Intersection Collision Warning System (ICWS)

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Description: Intersection Collision Warning Systems (ICWS) help to inform the crossing or entering vehicle regarding whether there is an approaching vehicle(s). The selection of insufficient gaps has been shown to be a contributing factor at intersections where one direction is stop-controlled while the other is uncontrolled. Intersections of this type in rural areas can be particularly challenging due to the high-speed nature of the through traffic. An ICWS can be defined as a "traffic control device placed on major, minor or both roads of an intersection to provide drivers with a real-time dynamic warning of vehicles approaching or waiting to enter the intersection." Therefore, ICWS are NOT intended to assist a driver in selecting appropriate gaps; rather, their intent is to assist a driver with *rejecting* unsafe gaps.

Rural Transportation Critical Needs

- ☑ Crash Countermeasures
- ☐ Emergency Services
- ☐ Operations & Maintenance
- ☐ Rural Transit & Mobility
- ☐ Surface Transportation & Weather
- ☐ Tourism & Travel Information
- ☐ Traffic Management

Issues Addressed

- ☐ Road Geometry Warning
- ☐ Highway-Rail Crossing Warning
- ☑ Intersection Collision Warning
- ☐ Pedestrian Safety
- ☐ Bicycle Warning
- ☐ Animal Warning
- ☑ Collision Avoidance
- ☐ Collision Notification

Strategies Achieved

- ☑ Road User
- ☐ Road
- ☑ Vehicle
- ☐ Safety Culture
- ☑ Engineering
- ☐ Emergency Response
- ☐ Enforcement
- ☐ Education

Applicability	Partnerships	Key Components
•ICWS are very applicable in the rural context and are a cost-effective approach to address collisions that while often infrequent, can have significant consequences.	•Applications benefit from collaboration among numerous agencies, which may include: •Departments of transportation (local, state, federal) •Research institutions •Law enforcement	•Key components are identified for systems with higher initial costs, as well as lower initial costs: •Higher initial costs •Traffic signal controller •Loop detectors/microloops •Wired •Commercial/power grid •Contracted maintenance •Lower initial costs •Relay-based or simple detector control method •Non-intrusive/radar •Wireless •Solar power/battery •Agency-provided maintenance

Examples of Implementation

- **Minnesota Department of Transportation**

The Minnesota Department of Transportation found that 80 percent of intersection crashes at thru-stop intersections were related to a driver's selection of insufficient gaps.

- **M-44 & Ramsdell Drive; Michigan**

A review of Michigan's rural intersection crashes was performed to identify potential locations for the installation of intersection decision support systems.

- **Intersection Collision Warning Systems in Georgia**

A review of Georgia's rural intersection crashes was performed to identify potential locations for the installation of intersection collision warning systems.

- **Olmsted County, Minnesota**

Through the development of a local road safety plan, Olmsted County, Minnesota identified the need for dynamic warning signs at rural stop-controlled intersections.

Implementation Considerations (General)

- An educational campaign, both for the public and law enforcement is recommended.
- Providing cameras on-site can help maintenance crews remotely monitor the functionality of the system.
- Each intersection is unique, so a "cookie-cutter" approach cannot be used.
- Presence of driveways on major and minor roadways may impact system installations.
- An estimated 60-100 kWh of electricity per month is required per site.
- Should NOT be applied to locations where the daily volumes of the minor roadway exceed 1,000 vehicles per day (VPD), major roadway exceed 6,000 VPD, or cross product of minor and major roadway volumes exceeds 12 million vehicles.
- ICWS primarily address right-angle crashes.
- Intersections near railroad crossings are NOT good candidates.
- Horizontal curves and presence of turn lanes may reduce their effectiveness.

Implementation Considerations (Pro)

- After experience with their first ICWS installation, county engineers requested another system.
- The benefit/cost ratio was 35:1 and 13:1 for a two-lane at two-lane intersection and two-lane at four-lane, respectively.
- ICWS have been found to reduce crashes at an intersection from 10% to 57% for two-lane at two-lane locations and 3% to 39% for two-lane at four-lane locations depending on the crash type.

Implementation Considerations (Con)

- Faulty equipment has been reported to have caused failures.
- Some reports of traffic not detected when observed.
- Complaints of small gaps.
- Reports of vandalism to the units.
- Concerns with "data overload."
- Concerns with whether or not motorcyclists are detected.
- Concerns that people do not read the "When Flashing" supplementary sign.
- Traffic on frontage road may activate sign.

Opportunities for Future Expansion

- An agency can choose to implement the technology on either the minor or major leg of the intersection, or to implement both concurrently. Therefore, one potential area for expansion would be to add the major or minor direction, depending on which one is chosen first for implementation.
- As vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) technology advances, the information could be directly sent to the vehicle rather than requiring a driver to react to the warning beacons.

Useful Tip

As identified in the Key Components section, an ICWS system can be set-up using lower initial costs or higher initial costs, depending on the preferences of the agency installing the system.

Additional Resources

- Minnesota Department of Transportation (MnDOT), *Intelligent Transportation System Projects, Rural Intersection Conflict Warning Systems (RICWS),* found here: http://www.dot.state.mn.us/its/projects2011-2015.html
- *Reducing Crashes at Rural Intersections: Toward Multi-State Consensus on Intersection Decision Support,* found here: http://www.dot.state.mn.us/guidestar/2006_2010/reducing_crashes_at_rural_intersections.html
- *MnDOT RICWS Safety*, found here: http://www.dot.state.mn.us/its/projects/2011-2015/rural-intersect-conflict-warn-system/documents/d3ricwssafety.pdf
- *MnDOT RICWS system video*, found here: https://www.youtube.com/watch?v=cLAL10hTEXI
- U.S. Department of Transportation, Federal Highway Administration, *Stop-Controlled Intersection Safety: Through Route Activated Warning Systems*, found here: https://ntlrepository.blob.core.windows.net/lib/42000/42200/42237/traws.pdf

Cost Range

(Cost/financial information, where noted, is based on 2016 dollars (unless otherwise specified). Cost/financial information is estimated, and will vary based on size and scope of project, number of units, etc. In general, capital costs include initial purchase costs of hardware, software, and other required equipment. Maintenance and operations costs include staff time to operate, monitor and maintain systems; data collection; system upgrades; evaluation; etc.)

Capital Costs: The total capital costs for this tool range from medium ($50,000 to $100,000) to high ($100,000 to $250,000). A study conducted in three states (Minnesota, Missouri, and North Carolina) found costs to deploy an ICWS could range from $8,602 to $136,204 depending on the number of road lanes and how the system is installed[1]. In Minnesota, installing a system ONLY on a minor or major route cost $51,000 whereas installing a system on BOTH a major and minor route ranged in cost from $102,000 to $127,500[2].

Operations Costs: The operations and maintenance costs for this tool are anticipated to be low (Less than $50,000). On average, those that have deployed the system reported one maintenance trip annually. In addition, the Iowa Department of Transportation reported that the maintenance costs were not very expensive; however, they have made a concerted effort to minimize their installations of ICWS to reduce the burden on their maintenance staff[1].

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