MnDOT's SPACE Tool: Using Equity Data to Inform Active Transportation Safety

Minnesota DOT (MnDOT) strives to serve all Minnesota residents by creating a multimodal transportation system that maximizes the health of people, the environment, and the economy. Between 2016 and 2020, 228 pedestrians and 42 bicyclists were killed in motor vehicle crashes in Minnesota.[1] MnDOT partnered with the Office of Traffic Safety within the Minnesota Department of Public Safety and the Minnesota Department of Health, along with other Federal, State, and local partners, to implement the _Toward Zero Deaths_ program. Minnesota's _Toward Zero Deaths_ mission is to "create a culture for which traffic fatalities and serious injuries are no longer acceptable."[2]

As part of the implementation of the _Toward Zero Deaths_ program, MnDOT focuses on three strategies: improving active transportation,[3] improving safety, and improving transportation equity across Minnesota's transportation system. MnDOT developed the **SPACE** tool—**S**uitability for the **P**edestrian **a**nd **C**ycling **E**nvironment—a GIS-based spatial analysis tool using publicly available data. An index of 19 social and demographic variables identifies where latent demand and crash risk exist on Minnesota's roadways, what areas warrant additional investigation, and helps with the selection and prioritization of projects and where to direct investments.

Using the SPACE Tool to Measure Latent Demand

The SPACE tool is an index of 19 social and demographic factors (listed in table 1) that are publicly available through the U.S. Census Bureau, the Twin Cities Metropolitan Council Planning Organization, and the Economic Research Service in the U.S. Department of Agriculture. These variables are used to calculate a SPACE score (out of a total of 100 points) for half-mile hexagons across the State; higher scores indicate latent demand and a potential need for bicycle and pedestrian facilities.

Table 1. SPACE score's 19 social and demographic factors.

% population **AGE 5-17** ≥ average	"Area of concern" by MPCA **ENVIRONMENTAL JUSTICE**
% population **AGE 65+** ≥ average	≥ 25% population within ½-mile of **SUPERMARKET**
% population **FOREIGN BORN** ≥ average	≥ 25% population within 1 mile of **K-12 SCHOOL**
% population **NATIVE AMERICAN** ≥ average	≥ 25% population within 500-feet of a **BUS STOP**
% population with **DISABILITY** ≥ average	≥ 25% population within an **URBAN** area
% workers **COMMUTING 15 MIN** or less ≥ average	**UNEMPLOYMENT** rate ≥ average
% workers **COMMUTING BY TRANSIT** > 0%	% population in **POVERTY IN URBAN** area ≥ 25%
% workers **COMMUTING BY WALKING** > 0%	Contains a state **BICYCLE TRAIL**
% workers **COMMUTING BY BICYCLE** > 0%	**HIGH RISK** trunk highway intersection for non-motorists
% workers with **NO ACCESS TO A VEHICLE** > 0%	

Using the SPACE Tool to Identify Fatal and Serious Injury Crash Risk

As shown in figure 3, the SPACE tool revealed that "71 percent of fatal and serious injury non-motorist [pedestrian and bicyclist] crashes occur within communities that have a SPACE score greater than 50, despite

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[1] For fatal pedestrian crashes in 2016-2020, there were 57 in 2016, 38 in 2017, 42 in 2018, 46 in 2019, and 45 in 2020. For fatal bicycle crashes, there were 7 in 2016, 6 in 2017, 7 in 2018, 11 in 2019, and 11 in 2020. National Highway Traffic Safety Administration (NHTSA) Fatal and Injury Reporting System Tool (FIRST). https://cdan.dot.gov/query

[2] Minnesota Toward Zero Deaths. https://www.minnesotatzd.org/

[3] "Transportation agencies and their partners can help people lead more active lifestyles by giving them options for getting to places they need to go without driving. They can also reduce the distance between destinations people travel to satisfy daily needs." U.S. Department of Transportation. Active Transportation. https://www.transportation.gov/mission/health/active-transportation

being the location of just 15 percent of the State's road miles."[4] Based on this analysis, MnDOT determined that a geographic unit with a SPACE score greater than 50 indicates a greater risk of fatal and serious injury non-motorized crashes. The score provides a metric that helps MnDOT prioritize the distribution of limited resources (e.g., time for site review, funding) to areas where safe Active Transportation infrastructure is most needed.
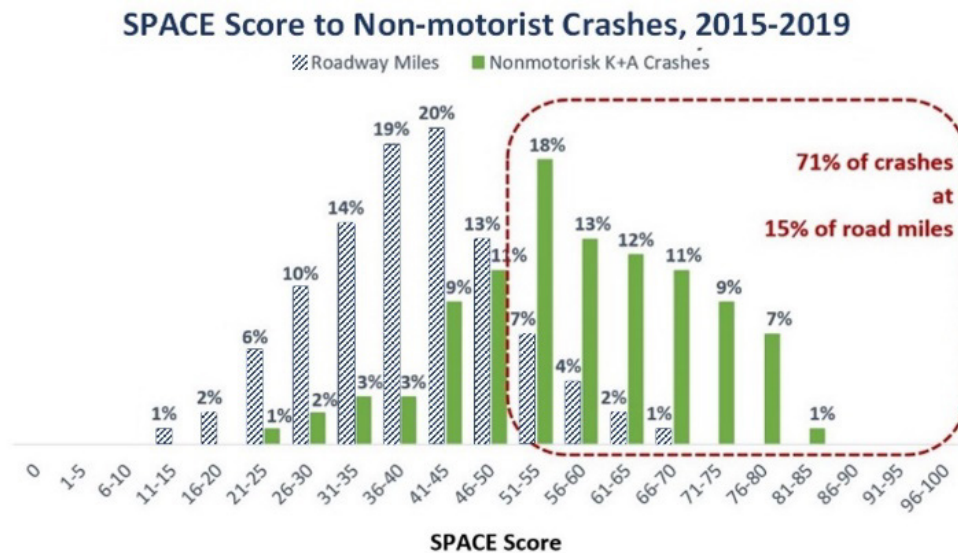

Figure 3. SPACE score as an indication of risk factor. Source: mndot.gov/trafficeng/index.html

Using the SPACE Tool to Aid in Project Identification and Prioritization

MnDOT integrated the SPACE score into current project identification and prioritization processes. The SPACE score helps MnDOT proactively identify locations with a high risk of fatal and serious non-motorist crashes. MnDOT then conducts Active Transportation scoping walks in these areas and provides recommendations to improve Active Transportation facilities.

Figure 4. Scoping walk. Photo source: MnDOT

Once a site is identified as a potential project location, the team invites local government officials and staff as well as local Minnesota Statewide Health Improvement Partners to join the scoping walk. This creates a collaborative environment to assess context-specific needs and builds buy-in between stakeholders.

The scoping walks help MnDOT better understand what the local user experiences while traveling along the project site. The scoping team assesses:

- *Motorized conditions:* Assess the speed limit and speed-related concerns against current contextual factors, traffic volumes, truck volumes, the road's overall cross section, and crash rates.
- *Non-motorized conditions:* Assess crash history, intersection risk assessment, crossing distances, visibility for both motor and non-motorized travelers, and the perceived comfort of facilities.
- *Types of roadway users:* Motorists, equipment (farm or other), pedestrians, bicyclists, ATVs, snowmobiles, etc.
- *Project context:* Destinations, origins, how welcoming is the space.
- *Origins and destinations:* Where might people walking or biking go to and from frequently.
- *Crossing locations:* Controlled, uncontrolled, mid-block.

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[4] mndot.gov/trafficeng/index.html

This information helps the scoping team understand demand, risk, and needs related to both equity and safety.

Poor pedestrian visibility at major intersection

Grass is noticeably worn where people want to walk

Figure 6. Factors to consider when conducting a scoping walk. Left: Limited visibility.
Right: Uncontrolled crossing location. Photo source: MnDOT

After compiling the observations from the scoping walk, MnDOT proposes a variety of countermeasures to include in upcoming construction projects, ranging from roadway reconfiguration to proven, cost-effective safety measures. These include Minnesota's Best Practices for Pedestrian and Bicycle Safety[5] (see below in figure 7), published in 2021, which highlights multiple countermeasures from FHWA's Every Day Counts Safe Transportation for Every Pedestrian (STEP) resources and NHTSA's Countermeasures That Work publication. The scoping team's recommendations are shared with the local project teams for consideration. MnDOT then conducts listening sessions with local partners to inform localities about the projects MnDOT will support and to learn about potential challenges that may occur during the implementation of the project.
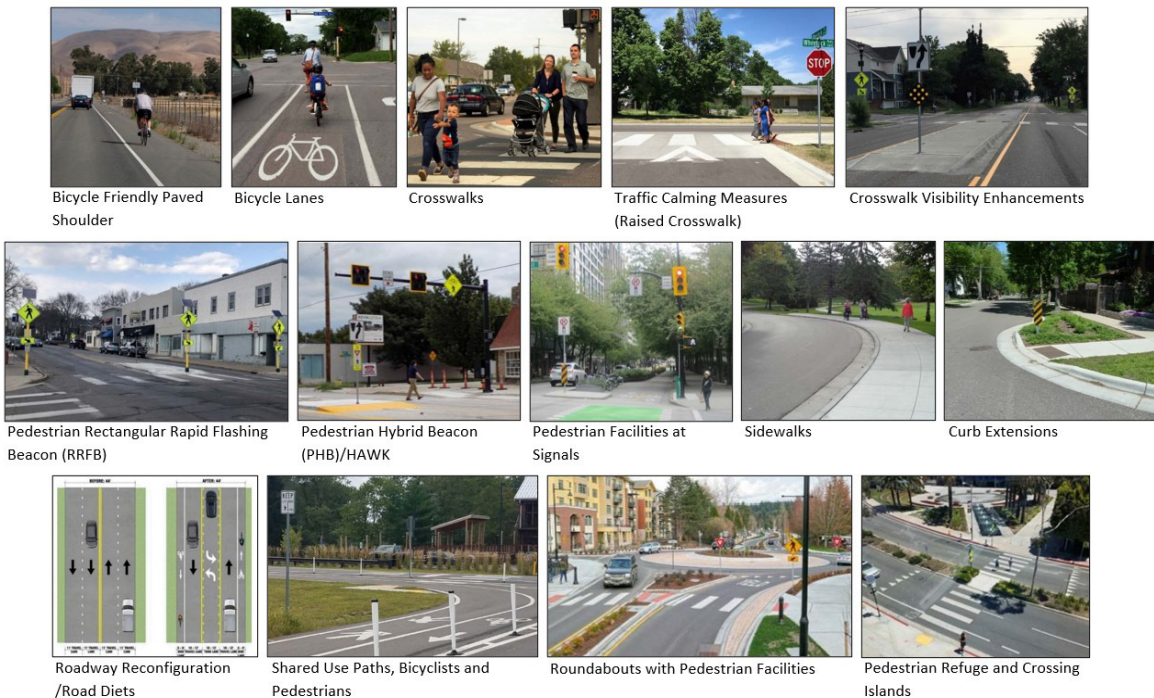

Bicycle Friendly Paved Shoulder | Bicycle Lanes | Crosswalks | Traffic Calming Measures (Raised Crosswalk) | Crosswalk Visibility Enhancements

Pedestrian Rectangular Rapid Flashing Beacon (RRFB) | Pedestrian Hybrid Beacon (PHB)/HAWK | Pedestrian Facilities at Signals | Sidewalks | Curb Extensions

Roadway Reconfiguration /Road Diets | Shared Use Paths, Bicyclists and Pedestrians | Roundabouts with Pedestrian Facilities | Pedestrian Refuge and Crossing Islands

Figure 7. MnDOT's pedestrian and bicyclists scoping recommendations. Photo source: all photos are from Minnesota's Best Practices for Pedestrian and Bicycle Safety, January 2021.

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5 http://www.dot.state.mn.us/stateaid/trafficsafety/reference/best-practices-ped-bike-safety.pdf

ST. CLOUD, MINNESOTA

Location: Central, MN. Roughly 1-hour northwest of Minneapolis, MN.
Population: 69,000 people (as of the 2020 census)
SPACE Score: 53 in 2018

The SPACE tool outputs, shown in Figure 1, highlighted the need for further investigation in St. Cloud, Minnesota. The results prompted the team to review Google map images shown in Figure 2, below. From Google map, the MnDOT team identified multiple uncontrolled crossings, labeled with "A" on in Figure 2, around a signalized clover interchange.
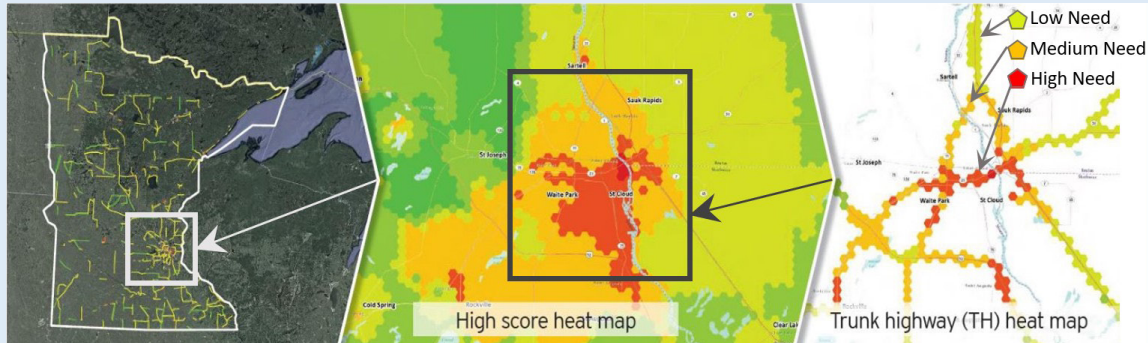

Figure 1. St. Cloud SPACE output. Source: MnDOT

Figure 2. St. Cloud uncontrolled crossing. Source: MnDOT

The MnDOT team conducted a scoping walk, revealing the walking public had to cross a state highway to access a grocery store, bank, churches, department stores, and transit stop at many uncontrolled crossing locations. Through targeted engagement, the MnDOT active transportation team was able to add active transportation routes to the interchange project. This includes adding a road with adequate walking/biking facilities to connect the East and West sides bridging the highway. Additionally, plans have been developed for future city projects to continue the connection on city streets. Finally, the team is working with the transit provider to relocate transit stops and implement additional improvements in order to provide reliable stops near homes and reduce rider needs to cross a high-speed highway.

Collaboration

The SPACE tool aligns with MnDOT's Toward Zero Death goals, and MnDOT's active transportation safety engineers use the tool's outputs to support outreach both internally, with other divisions and offices, and externally, with advocacy groups and the public.

Collaboration was critical for the development of the tool. MnDOT's active transportation safety engineers worked with local partners, MnDOT's Office of Transit and Active Transportation, MnDOT's Policy Planning Office, and other Minnesota State agencies to select the most relevant indicators to include in the SPACE tool. This collaborative approach resulted in multiple adjustments to the tool, making it more predictive with each iteration.

The active transportation team then worked to educate MnDOT staff and local stakeholders to ensure that users are aware of and understand the predictive power of the SPACE tool. As noted in the section above, the SPACE tool generates opportunities for continued collaboration between MnDOT staff and local partners during scoping walks.

BENA, MINNESOTA

Location: Northern, MN, within the Leech Lake Tribal Reservation
Population: 116 people (as of the 2010 census)
SPACE Score: 68 in 2018

Based on the high SPACE score, the MnDOT team conducted a scoping walk in Bena, MN. The walk revealed that individuals had to walk along a busy highway to reach employment and cross that same busy highway to access the General Store as shown in the image below. The scoping team also noticed multiple uncontrolled crossings. The team learned that Bena has low car ownership and is located 20 (town) to 35 (regional center) miles from the nearest employment center. MnDOT prioritized safety improvements for Bena, including improved high visibility crossings and transportation alternatives applications for a trail. Improvements are set to begin in 2023.

Figure 5. Bena SPACE output. Source: MnDOT

Current and Future Outcomes

Project locations originally identified by their SPACE score are currently in- or will soon begin - construction. As a result, before and after data is not yet available for the project sites selected using the SPACE tool.

MnDOT has continued to update the SPACE tool since its development to make it into the most predictive version. For example, MnDOT updated their Supermarket and Bus Stop variables by increasing the distance individuals are required to travel to reach a supermarket or access bus stops. These updates resulted from MnDOT's continued learning about the metrics and now provide a better representation of where and how far people in food deserts and transit-reliant communities need to walk and bike the most.

How to get started: "Just start, do something, and continuously iterate—there is a lot of public data available for agencies to use. Know that there will be hurdles."

The MnDOT team continues to improve upon and identify how the SPACE tool can facilitate proactive safety measures using predictive, data-driven analysis. Using SPACE, MnDOT can schedule scoping walks and potentially proactively address dangerous locations before serious injuries or fatalities occur. As Sonja Piper [Active Transportation Safety Engineer] noted, "You never get ahead if you follow historic crash data."

Summary

To systemically identify locations for pedestrian safety improvements, MnDOT developed the SPACE tool, an index of 19 social and demographic variables that has proven to proactively identify latent demand and fatal and serious injury crash risk. This data-driven approach has allowed for MnDOT's pedestrian safety specialists to expand existing and develop new partnerships as well as communicate with a broader audience, including public officials and community members. The tool is now being used to direct funding for infrastructure improvements to areas that will make the most difference in reaching the goal of zero deaths.

Lessons Learned

- Let equity data proactively drive project identification to limit selection bias and maintain consistent review of all sites.
- Tell a story—transform the information from numbers to people. Some readers, including local officials, transportation professionals, or the greater community, may respond more to the statistics while others may respond more to the stories of the community.
- Tailor messaging to your audience—show each group how their mission aligns with the goals of this tool, explain the business case through data to help leaders understand the benefits of the SPACE tool, and include necessary context.
- Use the SPACE tool outputs to inform other funding requirements such as HSIP or to advocate for grant funding in discretionary grant applications.
- Use the Statewide Pedestrian Safety Action Plan, Safe Routes to School, and other State plans and programs as a starting point. It does not need to be complicated. It's about leveraging the information that is available.
- Expand your network. Ask questions and don't be afraid to make mistakes. You will forge new relationships with the right people and offices this way.

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