Organizing for TSMO

Case Study 12: Border Crossings

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16. Abstract Given the varying stages of TSMO adoption and advancement, the Federal Highway Administration identified the need for case studies to provide examples of common challenges and best practices for transportation agencies to learn from each other. This is one of 12 case studies developed to support organizing for reliability. This case study focuses on how applying TSMO to border crossing operations can improve operations and help reduce challenges faced by agencies. Two agencies with mature border crossing and TSMO programs were interviewed: Whatcom Council of Governments (WCOG) and Niagara International Transportation Technology Coalition (NITTEC). Each agency provided information on how they managed border crossing challenges, their lessons learned, and the next steps to continually improve these efforts.		
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LIST OF ACRONYMS

AASHTO ....American Association of State Highway and Transportation Officials
CMM.. Capability Maturity Model
FHWA...Federal Highway Administration
IMTC.. International Mobility and Trade Corridor
ITS.. Intelligent Transportation Systems
MPO..Metropolitan Planning Organization
NITTEC ....Niagara International Transportation Technology Coalition
RFID ....Radio Frequency Identification
SHRP2... Strategic Highway Research Program 2
TRB...Transportation Research Board
TSMO .... Transportation Systems Management and Operations
UPWP .... Unified Planning Work Program
U.S. ....United States
WCOG .... Whatcom Council of Governments
WSDOT .... Washington Department of Transportation

EXECUTIVE SUMMARY

Transportation systems management and operations (TSMO) provides tools for transportation managers to address safety, system performance, and reliability. TSMO is "an integrated set of strategies to optimize the performance of existing infrastructure through the implementation of multimodal and intermodal, cross-jurisdictional systems, services, and projects designed to preserve capacity and improve security, safety, and reliability of the transportation system."[1] Through participation in the second Strategic Highway Research Program (SHRP2) workshops, transportation agencies are working to better support TSMO programs. Deploying intelligent transportation systems (ITS), hiring internal information technology staff, and using performance measures for data-driven decisions are just a few examples of many activities a TSMO program can support.

Given the varying stages of TSMO adoption and advancement, the Federal Highway Administration identified the need for case studies to provide examples of common challenges and best practices for transportation agencies to learn from each other. This is one of 12 case studies developed to support organizing for reliability. This case study focuses on how applying TSMO to border crossing operations can improve operations and help reduce challenges faced by agencies, including:

- Incorporating TSMO into existing processes and programs.
- Managing freight.
- Managing delay at borders.
- Collaborating between numerous local and international agencies.
- Managing ITS.

Two agencies with mature border crossing and TSMO programs were interviewed: Whatcom Council of Governments (WCOG) and Niagara International Transportation Technology Coalition (NITTEC). Each agency provided information on how they managed border crossing challenges, their lessons learned, and the next steps to continually improve these efforts. Some of the best practices identified include:

- WCOG's travel time algorithm improvements in collaboration with United States and Canada customs agencies.
- WCOG's border model to simulate potential operational improvements.
- NITTEC's involvement with multiple regional committees which discuss regional challenges and share best practices
- NITTEC's traveler delay messaging improvements in collaboration with international agencies.

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[1] Source: https://ops.fhwa.dot.gov/tsmo/index.htm

CHAPTER 1 – INTRODUCTION

Historically, transportation agencies have managed congestion primarily by funding major capital projects that focused on adding capacity to address physical constraints such as bottlenecks. Operational improvements were typically an afterthought and considered after the new infrastructure was already added to the system. Given the changing transportation landscape that includes increased customer expectations, a better understanding of the sources of congestion, and constraints in resources, alternative approaches were needed. Transportation systems management and operations (TSMO) provides such an approach to overcome these challenges and address a broader range of congestion issues to improve overall system performance. With agencies needing to stretch transportation funding further than ever and demand for reliable travel increasing, TSMO activities can help agencies maximize the use of available capacity and implement solutions with a high benefit-cost ratio. This approach supports agencies' abilities to address changing system demands and be flexible for a wide range of conditions.

Effective TSMO efforts require full integration within a transportation agency and should be supported by partner agencies. This can be achieved by identifying opportunities for improving processes, instituting data-driven decision-making, establishing proactive collaboration, and developing actionable activities to develop processes that optimize performance.

Through the second Strategic Highway Research Program (SHRP2), a national partnership between the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), and the Transportation Research Board (TRB), a self-assessment framework was developed based on a model from the software industry. SHRP2 developed a framework for agencies to assess their critical processes and institutional arrangements through a capability maturity model (CMM). The CMM uses six dimensions of capability to allow agencies to self-assess their implementation of TSMO principles[1]:

1. Business processes – planning, programming, and budgeting.
2. Systems and technology – systems engineering, systems architecture standards, interoperability, and standardization.
3. Performance Measurement – measures definition, data acquisition, and utilization.
4. Culture – technical understanding, leadership, outreach, and program authority.
5. Organization and workforce – programmatic status, organizational structure, staff development, recruitment, and retention.
6. Collaboration – relationships with public safety agencies, local governments, metropolitan planning organizations (MPO), and the private sector.

Within each capability dimension, there are four levels of maturity (performed, managed, integrated, and optimized), as shown in Figure 1. An agency uses the CMM self-assessment to

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[1] FHWA, Office of Operations, "Organizing for Reliability – Capability Maturity Model Assessment and Implementation Plans Executive Summary," May 2015. https://ops.fhwa.dot.gov/docs/cmmexesum/sec1.htm

identify their level of maturity in each dimension as well as their strengths and weaknesses and to determine actions they can take to improve their capabilities.
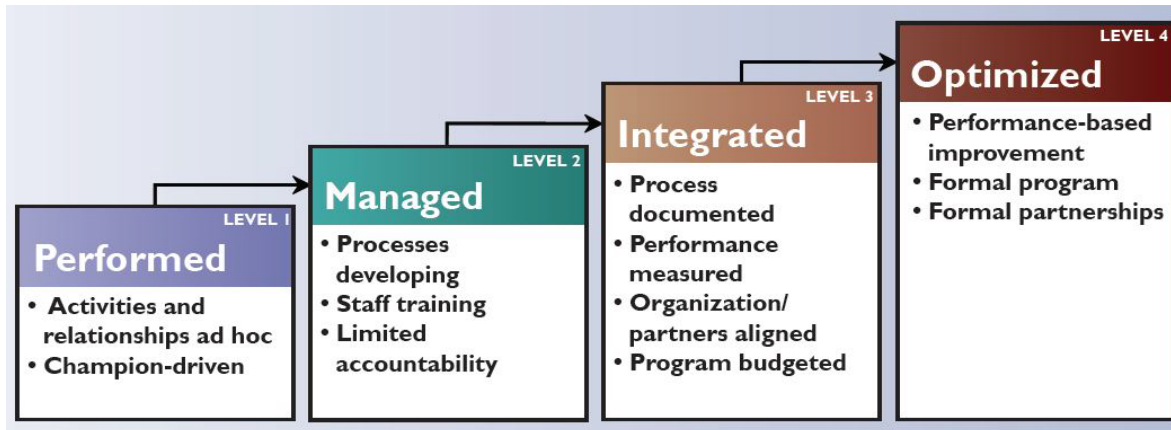

Figure 1. Chart. Four Levels of Maturity

Source: Creating an Effective Program to Advance Transportation System Management and Operations, FHWA Jan 2012

Purpose of Case Studies

In the first 10 years of implementation of the TSMO CMM, more than 50 States and regions used the tool to assess and improve their TSMO capabilities. With the many benefits experienced by these agencies, FHWA identified the need to develop case studies through previous efforts in SHRP2 to showcase leading practices in order to assist transportation professionals in mainstreaming TSMO into their agencies. The purposes of the case studies are to:

- Communicate the value of changing culture and standard practices towards TSMO to stakeholders and decision-makers.
- Provide examples of best-practices and lessons learned by other State and local agencies during their adoption, implementation, and mainstreaming of TSMO.

These case studies support transportation agencies by showing a wide range of challenges, opportunities, and results to provide proof for the potential benefits of implementing TSMO. Each case study was identified to address challenges faced by TSMO professionals when implementing new or expanding existing practices in the agency and to provide lessons learned.

Identified Topics of Importance

The topic of border crossings is important because of the unique challenges faced by border agencies, including collaborating with international stakeholders, mitigating security concerns, and managing traffic demands and congestion around the border check points. The agencies highlighted in this case study addressed those challenges through consistent collaboration, integrated intelligent transportation systems (ITS) solutions, and employing data-driven decisions.

Interviews

Agencies were selected for each case study based on prior research indicating that the agency was excelling in particular TSMO capabilities. Care was taken to include a diversity of geographical locations and agency types (departments of transportation, cities, and MPOs) to develop case studies that other agencies could easily relate to and learn from. Interviews were conducted with selected agencies to collect information on the topic for each case study.

Description of Border Crossings

Travel and transporting commercial freight across the United States borders into and out of Canada and Mexico play a vital role in each country's economy. Roads and bridges approaching the borders have a significant impact on the flow of people, goods, and services across international boundaries. Long delays at borders can cause logistical concerns for both the traveling public and commercial freight, so it is important to develop safe, reliable operations. Transportation networks around border crossing locations experience unique challenges such as increased security concerns, international coordination, and a higher saturation of commercial freight vehicles than other facilities. Incorporating TSMO into an agency's operating procedures can be advantageous for addressing these challenges efficiently and effectively.

> **Examples of border crossing opportunities within each capability dimension of TSMO include:**
>
> - **Business processes** – Developing a strategic plan and budget for improving freight management.
> - **Systems and technology** – Using ITS at border crossing to manage traffic and provide traveler information. The selection and availability of traveler information is determined in accordance with security protocols.
> - **Performance measurement** – Monitoring travel times, delay at ports of entry, or traffic flow rates as well as developing program performance measures from topics discussed at regional stakeholder meetings.
> - **Culture** – Providing outreach to border crossing operators to express the importance of moving traffic safely and efficiently and explaining the value of the data collected and potential mobility improvements.
> - **Organization and workforce** – Establishing a border crossing committee of regional stakeholders.
> - **Collaboration** – Working jointly with federal, State, and local agencies on both sides of the border to improve mobility across ports of entry.

CHAPTER 2 – BEST PRACTICE EXAMPLES

Both the Niagara International Transportation Technology Coalition (NITTEC) and the Whatcom Council of Governments (WCOG) participated in the second Strategic Highway Research Program (SHRP2) capability maturity model (CMM) workshops and used the results to guide them in implementing transportation systems management and operations (TSMO) in their agencies. The following section highlights several successful initiatives each agency accomplished.

Whatcom Council of Governments (WCOG)

WCOG supports the Whatcom County region in the State of Washington. It is the metropolitan planning organization (MPO) for the region and, as such, collaborates with seven cities, the Port of Bellingham, Washington State Department of Transportation (WSDOT) and other local agencies. WCOG is also the lead agency for the International Mobility and Trade Corridor (IMTC) Program, a binational planning coalition established in 1997 to improve transportation and commerce between the State of Washington and British Columbia, Canada.[1] The IMTC collects data from the four ports-of-entry between the Lower Mainland, BC and Whatcom County, WA. It also includes data collected from vehicle detection devices on Interstate 5.[2] Approximately 13.4 million travelers used the border crossings in this region to and from Canada in 2017, with 8 percent as truck volume.[3]

Incorporating Transportation Systems Management and Operations

WCOG promotes TSMO and mobility strategies in the region. The agency dedicated an entire monthly meeting with the IMTC steering committee (including border crossing operating agencies, port agencies, and other government agencies) to the topic of operations to determine if improvements to coordination could be made through strategies such as incident response.

WCOG reported that prioritizing efforts through TSMO activities and incorporating lessons learned have improved operations activities. Cross-border coordination now includes programming and operations – not just planning – in the work plan. The WCOG places a greater value on data, understanding that it can be used for marketing such items as travel information.

The United States (U.S.) Department of Homeland Security supports the NEXUS program, which allows expedited processing of pre-screened travelers at border crossings. With newly available lane-based travel time data, IMTC agencies supported a change, which WSDOT implemented, to show travelers wait times at NEXUS lanes alongside those for standard lanes. This data highlights the value of the NEXUS program in hopes of increasing the number of travelers using NEXUS lanes, which is beneficial to improving overall mobility.

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[1] http://wcog.org/
[2] https://theimtc.com/cascadegatewaydata/
[3] https://theimtc.com/data/

Freight Management

At Canadian port of entry inspection booths, commercial vehicles must turn off their engines and sometimes the vehicle will not re-start. With three freight inspection booths at the Pacific Highway port of entry, a disabled truck in one of those lanes significantly reduces capacity. Both U.S. and Canadian inspection agencies are researching an opportunity to manage these incidents. There are challenges with this because the incident may technically occur in Canada, but tow trucks employed may be from the U.S., leading to concerns about who pays for the service. WCOG is exploring incident management solutions in collaboration with WSDOT. WSDOT currently has a service patrol program for other parts of the State from which WCOG can gather lessons learned. Both customs agencies are currently tracking incident data to develop a business case for a local service patrol program at the border crossing in the future.

Managing Delay at Borders

The region has a total of four ports of entry, two of which are only one mile apart; thus, a wait time system was identified as a solution to provide travel information and more evenly spread demand among the ports of entry. In 2001, both Canadian and U.S. agencies installed loop detection. They enhanced the system in 2011 when funding became available nationally to install wait time systems. Data from these systems is used to estimate wait times, provide arrival rates, number of open inspection booths, volume data, and more. WCOG developed a data warehouse to archive data and develop reports to share with partner agencies.

U.S. Customs and Border Protection has the ability to change the number of available NEXUS lanes and their lane assignments to respond to demand as needed. The first-generation wait time system assumed a static number and location of NEXUS lanes causing inaccuracies in wait time reporting when NEXUS lane assignments changed. WCOG reached out to customs agencies to share lane status data so that travel time algorithms could be revised to accommodate dynamic NEXUS lane assignment. Following the algorithm revision, a before and after study confirmed improvements in accuracy. Through discussions with customs agencies, WCOG also requested the ability to archive new data elements on inspection times, departure rates, and vehicle occupancy as well as province or State information from vehicle license plates to support planning efforts.

Acquiring funding to create programs that archive and develop reports as well as coordinate data sharing between agencies is a challenge. WCOG applied for multiple grants to implement the existing system and is seeking additional funding to enhance systems capabilities. Figure 2 provides a view of the WSDOT website used to show traveler wait times. By clicking on gray boxes in the website image (e.g., "Southbound Wait Times and Cameras"), the user is linked to other websites with additional wait time information, such as the British Columbia Ministry of Transportation and Infrastructure.

Figure 2. Image. Border Traveler Information
Source: http://www.wsdot.com/traffic/border/default.aspx

In the future, WCOG hopes to integrate this new data set with their existing data warehouse (cascadegatewaydata.com) for easier access for partner agencies. WCOG sees opportunities to collaborate with other border crossing agencies in the U.S. to develop analytics for this data.

WCOG has had some concerns that, as smartphone routing applications have increased in popularity, variable message signs showing travel time information are not as beneficial to travelers. With the difference in travel times for NEXUS and standard lanes, these applications may not have accurate information. WCOG is exploring opportunities to collaborate with route guidance application developers and collecting traveler surveys to determine how to prioritize traveler information solutions.

International Collaboration

The IMTC program is WCOG's international collaboration mechanism, which includes more than 50 organizations from both sides of the border. IMTC is a binational coalition of government and private sector partners that collaborates on shared needs of the Cascade Gateway, which comprises the five land border crossings between Western Washington and Lower Mainland British Columbia. The Transportation Equity Act for the 21st Century provided the original funding for the IMTC program. Federal funding, made available through this program, has closed and was not part of the Moving Ahead for Progress in the 21st Century Act. Prompted by the lack of sustainable funding, the WCOG Policy Board integrated the IMTC in their programming efforts. The IMTC was not originally viewed as part of the MPO's core functions; however, WCOG's Policy Board agreed that the border crossing is a major part of the region's transportation system and determined that the IMTC should be considered in the Unified Planning Work Program (UPWP). The benefits to this change include regional modeling and data collection coordination, managing work efforts, and establishing sustainable funding for the IMTC.

> WCOG's Policy Board agreed that the border crossing is a major part of the region's transportation system and determined that the IMTC should be included in the MPO's UPWP.

Program funding is a challenge due to the absence of dedicated federal funding for the IMTC program. However, funding from the MPO work program has resulted in sustainability and an improved focus on regional goals for now. WCOG is currently funding the IMTC Program through a coalition strategy involving the State of Washington, the Vancouver International Airport, regional Surface Transportation Block Grant funds, and other partners. WCOG will continue participation in the Canada-U.S. Transportation Border Working Group alongside the Federal Highway Administration (FHWA) and Transport Canada. One topic of many that the Transportation Border Working Group covers is improving financial support for regional cross-border transportation planning programs, like the IMTC.

Since 2014, WCOG staff have billed IMTC hours to specific work categories based on performance areas: meetings; data collection, analysis, and distribution; and collaboration and

project management.[4] Figure 3 shows a comparison of performance area billing for 2014 - 2017. WCOG is in the process of making the performance measures easier to work with by transitioning them into a data visualization tool, Tableau©. The region is using the performance measures to study the four ports of entry with origin-destination data to determine if ports are providing optimal capacity. WCOG is considering probe- or location-based services (LBS) data to support planning efforts; however, challenges remain with LBS data in the cross-border environment due to changing cellular data coverage and algorithm defaults interpreting border stops with long wait periods as the end of trips.
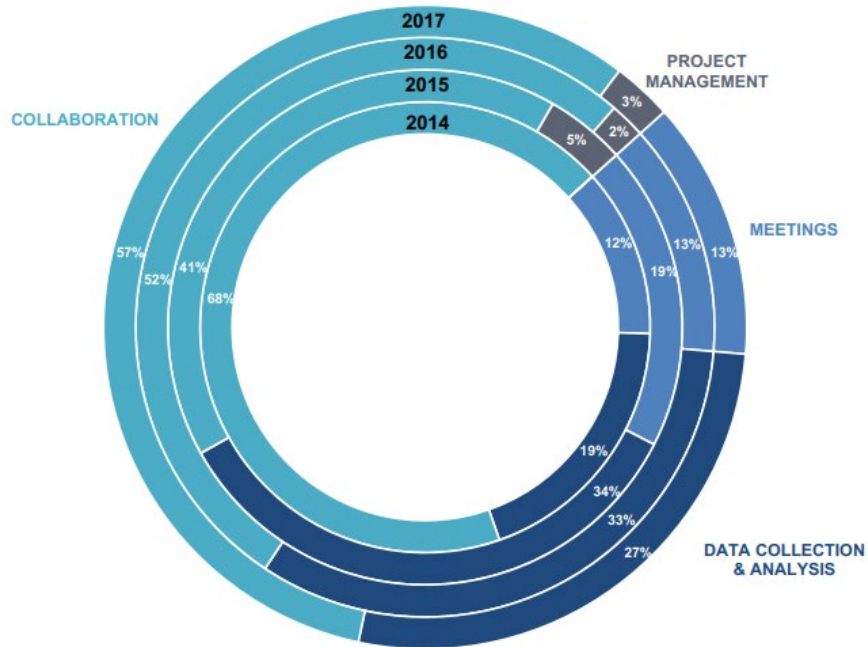

Figure 3. Chart. Performance Area Billing by WCOG Staff, 2014 – 2017
Source: 2017 IMTC Performance Report (WCOG)

Management of Intelligent Transportation Systems

In addition to the previously discussed intelligent transportation systems (ITS) solutions, WCOG is pursuing additional operational strategies to increase the effective capacity of existing facilities as an alternative to traditional infrastructure projects. To enable these decisions, WCOG developed a border simulation model for the Douglas-Peace Arch on I-5. The first strategy evaluated with this model was to determine if a subsidized radio frequency identification (RFID) solution should be implemented to improve wait times, as shown in Figure 4. Travelers using RFIDs have their documents read when they are next in line, thus speeding

A non-NEXUS subsidized RFID or app-based solution implemented to improve wait times was identified as having a benefit-cost ratio of 111:1, whereas the infrastructure and staffing solution had a benefit-cost ratio of 22:1 based on the border simulation model.

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[4] 2017 IMTC Performance Report

inspection agency queries and reducing primary inspection times by about 20 seconds. While not much for an individual vehicle, total system wait time reduction is estimated to be significant.[5] This solution was identified as having a benefit-cost ratio of 111:1, whereas the infrastructure and staffing solution had a benefit-cost ratio of 22:1 based on the model. This information was used to develop a business case to advocate for implementation funding. The model was also used to help customs agencies optimize openings and closures of inspection booths based on wait times and prepare for upcoming construction. Based on this information, WCOG is considering additional predictive analytics for continued improvement of inspection booth operations. They are collaborating with WSDOT and local universities to identify effective solutions.
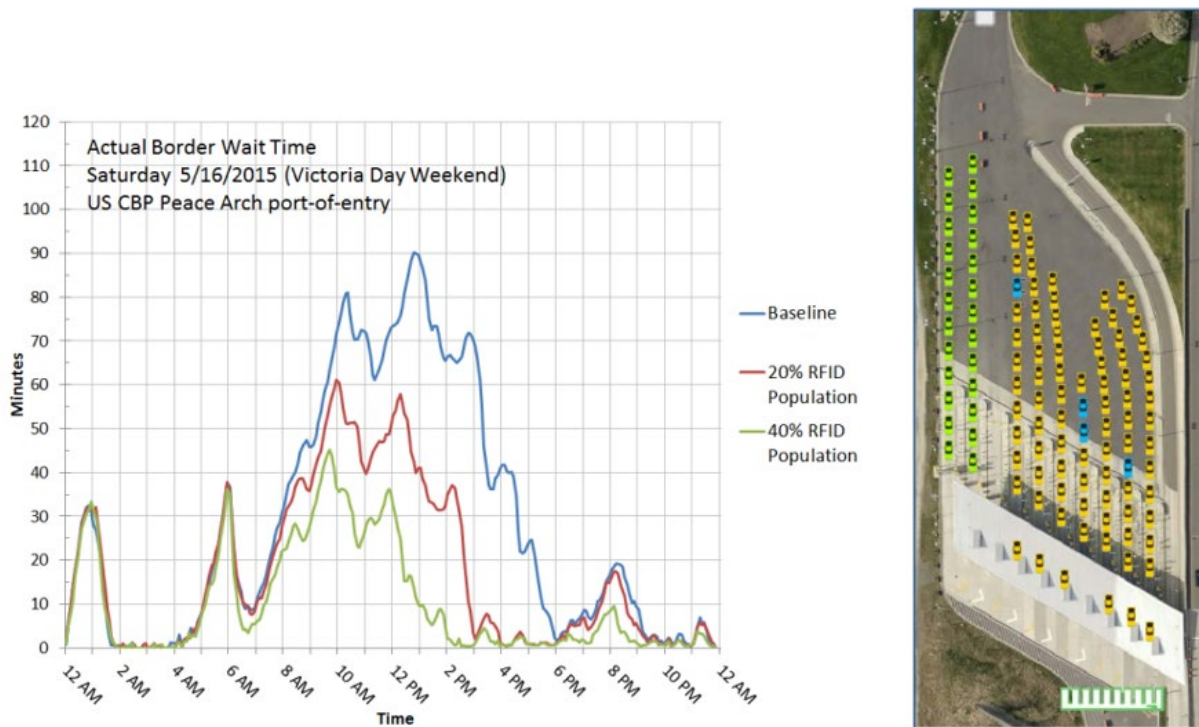

Figure 4. Image. Simulation Results for RFID at Douglas-Peace Arch (I-5)
Source: RFID Business Case

Niagara International Transportation Technology Coalition (NITTEC)

NITTEC is a binational, multi-agency transportation operations coalition in the Buffalo, NY region with 5 policy members, 9 general members, and 28 affiliate members. Its members are focused on improving mobility, reliability, and safety between western New York and southern Ontario. NITTEC is an independent agency in the Niagara region of New York State and Canada, which brings together 42 partner agencies on both sides of the border for regional collaboration on transportation. It has several committees that deal with specific subject matter such as border crossing, construction coordination, strategic planning, traffic operations, technology and systems, incident management, and regional traffic signals. These committees

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[5] www.theimtc.com/documents/rfid-business-case/

help inform partner agencies on regional efforts and contribute to regional projects dealing with TSMO, such as border wait time, border crossing traveler information systems, and integrated corridor management.[6]

Incorporating Transportation Systems Management and Operations

The majority of collaboration, such as planning and sharing of best practices among agencies in the region, is facilitated through several committees. Not all local agencies participate in all of the committees available.

> NITTEC attributes much of their success to their agency structure and regularly scheduled meetings.

NITTEC has used their committees to share the value of TSMO to partner agencies. Through these collaborative committees, NITTEC reported that agencies involved were brought closer together and developed a greater understanding of how they can incorporate TSMO in existing activities to better support the region. NITTEC attributes much of their success to the regularly scheduled committee meetings. Each committee has a mandate and a work plan of items to work on each year. The committees have a well-defined meeting frequency and its reliability leads to regular attendance from committee members.

Freight Management

NITTEC is taking steps to increase involvement with freight management activities. Currently, the region does not have a committee dedicated to freight management challenges and agencies' internal resources are already allocated to other transportation improvement committees and initiatives. NITTEC plans to begin providing a platform for freight discussions in the border crossing committee meetings. They are working to develop meeting agendas that will highlight freight needs and enable active freight discussion as part of the challenges experienced at border crossings. This effort will enable the efficient use of internal resources for additional agenda items. The ultimate goal is to include the Ontario Trucking Association and the New York State Trucking Association as active participants in the regional border crossing committee.

A major challenge for NITTEC is how to communicate weather and other special events to freight traffic about conditions at the border and on the roadway network. Partner agencies such as the State department of transportation (DOT) and the adjacent, cross-border Ministry of Transportation Ontario inform the region through dynamic message signing when weather conditions are unsafe and when an empty trailer or other freight restrictions are in place. However, this has historically resulted in freight traffic moving to the shoulder and waiting for conditions to improve. NITTEC worked with partner agencies to develop detour routes for truck staging areas during these events. This not only improves safety but allows snow plow trucks to access and clean roads quicker, improving overall mobility.

NITTEC received FHWA's Advanced Transportation Congestion Management Technology Deployment grant to support freight movement beginning in 2018, which will enable them to continue improving TSMO of freight in the region.

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[6] Partnerships – Working together yields benefits. FHWA. Peer Exchange Report, February 2018.

Managing Delay at Borders

During development of its strategic plan in 2007, NITTEC identified the need to form additional committees, including the border crossing committee that meets every other month. The border crossing committee includes U.S. and Canadian customs agencies, transportation agencies, and bridge operators. The border crossing committee has developed consistent messaging to communicate delay times on variable message signs that provide information to travelers at different border crossings. In recent years, routing applications have also supported this objective. The border crossing committee has collaborated to proactively reach out to the general public prior to holidays and peak travel seasons to encourage drivers to less congested ports of entry to reduce delay.

The greatest lesson NITTEC learned to improve delay management was to ensure that all agencies are reporting consistently. For example, the amount of time that constitutes a delay. To develop consistent language, stakeholders met at border crossing committee meetings and established uniform definitions. Since improving travel time messaging, NITTEC has experienced a reduction in travel time peaks. This information has been shared with customs agencies so that they are staffed appropriately and prepared for peak travel times. The travel time data is also used to support grant requests, as shown in Figure 5. The next action item that the border crossing committee has planned to discuss is whether or not reporting strategies or other techniques should be revised since the implementation of Bluetooth® detection for travel time data.

> The greatest lesson NITTEC learned to improve delay management was to ensure all agencies are reporting consistently.
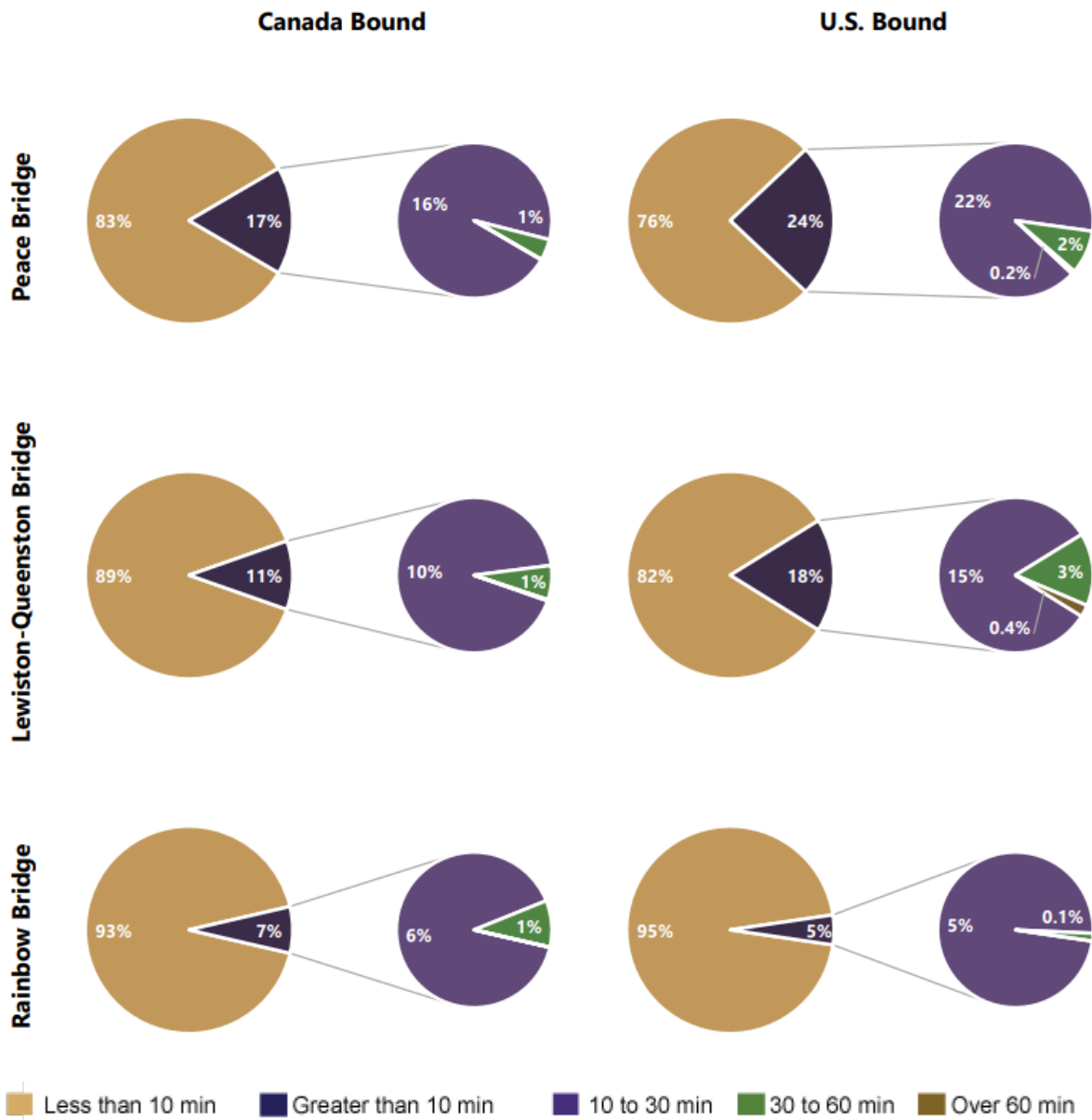
Figure 5. Photo. Percent of Delay Experienced by Travelers on Local Bridges (Canada/U.S.)
Source: 2018 Annual Report NITTEC [7]

International Collaboration

Forty-two agencies within NITTEC collaborate through various committees organized within the coalition to keep agencies informed on regional efforts and discuss upcoming projects, ongoing initiatives, and share best practices. More specifically, through these committees, each agency is able to contribute to regional TSMO activities such as border wait time, border crossing traveler information systems, and integrated corridor management. These agencies are facilitating

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[7] https://www.nittec.org/download/file/8813

communication and collaboration in their regions that normally may not occur. This has allowed the consortium to pursue several grants for projects, such as Integrated Corridor Management projects, and deploy new technologies and strategies in the region.[8]

Management of Intelligent Transportation Systems

NITTEC does not directly own and manage ITS for the region, but they do operate it. In a unique arrangement, NITTEC operates the region's 24/7 traffic management center (TMC). In 1995, the New York State DOT transitioned TMC operations from the DOT to NITTEC. By 2000, NITTEC was operating and monitoring ITS for all agencies in the region. NITTEC staff detects and deploys responses for incidents and provides traveler information in addition to all TMC operation responsibilities. The agency leads several initiatives to improve transportation operations in the region.

For the region's border crossings, NITTEC is currently working on a new traveler information initiative. At present, when an incident occurs at a bridge, the travel time information on the variable message sign is replaced with an incident notification message. NITTEC has identified locations at all three bridges to provide travel times to borders, enabling travelers to make informed route decisions based on real-time travel information. NITTEC is working with the New York State DOT, the New York State Thruway Authority, and the Ministry of Transportation Ontario on this project. The border crossing committee helped identify locations and collaborated with the technology and systems committee to develop specifications for a traveler information system. Figure 6 shows a depiction of this system. NITTEC, in part, funds this program with a revolving loan fund grant program that receives accrued interest dollars from the agency's Revolving Loan Fund.

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[8] Partnerships – Working together yields benefits. FHWA. Peer Exchange Report, February 2018.
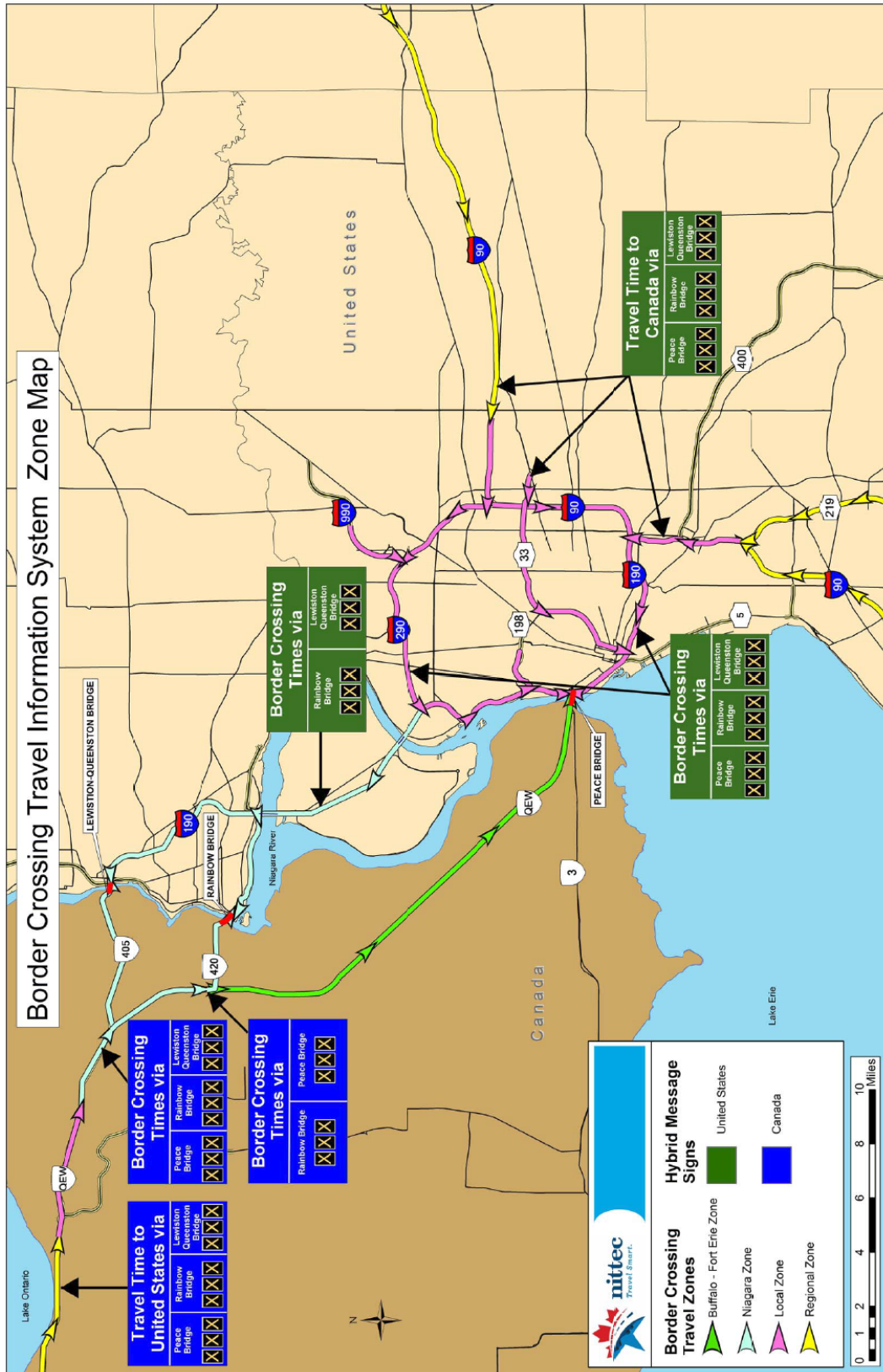
Figure 6: Image. NITTEC's Border Crossing Travel Information System Zone Map
Source: NITTEC

CHAPTER 3 – SUMMARY

Agencies with border crossings face many of the same challenges as other agencies (freight management, management of delay, and management of intelligent transportation systems [ITS] devices); however, they face added complexities since collaboration must be done across international boundaries and they must communicate with significantly more federal and local organizations. Both agencies interviewed for this case study saw this as an opportunity and had several key lessons learned that support the advancement of their TSMO programs:

- Consistent traveler information regarding international border delays, available through multiple sources (online, overhead dynamic message signs, or through routing applications) can help manage delay and distribute crossing locations. International collaboration is critical to provide accurate information. Neighboring agencies should agree on how this data is analyzed and data should be shared to improve cohesive and consistent information to both internal and external stakeholders.
- Border crossings can be bottlenecks, so valuing this facility as a core element of the transportation system can improve mobility. Similar to other facilities, attention to operation and maintenance supplied with innovative, flexible, and dynamic solutions is required. International agreements for deploying ITS should provide specific guidance on which nation is responsible for installing, operating, and maintaining equipment. Discussing and understanding the associated benefit to cost can prove the value for stakeholders and support expanding TSMO programming.
- Close collaboration with regional partners, both foreign and domestic, is valuable for the success of TSMO activities. Regularly scheduled committee meetings with international participants will foster relationships and encourage conversations that may not have occurred otherwise. Maintaining open lines of communication and addressing national border crossing policy, as needed, will help when deploying new technology or solving challenges that arise on the border.

National policy, varying agency policies, and data interoperability are just a few of the hurdles transportation agencies must overcome to improve travel conditions near and across international borders. Open and regular communication, international arrangements, and frequent collaboration on projects and activities are actions that have been essential to collaborative improvement of border crossing wait times, provision of accurate information to the public, improvement of freight travel conditions, national security, and more. The best practices highlighted in this case study are specific to challenges faced at international borders. However, agencies near State borders can consider how similar actions can mitigate challenges and provide benefits for their regions as well.

REFERENCES

Information for use in this case study was gathered from sources noted throughout the report together with the following web sites:

- FHWA's What is Transportation Systems Management and Operations (TSMO)?
    - https://ops.fhwa.dot.gov/tsmo
- AASHTO's TSMO Guidance
    - http://www.aashtotsmoguidance.org/
- FHWA's Organizing and Planning for Operations
    - https://ops.fhwa.dot.gov/plan4ops/
- FHWA's Organizing for Operations Resources
    - https://ops.fhwa.dot.gov/plan4ops/focus_areas/organizing_for_op.htm
- FHWA's Organizing for Reliability – Capability Maturity Model Assessment and Implementation Plans
    - https://ops.fhwa.dot.gov/docs/cmmexesum/sec1.htm
- FHWA's Creating an Effective Program to Advance Transportation Systems Management and Operations, Primer
    - https://ops.fhwa.dot.gov/publications/fhwahop12003/index.htm
- FHWA's Improving Transportation Systems Management and Operations – Capability Maturity Model Workshop White Paper – Business Processes
    - https://ops.fhwa.dot.gov/docs/cmmwhitepapers/busprocess/index.htm
- Additional SHRP2 Resources
    - https://www.fhwa.dot.gov/goshrp2/
- Whatcom Council of Governments
    - http://wcog.org/
- Niagara International Transportation Technology Coalition
    - http://www.nittec.org

Table 1. Interview Participants and Agencies

Agency	Whatcom Council of Governments (WCOG)	Niagara International Transportation Technology Coalition (NITTEC)
Agency Representative Name:	Hugh Conroy	Athena Hutchins
Agency Representative Title:	Director of Planning	Executive Director
Agency Representative Email:	hugh@wcog.org	ahutchins@nittec.org
Interview Date:	May 23, 2018	May 29, 2018

Permission was received from each agency to use the information discussed during the interview and shared afterwards for the purpose of this case study.