Multiple Threat Pedestrian Crashes & How We Can Reduce Them

Joe Gustafson | Washington County
Tyler Krage | Alliant Engineering Inc.

When it comes to pedestrians, multiple threat crashes are among the most likely to be severe or even fatal. Multiple threat crashes are defined as crashes in which one vehicle stops on a multi-lane approach to let a pedestrian cross, but another vehicle in the adjacent lane does not stop, striking the pedestrian. When a driver stops for a pedestrian, the pedestrian is likely to speed up their crossing pace, increasing the chance of a multiple-threat collision. Under Minnesota law, drivers are required to yield to a pedestrian who is within a crosswalk or who is crossing the roadway at an intersection without a marked crosswalk. But motorists are not required to yield to pedestrians who are not within the roadway, such as those standing behind a curb waiting for a safe gap, regardless of if a crosswalk is marked or not. In some of these cases, a well-intentioned motorist trying to aid the pedestrian in crossing may actually place the pedestrian in more danger.

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**www.nc-ite.org**
Mike Martinez, 2017 NCITE President

As I write this, I see the unmistakable signs of spring. I see green grass and leaves sprouting on the trees, Type III barricades and detours. The Wild are fighting off playoff elimination, the Wolves are preparing for the draft, but the Twins are just a game and a half out of first place?! They are also a half-game out of last place, but I’m keeping the glass half-full as long as I can.

NCITE has built on our strong start to 2017. Our first quarter was punctuated by two significant highlights. More on those later (that’s called a teaser in the business). First, I’d like to highlight ITE’s 15K Membership Campaign. ITE has a goal to add 500 new members by the start of the 2017 ITE Annual Meeting and Exhibit in Toronto at the end of July. This would help our organization reach 15,000 members. There are incentives for both sections and individuals who refer the most new, paid members.

Locally, NCITE will be using our May section meeting to highlight this event through an unprecedented incentive: NCITE is offering free registration to the May section meeting to individuals who are interested in learning more about ITE, but are not yet members. Members: there is also an incentive for you to attend this meeting in the form of discounted registration fees. NCITE is more than just six section meetings. Are you unsure if your coworkers and colleagues can find a benefit to joining our organization? Do you think we’re only focused on traffic engineers? Dispel those myths and check out our website at www.nc-ite.org. You’ll find that have seven active (and free) technical committees that meet on a regular basis. Membership also gives you access to the online ITE Community technical forums. In addition, the NCITE Younger Member Group plans events that focus on the interests of, well, younger members.

The May section meeting will feature one other unique event. It’s called the “Outshoot Shawn” contest and is a competition for a chance to win a free registration to the 2017 ITE Annual Meeting. In short, we’ll be shooting (soft) pucks at a goal guarded by a likeness of our esteemed international president, Shawn Leight. Of course, we’ll also have an informative technical presentation focused on median acceleration lanes and it will be held at the popular Gasthof Zur Gemutlichkeit (lederhosen optional).

Now onto the highlights I referred to earlier. First, our planning methods technical committee has started back up and held an extremely well-attended kick-off meeting. This timing is perfect given the release of the Metropolitan Council’s new activity-based travel demand model. Please visit our website (if you made it this far, you’ve already seen the link above) to get involved in upcoming meetings.

Second, and even more exciting, NCITE took the March section meeting on the road! We took the opportunity of some energy and initiative coming out of North Dakota to be hosted by our members in Fargo. We had a great turnout not only in Fargo, but also at the simulcast in the Twin Cities. This event helped confirm the interest related to starting an ITE Chapter in North Dakota. I would like to recognize SRF’s Sarah Schmidt and KLJ’s Mike Bittner for helping lead the effort in Fargo. We look forward to this becoming a reality soon. If you’re reading this in North Dakota, please reach out to Sarah and Mike (or anyone on the NCITE Board) to become involved. Did I mention there is a membership campaign going on?

I look forward to seeing you all at this year’s events,
Mike Martinez, HDR
2017 NCITE President

www.nc-ite.org
ITE Midwestern District Conference
June 18-20, 2017
The Concourse Hotel | Madison, WI

2017 Joint ITE/CITE 2017 Annual Meeting
July 30 - August 2, 2017
Sheraton Centre | Toronto, Ontario, Canada

For professional development opportunities:
http://nc-ite.org/content.php?page=Professional_Development_Meetings

NCITE Calendar:
http://nc-ite.org/calendar.php
Volunteers Moving ITE Forward

I am passionate about our ITE members who volunteer for the success of our profession. They are the backbone of the ITE Community and ensure the sustainability, visibility, strength, and growth of our organization. With my strong focus on volunteerism, backed by my 30+ years of active ITE membership, together we will Move ITE Forward as a leader in the global transportation community. I will support and encourage our volunteer efforts to be focused on the four cornerstones of ITE—Recognized, Relevant, Value-added, Connected.

I have been fortunate to serve at all levels of ITE leadership including, Western District Technical Chair and President, International Director, and Traffic Bowl Chair and Transportation Professional Certification Board Chair. This experience has given me the knowledge, ability, and excitement to effectively work with our volunteers to ensure we are:

- Recognized as leaders in the transportation community
- Focused on work relevant to our profession
- Adding value to our members and the profession
- Connecting globally to strengthen our worldwide community

As a principal at Kimley-Horn for 25 years, I have brought diverse groups together to work toward common goals by applying my unique blend of academic and applied transportation knowledge. This experience will serve as my foundation to ensure our volunteers at all levels are working to Move ITE Forward.

In addition to my ITE volunteerism, my community volunteerism includes serving as Scoutmaster with Boy Scout-Wood Badge, Leadership Las Vegas, and Corvette Club President to name a few. As your International Vice President, I will be a servant leader to our diverse volunteers and will successfully implement plans, programs, and ideas at the international level to ensure that ITE grows as a leader in the global transportation community. Thank you for your support.
Who am I? I am a devoted transportation professional with over 25 years of experience and passionate about ITE. I have served ITE at the Section, District, and International levels. My involvement includes recently completing a three-year term on the International Board of Direction. Further, I give back to the engineering community as an adjunct professor at the University of Regina. I intend to build upon the hard work and initiatives already started, and continue to develop ITE as a leading organization in operating and delivering services to members.

Goals:

Communication – we need to reflect how members like to communicate and receive information today. Whether it’s through the ITE Community, social media platforms, or cloud-based document sharing, we need to ensure that information is timely, relevant, and readily accessible by our members.

Collaboration – we need to work more closely with other transportation organizations. By sharing knowledge and resources, we can produce technical reference documents faster, at a shared cost, and with full recognition of our members’ contributions.

Knowledge – we also need to streamline the approval and release of technical documents so that valuable resource materials are in our members’ hands quicker.

Growth – we need to grow our membership to remain a healthy, vibrant organization. Key to this growth and our long term stability is developing new student chapters and encouraging highly active sections. We also need to start new sections outside of North America where there is growing interest in ITE membership.

I have the desire to see ITE grow and succeed. Simply, I have something to contribute.
The February Section Meeting was held on February 21, 2017 at Jax Café, Minneapolis, MN. The meeting topics included: general items, news on the next section meeting planned to be held in Fargo, North Dakota, the 2017 MWITE meeting in Madison, Wisconsin June 18-20, the upcoming Annual meeting in Toronto, Ontario, Canada July 30 – August 2, and 2018 ITE Annual Meeting planning.

The presenter was Reed Leidle from Safety Signs LLC, presenting on Temporary Traffic Control, Work Zone Safety, Design, and Administration from a Consultant’s perspective. Highlights of the presentation included:

Discussion
- How can we make work zones as safe as possible?
- What is the problem? What are we trying to fix?

Statewide Workzone Safety Committee (SWWZSC)
Mission – The SWWZSC will influence the actions of those involved with work zones through the information that is shared through the innovations and best practices that are identified so that we achieve safer work zones and fewer fatal and life changing crashes.

SWWZSC Industry Liaison Group
- Discuss industry suggestions for efforts to improve work zone safety.
- Identify industry thoughts regarding existing state guidelines, standards, and procedures.
- Determine actions that industry can implement or pursue to improve work zone safety.

NLATSSA Temporary Traffic Control (TTC) Committee
- For Industry and Agencies to work together to ensure the safest Work Zones.
- To improve working relationships and communication with Agencies.
- Being willing to hear and gain understanding of Agency perspectives.
- To offer solutions on ways to improve training, safety, specifications, and enforcement.
- To improve the consistency of how project specifications are interpreted and enforced.
- Meet with different stakeholders to share Industry concerns so as to improve Work Zone Safety.

Action Items
- Focus on positive aspects, outcomes, and accomplishments.
- Work with Prime Contractors regarding the communication of Traffic Control items, to ensure both specifications are being adhered to and achieve the utmost safety in Work Zones.
- Look at projects earlier (pre-letting) so as to afford ample time for clarification, when warranted.
- Provide examples of reoccurring “Specification Issues” so MnDOT can understand what we’re seeing and work towards improving.
- Meet with the Consultants to discuss, “What could improve Work Zone Safety from the Consultant’s perspective?”
- Let’s work together so we’re doing everything we can, on every project, to make our Work Zones as safe as possible.
The March Section Meeting was held on March 22, 2017 at Ramada Plaza Suites in Fargo, ND & webcast to Stantec, St. Paul, Minnesota. The meeting topics included: general items, the 2017 ITE Membership campaign, 2017 MWITE meeting in Madison, Wisconsin June 18-20, the upcoming Annual meeting in Toronto, Ontario, Canada July 30 – August 2, 2018 ITE Annual Meeting planning, and a technical presentation.

The presenter was Shawn Kuntz, North Dakota DOT, Andy Vandel, South Dakota DOT, and Brad Estochen, Minnesota DOT presenting on the State of the Traffic Safety in North Dakota, South Dakota, and Minnesota.

Shawn Kuntz, North Dakota DOT
- Implementation of Strategic Highway Safety Plan (SHSP)
- Integrate 4 E’s of Safety: Education, Enforcement, Engineering, EMS
- Based on the plan, look at data, and focus emphasis on priority areas:
  - Reduce impaired driving
  - Increase use of safety belts
  - Younger/Older driver safety
  - Curb aggressive driving
  - Improve geometry at key locations
- Success of SHSP relies on:
  - Active and committed leadership
  - Stakeholder involvement with active representation and accountability from partners
- Evidence based strategies to reduce fatal and serious crashes implemented include:
  - Behavioral: seatbelts, alcohol, speeding, younger/older drivers
    - Laws, fines, campaigns, outreach, graduated licensing
  - Infrastructure: Lane departure, Intersection crashes
    - Rumble strips, enhanced lighting, pavement messages and markings, roundabouts, access closures

Andy Vandel, South Dakota DOT
- With implementation of SHSP fatal and serious crash rates have decreased 12%-17%.
- Emphasis areas include: road departure, intersections, and motorcycles.
- Road Departure Improvements:
  - Shoulder widening
  - High friction surface treatments
  - Rumble strips
  - Snow Fence
  - Signing upgrades
  - Curve delineations
- Intersection Crash Improvements:
  - Adaptive signal control technology
  - Corridor signal timing
  - Turn lanes
  - Clear intersection sight triangles
  - Intersection Conflict Warning System (ICWS)
  - Signal back plates with retroreflective borders
- Motorcycle Crash Improvements:
  - Rural off-state system sweeping
  - Improved signing at curves
Brad Estochen, Minnesota DOT

- What is Safe?
  - Severity of crashes is the most important factor
  - Frequency is important, but not as high as severity
  - HSIP goal is to reduce/eliminate severe crashes
  - General traffic safety can be whatever you make of it…

- Emphasis areas include:
  - Inattentive drivers
  - Speed
  - Unbelted
  - Impaired drivers
  - Lane departure
  - Interactions
  - Culture/Awareness

- Solutions for angle crashes at intersections:
  - Reduced conflict intersections
  - Roundabouts
  - Intersection Conflict Warning System (ICWS)

- Locations Identified – Project Recommended:
  - $350 Million in safety project identified
  - Implementation of project is key to meeting safety reduction goals
  - Projects recommended tend to be moderate in cost
    - No reconstruction
    - No interchanges or expansion projects

(Left to Right)
Brad Estochen, Shawn Kuntz, Sara Schmidt, Mike Martinez, Andy Vandel, Abby Rickman
The NCITE Younger Member Committee (YMC) hosts at least one event every other month. The March event was a poker night at Spack Consulting. Attendees of various poker skills participated in this prestigious event, with Jeremy Melquist, the NCITE YMC Co-chair, winning the night and taking home a grand total of $5.00!

The most recent YMC event was held in April, which was a joint NCITE YMC/Interdisciplinary Transportation Student Organization (ITSO) networking event at the Town Hall Brewery next to the University of Minnesota West Bank Campus. At this event, young professionals presented to the students on what got them interested in the transportation industry, the job roles they have been in since graduation, and some of the current projects they are working on. This was a great event that connected University of Minnesota students and young professionals in the transportation industry. Thanks to ITSO for planning and hosting this event!

We are hoping to get more students involved in our future YMC events! Stay tuned for notification of our upcoming event in June!
NCITE Student Outreach recently attended the Irondale High School STEM Career Fair in New Brighton MN

Kevin Peterson, Washington County
During the spring 2017 semester, ITSO organized a variety of innovative events that have drastically increased our membership. Our TRANSPO Talk series has incorporated professionals from many realms of transportation planning/engineering including transportation demand management, connected/autonomous vehicles, freight rail planning and community engagement, and an introduction to crash worthiness. Each seminar has featured an open discussion platform where the audience is encouraged to direct the conversation in a way that interests them. Our membership has skyrocketed, going from 47 to over 100 newsletter subscribers.

In addition to our TRANSPO Talk series, we hosted a spring reception with the NCITE Younger Member Committee at Town Hall Brewery where professionals gave short presentation followed by appetizers and mingling. Finally, we attended a tour of the St. Paul airport in late April which helped us achieve our goal of incorporating all modes of transportation into our student group activities.

Administratively, ITSO will be competing in the ITE Traffic Bowl in June, writing our annual ITE report, and electing a new set of officers. We look forward to a busy spring and summer season.
60 pedestrians were killed in traffic crashes in Minnesota in 2016, indicating a 50% increase since 2012. Although only a portion of these crashes involved the multiple-threat scenario, these types of crashes have included some of the most high-profile crashes especially within the metro area, and they don't seem to be showing any sign of decreasing. They often happen at 4-lane undivided streets, which exist on a large amount of the existing metro roadway system.

One of the most common refrains to curb this crash type are for the motorists to be attentive and to slow down enough while passing slowed or stopped vehicles. That statement does have some degree of truth, but using typical assumptions for lane width, pedestrian walking speed, level grade, vehicle sizes, driver reaction time (2.5 seconds), and minimum braking distance, a driver traveling as low as 3 MPH would be unable to stop in time for an inattentive pedestrian who steps into the lane from behind an adjacent vehicle. With an attentive driver and a best-case reaction time of 0.65 seconds, a driver traveling as low as 13 MPH would be unable to stop prior to the crosswalk. We must ask: Is it reasonable to assume that motorists will slow down to that speed every time they overtake a slowed/stopped/turning vehicle, delivery vehicle, or transit bus at an intersection? Unfortunately, passing stopped or slowing vehicles at intersections is a common element of the driving environment, and the vast majority of crosswalks are indeed at intersections.

There are a few things that can be done by engineers to combat this type of crash. For example, pedestrian-activated flashing pedestrian beacons or signals can give warning that a pedestrian is present at that time and might be within the crosswalk, even when the sight line to the pedestrian is obstructed by another vehicle. Beacon compliance by both motorists and pedestrians is shown to have largely positive effects when used in a context-correct situation. Urging drivers to yield to pedestrians well in advance of the crosswalk serves as an even more cost friendly solution. Something as simple as a stripe of paint serving as an advanced stop bar can drastically improve available sight lines between the pedestrian and motorist to prevent a crash. Also, although more costly, traffic signals and pedestrian hybrid (“HAWK”) beacons, which utilize a red signal, can create gaps by stopping traffic an assigning the right-of-way to the pedestrian before the pedestrian enters the crosswalk.
A potential geometric solution is to convert 4-lane undivided streets into 3-lane roadways with a center left turn lane. These conversions have shown very positive benefits for reducing non-pedestrian crashes, and can also help improve conditions for pedestrians by eliminating one of the through lanes at all crosswalks, such that the multiple threat is much less likely to occur. As an added benefit, the center left turn space can be re-allocated at select locations to create a pedestrian refuge island, shortening the crossing time significantly and eliminating the multiple-threat issue. These conversions do have some challenges, especially when the roadway includes curbside transit stops, and may sometimes have peak-hour capacity issues at daily volumes in excess of 20,000 ADT. It is important to remember that four-lane undivided streets also do not work well at these volumes, given their well-documented safety issues for drivers and pedestrians alike.

![Pedestrian Refuge Island - Image Joe Gustafson](image)

The most effective strategy in reducing multiple-threat crashes may simply be accurate public education. The act of waving a pedestrian into the crosswalk can cause a two-fold reduction in safety: It could force a pedestrian to accept an uncomfortable gap; it can also give a sense of guilt to the pedestrian, urging a faster crossing speed, creating a scenario where the pedestrian is less likely to check for a passing vehicle. The regional attitude of “Minnesota Nice” adds a negative and unforeseen consequence in this scenario. Education efforts and media stories that imply, incorrectly, that a driver is required to stop for a pedestrian who is waiting behind the curb can increase exposure to the multiple-threat scenario and the risk of serious and fatal crashes. Educating both drivers and pedestrians could have a high impact on reduction of these dangerous crashes without implementing infrastructure changes. Proper education might translate to all locations, not just areas deemed critical by governing agencies. Teaching motorists that when yielding to a pedestrian, doing so in advance of the crosswalk could give motorists in adjacent lanes enough time to safely stop and yield, and for the pedestrian to see the other vehicles approaching.

Public education of pedestrians and motorists can take many forms, but avoiding the multiple-threat scenario could become a part of the culture of participating in a transportation system, just as “look both ways”, “click it or ticket”, “share the road”, or texting and driving campaigns have become the norm. Urging pedestrians to check each lane, around the stopped vehicles, while crossing and urging motorists to yield in advance of the crosswalk could become the new message. Some agencies hold street events or block parties advocating for safer usage to get the word out. Media campaigns and increased initial driver’s education also may play a role in crash reduction.

www.nc-ite.org (Continued on page 15)
There are many solutions in the engineer’s toolbox to combat multiple threat crashes, from high end infrastructure improvements to general culture changes. Finding the correct fixes are all case by case, but as long as certain unsafe conditions exist, crashes are bound to happen. Determining the ways to fix the problems lies within the engineers hoping to mitigate, but also in part to the public to correctly use the infrastructure in the safest ways possible.

To get more information on this topic as well as useful analysis tools for multiple threat crashes, contact the Pedestrian and Traffic Safety Committee.

Snelling Advanced Stop Line - Image Joe Gustafson
**Geometric Design Technical Committee**
Committee Chair: Kelly Besser - kbesser@stonebrookeengineering.com

Recent Agenda Items: MnDOT Roundabout Steering Committee Roundabout Design Presentation and Roundtable, Parts I and II
Future Agenda Items: MnDOT Roundabout Steering Committee Roundabout Design Presentation and Roundtable, Part III
Next Meeting: June 15th, 2017 8:30am – 10:00am, Stantec 2335 Highway 36 West, St. Paul, Minnesota

**Intersection Traffic Control Technical Committee**
Committee Chair: Tyler Krage - tkrage@alliant-inc.com

Recent Agenda Items: FYA logic programming and conventions
Future Agenda Items: Innovative Ideas for Pedestrians at Signals
Next Meeting: Off for summer, September Location TDB

**ITS Technical Committee**
Committee Chair: Derek Nieveen - dnieveen@alliant-inc.com

Recent Agenda Items: Metro Transit A Line Evaluation and Lessons Learned
Future Agenda Items: Enhanced Speed Compliance
Next Meeting: June 6th, 1:00pm – 3:00pm, MnDOT Water's Edge, Conference Room A

**Pedestrian and Traffic Safety Technical Committee**
Committee Chair: Caitlin Wotruba - caitlin.wotruba@kimley-horn.com

Recent Agenda Items: Stop For Me campaign presentation from Jeremy Ellison and Kevin Gallatin
Future Agenda Items: TBD
Next Meeting: TBD

**Planning Methods and Applications Technical Committee**
Committee Chair: Steven Ruegg - ruegg@pbworld.com

Recent Agendas Items: Upcoming TBI from Met Council, Twin Cities ABM Model Status, DTA model Status. Big Data Sources, DTA, ABM, Surveys – looking to refine these into a potential research project at the next meeting.
Future Agendas Items: TBD
Next Meeting: May 31st, 2017 11:00am – 1:00pm, SRF’s Saint Paul Office

**Traffic Operation and Maintenance Discussion Group**
Committee Chair: Adam Bruening - adam.bruening@co.washington.mn.us

Recent Agenda Items: ATSSA, vendors/ new products, and agency techniques of maintaining pavement messages. Asphalt crack filling and the masks/respirators used during application
Future Agenda Items: ROW permitting process. Who tracks the work of the contractors in the ROW?
Next Meeting: TBD

**Simulation and Capacity Analysis Technical Committee**
Committee Chair: Joe DeVore - joseph.devore@kljeng.com

Recent Agenda Items: Blue Line Extension: Formalizing result formatting, new CORSIM freeway modeling guidelines, and calibrating roundabouts in VISSIM to the new HCM 7 capacities.
Future Agenda Items: TBD
Next Meeting: June 27th, 2017, 1:00pm - 3:00pm, MnDOT Waters Edge.
The City of Bloomington has a master plan for its South Loop District that provides a framework for transforming the District’s densities and character, from suburban to urban, and builds on the District’s unique mix of assets. The District is expected to attract over 165,000 persons per day by the Year 2020, and has several distinct transportation connections that make it a prime area for additional development. The District has convenient light rail transit access and is adjacent to the Minneapolis Saint Paul International Airport (MSP). The South Loop also has several sites ready for new development and already includes the Mall of America (MOA) and Bloomington Central Station, a signature mixed-use, transit-oriented development.

The City of Bloomington identified the desire for an intelligent wayfinding system to manage traffic in its growing South Loop District. The system will assist drivers to destinations within the District and reduce congestion by balancing trips on area roadways.

The overall intelligent wayfinding system envisioned for the District was broken into three components: Freeway, Local Roadway, and Mall of America On-site. The overall goal of the project was to develop a system that could be utilized to balance traffic, make more efficient use of existing infrastructure, and use dynamic message signs (DMS) to direct motorists to destinations.

**Freeway Component**

The freeway wayfinding component was completed in November 2011 with the installation of seven dynamic hybrid signs within MnDOT right-of-way. MnDOT staff operates the signs on the regional system using pre-established sign plans based on the agreed upon protocol developed with the City of Bloomington and the MOA. Alliant provided design and construction services to the City for this component.

**Local Road Component**

The local road wayfinding component was completed in October 2015 and included the installation of 13 full color matrix DMS, five closed circuit TV (CCTV) cameras, and several static signs located on 24th Ave, 34th Ave, American Blvd, Killebrew Dr, Lindau Ln, and Old Shakopee Rd. The system utilizes fiber optic cable for communications between the devices and the Public Works building. Alliant provided design and construction services to the City for this component.
**Mall of America Component**

The MOA on-site wayfinding system was completed in November 2016 and includes 10 full color matrix DMS and several static signs located near the entrance and exit to the parking ramps and on the circulation road immediately adjacent to the mall. The Mall also evaluated a vehicle counting system as part of this project. This system will allow for staff to automatically collect vehicle counts by ramp level. If the Mall moves forward with expanding the count system to each parking ramp level, the Mall could use the data to update parking availability signs that are envisioned to be located at each parking ramp level entrance. Alliant provided the design and construction administration services to the MOA for this component.

**South Loop Wayfinding Operations and Protocol Plan**

The operations and protocol plan developed for the project is a unique application that uses existing technologies. Alliant worked with the City of Bloomington, Bloomington Port Authority, MnDOT, MOA, Metro Transit, and Hennepin County to detail five pre-established scenarios and outline the subsequent message sets for the system. MOA staff and Bloomington Police work together to identify a message request, select the pre-established scenario, and the signs are activated.

The City also decided to use IRIS, an open source software developed by MnDOT, to control the signs and CCTV cameras. This required modification to the IRIS coding to control the specific equipment used for the project. This is a new application of an existing software and an improvement to the open source software, which will also provide future value to users of the IRIS system. The MOA is currently looking to use IRIS to control the signs located on the MOA property.
Imagine a regional highway, carrying 15,000 vehicles daily, closed 10 times in 50 years solely due to flooding. Now imagine five of those closures occurring in the last six years. Residents of St. Peter and Mankato, along with thousands of Minnesotans who travel Highway 169 daily, had been dealing with this issue since the 1960s. The Minnesota Department of Transportation (MnDOT) District 7 and local agencies knew raising this roadway out of the Minnesota River floodplain was the only solution. However, with an estimated cost of more than $30 million, project funding was a significant hurdle. Region Nine Development Commission and the National Association of Developmental Organizations (NADO) approached MnDOT about pursuing Disaster Relief Funds from the Economic Development Administration (EDA). These groups collaborated and secured $9 million for the project, making Highway 169 the first roadway in the nation to be funded with EDA Disaster Relief Funds.

This four-lane divided roadway project was not easy. The improvements included replacing seven miles of concrete pavement, reconstructing and raising the grade of two miles (up to six feet in some areas), improving drainage, and adding median barriers to minimize head-on crashes - all within right-of-way restricted by the Minnesota River floodplain and nearby bluffs. In addition, because of the high traffic volume, it was imperative that closures and detour durations were minimized. Innovation was crucial to meet all of these stipulations.
Bolton & Menk, Inc. used the 3D modeling software Corridor Modeler by Bentley to develop 3D surfaces for all sections of the roadway. We were able to reach a level of accuracy not typically achieved with traditional alignments, profiles, and cross sections. The design team also analyzed the design through innovative 3D visualizations. Examples include a 3D analysis of the stopping sight distance around a proposed median concrete barrier on a superelevated curve; and a model replicating a 100-year flood event verified the proposed freeboard of the roadway. The 3D design information was also easily transferred to the contractor who used it for stakeless grading of the select granular, aggregate base, pavement bottom, and final slope grading surfaces.

In addition to the stakeless grading surfaces, the concrete pavement was constructed using a stringless paving process. This process was achieved by extracting 3D polylines at each lane line from the design and setting up adjacent control stations in the field to communicate with the concrete paver (Figure B). By providing the paving contractor the extracted 3D polylines from Corridor Modeler directly, we achieved far greater accuracy than standard roadway design methods. This process allowed the paving machine to travel along virtual edges.

Although stringless paving is relatively new to Minnesota construction, it has been used extensively in neighboring states and across the country. To date, there have been few stringless concrete paving projects in Minnesota; all were constructed by out-of-state contractors. Stringless paving technology allowed the contractor to be ready for paving in any area of the corridor, within hours, not days, because they were no longer reliant on surveyors to set up stringlines days in advance.

New technologies and innovative processes were essential to completing this project in an aggressive eight-month timeframe—with only 18 weeks under a full closure and detour. MnDOT, the consultant staff, and the contractor representatives worked together to provide the necessary design data, survey control, and machine control expertise to deliver this critical infrastructure and economic improvement project. This project has set a precedent. Future projects must strive to implement new design and construction technologies in an effort to improve design and construction outcomes.
The construction operations of completing stringless paving showing communication of the control stations.

Road Completion of TH 169 Looking South
Advances in mobile technology have given rise to new data resources for transportation professionals. The ubiquity of mobile phones and GPS-connected devices provide highly accurate locational data of travelers. Review of these data offer vast new possibilities to support additional investigation of regional travel patterns that can result in making smarter decisions about investments in our regional transportation infrastructure.

Several recent projects in the Twin Cities metropolitan area have utilized INRIX Trips and Waypoints data to enhance the evaluation of origin-destination and travel patterns. These projects include:

- I-494/TH 62 Congestion Relief Study
- Highway 169 Mobility Study
- Rethinking I-94 Study
- ABC Ramps Transportation Options Study

Using this data provided additional insight to spatial and temporal traffic patterns in these respective study areas, however the size and complexity of the data sets required pioneering of new computational methods and data processing techniques. This article offers a summary of the findings that contributed to these study outcomes along with some of the challenges and solutions to working with the data.

**Data Overview and Processing**

The raw trip record data used for the analysis was obtained through INRIX, a commercial vendor that works with various navigation and communication providers to collect GPS data. Underlying sources of the data include in-dash navigation systems, after-market GPS devices, as well as trucks, taxis, and shuttles with automatic vehicle location (AVL) systems. Mobile devices that have opted to utilize the INRIX traffic app were also included in the sample. GPS points are collected by INRIX and provided in two parts – trips records and waypoints. The trip records provide location coordinates of each trip’s starting and ending points, while the waypoints are presented as a series of intermediate locations depicting the trip’s path through the study area.
While the trip record start and end points provide extremely useful data, the detailed waypoint data allows for much more detailed travel pattern analyses. However, the extra detailed data comes at the cost of requiring more innovative processing methods and resources. For example, the three-month sample for the *Rethinking I-94 Study* included over 6 million trips with approximately one-half billion total waypoints. With Microsoft Excel’s limit of just over one million records, other tools were required to store and process the data.

The INRIX data was initially loaded into a PostgreSQL database, an open-source relational database compatible with a variety of other tools. Custom scripts were written in Python to read from the database and conduct basic filtering and post-processing. Some of the data included portions of trips, such as when vehicles use navigation systems for only part of the journey. By using GIS to compare trip endpoints to roadway right of way, the team filtered the data to a subset of complete trips to ensure the origin and destination pairings were accurate.

The INRIX waypoints, by nature, are a set of discrete points, associated with the trip record using a unique identifier. To make use of this data for select link and other analyses, it was necessary to correlate the trips to a network path from the Cube modeling software. This correlation was completed through a custom Python program which compared the discrete waypoints for each trip to possible paths between the origin and destination. In total, over one billion possible paths were generated for the study area and used to match the INRIX waypoints. Ultimately, the resulting paths are displayed in the travel demand modeling software Cube, which facilitates visualization of many travel and market analyses, including select link analysis, ramp-to-ramp travel patterns, zonal direction of approach, and trip length distributions, among many more.

Numerous routes connect Eden Prairie and downtown Minneapolis. The GPS travel pattern data was able to demonstrate the proportion of users on each route, with TH 212 / TH 62 / I-35W being the most frequently utilized.

(Continued on page 24)
Project Applications

Application of GPS travel pattern data helped provide additional insight to project stakeholders. In the I-494/TH 62 Congestion Relief Study, for example, trip patterns that using parallel routes of I-494 and TH 62 were distinguished to understand the differences in these travel markets. The data were also critical to validation of the regional travel demand model, which was found to replicate regional travel patterns quite accurately. The data was also beneficial to public engagement efforts, allowing the study team to target its outreach to communities observed to use the study corridors.

The Highway 169 Mobility and Rethinking I-94 Studies also benefited from use of this data.

An investigation of trip origin-destination patterns on the US Highway 169 bridge over the Minnesota River revealed that less than 70 percent of these trips actually use Highway 169; over 30 percent divert to other nearby river crossing locations.

Trips from Minneapolis and Saint Paul neighborhoods were reviewed to assess the proportion that utilize I-94 through these cities. 40 percent or more of the trips generated in many neighborhoods were found to use I-94.
Key destinations were identified along these corridors, as well helping to identify an understanding of key regional travelsheds that may or may not utilize these highways. By leveraging the objective findings of this real-world data, it helped some stakeholders to overcome a variety of preconceived notions of the functions of the corridors, and contributed to more unified baseline impression of today’s existing conditions.

Finally, the ABC Ramps Transportation Options Study allowed for several innovative new applications of the data. In addition to understanding the travel patterns of trips parking in these facilities, the data was also used to assess the spatial and temporal patterns of ramp users. Geographically, a trip length comparison showed that, on average, trips parking in the ABC tend to be 8 miles longer than downtown trips in general.

Another exciting revelation showed that while the ABC Ramps serve a large number of commuters on all weekdays, arrivals on weekday evenings with Twins or Timberwolves games are similar to or greater than the number of commuters!

Findings and Conclusions

Locational data from mobile devices ushers in exhilarating new opportunities for transportation system evaluation. GPS data represents a new data resource that was not previously available and can provide significant insight to transportation professionals. Previous methods of collecting origin-destination data through in-person surveys or license plate capture would be cost prohibitive at the regional scale, and the locational accuracy of the GPS points doesn’t diminish as the size of the study area increases. A number of questions about the sampling of the data remain unanswered, such as population bias, penetration rate, etc., however experts hope that this will become more transparent as the technology matures. Nonetheless, there is much to be gained from this new data and many opportunities to leverage it and make smart decisions about investments in our regional transportation infrastructure.

A travel pattern investigation showed the predominant routes used by trips parking in the ABC Ramps in downtown Minneapolis, particularly I-394 and I-35W (to the south) which have MnPASS lanes and high numbers of carpoolers.
Managing Event Traffic

Bryant Ficek, P.E., PTOE | Spack Consulting

For some land use types, the day-to-day operations are relatively minor with almost no impact on traffic operations. However, these same places have one or more events that generate significant traffic and could result in issues on the transportation network. With non-standard traffic occurring only a few times a year, how does that impact a traffic study?

We’ve had the good fortune of working on several of these types of land uses, including Rochester Horror: Fright at the Farm, the Elk River Extreme Motor Park (ERX), and, most recently, a Buddhist Temple in Hampton, Minnesota. With this type of event traffic, we generally move away from the normal traffic study, often focusing exclusively on traffic management plans.

As with any traffic plan, the goals of the study are to move traffic safely and efficiently, minimizing conflicts among cars and people as well as minimizing conflicts between event traffic and existing traffic on the public road. This usually involves examining both the internal and external traffic operations. Here are our seven generalized items to consider for event plans:

1. Well-Defined Access Driveway. Traffic needs to move safely and efficiently off the public road and to the site’s parking areas. To avoid back-ups on the highway and conflicts with attendees walking around the site, we consider items like channelizers on the access driveway to separate directions of travel, fencing for distance on each side of the driveway to keep pedestrians from the driveway, and parking attendants to assist motorists to the parking area. Crosswalk guards can also be necessary to keep people from wandering into the driveway.

2. Clearly-Marked Parking Spot Indications. Many sites use a gravel or grass lot that doesn’t have permanent markings to guide drivers into the correct spot. Similar to snowy conditions in the northern states that make parking lines invisible, drivers are typically unable to maintain even rows of parking without some guidance. The result is inefficient use of parking with the drive aisle widths often getting reduced between parked...
cars. Flags, cones, or other visible items, can help clearly mark the parking spots and give drivers a marker to properly align their cars.

3. **Street/Pedestrian Lighting.** Darkness is an element that impacts all operations. The entrances and exits, particularly where any tours or attractions start and end, should be well lit to improve the safety for everyone. The parking areas should also have a lighted pathway if possible to guide people to the front door. Getting a sprained ankle or some worse incident on the walk from the car will definitely decrease the enjoyment of the attraction.

4. **Personal Safety Equipment.** Employees and volunteers that help direct traffic and pedestrians around the site need to be seen. We recommend a minimum of wearing reflective safety vests and carrying flashlights. A host of other visibility-enhancements are available for any parking attendants, security, or other personnel that will be working in the busy traffic areas. Not only will that help these people be seen, it also provides a factor of authority for attendees to follow.

5. **Safe Intersection Movements.** Permanent changes like new turn lanes or a traffic signal may not be appropriate for these types of land uses. Instead, consider temporary changes that improve intersection safety. This could include using barrels and signs to restrict movements (right-in/right-out only or ¾-access), using off-duty police officer(s) to control intersection movements, creating one-way operations on access roads, or using bussing to get people from a remote lot to the front door. Temporary changes can greatly enhance safety for an event without significant inconveniences.

6. **Roadway Signs.** Besides a sign noting the site attraction and entrance, warning signs were needed to alert highway users of the potential congestion (slow-downs on the highway for newly turning traffic). We consider a series of “Event Congestion Ahead” warning signs in addition to changeable message signs located upstream from a site’s driveway. This gave plenty of warning to all drivers of the new condition. Also important, make sure the signs are covered if the event is on non-sequential days.

7. **Website Information.** Providing as much up-front information to people as possible is always good to do. Traffic flow in particular moves better with less frustration if drivers have expectations for themselves and others. We recommend putting parking information on websites as well as noting any temporary changes impacting normal travel routes.

Depending upon the site, an iterative approach may be the best approach, refining the traffic plan as more information is obtained about its characteristics. An iterative study was exactly our methodology for our Buddhist Temple project. The Temple had proposed a minor expansion. As part of the city permit process, concerns were raised about their event traffic and we were contracted to assist.

**Our First Step** involved developing a traffic control plan based on a site review and some conservative estimates of expected traffic. As a non-standard land use, trip generation data for base forecasts and capacity analyses are not readily available. This first “traffic study” recommended the following plan:

- Widen the site driveway to at least 22 feet to accommodate two-way traffic flow.
- Hire an off-duty police officer to monitor and, if necessary, direct traffic at the site access intersection during the next event.
• Monitor the next event to review operations and determine if an off-duty police officer will be needed to control the site access at future events.

You can download a copy of the initial event traffic study memo here. The township/county agreed to this plan and allowed the expansion to occur. We came back six months later and monitored the event traffic per the third bullet point.

**Our Second Step** was then to video the site access during one of the large events at the Temple with our COUNTcams. We recorded 820 vehicles over the course of the day, with most arriving between 8 a.m. and noon and most leaving between 11 a.m. and 3 p.m. You can download our follow-up event traffic study memo here. Even though 820 vehicles was more than initially thought would be generated by the site, our review of the video and our capacity analyses found the police officer was not needed to direct traffic. Intersection delays and queuing were acceptable without this additional element.

This case study is a good example of our experimental approach to unique traffic situations. Basically – set-up a conservative plan with temporary traffic control, monitor the real-world operation, and then adjust the plan for the next event based on the real traffic operations to right size the traffic control.
March 2017
MEMBERSHIP UPDATE

New Members

Kshitij Sharma - Upper Great Plains Transportation Institute
Andrew Wells - Rani Engineering
Sri Durga Yada - HDR, Inc
Ann Fanger - Alliant Engineering
Bradley Wentz - Upper Great Plains Transportation Institute
Samuel Darrell Trotman - KLJ, Inc.
Carlos Moreno-Gomez - Westwood Professional Services
Stephen H. Smith - Alliant Engineering
Thomas R. Cook - Student at South Dakota State University
Abigail Hinrichs – Student at North Dakota State University
Zachary Holweger – Student at North Dakota State University

Moves

Vemon E. Swing – Spack Consulting, formerly with Westwood Professional Services
John Tweet – WSB & Associates, formerly with URS Corporation
Joseph Kern – retired, formerly with SRF Consulting Group, Inc.
Michael McCurdy – Alliant Engineering, Inc., formerly with Short Elliott Hendrickson
Dr. Raj Bridgelall, Program Director of Transportation, formerly North Dakota State University
David Sheen – Hennepin County, Public Works – Transportation Department, formerly with MnDOT

If you or a friend has changed jobs or moved, we would like to stay in touch. Members, please update your information by visiting http://www.ite.org/membership/index.asp. To access this area, you will need to know your membership number. Your “username” is your membership number, and your “password” is the first 6 letters of your last name (e.g. Johnson=Johnso). Non-members please contact Nicklaus Ollrich via phone (612.373.5350) or email (nicklaus.ollrich@metrotransit.org) for assistance. Please provide you name, title, employer, complete street address (including mailstop, if applicable), telephone number, fax number, and email address.