modal operational policies.
- Active participation in policy-making groups such as the Pennsylvania Autonomous Vehicle Task Force, Smart Belt Coalition, and the Oakland Transportation Management Association.
- Interaction with researchers at Carnegie Mellon and elsewhere to identify new opportunities for research and transportation policy improvement. Included in this activity is participation in national organization such as Transportation Research Board Executive Committee and the Leadership Circle of the Intelligent Transportation Society of America.
- Research national and international disruptive transportation technology trends and associated policies. Synthesize and disseminate this information through the Traffic21/UTC blog, social media and industry recognized Smart Transportation Dispatch weekly email newsletter.

To enable the synthesis of technology trends related to improving mobility, Stan Caldwell curates an industry recognized blog and weekly email newsletter. The Smart Transportation Dispatch is a weekly synopsis of Caldwell's research on mobility technology and research trends. Key articles along with insightful excerpts are posted on a blog and a weekly email newsletter is sent to the over 3,600 subscribers. During the 12 months of this research project, over 1,075 news articles were researched, synthesized blogged and shared in social media with over 1,000 twitter followers.

## Research Outputs

Below are listed specific activities of researchers Chris Hendrickson and Stan Caldwell related to this research project. Activities include research presentation and meetings with government, community and corporate partners where synthesized policy research was transferred.

June 25, 2020

Stan Caldwell, Mobility21 Executive Director, participated in the Southwestern Pennsylvania Commission Transportation and Operations Forum and discussed the importance of workforce training for intelligent transportation systems workers through community colleges and universities.

June 9, 2020

Stan Caldwell participated in the quarterly meeting of the Keystone Transportation Funding Coalition ([KTFC](#)) to engage with Pennsylvania transportation policy stakeholders. Traffic21 students are conducting research on past and future transportation funding alternatives.

June 9 & 10, 2020

Held earlier this week, the Annual [Council of University Transportation Center](#)'s summer meeting brings together the nation's leading transportation professionals from academia along with U.S. DOT and other transportation agency officials. Raj Rajkumar, Director, Stan Caldwell, Executive Director and Lisa Kay Schweyer, Program Manager of Mobility21 participated in the two day conference.

June 10, 2020

Stan Caldwell participated in the quarterly meeting of the Smart Belt Coalition. The coalition includes universities and state transportation agencies in Michigan, Ohio and Pennsylvania to further develop a multi-state connected and automated vehicle real-world testing environment. Stan is a founding member of the coalition.

June 4, 2020

Mobility21 Executive Director Stan Caldwell was a featured panelist for the ITS America Webinar, "*Technology and the post COVID-19 Transportation Roadmap.*" The session explored the changes that may be seen with transportation after COVID-19, as well how to build the transportation system in the 21st century. View the full webinar [here](#).

June 3, 2020

Stan Caldwell, founding member of the [Pennsylvania Autonomous Vehicle Policy Task Force](#), attended the quarterly meeting of the task force where current AV activity in the state was discussed with public and private partners.

May 21, 2020

Featured in the CMU news article "*COVID and Transportation: What's Next for the Summer and Beyond*" are Mobility21 UTC Executive Director Stan Caldwell and UTC Researcher Sean Qian. In this article, they share their thoughts on the impacts COVID-19 could have on both travel for the upcoming summer and on long-term public transportation. Read the full story [here](#)...

May 20, 2020

Mobility21 Executive Director Stan Caldwell was invited by [Benjamin Schmidt](#), President of [Roadbotics](#) (a UTC spinoff company) to present as part of Roadbotics web discussion on lessons learned through the COVID-19 pandemic about the need for more resilient transportation organizations and cities. Watch the full web discussion [here](#).

May 19, 2020

Mobility21 [Executive Director Stan Caldwell](#) participated in the Port Authority of Allegheny County's NEXTransit Advisory Group Meeting. "The goal of the NEXTransit Advisory Group is to create a [long-term] plan for an improved transit system that will attract more riders, enhance mobility, and support community development and redevelopment initiatives throughout Allegheny County."

May 14, 2020

Mobility21 Executive Director Stan Caldwell presented the Mobility21 UTC project "*Changing Hunger: CMU Works with 412 Food Rescue and Allies for Children to Deliver School Lunches to Children due to COVID-19*" during today's Research, Education, and Training Reauthorization Coalition (RETRC) virtual spotlight for Congressional Offices and Transportation Stakeholders.

There were 85 registrants for the webinar, including 15 from Department of Transportation, 25 from congress, and 40 transportation stakeholders. Also presenting as part of the webinar were several other university representatives discussing how they are monitoring the impacts of COVID-19, working with health care and policymakers to address COVID-19's effects, and helping public transportation agencies to address the challenges of the pandemic now and in the future.



[RETRC](#) advocates for and advances university transportation research. RETRC is composed of 22 universities, which work with over 100 different universities spread across 42 states making it a truly national organization.

View Stan's presentation at 57:00 [here](#)...

May 11, 2020

Mobility21 Executive Director Stan Caldwell moderated the presentation for the [Association for Pennsylvania Municipal Management](#) (APMM) titled *“Ready or Not, Here it Comes: How Disruptive Technologies coming out of the Pittsburgh region will impact our communities and what local governments can do to prepare for and utilize these innovations to deliver more efficient and smarter services to its residents.”*

Also on the panel were Greg Barlow, CTO/Founder of [Rapid Flow Technologies](#) (a *Traffic21/Mobility21 spin-out company*); Tom Musgrove, Government Affairs Manager for [Crown Castle](#); Stew Frick, Partner Success Lead for [Robotics](#) (a *Traffic21/Mobility21 spin-out company*); and Aaron Bibro, Manager of [Hatfield Township](#).

May 5, 2020

Co-authors Chris Hendrickson, Director of Traffic21 and Laurence Rilett, Director of the Nebraska Transportation Center and the [Mid-America Transportation Center](#) are both US DOT University Transportation Center funded faculty. Their article “The Covid-19 Pandemic and Transportation Engineering” will appear in the July edition of the [Journal of Transportation Engineering, Part A: Systems](#). You can visit the [Journal of Transportation Engineering, Part A: Systems](#) in July to see the published version. Or you can click [here](#) for a link to the original manuscript.

March 25, 2020

Mobility21 Researchers Sean Qian and Stan Caldwell joined University of Pittsburgh Professor Alexandros Labrinidis on an Intelligent Transportation Systems panel for a joint Carnegie Mellon/University of Pittsburgh “Smart City and Technology” undergraduate mini-course. The class is typically held on Saturdays, but the panelists recorded their session to comply with social distancing.

March 25, 2020

Stan Caldwell participated in the Quarterly Meeting of the Smart Belt Coalition. The Smart Belt is multi-state connected and automated vehicle test bed including the Michigan, Ohio and Pennsylvania Departments of Transportation, Pennsylvania and Ohio Turnpike Commissions, Carnegie Mellon University, the Pennsylvania State University, Kettering University, the University of Michigan, the Ohio State University, the American Center for Mobility and the Transportation Research Center Inc.

March 24, 2020

CMU Professor [Vivian Loftness](#) in the School of Architecture, and professor [Chris Hendrickson](#) in the CMU Civil and Environmental Engineering department and Director of Traffic21, have been appointed to [The National Academies Committee for Accelerating Decarbonization in the United States: Technology, Policy and Societal Dimensions](#). The two-year committee is focused on the technologies and policies needed today for full decarbonization by 2050.



March 12, 2020

Traffic21 hosted a roundtable discussion with Lorraine M. Martin, President and CEO, The National Safety Council. Traffic21 faculty and deployment partners joined in a discussion of transportation safety issues in the workplace and potential research collaboration. NSC recently launched [A Road to Zero: A vision for achieving zero roadway deaths by 2050](#), a research report completed with a variety of non-profit and private sector partners.



February 26, 2020

Stan Caldwell presented an overview of the Mobility21 UTC and the Metro21: Smart Cities Institute to a visiting Japanese delegation from the Robot Revolution & Industrial IoT Initiative (RRI). The RRI is an organization that rebuilds the Japanese manufacturing industry in order to respond to the Fourth Industrial Revolution and Society 5.0 in cooperation with the industry and government.

February 25, 2020

Mobility21 Executive Director Stan Caldwell and UTC researcher Aaron Steinfeld were tapped by CMU alum Haley Townsend (now working as a consultant) to provide insights into artificial intelligence (AI) for the USDOT ITS Joint Program Office as they work to identify practical real-world scenarios where AI offers the potential to address transportation needs. Aaron Steinfeld shared information about his work in artificial intelligence for accessibility and mobility. Stan Caldwell provided information about how to engage local partners in AI initiatives.

February 21, 2020

Traffic21 Director Chris Hendrickson met with CMU students working on a Environmental Engineering Sustainability project. The students are developing a migration plan for a Zero-Emission Bus System in the Mid-Atlantic Region. Chris provided technical support and copies of the policy document he previously helped create, called *Which Alternative Fuel Technology is Best for Transit Buses?*

February 20, 2020

The Carnegie Mellon University Heinz School Politics and Policy Club hosted a civic forum discussion with PA Congressman Mike Doyle. Congressman Doyle serves on the [House Energy and Commerce Committee](#), which is one of only four exclusive committees in the House. There he sits on the subcommittees on [Communications and Technology](#) and [Energy](#) – and chairs the [Subcommittee on Communications and Technology](#). Mobility21 Executive Director, Stan Caldwell and Traffic21 Director, Chris Hendrickson participated in the session. During the session, Stan asked the Congressman about FCC’s notice of proposed rulemaking on the 5.9 GHz band currently reserved for transportation safety and vehicle communications.

February 19, 2020

Senator Camera Bartolotta, state senator for Beaver, Washington, and Greene counties in PA and a member of the Senate's Transportation Committee, visited CMU today to learn more about Mobility21 UTC research in action. Mobility21 Executive Director Stan Caldwell and UTC researcher Christoph Mertz provided the senator a tour of NavLab.

February 12, 2020

Mobility21 UTC Executive Director Stan Caldwell provided a keynote speech "*Smart Pavement / Smart Cities*" at the 53rd Annual Meeting of the Mid-Atlantic Quality Assurance Workshop. The Mid-Atlantic Quality Assurance Workshop is a three day annual event that has been held each year since 1967 and is dedicated to highway materials and quality control/assurance of highway materials. Delaware, Maryland, New Jersey, Pennsylvania, Virginia, West Virginia and the District of Columbia make up the Mid-Atlantic QAW area.

February 11, 2020

Mobility21's Rick Grahn, Stan Caldwell and Chris Hendrickson published a new policy report entitled "*Recommended Policies for the 21st Century Trends in US Mobility*." The report analyzes the 2017 National Household Travel Survey which captured impacts of emerging technologies on the transportation system to learn about users of such technologies and shifting travel behaviors resulting from technology adoption. Read the full report and review the team's policy recommendations here: [21st Century Trends in US Mobility](#).



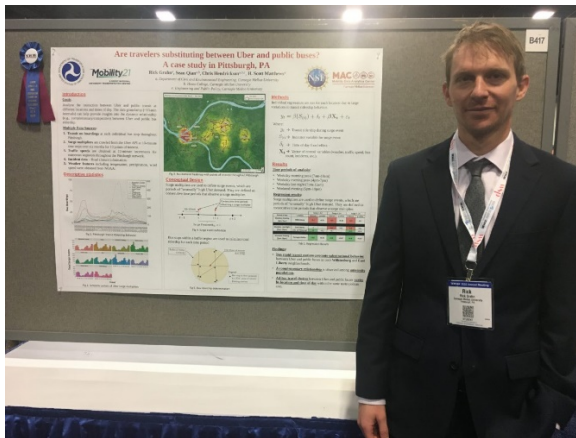
January 24, 2020

The first Smart Mobility Connection session of spring semester was held today featuring Mobility21 Executive Director, Stan Caldwell and CMU PhD student, Rick Grahn. They provided an overview and took questions about the project, *Research Results and Technology Trends to Inform Policies for Smart Mobility of People and Goods*. Everyone in attendance was also provided with a hard copy of the "*Recommended Policies for the 21st Century Trends in US Mobility*" policy guide. [Watch the full SMC video here](#).



January 14, 2020

As part of the U.S. Department of Transportation booth at the 2020 Transportation Research Board’s Annual Meeting, Mobility21 Executive Director Stan Caldwell, Program Manager, Lisa Kay Schweyer and Postdoctoral Research Associate Wei Ma staffed an demo and talked with attendees about the Mobility 21 research project “*Data-driven real-time traffic prediction and management.*”



January 16, 2020

Rick Grahn, a PhD student in the Civil and Environmental Engineering Department at Carnegie Mellon University displayed his poster on “*Are travelers substituting between Uber and public buses? A case study in Pittsburgh, PA*” at the TRB Annual Meeting this week. The poster won “Best in Session.” The poster session was a part of the ‘Standing Committee on Public Transportation Planning and Development’.



January 12, 2020

The American Road and Transportation Builders Association has selected Traffic21 Institute Director Chris Hendrickson, to receive the Research and Education Division's prestigious **S.S. Steinberg Award**. This award honors educators at an institution of higher learning for contributions to research and education in transportation, development or construction.

January 11, 2020

Last night at the Council of University Transportation Centers (CUTC) awards banquet at the Transportation Research Board Annual Meeting, Traffic21 Director Chris Hendrickson was presented with the prestigious **CUTC- HNTB Lifetime Achievement Award for Transportation Education and Research**. *"This award honors individuals who have had a long history of significant and outstanding contributions to university transportation education and research resulting in a lasting contribution to transportation."*

January 7, 2020

As part of the U.S. Department of Transportation booth at the 2020 Consumer Electronics Show, Mobility21 Executive Director Stan Caldwell and Postdoctoral Research Associate Wei Ma staffed a demo and talked with attendees about the Mobility 21 research project "Data-driven real-time traffic prediction and management."

December 20, 2019

Stan Caldwell, Executive Director of the Mobility21 UTC serves on the Public Stakeholder Group for Pittsburgh's Mobility Collaborative. As part of his role on the committee he provides guidance for crafting policy for the new micromobility technologies in the context of deploying new services in the City of Pittsburgh (*in a manner that augments existing resources such as transit and bikesharing while providing services for traditionally underserved populations*).





December 11, 2019

Mobility21 UTC Executive Director & Researcher, Stan Caldwell and UTC Researcher Don Carter, served as panelists at the Transportation Engineering and Safety Conference in State College, PA today. Speaking about *Transportation in Smart City Ecosystems*, their presentations included how transportation threads into the Smart City Ecosystems including energy, building systems, and telecommunication.

December 10, 2019

Traffic21 Director, Chris Hendrickson, is in California to participate in the Transportation Research Board's Research and Technology Coordinating Committee. *"The committee will monitor and review FHWA's research and technology activities and advise FHWA on (a) research agenda setting and coordination of highway research with states, universities, and other partners, (b) strategies to accelerate the deployment and adoption of innovation, and (c) potential areas where research is needed. The committee will hold at least two meetings annually and report via letter report annually, as requested by FHWA."*



December 4, 2019

Today, Traffic21 Director Chris Hendrickson participated as part of the transportation panel at the National Lieutenant Governors' Association in Kansas City. Dr. Hendrickson spoke about the Transportation Research Board's Future Interstate Study (he was one of fourteen committee members who helped develop this report).

November 21, 2019

Mobility21 UTC Director, Raj Rajkumar and Executive Director, Stan Caldwell, participated in today's "*Autonomous Vehicle Technology in PA Roundtable.*" The roundtable included a discussion of the economic development impact of AVs and included industry leaders, state department of transportation officials, representatives of the Pittsburgh Regional Alliance, Allegheny County and the city of Pittsburgh.

November 21, 2019

The Travelers Institute, the public policy division of The Travelers Companies, Inc., hosted a symposium today at Carnegie Mellon University. The program, "*Transforming the Driving Experience: Automated Vehicle Technologies and Human Attention,*" brought together experts to address the safety, regulatory and insurance implications of advanced technologies that are on the road today. Traffic21 Director, Chris Hendrickson and Mobility21 UTC Researcher Costa Samaras spoke as part of the event.

November 11, 2019

Traffic21 Director, Chris Hendrickson traveled to Washington DC to participate in the National Research Council Governing Board Meeting. Hendrickson, attended the meeting on behalf of the Transportation Research Board Division.



November 7-8, 2019

The Traffic21 Institute celebrated its **10-Year Anniversary** with a two-day Symposium at Carnegie Mellon University. The symposium brought together expert panelists, keynote speakers and participants from industry, academia and government to discuss emerging transportation technology and deployment. [Read the full recap >>>](#)





November 1, 2019

Mobility21 UTC Executive Director, Stan Caldwell, participated in the Girls of Steel Robotics Program at the CMU Robotics Institute. Caldwell worked with young women grades 4 to 8 who are interested in learning how to improve public transportation. Their project is a part of the FIRST LEGO League City Shaper challenge.

November 1, 2019

Roads Australia visited North America, including visits to the Mobility21 UTC at Carnegie Mellon University, Washington, Detroit and San Francisco to explore the future of transportation in smart cities. Stan Caldwell presented his research to this group on their visit. Based on their findings from their tour, they published a report of their findings – [Read the full report here.](#)

November 7, 2019

A talented group of national leaders attended the Carnegie Mellon University [Traffic21 Institute](#) and [Mobility21 National University Transportation Center](#) (UTC) Advisory Council meeting, held on CMU's campus today.



Mobility21 UTC Director, Raj Rajkumar and Traffic21 Director, Chris Hendrickson welcomed the group, and provided an overview of update of activities and plans at the centers. The day continued with a discussion on technology transfer and plans for the upcoming National UTC Mobility Summit scheduled to be held in Washington, DC on April 2, 2020.

Throughout the meeting Advisory Council members shared their expertise and ideas on workforce demand, technology trends, research needs, and new funding opportunities to advance the missions of Traffic21 and Mobility21.

The Mobility21 team is a tight collaboration among Carnegie Mellon University (Lead), the University of Pennsylvania, the Ohio State University and the Community College of Allegheny County, and brings to bear the reach and scale of all four institutions.

Tackling the multi-faceted nature of Traffic21 and Mobility21 objectives requires coordinated research, education, workforce development and technology transfer.

The distinguished Advisory Council of national leaders provides strategic guidance and counsel. Advisory Council members include:

- Raymond T. Betler, former President and CEO of Wabtec Corporation
- Rebecca M. Brewster, President and Chief Operating Officer of the American Transportation Research Institute
- Robin Chase, Co-founder Zipcar, Veniam, NUMo
- Ty Gourley, Vice President of the Hillman Family Foundations
- Charles L. Hammel III, President and owner, PITT OHIO Express
- Ashley Hand, Co-founder CityFi; formerly Transportation Technology Strategist Fellow for Los Angeles
- Katharine Kelleman, Chief Executive Officer at Port Authority of Allegheny County
- Jane Lappin, Director, Public Policy & Government Affairs, Toyota Research Institute
- Ken McLeod, Policy Director at The League of American Bicyclist
- James A. Misener, Senior Director, Technical Standards at Qualcomm
- Leslie Richards, Secretary of the Pennsylvania Department of Transportation
- David Roger, President of the Hillman Family Foundations
- Paul Skoutelas, President and Chief Executive Officer of The American Public Transportation Association
- Kirk Steudle, Senior Vice President of the Econolite Transportation Systems Group and subsidiary CAVita, and former Director of Michigan Department of Transportation

Learn more about the Advisory Council members [here](#).

The next in person meeting of the Advisory Council will be in November 2020.



November 1, 2019

Mobility21 Executive Director, Stan Caldwell, presented on a panel at the 14<sup>th</sup> Meeting of the American College of Business Court Judges in Pittsburgh. The panel was titled “*The Law, Economics, and Ethics of Artificial Intelligence in Driverless Cars and Other Advanced Technologies.*”



October 16, 2019

Mobility21 Executive Director Stan Caldwell met with a group of 6 Indonesian professionals working with issues relating to improving cities and regional economies. They are participating in a project entitled, “*Good Governance through Technology.*” They have been invited to the U.S. under the Department of State’s International Visitor Leadership Program for a 21-day project. Pittsburgh was the second city on their trip, the group will also visit Columbus, Denver and DC. The themes for the Pittsburgh segment of the program were: *Using technology to improve services and quality of life*; and *University and research partners in smart city development.*

October 4, 2019

In collaboration with Pittsburgh Region Clean Cities, the Mobility21 UTC academic partner, Community College of Allegheny County hosted Odyssey Day on Friday, October 4. This event is dedicated to promoting the use of alternative fuel and advanced technology vehicles and is designed to educate fleet managers, municipalities, school districts and others about cleaner transportation technologies and the important role they play in providing solutions to growing energy and environmental issues. Read the Full Press Release: [CCAC Press Release — Odyssey Day 2019](#). Watch the video [here](#).



September 22, 2019

The Federal Highway Administration established the Center for Accelerating Innovation to serve as the focal point for internal and external coordination for identifying and prioritizing innovations. The team held their Center of Accelerated Innovation Meeting in Pittsburgh on September 18, focusing on Pittsburgh's innovation. Stan Caldwell hosted a tour the National Robotics Engineering Center to learn more about transportation technology and initiatives being led at CMU.

September 15, 2019

Mobility21 Executive Director, Stan Caldwell, presented background information on Traffic21 and the Mobility21 University Transportation Center research to the the National Association of College and University Business Officers who are attending the 2019 Budget and Planning conference in Pittsburgh.

September 11, 2019

Traffic21 Director, Chris Hendrickson attended Public Works Expo in Seattle where he was a featured speaker, presenting his research entitled “*Past and Future of the US Interstate Highway System.*” The PWX Expo draws thousands of public works professionals from all over the world.

September 1, 2019

Mobility21 UTC Researcher, Sean Qian, is leading an interdisciplinary team from Carnegie Mellon University as they attempt to address rural transportation in Southwestern Pennsylvania’s Greene County. The team includes Traffic21 Director, Chris Hendrickson, UTC Researcher, Costa Samaras and Metro21: Smart Cities Institute Director Karen Lightman.

Working in collaboration with Greene County and Waynesburg University, the team from Carnegie Mellon University will test an innovative rural county mobility platform, with the ultimate goal that it can be replicated in other rural counties.

Sean Qian says this project has “the potential to advance the fundamental knowledge of how energy-efficient, affordable mobility services can work in rural America.”

August 28, 2019

Mobility21 UTC researchers Sean Qian and Stan Caldwell visited Butler County to meet with Commissioners Leslie Osche, Kim Geyer and county transportation officials to discuss transportation research and technology and explore potential collaboration.

August 11-15, 2019

Traffic21 Director, Chris Hendrickson, presented his talk: *Renewing the National Commitment to the Interstate Highway System: A Foundation for the Future* at the meeting of the AASHTO Committee on Construction in Franklin, Tennessee.

August 8, 2019

Port Authority of Allegheny County was one of the recent recipients of [Driving PA Forward](#) funding. With this \$1,104,00 award, Port Authority will purchase two battery electric buses and charging stations. Helping make the case for battery electric buses the Traffic21 study, *Which Alternative Fuel Technology is Best for Transit Buses?* was included in the grant application package.





July 31, 2019

Brent Vernon, Director of The Governor's Action Team, Department of Community and Economic Development, Commonwealth of Pennsylvania, visited Carnegie Mellon to learn more about Carnegie Mellon's perspective on the evolution of the autonomous vehicle industry in Pittsburgh. During Vernon's visit he met with Raj Rajkumar, Director of Mobility21, and Stan Caldwell, Executive Director of Mobility21.



July 26, 2019

Students advised by Chris Hendrickson, Director of Traffic21 and UTC Faculty, were featured in a poster session that highlighted the work the students have been doing on the Forbes Avenue reconfiguration. Their research included topics like air quality, bus ridership, speed and multi-vehicle detection.

July 24, 2019

Roads Australia, a delegation of Australian industry and government leaders traveled all the way to North America from 22 July – 2 August 2019 to explore *Future Transport: Smart Cities*. Their visit was designed to deepen their understanding of the progress, challenges and emerging trends in *Regulatory and Technological Innovation* around future transport and smart cities – more specifically, to learn about the latest strategies and solutions and how they might apply them in an Australian context.

One of their first stops in North America was Pittsburgh for a visit to Carnegie Mellon University to Meet with Mobility21. The Australian team was interested in meeting with key participants in the future of transportation, and Mobility21 was able to provide the delegation firsthand information on the types of research, partnerships and entrepreneurship that is happening in Pittsburgh through Mobility21 to enhance the future of transportation and mobility.

The delegation met with Stan Caldwell, Executive Director, Mobility21; Aaron Steinfeld; Associate Professor and UTC researcher, Carnegie Mellon University and Griffin Shultz, CEO of a Mobility21 spin-off, Rapid Flow Technologies.

Roads Australia was eager to learn more about the beneficial partnerships created through Mobility21, the variety of research projects supported by Mobility21 and how the City of Pittsburgh is working collaboratively – not competitively – to build a city focused on mobility and innovation for all.

July 17, 2019

Mobility21 Executive Director, Stan Caldwell, is a member of the [State Transportation Innovation Council](#) (STIC). The STIC meets three times each year in Harrisburg so members can provide feedback on innovations in development, approve Innovation Development Summaries and Deployment Plans, and receive updates on STIC activities, including communication and outreach efforts.

July 2019

Chris Hendrickson, Director of CMU's Traffic21 Institute and Larry Rilett, Professor of Civil Engineering, at the Univ. of Nebraska share their know-how with other researchers in the article "*What Papers Does the Journal of Transportation Engineering Want?*" Read the article here: [Journal of Transportation Engineering, Part A: Systems / Volume 145 Issue 9 – September 2019](#).

## Media Citations for Caldwell and Hendrickson

### **What will summer vacation be like in the midst of the coronavirus pandemic?**

*May 28, 2020 The Washington Post*

Stan Caldwell, a traffic researcher and chief of Carnegie Mellon University's Traffic21 Institute, said most Americans are likely staying at or near home this weekend and in the months ahead, noting that airplanes, trains and buses are operating well below normal levels following a plunge in demand early in the spring.

Revamping travel in those modes may be challenging because it is dependent on Americans regaining confidence in their safety.

Those who travel this summer will mostly do it by car and to regional destinations, experts say. Emptier roads and low fuel prices combined with cabin fever brought on by extended stay-at-home orders will probably drive regional and local leisure trips...

"Vehicle travel will be the travel of choice for summer vacation and starting this weekend," Caldwell said. "My prediction is that there will be more regional travel by vehicle, but less overall travel in general."

[More>>>](#)

### **Ridership down, cleaning costs up, Port Authority navigates financial hurdles of COVID-19**

*May 27, 2020 Public Source*

Diminished ridership numbers make the argument for reducing or eliminating fares in the long term and instead increasing public funding, according to Stan Caldwell, executive director of Carnegie Mellon University's Traffic21 institute. Caldwell said he believes that ridership will initially remain low even when the virus calms because many will choose other transportation options out of concern for their health.

"The natural reaction would be to either increase the cost or decrease the service," Caldwell said. "And by doing those, you're going to go back to the shrinking system that we had years ago where then that was creating a downward spiral where you're making transit less attractive to people to use."

Caldwell posits that transit agencies like the Port Authority should still seek state and federal funding but that transit agencies thrive whenever there is significant local funding, through mechanisms such as a sales tax. According to the Port Authority's most recent budget, the state provided about \$242 million in their 2019 fiscal year and the agency anticipated \$275 million in state funding for 2020. Caldwell noted that public transit in Salt Lake City has found success with local sales taxes, which funds about 69% of its operations.

[More>>>](#)



## Smart Belt Coalition issues RFI for truck automation

*March 3, 2020 The Highland County Press*

The Smart Belt Coalition (SBC), a tri-state collaboration between transportation agencies and educational institutions in Michigan, Ohio and Pennsylvania, is issuing a Request for Information (RFI) for information and a demonstration of “Truck Automation and Platooning” technology.

The SBC is looking for potential partners who are interested in deploying truck automation and platooning pilots through the three states on roadways operated by the five transportation agencies. While the focus of this RFI is on automated driving technologies, respondents are encouraged to respond on the potential operation and demonstration of other advanced driving technologies.

SBC members include:

- Pennsylvania Department of Transportation;
- Pennsylvania Turnpike Commission;
- Ohio Department of Transportation, through DriveOhio;
- Ohio Turnpike and Infrastructure Commission;
- Michigan Department of Transportation;
- Carnegie Mellon University;
- Pennsylvania State University;
- The Ohio State University;
- Transportation Research Center, Inc.;
- American Center for Mobility;
- Kettering University; and
- University of Michigan.

[More>>](#)

## How hyperloop could stand apart from existing transit modes

*February 17, 2020 Smart City Dive*

Stan Caldwell, executive director of Carnegie Mellon University’s Traffic21 Institute, said hyperloop could end up being an alternative to inter-city air travel, similar to the traditional rail system. That would be further helped by hyperloop stops closer to downtown than most airports, which are typically outside of downtown.

Hyperloop won’t necessarily replace existing modes of transportation though, according to Thea Walsh, director of transportation and infrastructure development at the Mid-Ohio Regional Planning Commission. The intention is to be more holistic, she said during a panel discussion on the technology at the Transportation Research Board’s (TRB) annual meeting in Washington, DC last month.

[More>>](#)

## Surtrac allows traffic to move at the speed of technology

*October 30, 2019 Tech Xplore*

Artificial intelligence is giving more Pittsburgh drivers the green light.

Developing and deploying the technology to keep the traffic flowing took a team of researchers and roboticists from Carnegie Mellon University together with the help of city engineers and funding from foundations.

It all started because Henry Hillman, the late Pittsburgh business leader and philanthropist, was frustrated with traffic signals that wouldn't turn despite a lack of traffic. In 2009, he reached out to then-CMU president Jerry L. Cohon, to promote the idea that Pittsburgh could be used as a test bed for transportation systems. Not only could it help make traffic move more smoothly, but technology could be developed and spun off, thereby creating more jobs in Pittsburgh.

Their conversation became the impetus for CMU's Traffic21 Institute, a multidisciplinary research institute with the goal to design, test, deploy and evaluate information and communications-technology-based solutions to address transportation problems. The center is directed from CMU's Heinz College of Information Systems and Public Policy.

"We don't have a transportation department, but we looked around and identified that there were faculty doing work across the university in transportation," said Stan Caldwell, executive director of CMU's Traffic21 Institute.

[More>>](#)

## In the Mon Valley, public transit limitations are felt by residents who've left

### Pittsburgh's core

*October 2, 2019 Public Source*

As Pittsburghers move to the Monongahela River Valley for affordable rents, transit activists describe the need for more robust options to help them stay connected to neighbors and services in their old communities...

One fix for an hourlong bus ride would be adding or extending bus lines to provide more options. But this can be costly and cumbersome.

"Cities like Pittsburgh traditionally have more transit access in the denser urban core and in the more dense urban neighborhoods," said Stan Caldwell, executive director of Carnegie Mellon's Traffic21 institute.

Public transportation works most efficiently in highly populated areas, according to Caldwell. As cities gentrify, he said, residents move from the urban core and start to lose access to the traditional transit systems from their old neighborhoods. "[I]t's difficult because people are more dispersed and you don't have a density to get the effectiveness of transit," Caldwell said.

[More>>](#)

## **Driverless cars could spell the end for downtown parking – and cities need to plan ahead**

*October 2, 2019 City Metric*

Imagine a scene from the near-future: You get dropped off downtown by a driverless car. You slam the door and head into your office or appointment. But then where does the autonomous vehicle go?

It's a question that cities would be wise to consider now. Self-driving cars may be on the roads within the next decade or two.

Automakers and specialized startups alike are aggressively developing automated vehicles (AVs), while government agencies explore ways to reduce regulatory barriers. Ride-hailing companies such as Lyft and Uber plan to operate some AVs, but others could become private robotaxis that drop owners off wherever they like and pick them up later.

Without policies to encourage sharing, it's possible there could be many private AVs on the road. We are civil and environmental engineers who collaborated with Chris Hendrickson, director of Carnegie Mellon's Traffic21 Institute, to examine the potential effects of private AVs on cities.

[More>>](#)

## **Autonomous Vehicles Are Reshaping The Tech World**

*September 9, 2019 Semiconductor Engineering*

“Automakers are finding out this is too big a job for any one company, so they're finding ways to pay for development and propagate this technology into the market gradually to help pay for the rest,” said Roger Lanctot, director of the automotive connected mobility practice at Strategy Analytics. “None of them can solve all the problems on their own.”

Some of these partnerships are in place simply to reduce cost or as a response to a short-term shortage of something very specific, according to Stan Caldwell, executive director of the Transportation Center for Safety, Traffic21 and Mobility21—U.S. Dept. of Transportation-affiliated research institutes focused on transportation safety.

Today, nearly all the major automotive OEMs have close alliances with at least one other car company, often to share the cost of the AV platform or the effort of developing an artificial intelligence (AI) pilot for the new, connected cars. The mesh of automotive partnerships helps spread costs over a wider area.

[More>>](#)

## Finding big savings in driver-assisted safety tech

*August 22, 2019 CMU College of Engineering Media*

Driver-assisted safety systems reduce the likelihood of crashes. How much would society benefit if they were installed on all cars? More than \$20 billion, according to research from CMU...

The average crash represents more than \$160,000 in combined private and public costs, according to recent research by Samaras and colleagues...

The study, led by CEE Ph.D. graduate Corey Harper and published in the journal *Accident Analysis and Prevention*, lays out the costs and benefits of three driver-assist technologies: blind-spot monitoring (BSM), lane-departure warning (LDW), and forward collision warning (FCW). The researchers find that, if these warning systems were installed on all cars in the US, the resulting reduction in crashes would put a lot of money back in our collective pockets.

[More>>](#)

## Study finds big benefits in embracing vehicle safety tech

*September 6, 2019 Tech Xplore*

Alerting drivers to potential threats through “driver-assist” warning systems has been shown to reduce the odds of a crash. Using cameras or radar, each tool detects potentially dangerous anomalies, such as drifting from a lane, and alerts drivers to the threat.

A study by Carnegie Mellon University researchers published in the journal *Accident Analysis and Prevention* lays out the costs and benefits of three driver-assist technologies: blind-spot monitoring, lane-departure warning and forward collision warning. The researchers find that, if these warning systems were installed on all cars in the US, the resulting reduction in crashes would put a lot of money back into consumers’ pockets.

“We don’t have to wait for a future with fully self-driving cars to realize a lot of the benefits of sensing and automation,” said Corey Harper, a presidential postdoctoral fellow in Civil and Environmental Engineering, who led the research. “A lot of crashes can be avoided with today’s tech.”

[More>>](#)

## Findings

Chris Hendrickson and Stan Caldwell Publications:

Caldwell, S., and C. Hendrickson (2020) 'Are We There Yet? Myths and Realities of Connected and Automated Vehicles,' Carnegie Mellon University Traffic21 Institute, <https://traffic21.heinz.cmu.edu/policy-briefs/>

Grahn, Rick, Stan Caldwell and Chris Hendrickson (2019) 'Recommended Policies for the 21st Century Trends in US Mobility,' Carnegie Mellon University Traffic21 Institute, <https://traffic21.heinz.cmu.edu/policy-briefs/>

Hendrickson, Chris, and Laurence R. Rilett. "The COVID-19 Pandemic and Transportation Engineering." (2020): 01820001.

Grahn, R., S. Qian, HS Matthews, C Hendrickson (2020) Are travelers substituting between transportation network companies (TNC) and public buses? A case study in Pittsburgh Transportation, 1-29

Grahn, R., Harper, C. D., Hendrickson, C., Qian, Z., & Matthews, H. S. (2019). Socioeconomic and usage characteristics of transportation network company (TNC) riders. *Transportation*, 1-21.

Hendrickson, C. and L. Rilett, (2019), 'What Papers Does the Journal of Transportation Engineering Want?', ASCE J. of Transportation Engineering Part A, 145(9).

National Academies of Sciences, Engineering and Medicine. 2019. The Vital Federal Role in Meeting the Highway Innovation Imperative. Washington, DC: The National Academies Press. <https://doi.org/10.17226/25511>.

## **Conclusions and Recommendations**

This synthesis of research trends impacting the mobility of people and goods has informed policy on the local, state and federal level. Activities associated with this research have brought together academics, government officials, industry leaders and community organizations to better understand and engage in discourse on policies related to disruptive transportation technology. Results of this research have been disseminated to legislators and transportation agency officials as well as civic leaders, advocacy organizations and the general public through the activity outlined in this report.

In addition to the disruptive technologies studied in this report, the impacts of COVID-19 have dramatically altered transportation patterns, exposed impacts of the digital divide particularly in rural areas, and redefined how transportation resiliency is defined. Furthermore during the research period, civil unrest around issues of racial injustice have exposed systemic inequity of our transportation systems and highlighted need for stakeholder input.

In the next phase of this research we recommend more research in a smart-regional approach to mobility to address issues of the urban/rural divide. Also recommended is more research in how disruptive technologies are addressing or exasperating transportation equity issues and what policies are needed. Evidence points to broadband communication accessibility as critical to the equitable distribution of new mobility service for people and goods.

With structures, activities and networks in place from the CMU Traffic21 Institute and the Mobility21 National University Transportation Center outlined in this report, continued synthesis research on these very timely policy topics are enabled.