

Reducing Commercial Traffic Wait Times at the World Trade Bridge: A Process Reconfiguration Approach

Balaji Janamanchi Ph.D.
Assistant professor of Management
DIBTS, College of Business Administration

1.0 Introduction

Laredo, Texas is the biggest land port of the United States and is ranked fourth in the overall trade behind New York, Detroit, and Los Angeles, as per the National Report in 2004 (LMT, 2007a). Much of Laredo's success is owed to its strategic location on Texas-Mexico border and the trade liberalization under NAFTA signed into law in 1994. It is not an exaggeration to state that Laredo's very foundation is based on the foreign trade and free trade transportation.

In the recent past, long wait times for commercial traffic at the World Trade Bridge IV (WTB) of Laredo, used exclusively for commercial trucks (ITS,2001 pp-16), have been a cause of concern. Consider, for example, the news report in Laredo Morning Times, "Bigger bridge: Feds call for 9 more lanes at World Trade" by Ashley Richards, featured in the main news section of Laredo Morning Times of May 10, 2007 (LMT, 2007b). As per this report, "Commercial traffic often experience a two-to-three hour wait when crossing the World Trade Bridge. To address this problem, U.S. Customs and Border Protection (CBP) have proposed an expansion that would double the number of lanes at the bridge from nine to eighteen."

To start with, the US CBP would like to have at least three temporary lanes in a preliminary phase of the bridge expansion project. However, even at modest estimates the addition of three new lanes would involve at least a couple of years of construction work and commissioning. Therefore, there is a reasonable need to find a short term solution for the increasing wait times and to reduce the congestion at the World Trade Bridge IV.

2.0 Need for fast action

Jose R. Uribe, CBP assistant port director, Laredo, TX, during a presentation to the city's

International Trade Blue Ribbon Committee on May 9, 2007 stated that “This is our bloodline. This is very important,” referring to the disturbing “wait times” for commercial traffic. He further added that seventy percent of bridge revenues come from commercial truck traffic (LMT, 2007b). Keeping the bridge operations efficient is vital to Laredo’s economic future because, other cities such as San Antonio (TX), Kansas City (MO), and various other Kansas City Smartport partner cities are eyeing these business volumes and are offering to provide alternate solutions to reducing congestion at borders (Boske, 2006; Kansas City Smartport, 2007). If those initiatives should take off faster than the Laredo City community can resolve the bridge congestion, Laredo will be left behind in the dust and smoke of the commercial truck traffic with no economic benefit to the city from traffic (Boske, 2006).

Understandably, the bridge expansion project will be implemented over the next three to five years. So there is an obvious and immediate need for improving the bridge operations to reduce the wait times and doing so will help prevent losing commercial traffic to other border ports along the Mexico-Texas border. This action will also help retain the revenues that accrue from increased commercial traffic forecast for current times and the near future (Boske, 2006; Phillips, 2005, 2007; LMT, 2007b);

2.1 ACE eManifest effect

On January 19, 2007, U.S. Customs and Border Protection published a Federal Register Notice establishing the mandatory use of Automated Commercial Environment (ACE) electronic Manifest (eManifest) at all land border ports in California, New Mexico and Texas. This notice established April 19, 2007 as the effective date for establishment of ACE eManifest as the approved data interchange for transmission of advance electronic cargo information (US CBP, 2007b). CBP Laredo Port Director Gene Garza states, “CBP officers were checking trucks in 45 seconds on average, but with the new eManifest system that time is up to two-to-three minutes” (LMT, 2007b).

From the statement above, one can infer that part of the problem is caused by the slower processing times for verifying the eManifest documentation. This is not surprising given that in an earlier Special Report (2001) the Texas Comptroller of Public Accounts has

listed deficiencies in entry documentation as one of the significant causes of delays at the US-Mexico border.

2.2 Increased Security procedures to address terror threats

Chilling memories of September 11, 2001 terror attack have spurred into action many a government agency to strengthen the safety and security measures in their day- to-day operations. The US Customs and Border Protection, the Department of Transportation (DOT), the Federal Motor Carriers Safety Administration (FMCSA) and other related agencies have accordingly incorporated increased safety and security measures into their operations both inland and at the international borders.

2.3 The Research Problem:

Stated simply, the research problem is, “What may be done in short-term to reduce the wait times for commercial traffic at the World Trade Bridge without compromising on the safety and security aspects of clearance?”

2.4 The Research Methodology intended and employed

This research aimed at studying the typical bridge operations involved in clearing commercial traffic with the objective of identifying “reconfiguration opportunities” to improve the process cycle times and thereby, reduce the wait times at the bridge. Process improvement is a four level managerial action sequence of Repositioning, Exploring, Reconfiguring and Radical Redesign (Upton, 1998). Given the time and resource constraints, the last stage of radical redesign is ruled out. Given that bridge operations have been carried out for some time now, it was assumed that the first two stages of repositioning and exploring may have already been explored by the CBP officers.

The research methodology as proposed involved both quantitative and qualitative analysis. A survey was planned for gathering quantitative data about the activity sequence and duration of typical commercial vehicle clearance at the bridge on several occasions to analyze and obtain average times to be adopted in the analysis and recommendations. Data of operations was to be collected from the officers and

administrators by conducting personal interviews (or questionnaires passed out for filling). Processes were to be reexamined to ensure complete compliance with the necessary requirements concerning safety and security of personnel as well as the goods being traded.

However, due to safety and security reasons, the port authorities declined to give permission for such on-site data collection or for sharing the internal intricate details of the inspections processes. So the research had to be limited to theoretical analysis of a possible solution for reducing the commercial vehicle wait times at the World Trade Bridge IV in Laredo, Texas.

3.0 What has been done?

At Federal, State and Local administration levels, considerable amount of time and efforts have been put in to identify the causes for the delays and long wait times at the border ports (Special Report, 2001; FMCSA, 2003). For obvious reasons, most of the initiatives dealing with the border crossing have been focused on redesigning the inspection process, finding long term solutions or identifying the causes for the delays (Center for Transportation research 2003, 2005; Center for Transportation Research and Texas Transportation Institute, 2002; FMCSA, 2003). This is not very surprising because, primarily, each of the sponsoring agencies was focused on certain aspects of the border crossing but the short term solutions were not a primary objective.

Consider for example, the findings listed in the special report (2001) as follows,

General Findings

“The law enforcement and regulatory functions of federal and state agencies involved in the border crossing process at the Texas-Mexico ports of entry involve separate legal jurisdictions. Therefore under current federal and state law, one individual cannot perform the Customs, immigration, and motor carrier enforcement functions....”

Please refer to the special report for a complete list and also Federal, State and Local findings (Special Report, 2001). Further, the report also includes a complete description of the sequence of steps involved in the commercial vehicle clearance at the border very

much like the other reports (Center for Transportation research 2003, 2005;Center for Transportation Research and Texas Transportation Institute, 2002).

More recently, the Federal and State agencies appeared to be concerned with finding short-term solutions to the border crossing at the 26 land ports on Texas-Mexico Border (TxDOT, 2007). However, this short term solutions project is scheduled to run for about a year before it can start making recommendations for implementation.

4.0 What could be done in short-term?

Drawing on the available current knowledge in the disciplines of Operations Management, Operations Research, Logistics, Systems Thinking and other management theories we can propose the following broad categories of solutions:

4.1 Structural Changes: While major structural changes could result in redesigning the commercial traffic inspection process, minor changes could simply fall in the short-term solutions category resulting in improvements of the existing process rather than becoming innovative solutions.

For example, a long term solution is,

Increasing the number of north bound lanes.

As reported in the introduction section, the US CBP is already acting in this direction.

Goldratt's (1984) Theory of constraints (TOC) which is an extension of the Optimized Production Technology (OPT) suggests that when a critical internal resource proves to be the classic bottleneck in a sequence of operations, then keeping the bottleneck resource fully occupied and busy is imperative for optimal results.

We know that the World Trade Bridge IV, now operates from 8.00 a.m. to midnight (US CBP, 2007a). So the first short term solution is,

Operating the bridge for longer hours on a daily basis..... [1]

It may be that the bridge need be open for 2 hours more each day to cater to the increased use (or perhaps, for three hours or longer). Since there are 8 lanes for the regular

commercial traffic, extended working hours can help immensely with the reduction of wait times.

While one can not expect to continue doing this for long spells, for the simple reason that the bottleneck resource may need some preventive maintenance, this solution nevertheless could be a very effective solution in a short run. However, this solution is subject to the availability of the support services to operate the bridge for longer hours. E.g. The CBP officers, TXDOT officers, and other Federal and State Agencies' agents.

4.2 Change Management: A related issue for the structural changes is the need for having in place change management plans. It is well known that the benefits of learning curve are affected each time some changes are made in the design of service, business processes, personnel or procedures. This is so because the affected employee (officer in this case) needs to learn the changed process. This was of course, a contributing factor for the increased delays and wait times as observed by Laredo CBP Port Director Gene Garza (LMT, 2007b) in respect of the recently introduced ACE eManifest.

Providing necessary training to all the Federal and State Agencies' officers for each and every small change made in the processes goes a long way in keeping up the utilization of the available capacity of the Bridge. So even though this may be a little time consuming,

“Providing the necessary training to officers to cope up with changes and to keep up the service levels”..... [2]

4.3 Leveraging the practice of Drayage

As we discussed earlier, 90% of the commercial traffic on the WTB is of drayage category (FHWA, 2007). While there is a wasted time in hand-offs, as Hammer and Stanton (1994) would observe. Typically, hand offs result in wasted time and effort. Any student of Professor Deming would be quick to point that “anything that doesn't add value is waste.”

While the practice of drayage may be considered a waste of time from a perspective, in a different perspective this could prove to be a blessing in disguise. For example, since drayage is operated only by the local customs brokers and all these brokers have permanent establishments and are interested in improving the process as stakeholders, it may be possible to operate dedicated lanes round the clock lanes exclusively for the drayage operators who pass the necessary security background checks and subscribe the initiatives like the Customs-Trade Partnership Against Terrorism (CTPAT) to ease the pressure on the WTB during the day time. So, yet another short term solution is

Operate dedicated lanes for CTPAT participants round the clock..... [3]

The implicit expectation in this solution is the expectation that, such stakeholders do not pose undue risk to the safety and security of the personnel operating the WTB at late night hours. As for now, the Free and Secure Trade (FAST) lane, a dedicated lane on WTB, catering to these type of operators is experiencing “minimal to no delays” (US CBP, 2007a).

4.4 Waiting Line Models

If all stakeholders reach an understanding to tackle the issue collectively with mutual cooperation most solutions become effective both in the short-run as well as in long -run. Any and every small saving in the processing times at the border post can effectively improve the utilization of the inspection facilities as will be explained with the help of waiting line models theory hereunder.

4.4.1 Waiting Line Models (Reid and Sanders, 2005)

The easiest waiting line model involves a single-server, single-line, single-phase, system. The following assumptions are made when we model this environment.

- a. The customers are patient (no balking, reneging, or jockeying) and come from a population that can be considered infinite.
- b. Customer arrivals are described by a Poisson distribution with a mean arrival rate of λ (lambda). This means that the time between successive customer arrivals follows an exponential distribution with an average of $1/\lambda$.
- c. The customer service rate is described by a Poisson distribution with a mean service rate of μ (mu). This means that the service time for one customer follows an exponential distribution with an average of $1/\mu$.
- d. The waiting line priority rule used is first-come, first-served.

λ = mean arrival rate of customers
(average number of customers arriving per unit of time)

μ = mean service rate
(average number of customers that can be served per unit of time)

However, we are dealing with multi server situation (eight identical lanes on the WTB excluding the one dedicated lane for FAST).

4.4.2 Multi server Waiting Line Model (Reid and Sanders, 2005)

In the single-line, multiserver, single phase model, customers form a single line and are served by the first server available. The model assumes that there are s identical servers, the service time distribution for *each server* is exponential, and the mean service time is $1/\mu$. Using these assumptions, the operating characteristics can be described with the following formulas.

s = the number of servers in the system

$p = \frac{\lambda}{s\mu}$ = the average utilization of the system

$P_0 = \left[\sum_{n=0}^{s-1} \frac{(\lambda/\mu)^n}{n!} + \frac{(\lambda/\mu)^s}{s!} \left(\frac{1}{1-p} \right) \right]^{-1}$ = the probability that no customers are in the system

$L_Q = \frac{P_0(\lambda/\mu)^s p}{s!(1-p)^2}$ = the average number of customers waiting in line

$W_Q = \frac{L_Q}{\lambda}$ = the average time spent waiting in line

$W = W_Q + \frac{1}{\mu}$ = the average time spent in the system, including service

$L = \lambda W$ = the average number of customers in the service system

$P_n = \begin{cases} \frac{(\lambda/\mu)^n}{n!} P_0 & \text{for } n \leq s \\ \frac{(\lambda/\mu)^n}{s!s^{n-s}} P_0 & \text{for } n > s \end{cases}$ = probability that n customers are in the system at a given time

Note: The total service rate must be greater than the arrival rate, that is, $s\mu > \lambda$. If $s\mu \leq \lambda$, the waiting line would eventually grow infinitely large. Before using the formulas, check to be sure that $s\mu > \lambda$.

Using the average numbers of trucks crossing per day at 4500/day (TCBEED, 2007) at

the World Trade Bridge as the basis, the arrivals per lane are approximately 500 trucks. Since one lane is dedicated to FAST, the other eight general commercial lanes are treated as 8 servers in a multiserver waiting line model. Using an approximate service level of 2min / truck which is kind of average between 45 sec/truck and the 3min/truck (before and after introduction of ACE eManifest) we can create the baseline model and simulate the possible alternate scenarios for the suggested short term improvements.

Alternate Scenario 1: operate WTB 2 hours longer each day (with 8 lanes at 2 hours this is a crude approximation of adding an extra lane for 16 hours)

Alternate Scenario 2: Improve the service levels to 1min/truck (close to the level obtaining before eManifest of 45 sec/truck) as a result of training and the benefits of learning curve effect.

We obtain the following table of results from the multiserver waiting line model.

Queuing Analysis Multiple servers	Baseline	OT 2hour/day	Service rate	
		=16lane hour	improved	
INPUTS		=1addl lane		
Time Unit	Hour	Hour	Hour	
Arrival rate (lambda)	250	250	250	
Service rate (mu)	40	40	60	
Number of servers (s)	8	9	8	
Intermediate calculations				
Average Time between arrivals	0.004	0.004	0.004	
Average service Time per server	0.025	0.025	0.0166667	
Combined service rate (s * mu)	320	360	480	
Performance measures				
Rho (Average server Utilization)	0.78125	0.69444444	0.5208333	
Po(Probability that the system is empty)	0.001584	0.00179789	0.0153318	
L(average number in the system)	7.743638	6.78626285	4.2450293	Trucks
Lq(average number waiting in the queue)	1.493638	0.53626285	0.0783626	Trucks
W (average time in the system)	0.030975	0.02714505	0.0169801	Hours
Wq(Average time in the queue)	0.005975	0.00214505	0.0003135	Hours

It is not hard to see the improved results, the average number of trucks in the system drops down from 7.74 to 6.79 and further down to 4.25 (scenario 2). Similarly, the waiting time drops dramatically under scenarios 1 and 2 compared to the baseline case.

Increasing the working hours or reducing the service times will improve the utilization and reduce the wait times.....[4]

However, it must be remembered that these numbers are the averages, and they do not reflect the actual real waiting times occurring at the WTB for the simple reason, that the arrival patterns at the WTB tend to be more stochastic than are modeled. Also, it is reported that the Mexican custom brokers tend to release batches of trucks rather than truck by truck when releasing after inspection as reported under Federal findings under the Special Report (2001). So, stakeholders' cooperation is essential for any of these suggestions to succeed.

Consider for example, "deficiencies in entry documentation" is a major cause for secondary inspection at border crossing as reported in the special report (2001). With training and increased awareness by special campaigns, these deficiencies can very easily be avoided. However, the stakeholders on either side of the border must buy into it and fully cooperate in implementing training and awareness campaigns.

4.5 Increase Safety and Security Awareness

As discussed before, the stake holders include not only the operators on the US side but also the operators on the Mexican side. Another solution to improving wait time at World Trade Bridge is to improve safety compliance awareness amongst motor carriers to decrease time delays. Mexican carriers and dredge companies who need to comply with U.S. regulatory requirements promulgated by Federal Motor Carriers Safety Administration (FMCSA). In this regard, the regional FMCSA staff schedule inspection meeting in Laredo and Nuevo Laredo to provide educational trainings as well as regulatory guidelines to business managers and transport mechanics ()

As a matter of fact, FMCSA in its Transportation Construction Coalition meetings announced plan to improve wait times by including the following measures. Primarily these are targeted towards providing the necessary training to transport company employees of Mexican Transport companies.

- a. Provide training to company maintenance personnel on inspection procedures
- b. Provide outreach presentations on reviewing carrier safety profiles
- c. Promote the Commercial Vehicle Safety Alliance (CVSA) inspection decal
- d. Promote review of company inspection system
- e. Provide training to company drivers on vehicle inspection report procedures

4.6 Increase Participation in CBP Border Initiative Programs:

All stakeholders must fully realize the fact that they are all but partners in a major supply chain. To enhance supply chain efficiency, and to provide customer service and secure shipments across international borders to end-users the stakeholder organizations must endeavor to take full advantage of CBP Border initiatives. The benefits of CBP initiatives such as the FAST program are as follows (FAST, 2007)

- a. Dedicated lanes for greater speed and efficiency in clearance of shipments
- b. Reduced number of examinations
- c. Enhanced supply chain security and safety while protecting economic prosperity
- d. For carriers, peace-of-mind and knowledge of transporting shipments for a C-TPAT
- e. Importers and Southern C-TPAT manufacturers.

As mentioned in previous sections, operators, custom brokers participating in CBP initiatives do benefit from being certified and/or accredited by the CBP. By providing value addition to customers and supply chain partners, CBP regulatory compliance can also drastically improve processes and wait times.

5.0 Stakeholders Involvement

Any managerial decision needs support and buying into by all the stakeholders in order to succeed. As we know the wait times at the World Trade Bridge is a concern for several stakeholders as follows,

- US Customs and Border Protection (US CBP)
- Department of Public Safety (TX DPS)
- Texas Department of Transportation (TX DOT)
- Federal Motor Carriers Safety Administration (FMCSA)
- Brokers and Freight Forwarders
- The Importers and Exporters
- Truck Drivers and Carrier companies
- Laredo City authorities
- All the Mexican counterparts of the stakeholders above.

One should bear in mind that any short-term or long term solution will succeed or fail depending on the degree of cooperation among the various stakeholders involved and to the extent all the stakeholders function as seamlessly as possible in achieving the common objective. There is an immediate need for all stakeholders to pitch in to help alleviate the difficulties in the short run until the new lanes are added. As has been discussed under each of the short-term solutions, stakeholder involvement and participation is essential for the success of any of these initiatives or solutions.

6.0 Contributions, Conclusions and future research:

The most significant contribution of this research study has been to impress upon the local community the need for short term solutions to address the wait times at WTB and not to let the other competitors to take away the business from local economy.

Incidentally, the research team is pleasantly surprised to note the launch of a comprehensive short term solution initiative by the concerned authorities as well (TxDOT, 2007). A second contribution of the study has been to suggest theoretically several viable and practical short term solutions to alleviate the long wait times problems at the WTB without compromising the safety and security issues. In particular, the demonstration of plausibility and probability of benefits by use of waiting line models.

6.1 Possible future research: A thorough analysis of the complete sequence of the inspection process at the World Trade Bridge for the commercial traffic needs to be made with an eye on identifying the opportunities of process reconfiguration. As explained above under waiting line models, given that there are eight identical lanes, small reduction in the processing times can result in substantial improvement in the overall processing speeds and thereby reduce the waiting lines immensely.

Further, as explained above, the wait times obtained under waiting lines model are but average wait times. So some part of the day the wait times could be shorter and at other times longer. To obtain an even level wait times, based on the historical patterns identified from the bridge wait times, specific programs may be introduced to

systematically encourage traffic to shift from peak hours to non-peak hours and thereby reduce the overall average wait times.

Develop a discrete stochastic simulation model to capture the commercial traffic clearance process at the world trade bridge. To simulate the model with random arrival times and random operational times (conforming to the observed behavior of those times-like random Exponential arrivals, random Poisson processing times etc) and assess the suitability of the recommendations or new proposals. Discover possible improvements to optimize the process reconfiguration that would yield the best utilization of available bridge capacity.

6.2 A word of caution: Cyril Northcote Parkinson's observation, popularly known as Parkinson's Law states that, "work expands to fill the time available." (Wikipedia, 2007) This law in reference to traffic on highways was restated as, "traffic increases to fill available spare capacity of the road" by a system dynamicist at System Dynamics Annual Conference, 2006. So it may not be long before the long-term solutions viz. adding more lanes or otherwise could be found wanting in addressing the wait times at the WTB.

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