Wisconsin's Oversize–Overweight Truck Route Evaluation and Efficiency

HANI TITI, NICHOLAS COLEY, DANIEL J. MULDER, AND WILLIAM WONDRACHEK

Titi is Professor and Coley is Graduate Research Assistant, Department of Civil and Environmental Engineering, University of Wisconsin–Milwaukee. Mulder is Freight–Roadside Facilities Section Chief, and Wondrachek is former Freight Engineer Lead, Bureau of Highway Maintenance, Wisconsin Department of Transportation, Madison.

A research project was conducted at the University of Wisconsin–Milwaukee, with funding from the National Center for Freight and Infrastructure Research and Education, or CFIRE, and the Wisconsin Department of Transportation (DOT), to develop an Oversize–Overweight (OSOW) vehicle traffic–history analysis portal. This application is focused on single-permit OSOW truck traffic to visualize routing trends, identify heavily traveled highway segments and intersections, evaluate truck routing and efficiency, and provide support to Wisconsin DOT for transportation infrastructure design and rehabilitation. Figure 1 (page 38) depicts an OSOW truck on State Trunk Highway 11 (STH-11) in Wisconsin.

Problem

Wisconsin DOT issues both single- and multi-trip permits for OSOW vehicles. Single-trip permits are granted for a specific vehicle and route. Permit routes for vehicles with a gross vehicle weight (GVW) of less than 270 kips (135 tons) are automatically analyzed by Wisconsin DOT's enterprise geographic information system (GIS), which includes a database of segment restrictions such as bridge ratings, spring thaw limitations, and temporal restrictions for traffic regulations or special events. Superheavy vehicle permits for vehicles heavier than 270 kips (135 tons) are analyzed manually by Wisconsin DOT's bridge and pavement engineering divisions before approval.

As the number of OSOW vehicle permits issued in Wisconsin have increased in recent years, the management and analysis of OSOW permit data has become more labor-intensive and time-consuming. Large quantities of archived OSOW permit data—in the hundreds of thousands—are held by Wisconsin DOT. The manual extraction and analysis of these data for various purposes requires significant effort, is time consuming and may cause project delays if the needed data are not readily available.

As a result, there was a need to develop an interactive application capable of analyzing and presenting the historical data, with the ability to expand by adding future data at the end of every quarter, to be available for the coming years.

Solution

The objectives of this research project were to create software that would draw from the state's extensive OSOW permit database and would be used to define historical route and system corridor activity. The data query application would allow both for operational assessments for new permit application considerations and would provide invaluable planning benefits for future system improvement projects. This data-driven approach is essential to modify OSOW truck route maps to reflect historical use.

A significant portion of the project was devoted to mapping the routes of the OSOW permits dataset (data from 2007 to 2018). The route information was available only as a textual route description. The researchers used customized Visual Basic for Applications scripts for text parsing and route processing, with the results linked to a GIS database to map the permit routes onto a digital map of Wisconsin's highway network. The OSOW permits database encompasses all single-trip permits issued in Wisconsin between May 2007 and December 2018, including axle records for

FIGURE 1 OSOW truck on STH-11 in Wisconsin.

OW permits. The route-matching algorithms succeeded in mapping 98.4% of all single-trip permits.

The results allowed for visualization of permit traffic, geospatial queries of permit routes, origin–destination (O-D) analyses, and identification of heavily used permit vehicle corridors (see Figure 2, page 39). These results have many applications for highway and pavement design, bridge engineering, freight trend analysis, and highway system planning.

Figure 2*a* depicts an output of the analysis application, in which the OSOW vehicle routing is visualized and quantified. The results show significant variations in the number of permit vehicles across different highways as well as the highways that were most used by permit vehicles in Wisconsin and an O-D map (as shown in Figure 2*b*).

As an example, these analyses led to the identification of segments that received high levels of permit traffic (see Figure 2*c*), including some relatively minor highways, such as STH-140. In the case of the two-lane STH-140, overweight permit traffic rivals the levels on the nearby six-lane Interstate highway I-90/I-39, in part because of STH-140's suitability for use by trucks as a bypass.

Visual identification of permit route patterns and heavily traveled segments assisted in the selection of highway segments for further study, including the *Mechanistic–Empirical Pavement Design Guide* analysis (using AASHTOWare ME Pavement Design Software) and field testing of current pavement conditions.

Application and Benefits

Based on this research project, Wisconsin DOT Truck Route Evaluation and Efficiency (TREE) was designed specifically as a system planning and improvement tool; however, it also has been a great operational resource in vetting daily permit requests to define alternative route options. The TREE task force finalized maps of OSOW routing and is in the process of updating Wisconsin DOT design guidance, the *Facilities Development Manual*. This has resulted in

1. Identification of frequently used OSOW vehicle routes;
2. Identification of average OSOW vehicle dimensions;
3. Identification of frequent O-D pairs;
4. Resolution of interregional route conflicts for proposed final mapping by allowing region by region review of historical use;
5. A draft standard for classifying Long Trucks, 75- and 65-foot-restricted routes, and sensitivity testing;
6. Verification of suitability of routes and intersections to accommodate movement of OSOW vehicles; and
7. Requirements for construction project reviews to define compliance to OSOW design standards on designated OSOW routes.

The most direct benefit of this research is that using this data tool has allowed Wisconsin DOT to evaluate the entire statewide OSOW route system. Based on this assessment, Wisconsin DOT has been able to

1. Reduce the total mileage of OSOW Truck Route (OSOW-TR) from 5,784 miles to 3,963 miles, and
2. Reduce the number of OSOW-TR Wide-Truck Route intersections from 269 to 151.

These reductions in system OSOW accommodations will benefit the public and save resources by precluding added investments to sustain higher design standards on 1,821 fewer miles and 118 fewer intersections, while still meeting the operational needs of industry. Since its implementation, this data tool has been used regularly both by the agency's operations and planning areas to provide accurate insights into OSOW routing histories.

Reduced intersections and OSOW-designed routes reduce engineering and permit staff resources needed to evaluate and maintain system assets and create more efficient and streamlined routing evaluations for staff and industry by convening the routing evaluations and system engineering assessments on a much-reduced system inventory.

Wisconsin DOT OSOW unit personnel experienced a significant time savings in providing data, trends, and information to various district engineers across the state for different needs. The Wisconsin DOT permit office formally consisted of six full-time equivalents (FTEs). It now consists of four FTEs, fully burdened at $58,968 each, for a total of $117,936; annualized savings of two positions was accomplished through attrition.

For more information, contact Hani Titi, Professor, Department of Civil and Environmental Engineering, University of Wisconsin–Milwaukee, at 414-229-6893 or hanititi@uwm.edu.

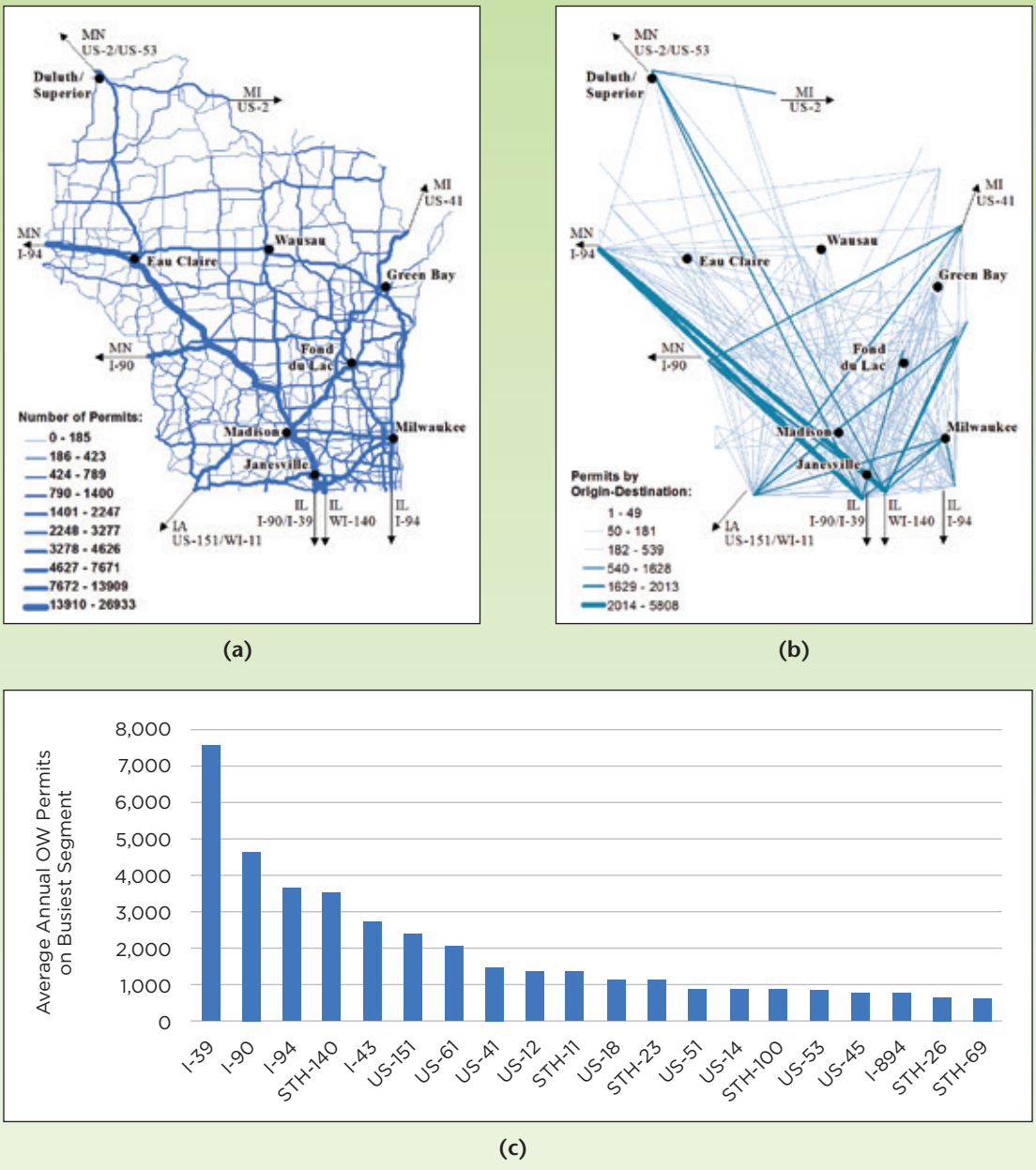

FIGURE 2 Typical results of the analysis tool developed for OSOW single-trip truck traffic: (*a*) maps of OSOW single-trip truck traffic; (*b*) OSOW O-D; and (*c*) most heavily traveled highways by single-trip OW permit trucks.

RESOURCES

Wisconsin Department of Transportation. Oversize-Overweight Permits, 2018. http://wisconsindot.gov/Pages/dmv/com-drvvehs/mtr-car-trkr/osowgeneral.aspx.

Adams, T., S. Malaikrisanachlee, C. Blazquez, and A. P. Vonderohe. GIS-Based Oversize/Overweight Vehicle Routing System. Report 0092-45-19. University of Wisconsin–Madison, 2002.

Coley, N., H. H. Titi, and V. Latifi. Mapping Overweight Vehicle Permits for Pavement Engineering Applications. *Journal of Transportation Engineering*, Vol. 142, No. 10, 2016, pp. 1–13. https://doi.org/10.1061/(ASCE)TE.1943-5436.0000875.

Shatnawi, A. S., N. Coley, and H. H. Titi. Interactive Data Framework and User Interface for Wisconsin's Oversize-Overweight Vehicle Permits. *Journal of Data in Science*, Vol. 3, No. 2, 2018, p. 20. https://doi.org/10.3390/data3020020.

Titi, H. H., N. Coley, and V. Latifi. Evaluation of Pavement Performance due to Overload Single Trip Permit Truck Traffic in Wisconsin. *Journal of Advances in Civil Engineering*, Vol. 2018, No. 1070653, 2018. https://doi.org/10.1155/2018/1070653.

Titi, H. H., N. Coley, V. Latifi, and M. Matar. Characterization of Overweight Permitted Truck Routes and Loads in Wisconsin. *Transportation Research Record: Journal of the Transportation Research Board, No. 2411*, Vol. 2, 2014, pp. 72–81.