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**Active transportation simulations.** Visualize your active transportation plan solutions and supplement your evaluations with PTV Vissim. This adds robust 3D animations capabilities. Foremost, simulating pedestrian and bicycle interactions visually confirms your LPIs and cycle-track operations. Furthermore, these realistic simulations effectively communicate your project decisions to stakeholders. Vissim animations give you strong public involvement content like images and videos. Above all, the easy migration from Vistro to Vissim makes the simulation of active transportation solutions budget-friendly.

Do you want to learn more about PTV Vistro’s traffic signal workflow and capabilities? Scan the QR code above to read our in-depth PTV Vistro Knowledge-Base article.
### Active Transportation

Bicycle commuting should be part of my week, but I have yet to commit. Currently, my primary excuse is trail bridge construction. Once it is finished, however, it will be an exceptional improvement. That particular crossing traverses a six-lane arterial at-grade and creates significant delay. Several attractive route alternatives exist, particularly once I cross into the Henderson, NV, USA jurisdiction. On the other hand, it is hot.

In general, my trips to the grocery store also involve a car despite the fact that the store is less than a mile away, and many of my trips retrieve only a few items. I live in a rural preservation area, so there are no sidewalks, but there is also very little traffic. The challenging decision is deciding to walk a short distance along Las Vegas Boulevard with no pedestrian infrastructure or to utilize the uninviting rear entrance to the shopping complex. I certainly would not use it after dark.

Unlike me, many other pedestrians, likely from the timeshares across the street, regularly access the store and cross the boulevard to do so. Few utilize the signalized crossing, as it requires backtracking and waiting in the Vegas sun for the walk symbol. The store access, or lack thereof, emphasizes the importance of human-scale projects in making short trips so much more hospitable and pleasant. Protected crossings, lighting, and a solid surface path would make a world of difference at this site.

Granted, those kinds of projects don’t always go as planned. A trailhead project in a newer neighborhood resulted in a small community protest. A few neighbors felt that adding a shade structure and picnic table would result in teenage keg parties. Keep in mind that the homes are less than 50 feet from the trailhead area. Subsequent photographic evidence of the disturbances showed volunteers in matching shirts cleaning the trail and mounted police patrolling. The naysayers, of course, now regularly use and appreciate the facility.

Frankly, the temperature excuse is really only applicable for a short period of the year. Generally, the weather in the Las Vegas Valley is quite conducive to active transportation in all forms. In fact, even the heat leads to one of the more unique Vegas experiences—running or walking The Strip on early weekend mornings. The buildings afford some of the only significant shade, and the ambiance is rather unique. Quite a few of the fellow pedestrians have yet to sleep from the previous night.

Personally, I know the benefits to my physical and mental well-being, but the knowledge isn’t enough to prompt a change. Several of my favorite vacations have included cycle trips, so perhaps the adoption of a more active lifestyle means appreciating the sights along my commute. Walking the neighborhood certainly affords the ability to see things I wouldn’t normally notice from a windshield. For instance, my neighbors tossed an entire fiberglass pool forms. In fact, even the heat leads to one of the more unique Vegas experiences–running or walking The Strip on early weekend mornings. The buildings afford some of the only significant shade, and the ambiance is rather unique. Quite a few of the fellow pedestrians have yet to sleep from the previous night.

Despite the infrastructure challenges, the occasional complainer, and the heat, active transportation is a joyful activity. Time to ditch the excuses, use my feet, and even get on that bike.

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**Alyssa A. Rodriguez, P.E., PTOE (F)**

*ITE International President*
Active Transportation

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By the ITE Industry Council

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By Laura Aston, Ph.D. (S) and David M. Levinson, Ph.D.

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On the cover: Summer Streets—a multi-day, annual car-free event held the first three Saturdays in August—takes place in Manhattan, NY, USA between the Brooklyn Bridge and Central Park. Nearly seven miles (11.3 kilometers) of New York City’s streets are open for people to play, run, walk, and bike along Park Avenue and its connecting streets. In 2019, nearly 300,000 people enjoyed the open streets (Source: NYC DOT).
A Wealth of Technical Knowledge

Throughout its history, ITE has been known for the technical knowledge we bring to the profession. This knowledge sharing takes many different forms—from conferences and meetings to technical reports and publications. Recognizing that different people consume knowledge in different ways, we have diversified our offerings so something is available for everyone.

In addition to our traditional Annual Meeting, we have added a virtual spring Technical Conference. Moving beyond our robust webinar program we have added blended-learning certificate programs and unstructured drop-in sessions. In addition to the monthly ITE Journal we have our biweekly Spotlight and our Transportation Talks podcast series. Under the leadership of our Chief Technical Officer Jeff Lindley and Coordinating Council Chair Eric Rensel, 2021 is primed to be a banner year of technical products and publications.

ITE Journal articles and Quickbites provide access to knowledge on new and emerging issues. The “Looking Beyond COVID-19: Implications for the Workplace” article on page 20 provides insights into how individuals and organizations have adapted to working from home, and provides lessons learned as workplaces reopen. Recent Quickbites cover vulnerable road user safety at signalized intersections, shared mobility, and autonomous vehicle shuttles.

Earlier this year, two new Informational Reports were released. The Consultants Council, in collaboration with the Public Agency Council, produced Best Practices in Selecting Transportation Consultants, and the Complete Streets Council delivered a new Micromobility Facility Design Guide. Coming later this year are the Pedestrian Crossing Policy Guide and Practices for Prohibiting Right Turns on Red.

Recommended practices serve as guideposts for our members and the profession and go through a rigorous process of member comment and review by the International Board of Direction prior to publication. Recently, a new Recommended Practice on Preemption of Traffic Signals Near Railroad Grade Crossings was developed by the Traffic Engineering Council. Later this year the Planning Council will be delivering a draft Recommended Practice on Multimodal Transportation Impact Analysis.

Shortly we will release the 11th edition of ITE’s flagship publication, the Trip Generation Manual. This edition will provide significant new data and land uses, integrate all of the multimodal data from the 10th Edition Supplement into a single resource, and add important features to the ITETripGen web application. Look for information on how to all of the multimodal data from the 10th Edition Supplement into a single resource, and diversify our offerings so something is available for everyone.

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We strive to bring you the latest knowledge so you are prepared to handle the challenges of today and tomorrow, but we couldn’t do it without hours of dedicated service by ITE volunteers. If you want to be involved in shaping the future of our profession, please get involved in a council or committee by contacting Coordinating Council Chair Eric Rensel (erensel@gfnet.com) or ITE Coordinating Council staff liaison Niloo Parvinashtiani (zparvin@ite.org). As always, you can reach me on the ITE e-community or on Twitter: @JPaniatiITE.

Jeffrey F. Paniati, P.E. (F)
Executive Director and Chief Executive Officer
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People in the Profession

Obituaries

ITE recently learned of the passing of the following members. We recognize them for their contributions to ITE and the profession, and send condolences to their families.

William F. Savage, P.E. of Bradenton, FL, USA, passed away on January 23, 2021. He was an ITE Fellow and Life Member of ITE.

Dr. Robert L. Bleyl, P.E. of Scottsdale, AZ, USA, passed away on February 16, 2021. He was an ITE Fellow and Life Member of ITE.

Andre Lemire, ing., of Dorval, Quebec, Canada, passed away on May 25, 2021. He was an ITE Fellow and Life Member of ITE.

Robert E. Kniefel, P.E. of Anchorage, AK, USA, passed away on June 8, 2021. He was an ITE Fellow and Life Member of ITE.

New Members

ITE welcomes the following new members who recently joined our community of transportation professionals.

Canada
Matthew Di Maria
Daniel Hall
Matthew Timothy Keleher
Tak Takeda, P.Eng.

Florida Puerto Rico
Christine Acosta
Nikesh S. Patel
Edwin Santos

Global
Daniel Albuquerque
Louis D. Roodt

Great Lakes
Riley Mitts
Derek Wayne Taylor
Noutheng Yang

Mid-Colonial
Jeff Engle
Vanessa Holt, P.E.
Rich Kercher
Regina S. Moore
Koby L. Nachenberg
Yipeng Peng
Christopher Daniel Walston

Missouri Valley
Justine Hull
Chad Pendley, P.E.

Mountain
William Haas

Northeastern
Jessica Bellow
Jennifer Carrier
Eva Marin
Jorge W. Patino-Velasquez
Fior Perez, E.I.T.
Steven Shoemaker
Charles Walonis

Southern
Auref Aslami
Amenti Bonja
Regina Bowman, P.E., PTOE
Jason D. Brooks
Darryn Buich
Caroline Anna Cheeves (Bojarski)
Michael DiSanza
Adam Gomez
Ryan W. Higgins, P.E., PTOE
Meredith Hilliard
David Jung-Hwi Lee, Ph.D.

Letters in parentheses after individuals’ names indicate ITE membership status: S - Student Member; IA - Institute; M - Member; F - Fellow; R - Retired Member; and H - Honorary Member. Information reported here is based on news releases, and other sources. If you have news of yourself or the profession that you would like considered for publication, please send it to Holly Stowell, hstowell@ite.org.

ITE Talks Transportation Podcast

A Safer, More Equitable Post-COVID Future for Transportation

Eulois Cleckley, Denver DOT Executive Director and NACTO President

Eulois Cleckley, Executive Director of the Denver Department of Transportation & Infrastructure in Colorado, USA, discusses how he helped launch a new transportation and infrastructure department in a large urban city. Cleckley, who serves as president of both the National Association of City Transportation Officials (NACTO) as well as the Colorado Chapter of the Conference of Minority Transportation Officials (COMTO), also shares insights on how cities are working together to achieve safer, more equitable environments for all road users in a post-COVID environment. Finally, he touches on a career move to Miami-Dade County in Florida, USA as its new Director and CEO of Transportation and Public Works.

All episodes available at www.ite.org/learninghub/podcast.asp  |  Subscribe for free via iTunes at http://apple.co/2hOUz8t
Go Green with ITE Journal

Not in the office to get your mail, or would you like to be more “green”? You can choose to stop the mailed delivery of ITE Journal by filling out a quick online survey at http://bit.ly/ITEJGo-Green. You will still get the emailed version of ITE Journal that goes out on the first or second of each month and have full access to the digital edition.

Need a New Playlist for Roadtrips?

By Carrie Falkenrath, P.E., PTOE, PTP, RSP1 (F)
Principal Transportation Engineer & Planner
Tsquared Traffic & Transportation

Road trips mean different things to different people. For some, it is the changing scenery and the changing light of a long day. For others, it is endless views, and an endless stream of wind through the window.

For me, a road trip always means music. Early road trips with my husband meant agreeing on a stack of CDs, and current road trips include a curated playlist of the family’s favorite songs (yes, even the kids weigh in). And just once in a while, a moment and a song come together in a perfect vacation memory.

Therefore, in the spirit of our remaining summer weeks and the probability of road trips on the horizon (pun intended) the Women of ITE assembled a playlist for our fellow transportation professionals. We dug deep through the jukebox for a wide variety of songs to fit a single shared passion—transportation. We hope you might find some new (old) favorite songs and make some new favorite memories of your own.

Did we miss any of your favorites? Let us know on Twitter! Use the hashtag #iteroadtrip to make your suggestions and find some additional playlist chapters.

Check out the playlist, as well as other blogs from the Women in ITE Information Crusade at www.ite.org/about-ite/women-in-ite-sub-committee.itej
**LeadershipITE 2022 Hybrid Program**

LeadershipITE is combining the past and the present by offering a hybrid program. As we begin to emerge from the COVID-19 pandemic, LeadershipITE is proud to announce that in 2022, LeadershipITE will consist of two in-person sessions and nine virtual sessions.

This hybrid approach will allow you to connect with your peers in person to kick off the year, support and balance your professional and personal lifestyle through virtual workshops throughout the year, and end with an in-person graduation and celebration.

This approach combines the best attributes of years past into a comprehensive, inclusive program that will enable you to evolve your leadership skills for the future. The virtual workshops will be supplemented by professional and social events that provide participants not only the same content that this program is built on, but also enhancements to provide additional ways to engage with classmates, alumni, and the greater ITE community.

The virtual workshops will not be your average webinars. The curriculum is built around engagement, and each of the nine, 4-hour virtual workshops beginning in January will include interactive and experiential elements. These workshops are led by Shelley Row, P.E., CSP (F), a professional leadership consultant who is also a registered professional engineer with a strong background in transportation. You are in great hands and will undoubtedly benefit from her expertise.

Additionally, small team projects will be conducted addressing real-world issues facing the transportation profession and/or ITE and its members.

Throughout the year, you will have many opportunities to meet new people and grow your networks with intimate social events, sessions, and assignments with LeadershipITE alumni and ITE leadership.

If you’ve been interested in LeadershipITE, and the travel schedule and costs have held you back, 2022 is your opportunity to experience this hybrid interactive and engaging program while minimizing time away from your family and work responsibilities.

To stay up-to-date on the latest LeadershipITE activities, send a note to leadership@ite.org.

For more information and to apply to LeadershipITE, visit www.ite.org/LITE.

Application deadline for the class of 2022 is September 16, 2021.
Courses

Transportation Impact Analysis (TIA) Training Program
September 27 – November 22
The Transportation Impact Analysis (TIA) Training Program is a new certificate-based, blended learning program that provides students with comprehensive coverage of the technical elements of the TIA preparation and review. Topics include conditions that require a TIA, recommended qualifications for both the preparer and reviewer, definition of the site development characteristics, designation of the study area and description of its characteristics, description of TIA-specific analysis tools, assessment of current conditions and forecast methods for evaluating future conditions, estimation of modal trips generated by site, distribution and assignment of site-generated modal trips, multimodal analysis, safety analysis, evaluation of site access needs, identification of on-site and off-site mitigation alternatives that support TIA recommendations, and preparation and presentation of a complete final report.

Designing Signalized Intersections
September 20 - December 13
The Designing Signalized Intersections course is a new certificate-based, blended learning program that provides students with a comprehensive coverage of the technical elements of designing signalized intersections. This training program consists of modules covering major topic areas, which will include overall introduction discussing the design of traffic signals, geometric design for signalized intersections, and detailed coverage of signal control elements. This course will provide a full understanding of the practice of designing signalized intersections including interactive instructor-led discussions and pre-recorded sub-modules accessible anytime within the program period to accommodate the pace and schedule of the student. This program is targeted towards practitioners early in their careers with a focus on foundational knowledge and skills necessary for designing traffic signals from planning through implementation. Additionally, students will have the opportunity to interact directly with a live panel of experts as they explore the intricacies of real world examples.

Upcoming Live Webinars

A Complete Streets Framework for Allocating Road Space
August 10
Sponsored by the ITE Complete Streets Council

Development of Speed Crash Modification Factors Using SHRP-2 RID Data
August 12
Developed by the ITE Safety Council, DDSA Working Group

Quick Build Solutions: Repurposing Streets for People in a Post-COVID World
August 19
Developed by the ITE Pedestrian and Bicycle Standing Committee

Webinars Available!
Missed a webinar? No problem! Take a look at the webinars still available to view on-demand on the ITE Learning Hub at www.pathlms.com/ite/events/.
A Passion for Micromobility

ITE JOURNAL: As Chair of the ITE Pedestrian & Bicycle Standing Committee, what are some of the topics the committee has focused on in the past year?

STRAYER: We have been primarily focused on wrapping up and delivering three technical products, which we hope will help practitioners be better equipped to plan, design, and implement bicycle and pedestrian facilities. Those products to keep an eye out for are:

- Pedestrian Crossing Policy Guide, an ITE Informational Report;
- Bicycle Signal Resource Hub, ITE informational website; and
- Micromobility Facility Design Guide (available now in the ITE Bookstore).

The Micromobility Facility Design Guide was published in April 2021, and the other two are on track to be published later this year. We also plan to offer additional webinars to share more information about them.

Earlier this year, our committee also prioritized the review of the MUTCD Notice of Proposed Amendments (NPA) and contributed to ITE’s collective comments in response to the NPA, with a focus on cyclists and pedestrians. We currently are planning a webinar on “Quick Build Strategies,” and collaborating with the Complete Streets Council on a “Repurposing Streets for People in a Post-COVID World” webinar.

ITEJ: Our theme this month is “Active Transportation,” and you have quite a wealth of experience in that arena. What are some of the most interesting projects you’ve worked on recently?

STRAYER: Some of the exciting projects I’ve had the opportunity to be involved in recently are the Pensacola Street Bikeway design in Honolulu (HI, USA), North Park-Mid City Bikeway in San Diego (CA, USA) and the L.A. Union Station, Forecourt and Esplanade project in Los Angeles (CA, USA).

All three required construction documents for signing and striping and traffic signal modifications. The Union Station project recently completed the design process, and it includes a two-way bikeway, bicycle signals, an off-street trail, and a raised crossing adjacent to the west entrance at Union Station, which will be a significant improvement from a complete streets perspective.

Currently, I am serving as the traffic engineer for the San Diego State University Mission Valley Campus project, which is developing the former Qualcomm Stadium site in Mission Valley, adjacent to the I-15 and I-8 freeways. Fehr & Peers handled the transportation planning and operations analysis, and we’re now engaged in the construction document phase, which requires traffic signal design, signing and striping, and temporary traffic control.

Claude T. Strayer, P.E., RSP1 (M)
Senior Associate, Fehr & Peers

Education
BS, Civil Engineering, Northeastern University
Minor, Mathematics, Northeastern University

ITE Leadership
Chair, ITE Pedestrian & Bicycle Standing Committee

Certifications
Sustainable Transportation Professional (STP)
Road Safety Professional (RSP1)
Claude also holds civil engineer registrations in California, Arizona and Hawaii.

Fun Fact
Claude worked as an adjunct professor at Cuyamaca College teaching Introduction to Engineering and Design, which he considered a very rewarding experience. He also recently guest lectured at San Diego State University and enjoys connecting with the next generation of transportation professionals.

The new Pensacola Street Bikeway design in Honolulu (HI, USA).
Rendering of the new active transportation L.A. Union Station (CA, USA) project.
The on-site improvements include two roundabouts, on- and off-street bicycle facilities throughout the new campus, raised crossings, and other crossing enhancements that will be critical for the new SDSU stadium. The project’s frontage along Friars Road is currently a buffered bike lane that will be restriped and upgraded to include flexible posts for additional separation. The site area around the proposed stadium will include a community center, office space, student housing, a hotel, restaurants/grocery, recreational facilities, and a river park that will connect to the proposed bike trail.

ITEJ: What do you like to do for fun? STRAYER: In my free time, I enjoy hiking with my wife, son, and dog. We also enjoy spending time at the beach and traveling to Hawaii. itej

Claude currently serves as the traffic engineer for the San Diego State Mission Valley Campus project, developing the former Qualcomm Stadium site in Mission Valley, CA, USA.

Claude enjoys spending time with wife Amy, son Owen, and dog Jake.

A Unique Way to Network through the ITE Mentoring Program

My mentoring experience through ITE was probably different than intended by the creators of the program. Instead of having a full mentorship with one mentor, I had several smaller scale mentor-mentee relationships with professionals across the country. I did this with the aim to learn about new techniques that certain agencies might use in their transportation networks, see how the industry works in their corner, make potential visits, or look into different career development approaches.

The majority of these were short one-time meet-ups; however, two of the mentorships stuck out as recurring discussions and check-ins. These have been likely smaller than the intended mentorship plan (meeting two to three times in addition to emails), but I still got a lot out of the mentorship program, and it helped me gain insight into different areas of the field.

—Tyler Krage, P.E., PTOE (M)

Learn from the Experience of Others & Share Your Experience with Others

Get involved: www.ite.org/professional-and-career-development/mentoring/

Read Tyler’s entire blog here: www.ite.org/professional-and-career-development/mentoring/

www.ite.org August 2021 13
Inside the Industry

Challenging the Next Generation to Save Lives: STEM Lessons for Pedestrian Safety

By Becky Crowe, Transportation Specialist, Federal Highway Administration and Kirsten Brookshire, MCRP (M) Research Associate UNC Highway Safety Research Center

The Federal Highway Administration’s Safe Transportation for Everyone Pedestrian (STEP) program promotes cost-effective countermeasures with known safety benefits that can help reduce pedestrian fatalities at both uncontrolled and signalized crossings. In addition to promoting countermeasures to practitioners, the STEP program has developed five science, technology, engineering and mathematics (STEM) lessons for children, tweens, and young adults. The STEM educational materials focus on improving kindergarten through 8th grade students’ understanding of roadway design and how changes can be made to make it safer for people to walk and cross the roadway.

The five STEM lessons emphasize the following key concepts related to roadway design and pedestrian safety:

- Improve ability of road users to see each other
- Shorten pedestrian crossing distances
- Increase the likelihood that a driver will stop for a pedestrian
- Reduce vehicle speeds
- Create space for all users (e.g., road diets)

The FHWA STEM lessons aim to bring to the forefront concerns for roadway safety and draw the relation to concepts in STEM education with grade-appropriate tasks. Most publicly available transportation- and engineering-related STEM lessons are designed for middle and high school students, and very few mention walking, bicycling, and transit while covering transportation topics. To fill this gap, the FHWA STEM lessons center on the importance of pedestrian safety while offering real-world examples of the key concepts, calculations for older students, and hands-on activities.

An additional benefit of teaching these lessons is that accompanying adults will be reminded that the built environment serves youth just as much as it serves adults, and hopefully they will leave the activity with a renewed appreciation for roadway design and operation.
Each FHWA STEM lesson offers an easy-to-follow format with step-by-step instructions, lists of suggested materials, and visual aids. A supplementary primer describes key concepts, offers tips for doing hands-on STEM activities with students, and includes a glossary of terms. The lessons also include information about tailoring the activity for different ages, group sizes, educational settings, and available space and materials.

Three lessons are designed to be completed in a classroom setting and last for 30 to 75 minutes. One lesson is designed for a smaller group of students to complete over a 1.5-to-2.5-hour period of extended engagement. One lesson offers an activity that can be completed on a rolling basis during a family event open to all ages, including K-8, older siblings, and caregivers. The lessons could be integrated into a typical school day, a special event at school (e.g., career day, STEM night), or provide an activity for an extracurricular gathering such as clubs, scouts, or camps.

Some examples of lessons and activities include:

- **Need for Speed?** in which students, through hands-on activities, measurement, and calculation, learn about reaction times and relate them to stopping distance, road design, and speed limits.
- A lesson on sight distance, **Can You See Me Now?**, where students learn about the need for drivers to see pedestrians and how street design can impact visibility by redesigning a roadway to eliminate obstacles to a driver or pedestrian’s line of sight.
- **Raise Them Up**, a lesson in which students learn about raised crosswalks by building their own crosswalks and comparing the height of pedestrians against the height of different styles of vehicle.

To prepare the next generation of transportation planners and safety engineers, the STEP STEM lessons introduce critically important information about pedestrian safety, science, and math so they will be ready to take on the challenge of saving lives. It is important to learn more about the STEP STEM lessons, contact Becky Crowe at rebecca.crowe@dot.gov.

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Learn More

FHWA website for STEP Resources
https://safety.fhwa.dot.gov/ped_bike/step/resources/

To learn more about the STEP STEM lessons, contact Becky Crowe at rebecca.crowe@dot.gov.
With an eye toward the future, the ITE Arizona Section places a major focus on young professional support and education. The Section boasts three student chapters: Arizona State University (ASU), Northern Arizona University (NAU), and the University of Arizona (UA). An active student liaison engages regularly with the chapters to ensure they stay active, have access to professional support, and are aware of the various programs available to assist in their professional development.

Part of this support includes an opportunity for each student chapter to receive $1,000 in travel funds for students to attend ITE-related events, including the Arizona ITE/International Municipal Signal Association (IMSA) Spring Conference, Student Leadership Summit, and ITE district and international meetings. The Section requires a written proposal from the student chapters to be eligible, which provides practical experience in budget reporting and justification statements.

Through this initiative, the Section’s student members have represented their chapter and the Section at multiple professional conferences. In 2020, for instance, about 20 students from three chapters attended the 2020 Arizona ITE/IMSA Spring Conference. The funding also paid for student registrations from NAU to attend the Joint Western & Mountain District Annual Meeting.

The Section maintains strong relationships with student members and actively encourages them to join ITE as professionals after graduating, taking advantage of the reduced fee structure for younger members. This close relationship also allows the Section Board to identify young professionals who are interested in serving in a leadership role as an officer or on a committee.

Once those students graduate and begin their engineering careers, they can join the Section’s Young Professionals (YP) Committee, established in 2019. Events coordinated by this new committee are not exclusive to ITE members, but by providing valuable and engaging networking opportunities, promoting the reduced dues structure for young members, and praising the many benefits of the ITE community, the Section hopes to continue converting non-members into active members.

The YP Committee has been very active since its inception, particularly during COVID-19 with the pivot to virtual events. In 2020, the Committee held six events on a variety of professional development and industry-specific topics. Highlights included a presentation from American Council of Engineering Companies (ACEC) Arizona President Justan Rice on ACEC’s role in lobbying for the engineering industry; a Q&A session with Maricopa County, Arizona, USA, DOT Transportation Director Jennifer Toth; and a goal-setting session with Nicolai Oliden from the leadership company engineering YOU. The Committee also partnered with the Young Professionals in Transportation—Phoenix Chapter (YPT Phoenix) to leverage the resources of both organizations and provide cross-networking opportunities for local young professionals.

Continuing education is important to the Section, and in addition to its work for students and young professionals, it has been fortunate to be well-represented in multiple Leadership ITE classes. Recognizing the value of the program and benefits provided to both the members selected and the ITE community, the Section provides a $500 scholarship to offset program tuition and/or travel expenses when a member of the Section is selected. Past participants continue to be actively involved with the Section, and the program is actively promoted to membership.
Additionally, the Section’s Technical Committee regularly provides education on relevant transportation-related topics, projects, and initiatives via shared publications, webinars, and presentations. These are sourced from ITE, the Federal Highway Administration (FHWA) and the Transportation Research Board (TRB), with the Section funding the hosting cost for webinars at a central location, making it convenient for members to attend.

One webinar, “High Friction Surface Treatment (HFST) for Improving Highway Safety,” was presented by local experts from Maricopa County DOT (MCDOT), Arizona Department of Public Safety (AZDPS), and FHWA. MCDOT is the first agency in Arizona to apply HFST. The Technical Committee also utilized a virtual meeting platform to invite national experts from across the United States to share knowledge on the benefits of DDI design, modeling, and operations, as well as CFI design and operations. The sharing of technical knowledge across geographic boundaries was highly educational and brought new ideas and solutions to the region.

Last year at the Arizona ITE/IMSA Spring Conference, the Conference Program Committee organized a professional development session focused on resume writing, interviewing techniques, soft skills, and elevator speeches. The Section’s Road Safety Committee continues to support and advocate transportation safety initiatives and holds its Road Safety Forum at the Conference to bring together stakeholders from across the state to discuss Vision Zero and Safe Systems Approaches, provide an overview of the Arizona Strategic Traffic Safety Plan (STSP) Emphasis Areas, and conduct breakout sessions on how transportation professionals can implement Safe Systems into the Arizona STSP Emphasis Areas.

These educational and networking opportunities keep the Section thriving for individuals seeking continued involvement, as well as individuals who are new to the profession.

Arizona Section of ITE
Mountain District

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Student Chapters
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Giving Back
The Section’s Service & Outreach Committee holds fundraising events for charitable causes and the Mountain District Student Endowment Fund. One of the charities the Section supports is Phoenix (AZ, USA) Rescue Mission’s Code:Red Summer Heat Relief Campaign to help the homeless community during the Phoenix summer with water, sanitation supplies, and other essentials and services. The Section also supports local charities to provide for those less fortunate during the holidays.

Fun Fact
Tucson, AZ, USA, was the birthplace of the High-intensity Activated crossWalk, or HAWK. City traffic engineer Richard Nassi, P.E., Ph.D. (R) (retired from Tucson but currently working for the Pima Association of Governments) first developed the HAWK, based on a similar concept seen in Europe. Nassi wanted to assist pedestrians crossing busy, higher-speed, multilane streets without requiring traffic signals to be installed. Traffic signals are expensive and can lead to unintended negative consequences, such as higher numbers of motor vehicle crashes and vehicular and pedestrian delays.

Nassi’s idea was to develop a new traffic control device that would provide greater responsiveness to pedestrians while minimizing delay to motor vehicle traffic at midblock and minor street crossings. Tucson did extensive field testing with the HAWK, and FHWA eventually adopted it for inclusion into the national 2009 Manual on Uniform Traffic Control Devices as the pedestrian hybrid beacon.

K-12 STEM Outreach
To garner support and excitement for the profession in schools, the Section sponsors a Professional Society Award at the Future City Competition for the Best Multimodal Transportation System. ITE members form a judging panel and review three-dimensional models of future cities addressing a specific need while incorporating typical needs of a city, including transportation. The models are constructed from recycled materials and presented before panels of judges, providing an excellent learning experience for the 6th-8th grade students.

Leadership Award Honors Grote
Each year, the Section recognizes an exemplary undergraduate/graduate student chapter member who has shown exceptional dedication to the transportation profession through ITE service, mentoring, research, real-world experiences and/or other noteworthy accomplishments. Initiated in 2016, the Jenny Grote Student Leadership Award was named in honor of ITE Past President Jenny L. Grote, P.E., PTP, PTOE (F) (R), who spent many years of her ITE service promoting student involvement through participation in an organization that serves all levels of all transportation career paths.
profession. The Section regularly holds joint meetings and events with other professional organizations, including IMSA, Association of Pedestrian and Bicycle Professionals (APBP), Intelligent Transportation Society (ITS) of Arizona, and Young Professionals in Transportation International (YPT). These meetings are excellent opportunities to exchange knowledge, network with other groups, and let them know about the benefits of joining ITE’s community of transportation professionals.

With all of its offerings, the Arizona Section actively works to diversify participation within its membership and encourage an inclusive environment across various groups. itej

Check Out ITE’s New Career Center!

The ITE Career Center is more than a webpage to find new employment opportunities or recruit new talent. It has numerous resources for everyone at all stages of their career, including:

- Certification
- Mentoring
- Webinars, videos, and podcasts
- Advice and tips on resume writing, networking, interviewing, and maximizing your presence on social media
Tackle complex urban design and complete streets projects

AQCESSRAMP
Plan, retrofit, design and 3D model compliant curb ramps in minutes

TRAFXSAFE
Collect, monitor and analyze traffic video data to create safe and sustainable transportation networks

AUTOTURN PRO
Validate the safety of your street design for different bicycle types

Learn more at transoftsolutions.com/road-safety-solutions
Looking Beyond COVID-19: Implications for Workplaces in the Transportation Industry

By the ITE Industry Council

This is the second of two articles prepared by the ITE Industry Council to assess the impacts of COVID-19 on members and member organizations, providing insights and lessons learned as we emerge from the pandemic. This article combines survey responses from more than 1,100 members, more detailed follow-up insights provided from a subset of respondents, and personal interviews with leaders from private sector companies and public sector organizations.
An Altered Work Environment

The analysis conducted by the Industry Council identified employers and employees realizing the potential of working-from-home (WFH) as the most significant long-term impact of COVID-19 on the workplace. Organizations or managers that were resistant to the concept were forced to embrace it during the pandemic. Employees who may not have had the opportunity previously—or may not have taken advantage of WFH programs—found it wholly necessary to adapt to a WFH environment.

Working-from-home was predominately viewed as a positive by employees and employers alike. Pre-pandemic, a common objection to working remotely was the suspicion that staff would disengage, and productivity levels would drop; evidence, however, suggests this has not been the case. Many cited increased productivity with fewer distractions and reduced commute and travel time.

Faye DiMassimo, Senior Advisor to the Mayor of Metropolitan Government of Nashville and Davidson County in Tennessee, USA, noted that “there was no appreciable difference in productivity noted while staff was working from home.”

For some, particularly those with children at home, creating a productive work environment was challenging. Still, others missed the impromptu opportunities to collaborate with colleagues or enjoy social moments in the office. While WFH does not necessarily work for all employees all the time, employers have seen that it can work in many situations and that productivity can be maintained and sometimes enhanced.

Looking deeper into the survey results, seven themes emerged that all relate in one way or another to the impact of a WFH environment. Some of these themes are the same issues that employees and/or employers faced pre-COVID-19; others must be reconsidered as the world emerges to increased remote work options. Many organizations are expected to adopt a hybrid work schedule, with employees working from the office part of the week and from home on other days. Some employers may embrace WFH full time and allow some employees to be geographically located at a significant distance from their coworkers.

A recent Wall Street Journal article, “If You Thought Working from Home Was Messy, Here Comes Hybrid Work,” confirms a broad movement toward a hybrid work model. “Analysis has proven that almost all staff favor some type of flexibility in the place they work. A survey of 9,000 employees discovered 83% of respondents considered a hybrid office as optimum, which implies firms want to determine the brand-new mores of labor, and quickly.”

Using these seven themes, this article identifies issues and questions that employees and employers should consider as they navigate a post-pandemic future, including, “So what does this mean for me or my organization?” and “What do we do to address this issue now?” Select lessons learned are highlighted to help individuals and organizations think through the possibilities and identify an appropriate path forward. A white paper prepared by the Industry Council, which will provide additional lessons learned and more detail, is expected to be available in early fall. More information on how to access the paper will be forthcoming.

Theme 1: Work-Life Balance

WFH has benefits and drawbacks in maintaining an appropriate work-life balance. Flexibility and time saved commuting were frequently cited as contributing to a better work-life balance. In a WFH environment, employees have more control over their time and how and when they work, and they have more hours available to them because of the reduction of lost time commuting. One respondent noted, “Work-life balance has been great during COVID. I have more time in the day to go for a walk, spend time with my wife, or get a few things done around the house. Mind you, I don’t have kids at home.”

On the flip side, an equal number of study respondents indicated that the lines between work life and home life have become blurred. “When I worked at home I was teaching and working; it was incredibly stressful and hard to focus,” one respondent noted. Some individuals reported WFH can make it harder to disengage and create boundaries between their personal and work responsibilities, with those juggling work and caretaking responsibilities struggling the most.

“Productivity relies on workers to both focus at the appropriate time and disengage at other times to recover from work-related stress and maintain a healthy work-life balance.” However, given pre-pandemic objections to a widely accepted WFH model, the increased (perceived) pressure to demonstrate that WFH is in fact productive has led to work becoming task-based, rather than time-based. This in turn results in long working hours and difficulties in disconnecting. One response noted: “I’m essentially living at work now. I’m working at all hours of the day with much less separation from work life and home life.”

This is an area where organizations and individuals with remote work experience prior to the pandemic can help provide lessons learned as organizations transition from a forced, full-time WFH environment to hybrid (part-time in-office, part-time WFH) arrangements post COVID-19.

Lesson Learned: Flexibility is the Secret Sauce

WFH and schedule flexibility is now seen as a key employee benefit. We want to attract good people and will need to provide this option to compete for talent. Employees value the reduced commute time and flexibility to spend more time with spouses and family, time to go for a walk and exercise, or time to take care of tasks around the house during the day.

Productivity can be maintained or enhanced with remote employees. The focus is no longer on when the work gets done, just that it gets done. The expectation of workers having to be in the
office 50 hours a week, or on an 8-5 schedule, has changed. A poll by Gallup covering the early part of the pandemic found that the share of American employees “engaged” at work reached its highest level since data began in 2000. “Covid-19 may be the best thing that ever happened to employee engagement,” argued Josh Bersin, a global research analyst. Employees are spreading their work out across the day, and employers are focused on the results, trusting they are working the necessary hours.

Jim Peters from DKS Associates noted that WFH flexibility has provided an opportunity to attract talent from remote locations. He explained that pre-pandemic, DKS would have insisted that employees live where they work, but the WFH experiment during COVID proved that people can deliver on projects from any location.

Theme 2: IT and e-Business

Information Technology (IT) capabilities were frequently cited as a key determinant of success working from home. Organizations that had made pre-pandemic investments in technology, software, and IT processes fared better than those who had to adapt on the fly. Similarly, employees with strong and stable connectivity were able to operate much more effectively, given the dependency on video-based collaboration tools. Specialized software requires consideration regarding remote access. Most organizations’ IT systems supported some level of remote work prior to the pandemic. Going forward, organizations need to think about their IT enterprise in a fully distributed manner that includes the office, the home, and on the road. Cybersecurity is an area of concern both at an organizational and individual level. Strong system protections and good personal cyber hygiene practices are key.

For public agencies, remote operations have forced creative solutions to public engagement and access to public services. However, this also has raised concerns about the digital divide, potentially isolating those without access to smartphones and/or broadband communications. While online services can benefit many, there is still a need for in-person alternatives and technology assistance for those who need it.

Lesson Learned: IT Was Key During COVID-19 and Remains Key to Future Success

According to a new McKinsey & Company global survey of executives, respondents noted that in response to COVID-19, their companies have accelerated the digitization of their internal operations and customer/supply chain operations by three to four years. The study notes that funding for digital initiatives has increased more than anything else.

Our survey responses echoed the findings of the McKinsey study. Keith Golden, Chief Information Officer for Econolite, and Randall Iwasaki, Leader, State and Local Transportation at Amazon Web Services (AWS) and former Executive Director, Contra Costa County Transportation Authority (California, USA) were interviewed about IT lessons learned by their organizations during the pandemic. Both noted increases in IT spending due to WFH.

Iwasaki reported that “Fortunately, Contra Costa contracts out all IT staff and implemented a paperless program four years prior to the pandemic. Along with migration to the cloud, this prepared the agency with a paperless, touch-free environment and processes, including e-signatures, electronic bidding, and constant backup of critical files.” Even with this proactive technology investment, additional spending was required for laptops, monitors, and expanded teleconferencing services.

Golden mentioned that “increased cybersecurity measures were put in place,” and an “Amber-Alert-type system was adopted to ensure the company could quickly and seamlessly communicate important messages to employees. This is a text message/cell phone-based service that sends alerts to all employees simultaneously.”

The increased investments in cloud infrastructure, specialized software, software patching, communications equipment, and telecom services are all expected to persist.

Theme 3: Where is the Work Best Done?

Not all work easily translates to a WFH environment, and not all employees work best remotely. Some tasks lend themselves to a WFH setting, but others are more difficult or even impossible. Specialized software or equipment might dictate an office presence unless those resources can be shared remotely. Videoconferencing technology cannot replicate all aspects of the creative process, and team collaboration is an essential part of problem solving and solution building. Non-verbal communication is also important and difficult to assess remotely.

Not everyone has an ideal work environment at home. Lack of private space, needs of family members, and distractions may impact the ability of employees to work productively from their houses. Employers will need to be able to evaluate what positions and what people are best suited to WFH, to what extent WFH (full or part-time) makes sense, and what processes or tools can be used to enhance productivity.
WFH also can create a divide among employees within the same organization with some more able to WFH than others. Those involved in manufacturing or onsite project work may be required to be in-person. Administrative support staff may have difficulty completing all tasks remotely. Establishing policies that treat all staff fairly and equitably, but not uniformly, can be challenging, particularly for the public sector.

**Lesson Learned: Fostering the Creative Process Takes Effort**
Developing a good design is a creative process that benefits from collaboration among the team.

A study about the impact of remote work found the biggest hurdles for creative and collaborative remote work were that communication suffers significantly, spontaneity is often lost, and lack of interpersonal relationships make the work less stimulating.

That sentiment was reported in our study as well with many respondents lamenting the loss of in-person interactions with colleagues. One respondent noted: “There are fewer watercooler conversations that would normally facilitate cross-pollination of ideas and informal check-ins.”

While videoconferencing tools can help, it is hard to replicate the impromptu engagement that comes from being located together in an office. Creating these opportunities while supporting the employee’s desire to WFH, at least part-time, will be key to future success.

**Theme 4: Trust and Transparency**
Building trust and being transparent with supervisors and co-workers is critical when operating in a remote environment.

The loss of personal contact makes it harder to forge and maintain relationships. For some there is a loss of connection to the team. Open and honest communication between managers and employees and among employees is essential. Employers must create opportunities for this communication to take place both on an individual and team level. This will require more time and effort and additional training for managers. “Emergency” practices put in place during COVID-19 must be mainstreamed. Trust by all parties is a key for success.

**Lesson Learned: Life is Messy**
Having empathy for your employees is critical, both from a personal and business standpoint. Appreciate challenges employees may be facing in balancing their personal and professional lives, and remember we all have complications that come with families, aging parents, etc. Encourage frequent touchpoints between managers and staff and among peers so people can share concerns and learn about how the organization is adapting to changing circumstances.

Faye DiMassimo put it well: “All that messy humanity that we saw on full display on computer screen meetings, I’m hopeful that we retain that sense of connection to the people we work with.”

**Theme 5: Staff Development**
Engaging, integrating, and developing new or junior staff is challenging in a WFH environment. Even in an in-office setting, learning the culture of an organization and fitting in can be difficult for new employees. For new employees working remotely it can be harder to understand the “unwritten” rules and to ask questions or seek guidance. For supervisors it is not as easy to observe newer staff and provide informal mentoring or guidance.

**Hardik Shah, P.E., PTOE (M)**
Traffic Group Leader at American Structurepoint, Inc., shared a few practices that his organization used during COVID-19 that contributed to maintaining healthy relationships between staff and managers, and to provide staff with ongoing development opportunities even in a remote work environment. They include:

- Standing weekly meetings between managers and employees to provide opportunities to review workload and priorities, but also to support mentoring and employee development.
- Supporting virtual peer networks that can provide new or junior employees with a safe space for questions and learning.
- Taking advantage of increased virtual learning opportunities to provide great access for younger employees because of the reduced costs associated with these opportunities.

**Lesson Learned: Do Not Leave (New) Employees on an Island**
Managers need to take on even more responsibility for employee development. They need to be prepared to train new staff so they are not left on an island to fend for themselves. With WFH it is easy for new staff to get lost and not know who to turn to for assistance. They do not want to be seen as incompetent by always running to the boss.

**Theme 6: Client Relationships**
On the private sector side, more intentional effort must be spent engaging with clients. This is particularly important when trying to build new relationships. Limited client access and a lack of informal networking opportunities hamper relationship building. Policies between the public sector and private sector may differ, creating a mismatch of expectations and access.

For public sector organizations, COVID-19 has forced innovations in public engagement that, if maintained and expanded, can give the public more input in decision making and enhance equity. Expanding beyond the traditional public hearing allows more voices to be heard than just those who have the time and ability to join in person.

**Lesson Learned: Maintain Business Remotely, Build Business In Person**
One respondent noted, “In some ways the pandemic has made client engagement easier. I don’t have to fly to meet clients; they squeeze me into their calendar. We have been setting up regular ‘coffee’ visits with clients, not always about business, but to maintain the
connection and trust that has been built through face-to-face contact over the years.” While also highlighting, “It is much easier to maintain an existing relationship remotely than to build a new one. It is a good environment to be the incumbent because the world is going back to trusted names and relationships. Being established has helped a great deal. If you are trying to build new business, you need an in-person connection and presence.”

**Theme 7: Rethinking Resource Allocations**

Work-from-home revealed opportunities to save resources, in terms of investments in office space, resources spent supporting travel, and staff time allocated for meetings inside and outside the office. Realizing these cost savings will require careful consideration of the trade-offs—team productivity and communications, developing staff, client relationships—as highlighted in other themes. Appropriate office space strategies may vary depending on the size of the organization and their business objectives. Some may decide to cancel expansion plans, others may continue to invest in new markets, and still others may take a “wait and see” approach.

From a travel and meetings perspective, organizations will need to evaluate the out-of-pocket and time savings of conducting business remotely versus the value gained from being in the same room together with customers. As noted under Theme 6, maintaining relationships remotely is easier than building new ones.

There may also be some unexpected new expenses. For example, one unexpected challenge that emerged is tax regulations. One respondent noted, “As a small 140-person company, it’s challenging to bear the additional administrative and tax burden of employees working internationally or in other states,” he said, something for organizations to consider in planning for post-pandemic return to work.

**Lesson Learned: Form Follows Function**

The pandemic and WFH is causing many organizations to evaluate the need for their physical space. Do we need all the space we have? Is that space configured correctly for a future when many employees will be working from home at least part of the time? Are our offices still optimally located to support our current and future clients and where our employees live?

These are important questions that have significant long-term implications on organization and office operations, employee productivity and morale, and organizational financial resources. Lease terms, prior strategic investment decisions, and employee housing locations may take precedence and preclude quick action. It will be important for organizations to balance these many considerations and be clear about their organizational culture and operations as they make strategic decisions regarding changes in office space and locations.

**Looking Ahead**

The COVID-19 experience has had significant impacts on the lives of our employers, employees, organizations, and communities. As we emerge from this experience, we have seen many elements of our society quickly rebound toward pre-COVID norms, while others remain in flux—still, others are likely fundamentally and permanently changed. The impacts of widespread and extended experience with working remotely within the transportation sector have almost certainly changed employee expectations and business operations for both the public and private sector. WFH, at least in a part-time, hybrid manner, is expected to be one of the lasting changes resulting from the pandemic. The ITE Industry Council hopes the seven themes identified in this article and the lessons learned help member organizations as they create their own “new normal.”

**References**


**About the ITE Industry Council**

The ITE Industry Council allows ITE to build closer working relationships and to increase collaboration with industry solution providers. The Industry Council is organization- and fee-based. Participation is at the corporate level with a focus on engaging senior management. All industry solution providers from all sectors of the transportation space including traffic management and control products, information providers, and new mobility companies are encouraged to join the Industry Council. For more information, contact Pam Goodell at pgoodell@ite.org and visit www.ite.org/membership/industry-council.
Accessibility-Oriented Planning: Why and How to Make the Switch

By Laura Aston, Ph.D. (S) and David M. Levinson, Ph.D.

Accessibility is not a new measure of transport system performance. It was first conceptualized in its present form more than 60 years ago.¹ It has garnered attention of late, buoyed by the dual concerns of equity and sustainability in transport, as well as the increased availability of data and software to measure it. The Transport Access Manual has been developed to demystify access measurement.² In this article, we look at the essential elements of access measurement.
First, we introduce the concept of access and distinguish it from other measures of transport system performance. Second, we describe the applications or uses of access tools. We then outline various access measures and their inputs. We provide a word of caution concerning biases and limitations of quantitative measures, before suggesting ways to build a team to develop or adopt an existing access tool today.

**Concepts of Access**
Access-oriented planning unifies conventions in transport engineering and land use planning. The former has traditionally emphasised concepts of flow, which dominate textbooks and standards. The latter concerns itself with the distribution of land uses, which in turn affects the distances and routes people and goods must travel.

The concept of accessibility combines the two, with its focus on the ease and availability of connections between people and places. The measure itself is mode-agnostic, though the measurements depend on the impendence to travel by various modes including walking and micromobility, and even telecommuting.

**Uses**
Access metrics have various applications in many different fields. This is because good access increases the viability and value of a range of different goods and services. The reverse is also true: Poor access can be detrimental to many industries. Measures can be used to establish baselines and monitor levels of access between people, goods, and places. They also are useful for setting performance standards, testing scenarios, evaluating land development potential, and identifying pockets of disadvantage or inequality requiring improvement. Therefore, access metrics should be used as inputs to decision making for transport as well as land use planning, real estate pricing, productivity, wages, and employment.

Some access measures in use today are widespread, while others are less conspicuous. A widely available measure that includes access to jobs and services is the English Indices of Multiple Deprivation (IMD). The United Kingdom has been charting access to various opportunities for small administrative units since the 1970s. The index allows governments and planners to monitor the distribution of opportunities and target policies to address relative deprivation.

A more nuanced application of an access measure is an emergency response performance standard set by the National Fire Protection Association (NFPA), which recommends a travel time of four minutes or less for 90 percent of fire and medical emergency incidents. The potential for this target to be met for the resident population could be estimated by measuring the proportion of the population within a four-minute travel-shed of the response locations. The 20- or 30-minute neighborhood concept is a planning paradigm that revolves around targets for the type and quality of opportunities available to people within a certain travel time by certain modes. The standards may be tailored depending on the level of urbanization of an area, its population profile, and transport mix. Common to all measures is the need for data about people, opportunities, and networks.

**Measures, Calculations, and Data**
With the breadth of applications of access comes a breadth of measures to quantify it. Accessibility measures can be broadly grouped into two categories:

- **Primal:** Measure the quantity of opportunities that can be reached in a given time, distance, or cost. Primal measures can be further broken down into weighted or unweighted counts of the opportunities reachable. Such measures may also account for competition between people for a fixed set of opportunities. For instance, “The number of jobs reachable within 30 minutes by automobile at 8:00 a.m.” would be a typical primal measure, which has the advantage of being directly comparable across scenarios within a city, before or after a change, or even between cities. Figure 1 depicts primal accessibility to elementary or primary schools in terms of the number of primary schools reachable within 20 minutes from each statistical area, by different modes in Melbourne, Australia.

- **Dual:** Measure the time or distance (cost) to reach (or be reached by) a given opportunity or set of opportunities. For example, “The travel time required to reach the nearest hospital emergency room” would be a dual-access measure. Similarly, “The travel time required to reach three grocery stores by walking or public transport” would be a different dual measure.

Figure 2 depicts dual accessibility to primary schools in terms of the average travel time to reach three primary schools by mode in Melbourne. These figures have assumed average speeds for different modes. Average walking speed is 5 kilometers per hour, giving rise to a 1.67-kilometer walk catchment. Average cycling speed is 6 kilometers per hour; the catchment radius, however, is rounded to 5 kilometers. A driving speed of 60 kilometers per hour, corresponding to a 20-kilometer catchment, is used.

Both figures convey the relative advantage in terms of access potential of motorized transportation. There is a small amount of variability in terms of the relative performance of SA1s on each scale. In general, the northwestern zones have the lowest accessibility. Interestingly, although the northeastern and southeastern zones convey poor accessibility for cyclists and walkers, the limitation is overcome in motorized vehicles. This reflects a somewhat uneven distribution of primary schools...
in space, with a higher density of primary schools beyond the eastern edge of the 5-kilometer cycling buffer.

Although the figures demonstrate uneven access between modes, perhaps a better question is whether the accessibility afforded by each mode is adequate. Considering children only attend one primary school at a time, it is plausible that access to a single primary school is sufficient, although a choice of several might be desirable. By this logic, people living in almost half of the administrative zones in Brimbank can reach three primary schools within a 10-minute bike ride. Most can access at least three within 20 minutes.

A limitation of the figures above is that the only travel impedance they account for is distance. They do not capture traffic congestion, which is likely to reduce the primary schools reachable (primal access) and increase the time needed to travel to up to three schools (dual access). At the same time, high traffic speeds reduce amenity and safety for pedestrians and cyclists, which may make the perceived travel time longer. All are worthy consider-
ations when developing indicators and tools to measure access, which are discussed later.

These measurements are just that—measurements, not standards. One can apply standards for access, for example, that everyone in the city should be reachable by a fire truck within 12 minutes. It is less clear what a standard would be for access to jobs (for instance, a standard that everyone can reach 100,000 jobs by transit in 45 minutes might make sense in some cities, but little sense in a small town). A standard that a proposed real estate development or piece of infrastructure should make access better (not worse) is simpler and more universal. In contrast with many level-of-service requirements, this can be achieved even if the development increases congestion because it also changes the land use pattern. But in any case, these standards would have to be decided locally, based on local conditions.

Each measure has strengths and weaknesses. Measures can account for differing levels of impedance, placing greater weight on closer destinations. The more nuanced the measure of access, the more data is required, and the less obvious their meaning to those that use the measures. All measures are beset by biases such as cut-off effects.

For example, using a 3-kilometer travel buffer for cycling excludes destinations that are 3.01 kilometers away, just as a bus service that departs at 6:59 a.m. is excluded if we consider a 7 a.m. to 9 a.m. peak period window. The granularity of data also affects the accuracy with which access can be measured, with larger travel zones delivering faster computation times but with less chance of detecting variation within zones. Such trade-offs are inherent to the measurement of any element of transport system performance and implies that the most appropriate measure of access will depend on the application.

Common to all measures is the need for data to account for people, places, movement, time, and costs. Data about places and movement is increasingly becoming available on open data platforms such as OpenStreetMap (OSM) and General Transit Feed Specification-based transit schedules used in online travel planners. Such data are often routinely collected by government bodies in the form of geographically enabled data sets. Open-source python modules that require little prior coding experience, such as OSMnx, are making this kind of network analysis increasingly feasible in small, non-technical teams. For example, Figures 1 and 2 made use of python module for network analysis OSMnx and open-source GIS software QGIS. In addition, features of interest were downloaded from the Victorian open data platform. Government repositories are a useful resource for “opportunities,” while OSM, which is leveraged by OSMnx for network analysis, is constantly updated with higher-resolution spatial data for networks as well as opportunities. The increasing availability of such data opens the potential to measure access in many ways.

The Transport Access Manual provides guidance for the quantitative measurement of access, most of which is geared toward network-wide evaluation of access. The guidance is useful for identifying broad trends but is not a substitute for consultative and user-centred approaches to understand contextual barriers to access and develop tailored strategies to improve access.

Implement an Access Measure
Access measures need to be relevant for policy and underpinned by theory. They should also have buy-in from stakeholders who will either use the measure or be impacted by what is being measured. They should be engaging and simple. They also should make use of readily available and high-quality data. Defining access measures requires the involvement of key stakeholders in the policy process, as well experts with an understanding of transport networks and the opportunity, goods, or populations affected by the access measure. Just as important as defining a valid and useful access measure is the ability to consistently and accurately measure it.

Teams need user-friendly tools, usually in the form of software, that enable them to measure access, which requires associated expertise in both software and data management. Off-the-shelf tools are available for many applications. Regardless of whether a ready-made or bespoke tool is desired, it is likely necessary to engage experts in software and data management to choose or develop the right tool.

To ensure that the tool is fit for purpose, it is also critical that the tool developer works closely with the team responsible for developing and reporting the access measures. Research shows that this collaboration—not just among technicians and policymakers, but also with the public and other stakeholders—underpins the success of access measures. The manual provides several resources for teams wanting to implement an access measure, including a list of available off-the-shelf tools.

What is the Transport Access Manual?
The Transport Access Manual, written by an international committee of professionals and academics dedicated to that purpose, is a guide for quantifying and evaluating access for anyone interested in truly understanding how to measure the performance of transport and land use configurations. The Transport Access Manual contains enough information to help transport and planning professionals achieve a more comprehensive look at their city or region than traditional transport analysis allows. It also provides a point of entry for interested members of the public and practitioners by being organized in a logical and straightforward way.
The document is a guide for practitioner researchers, with varied entry points depending on the level of technical involvement of its readers. It presents the state of the science of measuring transport access in just enough detail to be comprehensive, without being overly technical. Whether an individual is a policymaker or a software developer, the manual has a chapter (or three) to help measure, monitor, and plan transport access.

Essential characteristics of good access tools include transparency, interoperability, consistency, and widespread application. Making such tools open access is a key strategy to achieving these goals. To this end, the Transport Access Manual is openly available, and includes contributions from practitioners and researchers around the world. Download a copy online today (see below) or purchase hard copies for a fee.itej

**Transparency**

[Image: Transport Access Manual]

**Resources**

For more information, please download the Transport Access Manual here: https://hdl.handle.net/2123/23733 or to purchase a hard copy, please go to: www.blurb.com/b/10414924-transport-access-manual.

**References**


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Developing and Using Tables Showing the Pedestrian Optimum and Bicyclist Optimum Feasible Intersection Designs

By Joseph E. Hummer, Ph.D., P.E. (M)
Planners and designers have many intersection alternatives to choose from these days, and many considerations typically go into that choice. Pedestrians and bicyclists are high on the list of considerations at many sites. Even in areas that are currently rural, there may be a need to consider those road users due to a chance that the area will develop, and demands will emerge. However, it is usually not clear which alternative intersection design would be best for pedestrians and bicyclists from among the concepts that would otherwise fit at a particular spot.

Much of the literature on pedestrians and bicyclists at intersections is focused on how to improve existing conventional intersections, and many agencies are making efforts to provide safe and convenient multimodal networks.1, 2 Some researchers have focused on how to improve alternative designs for pedestrians and/or bicyclists.3, 4 Each of the four Federal Highway Administration (FHWA) guidebooks on the most popular alternative intersection designs has a chapter on pedestrians and bicyclists, but again the focus is on making the experience the best possible for those road users once the design concept has been chosen.5-8

FHWA guidance on intersection control evaluation (ICE), a formal process for considering alternative concepts early in project development, implies a qualitative assessment of how well each concept treats pedestrians and bicyclists.9 Indeed, there is little available guidance to planners and designers on which intersection concept to choose to best meet the needs of those road users.

Fortunately, there is a new method available in NCHRP Research Report 948 that quantifies the quality of experience for a pedestrian or bicyclist at any intersection.10 Based on focus groups, surveys, and expert opinions, the researchers developed a method that scores each crosswalk and bicyclist movement at an intersection on 20 different aspects. Each of the 20 aspects could be scored as “no flag” meaning no unusual concern about that aspect of the pedestrian or bicyclist movement; a “yellow flag” meaning concern that that aspect of the movement could be inconvenient or uncomfortable; or a “red flag” meaning concern that that aspect of the movement could lead to more crashes. NCHRP Research Report 948 provided detailed descriptions of each of the 20 aspects and criteria for what earns a yellow or red flag.

The author made a recent attempt to help planners and designers choose the safest feasible intersection design (SAFID) from among the set of possibilities. The SAFID tables showed, for any combination of major street size and demand and minor street size and demand, the safest design based on published crash modification factors.11 The idea was that planners and designers could start their search for the optimum intersection concept for any particular spot with the design from the SAFID tables.

The objective of this paper is to combine the ideas from NCHRP Report 948 and the SAFID effort to produce tables that show the pedestrian optimum feasible intersection design (POFID) and the bicyclist optimum feasible intersection design (BOFID). The aim is to provide, for any combination of major street size and demand and minor street size and demand, the feasible intersection concept that would minimize the number of flags for pedestrians and bicyclists. Like the SAFID tables, the POFID and BOFID tables could give planners and designers a default concept for a particular spot that could be the starting place for detailed analysis.

Method

The intersection designs considered included all of the four-legged concepts in the FHWA CAP-X tool except the partial median U-Turn (MUT) and the split intersection, which are very rare (I only know of one partial MUT in the United States, and no split intersections).12 The only other common four-legged intersection types that I could think of are jug handle and offset intersections. While jug handles are common in a few states, in North Carolina, USA, they are not considered to be a competitive design as they require more right-of-way than a partial continuous flow intersection (CFI) while delivering only a fraction of the delay savings. Meanwhile, it seems that agencies are much more often considering removing offset intersections than installing them. With the possible exception of offset intersections, the POFID and BOFID tables considered all common and feasible four-legged intersections.

To construct the POFID and BOFID tables, consideration was given to the feasibility of the various designs with the following rules, which were the same as for the SAFID paper.11
• All-way stop control (AWSC) is viable on two-lane roads with demands of less than 7,500 vehicles per day (VPD) on each road.
• Based on the latest national guide, a single-lane roundabout can handle up to 25,000 VPD total and a two-lane roundabout can handle up to 45,000 VPD total.11
• Based on the FHWA guidebook, a signalized reduced conflict intersection (RCI, a/k/a superstreet, J-Turn, or RCUT) can handle up to 25,000 vpd on the minor street.7
• Two-lane minor streets should be signalized in RCIs at demands ranging from 3,000 to 11,000 VPD based on North Carolina Department of Transportation (NCDOT) research.14
• Because RCIs have superior signal progression and are not as vulnerable to driver confusion, MUTs, CFIs, and quadrant roadway intersections only become feasible at minor street demands above 25,000 VPD.

Agencies often make exceptions to these rules, but they should serve well to start.

Once the competitor intersection concepts in each cell of the Table 1 were listed, the NCHRP Report 948 method was applied on each concept in each cell.10 The 20 aspects evaluated were:
1. Motor vehicle right turns
2. Uncomfortable/tight walking environment
3. Nonintuitive motor vehicle movements
4. Crossing yield or uncontrolled vehicle paths
5. Indirect paths
6. Executing unusual movements
7. Multilane crossings
8. Long red times
9. Undefined crossing at intersections
10. Motor vehicle left turns
11. Intersecting driveways and side streets
12. Sight distance for gap acceptance movements
13. Grade change
14. Riding in mixed traffic
15. Bicycle clearance times
16. Bicyclist crossing motor vehicle travel lane(s)
17. Channelized lanes
18. Turning motorists crossing bicycle paths
19. Riding between travel lanes, lane additions, or lane merges
20. Off-tracking trucks in multi-lane curves

Aspects 1-13 apply to pedestrians, and 4-20 apply to bicyclists.

Assumptions included typical road geometry, one exclusive lane for each signalized left-turning movement, and one exclusive lane for each right-turning movement on multilane approaches. Typical turning percentages (10 percent lefts and rights from the main street), peak-hour percentages (9 percent), and directional splits (60/40) also were assumed to translate daily volumes into hourly movement volumes as needed for NCHRP Report 948.
Table 1. Numbers of flags for intersection designs.

<table>
<thead>
<tr>
<th>Design</th>
<th>Cell number in Tables 2 and 3</th>
<th>Number of pedestrian flags</th>
<th>Number of bicyclist flags</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yellow</td>
<td>Red</td>
</tr>
<tr>
<td>AWSC</td>
<td>1</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Two-way stop control (TWSC)</td>
<td>1</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>7, 12, 17, 22</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Roundabout</td>
<td>1, 3</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>2, 4-6</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>8-10, 13-15, 18-20, 23-25</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>11, 16, 21, 26</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Signal</td>
<td>3-5</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>7-9, 12-14, 17-19, 22-24</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>28-30</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>10, 15, 20, 25</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>11, 16, 21, 26</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>32, 33</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>MUT or bowtie</td>
<td>8-10, 13-15, 18-20, 23-25</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>29-31</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>11, 16, 21, 26, 27</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>32, 33</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Unsignalized RCI</td>
<td>7-9, 12-13, 17, 22, 28*</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Signalized RCI</td>
<td>10, 14, 15, 18-20, 23-25</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>11, 16, 21, 26</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>29*, 30*, 31*</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Partial CFI</td>
<td>25</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>26, 27, 32-34</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>Full CFI</td>
<td>27, 32-34</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Quadrant</td>
<td>27</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>32, 33</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

* The numbers of flags shown in the table are for six through lanes in the major street. With eight through lanes the number of flags changed somewhat, but not enough to affect Tables 2 or 3.
Each of four pedestrian crossing movements and a left, a through, and a right bicyclist movement from each approach were evaluated. For bicycle facilities, the assumption was a marked bicycle lane next to each curb and that bicyclists used the most convenient way to complete a left turn between using the motor vehicle lanes and using a green box on the far-right corner of the intersection.

**Results**

Table 1 shows which design was feasible in each of the 34 cells in the POFID and BOFID tables (Tables 2 and 3) and then shows the numbers of yellow and red flags for pedestrians and bicyclists for each design in each cell. In Table 1 the “weighted total” column weights red flags by a factor of two before adding that result to the number of yellow flags. The weight of two acknowledges that safety is more important than comfort, but that comfort still matters. Note that the results do not change much for various other weights and agencies, or project teams can apply their own weights and recreate the tables as they wish.

Tables 2 and 3 show the POFID and BOFID tables, e.g., the feasible intersection design in each cell that minimized the weighted total number of flags. Shaded cells in Tables 2 and 3 represent cases when a particular design minimized the weighted total number of flags for both pedestrians and bicyclists. Red lettering indicates a design that was also the safest feasible intersection design as reported in Reference 11 based on total crashes.

For pedestrians in Table 2, the pattern was that AWSC was best at the smallest intersections; a roundabout was best at larger two-lane meets two-lane intersections; TWSC or conventional signal was best in the lower portion of the left column when a large main street meets a small minor street; a MUT was best at large intersections; and a MUT or its close variation bowtie were best in the middle of the table.15

For bicyclists in Table 3 the pattern was similar with AWSC best at the smallest intersections; a roundabout at larger two-lane meets two-lane intersections; a MUT at large intersections; and a MUT or bowtie in the middle of the table. The differences between the POFID and BOFID tables were along the lower left side where unsignalized RCIs or TWSC were generally best for bicyclists; along the bottom row where signalized RCIs are best for bicyclists; and along the right side for four-lane major streets meeting smaller four-lane minor streets where signalized RCIs were best for bicyclists. Some might be surprised that RCIs did so well for bicyclists, but they reduce conflicts with left-turn vehicles, shorten signal cycles, and break up long road crossings, and in the final tally those advantages outweighed their disadvantages.

The red lettering in Tables 2 and 3, showing designs that also were the safest in that cell (11), revealed that planners and designers often do not have to compromise motor vehicle safety to achieve optimum pedestrian and bicyclist experience. AWSC, roundabouts, and MUTs, in their niches, generally provide optimum safety, pedestrian experiences, and bicyclist experiences. Red lettering also shows up in Table 3 where sometimes RCIs are safest and best for bicyclists.

<table>
<thead>
<tr>
<th>Minor street</th>
<th>Number through lanes</th>
<th>2</th>
<th>4</th>
<th>6 or 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major street</td>
<td>Low AADT: 0</td>
<td>5,000</td>
<td>7,500</td>
<td>10,000</td>
</tr>
<tr>
<td>Number through lanes</td>
<td>High AADT: 5,000</td>
<td>7,500</td>
<td>10,000</td>
<td>15,000</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>7,500</td>
<td>1) AWSC</td>
<td>2) AWSC</td>
</tr>
<tr>
<td></td>
<td>7,500</td>
<td>15,000</td>
<td>3) Roundabout</td>
<td>4) Roundabout</td>
</tr>
<tr>
<td>4</td>
<td>10,000</td>
<td>15,000</td>
<td>7) TWSC or signal</td>
<td>8) Bowtie or MUT</td>
</tr>
<tr>
<td></td>
<td>15,000</td>
<td>20,000</td>
<td>12) TWSC or signal</td>
<td>13) Bowtie or MUT</td>
</tr>
<tr>
<td></td>
<td>20,000</td>
<td>25,000</td>
<td>17) TWSC or signal</td>
<td>18) Bowtie or MUT</td>
</tr>
<tr>
<td></td>
<td>25,000 and above</td>
<td>22) TWSC or signal</td>
<td>23) Bowtie or MUT</td>
<td>24) Bowtie or MUT</td>
</tr>
<tr>
<td>6 or 8</td>
<td>Any</td>
<td>28) TWSC or signal</td>
<td>29) Bowtie or MUT</td>
<td>30) Bowtie or MUT</td>
</tr>
</tbody>
</table>

Table 2. Pedestrian optimum feasible intersection design (POFID) table.
employing statistical techniques and sensitivity analyses as needed) and to help sharpen up a concept as it moves into later stages of design. Designing for pedestrians and bicyclists does not have to be a qualitative process in which the loudest voice wins, but can be a quantitative process of measurable improvements.

There are many avenues for productive future research and improvements along these lines. For example, the NCDOT has funded a research effort to validate the 20-aspects tool against crash data, and those results should be helpful and illuminating. Also, POFID and BOFID tables could be developed for three-legged intersections, grade-separated intersections, and interchanges. Finally, use of the SAFID, POFID, and BOFID tables could be formalized in agency project development procedures for early planning stages, funding and programming stages, and early design stages. Crucial project decisions like how to optimize pedestrian and bicyclist experiences should not be made in a haphazard manner.

As with the SAFID tables (11), TWSC and conventional signal almost never appear in the POFID and BOFID tables. There still may be reasons to stay with TWSC and conventional signal during any particular project, but optimizing the pedestrian and bicyclist experience might mean starting with a different concept.

As an example of the application of the tables, consider an intersection project I worked on recently where a six-lane arterial that will carry about 32,000 VPD in the design year meets a four-lane arterial that will carry about 27,000 VPD. Cell 33 of the POFID and BOFID tables show that a MUT is optimum for pedestrians and for bicyclists at this place (considerably better than a conventional signal as seen in Table 1) and show that a MUT is also the safest design. This information should be helpful to stakeholders as they consider the MUT, a new design in North Carolina.

### Conclusions

Hopefully, the POFID and BOFID tables will help planners and designers when choosing intersection control concepts. At intersections with pedestrians and bicyclists, planners and designers can use the tables to find a default concept against which other concepts can be compared. The fact that in many cells an AWSC, a roundabout, or a MUT is simultaneously the generally safest, the best for pedestrians, and the best for bicyclists is a bonus and indicates strong default candidates. The 20-aspects tool from NCHRP Report 948 is available to conduct detailed assessments (employing statistical techniques and sensitivity analyses as needed) and to help sharpen up a concept as it moves into later stages of design. Designing for pedestrians and bicyclists does not have to be a qualitative process in which the loudest voice wins, but can be a quantitative process of measurable improvements.

There are many avenues for productive future research and improvements along these lines. For example, the NCDOT has funded a research effort to validate the 20-aspects tool against crash data, and those results should be helpful and illuminating. Also, POFID and BOFID tables could be developed for three-legged intersections, grade-separated intersections, and interchanges. Finally, use of the SAFID, POFID, and BOFID tables could be formalized in agency project development procedures for early planning stages, funding and programming stages, and early design stages. Crucial project decisions like how to optimize pedestrian and bicyclist experiences should not be made in a haphazard manner.

### Acknowledgement

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References


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Sight Distance for Edge Lane Roads

By Michael Williams (M)

Vail ELR at tight corner.

www.ite.org August 2021 37
The name edge lane road (ELR) refers to a class of treatment that includes advisory bike lanes and advisory shoulders. Edge lane roads (ELRs) support two-way motor vehicle traffic within a single center lane and vulnerable road users (VRUs) such as bicyclists or pedestrians in the edge lanes on either side. Motorists may use the edge lanes, after yielding to any VRUs there, to pass approaching vehicles.

Operation of an ELR is demonstrated in the figures from the FHWA Small Town and Rural Multimodal Networks Guide. An ELR has no centerline. The center lane is separated from the edge lanes with broken lines. The broken line indicates a permissive condition allowing motorists to move into the edge lanes.

ELR use in the United States and Canada is growing; over 50 installations were known as of March 2021. Given the candidacy of millions of road-miles for this treatment, inclusion in the upcoming release of the AASHTO Guide for the Development of Bicycle Facilities, and its low cost, continued growth seems likely.

A notable feature of ELRs is the use of one lane to support two-way vehicular traffic and the need for motorists to maneuver to pass approaching traffic. This requires a sight distance that allows motorists to detect one another and safely avoid collision. But no ongoing or upcoming research on ELR sight distance requirements is known. Additionally, no appropriate American sight distance guidance exists. I was involved in three ELR projects in 2020 that required accurate sight distance guidance.

Given the need for this guidance, this article’s aim is to develop conservative, ELR-specific sight distance recommendations that can be used until field research can refine these recommendations.

**Existing Guidance and Literature**

Despite identical operating characteristics, ELR sight distance recommendations vary between countries. Danish guidance recommends twice the stopping sight distance (SSD). Dutch guidance makes no mention of sight distance. The Small Town and Rural Multimodal Networks Guide is the only U.S. guidance that addresses the topic, and it recommends passing sight distance. The AASHTO Guidelines for Geometric Design of Very Low-Volume Local Roads recommends that the sight distance provided for two-way travel on one-lane roads should equal twice the SSD. The same guidance is found in the 1984 Park Road Standards published by the National Park Service.

The concept of Head-On Sight Distance was named in the literature by J.L. Gattis, who wrote about the need for a sight distance greater than SSD on residential roads that provided insufficient width for two cars to pass one another. The use of twice the SSD, as opposed to SSD, is required because the object to be avoided (the approaching vehicle) is not stationary. The object to be avoided is, for our purposes, moving toward the driver at a similar speed. A driver must be able to stop within a distance that does not overlap with the stopping distance needed by the approaching driver.

SSD assumes a driver unalerted to the potential need to avoid an obstacle in the road and includes a long reaction time as a result. Doubling this long reaction time creates an overly conservative sight distance recommendation.

**Problems With Passing Sight Distance**

Passing sight distance is the only official American recommendation for this treatment. It is cited in the Small Town and Rural Multimodal Networks Guide as an ELR criterion. No other country is known to use PSD for ELRs.

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**Figure 1.** Motorists travel in the two-way center travel lane. When passing a bicyclist, no lane change is necessary.

**Figure 2.** When two motor vehicles meet, motorists may need to encroach into the advisory shoulder space.
Three issues exist with the application of PSD to ELRs. First, PSD assumes that a vehicle belongs behind another until a passing opportunity is detected and a passing maneuver is initiated. On an ELR, a vehicle is in the center lane until a maneuver is necessary to avoid approaching traffic.

Second, PSD assumes that the average speed of the passing vehicle while in the left lane is 12 mph greater than the passed vehicle. This difference will likely be larger during a vehicle-bicyclist passing maneuver. And in most cases, no acceleration is needed by the passing vehicle. This raises the average speed differential further.

Third, the PSD model assumes that both vehicles are 19 feet long. AASHTO stipulates bicycle lengths ranging from 70 inches (5.8 feet) for a normal bicycle to 117 inches (9.8 feet) for a bicycle with child trailer.

These issues demonstrate that PSD is not appropriate for ELRs. Fortunately, these issues produce overly conservative values so safety problems due to too-short sight distances are avoided. But appropriate American sites for ELRs have been passed over due to sight distance concerns based on this guidance, and the decision to not implement VRU facilities can decrease safety for all road users.

ELR-Specific Sight Distance Requirements

Because PSD and twice the SSD are inappropriate, an appropriate sight distance recommendation is needed that prevents collisions between two motor vehicles approaching one another.

With respect to VRUs, the provision of SSD protects them from drivers approaching from behind. Assuming VRUs are moving at the same or lower speeds as the motor vehicles, they should be protected from drivers approaching from ahead by the sight distance developed in this article. Protection of VRUs that are traveling significantly faster than motor vehicle traffic from drivers approaching from ahead is out of the scope of this article.

For motor vehicles approaching one another, two scenarios must be addressed. The first scenario, shown in Figure 3, involves the edge lanes being unavailable for maneuvering. This requires that both vehicles be able to stop before reaching the other or to slow sufficiently until an opening in the edge lane becomes available. The worst case of coming to a full stop before reaching the approaching vehicle is assumed from this point forward. The second scenario has drivers moving right for a pass without stopping as shown in Figure 4.
An ELR-Specific Sight Distance Model
For both cases, a common perception-reaction time is first estimated. Following that, the time required for actions specific to each case are estimated. These times are combined to create the proposed ELR sight distance models.

Perception-Reaction Time (PRT)
The time needed to perceive an object, recognize it, and decide upon a course of action is a well-studied subject. This work assumes that the driver is alerted, i.e., aware of the possibility of an approaching vehicle.

Where a driver must avoid an approaching motor vehicle, drivers need only detect another vehicle. The 3.5-foot object height used for PSD is assumed for this purpose.

Findings published in NCHRP Report 270 found 95th percentile perception-response times of 1.2 seconds for alerted drivers.11 The report added 50 percent to this value to account for other factors such as fatigue resulting in a recommended value of 1.8 seconds. The 50 percent value was sourced from a study that investigated the results of alcohol on driver performance.

As reviewed in NCHRP Report 400, Olson and Johansson’s data on perception-reaction times in an alerted condition were consistent.12, 13, 14 These studies produced a mean perception-reaction time of .73 seconds and a standard deviation of .16 seconds. A 95th percentile value for that data is 1.05 seconds. Adding the 50 percent factor used in NCHRP Report 270 results in an alerted perception-response time of 1.6 seconds.

Adding the 50 percent factor used in NCHRP Report 270 results in an alerted perception-response time of 1.6 seconds.

The 2011 Green Book recommendation of a 1-second PRT for PSD follows the recommendation made by NCHRP Report 605.8, 15 Because this is well-used, published guidance rather than research findings, this value is not derated by 50 percent.

Averaging the values from NCHRP Report 605 (1 second), NCHRP Report 400 (1.6 seconds) and NCHRP Report 270 (1.8 seconds), gives 1.5 seconds as an estimated PRT for an alerted driver in a simple setting.

Gattis’ research relied on other research and chose a 1.2-second PRT for his HOSD work.7

Given these findings, 1.5 seconds appears to be an appropriate and conservative PRT value for ELRs. Because this value approximates a 95th percentile value that is further derated by 50 percent and then used for both drivers, it can be argued that it is overly conservative. Future field research is needed to refine this aspect.

Case 1: Complete Stop to Avoid Collision
In the case of two drivers needing to come to a complete stop, the HOSD concept is adapted. HOSD is defined to be twice the SSD but with the 1.5 second PRT.

The SSD equations in the 2011 Green Book are:8

Metric
\[ SSD = 0.278Vt + 0.039(V^2/a) \]

Customary
\[ SSD = 1.47Vt + 1.075(V^2/a) \]

where SSD = stopping sight distance in meters or feet,
\( V \) = vehicle speed in km/h or mph,
\( t \) = PRT in seconds, and
\( a \) = deceleration rate of 3.4 m/s² or 11.2 ft/s², respectively.

Using a PRT of 1.5 seconds and multiplying SSD values by two produces the HOSD values shown in Tables 1 and 2. Calculated values are rounded up to the nearest value ending in 0 or 5.

<table>
<thead>
<tr>
<th>Table 1. HOSD - Metric</th>
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<tbody>
<tr>
<td>Speed (km/h)</td>
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<th>Table 2. HOSD - Customary</th>
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<td>Speed (MPH)</td>
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Case 2: Maneuver to Avoid Collision
In the case of drivers choosing to shift laterally to pass, the PRT must be added to the time needed to move right. In some situations, it will be necessary for the driver to scan the edge lane before shifting right. The distance needed by both drivers to accomplish these tasks before meeting is called the Avoidance Sight Distance (ASD).

Two variants of ASD are defined. ASD+scan refers to the ASD that includes time for an edge lane scan by the driver and ASD-scan refers to ASD without an edge lane scan. In many cases, a motorist will not need to scan the edge lane before executing a lane change. If the road is rarely traveled by VRUs or the speed differential between VRUs and drivers is significant, the driver need only be concerned with VRUs ahead of them.

The distance of the lateral shift is less than a full lane change. Assuming both drivers are in the middle of the center lane, they only need to move over one half of a vehicle width plus a safety margin. The assumption made is that each driver shifts 6 feet; this is equal to one-half the nominal width of a passenger car plus a safety margin of 3 feet. The 3-foot safety margin is based on anecdotal evidence that drivers tend to maintain a greater separation on ELRs than on standard two-lane roads. Six feet of distance between the vehicles provides sufficient margin for wider vehicles.
Scan of Edge Lane
The only information found that is relevant to the time needed to scan an edge lane before moving into it is work done by Mourant. Mourant found that drivers took an average of 0.66 seconds to scan the side view mirror; no other values were reported. This time is used as a surrogate for the time needed to scan the edge lane. The 0.66-second value is not derated as the PRT was for this case.

Lateral Shift Maneuver
For this work, the shifting taper requirement found in Section 6C of the 2009 Manual on Uniform Traffic Control Devices (MUTCD) is used. Shifting tapers are used when drivers must be shifted away from a work zone but are not required to merge with another traffic stream. Drivers are alerted to the shift in advance by signage and have clear sightlines. Tables 6C-3 and 6C-4 in the MUTCD provide the formulas for minimum shifting taper length:

L = WS^2/120  for speeds of 40 mph or less
L = WS/2  for speeds of 45 mph or more

where L is the length of the taper in feet, W is the width of the offset in feet (6 feet as described earlier), and S is the speed in mph.

The formulas for the ASD variants used to populate Tables 3 and 4 are:

ASD – scan = 2 * (1.5 * speed + L) and
ASD + scan = 2 * (1.5 * speed + 0.66 * speed + L).

where speed is the given speed (in m/sec or ft./sec), and L is the taper length (in m or ft.) from the equations immediately above.

The ASD formulas include the doubling needed to accommodate both vehicles and produce the values shown in Tables 3 and 4. Calculated values are rounded up to the nearest value ending in 0 or 5.

Table 3. ASD – Metric

<table>
<thead>
<tr>
<th>Speed (km/h)</th>
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<th>ASD-scan (m)</th>
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Table 4. ASD - Customary

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<th>ASD-scan (ft.)</th>
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Nighttime ELR Sight Distances
Detection of VRUs and oncoming vehicles is necessary during nighttime driving. The distance at which a driver can detect “a small or low contrast object on an unilluminated roadway” with their headlights is called the Headlight Sight Distance (HSD) and is stated to be 427 feet (130 meters) in NCHRP Report 400. The report also notes that large or high-contrast objects can be detected at longer distances under the same conditions.

If the headlights of both vehicles are on, physics dictates that detection at twice the HSD will not be a problem. The only circumstance where this may not be sufficient is the use of HOSD at 60 mph, as shown in Figure 5.
Detection of VRUs may be a problem at higher speeds but an ELR is preferable in these conditions because the vehicles and the VRUs are more likely to be horizontally separated than on a standard two-lane road without bicycle lanes.

**Results**

Three ELR-specific sight distances were derived and calculated: HOSD, ASD+scan, and ASD-scan. Figure 5 plots these sight distances with PSD.

The ELR-specific sight distance models produce shorter distances than PSD. ASD-scan produced shorter distances than ASD+scan. Both ASD variants produce shorter distances than HOSD with the exception of ASD+scan at 20 mph, where the difference is 5 feet. These outcomes are expected and reasonable.

These sight distance recommendations include the doubling of values with significant safety margins. This may produce longer sight distances than necessary.

Because HOSD ensures that both drivers have enough time to come to a full stop, it is more conservative than ASD and should be provided where possible. If edge lanes are expected to be unavailable at times, then HOSD must be provided.

**Conclusion**

Passing sight distance (PSD) is the current U.S. recommendation for sight distance on an edge lane road. It has been shown to be inappropriate and overly conservative. Two new sight distance models are proposed. The first model provides sufficient distance for the oncoming drivers to come to a complete stop before meeting; this is called Head-On Sight Distance (HOSD). The second model provides sufficient distance for the oncoming drivers to maneuver around each other without stopping; this is called Avoidance Sight Distance (ASD).

The choice of which sight distance to use depends on conditions. As the most conservative value, HOSD should be provided whenever possible. If edge lanes may be unavailable for motorist use, HOSD must be provided. ASD+scan includes time for drivers to scan the edge lane before shifting right. ASD-scan should be used on roads with lower VRU-motorist speed differentials or higher VRU volumes. ASD-scan does not include time for drivers to scan the edge lane before shifting right. ASD-scan may be used, if needed, on roads with higher speed differentials or lower VRU volumes. The intent of ASD-scan is to provide a possible fallback where ASD+scan is infeasible or for use on ELRs that are installed with a primary goal of reducing roadway departure crashes rather than provision of VRU facilities.

These models are appropriately conservative and can be used on ELR projects until future research creates more refined ELR-specific sight distance models.

**References**


Michael Williams (M) is Principal of Michael Williams Company, a transportation consulting firm specializing in solutions for the rural environment around active transportation, roundabouts, road diets, and traffic-calming strategies. Michael researches and raises awareness of edge lane roads (ELRs) in an effort to increase awareness of this overlooked treatment. Michael’s website, advisorybikelanes.com, is the most complete source of information on ELRs available. He holds three engineering degrees and more than 10 patents. Michael is a member of ITE and Association of Pedestrian and Bicycle Professionals.
ITE Council and Committee Meetings during #ITE2021 (August 2-5)

August 2
11:00 a.m.–1:00 p.m.
• Coordinating Council Meeting, Part 1: Quarterly Business Meeting

August 3
11:00 a.m.–1:00 p.m.
• Coordinating Council Meeting, Part 2: Collaboration and Leadership Workshop for CoCo
1:30–3:00 p.m.
• Education Council Meeting
• Urban Goods Movement Standing Committee Meeting
• Planning Council Meeting
4:00–5:30 p.m.
• Public Agency Council Meeting
• Transportation and Health Standing Committee Meeting
• Transportation Forensics & Risk Management Standing Committee Meeting

August 4
11:00 a.m.–12:30 p.m.
• Transit Standing Committee Meeting
• Ethics Standing Committee Meeting
• Joint Railgrade Crossing Standing Committee Meeting
1:30–3:00 p.m.
• Industry Council Meeting
• Sustainability Standing Committee Meeting
• Smart Communities Standing Committee Meeting
4:00–5:30 p.m.
• Vision Zero Standing Committee Meeting
• National SimCap Committee Meeting

August 5
11:00 a.m.–12:30 p.m.
• Roundabout Standing Committee Meeting
• Data Driven Safety Analysis Working Group Meeting
1:30–3:00 p.m.
• TSMO Council Meeting
• Joint Complete Streets Council and Ped/Bike Standing Committee Meeting
• NRITS Steering Committee Meeting
4:00–5:30 p.m.
• ITE CAV Standing Committee Meeting
• Traffic Engineering Council
• Parking Standing Committee Meeting

More information – www.iteannualmeeting.org
Bridging the Amenity Gap: How Emerging Data Can Help Detect Amenity Bypass

By Duong Vu, Anny ChiH, Cari Gostic, Lesley Miller, and Sakariya Aynashe

The contents of this paper reflect the views of the authors and do not necessarily reflect the official views or policies of the related organizations.
With rapidly increasing populations, new cities are emerging, and older cities are expanding to keep up with the growing needs of residents. Given the complex and dynamic nature of cities, it has become a challenge for urban planners to identify and equitably support the needs of different communities without the proper tools and adequate data. In recent years, the development of large-scale computing power and the increasing diversity of sensing technologies have provided unconventional sources of information that urban planners can tap into to gain a broader understanding of the urban service coverage and identify existing gaps.

**Defining Amenity Gaps and Amenity Bypass**

When residents of a community have to travel farther away than normal (compared to other communities) to access a doctor’s office, a grocery store, or a greenery park, these residents are most likely experiencing an amenity gap. When the community is in higher need for a given facility, this gap is exacerbated. When combined with relevant contextual information, anonymized connected vehicle data (CVD) can become an interesting proxy to evaluate those gaps.

Residents of service-deprived neighborhoods typically travel farther to access the amenities satisfying their needs, often bypassing some other amenities for quality or affordability reasons or because they run out of capacity. Some amenity bypasses are due to personal preferences: favorite doctor, off-leash dog park, near grandma’s home, etc., but most amenity bypasses are the direct result of a shortage of facilities for that community. By combining amenity bypass detection with other background information such as demographics, we are able to analyze communities with true amenity gaps on a greater scale. In this article, we will explore the concept of amenity bypass in detail.

**Literature Review**

Amenity gaps in urban planning is a concept that has not been extensively explored and is generalized in current methods of discovery. Previous research focused primarily on specific amenities such as health care facilities; public transportation; greenery parks; or food stores. Much of that research has pointed out the imbalance of amenity distribution and its correlation with the socioeconomic status of neighborhoods.

Detecting and filling these gaps would provide substantial positive impact and, as Kathryn Anderson (2018) suggested, more equitable provision of health care resources would mitigate negative impacts of segregation.

One popular approach is the two-step floating catchment area method that measures spatial accessibility to a variety of amenities such as jobs, primary care physicians, parks, etc. This method focuses on the ratio of facility to population within an isochrone around the population centroid. The isochrone is either based on raw distance or on travel time. With the assumption that people will travel to the closest amenity, this method ignores amenity bypass due to overcapacity or unattainability. We suggest using GPS data to better model population movement and reveal which amenities people actually use, instead of assuming that people will go to the closest one. This work proposes a general framework to locate amenity gaps using GPS data.

**Identifying and Contextualizing the Amenity Gap with Diverse Data Sources**

The four main types of data sources used in this project were GPS trace data (connected vehicle data), demographic information at the zip code level (population, age, income level, education, etc.), amenity-specific information, and geospatial data (amenity locations, land use and zoning, etc.).

**Connected Vehicle Data**

Most previous research on amenity gaps used survey data or geospatial data to find proximity or location as a way to evaluate the level of accessibility of an amenity. In this work, we look into anonymized connected vehicle data as an indicator of the movement of individuals. This data comes from vehicle sensors (GPS devices) recording specific events occurring in a passenger vehicle. The data used for this study spans from April 2018 to March 2019 (before the COVID-19 pandemic), and includes more than 10 million vehicle feeds, collected across 95 percent of the United States road network. Some relevant features of the dataset include...
journey ID (a unique identifier for any event that occurs between a trip start and a trip end for a given trip), event (trip start, trip end), location, and captured timestamp.

**Demographic and Amenity-Specific Information**

In addition to movement data, demographic information plays an important role in providing information about the characteristics of different communities, indicating the potential needs of each community for a specific amenity. For example, access to primary healthcare facilities is more critical for certain age groups, namely the very young and the elderly. To obtain this information, an Open Data Portal is one of the first official sources to gather demographic, education, and economic statistics data. Amenity-specific information also includes more details about each community, especially health statistics of locals, unemployment rates, and more.

**Geospatial Data**

A key part of this study examines the amenity bypass, which occurs when the closest amenity option is passed over in favor of one that is further away. As such, obtaining the spatial location for neighborhoods and the distances to several amenities around them is important for our analysis. We can do this by navigating to a city’s Open Data Portal and obtaining a shapefile of official city boundaries. This shapefile is used to filter other datasets so our analysis can focus on movements and residents within the selected area. A listing of amenity locations often can be found from other official departments of a city or state. OpenStreetMap is another public data source to obtain amenity locations, as it provides a free, open-license map of the world with layers of information.

**General Framework for Amenity Gap Analysis**

In this work, we propose a general framework for amenity gap analysis as shown in Figure 1.

**Defining Communities and Types of Amenities**

Before looking into the amenity gap, a clear definition of communities will help the analysis stay focused and the comparison between communities stay consistent. In this study, we define a community as all people living within a zip code, because of its well-defined boundaries and the availability of demographic information. However, the definition of a community could be changed to better fit the purpose of other analyses.

The next step is to select the type of amenity on which to focus. In this study, we select two amenities, which are greenery parks and healthcare facilities. The amenity could be defined in a higher level of detail: mental health facilities, kid-friendly parks, etc. This selection determines the amount of amenity-related information the analysis would need such as specific health issue statistics, population age, etc.

**Assigning Mobility Data Trips to Amenities**

In order to analyze travel patterns to an amenity, we first filter to only trips with the origin or destination within the selected amenity’s area. In most cases, an amenity’s polygon requires a small buffer around it to include street parking. In other cases, we will need to draw or obtain the parking lot polygon nearby, which is illustrated in Figure 2. We then count the number of trips from these amenities to each community in our analysis, where the last few points of the trips are within the home’s zip code.

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![Figure 1. Proposed general framework of amenity gap analysis in four steps.](image-url)
Preprocessing of Different Data Sources

Most of the datasets used for our contextual analysis come from open data sources, which requires extensive cleaning and geopositioning. Standard cleaning includes, but is not limited to, formatting values to the right type (date, time, integer, string, etc.), imputing or excluding missing values, and consolidating different/misspelling of the same objects (Biscayne Park vs. BISCAYNE PARK vs. biscayne park). Many of the amenity locations only include an address (123 Main Street) instead of an actual representation on the map (a polygon shape). This leads to a process of geopositioning to find or draw the shape of the amenity. On the other hand, connected vehicle data comes from sensors, so its features are more defined with fewer inconsistencies. The big preprocessing step for this data is to summarize the individual trips into counts and filter by polygons (trips only start or end within the amenities of selected city boundaries).

Calculating Need Score

We define need score as a community’s level of need for an accessible and attainable amenity. Accessibility is measured as median trip duration, and attainability refers to an amenity’s affordability, quality, and capacity. To calculate the need score of a community, first we need to identify the risk feature from each community. A risk feature is a factor that raises a community’s need for an accessible amenity. These features are created using demographic and amenity-specific information such as income, unemployment rates, education level, age, or proportion of population with disabilities. After identifying all risk factors, a weight will be assigned to each feature. These weights should reflect the indicated importance of a feature to a community’s needs compared to other features. We then normalize each feature value and multiply by the proportional weight for that feature. Finally, the sum total value across all risk features gives the need score for each zip code area.

Discovering Amenity Bypass

The three main ideas that we pursue are: (i) an amenity analysis framework that could be applied to any type of amenity and any size of communities; (ii) leveraging connected vehicle data as a true source of labeled data for amenity usage; and (iii) based on the result of (ii), detecting amenity bypass, another indicator of amenity accessibility.

The motivation of this project is to find a way to help jurisdictions of different levels (city, county, state, province) to detect service gaps in a more equitable way. Instead of having to select one or two specific communities or amenities to perform an analysis, we hope to introduce a more general approach and guideline on important data sources to succeed with an amenity gap analysis. In order to ensure equitable urban design, an unbiased evaluation of the current service accessibility should be done without any preference in mind. Moreover, by using connected vehicle data, we expect to include the majority of the population, such as underserved areas where surveys and official reports may not be utilized.

This dataset also leads us to a new concept: amenity bypass, which could be a separate study by itself. Note that we measure accessibility of an amenity by median trip duration, which provides more insight into which amenity the resident of a community actually traveled to instead of the closest one based on distance. We defined amenity bypass as occurring when a nearby amenity is passed over in favor of another further away due to its lack of attainability for a variety of reasons. If an amenity exists within a community but is too expensive, crowded, or run down to meet the needs of its residents, this still constitutes an amenity gap.

Figure 3 shows the number of trips from each pink triangle to the blue triangles, which represent a park amenity. The orange triangle in this figure represents the amenity bypass. We can see that although the orange triangle is closer to another park amenity, a portion of residents opted to travel to another one further away (represented by the blue triangles).

Furthermore, these shortages of service are contextualized by open source demographics, economics, educational statistics, and amenity-specific information to determine whether these gaps exist in more vulnerable communities.
**Assumptions and Future Work**

There are a number of assumptions built into this research that should be considered when using any insights derived from the analysis. First, we assume the connected vehicles are well-distributed throughout the city. An additional penetration rate analysis for each community would be recommended for confirmation. The second assumption is that people who travel to an amenity intend to use the amenity. This excludes all the officials and workers for that amenity, if any. Lastly, trips to an amenity always start or end at home zone areas.

We acknowledge that the movement data coming from car sensors may or may not represent the whole population. Each community has its own ratio for different modes of transportation such as walking, biking, driving, or public transit. In a community where there are more diverse ways of getting around, we suggest considering mobility data coming from mobile phones as another additional source of information.

**Conclusion**

Traditional analysis with survey data and official record data cannot adequately explain the movement of different groups of people within a community. Many residents of a city will not appear on official data records because of homelessness, lack of a fixed address, undocumented status, and many other reasons, leaving these groups underrepresented. This has, to date, made planning more biased toward those for whom we have census data. Having another source of data such as anonymized connected vehicle data to analyze supports the deep dive into community behaviors in a more scalable way. Diversifying the sources of data used gives us an opportunity to identify existing gaps and understand gap-driven population movements, ultimately helping increase the standards of inclusiveness in the city. In addition, this new source of data helps discover amenity bypass, an additional indicator of inaccessibility in the service network for the local community.

**Acknowledgement**

Thank you to UrbanLogiq for providing the data, facilities, and other resources for this project, especially my coworkers: Rachel Rasmussen and Anabel Chuinard for reviewing the paper with me, Morgan Cassels for helping on the software development of the project, and Julien Refour for helping on idea development. The core team worked on this analysis under the capstone project between UrbanLogiq and the University of British Columbia.
References


Duong Vu is a data scientist at UrbanLogiq, where her focuses are on geospatial and urban computing problems. Previously, she worked at the Indiana Auditor of State on data analysis and automating accounting books. Duong has a master’s degree in data science from the University of British Columbia and a master of jurisprudence from the Indiana University Robert H. McKinney School of Law. Since 2018, Duong has led the Vancouver Women in Data Science, organizing conferences, talks, workshops, and career fairs.

Anny Chih is a senior business analyst at Fraser Health Authority and has a master’s degree in data science from the University of British Columbia. Her work provides healthcare providers with analytical insights needed to make data-informed decisions, and she creates efficiencies within the organization by automating processes using Python and SQL. Prior to working in healthcare, Anny specialized in market research and analytics within the media and advertising industry across the United States and Canada.

Cari Gostic has an undergraduate degree in atmospheric science from Cornell University, and recently earned a master’s degree in data science from the University of British Columbia. She enjoys applying herself to projects with environmental or societal benefits. She currently works as a data scientist for Sonoma Technology, Inc., an environmental consulting firm that specializes in air quality solutions.

Lesley Miller is a data scientist at the University of Washington who is passionate about using data science tools to facilitate sustainable stewardship and conservation of natural resources. She develops and maintains the core software tools used across various outdoor recreation research projects and utilizes natural language processing algorithms to build models that provide insight into forest visitors’ interactions with nature and designated wilderness. She has a background in computational biology and genome evolution as an undergraduate at the University of British Columbia and a master’s degree in data science from UBC.

Sakariya Aynashe graduated from the University of British Columbia and has a master’s degree in data science. He is currently the program manager and data scientist at Tech Labs Academy. Also a recipient of the Mandela Washington Fellowship by the United States Department of State, Sakariya’s recent scientific interests include AI-driven solutions, machine learning, and cognitive computing.
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<td>Video/Radar Hybrid</td>
<td>$16K - $25K</td>
</tr>
<tr>
<td>Thermal*</td>
<td>$15K - $20K</td>
</tr>
<tr>
<td>Single Camera 360 Video*</td>
<td>$14K - $18K</td>
</tr>
<tr>
<td>Traditional Video*</td>
<td>$12K - $16K</td>
</tr>
<tr>
<td><strong>ITS Plus Lightning Series</strong></td>
<td><strong>$6K - $9K</strong></td>
</tr>
</tbody>
</table>

*PRICING MAY NOT INCLUDE ADVANCED DETECTION.*

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ITS Plus Vehicle Detection simultaneously performing Advanced Detection, Stop Bar and Vehicle Counts

All ITS Plus products are designed and manufactured in the USA.

[www.ITSPLUS3.com](http://www.ITSPLUS3.com)