

# RESEARCH SPOTLIGHT

## Project Information

**REPORT NAME:** Evaluating the Performance and Safety Effectiveness of Roundabouts—An Update

**START DATE:** March 2021

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**RESEARCH REPORT NUMBER:** SPR-1725

**TOTAL COST:** \$210,000

**COST SHARING:** 20% MDOT, 80% FHWA through the SPR, Part II, Program

## MDOT Project Manager



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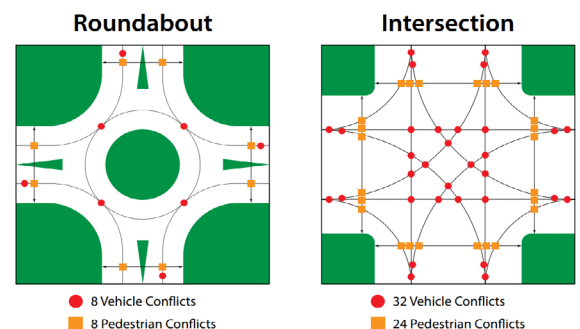
## Maximizing the safety, economic and environmental benefits of Michigan roundabouts

Roundabouts have well-documented traffic and safety benefits compared to many types of traditional intersections. As design standards have evolved and the number of roundabouts has more than doubled in Michigan over the last decade, a new assessment of the safety and operational effects of existing roundabouts and their environmental and economic impacts gives the Michigan Department of Transportation (MDOT) valuable insight for designing and constructing future roundabouts across the state.

### PROBLEM

Since Michigan's first modern roundabout was built in 1996, more than 180 have been installed statewide to replace intersections that previously had traffic signals or stop signs. In addition to their well-established safety benefits, roundabouts improve traffic flow and reduce traveler delays, fuel consumption and air pollution.

A [2011 MDOT study](#) demonstrated the safety benefits and cost-effectiveness of 58 roundabouts in Michigan. A [second 2011 MDOT study](#) evaluated driver behavior and developed a public education campaign to encourage support and increase user confidence. Since then, roundabout designs and safety features have evolved, many more roundabouts have been built and MDOT and transportation



Roundabouts have significantly fewer points where crashes may occur than traditional intersections with traffic signals or stop signs.

agencies around the state are planning more.

MDOT wanted an updated understanding of how the state's roundabouts were operating, if driver behavior had changed over the years and the best design practices to use moving forward. As construction costs continue to rise, the agency needed assurance that roundabouts are still a good

*“By applying what we’ve learned over the years regarding roundabout safety and performance, this comprehensive study helps MDOT – and potentially other state DOTs – to determine how roundabouts should be designed and where they should be placed to maximize their effectiveness.*”

**Jason Ealy, P.E.**

Project Manager

investment. The goal of this project was to assess the operational and safety performance, environmental efficacy and cost-effectiveness of roundabouts in Michigan to inform future planning and design efforts.

## RESEARCH

A comprehensive safety analysis included data from 2004 to 2019 for all of the state’s roundabouts and, for most, a nearby control intersection with traffic signals or stop signs. Roadway geometry data, traffic volumes and crash data from the Michigan State Police provided the bases for comparing the frequency and types of crashes at sites before and after the roundabouts were installed and at control sites.

To assess operational performance, researchers evaluated driver behavior and measured vehicle travel speeds at 18 selected roundabouts. The captured data reflected speeds of more than 19,000 vehicles and monitored gap acceptance behavior – the amount of space drivers allowed between vehicles – and drivers’ tendency to yield to other vehicles and pedestrians at crossings. Several variables, such as the presence of warning signs, speed limits and number of lanes in the roundabout, informed the data analysis.

Traffic volume data from MDOT and roundabout analysis software supported a comparison of 15 sites and their control counterparts for differences in traffic delays caused by congestion. Investigators then compared the savings from decreased fuel consumption, reduced delays and changes in crashes to the costs of converting a traditional intersection into a roundabout.

## RESULTS

Historical and field data collection, comparisons to traditional intersections and data analysis revealed some important performance differences among roundabout designs and site characteristics.

**Safety impacts:** Based on a review of the crash data for 142 roundabouts, the research showed that crashes occur more often at roundabouts than at traditional intersections. However, crashes at roundabouts are less likely to result in severe injuries or deaths.

**Operational and environmental impacts:** Compared to traditional intersections, roundabouts were found to reduce traffic delays by more than 63 percent on average and estimated fuel savings were more than \$69 per vehicle per year. Also, converting an existing intersection to a roundabout generally results in benefits six times greater than the costs of the conversion.

**Driver behavior:** A roundabout’s geometry, and other variables such as traffic volume and the presence of warning signs, influenced drivers’ speeds as they entered the roundabout. Drivers accepted smaller gaps at roundabouts with more than one lane, three-legged roundabouts and those located in rural areas. Roundabouts on interchanges, where speeds tend to be higher, had the lowest yielding rates toward pedestrians and other vehicles while roundabouts with pedestrian hybrid beacons produced higher yield rates than those without.

Lastly, to help MDOT transportation planners determine whether converting a traditional intersection to a roundabout

would be beneficial, researchers recommended traffic modeling tools that can predict the number of crashes at an intersection based on its design and other characteristics.

## IMPLEMENTATION

MDOT will incorporate the findings from this project into its [Safe System Approach](#) for eliminating fatalities and serious injuries for all road users, and may investigate additional opportunities and accommodations to make roundabouts safer for pedestrians and non-motorists.

## Research Administration

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### Final report and related materials are available online at

[MDOTjboss.state.mi.us/TSSD/tssdResearchAdminDetails.htm?keyword=SPR-1725](http://MDOTjboss.state.mi.us/TSSD/tssdResearchAdminDetails.htm?keyword=SPR-1725).

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