FREE AND SECURE TRADE WITH ENHANCED RELIABILITY (FASTER)

by

David Salgado, Swapnil Samant, Rafael M. Aldrete, and Mario Vazquez Ostos

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Center for International Intelligent Transportation Research
Texas A&M Transportation Institute
4050 Rio Bravo, Suite 151
El Paso, Texas, 79902

TEXAS A&M TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135

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DISCLAIMER AND ACKNOWLEDGMENTS

This research was performed by the Center for International Intelligent Transportation Research, a part of the Texas A&M Transportation Institute. The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein.

CHAPTER 1: INTRODUCTION AND OBJECTIVE

Due to inspections by various agencies during the cross-border process, land ports of entry (LPOEs) along the U.S.-Mexico border act as fixed bottlenecks with reduced capacity leading to extended crossing times for commercial vehicles. Border agencies from the United States and Mexico have implemented different programs to expedite cross-border operations of commercial vehicles, reducing crossing times.

One of these programs, the Free and Secure Trade (FAST) program, was initiated right after the September 11, 2001, terrorist attacks. The FAST program is a commercial clearance program for known low-risk shipments entering the United States from Canada and Mexico. The FAST program allows expedited processing for commercial trucking companies that have completed background checks and fulfill certain eligibility requirements. Commercial vehicles enrolled in the FAST program can use dedicated FAST lanes. More recently in 2018, U.S. Customs and Border Protection (CBP) and Aduanas Mexico started the Unified Cargo Processing (UCP) program. The UCP program allows CBP and Aduanas to inspect commercial vehicles using FAST at the same location and at the same time.

The FAST and UCP programs have decreased average crossing times for commercial vehicles. Data obtained from the Border Crossing Information System (BCIS) website (https://bcis.tti.tamu.edu/) shows that in 2018, commercial vehicles using FAST lanes at the Ysleta-Zaragoza LPOE spent, on average, 31 minutes to cross the border. That is 19 minutes less than the average crossing time spent by commercial vehicles using non-FAST (i.e., standard) lanes at this LPOE. Despite these programs, commercial vehicles using FAST lanes experience highly variable crossing times that can go from just 14 minutes to over 100 minutes. Other commercial LPOEs at the U.S.-Mexico border face similar situations.

Consequently, crossing times for commercial vehicles using FAST are unreliable. *Crossing time reliability* is defined as the variation of crossing time for the same border crossing at the same time from day to day (1). If the crossing time is reliable, cargo can arrive at its destination on the other side of the border at the time it is supposed to arrive, all the time.

The objective of this research was twofold:

- Identify a set of traffic management strategies agreed upon by stakeholders that could improve crossing time reliability at commercial LPOEs.
- Define different scenarios to group the strategies. These scenarios will be evaluated in a traffic simulation environment to quantify their benefits in terms of crossing time reliability using the Ysleta-Zaragoza commercial LPOE as a test bed.

This report consists of five chapters and two appendices:

- This chapter serves as the introduction and provides the research objective.
- Chapter 2 documents the findings of the literature review effort.
- Chapter 3 describes the research approach.
- Chapter 4 provides the results.

- Chapter 5 summarizes the main findings and conclusions of this research.
- Appendix A provides the poll questions used during the stakeholder workshops to identify the strategies that could improve crossing time reliability.
- Appendix B presents the results of the polls conducted during the workshops.

CHAPTER 2: LITERATURE REVIEW

Crossing time reliability can be used as a performance measure for commercial LPOEs. Therefore, Texas A&M Transportation Institute (TTI) researchers reviewed relevant studies in the area of performance measures for LPOEs. The researchers also reviewed previous work about strategies implemented at different transportation facilities with potential application for improving crossing time reliability at U.S.-Mexico LPOEs.

TTI operates and maintains the BCIS. This system measures wait times and crossing times in real time at nine commercial LPOEs in Arizona, New Mexico, and Texas. TTI also measures wait times and crossing times at four non-commercial LPOEs (i.e., for passenger vehicles) in El Paso, Texas. The system defines *wait time* as the time it takes, in minutes, for a vehicle to reach the CBP primary inspection booth after arriving at the end of the queue at the entrance of the LPOE. *Crossing time* is defined as the time it takes, in minutes, for a vehicle to exit the LPOE after arriving at the end of the queue at the entrance of the LPOE (2). Wait times and crossing times are two important performance measures that show the level of service at LPOEs. The BCIS also provides other monthly performance measures for commercial LPOEs: monthly average crossing time, median crossing time, 95th percentile crossing time, and buffer index (a crossing time reliability measure) (3).

In 2018, Sharma et al. (4) proposed a new performance measure to compare performance across U.S.-Mexico LPOEs. The new performance measure is the performance score (PS). The researchers used the Ysleta-Zaragoza and Bridge of the Americas (BOTA) LPOEs located in the El Paso in Texas, U.S. and Ciudad Juarez in Chihuahua, Mexico, border region as a test bed for this study. The researchers compared hourly and monthly performance of Ysleta-Zaragoza and BOTA LPOEs using the PS measure. More information about how the PS measure is calculated is available in the report titled *Developing Adaptive Border Crossing Mobility Measures and Short-Term Travel Time Prediction Model Using Multiple Data Sets* (https://static.tti.tamu.edu/tti.tamu.edu/documents/185917-00015.pdf).

As mentioned in Chapter 1, two initiatives are currently operating at certain commercial LPOEs and have the objective of expediting cross-border operations: the FAST and UCP programs. Participation in the FAST program requires that "every link in the supply chain, from manufacturer to trucking company to driver to importer, is certified under the Customs-Trade Partnership Against Terrorism program, or C-TPAT" (5). Vehicles enrolled in the FAST program benefit from a reduced number of inspections, priority processing, and access to dedicated FAST lanes, among other benefits (6). The UCP program allows CBP and Aduanas Mexico to perform joint inspections at FAST lanes. These two programs are currently implemented at the Ysleta-Zaragoza LPOE, which connects El Paso with Ciudad Juarez.

The literature reveals efforts to reduce congestion at different transportation facilities that could be adapted to LPOEs for improving crossing time reliability. For example, the Greening the Border initiative has the objective of reducing greenhouse (GHG) emissions at the border and improving air quality by reducing traffic congestion at the Peace Arch LPOE. This LPOE connects the State of Washington and the province of British Columbia, Canada. A traffic signal

was installed approximately 650 feet before the primary inspection booths. Vehicles are allowed to pass through the traffic signal in a series of pulses, or batches. Those that pass through the traffic signal advance to the staging area before the booths. Once the initial batch of vehicles has crossed a certain point in the staging area, the next batch of vehicles is allowed through to the staging area, until it is filled up. Vehicles that are waiting at the traffic signal are encouraged to turn off their engines in order to improve air quality and save fuel. Figure 1 presents the traffic operations as defined in this initiative. It is estimated that GHG emissions are reduced by 45 percent, and 0.5 quarts of fuel is saved per vehicle on each trip (7). This concept has since been implemented at other LPOEs due to its success.

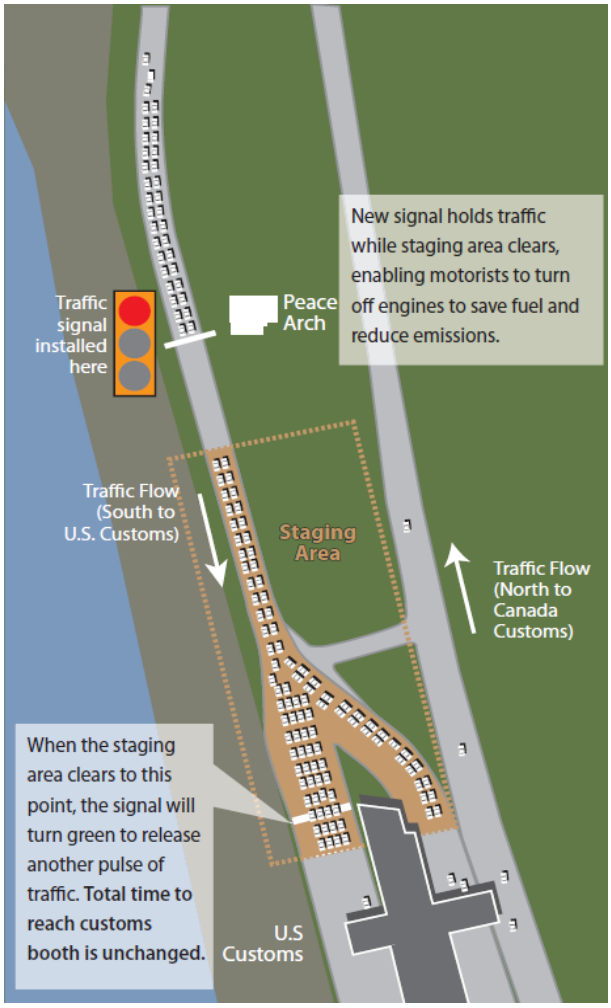

Figure 1. Illustration of Greening the Border Concept (7).

PierPASS is a not-for-profit organization created by marine terminal operators at the Ports of Los Angeles and Long Beach to address multi-terminal issues such as congestion, security, and air quality (8). PierPASS implemented the OffPeak program in 2005. The program provided an incentive for truckers to move containers during off-peak hours by charging a "traffic mitigation fee" on containers entering and exiting the port facilities during peak hours. The off-peak period starts at 6 p.m. and ends 3 a.m. on weekdays. On Saturdays, the off-peak period starts at 8 a.m.

and ends at 5 p.m. The fees charged to trucks entering and exiting the port facilities during peak hours are used to fund port terminal operations during off-peak hours (9).

PierPASS OffPeak program was replaced in November 2018 by the Pier Pass 2.0 appointment-based system. The system uses a single flat fee on both peak and off-peak container movements. All cargo must pay a fee except empty containers, rail intermodal containers, transshipped containers, domestic cargo, and bare chassis. Appointments are required for picking up import containers but not for unloading export containers. All appointments are made through the terminal system. The system assigns each truck a 2-hour appointment window (10).

The literature review revealed that crossing time reliability is currently used as a performance measure for commercial LPOEs. However, in cases where it is required for a comparison of performance across LPOEs, the literature suggests the use of the PS measure. Moreover, the researchers documented different strategies implemented at various transportation facilities with potential application for improving crossing time reliability. These strategies were presented during the workshops to give stakeholders perspective and facilitate the identification of strategies suitable for being implemented at U.S.-Mexico LPOEs.

CHAPTER 3:
RESEARCH APPROACH

The research approach consisted of six steps: data collection, data analysis, stakeholder engagement, traffic simulation model development, evaluation of strategies, and dissemination of results. This research used the Ysleta-Zaragoza LPOE as a test bed. Figure 2 shows how the research approach flows and how the steps are connected.

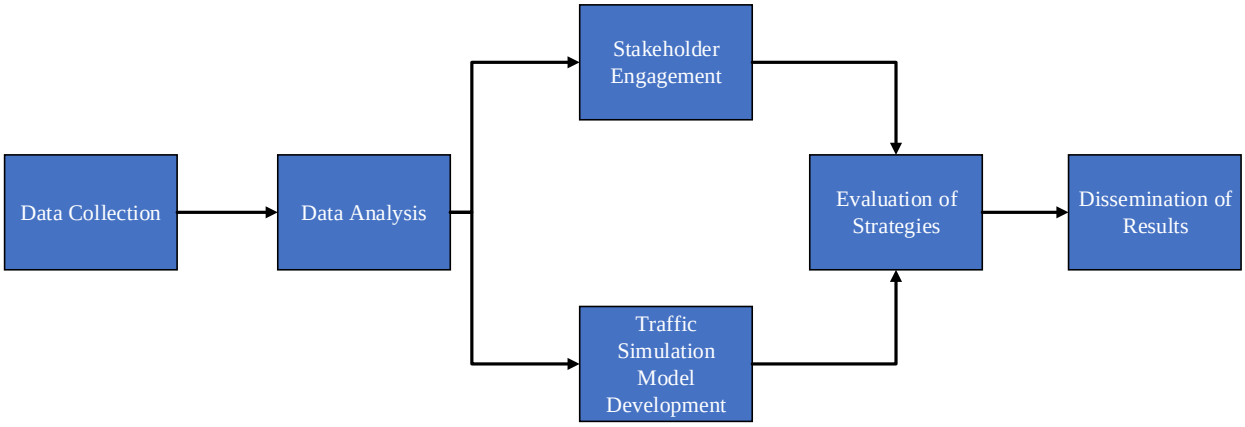

Figure 2. Research Approach.

As Figure 2 shows, the researchers collected data that characterize northbound traffic operations at the Ysleta-Zaragoza commercial LPOE. The researchers collected wait times, crossing times, truck volumes entering and exiting the LPOE, and the number of CBP primary inspection booths open every hour. Wait times and crossing times were collected from the BCIS. This system relies on radio-frequency identification technology to measure, in real time, wait times and crossing times of commercial vehicles traveling from Ciudad Juarez to El Paso via the Ysleta-Zaragoza commercial LPOE. Truck volumes entering and exiting the LPOE were collected in real time by means of light-emitting diode (LED) sensors deployed at the entrance and exit of the Ysleta-Zaragoza commercial LPOE. Finally, the number of CBP primary inspection booths open each hour was obtained directly from CBP. The researchers collected these variables starting January 1, 2020 and ending May 15, 2020. In addition to these variables, the researchers collected speed limits and the geometry of the LPOE from web-mapping services to satisfy the data requirements of the traffic simulation model.

In the data analysis step (see Figure 2), the researchers analyzed the data, looking for sources of unreliability in crossing times and wait times. Specifically, the researchers analyzed how variability in truck volumes and the number of CBP primary inspection booths open affected crossing reliability.

The next two steps, stakeholder engagement and the development of the Ysleta-Zaragoza LPOE traffic simulation model, ran in parallel as shown in Figure 2. In the traffic simulation model development step, the researchers built, calibrated, and validated the traffic simulation model of the Ysleta-Zaragoza commercial LPOE for the current conditions (i.e., the base scenario, called the Current Scenario). At the same time, the researchers started the stakeholder engagement step. For the successful completion of this step, TTI partnered with the City of El Paso International

Bridges Department. The two groups worked together to identify stakeholders, grouping them according to the activity they perform. The two groups of stakeholders are:

- Public sector: CBP, the El Paso Metropolitan Planning Organization, the Texas Department of Transportation, the Texas Department of Public Safety, Aduanas, Instituto Municipal de Investigación y Planeación, Fideicomiso de Puentes Fronterizos de Chihuahua, etc.
- Industry: trucking and manufacturing companies.

The researchers and staff of the City of El Paso International Bridges Department organized three virtual workshops using Microsoft Teams: one workshop for each group and a final workshop with both groups together. The objectives of these workshops were to:

1. Make stakeholders aware of the concept of crossing time reliability and the benefits of high crossing time reliability.
2. Present strategies implemented at transportation facilities with potential application for improving crossing time reliability at U.S.-Mexico LPOEs.
3. Identify and rank strategies that could improve crossing time reliability at U.S.-Mexico LPOEs.

Stakeholder inputs were collected by means of polling apps. Workshops took place in August 2020. Doodle polls were used to determine the date and time of each workshop. Once the workshop with each stakeholder group was completed, the researchers and staff of the City of El Paso International Bridges Department revised all strategies proposed and consolidated them for presentation at the final workshop. During the final workshop, stakeholders revised the resulted strategies.

The researchers defined scenarios in the evaluation-of-strategies step (see Figure 2). The researchers evaluated two of these scenarios using the Ysleta-Zaragoza traffic simulation model. The results obtained for each scenario were compared against those for the Current Scenario to quantify the improvement in crossing time reliability.

Finally, the researchers disseminated the results of the evaluation of strategies to stakeholders (see Figure 2) during the City of El Paso Bridges Steering Committee Meeting held on September 11, 2020.

CHAPTER 4: RESULTS

This chapter presents the results of the following research methodology steps: data analysis, stakeholder engagement, traffic simulation model development, and evaluation of strategies.

DATA ANALYSIS

During this step, researchers analyzed the data, looking for sources of unreliability in crossing times. Researchers did not find any direct correlation between the number of inspection booths open or hourly traffic volume and crossing time reliability. However, decompensation between the number of inspection booths open (supply) and traffic volume entering the LPOE (demand) produces high congestion levels, increasing the likelihood of unreliability. In a highly congested LPOE, a slight change in the supply and demand balance may result in excessive crossing times and an abrupt reduction on crossing time reliability. This finding agrees with findings from previous research on travel time reliability in other parts of the transportation infrastructure, such as freeways, highways, or major urban corridors (11; 12).

STAKEHOLDER ENGAGEMENT

TTI staff organized two initial workshops with stakeholders: one with the public sector and one with the industry (see Table 1 for the list of attendees). Different potential strategies to increase crossing time reliability at LPOEs were presented at the workshops. Attendees were encouraged to share their thoughts on these strategies, as well as any other strategies they thought could be implemented at LPOEs. Stakeholders' input was gathered by means of different polls. The poll questions and poll results appear in Appendix A and Appendix B, respectively.

Table 1. Workshop Attendees.

Name	***Agency/Company***	***Group***
Robert Tinajero	International Bridges Department	Public sector
Eddie Romero	International Bridges Department	Public sector
David A. Coronado	International Bridges Department	Public sector
Jesus E. Mendoza	International Bridges Department	Public sector
Paul Stresow	International Bridges Department	Public sector
Charles Hooper	International Bridges Department	Public sector
Salvador Gonzales-Ayala	El Paso Metropolitan Planning Organization	Public sector
Guillermo Quezada	Federal Motor Carrier Safety Administration	Public sector
Margarita Ortega	Fideicomiso de Puentes Fronterizos de Chihuahua	Public sector
Juan Aguilar	U.S. Customs and Border Protection	Public sector
Rocio G. Castrejon	U.S. Customs and Border Protection	Public sector
Fernando Thome	U.S. Customs and Border Protection	Public sector
Jose Cordova	U.S. Customs and Border Protection	Public sector
Nelson Calzadilla	NCH Customs Brokers	Industry
Patricia Sedano	Bosch	Industry

During the workshops, stakeholders identified various strategies that could potentially increase crossing time reliability by balancing demand (i.e., the number of trucks accessing the LPOE) with supply (i.e., the number of CBP inspection booths open). In other words, the strategies control the number of trucks entering the LPOE by implementing a set of procedures and actions agreed upon by stakeholders. These procedures and actions are not evaluated as part of this research. These strategies were grouped into the following scenarios:

- Demand spreading through the day.
- Demand balancing across LPOEs.
- An appointment-based system.
- LPOE specialization.
- Expansion of the CTPAT/FAST programs (only discussed with industry).
- Extension of LPOE hours of operation.

The following sections provide the input gathered from stakeholders regarding each scenario.

Inputs from Public Sector

General Remarks

Any new strategies implemented at LPOEs will require a collaboration from the public sector and industry.

Demand Spreading through the Day Scenario

The implementation of this set of strategies would require manufacturing plants to make changes in their production plans so certain shipments generally sent during peak hours could be moved to off-peak hours. Changes in schedule are not possible for just-in-time shipments. These must be sent out as soon as they are manufactured. Additionally, most manufacturing plants do not operate 24/7. This translates into less flexibility to make changes in production plans.

Demand Balancing across LPOEs Scenario

The implementation of this set of strategies may just transfer the congestion from one LPOE to another. Moreover, diverting traffic from a non-tolled LPOE to a tolled LPOE will result in an additional economic cost for trucking companies. Also, the existence of FAST lanes and the nature of the cargo (e.g., hazardous, overweight, or oversized) must be considered if this set of strategies is implemented.

Appointment-Based System Scenario

The implementation of this set of strategies would require manufacturing plants to make changes in their production plans so trucks carrying shipments can arrive at the LPOE at the appointment time. Ideally, appointments should be made at least 24 hours in advance. Otherwise, it will be difficult for CBP and Aduanas to adapt staffing levels to the number of appointments. Also, the implementation of this set of strategies would require traffic management measures to ensure access for trucks with an appointment is not blocked by other trucks without an appointment. This would ensure that trucks with an appointment cross the border as planned.

LPOE Specialization Scenario

Stakeholders from the public sector stated that some LPOEs could be specialized to serve trucks with an appointment (if an appointment-based system is implemented), FAST trucks, or empty trucks. Also, the implementation of this set of strategies might require certain LPOE infrastructure improvements.

Extension of LPOE Hours of Operation

The implementation of this set of strategies would require manufacturing plants to make changes in their production plans so certain shipments generally sent during the day can be sent at night. This strategy was implemented in the past and had limited success.

Inputs from Industry

General Remarks

In the Laredo-Nuevo Laredo region, cargo is stored in warehouses, waiting to cross the border. Therefore, trips can be planned well in advance. In the El Paso-Ciudad Juarez region, goods are transported across the border as soon as they are manufactured based on customer orders. This operating procedure decreases the capability of planning trips in advance. For a better assessment of the needs of the El Paso-Ciudad Juarez region, LPOEs would need to operate at full capacity, and according to the industry, they do not operate at full capacity right now.

Demand Spreading through the Day Scenario

In order to implement this set of strategies, the following issues should be accounted for. Generally, paperwork is requested in the early morning to send shipments across the border the same day. If the manifest is submitted electronically (e-Manifest), the approval is obtained within minutes. However, if the manifest is submitted manually, it can take hours to get the approval due to staff limitations at CBP.

If a correction is necessary on the manifest, it must be submitted manually. A process for corrections to be sent in electronically would be very beneficial.

Manufacturing plants prefer to send shipments in the late morning or afternoon. They normally do not send shipments in the early morning because it takes time to submit the manifest and get CBP approval.

The time selected for sending shipments also depends on supply chain factors, the requirements of the client, and the departure time of the delivery company in El Paso (e.g., the FedEx airplane departs at 10:00 p.m., so the shipment should arrive by 8:00 p.m. at the airport). Infrequently, shipments need to be modified right before loading the trucks due to changes in client orders.

Demand Balancing across LPOEs Scenario

Demand balancing across LPOEs after the manifest has been approved by CBP is complicated since the LPOE to be used is declared in advance, and the manifest would need to be amended on the fly. In order to do the amendment, all parties involved would have to coordinate in real time.

Other issues that may arise are capacity limitations (i.e., staff and number of lanes) that some LPOEs such as Santa Teresa may have.

Finally, geographical limitations are also present. In instances where the manufacturing plant in Ciudad Juarez and the warehouse in El Paso are very close to the same LPOE, demand balancing across LPOEs may not be efficient or convenient at all.

Appointment-Based System Scenario

To implement this set of strategies, the following issues should be accounted for. Generally, shipments are transported across the border in the late morning or afternoon after the manifest is submitted and approved. Therefore, most trucking companies would like to make appointments at that time. Most trucking companies do not have shipments to transport in the early morning.

Shipments are not equally distributed through the month. The volume of shipments sent across the border tends to increase at the end of the month so manufacturing plants can maximize benefits for the current month. Having the shipment ready the previous day would require discipline and organization from manufacturing plants.

Manufacturing plants do not know 24 hours in advance which shipment they will send. Their preference would be to make the appointment and send the shipment across the border the same day. It would help if the appointment could be canceled, modified, or made 2–4 hours in advance (express appointments).

If the appointment-based system gives manufacturing plants the certainty that their shipments will arrive at the planned time, they will be willing to make the effort to send the shipments at the appointment time even if the appointment is in the early morning and the shipment needs to be prepared the previous day.

This system will require coordination between CBP and Aduanas to notify if Aduanas has stopped a truck in the southbound direction and the truck will not be able to make the second appointment of the day. This is why the possibility of canceling an appointment should be included in the system.

Not all shippers and truckers have the capability of sending shipment information to brokers through an electronic data interchange.

Expansion of CTPAT/FAST Programs Scenario

Currently, 26 percent of the trucks are part of the FAST program. The process of making drivers FAST approved is very slow because a background check is required and CBP has

insufficient staff to perform this task. Some drivers are not interested in going through a background check.

To send shipments via FAST lanes, the manufacturing plant should be part of the CTPAT program. To be part of the program, manufacturing plants need to invest in security cameras, guards, etc. This can cost up to $2 million for some manufacturing plants. Therefore, small manufacturing plants will not join the program due to the high costs associated with it. Manufacturing plants see the benefit of being part of the CTPAT program, but it is an investment that is recovered in the medium or long term. In addition to the reduction of crossing time, being part of the CTPAT program allows manufacturing plants to save time when preparing the shipments (e.g., from 4.5 to 2.5 hours after joining CTPAT).

LPOE Specialization Scenario

Having a dedicated LPOE for empty trucks will result in an underutilization of that LPOE. Shippers and trucking companies try to minimize the movement of empty containers. Empty trucks cross mainly in the morning.

Extension of LPOE Hours of Operation Scenario

Manufacturing plants have two or three shifts based on customer orders, not based on LPOE schedules. Additionally, some manufacturing plants are reluctant to send shipments at night due to security concerns. During the program that allowed the operation of LPOEs 24 hours a day, only a few crossings occurred from 3:00 to 6:00 a.m. Therefore, opening LPOEs 24 hours is not helpful. However, extending operating hours until 2:00 a.m. might be helpful.

On the other hand, if the manufacturing plant is experiencing extremely high product demand, sometimes the production and shipments accumulate from Saturday afternoon and Sunday; Monday mornings typically experience very heavy demand due to this.

TRAFFIC SIMULATION MODEL DEVELOPMENT

The researchers successfully developed, calibrated, and validated a microscopic traffic simulation model of the Ysleta-Zaragoza LPOE for a typical day in October 2018. A typical day at the Ysleta-Zaragoza LPOE is characterized by three variables: traffic volumes exiting the LPOE, vehicle crossing times, and the number of inspection booths open. The researchers computed these three variables by averaging the values obtained from the field during weekdays (i.e., from Monday to Friday) in October 2018.

Traffic Volumes Exiting the LPOE

The LED sensors deployed at the Ysleta-Zaragoza LPOE collected traffic volumes. The data collected were processed and aggregated in 1-hour intervals. Since the LED sensors are unable to differentiate between FAST and standard vehicles crossing the border, the researchers assumed, based on previous field observations, that one-third of the vehicles were FAST vehicles and two-thirds were standard vehicles. Figure 3 shows the average northbound traffic volume per hour exiting the LPOE for a typical day in October 2018.

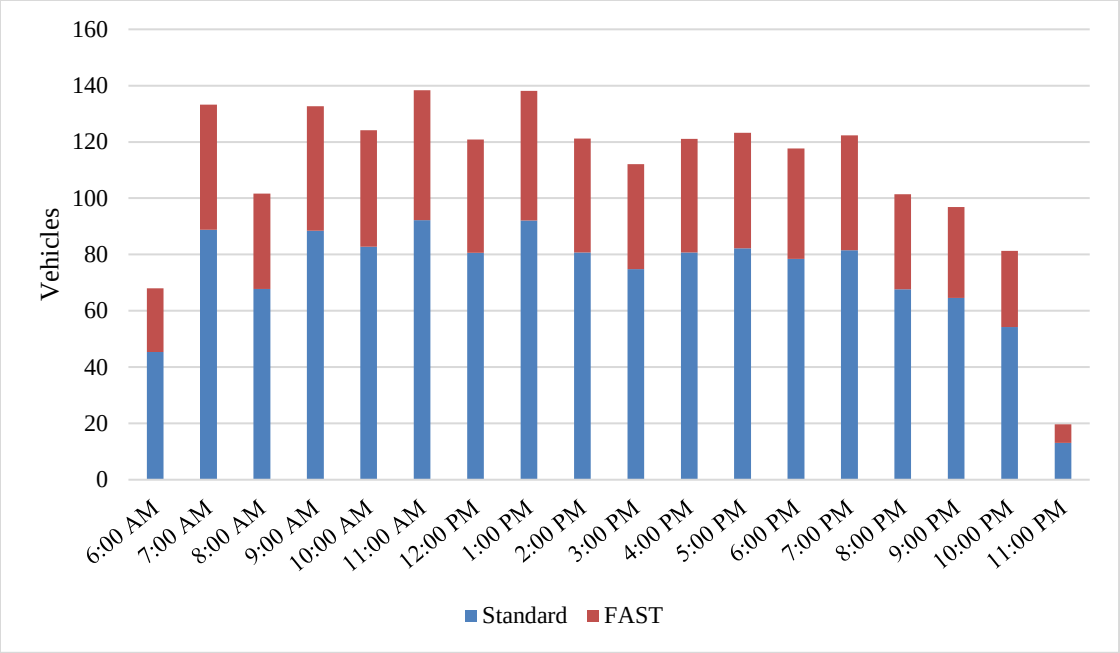

Figure 3. Average Vehicle Volumes per Hour in October 2018.

Vehicle Crossing Times

Crossing times collected from the BCIS were aggregated in 1-hour intervals for the entire month of October 2018. Figure 4 displays the hourly average crossing times for a typical day in October 2018. The time of day that trucks experienced the longest crossing time was from 11:00 a.m. to 4:00 p.m. This shows the direct correlation between volumes and crossing time; the volume count is the highest during those times. The high crossing time toward the end of the day could be due to having fewer inspection booths open as shown in Figure 5.

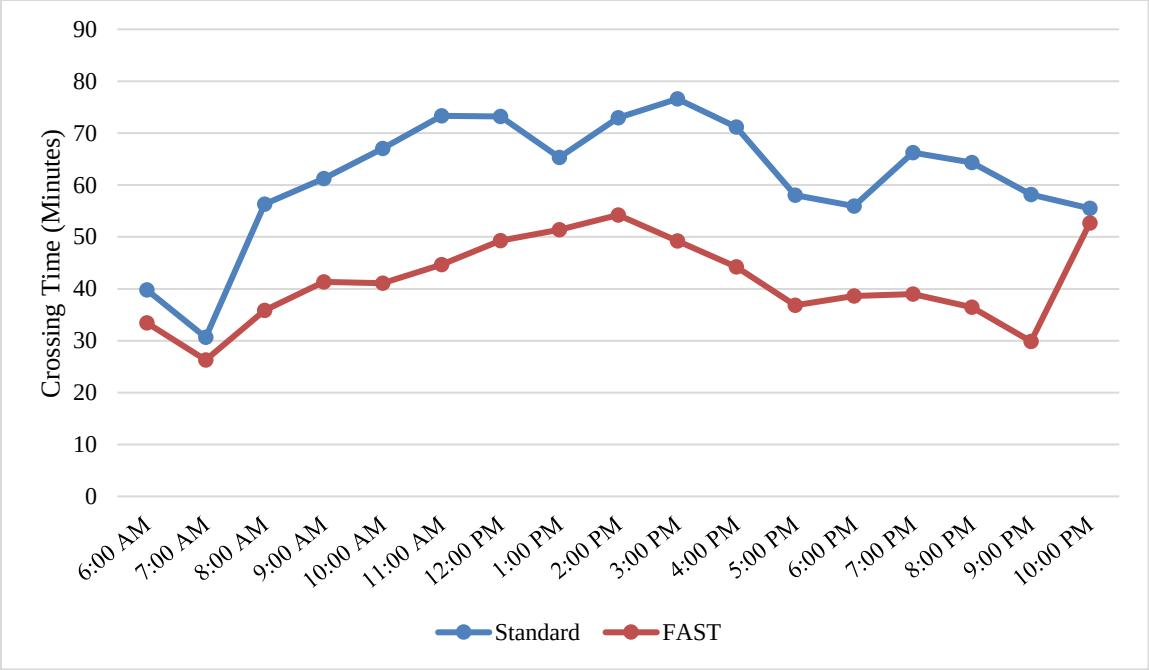

Figure 4. Average Crossing Time in October 2018.

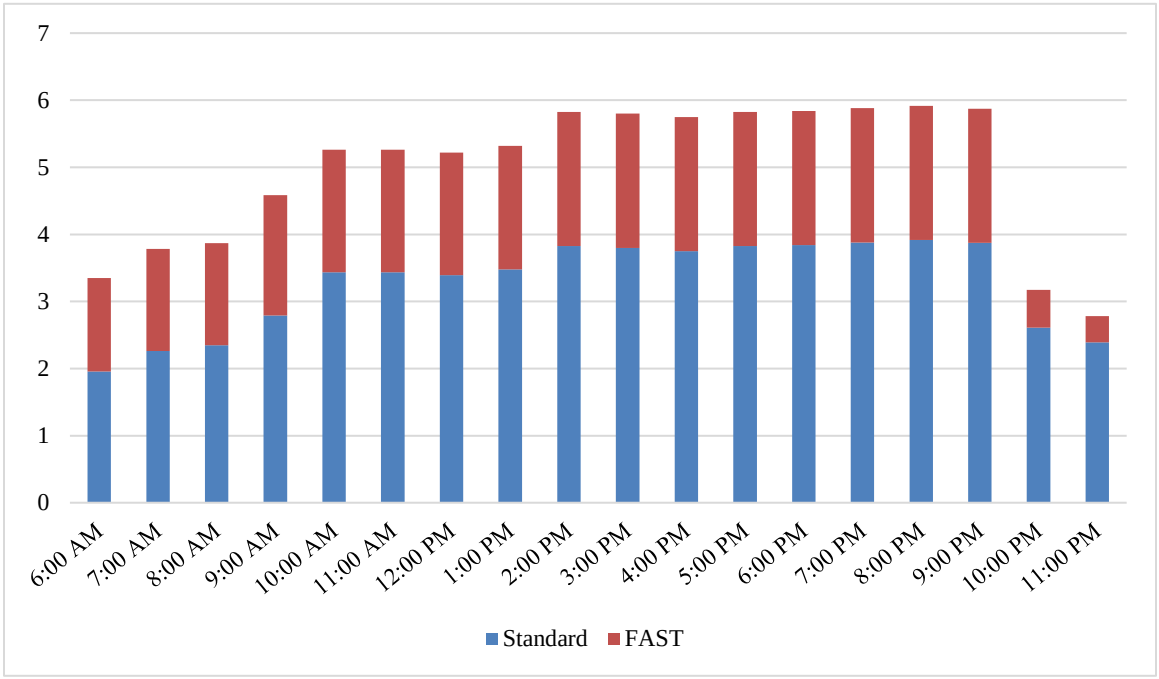

Figure 5. Average Inspection Booths Open in October 2018.

Number of Inspection Booths Open

The researchers also collected the number of inspection booths open. These data were collected from the U.S. CBP Border Wait Times website (https://bwt.cbp.gov/). To obtain these data, the researchers developed a computer program that extracted the information posted on the website. Then, the researchers processed the data that corresponded to the month of October

2018 and acquired the average number of inspection booths open per hour. Figure 5 shows the hourly average of inspection booths opened for a typical day in October 2018.

Model Calibration and Validation

The Ysleta-Zaragoza LPOE traffic simulation model was calibrated and validated using traffic volumes exiting the LPOE and vehicle crossing times, respectively. The calibration was done for FAST and standard lanes. Figure 6 and Figure 7 present calibration and validation results, respectively. The results show that the microscopic traffic simulation model is valid and accurately replicates cross-border operations at the Ysleta-Zaragoza commercial LPOE for a typical day in October 2018. The researchers considered this model as the Current Scenario and used it to evaluate different scenarios that stakeholders proposed during the workshops.

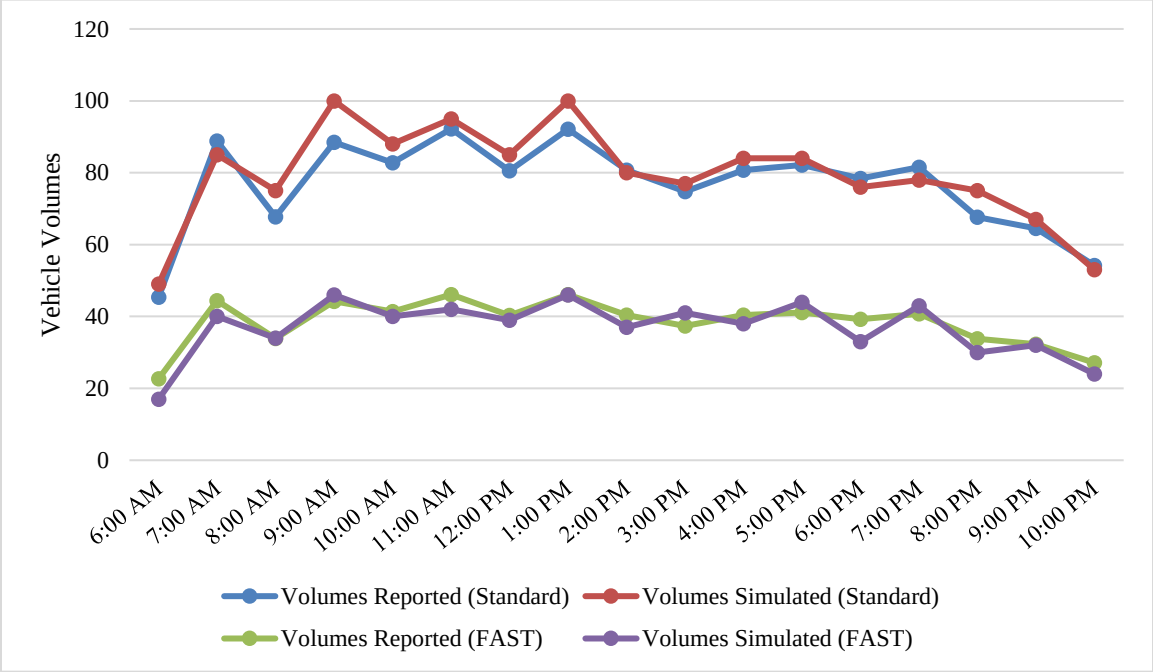

Figure 6. Ysleta-Zaragoza LPOE Calibration Model Results.

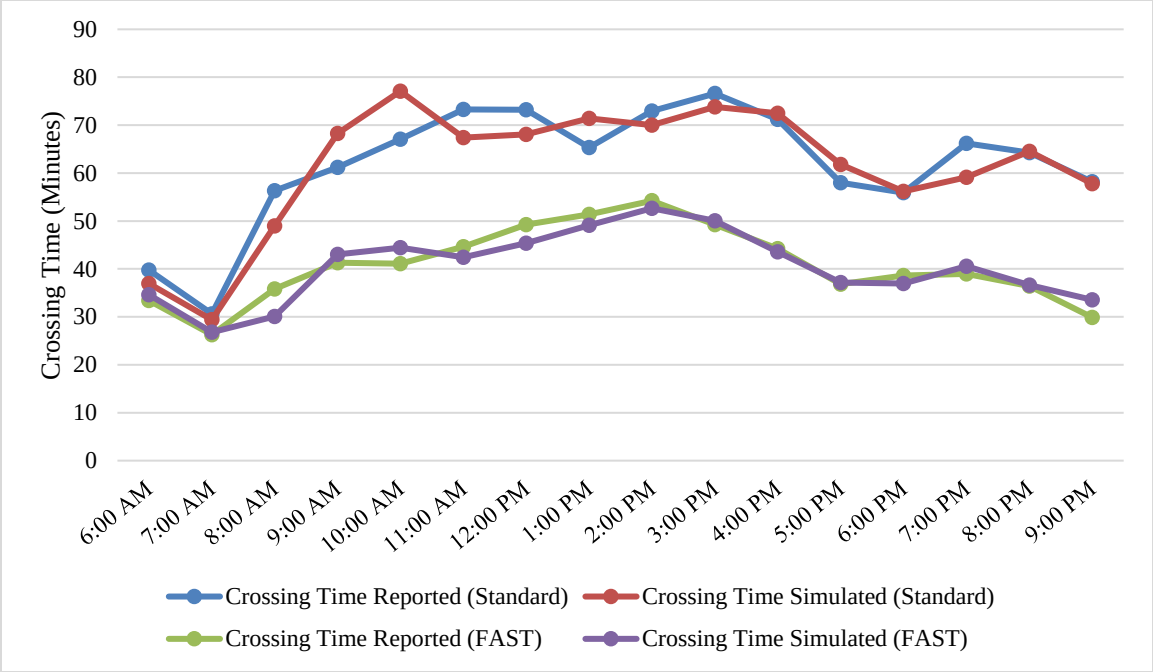

Figure 7. Ysleta-Zaragoza LPOE Validation Model Results.

EVALUATION OF STRATEGIES

As previously mentioned, the strategies identified in the workshops were grouped into six scenarios. The researchers evaluated the following two:

- Appointment Scenario.
- Demand Spreading Scenario.

Both scenarios were coded in the microscopic traffic simulation model of the Ysleta-Zaragoza LPOE, and the simulation results were compared against the results obtained for the Current Scenario (baseline). The researchers used three performance measures to quantify the improvement of the defined scenarios in comparison with the Current Scenario: average crossing time, 85th percentile crossing time, and buffer time. The buffer time equals the 85th percentile crossing time minus the average crossing time. The buffer time is defined as the extra cushion a driver must plan to account for variability in crossing times.

The researchers used the 85th percentile of crossing time instead of the 95th percentile to compute the buffer time. This decision was made based on results from previous research that revealed that 95th percentile travel times may be too extreme to reflect the impact of certain improvements (13). The researchers computed the performance measures for each scenario plus the Current Scenario by using individual vehicle trajectories extracted from the microscopic traffic simulation models of the Ysleta-Zaragoza LPOE. This approach agrees with the approach proposed by Stogios et al. (14). The following sections describe how the two scenarios were evaluated and the improvements attributable to them.

Appointment Scenario

The Appointment Scenario assumes that the FAST lanes of the Ysleta-Zaragoza LPOE are exclusively used by trucks with an appointment from 6:00 to 11:00 a.m. The number of appointments given per hour is equal to the trucks inspected in that hour in the typical day in October 2018. In other words, the researchers matched the number of trucks entering with the number of trucks processed in the same hour from 6:00 to 11:00 a.m. The typical number of trucks processed per day was kept constant. That is, 1,410 trucks used standard lanes, and 630 trucks used FAST lanes.

Figure 8 presents the number of trucks entering the Ysleta-Zaragoza LPOE for the Current Scenario and the Appointment Scenario on the y-axis and the hourly periods of time on the x-axis. Figure 9 shows the hourly average crossing time for the Current Scenario and the Appointment Scenario on the y-axis and the hourly periods of time on the x-axis. The appointment period is highlighted in light green in both figures. As Figure 8 shows, the distribution of hourly trucks entering the Ysleta-Zaragoza LPOE is very similar except for the 6:00 and 8:00 a.m. hourly intervals. This new distribution of hourly trucks generates a significant reduction of hourly average crossing time during the entire day as Figure 9 shows. The reduction is maximized during the appointment period.

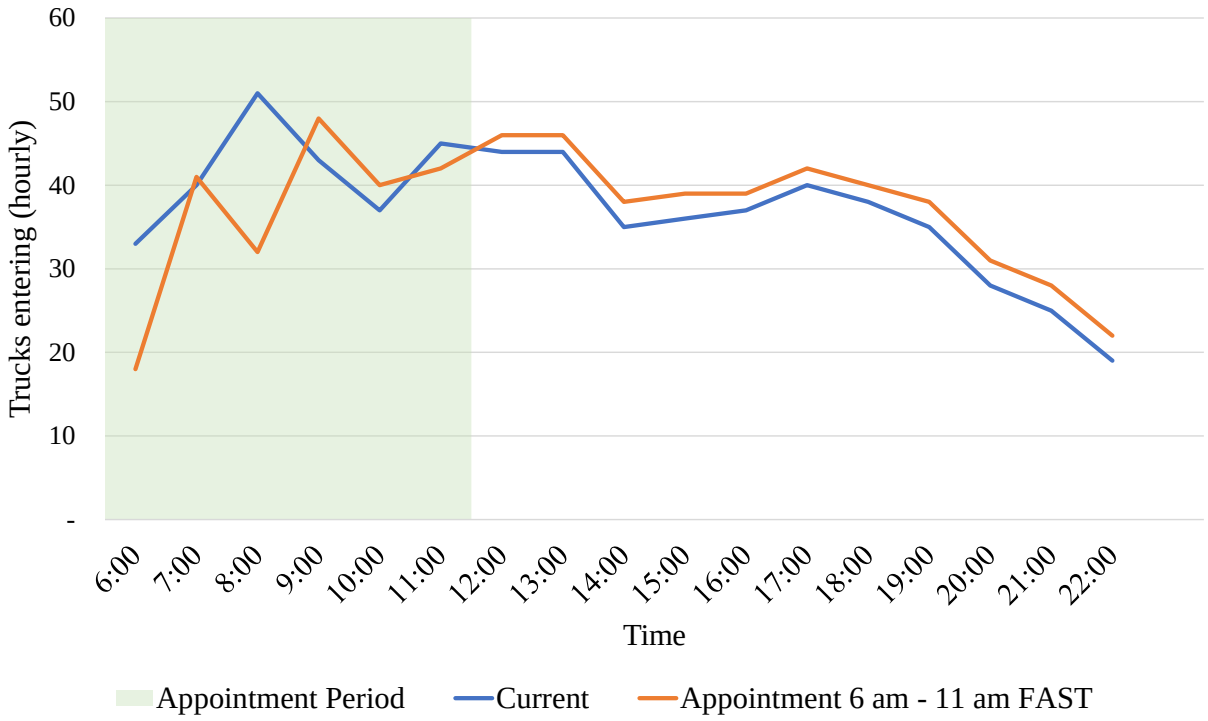

Figure 8. Appointment Scenario—Trucks Entering.

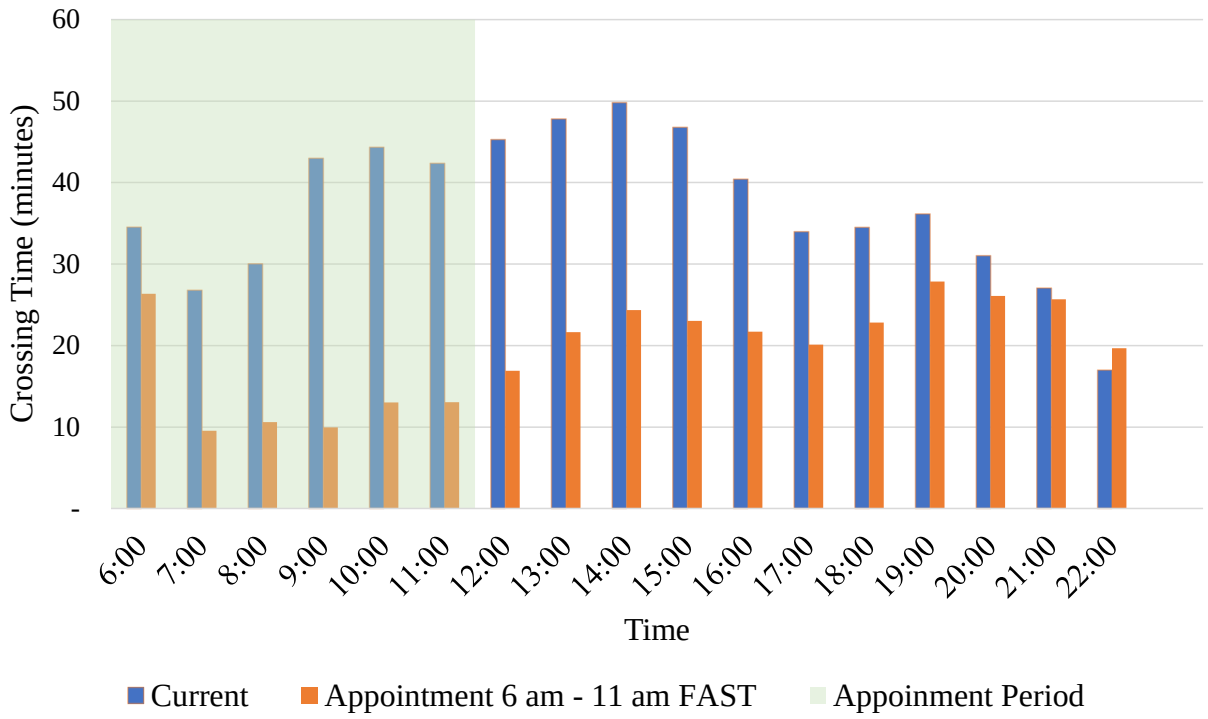

Figure 9. Appointment Scenario—Crossing Time.

Table 2 presents the results of the three performance measures computed to quantify the improvement of the Appointment Scenario in comparison with the Current Scenario. The supply-demand balance performed during the appointment period produces a significant reduction of the average crossing time, 85th percentile crossing time, and, consequently, buffer time. As Table 2 shows, the improvement is evident for the entire day and maximized during the appointment period. Regarding crossing time reliability, the buffer time of the Current Scenario is reduced from 8.93 minutes to 6.60 minutes (i.e., a 26 percent reduction) if an appointment period is implemented from 6:00 to 11:00 a.m. at the Ysleta-Zaragoza commercial LPOE. The implementation of this scenario also generates a reduction of average crossing time of almost 50 percent as Table 2 shows.

Table 2. Appointment Scenario Crossing Time Reliability.

Performance Measure	***Current FAST (Minutes)***	***Appointment Scenario***	
		Appointment Period (Minutes)	***Entire Day (Minutes)***
Average Crossing Time	37.96	12.25	19.15
85th Percentile	46.89	13.70	25.75
Buffer Time	8.93	1.44	6.60

Demand Spreading Scenario

The Demand Spreading Scenario assumes that access to the FAST lanes of the Ysleta-Zaragoza LPOE is controlled, allowing only a certain number of vehicles. In practice, the access control will not be effective unless an appointment system is implemented to control truck volumes arriving at the LPOE. If an appointment system is not implemented, trucks will arrive at

the LPOE as they are doing in the Current Scenario with the difference that they will wait at the corridors leading to the LPOE rather than at the inspection booths. Therefore, a mechanism should ensure the demand is balanced with the supply. In other words, the Demand Spreading Scenario can only be implemented by having an appointment-based system to ensure the balance between supply and demand through the day. The number of trucks entering the Ysleta-Zaragoza LPOE per hour is equal to the trucks inspected in that hour in the typical day of October 2018. The typical number of trucks processed per day was kept constant. That is, 1,410 trucks used standard lanes, and 630 trucks used FAST lanes.

Figure 10 presents the number of trucks entering the Ysleta-Zaragoza LPOE for the Current Scenario and the Demand Spreading Scenario on the y-axis and the hourly periods of time on the x-axis. Figure 11 shows the hourly average crossing time for the Current Scenario and the Demand Spreading Scenario on the y-axis and the hourly periods of time on the x-axis. This new distribution of hourly trucks generates a significant reduction of hourly average crossing time during the entire day as Figure 11 shows. The reduction is maximized from 9:00 a.m. to 5:00 p.m.

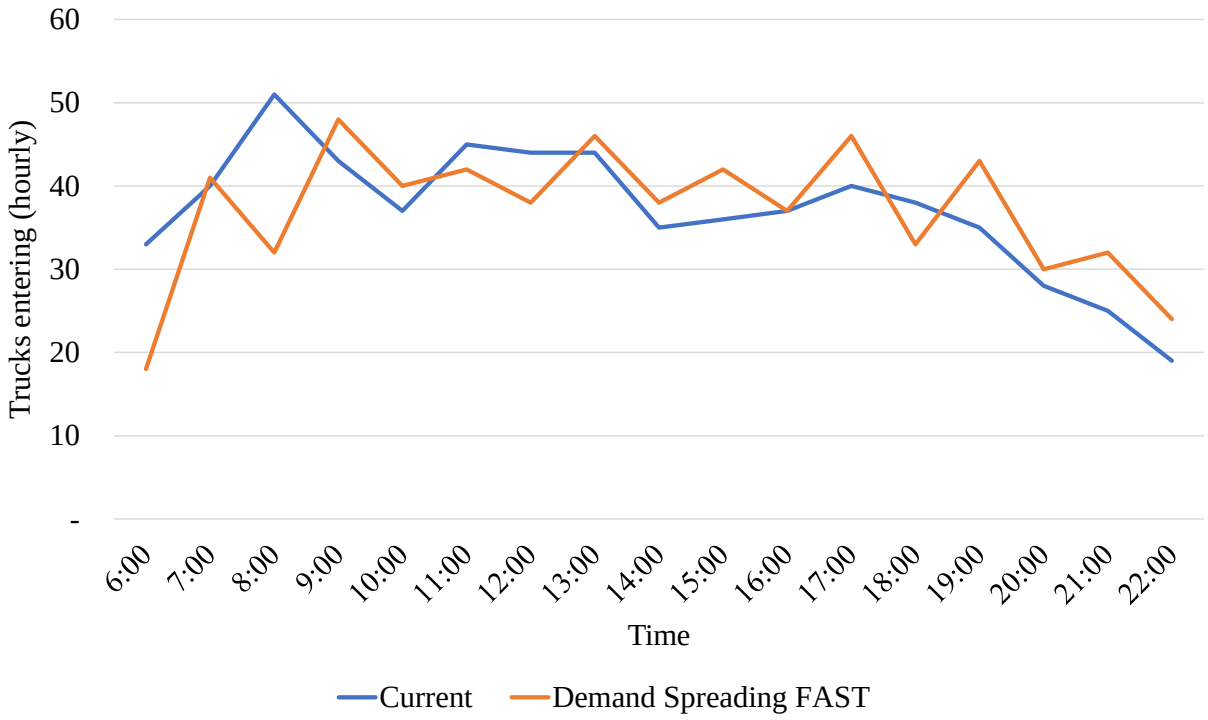

Figure 10. Demand Spreading Scenario—Trucks Entering.

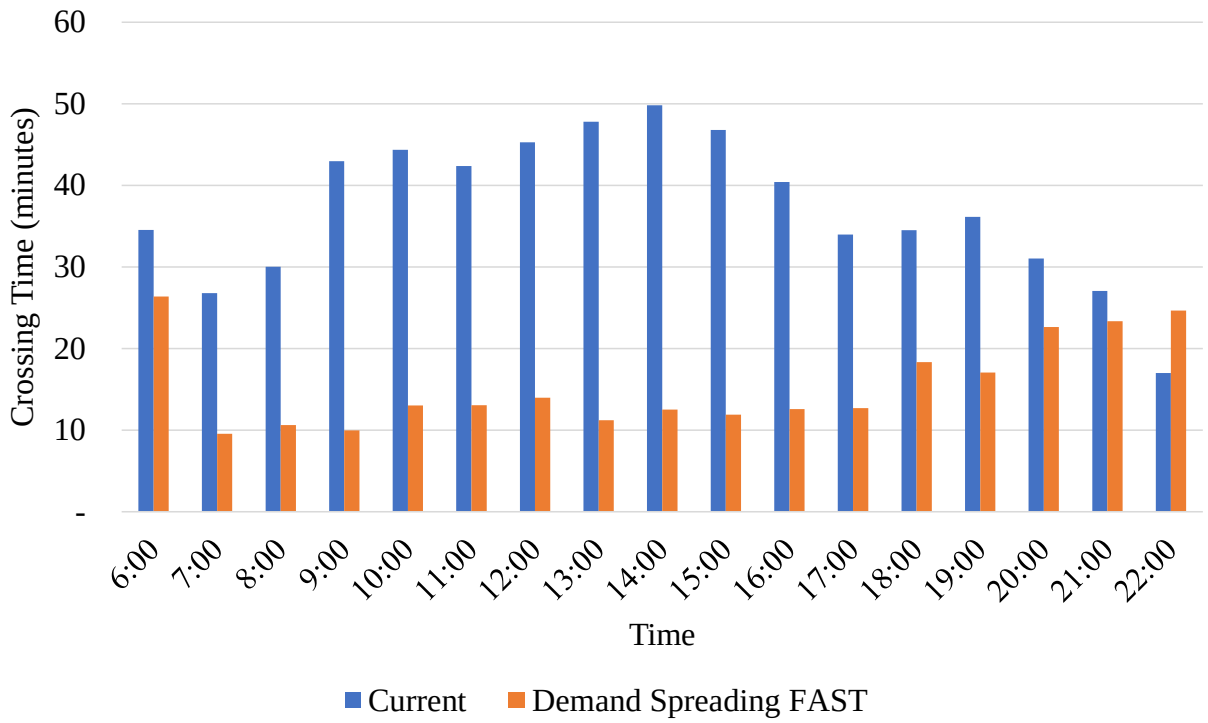

Figure 11. Demand Spreading Scenario—Crossing Time.

Table 3 presents the results of the three performance measures computed to quantify the improvement of the Demand Spreading Scenario in comparison with the Current Scenario. The supply-demand balance performed produces a significant reduction of the average crossing time, 85th percentile crossing time, and, consequently, buffer time. As Table 3 shows, the average crossing time is reduced by 60 percent from 37.96 minutes to 14.84 minutes, and the buffer time is reduced by 22 percent from 8.93 minutes to 6.94 minutes. Therefore, the crossing time is shorter and more reliable if the Demand Spreading Scenario is implemented at the Ysleta-Zaragoza commercial LPOE.

Table 3. Demand Spreading Scenario Crossing Time Reliability.

Performance Measure	***Current FAST (Minutes)***	***Demand Spreading (Minutes)***
Average Crossing Time	37.96	14.84
85th Percentile	46.89	21.81
Buffer Time	8.93	6.97

CHAPTER 5:
FINDINGS AND CONCLUSIONS

The researchers evaluated two scenarios that consists of a set of strategies identified by stakeholders representing the public sector and the industry in the two workshops. These scenarios are the Appointment Scenario and the Demand Spreading Scenario. The Appointment Scenario proposes a balance between demand and supply by only allowing the entrance of trucks that have an appointment from 6:00 to 11:00 a.m. The Demand Spreading Scenario proposes a balance of demand and supply during the entire day. In practice, the only way to implement the Demand Spreading Scenario is by using an appointment-based system for the entire day without allowing trucks that do not have an appointment to enter the Ysleta-Zaragoza LPOE. In order to work, this appointment-based system should allow express appointments made 2–4 hours in advance so last-minute just-in-time shipments can cross the same day they are requested regardless of whether they have an appointment or not.

These scenarios were successfully evaluated using a microscopic traffic simulation model that the researchers developed for the Ysleta Zaragoza LPOE. The results of the evaluation show that the average crossing time can be reduced by 50 percent and the buffer time by 26 percent compared to the Current Scenario if the Appointment Scenario is implemented. The average crossing time can be reduced by 60 percent and the buffer time by 22 percent compared to the Current Scenario if the Demand Spreading Scenario is implemented.

Future research should focus on working with the public sector and the industry to carry out a pilot project at an LPOE along the U.S.-Mexico border to confirm the benefits obtained from the evaluation in a microscopic traffic simulation environment.

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APPENDIX A:
POLL QUESTIONS

PUBLIC-SECTOR POLL QUESTIONS

1. Vote for your preferred strategies to manage demand:
    a. Demand spreading through the day
    b. Demand balancing across LPOEs
    c. Appointment-based system
    d. Please provide others in comment box
2. Are there constraints to implement traffic demand spreading through the day?
    a. Yes
    b. No
    If yes, which are those? Please provide comments.
3. Are there constraints to implement traffic demand balancing across LPOEs?
    a. Yes
    b. No
    If yes, which are those? Please provide comments.
4. Are there constraints to implement an appointment-based system?
    a. Yes
    b. No
    If yes, which are those? Please provide comments.
5. Are there constraints to implement the other strategies identified?
    a. Yes
    b. No
    If yes, which are those? Please provide comments.

INDUSTRY POLL QUESTIONS

1. Is it important for your company that the shipments arrive at the destination at a certain time?
    a. Never
    b. Sometimes
    c. Most of the times
    d. Always
2. Before starting the trip, does your company consider the arrival time to plan the departure time?
    a. Never
    b. Sometimes
    c. Most of the times
    d. Always
3. How much buffer time does your company consider to cross the border via the Ysleta-Zaragoza LPOE?
    a. 0–15 minutes
    b. 15–30 minutes
    c. > 30 minutes
    d. I do not consider buffer time
4. Usually, how many cross-border trips per truck is your company able to complete?
    a. 1
    b. 2
    c. 3
    d. More than 3
5. Would it be useful for your company if each truck in your company could complete an additional trip per day?
    a. Yes
    b. No
6. Vote for your preferred strategies to manage demand:
    a. Demand spreading through the day
    b. Demand balancing across LPOEs
    c. Appointment-based system
    d. Please provide others in comment box
7. Are there constraints to implement traffic demand spreading through the day?
    a. Yes
    b. No

    If yes, which are those? Please provide comments.

8. Are there constraints to implement traffic demand balancing across LPOEs?

    a. Yes
    b. No

    If yes, which are those? Please provide comments.

9. Are there constraints to implement an appointment-based system?

    a. Yes
    b. No

    If yes, which are those? Please provide comments.

10. Are there constraints to implement the other strategies identified?

    a. Yes
    b. No

    If yes, which are those? Please provide comments.

APPENDIX B:
WORKSHOP POLL RESULTS

PUBLIC SECTOR

1. Vote for your preferred strategies to manage demand:

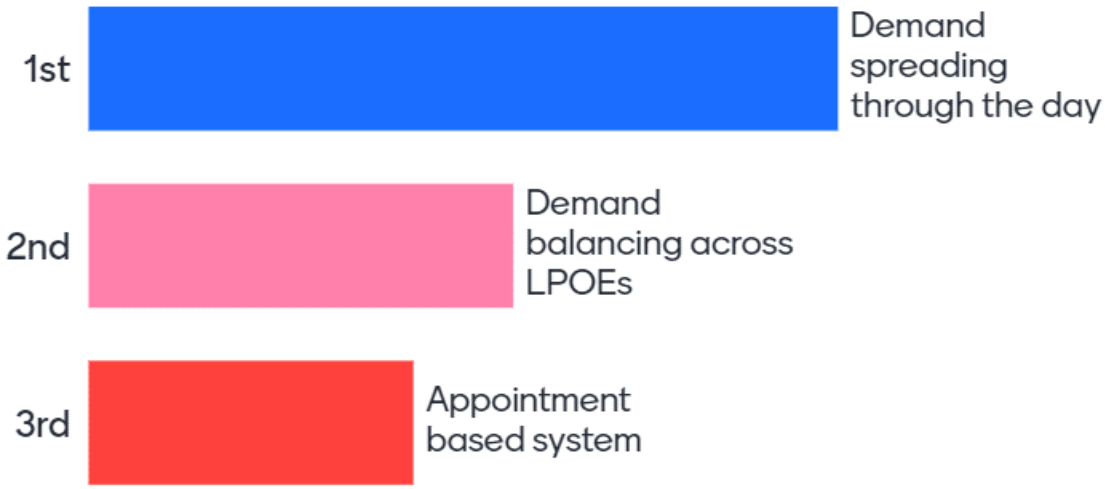

Figure 12. Public-Sector Preferred Strategies.

2. Are there constraints to implement traffic demand spreading through the day?

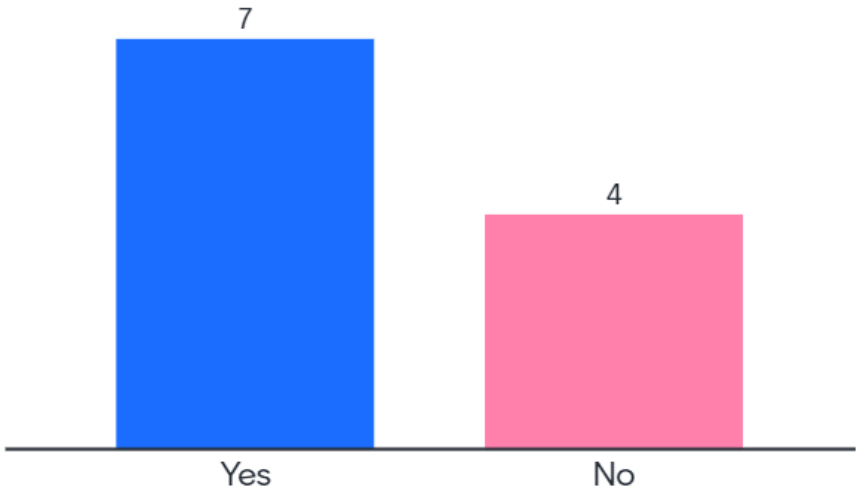

Figure 13. Public-Sector Poll Results on Demand Spreading through the Day.

3. Are there constraints to implement traffic demand balancing across LPOEs?

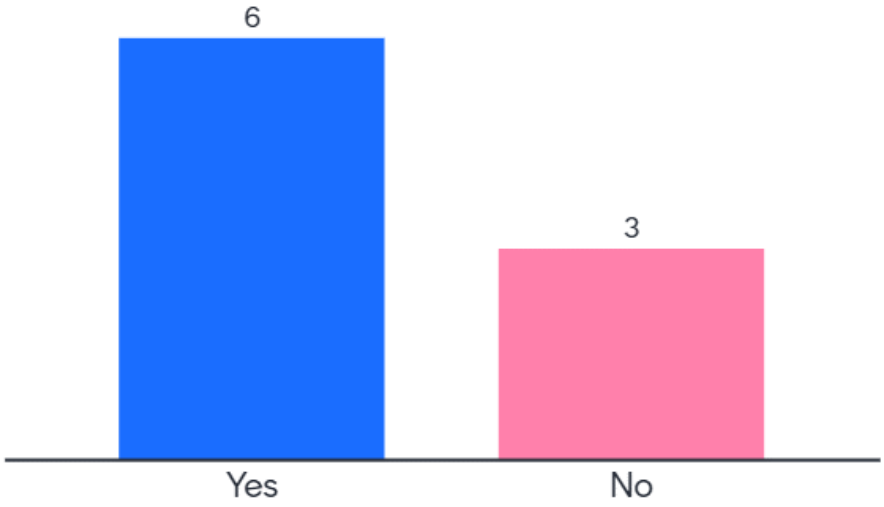

Figure 14. Public-Sector Poll Results on Traffic Demand Balancing across LPOEs.

4. Are there constraints to implement an appointment-based system?

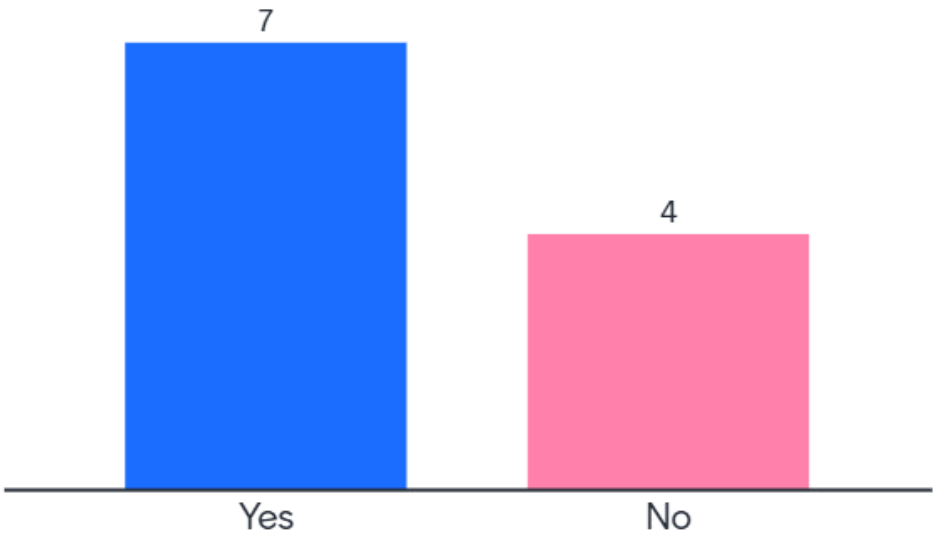

Figure 15. Public-Sector Poll Results on Appointment-Based System.

INDUSTRY

1. Is it important for your company that the shipments arrive at the destination at a certain time?

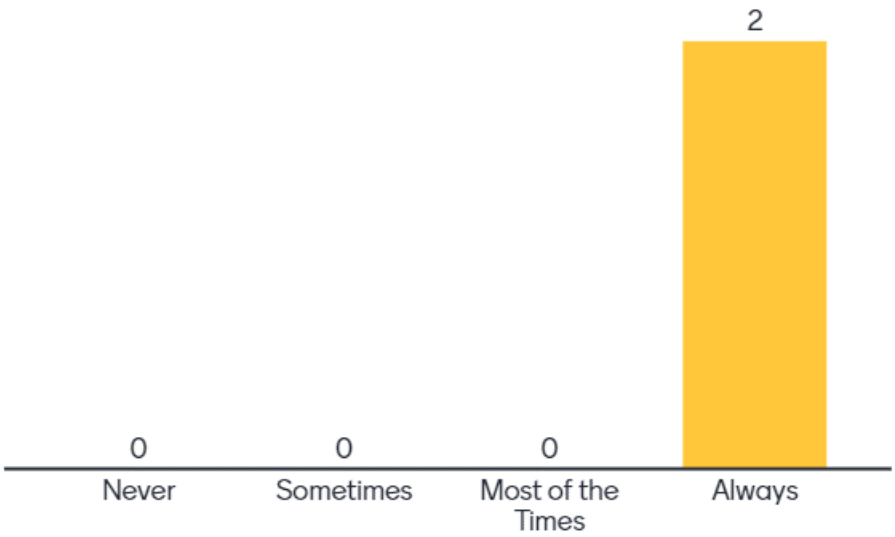

Figure 16. Industry Poll Results on Importance of Shipments Arriving on Time.

2. Before starting the trip, does your company consider the arrival time to plan the departure time?

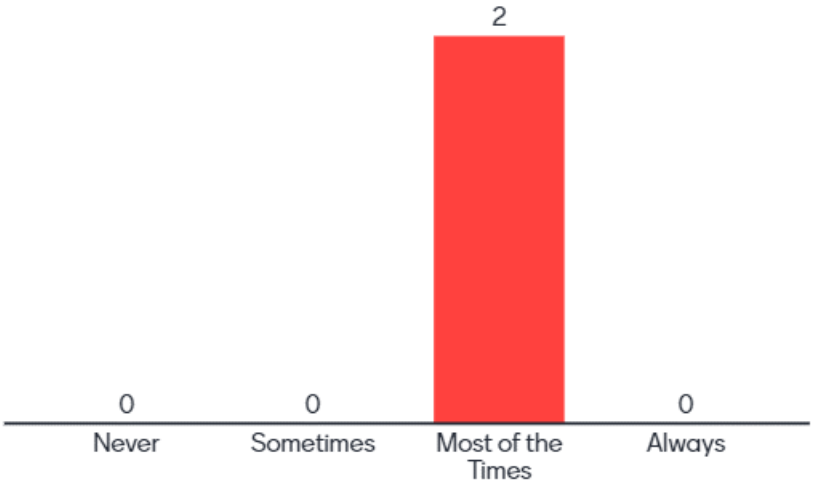

Figure 17. Industry Poll Results on Importance of Arrival Time When Planning Departure Time.

3. How much buffer time does your company consider to cross the border via the Ysleta-Zaragoza LPOE?

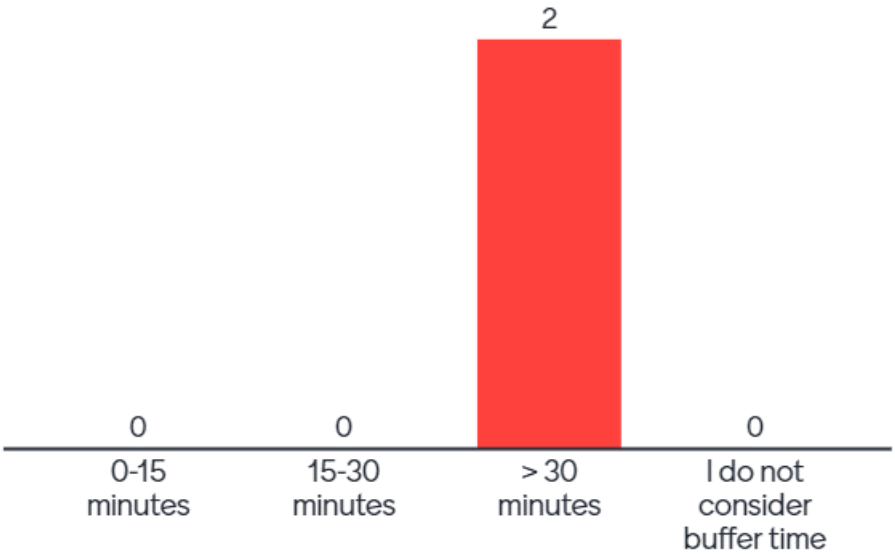

Figure 18. Industry Poll Results on Buffer Time Consideration When Crossing the Border.

4. Usually, how many cross-border trips per truck is your company able to complete?

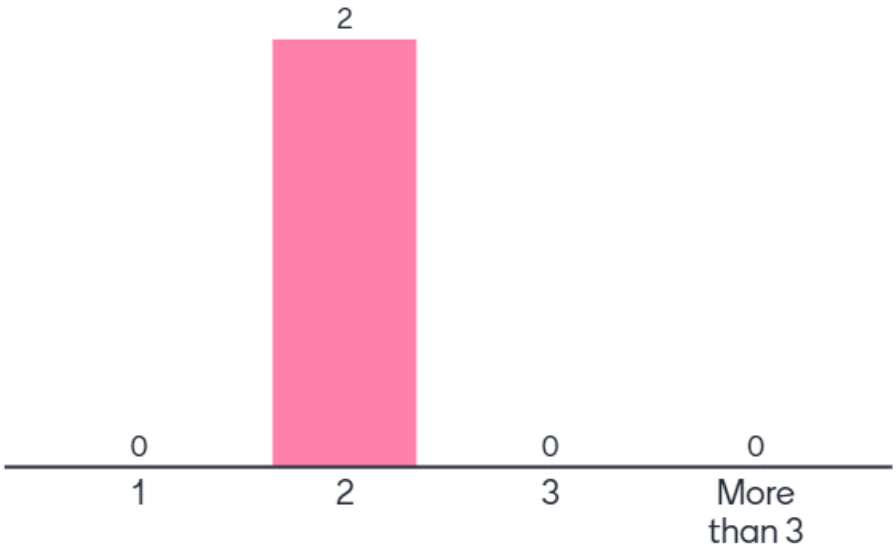

Figure 19. Industry Poll Results on Number of Cross-Border Trips per Truck and per Day.

5. Would it be useful for your company if each truck in your company could complete an additional trip per day?

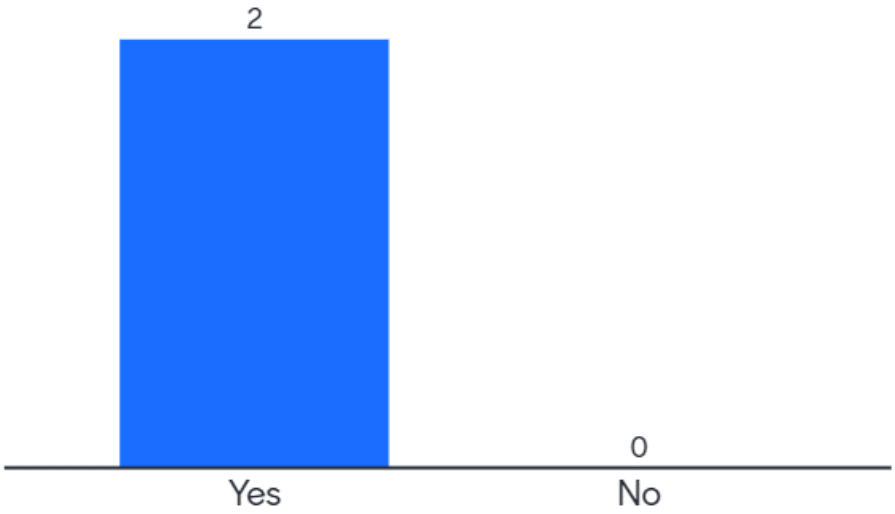

Figure 20. Industry Poll Results on Usefulness of Completing an Additional Trip per Truck and per Day.

6. Vote for your preferred strategies to manage demand.

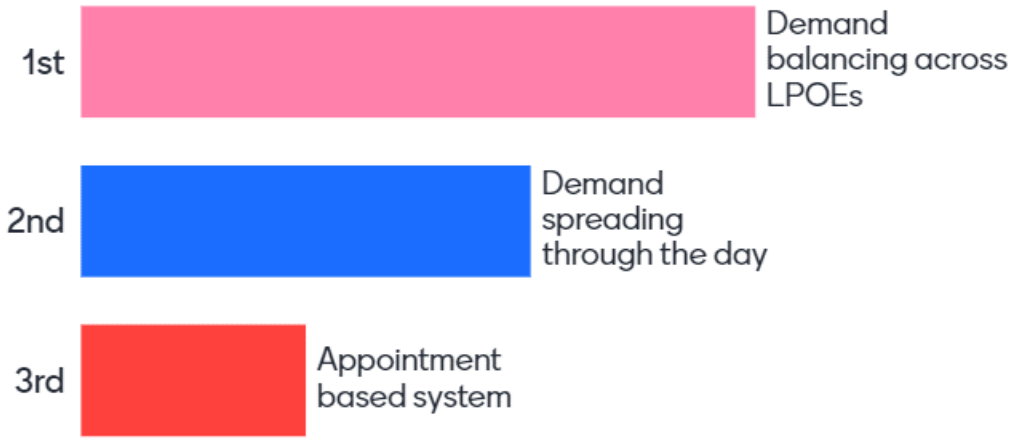

Figure 21. Industry Preferred Strategies.

7. Are there constraints to implement traffic demand spreading through the day?

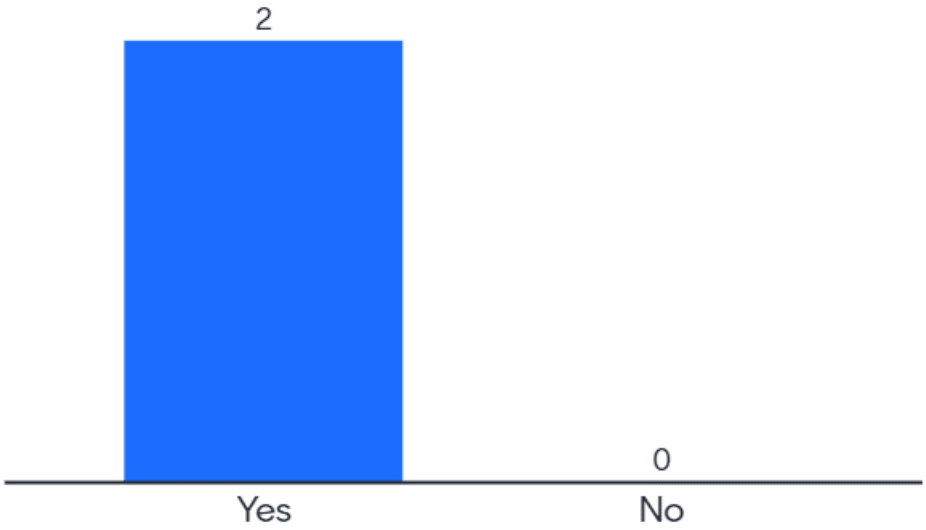

Figure 22. Industry Poll Results on Demand Spreading through the Day.

8. Are there constraints to implement traffic demand balancing across LPOEs?

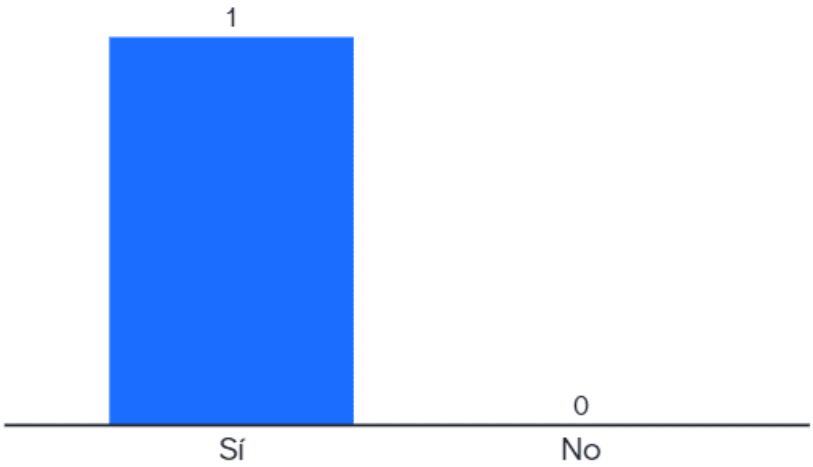

Figure 23. Industry Poll Results on Traffic Demand Balancing across LPOEs.

9. Are there constraints to implement an appointment-based system?

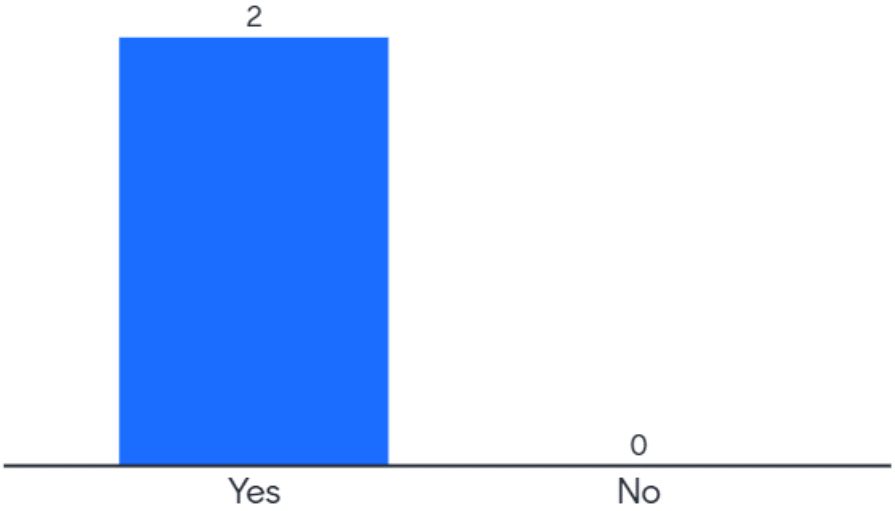

Figure 24. Industry Poll Results on Appointment-Based System.