

Container Terminal Reservation Systems Design and Performance

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Abstract

In October 2009 the author presented a paper entitled Container Terminal Reservations at the 3rd Annual METRANS National Urban Freight Conference in Long Beach. The paper profiled four examples of terminals which pioneered the use of appointment systems in their respective regions: Port Botany Australia; Southampton UK; Port Metro Vancouver; and the TTI terminal at the Port of Long Beach. This paper updates that research to compare terminals' performance in distributing drayage activity throughout the day, and in improving the efficiency of drayage operations at the terminals.

Container terminal reservation systems (Vehicle Booking Systems) are commonly implemented to control truck arrivals at the terminal gates to avoid congestion during peak periods. Typically this is accomplished by extending gate hours and scheduling truck visits to spread activity more evenly throughout the day. Appointment systems have also been touted to reduce truck queuing delays and long in-terminal turn times. Comparative measurement of these impacts has been facilitated by increased use of GPS or RFID technology to monitor delays.

The use of appointment systems has taken on broader significance as a means of mitigating congestion and environmental impacts related to port operations. Environmental performance can be improved by reducing truck idling in terminal queues. Appointment systems can also reduce both local and regional traffic congestion. These benefits can be seen as byproducts of improved drayage efficiency at the terminals.

For purposes of this research, the objective measures of system performance include the distribution of traffic throughout the day, and truck turn times.

Analysis of available data shows that Port Botany has been most successful in spreading activity

throughout the day. The Ports of LA/Long Beach and Southampton have similar performance in this category. However, total turn times are lowest at Port Botany, and highest at LA/Long Beach.

These results suggest the following lessons for designing effective reservation systems:

- Based on Port Botany, average total turn times of 25 to 30 minutes are achievable in a regulated environment with financial penalties for both drayage carriers and terminal operators.
- A lead time of 24 hours or less for confirming appointments appears to be sufficient to enable terminal operators to plan their daily operations, primarily based on labor dispatch requirements.
- The examples surveyed in this paper suggest that mandatory reservations for all transactions are required to effectively control truck arrival rates and to achieve high utilization and compliance rates.
- Financial penalties appear to be the most effective means of enforcing system compliance.
- The PierPass Traffic Mitigation Fee can be considered as a financial penalty for transactions during the day shift; however its utility in spreading traffic more evenly through the day is limited relative to appointment systems, which can be fine-tuned to determine truck arrivals in smaller time intervals (typically one hour) to enable consistent turn times even during interruptions in terminal operations for lunch breaks, etc.
- The incremental costs of a system to accomplish the objectives of reducing local and regional congestion and low total turn times will vary depending on initial conditions. In Port Botany, ongoing costs related to implementation of the Port Botany Landside Improvement Strategy included an increase in wharfage fees of AUS\$10 per TEU, and an increase in reservation fees of AUS\$5. However, the terminals were already operating 24 hour truck gates and the reservation system was already in place. The implementation of PBLIS has also resulted in transfers among system participants (terminal operators and drayage carriers).
- The Port Botany and Vancouver systems require rigid adherence to advance notice

requirements and scheduled appointments. In contrast, the system in use at Southampton allows greater flexibility, enabling users to make appointments up to the end of the appointment window and move them within a 6 hour window, if reservations are available. The FRATIS trial in Southern California is testing the use of real time information to enable dynamic adaptation of drayage operations to current conditions. This is probably unworkable under a system with rigid appointment scheduling, but a flexible appointment system similar to that used by DP World Southampton might facilitate implementation.

Background

Container terminal reservation systems (Vehicle Booking Systems) are commonly implemented to control truck arrivals at the terminal gates to avoid congestion during peak periods. Clustering of truck arrivals typically occurs during specific days of the week, as a result of scheduling of vessel activity, and at specific hours of the day due to the restricted hours of operations of shippers and receivers of containerized cargo, generally daytime on weekdays (World Cargo News 2003).

Container terminal reservation systems offer a number of potential advantages to terminal operators, by eliminating peaks and improving the predictability of truck processing transactions. They can reduce the capital investment required for deployment of machinery to load and unload trucks by ensuring more effective utilization of the capital stock (Acosta, 2009, p. 12). They can also ensure more efficient scheduling of longshore labor, the largest component of terminal variable costs.

Vehicle Booking Systems are frequently adopted to address chronic problems of terminal congestion, which lead to truck queuing delays and long in-terminal turn times. As such, it is often presumed that the use of appointments will automatically result in benefits to the trucking sector. Experience has not universally supported this presumption. Quantification of these impacts has been typically hindered by a lack of data. Terminal operating systems provide relatively precise data on in-terminal turn times, but queuing delays have not typically been measured. Data is becoming more readily available through the use of GPS or RFID technology

to monitor delays.

The use of appointment systems has taken on broader significance as a means of mitigating congestion and environmental impacts related to port operations. Environmental performance can be improved by reducing truck idling in terminal queues. Appointment systems can also reduce both local and regional traffic congestion. Local congestion can be reduced by preventing queues from blocking traffic on roads in the vicinity of terminals. Regional congestion can be reduced by shifting truck traffic to off-peak periods. These benefits can be seen as byproducts of improved drayage efficiency at the terminals.

Port Botany, Australia

Port Botany is located in Sydney Australia. Container traffic at the port totaled approximately 2.1 million TEU's in 2012. There are two major terminal operators with operations at Port Botany: DP World and Patrick. Patrick is a subsidiary of the Australian transport firm Asciano.

A Vehicle Booking System was introduced by P&O Ports in Melbourne in the mid-1990's. Patrick introduced a vehicle booking system (VBS) at Port Botany in 1999 (Patrick Corporation 2007 p.22). Currently the Patrick and DP World terminals operate individual VBS systems at Port Botany. Both systems are accessed through a common web portal provided by 1-Stop, a jointly owned subsidiary of the two companies which was formed in February 2003. 1-Stop was operational at Port Botany by 2006.

Ports in Australia are under the jurisdiction of State governments. In 2008 the New South Wales government responded to the recommendations of a review conducted by the Independent Pricing and Regulatory Tribunal of NSW (IPART) regarding the interface between the road transport industry, rail operators and the stevedores at Port Botany by instructing Sydney Ports Corporation (SPC) to take the initiative in a Port Botany Landside Improvement Strategy (PBLIS). The first phase would rely on voluntary solutions. If necessary, the second phase would require Sydney Ports Corporation to implement mandatory performance standards (Government of New South Wales, 2008 p.5).

Following approximately two years of negotiation and facilitation with industry and other key
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stakeholders Sydney Ports Corporation was unable to reach an agreement on voluntary solutions. The government's response was the implementation of regulations introducing an Operational Performance Management (OPM) framework to establish roadside performance standards and penalties for road and rail.

A brief summary of standards for drayage carriers from the original regulations is shown below; penalties are paid to terminal operators.

- Early arriving trucks: AUS\$100
- Late arriving trucks: AUS\$50
- No shows: AUS\$100
- Cancellations less than 12 hours prior to appointment: AUS\$50
- Cancellations 12 to 24 hours prior to appointment: No penalty if appointment taken up; AUS\$50 otherwise.
- Penalty for non-service by drayage carrier (inadequate equipment, etc.): AUS\$100

A brief summary of standards for terminal operators from the original regulations is shown below; penalties are paid to drayage carriers.

- Total turnaround time greater than 50 minutes (single transaction): AUS\$25 per additional 15 minutes
- Cancelled reservations less than 2 hours prior: AUS\$100
- Cancelled reservations more than 2 hours prior: AUS\$50

Terminal operators are required to offer a minimum number of reservations during peak hours. Terminal rail charges and rail loading performance were also regulated. Subsequent amendments to the Regulations included provisions for waiving penalties for trucks failing to keep their appointments as a result of delays at the terminals ("Stevedore Impacted Trucks").

The regulations were accompanied by development of an RFID truck tracking system to independently capture and transmit truck tracking data leading into and out of the container

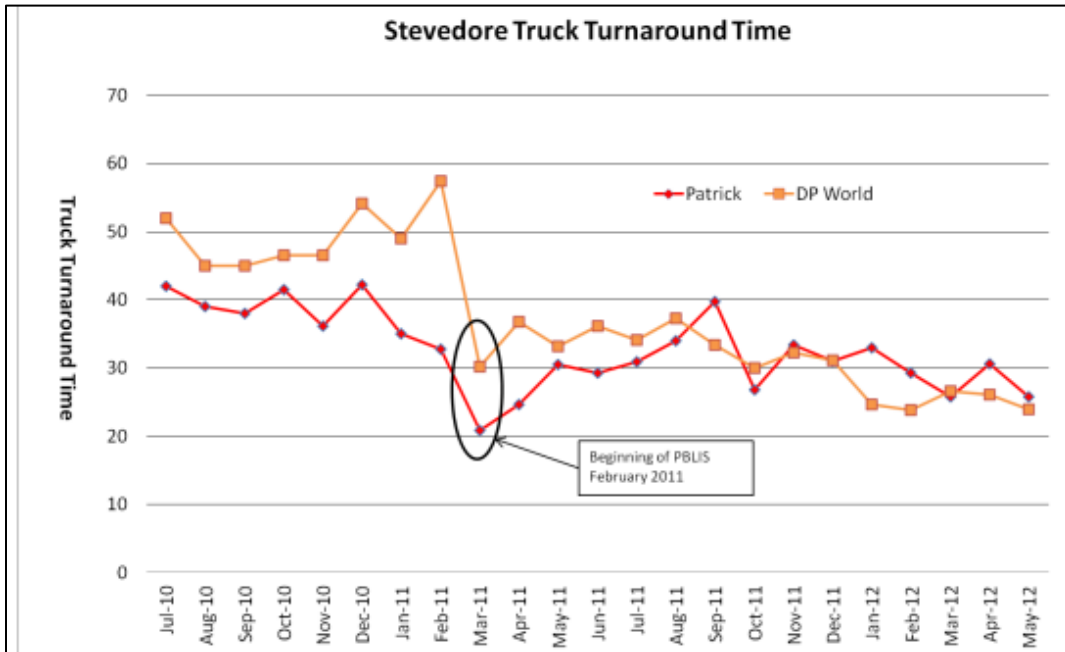
terminals; and an operational performance system for capture, storage and analysis of data from multiple sources to monitor landside operations in Port Botany. Costs of implementing PBLIS were to be recouped by an increase in Sydney Ports wharfage fee by AUS\$10 per TEU for all import and export containers except empty containers, transshipments and containers in coastal trade.

Infrastructure investments in support of PBLIS included construction of a Truck Marshalling Area (TMA) which provides a safe and secure area for early arriving trucks to be staged before they are serviced by the stevedores. Onsite amenities include washrooms and an outdoor lunch area. Capacity of the TMA is approximately 50 trucks. Penalties for early arrival of trucks at the terminals were implemented in September 2012 following completion of the TMA.

Implementation of the regulations appears to have been supported by all major stakeholders except the terminal operators. Shipping Australia, the shipping lines' representative, expressed support for the regulations as a means of increasing efficiency and reducing demurrage costs, though the appropriateness of the increase in wharfage fees was questioned (Baird Maritime, 2010). Other stakeholders expressing support included the Custom Brokers and Forwarders Council of Australia, the Australian Federation of International Forwarders, and Australian Trucking Association NSW (Sydney Ports Corporation, 2010). However, opinion was split in the trucking sector, with some firms preferring negotiation of commercial agreements with the terminal operators (Transport & Logistics News, 2010).

PBLIS was implemented on February 28, 2011. The immediate result was a dramatic reduction in Total Turn Times at the two terminals, as shown below.

Port Botany Total Turn Times Pre and Post PBLIS



Source: (Sydney Ports Corporation, 2012 p.6)

Terminal operators are constrained in their ability to increase charges by provisions of the Regulations to prevent them from passing on the costs of non-performance penalties. An increase of approximately AUS\$5 in reservation fees was implemented in March 2011 to compensate for the costs of developing IT systems for implementation of PBLIS. Daily demurrage charges have also increased, though these increases were implemented in 2009 prior to PBLIS. Patrick implemented a fee for early receiving of export loads in May 2012.

A cost/benefit analysis of PBLIS was undertaken in 2012 as part of the NSW Government's Regulatory Impact Statement (Transport for NSW 2012). The study observed the following improvements in efficiency in the first 12 months of operation:

- Reduction in truck turnaround times of 30%.
- Increase in trucks arriving on time from 72% to 95%.
- Significant reduction in congestion at peak periods.
- Greater uniformity in slot availability across the week.

Unquantified benefits included:

- Safety, environmental, and economic benefits of reduced congestion around Port Botany;
- Benefits to importers and exporters of increased consistency of truck deliveries, and almost complete elimination of demurrage payments;
- Benefits from delay of infrastructure investments.

Costs included in the analysis included Sydney Ports' and terminal operators' capital and operating costs for implementing PBLIS; increased terminal labor costs due to off-peak operations; and the cost of the Truck Marshalling Area.

The analysis estimated a net benefit of AUS\$54.7 million over the period to 2018, based on a discount rate of 7%. This is significantly higher than a similar cost/benefit analysis conducted prior to implementation, which estimated a net benefit of AUS\$21 million over the same period. The improved average TTTs were the main driver of the benefits, contributing \$39.1 million to the NPV of the PBLIS above that initially estimated.

The cost/benefit analysis did not include the impact of transfers among carriers and terminal operators. Data on these payments is collected under the Regulations and is confidential. However, based on communications with Sydney Ports Corporation the terminal operators consistently receive more revenue from penalty payments while in aggregate the trucking companies pay more than they receive. Performance varies considerably among trucking firms. Medium size carriers (20 to 40 trucks) tend to be more efficient, often resulting in a positive balance. Most large carriers and a number of smaller truck operators regularly have a negative balance due to poor planning of operations (Sydney Ports Corporation 2013).

Administration of PBLIS was transferred to Transport New South Wales following the privatization of Port Botany in early 2013.

Vancouver, British Columbia

There are four container terminals under the jurisdiction of Port Metro Vancouver¹ in British Columbia's Lower Mainland: Centerm and Vanterm in the Inner Harbour, Deltaport on Roberts Bank approximately 40 km south of the inner Harbor, and Fraser Surrey Docks on the Fraser River. Container throughput at Port Metro Vancouver totaled 2.7 million TEU's in 2012.

In the summer of 2005 Lower Mainland drayage owner-operators withdrew their services to protest low trip rates and long waiting times at port and off-dock facilities. A Task Force appointed by the federal and British Columbia governments to advise on port efficiencies and industrial relations made two recommendations relevant to this study: extension of terminal gate hours, and development of a centralized mandatory reservations system for all terminals (Federal-Provincial Task Force, 2005.)

Terminal operators were reluctant to operate extended gates due to increased labor costs. In November 2005 Vancouver Port Authority announced their Extended Gates Program which set a target to increase container truck gate operations at Vanterm, Centerm and Deltaport by an average of 20 per cent, per year, over the next five years. By 2007 the terminals had adopted "two-shift" operations, with Vanterm and Deltaport typically offering night gates to 2300 on Monday through Thursdays and Centerm on Mondays through Fridays. In addition, Saturday day gates were offered.

The downturn in TransPacific container volumes in 2008 and 2009 resulted in elimination of regular night gates at all of the terminals. Current gate hours are based on single-shift operation of day gates on weekdays, typically from 0700 to 1630. Night, weekend and speed gates are scheduled based on volume.

A web-based voluntary container reservation system was introduced at Port of Vancouver terminals in 2001 (Vancouver Port Authority, 2000). A mandatory reservation system was

introduced by Centerm (P&O Ports at the time, now DP World Canada) in August 2005 and by Deltaport and Vanterm in the spring of 2006. (IBI Group, p.51). Port Metro Vancouver requires compliance with reservations systems as a licensing requirement for trucks serving the Port under federal regulations (Canada Gazette Part II). Currently each of the four Port Metro Vancouver terminals has a different reservation system.

Growth in traffic and the return to single-shift operation of terminal truck gates has resulted in a deterioration of terminal performance. In November 2012, the Canadian International Freight Forwarders Association noted growing frustration with problems at Deltaport, Vanterm, and Centerm, including high storage and demurrage charges because truckers are unable to obtain reservations on a timely basis, the inability of drayage firms to schedule drivers to serve “random” night gates, and inequitable allocation of reservations among drayage firms. (CIFFA, 2012)

In 2009, the terminals typically experienced compliance rates for reservations of close to 90%; however the number of appointments actually completed was significantly lower, averaging between 60% and 70% in 2009 (Transport Canada, 2009, p.58). By 2011, 52% to 55% of appointments were being missed or cancelled. (Port Metro Vancouver, 2011). The scarcity of reservations was attributed to non-performance by drayage carriers by Port Metro Vancouver and the terminal operators. In 2011 they initiated the Terminal Gate Compliance Initiative (TGCI) to reduce the number of appointment cancellations and missed reservations.

Prior to TGCI, carrier compliance was enforced by the threat of having their access privileges to the terminals interrupted. Compliance required cancellation of appointments no later than 2 hours prior. TGCI was designed to enforce compliance through monetary penalties. The original plan included reservation fees of CDN\$1 per appointment and penalty fees of CDN\$25 for each cancelled or missed appointment, to be implemented in September 2011. Penalties were to be applicable to all appointments missed or cancelled. Following industry consultations the plan was altered to include an appointment charge of CDN\$25 which would be refunded when appointments were completed; and penalties for cancelled appointments to be waived if

cancellation takes place prior to 4 pm on the prior business day. The terminal operators implemented a Completion Incentive of up to 5% of cancelled appointment fees, to compensate for factors beyond the trucker's control such as cargo delays at the terminals, truck breakdowns, changes in vessel ERD's, ocean carrier booking changes, etc. The revised TGCI was implemented on January 1, 2012.

Based on comparisons with 2010 results, the new financial penalties increased carriers' compliance rates for the three major terminals from 88% to 92%. Utilization of day gate capacity averaged 87% among all of the terminals for the first nine months of 2012 (Port Metro Vancouver Oct. 2012), in spite of low terminal capacity utilization at Centerm and Fraser Surrey Docks (Port Metro Vancouver Dec. 2012).

In October 2012 Port Metro Vancouver unveiled their Reliability Initiatives and Drayage Strategies at a Town Hall Meeting. (Port Metro Vancouver October 2012). The strategy included a proposal for a CDN\$30 penalty to be paid by the terminal operators to PMV for total turn times exceeding 2 hours. Based on data presented by PMV, the penalties would apply to approximately 5% of all transactions. This penalty is being implemented on October 1, 2013.

In February 2013 Port Metro Vancouver announced their new Smart Fleet Strategy which includes mandatory tracking of port trucks using Global Positioning System (GPS) transponders. GPS units are being provided by Port Metro Vancouver at no cost to the truck owner/company. Costs are being shared between Transport Canada, the British Columbia Ministry of Transportation and Infrastructure and Port Metro Vancouver.

Port Metro Vancouver currently posts weekly average turn times for each terminal on their website. For July 2013, total turn times (including queuing delays) ranged from 26 minutes for Fraser Surrey Docks to 68 minutes for Vanterm. The only historical data available for comparison was gathered for development of a container trucking simulation model for the BC Ministry of Transportation Container Trucking Forum in 2006 (IBI Group, 2007). Based on this

data, the major change is an increase of approximately 28% in total turn times at Deltaport and Vanterm, from 52 to 67 minutes and 53 to 68 minutes respectively.

Southampton UK

The Port of Southampton has a single container terminal, DP World Southampton (formerly Southampton Container Terminal). In 2011, DP World Southampton handled 1.6 million TEU's. The terminal is a joint venture owned 49% by Associated British Ports and 51% by the terminal operator, DP World.

The terminal suffered from yard congestion and high truck turn times due to rapid growth in traffic volumes from 2001 to 2004. Peaking of truck arrivals was a major contributor to poor turnaround times at the terminal. A voluntary Vehicle Booking System implemented in 2003 failed to resolve the problem. In 2005 SCT implemented their mandatory Simplified Vehicle Booking System which was successful in reducing average turn time and improving reliability (Discover Southampton 2006).

Under the Simplified VBS, all bookings at the terminal require a container number. Truckers are limited to a maximum of 10% of total appointments within each hourly slot (DP World Southampton 2009). Unneeded appointments may be returned to an exchange where they can be taken up by other carriers. Bookings for slots within peak hours cost £1, bookings for off-peak hours are free. Peak hours are 04:00 to 06:00 and 14:00 to 18:00 Monday to Friday. Landside Operations are open from 19:00 on Sunday to 18:00 on Saturday. A no-show fee of £25 is charged for cancelled bookings or bookings which are returned to the exchange and not taken up by other carriers.

The system has a number of features which increase the flexibility of bookings for carriers:

- The details of a booking can be amended as many times as required free of charge.
- A booking can be moved within a tethered window, up to six hours before or after the original booking, as long as there is a booking available and the trucking company does not

exceed the hourly allowance.

- Bookings can be made any time prior to the end of the booking window if there are bookings available.
- Carriers can book an appointment for a single container and add other containers to that appointment. They can also remove containers from an appointment.
- The system allows drivers to amend appointments by cell phone or text messages as required. There is a commercial truck stop in the vicinity where drivers can park to await their appointment window.

The Southampton VBS appears to have been successful at reducing turn times at the terminal. The terminal operator reports an in-terminal turn time averaging 30 minutes over the last 12 months. (DPW Southampton August 2013) In January 2013 DP World Southampton introduced a new VBS Premium system with a new intuitive visual interface to streamline the booking process.

The use of appointments at container terminals in the UK was pioneered by Southampton. Its success can be gauged by the subsequent adoption of appointment systems at other major UK terminals (Feilxstowe and Tilbury) and by the inclusion of guidance on the use of appointment systems in the National Ports Policy. The National Ports Policy provides the framework for decisions by the Infrastructure Planning Commission (IPC) on proposals for new port development. For container ports, expansions or new facilities with a capacity of 500,000 TEU's per year must be referred to the IPC. In assessing these projects, decision-makers are urged to consider the use of vehicle booking systems to mitigate air emissions (sec 5.7.11), and congestion on the road network (sec 5.4.12). (Department for Transport, 2012).

Los Angeles/Long Beach

The impact of terminal gate appointment systems at the ports of Los Angeles and Long Beach was extensively analyzed in Dell'Aquila, Giuliano, Hayden and O'Brien. Adoption of terminal gate appointments in California was spurred by passage of Assembly Bill (AB) 2650 in 2002. The legislation imposed a penalty of \$250 on marine terminal operators for each truck idling more

than 30 minutes while waiting to enter a terminal gate at the Port of Los Angeles, Long Beach or Oakland. Terminals could avoid fines by extending gate hours to 70 per week (65 hours at the Port of Oakland), i.e. adding full service evening or weekend gates designed to spread out truck traffic, or by offering a gate appointment system to trucks to drop off or pick-up cargo containers.(Dell'Aquila et al, p. 17.) Most terminals responded by offering voluntary reservation systems either through the third party service provider e-Modal or through terminal proprietary systems. However, use of the appointment systems was relatively low, ranging from 5% to 30% of total gate moves. (Dell'Aquila et al, p. 31.)

In 2005, all of the Southern California terminals implemented extended gate operations through the OffPeak program. OffPeak is administered by PierPASS, a non-profit organization of the terminal operators operating under antitrust immunity granted by the Federal Maritime Commission. OffPeak uses a Traffic Mitigation Fee (TMF) levied on daytime truck transactions (8 am to 5 pm) to provide an incentive for shifting traffic to night gates (6 pm to 3 am). The TMF is levied directly on beneficial cargo owners.

The TMF was designed to provide sufficient revenues to reimburse terminal operators for the costs of operating night gates. However, PierPASS indicates that revenues have never been sufficient to cover additional expenses, and in 2012 costs exceeded revenues by \$66.4 million. (PierPASS Financial Review, 2013). PierPASS implemented an increase of \$5.00 per TEU in the TMF to \$66.50 per twenty-foot container or \$133.00 per forty-foot container in 2013. (PierPASS July 2013) Data for the 4th quarter of 2012 indicates that 58% of eligible container moves at the two ports took place on the night shift. (PierPASS, 2013).

The implementation of PierPASS removed the incentive of AB 2650 for implementation of terminal appointment systems. However, some terminal operators have embraced appointment systems as a means of improving terminal performance.

Total Terminals International (TTI) at the Port of Long Beach was the first terminal at the Ports of Los Angeles and Long Beach with a mandatory reservation system. TTI uses the proprietary Terminal Navigation System (TNS) reservation system.

The reservation system at TTI Long Beach was initially introduced to mitigate peaking of truck arrivals early in the day, which resulted in long turn times and queuing which affected the public road network. The implementation of PierPASS shifted arrivals to off-peak hours but peaking was still a problem at the start of the off-peak gates at 1800. Mandatory appointments were implemented for import pickups by April 2007 (Longbotham, 2007) and for export drop-offs on September 2, 2008 (TTI, 2008). Currently chassis and empty container movements do not require appointments.

Reservations may be made 72 to 96 hours prior to the appointment time, even if some information is missing. The system prompts users to enter missing information 24 hours prior to the appointment to enable truckers to contact the terminal and resolve the issue. If the issue is not resolved, a second message is sent 1 hour prior to the appointment slot. There are no financial penalties for late arrival or no-shows, and no booking fees. TTI encourages cancellation a minimum of 45 minutes prior to the window to enable others to use the slot. Recent in-terminal turn times average 27 to 39 minutes.

While the reservation system has eased congestion at the terminal, there are issues relating to the design of the system and the impacts of the OffPeak program which impact performance. The exclusion of empty container and chassis transactions from mandatory reservations can result in peaking due to unanticipated surges in truck traffic. There are no penalties for non-compliance. As many as 30% of appointments are missed and not cancelled, reducing available gate capacity in peak periods.

The OffPeak program significantly affects terminal efficiency in the change-over period from day to night gates. In-terminal turn times are increased as trucks entering the terminal as early as 4 pm are unwilling to exit the terminal prior to the 6 pm night gate start, in order to avoid the TMF. Similarly truckers are unwilling to enter the terminal prior to 6 pm, though they start to queue in advance. Unlike some terminals, TTI maintains gate operations during the 5 pm to 6 pm; however trucks queue in the in-gate lanes, blocking access to the gates for truckers wishing to enter.

A new approach to reducing terminal congestion is currently under investigation in Southern California. The Freight Advanced Traveler Information System (FRATIS) project is being sponsored by the FHWA Office of Freight Management. FRATIS is primarily focused on the use of real-time information on drayage and terminal operations to support planning and operations of dray trucking operations in the region, and real-time information on terminal queues, including predictive algorithms, to support planning and potential diversions/reassignment. The focus on real time information is qualitatively different than reliance on mandatory reservation systems in that it relies on dynamic adaptation of drayage operations to existing conditions, rather than rigid scheduling.

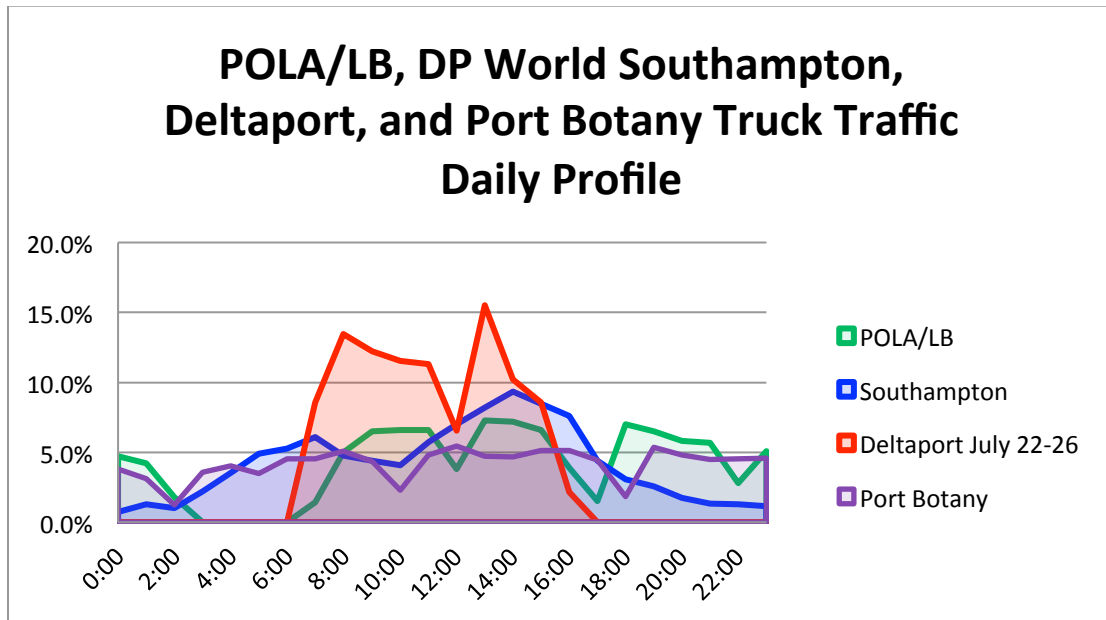
A pilot project is under way with the cooperation of Yusen Terminals at the Port of Los Angeles and Port Logistics Group, a firm providing drayage service in the region. Information flows will include estimated truck arrival times (ETA's) planned by the drayage operator by noon the preceding day to facilitate planning of terminal labor and equipment requirements; automated alerts on terminal queue conditions to carriers one hour prior to the truck ETA, and to terminals 10 minutes prior to truck arrival; and enhanced communication between the truck and the terminal operator while the truck is inside the terminal. FRATIS may also make use of information from Yusen's reservation system. Truck processing into and across key points in the terminal (e.g. gate, trouble queue, empties queue, PierPASS "waiting") will be continually optimized by the terminal operator using the FRATIS comprehensive queue time measurement system. (Jensen, 2013)

Performance Comparisons

The predominant reason for the adoption of container terminal reservation systems is the avoidance of peaking of truck arrivals at the terminal gates. Three of the four examples analyzed in this paper use reservation systems to shift truck arrivals to off-peak periods, potentially reducing truck turn times and reducing local and regional traffic congestion. In Vancouver, the reservation system is used to maximize the utilization of day gate capacity and

avoid the costs of operating night gates. Typical hourly truck traffic patterns at Southampton, Vancouver and the Ports of LA and Long Beach are shown below.

Hourly Truck Traffic – Four Ports



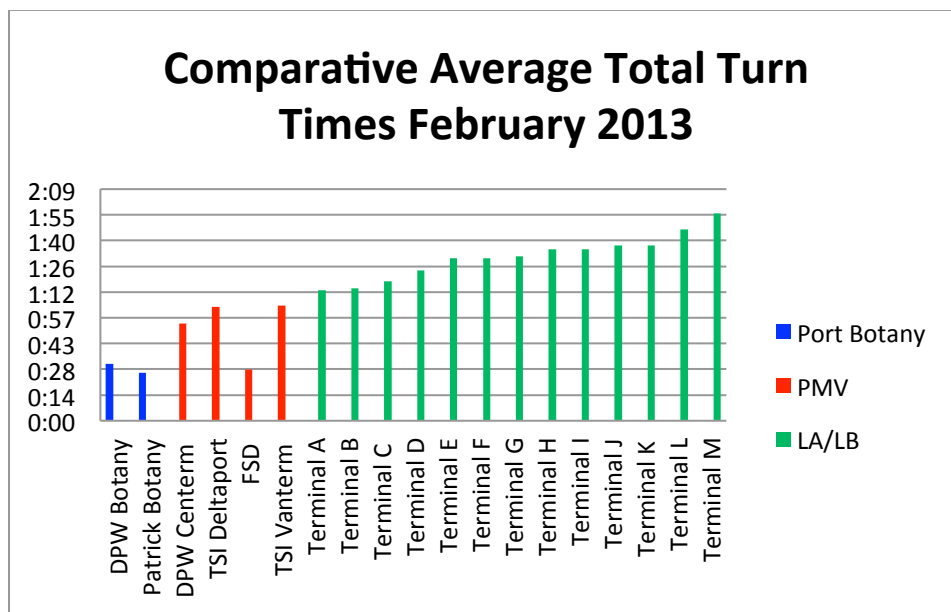
Reservation systems and peak period surcharges (such as OffPeak) have been portrayed as competing solutions to peaking of truck movements. Off Peak has been very successful in transferring activity from the day shift to the night shift. However, the current design of the program actually induces peaking around the shift change-over, increasing both queuing delays and in-terminal turn times. Truck turn times are also typically increased during longshore lunch breaks, when terminals are not fully staffed.

Comparison of total turn time performance among terminals has become feasible due to the development of RFID and GPS applications for tracking queuing as well as in-terminal turn times. In Port Botany and Vancouver, tracking systems have been developed by the ports for the purposes of monitoring performance. In both cases, these systems have been motivated in part by conflict between terminal operators and the trucking community over turn time performance.

In response to complaints regarding long turn times in 2010, PierPASS conducted a study on turn times at the Ports of Los Angeles and Long Beach in 2011 to benchmark performance (including queuing delays). The study found a median queuing delay of 20 minutes and a median in-terminal turn time of 31 minutes for a total of 51 minutes. (PierPASS, 2011)

More recently the Harbor Trucking Association has undertaken a study of turn times at Southern California terminals using GPS technology. The HTA figures are substantially higher than those recorded in the PierPASS study in 2011. (La Rosa, 2013) Based on the HTA estimates, comparative total turn times for terminals at Port Botany, Vancouver and LA/Long Beach are shown below.

Comparative Total Turn Times February 2013



Comparable figures are not available for Southampton. DP World claims an average in-terminal turn time of 30 minutes over the last 12 months of operations. No system for measuring queuing delays has been developed. There have been no recent reports of queuing delays at Southampton, which may reduce the incentive for development of a monitoring system.

Implications for the Design of Container Reservation Systems

What are the practical limits for system performance?

The Port Botany example indicates that reservation system compliance rates in excess of 90% and high efficiency in total turn times are achievable in a regulated environment with financial penalties for non-performance. It is useful to note that the Port Botany terminals have found it necessary to achieve average Total Turn Times below 30 minutes in order to comply with a maximum standard of 50 minutes. For fiscal year 2012-13, average TTT was approximately 30.7 minutes for DP World and 26.1 minutes for Patrick. For the fiscal year, the maximum TTT under the performance standard was exceeded in only 6.0% of completed bookings. Tight scheduling of truck appointments enabled the terminals to maintain a low TTT while accommodating regularly scheduled longshore lunch breaks.

What is the optimal advance notice requirement for system compliance?

Reservation systems often allow carriers to make reservations several days in advance. However, they typically impose a shorter window for compliance (i.e. the mandated or recommended advance notice requirement for cancellation of appointments). For systems with financial penalties, this window represents the minimum advance notice for cancellation of appointments without penalty.

Among the examples surveyed in this paper, only Port Metro Vancouver has proposed imposition of penalties for cancellation of appointments regardless of lead time, and following consultation this was amended to penalize only appointments cancelled after 4 pm on the day prior to the appointment. The ability of drayage carriers to consistently complete reservations made far in advance is limited by uncertainties related to the availability of containers, and of reservations.

A real-time information system on terminal delays like the FRATIS trial in Southern California may enable carriers to reschedule terminal visits, but would require the flexibility to modify existing appointments on short notice. This would reduce the predictability of truck arrivals at the terminal. A flexible appointment system similar to that used by DP World Southampton, which allows appointments to be made up to the end of the appointment window and moved

within a 6 hour window, might be appropriate.

From the terminal operator's perspective, the predominant factor in defining advance notice requirements for reservations is the dispatch arrangements for longshore labor. Labor is typically dispatched on short notice depending on the volume of work anticipated. For example, in Vancouver terminal operators have to finalize their labor orders for the 0700 shift by 0630 the same day. The advance notice requirement adopted for truck reservations – 1600 the previous day – provides sufficient time for the terminal operator to finalize plans for labor utilization for truck transactions by the end of the day shift of the previous day. Drayage carriers are likely to prefer to make reservations earlier in order to ensure a slot will be available, particularly where a peak period slot is desired.

Mandatory vs Voluntary Appointments

The examples surveyed in this paper suggest that mandatory reservations for all transactions are required to effectively control truck arrival rates and to achieve high utilization and compliance rates. Voluntary systems were tried and abandoned in both Southampton and Vancouver. TTI Long Beach reports that peaking of truck traffic at the terminal gates can occur due to unpredictable surges in empty container and chassis transactions, which do not require appointments.

Financial Penalties

Financial penalties appear to be the most effective means of enforcing system compliance. Three of the examples surveyed in this paper use financial penalties levied on drayage carriers to enforce compliance. Both Port Botany and Vancouver achieve compliance rates of 90% or higher. Port Botany also assesses financial penalties on terminal operators for long turn times, which appear to have been instrumental in achieving the lowest total turn times among the ports surveyed.

The PierPass Traffic Mitigation Fee can be considered as a financial penalty for transactions during the day shift; however its utility in spreading traffic more evenly through the day is

limited relative to appointment systems, which can be fine-tuned to determine truck arrivals in smaller time intervals (typically one hour) to enable consistent turn times even during interruptions in terminal operations for lunch breaks, etc.

Costs

The incremental costs of a system to accomplish the objectives of reducing local and regional congestion and low total turn times will vary depending on initial conditions. In Port Botany, ongoing costs related to implementation of the performance framework included an increase in wharfage fees of AUS\$10 per TEU, and an increase in reservation fees of AUS\$5. However, the terminals were already operating 24 hour truck gates and the reservation system was already in place. Implementation of the performance framework also resulted in transfers among system participants (penalty fees between terminal operators and drayage carriers).

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¹ Port Metro Vancouver was created by the amalgamation of the three former Lower Mainland port authorities (Vancouver Port Authority, Fraser River Port Authority, and North Fraser Port Authority) on January 1, 2008.

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