Situational Analysis of the Container Trucking Sector at the Port of Halifax

for Transport Canada

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Submitted by

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With

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Executive Summary

Transport Canada recently launched a federal contribution funding program, the *Clean Transportation Initiative on Port-Related Trucking*, with the objective of providing up to $7.5 million in funding over fiscal years 2012-13 to 2015-16, in support of trucking efficiency improvements through technological innovation.

The purpose of this project is to document and identify for Transport Canada the critical issues in container port trucking at the Port of Halifax. Furthermore, through consultations with stakeholders, the project identifies barriers and incentives to the development of potential projects that support clean transportation priorities, and addresses the needs of port authorities, terminal operators, trucking operators and other supply chain participants that have an interest in port-related trucking. Our role was to facilitate the consultation process, to identify the challenges faced by local stakeholders and to provide a more in-depth understanding of the container trucking sector in Halifax. All three tasks have been completed and this report presents the results of that work.

Background on existing port truck traffic

A very noticeable aspect of Halifax's container traffic is the increasing importance of truck-based volumes versus rail-based container traffic. We were provided with data on Halifax's **import** rail : truck split for the period 2006-2012. Historically, the truck-based share of Halifax's container traffic was 20-25%. In the past five to six years, the proportion handled by truck has grown significantly and in 2012 was approaching 40%. Water-based volumes are likely those handled by the now-defunct American Feeder Line and other feeder services that have served the New England market. As the data exclude Oceanex shipments, its role is not discernible.

Halifax's changing hinterland

Halifax's hinterland has changed in the past decade, with the Atlantic region remaining constant in terms of overall volume, but becoming proportionally more important to the port than it was five or six years ago.

In 2006, Atlantic Canada accounted for 37% of the port's traffic volume, and this grew to almost 50% in 2011.

Key findings from the port trucking literature review

Many ports and terminals experienced increased cargo throughput as a result of growth in international trade in the last few decades (Giuliano and O'Brien, 2007). One of the consequences is that truck traffic to and from port facilities has also risen substantially (Chen, Govindan and Yang, 2013; Karafa *et al.*, 2013). Since many terminals are located

near or in urban centres, the growth in truck traffic has resulted in more impacts on residents in those areas, such as increased health risks and air and noise pollution (Hartman and Clott, 2012). Consequently, many terminal operators are facing a array of frustrated stakeholder and community groups that threaten future growth of the terminals (Le-Griffin, Mai and Griffin, 2011). As a response, ports and terminals are implementing strategies to reduce the effect of the terminals' truck-related traffic. Reducing environmental impacts and making more efficient use of existing transportation infrastructure is seen as a better path for accommodating growing demand than further infrastructure investment (Maguire *et al.,* 2010). The literature review examined a wide variety of sources and contributed many suggestions for improvements to port-related trucking, most of which were discussed in the focus groups.

Key findings from the consultations and follow-up

Using a Chatham House Rule, two focus groups were held. A number of issues were identified in the consultations. These included:

- The location of Halterm and traffic congestion in the downtown core of the city en route to the terminal
- Gate congestion, turnaround time, union work hours and off-peak access, an issue that has been largely resolved through gate management in the last year.
- Truck drivers idling when in the queue at the gate
- Some shipping lines charging a fee for a street turn
- GHG emissions resulting from the management of reefer containers (an issue where a closer look at cold chain integrity maintenance might prove to identify alternate process or technological solutions)
- Container yard equipment as a source of GHG emissions

Against each of these, solutions were discussed and opportunities are detailed in the report. They vary from changing traffic lane arrangements to reduce idling/congestion in the downtown core to extended gate hours and the ability to move empty containers off-peak. While there were a number of opportunities discussed, including further use of GPS and existing MacPass® transponder capabilities or the introduction of outside-the-gate plug-in facilities for trucks, many of these need further proof-of-concept development. A number of starting points for discussion were noted in section 5 of the report.

Other input was received in the form of general comments, and specific follow-up was undertaken using an Internet survey, to clarify the general sentiment within the Halifax port-related trucking community.

What projects attracted interest?

We discussed the potential use of GPS (Global Positioning Systems), which most trucking companies already have installed on their vehicles. The view was that making better use of the technology would only send every company's truck to the terminal at the same time—when slots are available. As this may be too simplistic, it merits closer examination. There is a technology company in Halifax that has done similar work in other ports and which could be engaged in this project.

The data currently being collected from one trucking company by Transport Canada are not being shared with the trucking company. Perhaps the project could start with these data to ascertain the incidence of congestion and nature of the challenge for Halifax. Furthermore, it would be useful to extend the pilot project to other trucking companies.

A pilot study focused specifically on the maintenance of cold chain integrity received some interest, particularly as the technologies to explore the issue exist. A study of cold chain processes through the May to September period of 2013 could be well-timed, and as the majority of reefers on trucks are diesel-powered, the impact on GHG (greenhouse gas) emissions from the cold chain moves would be better understood.

There was also interest in assessing alternative processes for the handling of empties to reduce the number of empty moves and therefore the GHG emissions impact as well.

Also raised was the suggestion that the Port of Halifax consider “cold ironing for trucks” that arrive late evening for the next morning, or are in line on cold days before the gates open. There must be technology available to address this. The trucking firms need to see the benefit of making the vehicle ready for such a ‘plug-in’, the port and terminal operator should consider providing such equipment, and the funding of such technology would need to be discussed.

There was one focus group participant and one person providing follow-up information who mentioned using the rail cut to address trucks moving through downtown and the congestion and GHGs they produce. While the focus of some study, the option to move containers from Halterm on rail shuttle to Burnside Industrial Park has not been costed thoroughly, nor the societal benefits assessed.

What needs further study in support of funding proposals?

Transport Canada could consider studying a SynchroMet-type system/virtual container yard concept. Could the supply of containers in off-docks be better managed with such a system? Halifax has four off-dock container yards (three of which are new in the last five years), five if the near-dock facility close to Ceres is counted.

One of the most interesting suggestions was to use hybrid electric or alternative-fuel yard equipment. This technology has been introduced on Canada’s west coast and has resulted in both fuel savings and reductions in GHG emissions. The payback time can be quite short.

Finally, there was considerable discussion about the use of MacPass® technology to track a pre-weighed container and tractor, and use of that information in conjunction with the weigh-in-motion scales to reduce gate times. This could also be an interesting pilot study.

Ideas that did not resonate with the industry stakeholders

The workshop participants displayed no enthusiasm for GIS and RFID monitoring except as they relate to either cold chain integrity or congestion within HRM, in particular downtown Halifax en route to Halterm. There could be an opportunity to examine both issues.

The workshop participants were not in favour of a gate appointment system; they only saw potential for abuse.

There was no support for a PierPASS® style off-peak system given current capacity availability at the terminals, leaving the door open for future consideration should the situation change. The issue seems to boil down to: what is the added cost, who pays for the additional hours of access, and is it worth that added cost?

Summary

This situation analysis examined the current state of port-related trucking in Halifax. It explored many ideas found in the literature with focus group participants and clarified local sentiment via follow-up contact.

Most participants in this situational analysis thought that the greatest GHG reductions would be from investments in newer container yard equipment.

One participant indicated that interesting CN in short line moves from Moncton to Halifax would also reduce GHGs.

Those interested in further developments were identified and their contact information supplied to Transport Canada separately.

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Situational Analysis of the Container Trucking Sector at the Port of Halifax

1. Introduction to the Project

Trucking challenges at Canada's major container ports continue to grow as traffic grows, and congestion resulting from traffic growth can contribute to unnecessary greenhouse gas (GHG) and air pollutant emissions. We understand that Transport Canada is looking at ways the deployment of innovative transportation technologies and operating practices can enhance the economic efficiency and environmental performance in the container trucking sector at Canada's major container ports, including the Port of Halifax. Transport Canada recently launched a federal contribution funding program, the *Clean Transportation Initiative on Port-Related Trucking*, with the objective of providing up to $7.5 million in funding over fiscal years 2012-13 to 2015-16, in support of trucking efficiency improvements through technological innovation.

The purpose of this project is to document and identify for Transport Canada the critical issues in container port trucking at the Port of Halifax. Furthermore, through consultations with stakeholders, the project will identify barriers and incentives to the development of potential projects that support clean transportation priorities, and address the needs of port authorities, terminal operators, trucking operators and other supply chain participants that have an interest in port-related trucking. Our role is to facilitate the consultation process, to identify the challenges faced by local stakeholders and to provide a more in-depth understanding of the container trucking sector in Halifax.

2. Methodology/Approach

We met with members of the Halifax Port Authority (HPA) management team and discussed the project, the process and the timeline for the scope of work based on a briefing document we developed for participants. They agreed to provide us with a contact list of those they felt should be invited to supplement our lists of potential focus group invitees. They also agreed to send an introductory email to their list asking for support of the initiative and our request. We prefer this approach as it signaled to those we asked that the HPA supported the request we made of them. Furthermore, the HPA assigned a senior staff member to be our contact during the project. No HPA staff attended any of the consultations as requested by the investigators. Likewise, the invitations were not sent to local government or development agencies as the purpose was to concentrate discussion on those in industry alone, as they are the ones who will have to fund improvements and adopt solutions.

The HPA supplied a list of 22 trucking companies serving the port, along with a list of five other interested parties, including the two container terminal operators. We compared this list with our list of local trucking companies and cargo interests that we expected would do their own trucking. We also added shipping company contacts in case the shipping

companies were sub-contracting port trucking and wanted to provide input. In all, 61 distinct companies were contacted (in some cases we went through several names before finding the right person for this initiative).

In addition to the invitations to attend the focus group, we conducted a concurrent survey to identify all literature related to the topic, and reviewed it. The list was circulated to Transport Canada for any additions they might wish to make. It was then annotated and relevant material extracted to identify content that might be appropriate for focus group discussion. The purpose of the annotation was to identify current issues, obstacles and barriers in the particular markets, possible problem solutions and outcomes where solutions have been tried. It was also intended that there be enough detail for Transport Canada to know what the important elements are from each article, so a few articles have annotations longer than a page.

In addition to the contact from HPA, each company invited to participate received two personalized email invitations and at least one follow-up phone call. We also set up a page on our web site and extended an invitation via the Halifax Gets It There! LinkedIn Group. Several companies indicated that they were not interested in participating in the focus groups, while a few others were unable to attend but signalled their interest in being kept informed and being invited to a meeting with Transport Canada. We scheduled three but ultimately offered two focus groups.

Each focus group participant received instructions on the location, information on the program, and an advanced survey to complete on their operations and on what they thought were the key issues, barriers, opportunities and solutions. The Agenda and Advanced Questions are attached as Appendices 1 and 2, respectively.

Focus Groups were held on January 23 and January 29. Each group had trucking and terminal operations representatives in the mix. A personalized follow-up email seeking clarification of statements made in the sessions and a thank-you was extended. Three non-participants in the workshop were subsequently interviewed in person or by telephone for additional input and two who could not attend provided written comments.

In early February a brief Internet survey was undertaken to get a clearer picture on issues and priorities . The results of that effort are presented in section 6 of the report.

Full Name	Company	Type of Company
Of Attendees		
Derek Babineau	Mathers Freight Management Inc	Shipper agents or 3PLs
Kevin Baillie	Halterm	Terminal operator
Pat Berrigan	Guysborough Transfer	Trucking and warehouse
Colleen Best	Oceanex	Shipping line
Brian Conrad	Conrad Transport Ltd.	Trucking and warehouse
Pat d'Entremont	Nicom IT Solutions Inc.	Port IT support services
Tom Jennegren	Maritime Paper Products Ltd.	Shipper (cargo interest)
Brenda Keddy	Halterm	Terminal operator
Greg Merchant	Oceanex	Shipping line
Jean Marc Picard	Atlantic Provinces Trucking Association	Trucking association
Don Rawle	Armour Transportation Systems	Trucking and warehouse
Greg Sheaves	Atlantica Worldwide Logistics	Shipper agents or 3PLs
Steve Snider	Halifax-Dartmouth Bridge Comm.	Bridges
Jean St. Onge	Midland Transport	Trucking and warehouse
Calvin A. Whidden	Ceres Terminals Inc.	Terminal operator
Others providing input		
Ashley Dinning	Halterm	Terminal operator
Brad Doell	Nova Scotia Liquor Corporation	Shipper (cargo interest)
Tom MacSween	T L Shipping Services Ltd.	3PL or logistics services
Verna Siteman-Burns	Sable Warehousing & Distribution Ltd.	Trucking and warehouse
Barry Smith	Nova Cold Storage	Trucking and warehouse

Of those who were approached but did not attend, 19 were trucking and warehouse companies, 16 were shippers (cargo interest), 11 were shipper agents or 3PLs and six were shipping lines.

Section 4 of this report summarizes the findings of these focus groups in the format of the questions on the advance survey and agenda.

3. The Halifax Context: Existing Port Container Traffic

In 2012, Halifax handled 416,572 TEUs[1] of container cargo, an increase of 1.4% over 2011. Volume has increased since 2008 but is well under the port's peak of 550,214 TEUs in 2005. As port trucking concerns the number of moves and not the number of TEUs, we have identified the number of full moves from port data provided by the Halifax Port Authority. As these data do not include empties, we have reverted to the use of TEUs in a number of places in this report where container volumes are not available.

Port of Halifax Container Volumes (by number of full units), 2006-2012

Year	Import laden	Export laden	Total laden
2006	128,570	137,026	265,596
2007	109,013	133,714	242,727
2008	87,080	102,931	190,011
2009	68,075	97,425	165,500
2010	83,326	118,684	202,010
2011	81,054	111.250	192,304
2012	91,504	109,712	201,216

Source: Halifax Port Authority

The data illustrate that Halifax, like most ports, suffered a decline in volume during 2008-09, and has somewhat recovered since then. Laden exports have outpaced imports throughout the period, which means empty containers have to be repositioned from other markets to serve Halifax export demand.

In terms of commodities, the port's greatest strength is its reefer market, which accounts for about 15% of overall volume. Export reefer commodities include seafood, French fries, Christmas trees and frozen blueberries.

Berths at both container terminals have been deepened to 17m, making them the deepest on the East Coast of North America, and enabling the port to accommodate large post-Panamax vessels[2] such as those that will be transiting the expanded Panama Canal and are already transiting the Suez Canal.

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1 A TEU is a 20' equivalent unit. The ISO standard container measures 20' x 8' x 8'.
2 Post-Panamax vessels are those too large to transit the existing Panama Canal.

Halifax is pinning its future growth expectations on both the Chinese and Indian markets, as well as Southeast Asian markets like Vietnam and Malaysia; in September 2012 the HPA signed an MOU with the Panama Canal Authority.

3.1 Background on existing port truck traffic

A very noticeable aspect of Halifax's container traffic is the increasing importance of truck-based volumes versus rail-based container traffic.

We were provided with data on Halifax's **import** rail : truck split for the period 2006-2012. Historically, the truck-based share of Halifax's container traffic was 20-25%. In the past five to six years, the proportion handled by truck has grown significantly and in 2012 was approaching 40%. Water-based volumes are likely those handled by the now-defunct American Feeder Line and other feeder services that have served the New England market.

Volume of import containers loaded at both container terminals by mode (excluding those loaded to Oceanex vessels)

Year	Total import	Containers by rail	Rail %	Containers by water	Water %	Containers by truck	Truck %
2006	108,118	73,427	67.9%	12,335	11.4%	22,356	20.7%
2007	102,888	65,818	64.0%	8,271	8.0%	28,799	28.0%
2008	84,016	53,360	63.5%	3,204	3.8%	27,452	32.7%
2009	66,285	42,362	63.9%	1,609	2.4%	22,314	33.7%
2010	79,781	51,089	64.0%	1,483	1.7%	27,209	34.1%
2011	78,555	49,267	62.7%	1,661	2.1%	27,627	35.2%
2012	92,174	52,232	56.7%	4,747	5.2%	35,195	38.2%

Notes: Total Import box counts as reported to HPA by Ceres and Halterm (but excluding Oceanex imports). The rail box count is as reported to HPA by CN Rail. The water box count is based on HPA non-revenue container cargo box counts. Truck box counts are calculated as Total Import Box Count minus the total of Rail Box Count and Water Box Count.

Source: Halifax Port Authority

In 2006, about 20% of the port's import volume moved by truck, with almost 68% by rail. (The balance moved by short sea to Newfoundland and New England.) In 2012, the share handled by truck had increased, as more than 38% of the port's import volume left the terminals by truck, compared with 57% by rail. This reflects the establishment of transload facilities in the period since 2007. We estimate there are 10-12 such facilities (shown on page 9).

The rail : truck modal split differs by terminal. In 2006, 20% of Ceres' import volume was handled by truck and 22% of Halterm's was truck-based. In 2012, these were 33% and 49%, respectively. Ceres told us anecdotally that close to 50% of their volume was trucked in 2012, which suggests a much larger proportion of exports are handled by truck. When one

considers the location of Halterm vis-à-vis Ceres, and the potential impact on greenhouse gas emissions, the change in percentage since 2006 is significant.

We were only provided with two years of container export data, but it is quite noteworthy. The percentage handled by truck is impressive.

Volume of export containers loaded to ship at both container terminals by mode (excluding those loaded to Oceanex vessels)

Year	Total import	Containers by rail	Rail %	Containers by water	Water %	Containers by truck	Truck %
2011	103,026	46,968	45.6%	1,819	1.8%	54,239	52.7%
2012	105,363	44,631	42.4%	8,197	7.8%	52,535	49.9%

Source: Halifax Port Authority

MariNova's *Use of Containers in Canada* (2006) study noted that empty containers, particularly reefer units, are frequently repositioned from other markets to Halifax. These can arrive by rail as domestic repositioned boxes, by water from New York or from elsewhere like the Caribbean and even Europe. These empties would then move from the terminals by truck to pick up an export load.

3.2 Halifax's changing hinterland

Halifax's hinterland has changed in the past decade, with the Atlantic region remaining constant in terms of overall volume, but becoming proportionately more important to the port than it was five or six years ago.

In 2006, Atlantic Canada accounted for 37% of the port's traffic volume, and this had grown to almost 50% in 2011.

Port of Halifax Overall Container Volumes by Region (TEUs)

		Atlantic		Central Canada and the Midwest	
Year	TEUs	% share	TEUs	% share	TEUs
2006	529,890	37%	194,798	48%	256,160
2007	490,071	42%	207,715	48%	238,249
2008	387,347	48%	186,706	51%	198,072
2009	344,811	46%	159,843	50%	172,744
2010	435,461	41%	178,362	48%	209,063
2011	410,649	49%	203,022	53%	218,192

Sources: www.portofhalifax.ca; calculations by MariNova

Major **imports** include manufactured goods, retail goods, clothing, auto parts and rubber. It should be pointed out that the growth of transloading,[3] particularly of import cargo, skews the proportion of Atlantic region cargo volume and underestimates Central Canadian volume, since transloaded cargo is ultimately shipped to distribution centres in Quebec or Ontario. (Transloading affects data collected by the port and Statistics Canada, as the cargo ultimately gets classified as interprovincial trade instead of international traffic once it is transloaded.)

Likewise, in 2011, Atlantic Canada accounted for 60% of **exports**, up from 47% in 2006. A large proportion of the local export market is high-value seafood and frozen vegetables, as well as forest products and tires.

3.3 Transload and off-dock operations

As noted above, an important component of the port's import market is cargo being transloaded from 40' marine containers into domestic 53' units.

The 2011 *Transload Mapping Study* for Transport Canada found the total volume of import containers transloaded in 2010 was approximately 11,000 FEUs or 40' equivalent units, or 13.5% of the 80,000 import containers.

We also understand that export transloading has become quite significant in the past two to three years and volumes are now over 11,000 units per annum as well. Cargo is typically trucked or railed to Halifax and transferred to a container; destuffing and stuffing either happens in the port area or in Burnside Industrial Park.

The port has announced that refined nickel from Vale Inco's new smelter will be moved by vessel from Long Harbour, NL, to Pier 9 in Halifax. It will then likely be trucked to Burnside for loading into containers and back across the MacKay Bridge to either of the container terminals. Anticipated volumes are not known at this time.

There are four off-dock container yards[4] in the Halifax region (see page 8 for map). They are operated by Armour Transportation, Conrad's Trucking, Container Transport Services (CTS), and Consolidated Fastfrate. All but one of these is located in Burnside Industrial Park and all but one (CTS) also operate a transload facility. Conrad's is located close to one of the major highways in the region.

Another yard might be termed a near-dock yard, as it is just outside Ceres' Fairview Cove Container Terminal. Operated by Armour Transportation, it allows much quicker turnarounds for the tractor unit assigned to work at Ceres and improves the productivity of the assets

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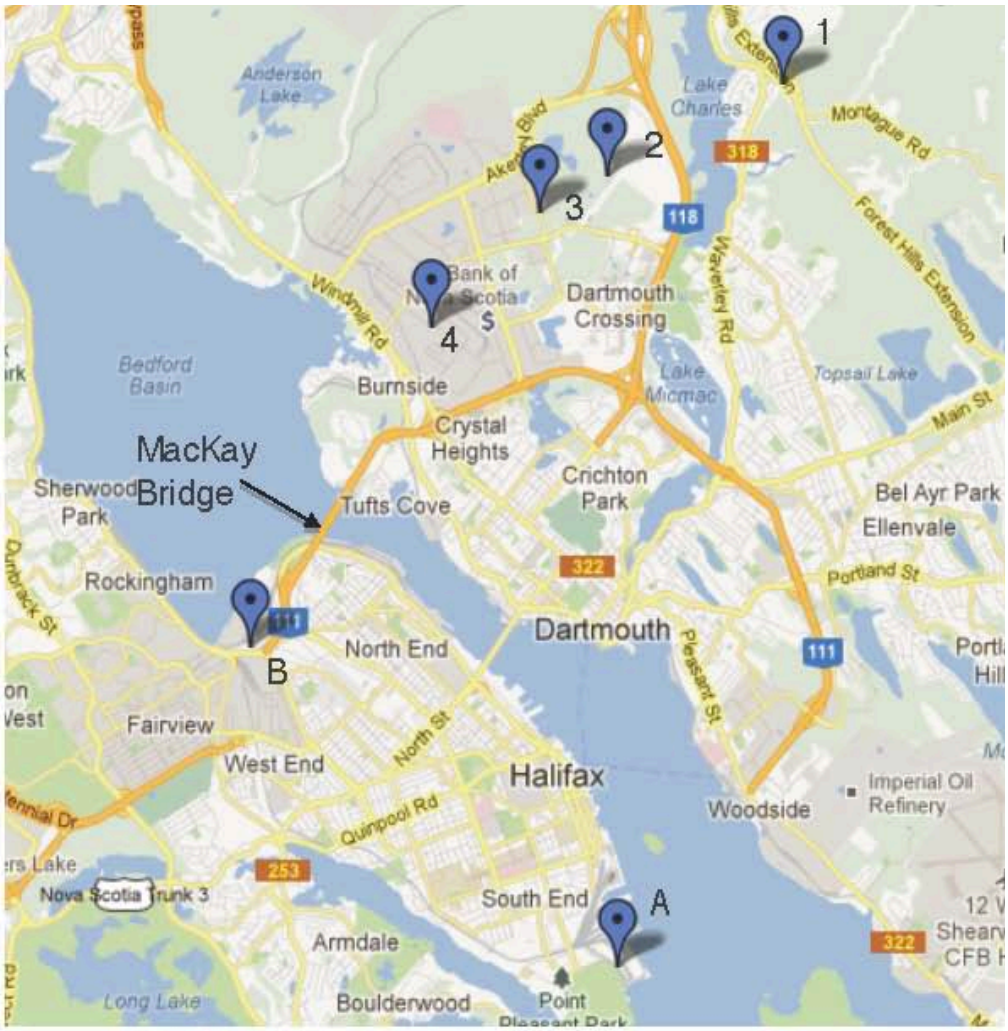
[3] A transload facility is defined as one where cargo is primarily transferred from one type of container to another; it may involve sorting the cargo as a cross-dock function.

[4] An off-dock container yard is defined as a storage yard for empty containers. A virtual container yard is a storage area for containers where they wait until reassignment via an Internet portal IT system. The purpose of a virtual container yard is to reduce empty moves.

used. Units crossing the MacKay Bridge to pick up cargo at Ceres do not need to enter the terminal to collect this cargo, thus saving considerable time.

In 2011, MariNova analyzed the transload business in Halifax, and surveyed all known transload operators. Some of these are the same companies that operate off-dock container yards. Transload locations are mapped on page 9.

Off-dock and Container Yard Locations



Note: 1=Conrad's, 2=Consolidated Fastfrate, 3=Armour, 4=Container Transport Services, A= Halterm, and B=Ceres.

Source: www.googlemaps.ca

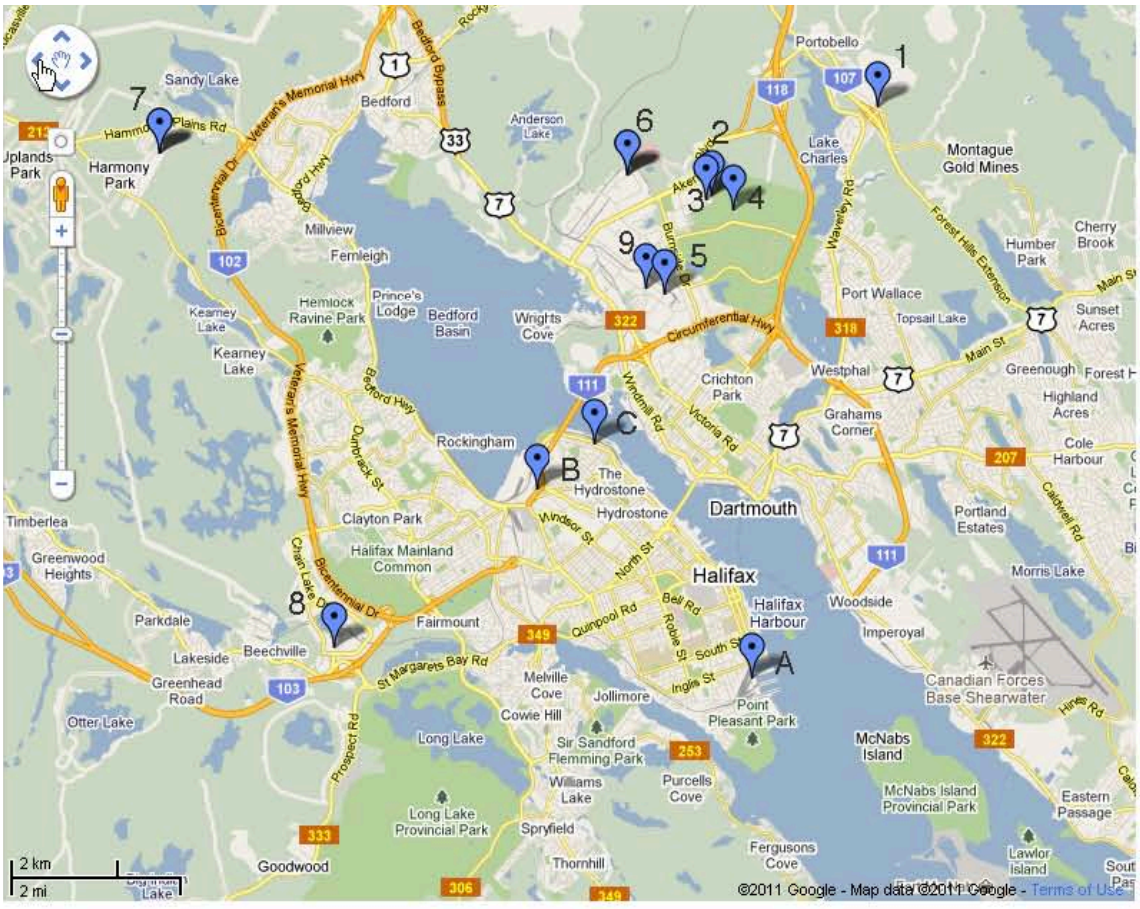
In 2011, MariNova found that many units were moving into and out of the city empty. For example, a marine container destined for a transload in Burnside would move as follows:

- Pick up at Halterm (or Ceres)

- Destuff at transload
- Return to Halterm (or Ceres) empty
- Enter Halterm (or Ceres)
- Leave Halterm (or Ceres) empty for export load
- Return to Halterm (or Ceres) with export load

As one can imagine, empty moves contribute to traffic congestion and wait times at the container terminal gates, both in and out, as well as creating GHG emissions. Therefore, one of the focus group elements was to explore the situation with empty moves in more detail.

Location of Transload Operations



Note: 1=Conrad's, 2=Consolidated Fastfrate, 3=Armour, 4=Mathers, 5=Guysborough Transfer, 6=Midland, 7=Sable Warehousing, 8=Nova Scotia Liquor Corporation, and 9=Western Logistics; A=Halterm, B=Ceres, and C=Halifax Intermodal Terminal.

Source: Google Maps; MariNova Consulting Ltd (2011)

3.4 Truck gate improvements already undertaken

The **Ceres truck gate** design includes optical character recognition (OCR) camera technology, weigh scales at all four inbound gates, paperless transactions, truckers speak to clerks from their truck cab, the seals and container damages are recorded on a handheld electronic unit by checkers at the in-gate. Outgoing trucks have a printed ticket with a bar code that identifies the container that should be on the truck. The truck drives through one of the two exit lanes equipped with an OCR unit. When the truck arrives at the barrier arm, the driver inserts his bar-coded slip into a reader. If the bar code matches the OCR read, the barrier arm raises automatically without human intervention and the truck exits the terminal.

The **Halterm truck gate** is currently being improved, with the new infrastructure completed by the end of February 2013, and therefore immediately before the completion of this report. The box on the next page contains the description provided by Halterm management as to what these improvements do and what they expect to achieve.

3.5 Trucking into and out of Halterm through downtown

While each terminal tracks its own container flows from the time the truck is approached by a checker until the truck exits the gate, and Transport Canada has a pilot program to track these same flows, there is no current research underway to track container flows by truck throughout the Halifax Regional Municipality.

A number of studies in the past five to six years have examined the issue of trucking through the downtown core to and from Halterm.

The *Halifax Inland Terminal and Trucking Options Study* was undertaken by MariNova Consulting (2005) to examine ways to remove container traffic from downtown Halifax streets. The study suggested that better use could be made of CN's "rail cut" that connects the Ocean Terminals and the CN mainline. The concept encountered opposition from the port as well as local residents and a new concept was developed for a Distripark closer to an existing industrial park and proposed transportation node.

MariNova Consulting's (2008) *Atlantic Gateway Distripark Study* was a follow-up to the 2005 study. Because the transload business had begun to grow, the study focus shifted from getting trucks off local roads to helping speed the flow of import and export containers to and from transload facilities, as well as providing some synergy for the proposed transportation node in Burnside Industrial Park. It relocated the inland terminal adjacent to the transportation node. The concept was 25% of the cost of the 2005 proposal, and included the possibility of moving other CN facilities such as the intermodal terminal and a rail yard in downtown Dartmouth. Containers would have been shuttled by rail from terminals on the Halifax peninsula to Burnside Industrial Park. Some stakeholders (including trucking and warehouse companies) liked this concept and some did not.

An interesting aspect of the concept was the Distripark design, which incorporated a private terminal with both public and private access to each transload facility. This would allow containers to be moved from the terminal to the transload warehouse by terminal labour, and for it to be done seamlessly. The same design has been incorporated into new terminals in Calgary and Winnipeg.

Halterm Gate Improvements as Reported by Halterm Management

Halterm's **old gate** was heavily manned and the processes were manual input. On top of this we only had access to 2 in-bound gates and 2 out-bound gates. For trucks entering and exiting there were always line-ups, some for extended periods of time and some were short. Our gate clerks had to manually check all container information for accuracy; this in itself was time consuming. Once we had the trucker inside, the instruction to which terminal machine would do the move was again a manual affair. The ILA checker would decide which machine to move, generally this process was quite quick.

The trucker would arrive at the marshalling yard and, if they didn't know the container information, they would go into the gatehouse to clarify the information; this delayed the process. If they had the correct information, the ILA checker would approach them while they were in the truck and key in the information, again manual process. On exiting the terminal the trucker would stop at the exit gate, the ILA checker would again verify the container information, the trucker would exit the truck and visit the gate clerk inside. Here they would get an interchange document; once everything was finalized, they would exit to their truck and leave the terminal.

New Gate: All shipping lines and trucking companies will have access to our TOS (Terminal Operating System), this way they can verify all container information prior to arriving to the Terminal, this will speed the process up, there will be no need to exit the truck.

The trucker will enter the marshalling yard through an OCR building. The OCR will read the container number, road chassis number, and truck license plate. This information is sent directly to our TOS, and the system will verify the associated container information prior to the trucker approaching one of four in-gate lanes. Once the trucker drives onto the scale they will stop at a kiosk; at this point if they need to communicate with the gate clerk inside, they will be able to do it remotely. At no time will the trucker need to leave the truck. Our TOS, through a camera, at the in-gate will recognize the container number and the information will automatically come up on the clerk's computer screen; this is a quick physical second check. To complete the transaction, a request is sent to the ILA checker to input the container seal number. The trucker will receive a printed ticket from the kiosk, which tells him/her where to go on the terminal for a drop-off and pick-up.

Once on the terminal, the TOS will send the move instruction to the terminal machinery, so the TOS will be selecting the equipment.

The new out-gate process is also much quicker. All trucks will exit the terminal through a second OCR building and then chose one of two outbound lanes. As at the entrance OCR, the exit takes pictures of the container number, road chassis number and trucker license plate. If all information matches up to work that was requested by the shipping line or trucking company, the gate arm at the final check point before exiting to Marginal road will raise automatically and the trucker will roll through. If there is a problem, the gate arm will not raise and the trucker will be forced to stop; at this time an ILA checker and a Halterm gate clerk will get involved to correct any problems.

The trucking company and shipping line can go into our TOS and print out an interchange for the trucker's transaction. This will be matched up with the ticket the trucker received from the kiosk at the entrance to the terminal.

The McCormick Rankin (2008) *Integrated Rail Cut Study* looked at developing the rail cut as a multi-use corridor. The cost of this project was $225-$300 million, not including land expropriation or repairing the bridges over CN's tracks. This concept also encountered significant opposition, this time by the surrounding community. As transport operations

require social license from stakeholders, this approach failed on two counts—inadequate social license and a high price tag—not to mention disinterest on the part of CN.

4. Key Findings from the Port Trucking Literature Review

One of the very first steps in this project was to consolidate the literature on port-related container trucking and on trucking contributions to GHG emissions at ports. This section of the report assesses the literature found (published 2006 or later) and provides a summary in the annotated bibliography located in Appendix 3. In the process, a number of studies were dismissed as 'not relevant' to this study but their abstracts have been retained in Appendix 4. To the literature review in Appendix 3, the only pre-2006 study that has been added is Marshall Macklin Monaghan and Atlantic Road & Traffic Management (2004) as it was of particular relevance in the discussion below.

Many ports and terminals experienced increased cargo throughput as a result of growth in international trade in the last few decades (Giuliano and O'Brien, 2007). One of the consequences has been that truck traffic to and from port facilities has also risen substantially (Chen, Govindan and Yang, 2013; Karafa *et al.*, 2013). Since many terminals are located near or in urban centres, the growth in truck traffic has had a greater impact on residents in those areas, such as increased health risks and air and noise pollution (Hartman and Clott, 2012). Consequently, many terminal operators are facing a frustrated array of stakeholder and community groups who threaten the future growth of terminals (Le-Griffin, Mai and Griffin, 2011). As a response, ports and terminals are implementing strategies to reduce the effect of the terminals' truck-related traffic. Reducing environmental impacts and making more efficient use of existing transportation infrastructure is seen as a better path for accommodating growing demand than further infrastructure investment (Maguire *et al,* 2010).

4.1 Efficiency problems and improvement measures

Efficiency of truck operations in ports and terminals is one of the major issues that can cause serious safety, congestion and environmental problems (Karafa *et al.*, 2013), and causes have been detailed extensively by the Tioga Group (2011):

- Long and unpredictable overall truck turn times at marine terminals;
    - Long and unpredictable marine terminal gate queuing;
    - Marine terminal gate processing delays;
    - Marine terminal procedural exceptions and trouble tickets;
    - Container chassis supply time and delays;
    - Marine terminal container yard congestion delays; and
    - Marine terminal disruptions.
- Extra empty equipment moves; and
- Congestion on streets and highways.

The literature on port trucking shows that there are a large number of initiatives that aim to increase the efficiency of port trucking operations. These can be divided into three categories—business process improvements; infrastructure investments; and policies—although in reality some might have components from other categories.

4.1.1 Business process improvements

Through better coordination of terminal and port trucking operations, strong efficiency gains can be obtained. In some cases this might require technology investments, and in others simple adjustments to current practices might be sufficient. One such practice is the planning of port trucking operations by companies that dispatch independent owner-operators (IOO). As IOOs are paid by the trip, there is little incentive for drivers' time to be managed efficiently by the trucking companies that dispatch them. This suggests that an improvement of dispatching practices of IOOs could generate substantial efficiency gains (Haveman and Monaco, 2009). However, in the Port of Oakland, IOOs and employee drivers report similar waiting times. No quantitative data were found to suggest that employee drivers are actually more effectively dispatched than IOOs.

Terminal operators have also started to work with truck appointment systems. In the case of the ports of Los Angeles and Long Beach, this was mostly the result of political pressure. Terminals could choose to extend gate hours or implement an appointment system. This latter option was the cheaper solution as it did not result in additional labour costs. Because most terminals did not choose willingly to implement an appointment system, the system brought little benefit to the trucking companies and it was therefore hardly used. The Californian terminals that had already developed an appointment system (before they were required to do so) saw it as an essential means for managing dock operations. They argued that appointment slots spread traffic on the docks across the day in order to ration high demand areas (Giuliano and O'Brien, 2007). The example of the Port of Vancouver shows that implementation of the appointment system can reduce truck waiting times significantly. Since the implementation of the appointment system, waiting time has dropped from as long as three hours to less than 30 minutes on average (Morais and Lord, 2006).

Technical solutions have been shown to greatly improve terminal productivity and as a result reduce truck turnaround times. Numerous illustrations are provided by Morais and Lord (2006) and discussed in considerable detail (with selected examples found in Appendix 3's annotations of the study). As one example, operation efficiency and productivity (moves/day) have increased up to 7500 containers moved per day (previously 1500–1800 moves/day) in the TraPac terminal at the Port of Los Angeles; the terminal operator stated that these technology investments were more effective in reducing truck congestion at the terminal than a truck appointment system (Morais and Lord, 2006).

The Port of Oakland and SynchroNet have developed and implemented a virtual container yard (VCY). Empty containers can be released through the VCY and matched in real time with off-terminal demand (Morais and Lord, 2006). Before implementation of this system, empty containers were brought to the terminals after they were emptied at the shipper's premises or a transload centre. Exporters that needed an empty container had it picked up at the terminal. The VCY makes it possible to match supply and demand of empty containers without the containers having to be moved through the terminal. This has the potential to significantly reduce truck traffic to and from terminals.

4.1.2 Infrastructure utilization improvements and investments

Investments in other infrastructure modes can generate a modal shift and reduce truck traffic to and from the terminals. In Japan, for example, investments have been made in a barge connection between the ports of Tokyo and Yokohama. Empty containers generated

in Tokyo were trucked to the Port of Yokohama, but are now transported by barge. This has caused a reduction of truck traffic and an 85% decrease in CO_2 emission associated with the transportation of empty containers.

Another adjustment to infrastructure is the more efficient use of the infrastructure through incenting, for example, off-peak activities. For example, a terminal might introduce a 'peak usage fee'. This means that trucks that arrive at a terminal during peak hours have to pay an additional fee. The Southampton Container Terminal, UK, is reported to have succeeded in cutting congestion at and around the port through the introduction of IT systems coupled with peak pricing for trucks. Trucks are charged £1 for bookings in peak hours and £25 for no-shows in peak hours (Lubalwa *et al.*, 2011). The Port of Montreal introduced extended gate hours at its terminals in an attempt to shift truck traffic to off-peak hours. However, this initiative was not successful because distribution centres were not open during off-peak hours (Morais and Lord, 2006). The terminals in the ports of Los Angeles and Long Beach have introduced the PierPASS®, which is a combination of a peak-fee and extended gate hours. The peak fee was $50 (in 2006) and, based on data provided by PierPASS®, this initiative managed to reach an average share of off-peak cargo of almost 40%[5] (Giuliano and O'Brien, 2008).

4.1.3 Policies

An example of a policy implemented in a port that directly affects port trucking operations is the Clean Trucks Program adopted by the Ports of Los Angeles and Long Beach. Trucking companies have to comply with a number of criteria in order to be eligible for a concession. In 2008, these criteria were:

1. The trucking company only has employee drivers (in the case of the Port of Los Angeles only),
2. The company operates trucks fitted with automatic vehicle location devices and radio frequency identification (RFID) devices,
3. The trucks of the company meet the 2007 U.S. Environmental Protection Agency's standard, or the company pays a 'truck impact fee'.

Goodchild and Mohan (2008) argue that these measures will not improve truck turnaround times at the terminal. The only measure that could lead to an efficiency gain is the requirement for employee drivers. As noted under business process improvements, there is no evidence that these efficiency gains will be obtained. The requirement that trucks have to comply with specific standards might not have a direct effect on the efficiency of port trucking operations, but it does increase fuel efficiency and lower emissions.

Longshore labour policies are an important element to consider in relation to increasing the efficiency of port trucking operations. Many terminals refrain from introducing extended hours of operation because the longshore labour contract provides for differential shift pay, overtime pay, minimum hour guarantees and minimum size of labour work units (Giuliano

[5] This does not include all containers, since fee exemptions were made for empty container returns, chassis returns, domestic freight, freight being transhipped to other ports and cargo already subject to the Alameda Corridor rail fee. The average was determined over the period July 2005–September 2006.

and O'Brien, 2008). The labour contracts often also include lunch breaks, as a result of which the terminal closes completely during the lunch period (Tioga Group, 2011).

4.2 Key stakeholders

The literature shows that in order to take measures that are successful, all key stakeholders have to be included in the development and implementation of the measures (Giuliano and O'Brien, 2007; Maguire *et al*., 2010; Tioga Group, 2011). Measures that are imposed by "outsiders" have a greater probability of failing (Giuliano and O'Brien, 2007). It is suggested that efficiency measures can only result from a stakeholder process when the economic strength of the participating companies is balanced (Lubalwa, Malarz and Wang, 2011). This could be one reason why a measure such as PierPASS® in the Port of Los Angeles led to productivity improvements for the terminal operator, but did not, according to the port trucking companies, significantly improve port trucking operations (Giuliano and O'Brien, 2008). A mediating role by the port authorities could result in a more balanced process. For example, in the case of the development of a port trucking strategy in the Port of Vancouver, there was consensus among the stakeholders that Port Metro Vancouver would take a stronger leadership role in the development process (Lucent Strategies Inc., 2012). Stakeholder engagement and information sharing should continue after the developed measures have been implemented.

Stakeholders, their motivations and possible actions to improve efficiencies in port trucking are summarized in the table below. Any action to address port trucking issues must take these into account.

Stakeholder Motivations and Actions

Stakeholder	Key motivation	Possible actions to increase efficiency
Port trucking companies / drayage firms	Optimize productivity, minimize costs, customer satisfaction (the terminal is not the client)	Direct incentive to take action to increase efficiency (unless IOOs are contracted). The companies can increase their driver training effort, maximize use of port and terminal cargo clearance systems and work with customers to reduce booking errors.
Terminal operators	Optimize productivity, minimize costs, customer satisfaction (the trucking company is not the client)	No direct incentive to specifically address port trucking efficiency, only when measures increase overall terminal productivity or delays threaten customer satisfaction. Terminals can improve gate processing, reduce operating system "glitches," stagger break times to prevent gate closures, extend gate hours as required and increase capabilities to simultaneously serve vessels and trucks.

Stakeholder Motivations and Actions (continued)

Stakeholder	Key motivation	Possible actions to increase efficiency
Port authorities	Optimize return on long term investments, customer satisfaction (terminals are the main clients), create employment and maintain license to operate	Port authorities have a direct incentive to improve port trucking efficiency as the quality of the hinterland connections is an important port selection criterion. The port authority can improve communications, support legacy terminal improvements, coordinate appointment systems and participate in port-area congestion mitigation.
Labour unions	Ensure adequate labour standards and job security	No direct incentive to take action to increase trucking efficiency, only when inefficiencies lead to a significant loss of terminal clients / cargo and job security is threatened. Unions can be more flexible in terms of operating hours and technology implementation.
Ocean carriers	Optimize productivity, minimize costs, customer satisfaction (trucking company is sometimes the client of the ocean carrier)	No direct incentive to take action to increase trucking efficiency, only when customer satisfaction is threatened. Ocean carriers can rationalize empty returns, reduce booking errors and exceptions and support terminal improvements and extended gates.
Shippers	Minimize transport costs and ensure customer satisfaction	Have a direct incentive to improve port trucking efficiency, if this would lead to lower transport costs. Shippers can reduce booking and paperwork errors, and use experienced knowledgeable drayage firms.
Government	Increase employment and ensure efficient and sustainable infrastructure networks	Have a direct incentive to improve port trucking efficiency if this leads to a more sustainable society. Government can mitigate congestion on port-area streets and highways, subsidize improvement measures and provide strategic direction.

Source: Based on Tioga Group, 2011

An important aspect of achieving successful outcomes is that the key actors should possess the capabilities and willingness to implement and use the measures. In the case of an appointment system, this could refer to terminal operators providing actual efficiency benefits to trucks that have an appointment and truck drivers showing up for their appointments (Maguire *et al.*, 2010). Penalties for trucks that do not keep their appointments have been implemented in Southampton, UK, and penalties for terminals that do not meet

waiting time standards have been implemented in Port Botany, Australia (Lubalwa *et al.*, 2011). This creates an incentive for the key actors to make use of the implemented measures in case market incentives are insufficient.

By including all key stakeholders in the development and implementation process it also becomes easier to ensure that the measures do not lead to unforeseen impacts. Any measure that focuses on some particular area of container operation system could result in merely a shift of the problem to a different area of the system (Le-Griffin, Mai and Griffin, 2011).

4.3 Ensuring success

An important point raised in the literature is that in order to determine success, clear goals, indicators of efficiency and emissions baselines must be established. Without first establishing a baseline, how can the efficiency of the measures introduced be assessed?

Arduino *et al*. (2005) researched innovations in ports and defined them (page 2) as follows:

> *A technological or organisational (including cultural, including marketing, as a separate sub-set) change to the product (or service) or production process that either reduces the cost of product (or service) or production process or increases the quality of the product (or service) to the consumer.*

Based on this definition, most of the measures discussed to increase port trucking efficiency and reduce emissions may be considered innovations. Consequently, their findings regarding successful innovations in ports could also be applied to the discussed measures in this literature review. This means that successful innovation depends on institutional and socio-economic factors as well as the engaged and supportive stakeholders already noted.

4.3.1 Key institutional factors

Measures can only be successfully implemented if they are supported by legislation and regulations. Measures such as the PierPASS® in the ports of Los Angeles and Long Beach and the attempt to reduce single-runs in the Port of Fremantle, Australia, were only possible after amendments to anti-competition laws (Giuliano and O'Brien, 2008; Lubalwa, 2011).

Legislation and regulations (or the threat thereof) can also force measures upon the industry (Morais and Lord, 2006). Port authorities (often public or semi-public) can also push for measures to be taken. For example, the Port of Rotterdam included modal split requirements in a terminal concession contract (De Langen, Van den Berg and Willeumier, 2012). The modal split targets aligned with the port's overall sustainability strategy. The fact that the intentions of the port authority are clear, that the terminal operator was aware of the targets before obtaining the concession and that the operator is able to determine what actions it will take to reach those targets, makes it more likely that they will be reached. The concession contract allows the port authority to impose financial penalties if the targets are not reached.

4.3.2 Key socio-economic factors

In order for measures to be effective they must be in line with local social, economic and business practices. For example, the drayage system in a U.S. port might be different from the Canadian context and require different solutions. Likewise, the situation in Halifax could be very different than in a port such as Los Angeles, Vancouver or Montreal. For instance, if capacity is underutilized, spreading out the truck arrival pattern to off-peak hours could add to the productivity problem (Chen, Zhou and List, 2011). Furthermore, much depends on the information that port trucking companies are willing to provide concerning their schedules and this can significantly reduce container re-handling in the terminal yard (Zhao and Goodchild, 2010). The degree to which actors influence each other's actions will differ in each port as well.

4.3.3 A suggested process

Communication is key to a successful identification of opportunities and the development of new concepts and solutions to reduce GHG emissions from port-related activities in the Port of Halifax, and in particular to those from port-related trucking. There has been considerable effort in the U.S. to develop a Framework supportive of community engagement and identification of opportunities, funded by the Strategic Highway Research Program (SHRP-2).

The SHRP-2 Framework for *Incorporating Greenhouse Gas Impacts into Transportation Decision Making* (Meyer, 2012) has been provided in the figure in Appendix 3, page 64, and provides guidelines that might be used by Transport Canada. There is also the potential to examine the GHG sources, impacts and solutions noted in Section 7.2 as part of the process.

5. Identification of the Key Issues and Solutions in GHG Emission Reduction Arising from Consultations

This section reports on the key issues as seen by those stakeholders (with a key business interest) attending the focus groups, along with any other feedback received. Each of the focus groups operated under the Chatham House Rule; that is, participants were encouraged to speak freely knowing that their names would not be associated with specific opinions in this report. Furthermore, given the number of attendees and the variety of roles they play, we have combined the focus group results. We also followed the focus group methodology of asking broad, minimally directive questions (those distributed in advance coupled with probing by the facilitator and recorder); to be too directive would have diminished the trust of the participants and their willingness to express views frankly.

As we sought to meet the request to identify challenges and solutions within the container trucking sector (i.e., port-trucking/drayage) in Halifax, as requested in the study terms of reference, the discussion took place in two blocks, one on issues and barriers, and the second on opportunities and solutions (see the Agenda in Appendix 1). In each case, responsibilities and appropriate stakeholders were clarified. The discussion below restructures the content of the two meetings into an Issue or Barrier, followed by the relevant Opportunity or Solution discussed later. There is no priority placed on the order of the discussion below; our assessment of the meeting comes later.

5.1 Issue: Location of Halterm and traffic congestion in the downtown core

A key issue for discussion was the location of Halterm and the issue of road congestion between Halterm and various transload centres in the Halifax Regional Municipality (HRM). This is particularly a problem during peak traffic periods (morning and late afternoon) and during special events on the waterfront (such as the beach volleyball tournament, Buskers Festival or Tall Ships). While the participants recognized that very little could be done about special waterfront events, they expressed disappointment that, after making Lower Water Street a one-way route, the city had retained parking along the street, effectively reducing truck traffic to one lane when two-lane capability was expected. They also reported problems along Hollis Street, particularly with couriers making deliveries and snow not adequately cleared in winter. While they recognized that Lower Water Street narrows significantly at Historic Properties, concerns were mostly about flow restrictions elsewhere along the street.

The issue of congestion (and traffic flow restrictions on trucking) means that service between the Burnside Industrial Park and Halterm often results in only three local truck return trips per day instead of four, with four being profitable and three unprofitable. Congestion also occurs at Joseph Howe Drive for traffic going from Halterm to Bayers Lake Business Park. During the focus group summation, when participants were asked to indicate their three highest priority issues, the downtown core and routes through the city were viewed as one of the biggest issues.

Solutions

- **Two lanes into and out of downtown** were considered the minimum to reduce idle time in traffic.
- Possible solutions to idling due to peak traffic were CNG (compressed natural gas) or LNG (liquid natural gas) vehicles or hybrid vehicles.
- Investment in fleet tracking using GPS technology was discussed as a possible solution to congestion in the downtown core. The belief was expressed that even if Transport Canada was to fund a congestion mapping system, it still would not solve the problem of every trucking company seeing a gap in the traffic flow and dispatching a truck at the same time another company dispatches a truck.
- Another solution discussed was **extending the gate hours** to avoid peak traffic periods in the downtown. This is discussed as a separate item associated with the next issue.

5.2 Issue: Gate congestion—turnaround time, union work hours and off-peak access

At both the Ceres and Halterm terminals, gate congestion and gate processing was seen in the context of the level of service provided to customers. The complaints centred on times when there is an insufficient number of checkers or when junior checkers are processing the trucks. It was noted that junior staff could process only six trucks in the same time frame as a senior checker could process 10.

The Ceres terminal has an OCR processing system and the investment has been well received by the trucking community. Gate congestion does, however, arise when the truck

at the head of the queue does not have the right paperwork to be processed and blocks access to those vehicles behind. The congestion issue was not seen as a high priority by more than two attendees at the second focus group.

There was considerable discussion of how Halterm's new investment in an OCR gate traffic management system would impact total truck turnaround times. The reduction in processing time from first check-in to departure is anticipated to provide a saving of 40%. The benefits of the new gate management system on trucking efficiency were welcomed by all at the first focus group. Before suggesting additional programs, the new investment at Halterm will need to be assessed.

Solutions

- A **gate appointment system** was dismissed outright in one of the focus groups and discussed with greater openness in the other. It was reported that truck drivers do not like it and that it only works in terminals where shipping lines own the chassis, as in the U.S. The fear that competitive spirit would lead to one trucking company booking numerous appointment slots so others could not get access was expressed. In the other group, it was reported that it is not liked in other terminals/locations, but that this concern was mostly related to 'hiccups' at the beginning of each program. Knowing day-to-day traffic volumes would help truck drivers and their customers flatten out daily production expectations; this was seen as an indicator in favour of adopting a reservation system for gate appointments, and it would also allow terminal operators to plan operations in the 24 hours before the reservation was used. A reservation system was seen as a better option for international shipments than for domestic short sea shipments, as international shipments are known three days in advance, and domestic shipments are often booked closer to the sailing time. Such a system was seen to be the best solution for days of peak activity in order to spread the traffic over the day. It was suggested that one lane could be left for ad hoc arrivals, and the remainder used for reserved access. The solution could work in Halifax but would need more study and a pilot program before participants could see its adoption.
- The potential to offer **extended gate hours** like 7AM to 7PM was also proposed and discussed. To quote one participant: "It is a challenge when a 24/7 operation has to do business with a 8-10/5 one." Under the current Union contract, this would result in the one-hour period before 8 AM incurring significant overtime. Similarly, staffing the lunch hour would require an extra person, that is, eight hours of staff time for one hour of additional gate service. In all, there was consensus that extended hours are expensive and currently not needed most of the time. The trucking companies have adjusted their dispatch plans to accommodate current ILA work rules and gate hours.
- The ability to **pick up empty containers during off-peak times**. While this would result in lower GHG emissions from trucking, as the travel time would be faster, off-peak access incurs considerable expense for the terminal in staffing the gate and terminal operators present at the focus group did not see this as being economically feasible. There did not seem to be any desire for an off-peak gate access system.

Most participants believed that congestion at the gate was predominantly from trucks lined up before opening hours.

- It was proposed, for local trucking companies, that if a **MacPass® transponder**[6] was connected to a single truck and chassis, which was weighed in advance, then the scales at the gate could be used to automatically process the weight of the cargo as the difference between the scale-recorded weight and the previously recorded weight of the truck chassis. This would speed up processing at the gate. It was agreed that a pilot study of this use of the technology could be worthwhile for Transport Canada to consider.

5.3 Issue: Truck drivers idling when in the queue at the gate

There was considerable discussion about the incidence of truck drivers idling at the gate and the impact of that on GHG emissions.

There was general consensus in one focus group that when the trucks arrive at the gate to Halterm, engines are turned off; trucking companies are being very careful given the price of fuel, and only a few drivers continue to idle trucks while waiting for the checkers to enter their data into the system. As a result, gate turnaround was not seen as a key contributor to greenhouse gas emissions. If most truck engines remain off while waiting, the benefits are considered to be in efficiency and profitability, but not in GHG reduction.

On the other hand, at the other focus group, truck idling at the gate was seen as a major cause of GHG emissions from port-related trucking. It was agreed that about 35-40% of truck drivers run their engines to keep warm on cold days or cool in the summer months. The highest use of idling at the gate was identified to be from long-haul truck drivers who arrive the evening or night before and run their engines until the gate opens. (It was noted by this group as well that most long-haul trucks are less than 5 years old while local trucking equipment tends to be 5 to 7 years old, and so the idling contribution to GHGs is less than it might be if it was from local trucks.)

Solutions

- One solution discussed was **add-on heaters for the trucks,** but it was noted that these seldom have a lifespan of more than one year and are an unlikely solution to a very time-specific and location-specific problem at the gate.
- On the other hand, the suggestion of a concept of a **"cold ironing for trucks"** station being available at the gate did not garner support.

[6] Halifax-Dartmouth Bridge Commission operates the MacKay and Macdonald bridges across Halifax Harbour as toll bridges; most residents and trucking companies pay tolls through the use of an in-vehicle transponder that communicates passage through the toll plaza and the toll is deducted from a pre-arranged account.

5.4 Issue: Some shipping lines charge a fee for a street turn

The movement of empty containers was estimated by attendees to account for 50-55% of all moves. The presence of this fee encourages additional moves of empty containers and therefore contributes additional GHG emissions that might be eliminated.

Solution

- No solution to this problem was seen but it was noted that more street turns are happening now than were previously and some trucking companies are storing containers at their container yards to reduce their empty moves.

5.5 Issue: GHG emissions resulting from the management of reefers

There was considerable discussion of the need for cold chain integrity in the Halifax market, given the sheer volume of refrigerated traffic through the port. If the truck arrives at the gate and the reefer container is not at temperature, the truck must wait and idle until the container reaches the temperature acceptable to the shipping line for loading. Truck idling adds GHG emissions whereas terminal plugs do not.

Solution

- A **process change** would result in fewer GHG emissions if the truck could drop the reefer container at the terminal, and use the more efficient container yard plug-ins to bring the box down to acceptable temperature. This was considered a priority of one of the attendees whose business is primarily reefer-based. However, if legal liabilities arising from clean bill of lading requirements are considered, this option is likely not possible. What is possible needs further study and development.
- A **better solution** would be to pre-trip the reefer to its desired setting and load the container at a cold storage facility where the correct temperature would be maintained. Refrigerated containers can also be loaded directly from a trailer if both are at the same temperature.

5.6 Issue: Yard equipment as a source of GHG emissions

There was consensus that yard equipment contributes more GHG emissions than cars or long-haul trucks, and that the conversion of such equipment to electric or hybrid power would have a considerable effect on reducing emissions. The challenge is that such ‘regeneration’ will require considerable investment by the terminal operators who do not view such investment as their highest priority. (In other ports, however, by investing in such technology, there has been a significant saving in terms of fuel costs and emissions.)

Solution

Perhaps Halifax’s terminals could be induced or persuaded to examine the potential savings.

5.7 Other issues or barriers noted

Other delays in the system noted included waiting for the checkers' shift to start (the trucker has arrived before 8 AM) or when CN chooses to shunt trains at the Halterm or Ceres yards, which sometimes blocks truck lanes just before a sailing. In the case of the second issue, the container can miss the sailing, and the trucker may only make three trips that day, which then becomes unprofitable.

When participants were asked to indicate their highest priorities, terminal turn time garnered the most support. This is important because the movement of containers was seen to have no pollution impacts but, short of stopping the movement of containers, the solutions suggested included a congestion monitoring system and a gate appointment system.

5.8 Other opportunities or solutions

There was some discussion about the solutions offered by newer truck technologies. It was reported that many newer trucks offer fuel technologies that are still not proven. One company noted that while the manufacturers are still trying to get the new technologies right, there are more equipment breakdowns than usual, and so the investment sentiment is predominantly 'wait and see'. When asked about where the greatest impact on greenhouse gas technologies might be felt, there was consensus that the biggest impact would come from replacing older container yard equipment with equipment using newer fuel technologies, as much of the yard equipment has not been fully modernized and this opportunity would both reduce GHG emissions and fuel costs. The second biggest impact would come from new fuel technologies on trucks moving through HRM. It was also noted that competitive concerns inhibit collaboration on solutions that require sharing data. One participant suggested that a possible solution would be to identify a solution that is not only 'green' (from an environmental perspective) but also saves money for all adopters, and thereby increases port traffic in total.

There was little interest in discussing Long Beach's Clean Trucks Program, as Halifax does not suffer from the use of exceptionally old vehicles or have the traffic congestion faced at that port. What was discussed was the lack of incentives to purchase new trucks with better emissions ratings, as the cost of the truck is not reflected in the rates paid for the move. It was noted that most trucking companies buy a new truck, run it long-haul for about four years, and then use it in town for local moves for the remainder of its useful life. Tax incentives like accelerated depreciation for new equipment might assist in speeding up the adoption of newer, low emissions trucks. The use of tax incentives was given a higher priority than investing in new fuels as a way of reducing greenhouse gases in the short-term.

In one focus group, there was some discussion of new fuels but it was concluded that most trucking companies have not researched the impact of new fuels or hybrids, nor do they know who is using LNG (or CNG), or where refueling stations are going to be established. Furthermore, there was no understanding of the cost to convert an existing fleet to a new fuel or the cost of buying a fleet with new fuel options. Because fuels and fuel technology were seen as an area of considerable impact on GHG emissions, future research and trucking company education were seen as a possible roles for Transport Canada to undertake, but not viewed as the highest priority. In other words, the trucking companies and shippers at the focus groups were open to hearing more, but were not yet ready to

initiate or invest. Fuel technology and new fleet investment were seen as areas of competitive advantage and therefore individual companies will likely remain silent rather than collaborate.

In the other focus group, investment in trucking technology like truck skirts, hybrid engines and alternative fuels was raised. In this group, the impact on GHG emissions of these equipment technologies was seen as mostly reducing emissions for highway trucking **and not local trucking**. It was reported, in contrast to the other group, that information on alternative fuels and engines was readily available and that this was not a matter of education and information.

In one focus group, the majority of participants believed the biggest reduction in GHG emissions from port-related trucking would come if truck traffic from New Brunswick was to arrive at the terminals via intermodal rail, as at least one trucking firm has attempted. This was seen as a critical structural shift by the majority of participants, and those in favour included trucking companies, terminal operators and cargo interests.

5.9 Summary of focus group discussions

In the course of the focus groups, we learned that the presence of four off-dock facilities now reduces the number of empty moves, as container lines are more tolerant of 'street turns'.[7] We were also told that it has an impact on container terminal revenues because they lose two moves. (Presumably, it also makes them more efficient, though. Efficiency in this context is less a consideration when volumes are down, as terminals want every dollar of revenue.)

There was considerable discussion about altering business processes to reduce GHG emissions. Both container terminals have made a significant number of investments in order to reduce time in the system and queuing at the gate due to documentary flows. The view expressed by some participants was that the Transport Canada initiative is late, as terminal plaza technology investments have already been made at both container terminals in Halifax (see page 10). These significant investments in gate management systems have, and are expected to have, reduced congestion considerably from its previous levels. Blocking the lane at the gate due to errors in documentation has also been addressed for the most part, and further improvements should occur as drivers become used to the systems.

As Transport Canada already tracks gate congestion at both terminals via a pilot project with Conrad's Trucking, there is the possibility that the existing data collected could be used by Transport Canada to verify the changes that have occurred at the terminals since the fluidity project was initiated.

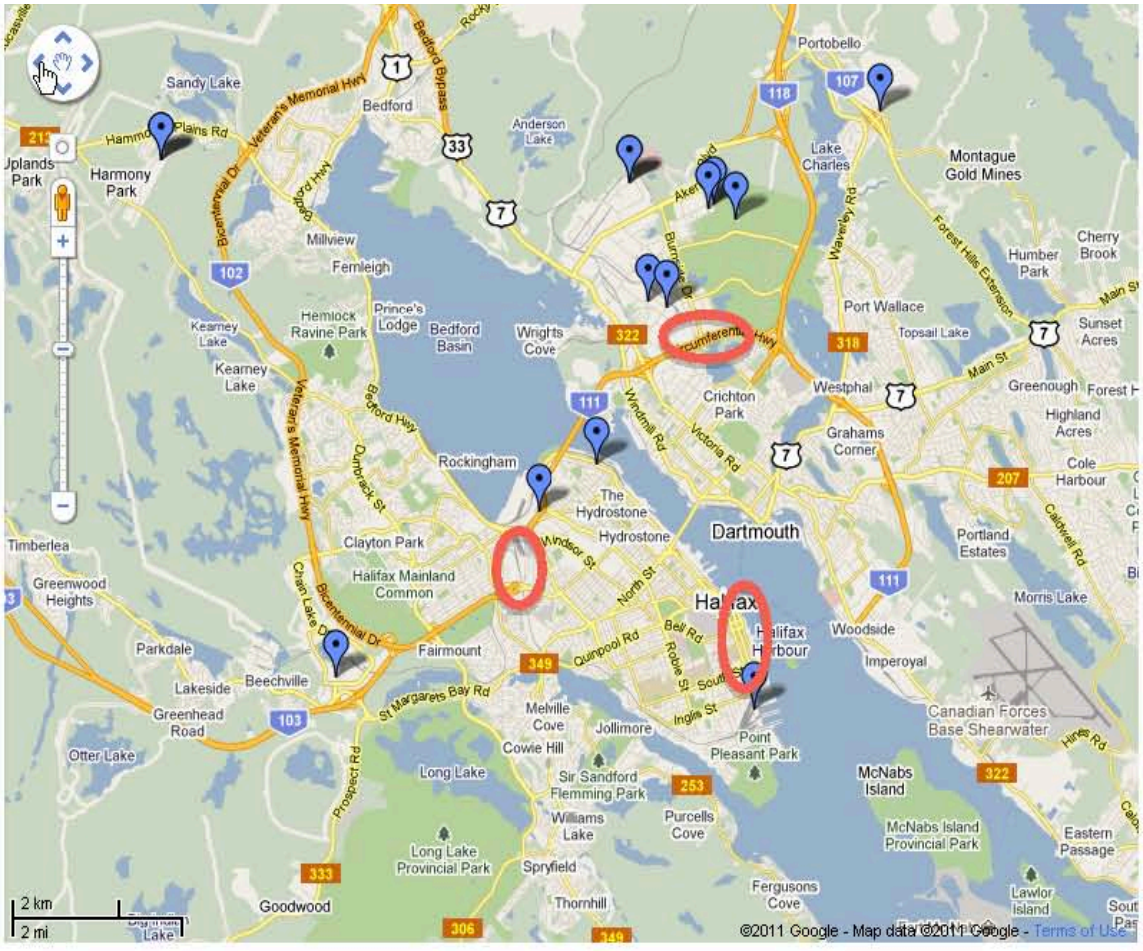
We also learned that Ceres currently offers a trucker Internet portal so that truckers can login to see if the container is ready for pickup, and this will be available at Halterm when

[7] A 'street turn' occurs when an import container moves directly from an import consignee to an exporter, without going back to the terminal empty and being re-processed for the export load. It effectively eliminates two empty moves.

the new gate processing system becomes operational later in February 2013. Ceres now stacks the same type of containers together to facilitate the flow of empties, a solution similar to Halterm's LIFO (last in, first out) empty container management system.

The industry will know within a few months whether the OCR gate management system installed at Halterm will reduce gate turnaround time, but delays in truck traffic appear to be largely related to shift start periods, lunch periods and periods of peak traffic congestion in the downtown core. When there are special events or cruise ships in town, exceptional volumes of pedestrian traffic in the downtown core add to delays caused by issues relating to the traffic flow on Hollis and Lower Water Streets and other congestion points noted in the map below.

Identified Congestion Points



Note: The transload map used earlier in the report has been marked to illustrate the three chokepoints noted by focus group attendees: Lower Water and Hollis Streets in the downtown core, Joseph Howe Drive and the access to Burnside Drive.

There was considerable discussion at one focus group on the integrity of cold chain requirements at Halifax. Given the importance of this particular cargo to the economic trade of the region, it would be a Halifax-specific project possibly evaluating the flow of this type of cargo specifically using similar technologies to that used in the gate turn time study being conducted by Economic Analysis & Research. There could be RFID technologies that are appropriate to the Halifax context and we know that some of this technology has been developed here.

6. Other Input Received

6.1 General comments received

We have concerns about how much of the *perceived* problem with port-related trucking is a *real* problem, given current volumes and excess yard capacity at the terminals. We recognize that, should volumes at the port increase significantly, the congestion from port-related trucking will worsen and GHG emissions grow more rapidly. As indicated by one shipper:

> *A few years ago, we used to hear back from [trucking company], informing us of significant delays at the port. They even threatened to charge extra fees for the extensive wait times they were faced with. These days, things seem to operate quite well and we have not heard any such complaints.*

A number of companies have initiated policies on truck idling and invested in newer engines and other technologies. Other initiatives and technologies reported include:

> *The use of trailer side skirts provides 4-7% increase in MPG along with Low Rolling Resistance Tires for an additional 3%.*
>
> *We have been a member of SmartWay (U.S. Environmental Protection Agency) since 2008 and are designated as "SmartWay Qualified".*
>
> *[We have looked at] Shaw in Cab Satellite Tracking & Trailer Tracking*
>
> *We are using a tool designed by [Dalhousie student] to optimize our scheduling.*

Only three trucking companies (two large and one medium) shared their fleet data with us.

How many trucks in your fleet are…
(converted to % of fleet)

Model Year	Company A %	Company B %	Company C %
Model year 2010 and newer	70%	50%	30%
Model years 2007-2009	15%	35%	29%
Model years 2004-2006	15%	15%	22%
Earlier than 2004	0%	0%	19%

The companies presented a very mixed profile, indicating that between 6% and 100% of their trucks are involved in port-related trucking, with short haul (within HRM) ranging from 25% to 70% and long haul (beyond Nova Scotia) accounting for 20% to 50% of the business. This information reinforced, to us, that the Port of Halifax does not have a problem with older trucks being used primarily for local traffic as occurs in Los Angeles and Long Beach.

Some of the feedback provided included:

Issues

> *… Halterm marshalling yard too small, trucks end up delayed too long*
>
> *Limited gate access [is a problem]. Vessels arrive on Sunday and we pay demurrage because we can't get into the terminal until Monday or Tuesday. We would like extended gate hours.*

Solutions

> *… Most trucks already have emission controls, [but] removing the movement through the downtown area will go a long way in this area.*
>
> *Tax benefits*

One of the items that might be considered for further development is exploring “cold ironing for trucks.” To quote one trucking company:

> *… For overnight stays if there were some way to have electrical hook-ups in the holding area drivers could plug in and run their heat system, instead of running the truck all night. Might be a bit of a*

stretch but consider 10 trucks running all night, that is fuel used and GHG emissions.

From another:

… bought Webasto auxiliary heating units for trucks

From one shipper we heard:

[An] electronic weight scale would help. I also think there is a chance to improve by allocating a fast-track lane for truckers only picking up empties or perhaps allocating empties at an outside yard somewhere.

6.2 The Internet-based survey

In early February, a brief Internet-based survey was sent to those trucking companies invited and to all focus group participants to get a clearer picture on issues and priorities. Ten respondents completed the short survey and the results are presented next.

Greatest impact on GHG Emissions from Trucking (n=10)

Contribution	Least Impact	Moderate Impact	Greatest Impact	Not Relevant
Congestion at the terminal gate	40%	30%	30%	0%
Congestion elsewhere in HRM	50%	50%	0%	0%
Congestion in the downtown core	30%	40%	30%	0%
Diesel container yard equipment	10%	30%	50%	10%
Document inefficiencies at the gate	40%	40%	10%	10%
Reefer plug availability outside the gate	60%	40%	0%	0%
Shipping line charge for moving empties	60%	20%	0%	20%

While conversion of yard equipment is a clear favourite in the greatest impact column, the previous complaints about shipping line charges no longer seem to be the issue it once was. Congestion at the gate and in the downtown core are of some importance.

Solutions with Greatest Impact on Reducing GHG Emissions from Trucking at the Port of Halifax (n=10)

Contribution	Least Impact	Moderate Impact	Greatest Impact	Not Relevant
Gate appointment system	50%	40%	10%	0%
Support for yard equipment conversion	0%	40%	60%	0%
Reefer support outside the gate	30%	60%	0%	10%
Truck plug-in support outside the gate	40%	30%	10%	20%
Near-gate truck rest area	50%	40%	0%	10%
CCTV information system	50%	40%	0%	10%
Virtual container yard	50%	10%	10%	30%
More/larger off-dock container yards	30%	40%	20%	10%

Again, support for yard equipment conversion was high, while gate appointment systems, near gate truck rest areas, CCTV information systems and a virtual container yard did not capture support.

The survey generated additional comments, two of which particularly resonated in the focus groups:

> *Off-dock container yards with rail connections would have the greatest impact.*
>
> *Conversion of the yard trucks at the terminal to electric or hybrid power would also be of benefit.*

We have not reported all the feedback we received, as much of it was already captured in the focus group discussions. The next section summarizes our conclusions arising from this situation analysis.

7. Our Key Conclusions

In this section we present our overall conclusions, arising from the literature review, the focus group discussions reported in section 5 and from the individual feedback and follow-up survey content noted in section 6.

7.1 Which projects attracted interest?

Both terminals will shortly have OCR, so the time to fund new gate infrastructure has passed. That said, there were a number of ideas forthcoming that hold promise.

We discussed the potential use of GPS, which most trucking companies have installed on their vehicles. The realities of Halifax's geography (i.e., located on a peninsula with one entry point for trucks) means that trucking companies are very well aware of the congestion points (Fairview interchange and downtown core as noted in the maps in section 3.5) and unable to re-route their trucks when congestion occurs. The view was that making better use of GPS data would only send every company's truck to the terminal at the same time—when slots are available. Perhaps this is too simplistic and we need to look at GPS data-sharing more closely. A technology company in Halifax has done similar work in other ports and could be engaged in this project.

The data currently being collected from one trucking company by Transport Canada are not being shared with the trucking company. Perhaps the project could start with these data, to ascertain the incidence of congestion and nature of the challenge for Halifax. Furthermore, it would be useful to extend the pilot project to other trucking companies.

RFID is a shipper- and container-tracking technology not directly related to trucking *per se*. However, it could have some potential, particularly with respect to understanding and examining cold chain integrity. A pilot study focused specifically on the maintenance of cold chain integrity received some interest, particularly as the technologies to explore the issue exist. A study of cold chain processes through the May to September period of 2013 would be well timed, and as the majority of reefers on trucks are diesel-powered, the impact on GHG emissions would be better understood.

There was also interest in assessing alternative processes for the handling of empties to reduce the number of empty moves, and therefore the GHG emissions.

Also raised was the suggestion that the Port of Halifax consider investment in "cold ironing for trucks" that arrive late evening for the next morning, or are in line on cold days before the gates open. There must be technology available to address this. The trucking firm needs to see the benefit of making the vehicle ready for such a 'plug-in', the port and terminal operator need to consider providing such equipment, and the funding of such technology would need to be discussed.

There was one focus group participant and one person providing follow-up information who mentioned using the rail cut to address trucks moving through downtown and the congestion and GHGs they produce. This option has always looked easier to implement than it is, and has had vociferous discussion on the part of those in favour and those who are not. The McCormick Rankin *et al.* study of 2009 tried to accommodate trucking and transit uses, and to share the rail cut with CN. The price tag, without land acquisition costs, was $225-$300 million. Residents of both downtown and around the rail cut tend to favour a rail shuttle while the shipping terminals, the port and some (not all) trucking firms would seem to prefer paving the rail cut and sharing it with CN. A simpler option to move containers from Halterm on a diesel electric–powered hybrid rail shuttle to Burnside Industrial Park has not been costed thoroughly, nor the societal benefits assessed.

We feel it is particularly important that the baseline emissions be documented and the goals more clearly defined, as is proposed in the SHRP-2 program approach (see web link on page 65 of Appendix 3) and is one of the best practice approaches identified in our literature review. This is because we heard that most participants in the focus groups thought that the greatest GHG reductions would be from investments in newer container yard equipment. One participant indicated that interesting CN in short line moves from Moncton to Halifax would also reduce GHGs.

7.2 What needs further study in support of funding proposals?

Transport Canada could consider studying a SynchroMet-type system/virtual container yard concept. Could the supply of containers in off-docks be better managed with such a system? We have four off-dock container yards (three of which are new in last five years), five if the near-dock facility close to Ceres is counted.

One of the most interesting suggestions was the potential use of hybrid electric or alternative-fuel yard equipment. This technology has been introduced on Canada's west coast and has resulted in both fuel savings and reductions in GHG emissions. The payback time can be quite short.

One participant had some misguided notions about how to handle refrigerated cargo and would perhaps benefit from a 'cold chain' workshop; the procedures at each exchange point in the cold chain need to be clearly understood by all parties. Perhaps other companies and stakeholders in the Halifax Regional Municipality would benefit too from a closer examination of these processes. As this sector has been a priority of the Halifax Port Authority, and it has invested heavily in reefer infrastructure, this idea might prove to be worthwhile. There are 500 reefer plugs at each of the two container terminals. There are also a number of very large reefer shippers in the region including Clearwater, Oxford Frozen Foods, Cavendish and McCain. There is also cold storage capacity in place and being built in Burnside Industrial Park (e.g. VersaCold and Nova Cold). A number of trucking companies and service providers also specialize in the movement of reefer cargo.

A preliminary investigation into the 'cold ironing for trucks' concept seems worthy of consideration.

The perception revealed in the focus groups was that the primary producer of GHG emissions in Halifax container port operations is the container yard equipment when the focus of this study was port-related trucking. It would be worthwhile identifying the sources of GHG emissions against those who are impacted by them and those who would pay for their mitigation; this would go some way towards understanding how best to proceed with implementing solutions suggested.

Likewise, there are many beneficiaries to clarification of the state of congestion in the city. While the participants in the focus groups identified their points of congestion pain, the city's taxis and Metro Transit could also benefit from collaborative efforts. Partnering with the Halifax Regional Municipality to examine congestion within the city using taxi-, bus- and truck-produced GPS data to identify congestion points and develop strategies to mitigate congestion along the lines used by Morgul et al. (2013) might be worthy of consideration for future study.

Finally, there was considerable discussion about the use of MacPass® technology to track a pre-weighed container and tractor, and use of that information in conjunction with the weigh-in-motion scales to reduce gate times. This could also be an interesting pilot study.

7.3 Ideas that did not resonate with the industry stakeholders

The workshop participants displayed no enthusiasm for GIS and RFID monitoring except as they relate to either cold chain integrity or congestion within HRM, in particular downtown Halifax en route to Halterm.

The workshop participants were not in favour of an appointment system, as has been introduced at other ports. They only saw potential for abuse, i.e., a large company could block book and squeeze smaller companies out. This was tried by Marine Atlantic on its Newfoundland ferries and the same thing happened. However, the way to handle this type of situation is to charge truckers for 'no-shows'.

There was no support for a PierPASS® style off-peak system given current capacity availability at the terminals. If one of the terminals became severely congested in the future, there might be support for this idea. The issue seems to boil down to: what is the added cost, who pays for the additional hours of access, and is it worth that added cost?

7.4 Summary

Communication is key to a successful identification of opportunities and the development of new concepts and solutions to reduce GHG emissions from port-related activities in the Port of Halifax, and in particular to those from port-related trucking. This report has clarified the existing port-related trucking situation in the Halifax area, identified key literature of relevance to understanding the technologies that might possibly reduce GHG emissions in the area, and reported on the perceptions held by the local trucking community and terminal operators on what will and will not work within the community to improve the situation. Most participants in this situational analysis thought that the greatest GHG reductions would be from investments in newer container yard equipment. One participant indicated that interesting CN in short line moves from Moncton to Halifax would also reduce GHGs.

In addition, a number of suggestions for future studies have also been made in section 7.2.

The study team has supplied updated contact information to Transport Canada separately in support of a continued innovation program to address GHG emissions in the wider port community.

Appendix 1: Agenda (minus background on the project and location of meeting map)

Ground Rules for the Meeting

Please note that the sub-items in the agenda are merely to spark discussion, and it is not planned to discuss the issues or the solutions in a particular order, only to focus on 'issues and barriers' before the stretch break and 'solutions and opportunities' after.

In the report to Transport Canada on the session, your concerns and issues will not be identified with your name. All reporting will follow the 'Chatham House Rule'. Any answers provided below will not be directly attributed to you.

Preparation

In advance of the session, please consider the preparation questions accompanying this agenda and bring your answers with you. If you feel that the question is not relevant to your particular company, just complete with NA (for Not Applicable). As some of these issues are quite complex, we ask you to expect to leave the sheets behind.

Agenda

Item	Time allocation
Introductions by those attending	5 minutes
A review of the structure of the session	5 minutes
Issues and barriers	35 minutes
Physical infrastructure (availability, quality)	
Fleet and equipment (availability, quality, age)	
Physical flows (bottlenecks, congestion)	
Hours of service (trucking regulations, terminal operations, …)	
Any other suggestions	
What has already been done? Why did it work or not work?	10 minutes
Stretch Break	5 minutes
Opportunities and solutions	45 minutes
Physical infrastructure investment	
Incentives for fleet replacement/investment	
New technologies (for emissions reduction, fleet management, gate management, business process, management, …)	
Regulatory policies	
Any other suggestions	
Wrap-up and feedback (next steps)	15 minutes

Appendix 2: Advance Preparation Questions

In advance of the session, please consider the questions below and bring your answers with you. If you feel that the question is not relevant to your particular company just complete with NA (for Not Applicable). As some of these issues are quite complex, we may ask you to leave the answers behind.

1. What are the top three issues you face in terms of container trucking activity at the port?

Issue 1:

Issue 2:

Issue 3:

2. What do you see as the best solutions to the challenge of reducing GHG emissions from trucking?

Issue 1:

Issue 2:

Issue 3:

3. Has your company looked at greenhouse gas emission issues before, and if so, what did you find?

4. What, if any, technologies have you considered?

___We have not considered any technologies.

5. Are there any technologies we should investigate?

6. In what type of business activities is your company engaged?

_____Trucking company _____Warehouse operations

_____Shipping line _____Freight forwarder or third party logistics

_____Cargo owner (do own trucking) (do not own trucking) _____Other type of business

If you are a trucking company or operate your own trucking for your moves, please answer the questions on the following page.

If you are a trucking company or operate your own trucking for your moves, please answer the following questions. (Answers will be kept confidential and will be aggregated.)

A. How many trucks in your fleet are…

Model Year	Number of trucks	Percentage involved in port-related truck moves
Model year 2010 and newer		
Model years 2007-2009		
Model years 2004-2006		
Earlier than 2004		
Total number of trucks		

B. For just your port-related trucking, what percentage of moves is

_____short-haul dray (within HRM)

_____longer-haul (within Nova Scotia)

_____long-haul (beyond Nova Scotia)

100%

C. What would motivate you to switch to newer trucks, or renew your fleet (e.g., new fuel/engine opportunities, tax incentives, policies, other programs)?

Appendix 3: Annotated Bibliography of Relevant Studies

APEC Maritime Expert Group (2009). Sharing best-practices in reducing greenhouse gas emissions at ports. Retrieved from http://www.fmc.gov/userfiles/pages/file/GHGBestPractices.pdf, accessed on 12 January 2013.

DOI: NA

Abstract: Provides several examples of best practices that ports have implemented to reduce the amount of GHG emissions as a result of port operations.
Key words: Not provided

Contribution to current research
During a meeting of the APEC in Manila it was decided that the member economies would benefit from exchanging best practices in attempts to reduce GHG emissions at ports. The economies were requested to report measures taken by port authorities, port operators, port facility owners and ship operators by filling in a questionnaire. This questionnaire was dispatched to APEC economies in September 2008 and there were 20 answers from nine economies received.

One of the best practices that is brought forward under “modal shift” is the case of the Port of Tokyo, Japan. Part of the empty containers generated at the port of Tokyo are transported by truck to the Port of Yokohama. This causes a large amount of CO_2 emission and heavy traffic on the landward side of the port. In order to mitigate these impacts, some of the containers are now transported by barge in Tokyo Bay. This barge is part of a green partnership project and the construction of the barge was subsidized by the government. It is estimated that the use of the barge reduces the CO_2 emissions [associated with the transport of the empty containers] from the Port of Tokyo to Port of Yokohama by about 85%.

Another best practice included in the report is that of the Port of Kaohsiung in Taiwan. This port installed an Automatic Identification (Controlling) System at port checking gates. This system takes photos of the trucks and processes the truck’s license plate and the cargo’s number. The image is crosschecked with the Custom’s Release Data via computer in order to approve the permission of passage. Trucks no longer have to stop at the gate for a manually gate checking system and truck idling is avoided. 700 million trucks pass through the checking gate annually and by adopting the new system some 112 tons of CO_2 can be reduced per year.

Arduino, Giulia, Aronietis, Raimonds, Crozet, Yves, Frouws, Koos, Ferrari, Claudio, Guihéry, Laurent, Kapros, Seraphim, Kourounioti, Ioanna, Laroche, Florent, Lambrou, Maria and Lloyd, Michael (2012, Article in Press). How to turn an innovative concept into a success? An application to seaport-related innovation, Research in Transportation Economics.

DOI: 10.1016/j.retrec.2012.11.002

Abstract: The main objective of this paper is 'to assess the conditions, including policy support, under which innovative concepts have a high chance of getting adopted and being successful'. The work will start from the state-of-the- art with the following goals targeted. Firstly, to identify the paths that new innovative concepts usually follow, what key determinants are, which actors are involved, and what policy has been doing and can do. As part of this, a typology of variables is established, which will be the basis for the identification of successful adoption paths. Illustrations are provided of the performance of different innovative concepts in the seaport sector. A further goal is to propose policy recommendations, identify best practices, barriers to implementation and transferability of innovative concepts and processes. Finally, the research establishes developments needed in assessment methods and a methodological framework if innovative concepts are introduced.

Key words: Seaport innovation, Indented berth, Port community system, Cold ironing and Adoption path

Contribution to current research

The paper suggests that the port sector in general appears to be rather conservative in introducing innovation in its processes. It argues that this could be a consequence of a network of players deeply interrelated either horizontally and vertically, with a great use of standards, that slows down the adoption of innovations. The paper presents a number of key factors that could help innovations in ports to be implemented successfully.

- Key networks of actors:
- Key institutional factors
- Key socio-economic factors

This list of key factors was developed based on a number of case studies. One of these case studies consisted of the implementation of Port Community System (PCS) in the Port of Thessaloniki.

Berechman, J. (2009). Estimation of the full marginal costs of port related truck traffic, Evaluation and Program Planning, 32, pp. 390–396.

DOI: 0.1016/j.evalprogplan.2009.06.008

Abstract: NY region is expected to grow by additional 1 million people by 2020, which translates into roughly 70 million more tons of goods to be delivered annually. Due to lack of rail capacity, mainly trucks will haul this volume of freight, challenging an already much constrained highway network. What are the total costs associated with this additional traffic, in particular, congestion, safety and emission? Since a major source of this expected flow is the Port of New York–New Jersey, this paper focuses on the estimation of the full marginal costs of truck traffic resulting from the further expansion of the port's activities.

Key words: Port expansion, Societal costs and Truck traffic

Contribution to current research

The paper tries to estimate the full marginal costs (FMC) of increased truck traffic associated with increased transport flows to and from the Port of New York - New Jersey (PNYNJ). The insights presented in the paper could also be used to determine the marginal benefits of reducing or shortening truck movements. These benefits could be taken into account when making a cost-benefit analysis of potential investments aimed to increase efficiency of port trucking.

The paper also briefly outlines several policies that could help prevent an increase in truck movement, without disturbing trade growth:

- Barges: The paper points out that the main destination of truck traffic generated from the PNYNJ is the Philadelphia–Camden market. This market can be reached by barge, which could reduce the number of trucks on the road significantly. However, the per mile barge costs are much higher than trucking the cargo due to travel time differences, insurance and additional loading and unloading movements. Subsidizing barge operations might be justified, when taking into account the externality costs associated with trucking operations;
- Regulation: Truck owners are free to use the truck type and model they see fit (2007). Yet old trucks tend to pollute more and are known to be unreliable. Thus, regulating the age of trucks that haul containers within and from the port is another method to curtail air and noise pollution;
- Efficient road pricing: the potential effectiveness of road pricing is debated. The aim would be to reduce the number of peak-hour truck trips, but (1) change in hauling prices is divided among many customers with insignificant effect on each; (2) tolls are regarded as fixed costs, which would not change behavior, as contracts are distance-based; (3) since the trucking industry is highly competitive, increase in fixed costs may be absorbed by falling profit margins but not by increasing prices.

Chen, Gang, Govindan, Kannan and Yang, Zhongzhen (2013). Managing truck arrivals with time windows to alleviate gate congestion at container terminals, International Journal of Production Economics, 141, pp. 179 –188.

DOI: 10.1016/j.ijpe.2012.03.033

Abstract: Long truck queues at gates often limit the efficiency of a container terminal and generate serious air pollution. To reduce the gate congestion, this paper proposes a method called 'vessel dependent time windows (VDTWs)' to control truck arrivals, which involves partitioning truck entries into groups and assigning different time windows to the groups. The proposed VDTWs method includes three steps: (1) predicting truck arrivals based on the time window assignment, (2) estimating the queue length of trucks, and (3) optimizing the arrangement of time windows to minimize the total cost in the system. A conventional Genetic Algorithm (GA), a multi-society GA, and a hybrid algorithm using GA and Simulated Annealing are used to solve the optimization problem. A case study based on a real container terminal in China is performed, which shows the VDTWs method can flatten the truck arrivals and reduce the gate congestion significantly.

Key words: Container terminal, Gate congestion, Arrival control, Fluid based queueing model, Time window optimization, Hybrid metaheuristics

Contribution to this research

The paper shows through the use of a case study that in theory a VDTW method of controlling truck arrivals at ports can:

- Flatten peak traffic demand, which is one primary cause for the gate congestion in container terminals;
- Result in a reduction of the truck/ driver waiting time, and hence the air pollution caused by truck emissions will also be reduced;
- Improve a terminal's utilization of the storage space by virtue of shorter export container storage time.

The model results in much shorter time windows for truck arrivals than is currently the case and these shorter time windows result in a more even and controlled spread of truck arrivals. Though the model developed is not applicable to the Halifax situation the paper does point out a number of relevant issues:

- Truck arrival management (TAM) can have significant positive efficiency impacts and thus reduce environmental impacts
- In order for a TAM system to be successful it is important to assess whether terminal operators [or trucking companies] will be reluctant to use the system,.
- In most cases a TAM is not a one size fits all solution and a terminal should implement a TAM solution based on its local conditions (it should be aligned with and facilitate operations)

To avoid the yard congestion, the gate capacity has to be lower than the yard handling efficiency. The paper also provides formulas to estimate truck arrivals, gate capacity and queue length developments, which appear to be universally applicable.

Chen, Xiaoming, Zhou, Xuesong, List George F. (2011). Using time-varying tolls to optimize truck arrivals at ports, Transportation Research Part E, 47, pp. 965–982.

DOI: 10.1016/j.tre.2011.04.001

Abstract: An analytical point-wise stationary approximation model is proposed to analyze time- dependent truck queuing processes with stochastic service time distributions at gates and yards of a port terminal. A convex nonlinear programming model is developed which minimizes the total truck turn time and discomfort due to shifted arrival times. A two-phase optimization approach is used to first compute a system-optimal truck arrival pat-tern, and then find a desirable pattern of time-varying tolls that leads to the optimal arrival pattern. Numerical experiments are conducted to test the computational efficiency and accuracy of the proposed optimization models.

Key words: Port management, First best toll pricing, Time-dependent queuing model, Stochastic service time distribution

Contribution to this research

The paper presents a theoretic desirable pattern of time varying tolls that leads to optimal truck arrival pattern. When the average terminal (gate) utilization rate approaches full capacity in the simulation, the optimization model is able to reduce the truck turn time dramatically by more than 50% compared to the cases without tolls. The paper concludes that this optimization strategy will enable the seaport operators to fully utilize the terminal capacity, without significant loss in level-of-service.

Apart from showing that a toll system can be useful in certain situations to reduce gate congestion it also raises a couple of interesting points regarding truck appointment systems:

- A successful truck appointment system gains truck driver support by providing clear benefits, e.g. guaranteed entry times, reduced queue lengths and shorter truck turn times.
- The time-varying length of the truck queue and delays at the gates and yards are essential measures of effectiveness for truck appointment strategies; these performance metrics need to be estimated accurately.
- Underestimating the truck turn times can lead to difficulties in maintaining the desirable level- of-service for truck drivers, and further reduce the attractiveness of the appointment mechanism.
- Spreading out the truck arrival pattern too much can underutilize limited equipment and labor resources and cause inconvenience for the truck drivers.

De la Guia, Jose Garcia (2010). Technology for the port cluster efficiency: valenciaportpcs.net [PowerPoint], Terminal Operations Conference Europe, 08 – 10 June 2010, Valencia, Spain. Retrieved from http://www.tocevents-europe.com/files/speaker_24_jose_garcia.pdf, accessed on 15 January 2013.

DOI: NA
Abstract: NA
Key words: NA

Contribution to current research

This presentation given by De la Guia in 2010 provides a brief overview of the Port Community System developed for Valenciaport. As one of the successes of the system the presentation notes that because all the information is at the Terminal System before the arrival of a truck, the average time at the gate has been reduced from 5 minutes to only 35 seconds. This has resulted in the Maritima Valenciana Terminal (1.8 million TEUs) being more efficient now with 4 gates than previously with 10 gates. Valenciaport could be used as a 'best practice' for a PCS, thought more detailed documentation would need to be gathered.

De Langen, Peter W., Van den Berg, Roy and Willeumier, Aernoud (2012). A new approach to granting terminal concessions: The case of the Rotterdam World Gateway terminal, Maritime Policy & Management, 39, 1, pp. 79-90.

DOI: 10.1080/03088839.2011.642311

Abstract: This paper describes in detail the award process of the concession for a large container terminal in the Port of Rotterdam. This process can be termed competitive bidding, and differs from a tender because of the frequent interaction between the Port of Rotterdam Authority and the candidates. The competitive bidding process is a potentially attractive form in which to grant concessions, if there is sufficient interest in the concession as well as an impartial and trusted Port Authority with the capability to manage the process. Criteria that foster sustainable port development can be incorporated into the bidding process. In the Rotterdam case, modal split requirements were introduced, a novelty in the port industry.

Key words: Not provided

Contribution to current research

The paper presents an example of how a terminal concession can be used by a port authority to ensure sustainability targets are met. In the case of the Port of Rotterdam (PoR), sustainability was mainly translated into modal split requirements **in the terminal concession**, i.e. to deal with the challenge of reducing the share of road transport in the modal split. Parties that wanted to make a bid for a terminal concession were asked to focus on minimising the share of road transport. Candidates had to indicate what share of road transport would be feasible for them and how they would achieve that modal split with a reference to their hinterland strategy and terminal concept. In addition, candidates where asked if they intended to co-operate with other logistic service providers like barge and rail operators to promote a favourable modal split.

The modal split requirements were introduced for three reasons: first, to improve the sustainability of container transport; second, to alleviate congestion on the main access highway to/from the port; and third, to ensure that port development would not be constrained by the environmental regulations, especially those related to air quality.
The modal split requirements have been incorporated into the concession contract as an obligation for the terminal. If the targets are not met, financial consequences can be enforced. PoR emphasised its commitment to reduce the share of road transport in the modal split. PoR is also investing to enable this (for instance, in a ‘container transferium’ [transload centre] and rail terminals). However, the contract does not specify the set of investments PoR needs to make as a condition of the modal split requirements. The paper mentions that some other ports have started to develop in a similar direction. For instance, Antwerp also discusses modal split with concession candidates and sets modal split targets. In the case of the PoR the concession clearly fits within the overall sustainability strategy of the port. This makes such measures better understood and accepted by terminal operators.

Eisele, William L., Schrank, David Lynn, Schuman, Rick, Lomax, Timothy J. (2013). Measuring and reporting travel time reliability statistics for the most congested corridors in the United States: Methodology and results (#13-1338), Presented at the 92nd Transportation Research Board Annual Meeting, January 2013, Washington, DC.

DOI: NA

Abstract: For nearly 30 years, the Texas A&M Transportation Institute (TTI) has developed methodologies and appropriate performance measures for estimating congestion performance and communicating them to technical and non-technical audiences. TTI's Urban Mobility Report (UMR) informs decision-making at the federal, state, and local levels. While very important for guiding policy discussion and assisting resource allocations to infrastructure, the congestion statistics in the UMR only tell part of the congestion story – the magnitude of the problem based on area-wide average congestion levels.
The reality is that congestion is not just an "average" problem. Reliability performance measures capture an important aspect of the travel experience, and they illustrate the variability in traffic congestion so that travelers can estimate the extra "buffer" time needed to ensure on-time arrival.

The transportation profession is moving toward the use and application of travel reliability performance measures for project prioritization and decision-making. However, the practice of using reliability measures for decision-making is in its relative infancy. This paper describes the methodology and analytical procedures for computing and ranking corridors throughout the United States with reliability measures. The results are documented in TTI's inaugural 2011 Congested Corridors Report (CCR). In this paper, researchers describe the methodology and reliability measures presented in the inaugural CCR. The results of the CCR identify the 328 most unreliable roadway corridors as ranked by the buffer index. The performance measures and detailed data like those used in the 2011 CCR can guide investments and improve decisions and communication about the congestion problem.

Key words: Not provided

Contribution to current research
This is the latest TTI study on congestion. TTI methodologies and approaches set the U.S. standard for measuring congestion performance, should it be needed for future studies by Transport Canada.

Giuliano, Genevieve and O'Brien, Thomas (2007). Reducing port-related truck emission: The terminal gate appointment system at the ports of Los Angeles and Long Beach, Transportation Research Part D, 12, pp. 460–473.

DOI: 10.1016/j.trd.2007.06.004.

Abstract: Growth in international trade and changing patterns of production have resulted in greatly increased volumes of freight traffic in urban areas. Metropolitan areas serving as major nodes within the international trade network are particularly affected. In California, state regulation was imposed on port operations in an effort to mitigate congestion and air pollution associated with increased port-related trade. This paper presents an evaluation of the outcomes of California Assembly Bill (AB) 2650 at the Ports of Los Angeles and Long Beach. The legislation permitted terminals to adopt either gate appointments or off-peak operating hours as a means of reducing truck queues at gates. There is no evidence of reduced queuing or transaction times, and hence that AB 2650 did not result in reduced truck emissions.

Key words: Port operations, Inter-modal transportation, Air quality, Regulation

Contribution to this research

The paper shows that there was a strong incentive to take action against the negative effects of increased cargo transport in Southern California. Increased truck traffic resulted in more congestion, more delay due to accidents, and more vehicle emissions. A key driver to taking action were Southern California studies which showed that the air pollution from diesel exhaust increases cancer risk. It was clear from surveys that the efficiency of drayage operations could be improved, especially with regard to the waiting times (and idling) at terminal gates. However, this paper claims that there is no reliable data on queuing in Southern Californian ports from the period before the specific regulations and measures discussed in the paper.

Appointment systems were implemented with different providers, appointments arrangements, and gate procedures. Overall the authors found no evidence to suggest that the implemented appointment system reduced queuing at terminal gates and hence emissions. Truckers [and politicians] expected that appointments would reduce transaction time by assuring that containers and/or chassis were ready and available for pick-up. However, this was not the case; practices ‘‘inside the gate’’ did not change as a result of the appointment system.

Reasons mentioned by terminal operators not to implement / promote the use of appointment system included: (1) Terminals must be flexible and organize their operations based on the nature of their business. (2) There is great variety in type of product, number of ships served, customer requirements, and dock space. (3)The web-based container information systems were already providing data on container availability; hence it was unclear what additional benefit appointments would add.

The most promising option for improving productivity is technology, such as efficient use of OCR, using GPS to track container movers, and streamlined cargo tracking.

An appointment system adds to the data burden of terminal operators.

In the case of Southern California, there is an incentive to discourage appointments, since the greater the proportion of appointments, the more likely it will be that a truck with an appointment will be present in a long queue, and hence the greater risk of being fined.

The terminals that had already developed an appointment system saw it as an essential means for managing dock operations. Appointment slots can be determined for each yard area so that traffic on the docks is smoothed across the day, and so that high demand areas can be rationed. Appointments are less disruptive and less costly than extended gate hours, because of high longshore labour costs.

Data shows strong increase in the use of appointments once terminal operators start promoting the use of the system. Though the paper does not explicitly describe how the appointment systems are promoted, it seems rational to assume that this is done partly by ensuring that making appointments brings benefits to the trucking companies (dedicated lanes, faster service, etc.). As the authors point out “If appointments reduce trip times by reducing wait time, or making sure cargo is released and ready for pick-up, truckers have every incentive to make them, because they are paid by the load, not by hour”. Even if terminal operators put in the effort to ensure the appointments are kept, the system can only work if the trucking companies do the same. Survey results presented in the paper show that the average percentage of appointments kept by trucking companies was 63%, with a range of 6–100%. Since there was no penalty for missing or cancelling appointments, the incentive was to keep them only when convenient to do so. The survey also showed that the extent to which appointments are used is correlated with the percentage of customers that require appointments. Trucking companies that already use technology, such as vehicle tracking systems, use appointments more extensively (52% versus 34% of all transactions).

There are a number of overall key lessons for the implementation of a truck appointment system detailed in the report.

Giuliano, Genevieve and O'Brien, Thomas (2008). Extended gate operations at the ports of Los Angeles and Long Beach: A preliminary assessment, Maritime Policy and Management, 35, 2, pp. 215–235.

DOI: 10.1080/03088830801956854

Abstract: The paper examines the implementation of extended gate operations at the Los Angeles/Long Beach ports. The programme, known as PierPASS®, assesses a Traffic Mitigation Fee (TMF) on eligible containers moved into and out of the ports during peak hours. The fees are intended to defray the costs of extended operations at the ports.

In this paper we focus on the implementation of the programme and its outcomes over a year of operation. We discuss the motivations and actions of key stakeholders and place our examination in the institutional framework of the goods movement supply chain. Our results are based primarily on a series of extended interviews with stakeholders, together with data provided by PierPASS® and by three drayage trucker surveys. We find that the PierPASS® programme was a response by terminal operators and steamship companies to growing political pressure. Given their market power within the supply chain, they were able to create a programme that protected their interests yet responded to political imperative. The PierPASS® programme has been a success: the peak fee has shifted a significant share of cargo to evenings and weekends, as intended. Winners and losers of PierPASS® reflect the larger structure of the international supply chain.

Key words: Not provided

Contribution to this research
This paper addresses the PierPASS® programme, which seeks to shift truck traffic out of the peak by imposing a fee on weekday container pickups and deliveries at the Los Angeles and Long Beach ports. PierPASS® was designed and implemented by marine terminal operators (MTOs). It is a response to threatened regulation that would have established a new public authority to impose a peak fee on container traffic. Another contributing factor was that in 2004 (the year before introduction of the PierPASS) the industry had anticipated a 5% increase in container volume, but the actual increase was 12%. The increase overwhelmed the ports and significant processing delays occurred.

The article notes that one main reason why terminals had not yet put more effort into shifting truck traffic of peak hours is longshore labour costs and work conditions provided in the union contract. A second reason for the absence of extended gate hours before PierPASS® was resistance from truck drivers and customers. For truck drivers, off-peak work means either an extended work day or a shift in schedule to a less family friendly night shift, without guaranteed pay increase. Warehouses, distribution centres, manufacturers and other entities must also be available to process cargo during off-peak hours.

The authors of the paper were unable to obtain sufficient data on off-peak moves before PierPASS® implementation to estimate a ‘‘before’’ share so an assessment of the effectiveness of the program could not be definitively made.
Key lessons include:

- A system such as the PierPASS® has enabled the terminal operators to accommodate significant growth in container volumes with all terminals agreeing to the same rules of operation;
- The terminal operators do in general, not perceive congestion at the terminal gates as a problem (they have no contract with the trucking companies). The papers showed that the terminals in California only took action under the threat of political action;
- Systems that are developed without the inclusion of the main stakeholders will not have the intended effect.
- If left to the market, a system is developed that is dominated by the strongest players.
- The authors suggest that ports can exert influence [on terminal congestion] in the lease negotiation process and are more willing to do so now that they are feeling external pressure from elected officials, environmentalists and community groups who live near the ports.

Goodchild, Anne and Mohan, Karthik (2008). The Clean Trucks Program: Evaluation of policy impacts on marine terminal operations, Maritime Economics & Logistics, 10, pp. 393–408.

DOI: 10.1057/mel.2008.13

Abstract: The Clean Trucks Program is a Clean Air Action Plan initiative currently being adopted by the Ports of Los Angeles and Long Beach. This paper examines each of the Clean Trucks Program's current requirements and estimates the impact on terminal operations. Using terminal operations data supplied by three terminal operating companies, we conduct a simple queuing analysis and present a regression model which allow us to consider the potential impact of the policy changes. While the impact at a specific terminal is not estimated in this paper, we consider order of magnitude effects. While the programme itself does not require terminal operations changes, the programme will modestly increase incentives to improve operational efficiency outside the terminal and reduce terminal gate processing time. It will also require technology that could be used for further operational changes. We show, however, that unless gate time improvements are matched with these operational improvements in the terminal, they will only move the delay inside the terminal and not reduce total terminal time. Our research considers the impact of the Clean Trucks Program on the Ports of Los Angeles and Long Beach, but similar concerns are driving changes at ports around the globe.

Key words: Marine terminal operations, freight transportation policy

Contribution to current research

The paper describes the potential impacts of the Clean Truck Program (CTP) on terminal operations. Under the terms of the current programme, ports will authorise trucking firms to access the port through offering concessions that will be granted to trucking firms that can meet certain criteria. Meeting the criteria are necessary for but not a guarantee to being granted a concession.

In the article it is suggested that drivers could become more productive as a result of becoming employees of a drayage company. Legal employment protections and employee benefits such as healthcare and sick leave and this could convince drivers to stay in the industry longer. According to the authors it is reasonable to assume that more experienced drivers may reduce the number of “trouble transactions” at terminal gate. These transactions require additional attention and time from terminal employees at the gates. The paper also raises the suggestion that that employee drivers could improve terminal operations as trust and cooperation between drayage drivers and terminal operators increases, i.e. less identification time. However, if all other operations stay the same at the terminal, waiting times would shift from the gate to inside the terminal.

Overall the effects of CTP on terminal efficiency and turn around times of drayage trucks appears to be limited. The authors did not assess whether or not it is an effective program to reduce the environmental impacts associated with drayage practices in the ports of Los Angeles and Long Beach.

Hall, Peter, V., O'Brien, Thomas and Woudsma, Clarence (2012, Article in press). Environmental innovation and the role of stakeholder collaboration in West Coast port gateways, Research in Transportation Economics.

DOI: 10.1016/j.retrec.2012.11.004

Abstract: The paper explores the role of stakeholder collaboration in the adoption of innovations as part of the environmental and sustainability agenda of port gateways. We do this through a comparative assessment of the Port of Vancouver, British Columbia, and the twin ports of Los Angeles and Long Beach, California. An inductive research approach is used to identify and assess the initiation and implementation process behind exemplary innovations. Innovation includes new technologies and processes for handling and moving cargo, mechanisms for planning and policy making, as well as financing, implementing, upgrading, managing and operating infrastructure systems. A relatively new arena for competition on the basis of innovation concerns environmental performance. The conceptual framework and empirical evidence suggest that while there may be intense demand for and supply of innovation in port gateways, the complex dynamics of the logistics chain are such that successful innovation requires conscious involvement and collaboration of stakeholders.

Key words: Gateways, Logistics chains, Seaport, Stakeholders, Environmental innovation

Contribution to this research

The authors argue that stakeholder collaboration is central to the successful initiation and implementation of innovations pursued as part of the environmental and sustainability agenda of port gateways. Collaboration should be facilitated and structured through a variety of inter-organizational forums, learning and information-sharing, and formal and informal institutional arrangements.

The paper states that stakeholder collaboration for the purpose of initiating environmental innovations in the Vancouver gateway is being challenged by the uncertain economic climate. Companies may be more concerned with external competition than with responding to local environmental pressures.

A second challenge is the lack of corporate head offices in the Vancouver gateway. This is important with regards to innovation, because the paper points out that headquarters are part of the infrastructure of innovation. Also geographic concentrations of head quarters contribute to concentrations of research, development and other sources of knowledge. According to the authors this could explain the lack of a traditional focus on transportation in the local research and advanced services sector in the Vancouver gateway.

This situation is comparable to the situation in which Halifax finds itself. Most headquarters of key clients of the Port of Halifax are not located in Halifax or even Canada. It should be ensured that those parties involved in potential agreements concerning measures that increase the efficiency of port trucking, have the mandate necessary for successful implementation of the measures.

Hartman, Bruce C. and Clott, Christopher B. (2012). An economic model for sustainable harbor trucking, Transportation Research Part D: Transport and Environment, 17, 5, pp. 354-360.

DOI: 10.1016/j.trd.2012.02.004.

Abstract: Truck emissions at a port may have a severe impact on neighbors, resulting in a politically sensitive sustainability issue for the port management. Strict emissions controls may adversely affect throughput whereas the lack of strict controls will be unacceptable to local citizens and environmental interests. We develop an economic model minimizing cost of truck emissions control and collateral production changes and apply it to decision making for a port seeking to meet a throughput goal while also attempting to satisfy an emissions constraint. Outcomes predicted by the model allow informed decisions about the impact of controls.

Key words: Port economics, Harbor trucking, Emissions policy, Sustainable port management

Contribution to this research

Maritime ports have come under pressure to control emissions from ships, trucks, and other equipment used in landing containers and other products. Many maritime ports still use diesel trucks to bring containers to and from them. These trucks are large sources of nitrogen oxide (NOX) and particulate matter (PM) which have been shown to be injurious to the local population, and add to the emissions load generated by the port. The authors do not consider the possibility of increasing the efficiency of port trucking operations in order to lower environmental impacts. In stead they only consider the use of trucks that pollute less per tonne/km. The model that the authors developed could be used as a starting point if a port truck replacement program is selected as a measure in Halifax. It could help to determine the number of trucks that would need to be replaced to reach the goals of the program and the shadow prices of production and emission constraints (for emissions it indicates a price for additional emissions, which could be compared to a market if it would exist).

Haveman, Jon and Monaco, Kristen (2009). Comprehensive Truck Management Program: Economic Impact Analysis, Beacon Economics. Retrieved from http://www.portofoakland.com/pdf/CTMP_Beacon_Final.pdf, accessed on 12 January 2013.

DOI: NA

Abstract: This report was commissioned by the Port of Oakland (Port) to provide economic insight into the current functioning of the drayage, or trucking, system at the Port. The Port also requested recommendations that will help to inform the development of a Comprehensive Truck Management Program (CTMP). The CTMP is intended to identify and address shortcomings in the drayage services provided to Port customers. The Port has outlined a set of 10 key elements that include increasing drayage productivity, reducing community impacts, and developing a sustainable drayage workforce.

Our methods of analysis included extensive surveys of drivers, licensed motor carriers, and other supply chain participants; discussions with industry participants and Port staff; and a reliance on fundamental economic principles. Through this process, we have gained significant insight into the functioning of the drayage sector at the Port, with a better understanding of driver compensation and costs, operational inefficiencies, market structure, the potential effects of security and regulatory (environmental) constraints, and other issues.

Key words: Not provided

Contribution to this research

The report describes the problems associated with trucking services to and from the Port of Oakland. It points out that the East Bay Alliance for a Sustainable Economy and the Pacific Institute estimate the economic cost of health impacts from Port emissions to the Bay Area is at least $153 million annually. The report also indicates inefficiencies in the drayage market

There are three potential sources for inefficiency:

1. Trucking company dispatch policies;
2. Marine terminal inefficiencies;
3. Driver inefficiency.

The authors estimate that these inefficiencies result in the port being over-trucked by as much as 25%.

Higgins, C.D. and Ferguson, M.R (2011). An exploration of the freight village concept and its applicability to Ontario, McMaster Institute of Transportation and Logistics, Retrieved from http://mitl.mcmaster.ca/research/documents/MITL_Freight_Villages_January.pdf, accessed on 16 January 2013.

DOI: NA

Abstract: This research was carried out for the Ontario Ministry of Transportation. The purpose of the research was to explore the concept of a freight village and provide some high level insights on the applicability of the concept in the province of Ontario. A freight village is an advanced form of logistics centre where a cluster of goods movement oriented and logistics facilities are co-located and co-ordinated to achieve synergies. Key attributes include an intermodal terminal, warehousing, manufacturing, wholesaling, logistics services and access to shared facilities, equipment and services. Centralized management and ownership and partnership between the public and private sectors are also central elements. In its pure form, a freight village can serve as an incubator for smaller logistics and related firms. Extensive details about the concept and its relevance for Ontario can be found in the report.

Key words: Not provided

Contribution to current research:
The report provides extensive information on freight villages, including numerous examples. As one of the benefits the report states that freight villages can be used to mitigate congestion and can function as a form of traffic management. It provides case studies and quantitative information on the reduction of truck movements in those cases, mainly as a result of modal shifts (truck to train).

Le-Griffin, Hanh D., Mai, Lam and Griffin, Mark (2011). Impact of container chassis management practices in the United States on terminal operational efficiency: An operations and mitigation policy analysis, Research in Transportation Economics, 32, pp. 90–99.

DOI: 10.1016/j.retrec.2011.06.007

Abstract: Existing policies designed to mitigate the environmental and social impacts of truck queuing at maritime terminals often focus on congestion problems outside of the terminal gate, targeting a reduction in the waiting and turn time of trucks as the measure of success. This paper evaluates the impact that intra-terminal truck and equipment movements have on the terminal's overall performance and the implications that these movements have on the effectiveness of current mitigation policies. Through a simulation of terminal processes occurring at Southern California ports it is shown that measures driving reductions in truck turn times impose greater operational loads on terminal equipment, essentially transferring savings in truck turn time rather than eliminating it in terms of the overall system. Consequently, the paper finds that total truck and cargo handling equipment movement and operational time constitutes a more accurate measure of the effectiveness of policies seeking to mitigate the impacts of truck operations at marine terminals.

Key words: Ocean container chassis Intra-terminal operations Container transaction processes Container terminal performance Mitigation policy effectiveness

Contribution to this research

The paper describes the current situation for many terminal operators in which they are facing an increasingly frustrated array of public officials and community groups who are prepared to challenge future growth unless the impacts of goods movement on local communities are adequately addressed. This is especially true for the ports of Los Angeles and Long Beach which are used as a case example in this paper.

The focus of the paper is on the system that is unique to the United States in which the maritime chassis is not provided by the trucker or transportation. company, but is rather owned or managed independently by ocean carriers. Though this system is unique to the US, there are certain lessons that can be learned from the article:

- Handling of container cargo is processed through an integrated and dynamic system of operations. Therefore, one should not look at just one segment of the system in isolation, but consider the system as a whole;
- Any regulation and/or policy focusing on some particular area of container operation system would prove to be impractical, tending to merely switch the difficulty to a different area of the system;
- Evaluating and monitoring both truck and terminal equipment movement and operational time would constitute a more effective measure of vehicle emissions mitigation policies

Karafa, Jeffery; Golias, Mihalis M.; Boile, Maria; Theofanis, Sotiris (2013). Evaluation of gate strategies at marine container terminals (#13-2961), Presented at the 92nd Transportation Research Board Annual Meeting, January 2013, Washington, DC.

DOI: NA

Abstract: Intermodal marine container terminals are experiencing growth in volumes and are under pressure to develop strategies to accommodate increasing demand. One of the major factors contributing to the problem is inefficient gate operations that can cause serious safety, congestion, and environmental problems. There is a plethora of ongoing discussions concerning the implementation of different operational strategies that may reduce the effect of these externalities. This research presents the development of a traffic simulation model capable of measuring the impact of various gate strategies on congestion at terminal gates and on the environment.

Key words: Not provided

Contribution to current research

Apart from increased social pressure on terminals to increase their efficiency and reduce emissions, the paper also raises the point that physical expansion is not always an option for terminals to deal with increasing cargo flows. When terminals are located in densely populated urban areas and physical expansion is not feasible, planners and engineers have to address volume increases with corresponding increases in operational efficiency or face the possibility of crippling congestion.

The paper shows the result of a traffic simulation model capable of measuring the impact of truck appointment systems and extending the terminal gate hours. Results from the simulated case study indicate that the most effective gate strategy under low levels of demand increase is the appointment system while for high levels of demand increase extending the terminal gate hours to divert demand to off-peak periods is more beneficial. This seems a logical conclusion as at low levels traffic can be spread more evenly over normal operating hours and reduce overall waiting times. However, when demand levels increase all periods within the regular operating hours will become more busy and expanding gate hours will provide an opportunity to reduce congestion.

Lubulwa, Godfrey, Malarz, Adam and Wang, Shun Peng (2011). An investigation of best practice landside efficiency at Australian container ports, Australasian Transport Research Forum 2011 Proceedings 28-30 September September 2011, Adelaide, Australia, Retrieved from http://www.atrf11.unisa.edu.au/Assets/Papers/ATRF11_0031_final.pdf, accessed on 12 January 2013.

DOI: NA

Abstract: The National Ports Strategy proposed by Infrastructure Australia and the National Transport Commission has special focus on landside efficiency of ports. One of its recommendations is that BITRE should conduct and publish research into best practice arrangements for the landside efficiency of ports. This paper describes some of the economic issues that arise from the way container ports in Australia are organised. Among other things, the paper points to the need for better balancing of competitive strengths of, and the enhancing of cooperation between, companies operating in Australian container ports. The landside of a port includes the space within the gates of the port and the port's hinterland. Within the gates of a port, efficiency refers to the speed of processing containers measured by container turnaround times, truck turnaround times, and container dwell time—the length of time a container spends at port. Over the port's hinterland interest is in the cost and optimality of the mode used to move a container to and from the terminal and is measured by indicators like cost per container; rail mode share; and the efficiency of truck utilisation.

The paper discusses five areas:

- Management of peak demand for container pick up and drop off;
- Truck turnaround times;
- Congestion in the port's hinterland;
- Rail's mode share in container haulage.

Efficiency at both the wharf-side and land-side of a container port terminal is important since ports are economic 'gates' for a country's exports and imports.

Key words: Landside of port, efficiency, containers.

Contribution to current research

This paper discusses possibilities of increasing the efficiency of the use of existing infrastructure at Australia's port terminals. Road transport is the dominant transport mode for moving freight to and from the five major Australian container ports. According to available data on container truck companies there is intense competition in this market. Though this might suggest that the market will function efficiently, this is not the case. Trucking operators waste time in queues at port gates and increase congestion at peak times, because the waiting time is paid for by importers and exporters who pass them on to consumers in form of higher prices for goods. This could become a barrier to implementing measures that intend to increase efficiency. An interesting conclusion of the authors is that "Port efficiency requires balance of economic strength among participating companies." The articles that focused on the ports of Los Angeles and Long Beach showed clear evidence of this conclusion (measures have been dominated by the terminal operators), but did not draw this conclusion explicitly.

Lucent Strategies Inc. (2012). Container trucking strategy stakeholder engagement process. Summary report workshops May 2012, Vancouver, Canada. Retrieved from: http://portmetrovancouver.com/Files/FINAL%20-%2020120619%20-%20Container%20Trucking%20Strategy%20Workshops%20Summary%20Report.pdf, accessed on 15 January 2013.

DOI: NA

Abstract: In December 2011, Port Metro Vancouver launched a stakeholder engagement process to develop a broadly supported, long-term vision for the Container Trucking Sector that would enhance its global position as a sustainable and competitive supply chain leader. Part of this process included workshops with container sector stakeholders to help inform and shape the strategy.

Key words: Not provided

Contribution to current research

The report provides information on a similar process as currently undertaken for the Port of Halifax. Both the methodology and outcomes of the stakeholder engagement process are included in the report. Representatives from trucking companies, shipping companies, terminals, off-dock facilities, regulators, owner-operators, rail companies and unions, as well as individual drivers were invited to participate and 139 individuals participated (none of which representing terminal operators). They provided their opinion on the challenges and potential solutions on the following seven key themes.

- Marine terminal and off-dock operations;
- Reservation system;
- Understanding and mutual respect;
- Communication;
- Truck Licensing System (TLS);.
- Rates; and.
- Road and port congestion.

Maguire, A., Ivey, S., Lipinski, M.E., Golias, M.M. (2010). Relieving Congestion at Intermodal Marine Container Terminals: Review of Tactical/Operational Strategies. 51st Annual Transportation Research Forum, Arlington, Virginia, 2010. Retrieved from http://www.trforum.org/forum/downloads/2010_161_Relieving_Congestion_Marine_Terminals_Strategies.pdf, accessed on 15 January 2013.

DOI: NA

Abstract: Until 2009, intermodal marine container terminals had experienced constant growth in container volumes since widespread containerized trade began. Even with the downturn in freight volumes due to recent economic conditions, forecasts are that freight volumes will rebound and will increase dramatically by 2020, resulting in substantial increases in congestion. The port industry is under pressure to develop strategies and capacity to accommodate these increasing freight volumes. Efficient gate operations are crucial to intermodal freight terminals since their impact is not isolated to the efficiency of the operations within the terminal but also extends to the road traffic on nearby freeways and access ramps. There is an ongoing discussion concerning the implementation of different gate operation strategies that may relieve these effects. Among the gate operation strategies being considered to relieve the impacts of congestion and delay are gate appointment systems, extended hours of operations for terminal gates, and advanced technologies for gates and terminals.

Key words: not provided

Contribution to current research

The paper critically reviews the published literature on the different gate strategies. This paper also presents existing attempts at reducing truck queues at terminal gates and improving terminal operations and traffic conditions in the vicinity of the terminals and the technologies available that support the implementation of this type of strategies. The operational strategies discussed in the paper are: Gate appointment strategies and Extended gate hours. No information is provided on the results of such strategies in ports (other than simulations).

The paper also provides a short description of relevant technologies that are used Terminal Operation Systems.

The paper concludes that coordination between trucking companies and port intermodal terminals is essential for efficient terminal operations; Incentives are necessary to get trucking companies to buy into appointment systems and actually make appointments (and keep them); Gate appointments are a more favoured alternative than extended gate hours, since the cost is lower; Gate appointment systems have the potential to dramatically improve operations inside the terminal as well as at the gate, and as a secondary result, reduce congestion on the roadway system, and therefore reduce harmful emissions in the neighbouring communities; The key to developing effective gate appointment systems is to ensure participation from all key stakeholders.

MariNova Consulting Ltd. (2011). Halifax Transload Mapping Study, Prepared for Transport Canada.

DOI: NA

Abstract: Not provided

Key words: Not provided

Contribution to current research

The report provides valuable and up-to-date background information on transload activities in Halifax, i.e.: provides (information on):

- A process map of physical flows of inbound containerized cargo;
- A list of all import transload facilities in Halifax handling significant volumes of inbound cargo;
- The percentage of total import volume moving from marine terminals to transload facilities by truck;
- A determination of:
    - percentage destined for local (Atlantic) markets;
    - percentage loaded on trucks destined for destinations outside Nova Scotia;
    - the percentage shipped by rail for “westbound” destinations, i.e. Quebec, Ontario, mid-west;
- Dwell time of product in transload facilities;
- Discussion of how changing trade flows have impacted on local import and export activities;
- Cost data for both the transportation of containers to and from terminals, as well as transload activity itself.

Marshall Macklin Monaghan and Atlantic Road & Traffic Management (2004). Railway Cut Investigation Study: Final Report, February, Halifax Regional Municipal Municipality.

DOI: NA

Abstract: The general increase in the percentage of truck traffic versus rail at the Port of Halifax was beginning to cause negative impacts in terms of noise and congestion in the downtown core. The report examined whether it is possible to use the rail corridor as a route for vehicular traffic as well as trains.

Key words: Not provided

Contribution to current research

This report was the first in a series of reports beginning in 2004 that examined ways to mitigate truck traffic in downtown Halifax. It provided estimates ranging between $40-$50 million for turning one side of the rail corridor into a vehicular corridor from Joseph Howe Drive to Ocean Terminals (Halterm). The Chebucto Road rail bridge replacement was estimated to cost another $18.5 million. It did not recommend building an elevated expressway above the CN line due to costs and community impacts, nor further exploration of building a ramp at the south end of Robie St., which would have removed trucks from downtown streets but put them in residential, hospital and university neighbourhoods. It was ultimately determined that one-way traffic in either direction was impractical.

MariNova Consulting Ltd., UMA Engineering, Colliers International, Starboard Alliance LLC, CBCL Engineering and Trampoline (2007). Building the container transload sector in Halifax, Prepared for the Greater Halifax Partnership, Retrieved from http://www.halifaxgateway.com/site-ghp2/media/HalifaxGateway/Transload_Final_Report.pdf, accessed on 16 January 2013.

DOI: NA

Abstract: NA

Key words: NA

Contribution to current research

The report provides background information on the transport market in Halifax and especially the competitive position of the port to attract additional TEUs. Though the report focuses on attracting additional cargo by building a transload centre, which might be less relevant for the current research, it also describes the market dynamics. Since the captive market of the port is relatively small in terms of population / consumers, the port is in direct competition with other east coast ports to service regions such as the US Midwest, Quebec and Ontario. Shippers and 3PLs will only select the Port of Halifax if this optimizes their total supply chain. Therefore it is important when taking measures that influence the efficiency of port trucking, that this is not just analyzed from the perspective of the terminal operators and the trucking companies, but also from the perspective of those parties who are responsible for port selection decisions.

MariNova Consulting Ltd. (2007). The use of containers in Canada. Transport Canada, Retrieved from http://www.tc.gc.ca/media/documents/policy/use_of_containers_in_canada_final_report_0.pdf, accessed on 16 January 2013.

Abstract: This report is the first phase of a two-phase study that describes container usage in Canada. As such, it describes the flow and use of containers and was commissioned to identify state of play, major issues and recommended areas for further study. Phase II will examine recommended solutions.

This report addresses the existing context, and provides a thorough understanding and description of container movements and logistics in Western Canada, in particular, as well as in Central Canada and the Atlantic Region. The study also provides several illustrations of best practices in similar situations in Canada and around the globe.

Key words: Not provided

Contribution to current research
The report describes the flow of containers throughout Canada, and the potential role for intermodal terminals across the country. It is relevant in the present context for its description of ‘domestic repositioned boxes” or DRPs and the fact that some regions are in deficit with respect to empty containers while others are in surplus.

McCormick Rankin Corporation, Canmac Economics Limited, O'Halloran Campbell Consultants Limited (2009). Integrated transportation corridor: Phase 1 feasibility study, Province of Nova Scotia, Retrieved from http://www.halifaxurbangreenway.org/pubdocs/ITCFinalReport.pdf, accessed on 16 January 2013.

DOI: NA

Abstract: It is the desire of the Government of Nova Scotia to play a strategic role in the Province's development as a major international gateway. As part of this intent, this study was commissioned to examine the feasibility of introducing a roadway into the CN rail corridor on the Peninsula of Halifax to provide a highly efficient, free-flow route for trucks serving Halterm and nearby port services: effectively consolidating truck and rail freight movement related to these facilities into one corridor.

Key words: Not provided

Contribution to current research

The report presents an overview of the main current (2009) road network congestion and bottlenecks on the Halifax Peninsula and the potential effects of the construction of an integrated transportation corridor that bypasses the city centre. The report also notes that shippers and carriers have assigned cost estimates to freight delays that range from $25 to $200 per hour. Hereby indicating the importance of an efficient and predictable transport system which prevents unexpected delays.

Meyer, Michael D. (2012). "Incorporating Greenhouse Gas Impacts into Transportation Decision Making," TR News, 281, July-August, Washington, DC: Transportation Research Board, pp. 22-23.

DOI: NA

Abstract: Not provided.

Key words: Not provided

Contribution to current research

This article provides a two-page synopsis of the Strategic Highway Research Program (SHRP-2) tool, TCAPP (Transportation for Communities: Advancing Projects Through Partnerships), for on-line decision support that incorporates GHG impacts into transportation planning activities. The GHG Analysis Framework provides a five-step process with associated questions that will guide action and assist multiple stakeholder groups reach useful and synergistic outcomes when integrating transit investments, land-use planning and bottleneck reductions with congestion pricing. We see the framework as a useful guidance tool for this project moving forward, and so have added the table explaining it to the main text of this report. The report references the TCAPP tool as available at: www.transportationforcommunities.com/shrpc01/ghg_application_kdps/26/0

SHRP-2 GHG Analysis Framework

Analysis Step	Key Questions
I. Determine information needs	1. Which stakeholders should be included in GHG strategy development and evaluation?
	2. What is the scope of GHG emissions analysis?
II. Define goals, measures and resources	3. Which goals objectives and policies relate to GHG reduction?
	4. Which GHG related evaluation criteria and metrics will be used?
	5. What are the baseline emissions for the region or study area?
	6. What is the goal or target for GHG reduction?
	7. How will GHG considerations affect funding availability and needs?
III. Define range of strategies for consideration	8. Which GHG reduction strategies should be considered?
	9. Are strategies and alternatives consistent with long-range plan or other relevant plans to meet GHG reduction objectives?
IV. Evaluate GHG benefits and impacts of candidate strategies	10. Which calculation methods and data sources will be used to evaluate the GHG impacts of projects and strategies?
	11. What are the emissions and other impacts of a particular project, strategy or design feature?
V. Select strategies and document overall GHG benefits and impacts of alternatives	12. Which GHG-reducing strategies should be part of the plan, program or project?
	13. What are the net emissions impacts for the plan, program, corridor or project alternatives considered, or for the alternative selected?

Morais, Phillipe and Lord, Elisabeth (2006). Terminal appointment system study, Transport Development Centre of Transport Canada, TP 14570E, Retrieved from http://www.tc.gc.ca/media/documents/policy/14570e.pdf, accessed on 16 January, 2013.

DOI: NA
Abstract: The study reviewed programs and strategies currently applied at North American ports to accelerate cargo handling at ports and terminals aimed at reducing congestion, gate idling time, and greenhouse gas emissions (GHG). The study found that automation technologies, extended gate hours, and gate appointment (reservation) systems can be effective in reducing the overall truck idling time at terminals and limit GHG emissions associated with terminal drayage activities. A quantitative method was developed to assess the impact of port technologies and appointment systems to reduce GHG emissions. The report proposes a strategy to improve port/terminal operation efficiency and reduce emissions at Canadian ports. A comprehensive Canadian strategy would include policies, programs, regulation, air quality mitigation programs, and infrastructure improvements.

Key words: Ports, terminals, containers, ITS, intelligent transportation systems, appointment systems, trucks, greenhouse gases, GHG, emissions, air quality, idling, queuing, congestion, Canadian applicability, reservation systems

Contribution to current research

This 2006 provides a large number of examples of initiatives taken by ports to increase terminal efficiency, especially in relation to port trucking. The table below provides an overview of a number of technologies used by ports / terminals.

Description	Terminal operation	Application
Optical Character Recognition	Equipment Identification and Security Enhancement	At portal and pedestal gates – automatically identify containers, truck plate and chassis number. Automated data capture at entry and exit gate to fully automate the gate process
		On quay crane, RTG and container handling equipment and rail portal gates – automatically identify containers
		On crane loading – automatically identify truck plate
Global Positioning System	Equipment and Container Localisation	In yard on container handling equipment – help localise mobile equipment and container (for stacking and yard inventory)
		On quay crane, and rail portal – help localise mobile equipment and container (for stowing and stacking)
Radio Frequency Identification Device (Tags)	Equipment Identification, Localisation and Security Enhancement	On container – electronic transmission of transaction data prior to truck arrival (at gate)
		At portal and pedestal gates – automatically identify container and truck
		In yard – automatically identify and track handling equipment, container and truck

Description	Terminal operation	Application
Radio Frequency Identification Device (Tags)	Container Localisation and Security Enhancement	On container – seal installed at origin and checked by reader at destination for any opening, closing or tampering with and can be monitored in real time, both in transit and in yard
Weigh-in-Motion Scale	Equipment Identification and Security Enhancement	At portal and pedestal gates – automatically weight, count and classify moving trucks (with or without chassis and containers) at specific location.
Closed-Circuit Television Camera	Equipment Identifi-cation and Security Enhancement	At portal and pedestal gates and in yard – monitoring traffic and terminal activities.
Variable Message Sign (VMS)	Traffic Control, Information (all types) and Security Enhancement	Before and at portal and pedestal gates – display real-time information (on traffic and terminal general situation)
Bar Code Readers and Mounted Data Collection Comp	Equipment Identification Security Enhancement and Data Collection	At gate, in yard on container handling equipment, on quay crane, rail portal and or mobile – identify container (for stacking and yard inventory)

Another technical innovation is the development of Port Community Information Systems (PCS). These are systems structured to facilitate end-to-end electronic information flow between trading partners, optimise the terminal/trucking interface and provide the members with a web-based low cost connectivity option relative via Electronic Data Interface (EDI). In some cases the Terminal Operating Systems (TOS) provide information to these PCS. The table below provides examples of PCS and TOS currently in use in North America.

Name	Description	Effectiveness
FIRST	Freight Information Real-Time System for Transport (FIRST) is an Internet-based, real-time network that intended to integrate many resources into a single, easy-to-use Web site on cargo and port information. This should have facilitated safe, efficient, secure, and seamless movement of freight through the Port of New York and New Jersey. To investigate the potential time saving benefits of adding an appointment system, a simulation model was constructed. At 100% use of the appointment system, the total in-terminal time across all trucks was 40,539 minutes/day, a 48% decrease compared to the 0% use scenario.	The system did not gain measurable levels of use over the course of deployment. The major concerns were that it had limited data and when the data was available, it was not always accurate and timely. Consequently: • Terminal operators had to answer additional inquiries via the Internet from trucking companies about data; • Truck drivers had to visit multiple websites to find all the information they needed; • Terminal operators and ocean carriers have begun to start their own Websites for their customers and are not going to send data to an outside source if they can do it in-house.

Name	Description	Effectiveness
Port of Montreal Extranet	An information exchange system developed by Transport Canada and the Port of Montreal. An extranet is defined as a virtual private network separated from the public Internet by a firewall and anticipated benefits are: • Less congestion at gates with fewer delays; • Reduction of paperwork; • Real-time container information; • Improved operational efficiencies through better visibility of container status; • Improved customer service; and • Better planning and decision-making capabilities for all stakeholders.	At the time the report was written, the system still had to be developed and implemented
Pacific Gateway Portal (PGP)	PGP is a non-profit company operated by the Port of Vancouver. PGP is a web-base port community information system for stakeholders and customers in the Vancouver area. It provides information on containers status, vessel activity, and real time video images from port landside infrastructure as well as driver validation. The web portal features a dangerous goods application and a truck appointment system available to registered users for a fee. The truck appointment/reservation system known as Container Terminal Scheduling System is operational for all three terminals within the port. The truckers with reservations are given specified hourly time slots. All trucks must be in line at the gate entrance at least 15 minutes before the expiration of their slot reservation. Trucks arriving late are shunted to the non-reserved gates or require new reservations. Motor carriers who overbook or fail to honour rules are denied access to the reservations system. Motor carriers who persistently abuse the system risk having their licence to operate at the port revoked.	The report mentions that the Container Terminal Scheduling System has enjoyed considerable success. It has by and large gained acceptance by the trucking community, because it is said to be easy to use, but most likely also because the terminals have dedicated lanes for trucks with appointments and all import container pick ups are required to have reservations.

Name	Description	Effectiveness
Synchro Met™	SynchroMet™ On-Line, the virtual container yard service provider for the Oakland Port Community (Public System). The Port Authority and SynchroNet Marine Inc have partnered to implement a congestion management tool to alleviate public road and port congestion at local marine terminals. Empty equipment (container) can be released through the virtual container yard (VCY) and matched in real-time with off-dock equipment needs to cover export bookings. SynchroMet™ provides Motor Carriers (trucks) and Ocean Carriers with the ability to: • Communicate street inventory or equipment needs; • Facilitate a street turn transaction with Ocean Carrier approval; • Generate an EIR (Equipment Interchange Receipt) and transfer liability for the equipment; • Access empty equipment direct from local ramps and depots (outside the terminal); • Automate the confirmation process via EDI.	No quantitative information is provided, but it is mentioned that SynchroMet™ reduces empty truck miles and waiting time at local marine terminals; having a positive impact economically and on the local environment.
SEA LINK®	SEA LINK® provides trucking companies serving the Port of New York and New Jersey (PNYNJ) a central database to register their companies and their truck drivers. The database is linked to the Port Authority's uniform truck driver identification system, which requires a single identification card for calls at any of the marine terminal in PNYNJ. SEA LINK uses ACES, the port's Automated Cargo Expediting System, to transmit information about the drivers to terminal operators.	No quantitative data on effectiveness is provided, but it is stated that drivers save time to enter the terminals.

Name	Description	Effectiveness
Terminal Operating Systems (TOS)	Examples of TOS in use: • Navis (Yard Management); • COSMOS (Yard Management, Gate Control and Container Tracking); • Embarcadero (ESC) (Yard Management, Gate Control and Appointment System)	No quantitative data on effectiveness is provided, but it is concluded terminals would not invest in these types of systems if they did not improve efficiency. The terminals in the Port of Halifax use COSMOS.

The report presents a number of case studies of ports of measures that ports have taken to improve productivity and reduce turn around times and congestion problems.

The key findings regarding the measures implemented in both US and Canadian west coast ports to reduce congestion, decrease emissions and increase productivity can be summarized as follows:

- Regulation and Legislation
- Terminal Appointment System
- Extended Gate Hours:
- Innovative Technology, Automation and Equipment:

Morgul, Ender Faruk; Ozbay, Kaan; Iyer, Shrisan; Holguín-Veras, Jose (2013). Commercial vehicle travel time estimation in urban networks using GPS data from multiple sources (#13-4439), Presented at the 92nd Transportation Research Board Annual Meeting, January 2013, Washington, DC.

DOI: NA

Abstract: Realistic travel time estimation for urban commercial vehicle movements is challenging due to limited observed data, large number of Origin-Destination (OD) pairs, and high variability of travel times due to congestion. Moreover most traditional data collection methods can only provide information in an aggregated form which is not sufficient for micro-level analysis. On the other hand, the usage of Global Positioning Systems (GPS) data for traffic monitoring and planning has been continuously growing with significant technological advances in the last two decades.

In this paper we provide a comprehensive review of the current usage of GPS data in transportation planning applications and present a practical integrated methodology for using a robust source of GPS data, for commercial vehicle travel time prediction. A comparison with observed truck travel times collected from a limited source of truck-GPS data reveals that travel times obtained from taxi-GPS data approximate those of trucks, and can be used to supplement truck-GPS travel time data on a wider scale. While the amount of truck-GPS data is limited to a small number of trucks serving very few OD pairs, taxi-GPS provide citywide penetration and can estimate travel times between most OD pairs in a city. The provided methodology leads to simple and effective travel time estimations using taxi-GPS data without a need for an extra data collection effort.

Key words: Not provided

Contribution to current research

Should future research fund the collection of GPS data from trucking, this research demonstrates that the use of taxi GPS to supplement truck GPS can be used to gain a richer appreciation of congestion and bottlenecks in urban corridors as the volume of data is higher and acts as a good supplement to the trucking data. The research explains how to integrate different data systems to identify challenges facing trucks and their use in urban corridors. It could be useful in the Vancouver and Montreal cases if not useful in Halifax.

Namboothiri, Rajeev and Erera, Alan L. (2008). Planning local container drayage operations given a port access appointment system, Transportation Research Part E, 44, pp. 185–202.

DOI: 10.1016/j.tre.2007.07.004

Abstract: This paper studies the management of a fleet of trucks providing container pickup and delivery service (drayage) to a port with an appointment-based access control system. Responding to growing access congestion and its resultant impacts, many US port terminals have implemented appointment systems, but little is known about the potential impact of such systems on drayage fleet efficiency. To address this knowledge gap, we develop a drayage operations planning approach based on an integer programming heuristic that explicitly models a port access control system. The approach determines pickup and delivery sequences for daily drayage operations with minimum transportation cost. We use the framework to develop an understanding of the potential productivity impacts of access control systems on drayage firms. Most importantly, we find that it is critical for terminal operators to provide enough access capacity for drayage, since vehicle productivity can be increased by 10–24% when total access capacity is increased by 30%. Furthermore, poor (but not unreasonable) selection of access appointment time slots by drayage firms may result in substantial customer service deficiencies, reducing the number of customers that can be served by up to 4% for a fixed level of total access capacity.

Key words: Drayage; Pickup and delivery

Contribution to this research

The paper discusses what effects an appointment system could have on the productivity of port trucking operations. The simulations show that the productivity of port trucking firms serving many daily requests can be significantly impacted by relatively minor changes in the characteristics of the allowable port accesses. Simulations results show that:

- It is critical that terminal operators provide drayage firms with enough access capacity. Results show that vehicle productivity can be increased by 10–24% when total access capacity is increased by 30%.
- Drayage firms must make good port appointment selections in order to maintain high levels of customer service; differences between the best and worst selections for a capacity distribution resulted in decreases in number of customers served by up to 4% for a fixed level of total access capacity.
- The duration of the appointment windows also may affect the ability of drayage firms to provide high levels of customer service. Test results indicate that up to 4% additional total [slot] capacity may be needed to maintain the same level of customer service if the slot duration is reduced by half.

The paper shows the effect that terminal operators can have on port trucking productivity and stresses that operators need to carefully consider such productivity impacts when designing a port access system. Further, drayage companies operating under such a system should seriously consider using a decision support system, as the impacts can be complex.

Sharif, Omor, Huynh, Nathan and Vidal, Jose, M. (2011). Application of El Farol model for managing marine terminal gate congestion, Research in Transportation Economics, 32, pp. 81–89.

DOI: 10.1016/j.retrec.2011.06.004

Abstract: Truck queuing at marine terminal gates has long been recognized as a source of emissions problem due to the large number of trucks idling. For this reason, there is a great deal of interest among the different stakeholders to lessen the severity of the problem. An approach being experimented by some terminals to reduce truck queuing at the terminal is to provide live views of their gates via webcams. An assumption made by the terminals in this method is that truck dispatchers and drivers will make rational decisions regarding their departure times such that there will be less fluctuations in truck arrivals at the terminal based on the live information. However, it is clear that if dispatchers send trucks to the terminal whenever the truck queues are short and not send trucks when the truck queues are long, it could lead to a perpetual whip lash effect. This study explores the predictive strategies that need to be made by the various dispatchers to achieve the desired effects (i.e. steady arrival of trucks and hence less queuing at the seaport terminal gates). This problem is studied with the use of an agent-based simulation model and the solution to the well known El Farol Bar problem. Results demonstrate that truck depots can manage (without any collaboration with one another) to minimize congestion at seaport terminal gates by using the provided real-time gate congestion information and some simple logics for estimating the expected truck wait time.

Key words: Drayage operations, Truck queuing, Terminal webcams, Multi-agent systems Simulation, El Farol bar problem

Contribution to this research

The authors of the paper argue that port trucking companies can effectively and successfully minimize truck wait time at the terminal gate by adopting an approach that they developed. This methodology results in a distribution of the gate arrivals more uniformly over the operational hours. Port trucking companies do not have to collaborate with one another nor with the terminals, but the approach is depended on the provided real-time gate congestion information. If this were to be a realistic approach, this would reduce the need for the development of appointment systems or other technology investments. However, the approach requires the port trucking companies to have a pool of 200 predictive strategies with each company employing 12 predictors. The companies will have to use different strategies and must not share identical set of predictors. This makes the approach highly theoretical and unlikely to be implemented. The results do, unintentional, point out that an appointment system could improve efficiency, as a better spread of truck arrivals at terminal gates is expected to reduce the waiting times.

Tioga Group (2011). Truck drayage productivity guide. Retrieved from http://onlinepubs.trb.org/onlinepubs/ncfrp/ncfrp_rpt_011.pdf, accessed on 12 January 2013.

DOI: NA

Abstract: Truck drayage is an integral part of the intermodal freight transportation system. The most visible drayage sector is at seaports, where dray drivers spend a considerable amount of time waiting to enter marine terminals and then often operate in non-productive ways while inside the terminal gate. This leads to increased truck idling, resulting in air pollution and congestion on the roads leading into terminals. Diesel emissions from idling trucks are a serious health concern for communities adjacent to seaports, especially deepwater ports.

Key words: Not provided

Contribution to current research

The report provides over 100 pages of information on drayage processes in the U.S. The insights the report presents into the problems, impacts, solutions and role of the different stakeholders are especially relevant to the current research. This report used webcam data and truck driver surveys to assess gate and terminal management issues and provides a suitable study methodology for future work. The study examines detailed congestion flow and truck turnaround times and identifies key gate problems, ranging from inexperienced drivers through to improper document management and identifies the impacts on gate processing systems. The documented majority of truck turnaround times in the report, however, range from 30-40 minutes, but have a very long statistical tail (when 'things go wrong', and increase exponentially once the number of trucks in a day passes a threshold of 1100. Also interesting is the identification of 2.5 truck moves for every full truck move, indicating a significant volume of empty moves.

Possible solutions presented in the report include

- Better use of port and terminal information systems to ensure that import containers are ready to be picked up;
- Two-stage terminal entry gates (or equivalent capabilities) to segregate and handle exceptions without delaying routine transactions;
- Appointment systems that can make terminal transactions more predictable and reduce gate and container yard congestion;
- Extended gate hours, where required, to reduce and accommodate peaking;
- Better driver and drayage firm information and training;
- Importer and exporter preference for experienced drayage firms that understand and use the available productivity tools;
- Rationalization of empty container and chassis return requirements;
- Wider use of OCR, RFID, and other technologies to automate, streamline, and routinize terminal gate processing;
- Elimination of gate closures for lunch or other breaks;
- Improved accuracy of exporter booking instructions and documentation;

- Correction of terminal systems “glitches” that lead to trouble tickets or dysfunctional work-arounds;
- Regular meetings and other communication within the port community, including port staff, terminal operators, drayage firms, ocean carriers, customers, and other stakeholders as required;
- Sufficient terminal resources and capabilities to simultaneously serve vessels and trucks;
- Customer preferences for ocean carriers with good drayage transaction records;
- Reduction in port-area and urban street and highway congestion;
- Improvements to legacy marine terminals;
- A number of improvements to the marine chassis logistics (specific to the U.S. situation)

Van der Horst, Martijn R. and Van der Lugt, Larissa, M. (2011). Coordination mechanisms in improving hinterland accessibility: Empirical analysis in the Port of Rotterdam. Maritime Policy and Management, 38(4), 415 – 435.

DOI: 10.1080/03088839.2011.588257

Abstract: Hinterland accessibility is one of the main determinants in port competition. Improving hinterland accessibility is a complex process in which many actors are involved and many factors play a role. It requires coordination mechanisms beyond the price mechanism; conditions of complexity can become such that assistance is needed from other coordination mechanisms, such as introduction of incentives, creation of an interfirm alliance, changing scope, and creating collective action. The goal of this paper is to gain a better understanding on coordination in hinterland chains. Based on the insights of Transaction Cost Economics, a set of variables is explicated in order to understand when, by whom, and under which conditions and situations coordination arrangements are chosen. The variables can be divided into variables related to the complexity of the coordination problem and variables related to the coordination arrangement. The variables are used in an empirical analysis of coordination arrangements in hinterland transport from and to the Port of Rotterdam. This analysis provides insight into the patterns and conditions of the emergence of different coordination arrangements that improve hinterland accessibility.

Key words: Not provided

Contribution to this research

The paper provides information on the different levels of coordination in the Port of Rotterdam and examples are included relating to port trucking. These example show that the Rotterdam Port Authority takes an active approach to ensure efficiency of the hinterland connections. Examples are:

- The Traffic Management Company initiated by the Rotterdam Port Authority in 2008. The purpose of which is to reduce traffic on the main road (A15) to and from the port during rush hours. The PoR acted in close cooperation with the national branch organizations of shippers, the branch organizations of all logistical and industrial companies in the port, the Chamber of Commerce, the Province, and municipalities;
- The development of a road-barge transload centre, just outside the port area, where trucks can deliver their containers. The final 50km are executed by barge, thus reducing truck movements on highway A15.

Zhao, Wenjuan and Goodchild, Anne V. (2010) The impact of truck arrival information on container terminal rehandling, Transportation Research Part E, 46, pp. 327–343.

DOI: 10.1016/j.tre.2009.11.007

Abstract: This paper uses simulation to evaluate the use of truck arrival information to reduce container rehandles during the import container retrieval process by improving terminal operations. A variety of scenarios with different levels of truck information and various container bay configurations are modeled to explore how the information quality and bay configuration affect the magnitude of benefit. The results demonstrate that a complete arrival sequence is not required to substantially reduce rehandles, significant benefit can be obtained under small amounts of information, the benefits grow with the bay size, and that updating information in real time significantly lowers information requirements.

Key words: Container terminal; Container rehandle; Truck arrival sequence; Heuristic algorithm

Contribution to this research

The simulations in the paper show that terminal operators can benefit from gaining more information on port truck arrivals. Significant reductions in rehandles can be obtained with small improvements in terminal information regarding truck arrivals. Terminals with taller stacks and larger number of rows can especially obtain significant rehandle reductions, according to the simulations. Technology investments such as equipping trucks with GPS units to keep track of truck location in real time are not necessarily required to obtain this truck information. Gate appointment systems could be a good source for providing information about truck arrival time windows, but phone calls from approaching trucks could also be sufficient. This requires cooperation, and collaboration between the terminal and trucking operation. This could be an important argument to convince terminal operators to more actively develop effective, and accepted by the port trucking companies, terminal appointment systems.

Zhao, Wenjuan and Goodchild, Anne V. (2011). Truck travel time reliability and prediction in a port drayage network. Maritime Economics & Logistics, 13, pp. 387–418.

DOI: 10.1057/mel.2011.24

Abstract: Port drayage is an important component of the marine intermodal system and affects the efficiency of the intermodal supply chain. Sharing and utilizing drayage truck arrival information could improve both port drayage and port operational efficiency. To assess the feasibility of truck arrival time predictions, this research explores how reliable the port drayage network is. First, two reliability measures are used to evaluate how the travel time reliability changes with trip origins and across drayage networks. Then, the truck routing choices between Origin-Destination (OD) pairs are examined. Last, a simple method is proposed to predict the 95 per cent confidence interval of travel time between any OD pair and is validated with GPS data. The research results demonstrate that the proposed travel time prediction method is sufficient for predicting truck arrival time windows at the terminal and can be translated into truck arrival group information. It is therefore sufficient to support the implementation of a previously proposed container-handling strategy and to improve the efficiency of the drayage truck/container terminal interface.

Key words: port drayage network; travel time reliability; travel time prediction

Contribution to current research
Should research into travel time variability be conducted in the Halifax context using GPS data, this paper will be valuable in informing the study design.

Appendix 4: Abstracts of Articles Deemed Not Relevant or Supplying No New Knowledge

ADI Limited (2006) Final Report Canada East Inland Port – A Feasibility Study Atlantic Institute of Logistics and Transportation, November.

Abstract: This study envisioned the development of the Canada East Inland Port adjacent to Greater Moncton International Airport. It focused on export industries which could ship by air or container. It suggested that entry processing of marine containers for distribution in Atlantic Canada, for onward shipment to central Canada or New England could take place at such a facility. Cargo would be trucked or railed to Moncton from Halifax, and then trucked or railed to central Canada and New England. Long Combination Vehicles (LCVs) could be assembled at the facility as well.

Andrew, Robbie and Forgie, Vicky (2008). A three-perspective view of greenhouse gas emission responsibilities in New Zealand, Ecological Economics, 68 (1–2), pp. 194–204.

DOI: 10.1016/j.ecolecon.2008.02.016.

Abstract: While responsibility for the environmental impacts of production has been commonly assigned to producers, production is driven by consumer demand, and it is valid to question whether impacts should instead be assigned to consumers. However, in each of these approaches producers and consumers either bear the full burden of responsibility or none at all. An example of this is the Kyoto Protocol, where all greenhouse gas emissions are assigned to the producer and no consideration is given to where goods are finally consumed. Rather than taking the conventional producer or consumer responsibility approach, a third perspective is possible in which responsibility is shared. We use input–output analysis to apply all three of these responsibility perspectives to New Zealand's domestic greenhouse gas emissions. Our main findings from the shared responsibility approach are that New Zealand producers are responsible for 44% of domestic emissions, New Zealand consumers take 28%, and 27% are exported. A shared responsibility approach appears to distribute the burden of responsibility and associated liability between parties more fairly, and is likely to be more widely acceptable than pure producer or consumer perspectives.

Key words: Producer responsibility, Consumer responsibility, Shared responsibility, Contribution analysis, Input–output analysis

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Bode, Sven (2006), Long-term greenhouse gas emission reductions—what's possible, what's necessary?, Energy Policy, 34 (9), pp. 971–974.

DOI: 10.1016/j.enpol.2004.08.053.

Abstract: Climate is changing (WMO, Press release No. 695, 2003) and there is increasing evidence that this is due to human activity (IPCC, Climate Change 2001—The Scientific Basis, Cambridge University Press, Cambridge, 2001). One way to react is to reduce greenhouse gas emissions into the atmosphere. Although this approach generally does not cause much objection, disagreements do occur when concrete emission targets are to be set. Against this background, the following article provides an arithmetic approach for the determination of long-term emission targets where the US and the EU are studied as examples.

Key words: Emission reductions, GHG emission intensity, Economic growth

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California Air Resources Board (2013). Verification Procedure - Currently Verified. Retrieved from http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm, accessed on 12 January 2013.

DOI: NA

Abstract: The following information is provided as a summary of verified diesel emission control strategies. Additional requirements specific to engine compatibility are provided in the Executive Order. The factors outlined in the Executive Order are legal requirements of each verification; therefore, these conditions must be met before determining if a particular device is applicable to the end-users type of engine. The Air Resources Board recommends that you contact the manufacturer, or their authorized distributor, prior to making any purchasing decision. Please click on the manufacturer link for additional information.

Key words: Not provided

Cao, Jinxin, Shi, Qixin, Der-Horng Lee (2008). A Decision Support Method for Truck Scheduling and Storage Allocation Problem at Container, Tsinghua Science and Technology, 13(S1), pp. 211–216.

Abstract: Truck scheduling and storage allocation, as two separate subproblems in port operations, have been deeply studied in past decades. However, from the operational point of view, they are highly interdependent. Storage allocation for import containers has to balance the travel time and queuing time of each container in yard. This paper proposed an integer programming model handling these two problems as a whole. The objective of this model is to reduce congestion and waiting time of container trucks in the terminal so as to decrease the makespan of discharging containers. Due to the inherent complexity of the problem, a genetic algorithm and a greedy heuristic algorithm are designed to attain near

optimal solutions. It shows that the heuristic algorithm can achieve the optimal solution for small-scale problems. The solutions of small- and large-scale problems obtained from the heuristic algorithm are better than those from the genetic algorithm.

Key words: container terminal, vehicle scheduling, genetic algorithms, heuristic algorithm

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Cao, Jinxin, Shi, Qixin, Der-Horng Lee (2010). Integrated Quay Crane and Yard Truck Schedule Problem in Container Terminals, Tsinghua Science and Technology, 15(4), pp. 467–474.

Abstract: Quay crane and yard truck scheduling are two important subproblems in container terminal operations which have been studied separately in previous research. This paper proposes a new problem for the integrated quay crane and yard truck scheduling for inbound containers. The problem is formulated as a mixed integer programming (MIP) model. Due to the intractability, a genetic algorithm (GA) and a modified Johnson's Rule-based heuristic algorithm (MJRHA) are used for the problem solution. In addition, two closed form lower bounds are given to evaluate the solution accuracy. Computational experiments show that the solution algorithm can efficiently handle the scheduling problem and that the integrated methods are very useful.

Key words: container terminal, scheduling, mixed integer programming, heuristic algorithm

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Chen, Lu, Langevin, André and Lu, Zhiqiang (2013). Integrated scheduling of crane handling and truck transportation in a maritime container terminal, European Journal of Operational Research, 225, pp. 142–152.

DOI: 10.1016/j.ejor.2012.09.019

Abstract: This paper studies the interactions between crane handling and truck transportation in a maritime container terminal by addressing them simultaneously. Yard trucks are shared among different ships, which helps to reduce empty truck trips in the terminal area. The problem is formulated as a constraint programming model and a three-stage algorithm is developed. At the first stage, crane schedules are generated by a heuristic method. At the second stage, the multiple-truck routing problem is solved based on the precedence relations of the transportation tasks derived from the first stage. At the last stage a complete solution is constructed by using a disjunctive graph. The three procedures are linked by an iterative structure, which facilitates the search for a good solution. The computational results indicate that the three-stage algorithm is effective for finding high-quality solutions and can efficiently solve large problems.

Key words: Scheduling, Container terminal, Container handling, Constraint programming, Disjunctive graph

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Cheon, SangHyun and Deakin, Elizabeth (2010). Supply chain coordination for port sustainability, Transportation Research Record, 2166, pp. 10–19.

DOI: 10.3141/2166-02

Abstract: The rapid expansion of trade and the intense pace of the economic activities of ports pose numerous social and environmental challenges, and thus put port hinterland regions at risk and challenge traditional port business models. Few studies have examined the conceptual and empirical issues involved in improving port sustainability, although port sustainability issues have recently been discussed with some urgency in the goods movement sector. This paper sets out a conceptual model of port sustainability, presents and examines multiple concepts of supply chains surrounding port activity, and identifies both institutional barriers and supply chain bottlenecks. Three different supply chain concepts for seaports are discussed: physical infrastructure chain, economic value chain, and institutional chain. Rather than a narrow focus on an individual port's operational aspects, broader, more systematic supply chain perspectives on cargo movement systems are essential to introduce port sustainability effectively to current U.S. port business practices. Actions are needed, not just from port authorities, but also from other stakeholders, including government, industries, and community groups. Coordinated activities and collaboration would significantly facilitate the implementation of sustainable models of seaport businesses and cargo movement services.

Key words: Not provided

Contribution to current research
This article focuses on port sustainability from a supply chain perspective and identifies both institutional barriers and supply chain bottlenecks. It is not clear from the abstract if the article explicitly deals with port trucking issues, but it does raise the interesting notion that government policies can prevent efficient / sustainable operations in ports.

Chris Lowe Group (2007). Atlantic gateway strategy opportunity assessment, Municipality of East Hants Milford Nova Scotia.

DOI: NA

Abstract:

Key words: Not provided

Contribution to current research
This report prepared for Municipality of East Hants makes the case that this municipality would be a good location for an inland port / integrated intermodal logistics centre. It states that an inland port could be a tool to reduce truck traffic on the Halifax Peninsula. No quantification of the potential impact of an inland port on port trucking in Halifax is provided. The reported is not deemed relevant at this stage.

De Langen, Peter W. and Kymlicka, Stephen (2007). Everybody wins: why growing the Port of Halifax matters to Moncton (and Saint John, Amherst, Bangor...), Atlantic Institute for Market Studies, retrieved from http://www.aims.ca/site/media/aims/EverybodyWins.pdf, accessed on 16 January 2013.

DOI: NA

Abstract: (summary) This report looks at the Port of Halifax and tries to understand the structure of its cluster. Specifically it looks at the direct and support services for transportation providers. It also looks at associated port-led industry, warehousing and distribution. While industry surrounding the Port of Halifax participates in all of these areas, it participates less than expectations derived from port container volume. However, by analyzing the catchments area for the port, a more balanced picture emerges.
The major finding of the report is that the major beneficiaries of the port are not localized in Halifax, but dispersed through the region as suppliers, consumers, transportation providers and regional distribution hubs. Not all supporting industries are equally concentrated however and the port would likely benefit from a stronger warehousing and distribution base. Market forces may be addressing any shortfalls as seen in recent investments in the port, transload facilities and corridor infrastructure. These investments provide additional reasons for regional integration in the port cluster. The success of the Port of Halifax and the region are tied in a virtuous circle; when one wins, we all win.

Key words: Not provided

Frost, James D. (2010), The "Close" Dry Port Concept and the Canadian Context, Proceedings of the Canadian Transportation Research Forum, pp. 199–213.

Abstract: A dry port is defined as "an inland intermodal terminal directly connected to a seaport, with high capacity traffic modes, where customers can leave/collect their goods in intermodal loading units, as if directly at the seaport". There are three types of dry ports: "distant" dry ports, "mid-range" dry ports and "close" dry ports. The issue of "dry ports" or inland terminals has been considered in Nova Scotia, New Brunswick, B.C., and on the Prairies. This paper considers several examples in North America and Europe and suggest their applicability in the Canadian context. The issue is important from a "sustainability" or "social license" standpoint, in terms of container movements within congested urban areas. They also have the potential to provide efficient a means for coastal ports to extend their markets inland.

Frost, James D. and Kymlicka, Stephen (2007). Reaching out: Transload extends the accessible market in Halifax. Atlantic Institute for Market Studies, Retrieved from http://www.aims.ca/site/media/aims/ReachingOut.pdf, accessed on 16 January 2013.

DOI: NA

Abstract: This report takes an in-depth look at the state of warehousing and distribution in Halifax. It then discusses the strengths and weaknesses of a generic transload strategy and the potential application of such a strategy to the conditions in Halifax. The report concludes that the strategy makes a great deal of sense for Halifax. In fact, the potential growth could be 25 per cent; however, the exact size of the opportunity will depend on individual market forces across a broad range of industries.

Key words: Not provided.

Ehrler, Verena and Wolfermann, Axel (2012). Traffic at intermodal logistic hubs: Shedding light on the blind spot, Transportation Research Record, 2288, pp. 1–8.

DOI: 10.3141/2288-01

Abstract: Intermodal logistic hubs attract significant amounts of different types of traffic. Trucks deliver and pick up goods, containers are moved, service and heavy vehicles pass through, and sometimes public roads cross the site. The organic growth of these facilities and the multitude of involved parties frequently result in inefficient and insufficient traffic infrastructure, unnecessary negative environmental impacts, and high costs for stakeholders. For the optimization of infrastructure and the operation of these hubs, many factors need to be known, but often are not. These factors include the requirements of the stakeholders, service times at facilities, origins and destinations of vehicles, and routes and speeds of vehicles. This paper scrutinizes the issues, with the Port of Hamburg, Germany, as an example. The focus is the methodology used to analyze the traffic on this intermodal logistic hub, which covers an area of 43 km^2. More than 120,000 vehicles enter and leave the hub every day. Expert and street side interviews, vehicle tracking, and screen-line traffic counts were combined to answer questions on bottlenecks, emission black spots, and viability of electric vehicles. This combination of traditional and modern survey techniques provides a wealth of information, which allows for improved processes and procedures that lead to increased turnover of goods within the given infrastructure and fewer negative impacts. The paper is particularly relevant to intermodal logistic hubs in Europe, which often have organically grown structures, unlike U.S. hubs, which have more restrictive access.

Key words: Not provided

Contribution to current research

The abstract suggests that the paper focuses on the methodology used by the Port of Hamburg to analyze the traffic to and from this intermodal logistic hub. This methodology could include an overview of the factors that need to be known to optimize the traffic flows to

and from the port. This methodology (or parts thereof) could potentially be used to assess what factors should be taken into account when optimizing traffic flows to and from the Port of Halifax. Given the depth of the research provided by Tioga Group (2011), we see little additional contribution from this article, although it might provide value should a detailed flow study be of interest.

Goodchild, Anne, Globerman, Steve and Albrecht, Susan (2008). Service time variability at Blaine, Washington, border crossing and impact on regional supply chains, Transportation Research Record, 2066, pp. 71–78.

DOI: 10.3141/2066-08

Abstract: Variable service times at vehicle processing facilities (borders, weigh stations, landside marine port gates) cause transportation planning challenges for companies that regularly visit them. Companies must either build more time into their schedules than is necessary, and therefore underutilize their equipment, or risk missing delivery windows or exceeding hours of service regulations, actions that can result in fines, lost business opportunities, or other logistical costs. Border crossing times are examined at Blaine, Washington, between Whatcom County, Washington, and the Lower Mainland of British Columbia, Canada, to assess the variability in crossing times at this border crossing and the impact of this variability on regional supply chains. Variability data collected for bidirectional trade are presented. Directional, daily, hourly, and seasonal variations are examined, and interviews are conducted with regional carriers to better understand the current response to variability, the benefit of a reduction in variability, and how that is related to the goods moved or to other business operating characteristics. This paper describes the level of variability in border crossing times and carriers' responses to this variability and shows that the primary strategy used, increasing buffer times, reduces carrier productivity. However, this cost is negligible because of the current nature of the industry.

Key words: Not provided

Contribution to current research

Though the article focuses on the effects of variability in service times at border crossings the conclusions could also be relevant for port trucking operations. Especially the conclusion that applying increased buffer times by trucking companies to overcome variable service times results in negligible costs is interesting. If this would also apply for the drayage sector in Halifax, this would mean that there is little financial incentive for drayage companies to increase efficiency at the terminals (it sounds counterintuitive and is a different conclusion than drawn in previously discussed articles). Given the depth of the research provided by Tioga Group (2011), we see little additional contribution from this article.

Guan, Chang Qian and Liu, Rongfang (2009). Modeling gate congestion of marine container terminals, truck waiting cost, and optimization, Transportation Research Record, 2100, pp. 58–67.

DOI: 10.3141/2100-07

Abstract: As a consequence of the continuing growth of container volume and the introduction of 13,000 containerships carrying 20-ft-equivalent-unit (TEU) containers into major trade routes, the port industry is under pressure to come up with the necessary capacity to accommodate the increasing freight volume. One critical issue is the gate capacity of marine container terminals. Limited gate capacity leads to congestion. The harbor trucking industry operates in a competitive environment, and gate congestion is detrimental to its economic well-being. This paper applies a multiserver queuing model to analyze gate congestion and to quantify the truck waiting cost. An optimization model was developed to minimize the total gate system cost with data from field observations. A case study was applied to analyze gate congestion behavior and the truck waiting cost. The sensitivity of the model is discussed. With optimization, the truck waiting cost can be drastically reduced. Several congestion mitigation alternatives can be derived from the optimization model; the use of a truck appointment system seems to be the most viable way to reduce gate congestion and increase system efficiency.

Key words: Not provided

Contribution to current research
The abstract suggests that the article provides valuable information regarding the financial impacts of truck queuing at terminals on the trucking companies. It also looks at congestion behavior, presumably of truck drivers. Apart from describing the problems, the article also provides mitigation alternatives and evaluates these.

Huynh, Nathan (2009). Reducing truck turn times at marine terminals with appointment scheduling, Transportation Research Record, 2100, pp. 47–57.

DOI: 10.3141/2100-06

Abstract: This paper addresses a critical component of truck appointment systems: scheduling rules. The goal of this study is to gain an understanding of how the various scheduling rules affect resource utilization and truck turn time in grounded operations. Such an understanding could influence terminal operators and appointment service providers to make changes to their current scheduling practice. To this end, this study seeks to develop a framework for the evaluation of (a) the performance of various simple appointment-scheduling rules under a variety of operating scenarios and (b) the major factors affecting the performance of scheduling rules. This study considers two types of appointment-scheduling strategies that were adopted from the health care sector: (a) individual appointment systems (IASs) and (b) block appointment systems. To determine the effectiveness of the scheduling strategy, this study relies on a simulation model of a container terminal. Simulation is used because it provides a more realistic representation of the complex operations at terminals. In addition, it circumvents the restrictive assumptions of

analytical methods. The simulation model developed was constructed with the Flexsim CT discrete event simulation software, the first commercially available off-the-shelf simulation tool for container terminals. The experimental results show a clear benefit for a terminal without an appointment system to use the IAS. Such a scheduling system keeps the yard cranes highly utilized, and it improves the internal yard turn time by about 44%. With the proper spacing between appointments, the IAS can be effective even when a good portion of trucks are walk-ins, no-shows, or late (up to 1 h).

Key words: Not provided

Contribution to current research

This research is a subset of the research reported in Tioga Group (2011). See Appendix 3.

Huynh, Nathan, Harder, Frank, Smith, Daniel, Sharif, Omor and Pham, Quyen (2011). Truck delays at seaports: Assessment using terminal webcams. Transportation Research Record, 2222, pp. 54–62.

DOI: 10.3141/2222-07

Abstract: Truck queuing at marine terminal gates has long been recognized as a source of emissions problems because of the many trucks that are idling. For this reason, stakeholders have a great interest in lessening the severity of the problem. Most past studies that gathered truck-related data at marine terminal gates were done with field-based observations. With an increasing number of terminals offering live views of their gates with webcams as a means of managing demand for the terminals, these webcams can be used to gather much needed truck queuing information and other truck-related data. Webcams were used to observe truck queuing patterns and to analyze truck processing time, truck interarrival time, and truck queuing time at the entry gate of marine terminal to understand better the underlying reasons behind truck queuing. The data obtained from webcams were comparable to those collected during field observations: the identified best-fit distributions corresponded to the best-fit distributions reported in previous studies. From the gathered data, the reasons for truck queuing at marine terminal gates, aside from the gate capacity issue, included the drayage drivers' desire to make their first move at the beginning of the day to allow more time for subsequent moves later in the day, terminals' policy to close for lunch, trouble transactions, variability in truck arrivals at the terminal throughout the day and week, and inclement weather.

Key words: Not provided

Contribution to current research

This research is a subset of the research reported in Tioga Group (2011). See Appendix 3.

Huynh, Nathan and Hutson, Nathan (2008). Mining the sources of delay for dray trucks at container terminals, Transportation Research Record, 2066, pp. 41–49.

DOI: 10.3141/2066-05

Abstract: To isolate the causes of abnormally high truck turn time, this paper develops a methodology for examining the sources of delay for dray trucks at container terminals. It is motivated by the need of port authorities and terminal operators to develop specialized solutions to reduce turn time based on terminal-specific causes. Although many ports have taken steps to improve the general level of service for trucks, such as establishing chassis pools and extending gate hours, fewer have performed the transaction-level analysis required to determine why a certain subset of operations is significantly higher than the average, thereby hindering the overall level of service. After problematic steps in the truck transaction process are isolated, terminals can select and deploy a range of technological or organizational countermeasures to address the problem. This study draws on a database of truck activity from the Port of Houston, Texas. Because of the large number of gate transactions and potential factors that could contribute to high truck turn time, a data mining technique is used. Specifically, a decision tree technique is explored and described in this paper. Results indicate that import transactions that require chassis tend to have high truck turn time because truckers need to find a matching chassis. This paper demonstrates how decision trees can be used by port authorities and terminal operators to gain insight into their operations without the need to perform exhaustive data analysis.

Key words: Not provided

Contribution to current research:
In the abstract it is indicated that the paper presents a methodology for examining the sources of delay for dray trucks at container terminals. It also suggests that this methodology would allow terminal operators to gain insight into the [trucking] operations [in their terminals] without the need to perform exhaustive data analysis. This could potentially increase the efficiency of the current research in case there is a lack of sufficient data on port trucking operations in Halifax.

Huynh, Nathan and Zumerchik, John (2010). Analysis of stacking priority rules to improve drayage operations using existing and emerging technologies, Transportation Research Record, 2162, pp. 1–8.

DOI: 10.3141/2162-01

Abstract: Of the many emerging technologies being developed to expedite the flow of cargo through intermodal facilities, automated transfer management systems (ATMSs) have the potential to improve trucks' in-terminal dwell times significantly while the trucks are performing outbound or inbound moves. This paper presents a framework for integrating existing technologies (e.g., intelligent transportation systems, e-business systems) and emerging technologies (e.g., ATMSs) and using this framework to shorten the time for a

drayage truck to pick up an import container. Shortening this time is of critical importance in reducing engine idling time and stop-and-go lugging time. Reduced truck idling translates directly into reduced diesel emissions, including emission of fine particulate matter, nitrogen oxides, and greenhouse gases. This paper specifically investigates the effect of priority rules for stacking containers into the ATMS to improve port drayage operations. The analysis of priority rules is made on the basis of a computer simulation model developed for this study, and the analysis of emissions reduction is based on the U.S. Environmental Protection Agency's SmartWay DrayFLEET model. The obtained results confirm the hypothesis that the earliest arrival time priority rule yields better drayage performance than the closest appointment time priority rule.

Key words: Not provided

Contribution to current research
The abstract suggests that the article provides an explanation of different technologies that could assist in increasing the efficiency in port trucking / drayage operations. The mentioned conclusion indicate that part of the article focuses on the best terminal appointment system for drayage operations. This work by these Tioga Group authors is an earlier piece of research to Tioga Group (2011), and the technologies available in Halifax have moved quickly to incorporate OCR capabilities, and so we placed a lower priority on it for input to the study.

Kirkland, Claire (nd). Assessing the potential for inland port success, Canada's Asia-Pacific Gateway and Corridor Initiative, Retrieved from http://www.gateway-corridor.com/roundconfpapers/documents/Kirkland_Clare_Regina.pdf, accessed on 16 January 2013.

DOI: NA

Abstract: Many communities are pursuing economic development opportunities related to expansion of containerized trade. Four necessary conditions for success are postulated [value to shippers or carriers, major rail carrier commitment, capability of accommodating growth, and public agency support] and tested against seven cases, four judged successes, and three judged failures. Three cases in development are then assessed as to their likely success. Within the limited number of cases and the limited analysis completed the postulated conditions for success appear necessary.

Key words: Not provided

Contribution to current research
The paper provides interesting information on the success factors of an inland port. The example of Vancouver shows how an inland port can reduce the number of trucks to and from ports (modal shift from road to rail), without providing quantitative information.

Konur, Dincer and Golias, Mihalis, M. (2013). Cost-stable truck scheduling at a cross-dock facility with unknown truck arrivals: A meta-heuristic approach, Transportation Research Part E, 49, pp. 71–91.

DOI: 10.1016/j.tre.2012.06.007

Abstract: We study a cross-dock operator's truck scheduling problem at inbound doors in case of unknown truck arrival times. Due to uncertainty of truck arrivals, a scheduling strategy is subject to variations in costs of serving the trucks. A cost-stable scheduling strategy is defined as a schedule with low variation levels. In this paper, we analyze the cross-dock operator's problem of determining a cost-stable scheduling strategy while minimizing the average of total service costs. A bi-objective bi-level optimization problem is formulated and we discuss a genetic algorithm based heuristic to find Pareto efficient schedules. The proposed approach is compared to first-come-first-served policies.

Key words: Cross-dock operations Unknown truck arrivals Stable scheduling Bi-objective optimization

Lee, Gunwoo, You, Soyoung, Ritchie, Stephen, G., Saphores, Jean-Daniel, Jayakrishnan, R. and Ogunseitan, Oladele (2012). Assessing air quality and health benefits of the Clean Truck Program in the Alameda corridor, CA, Transportation Research Part A, 46, pp. 1177–1193.

DOI: 10.1016/j.tra.2012.05.005

Abstract: In this paper, vehicle microscopic simulation and emission models were combined with an air pollutant dispersion model and a health assessment tool to quantify some social costs resulting from urban freight transportation in the Alameda corridor that links the Ports of Los Angeles and Long Beach to downtown Los Angeles. Traffic on two busy freeways, the I-710 and the I-110, and some heavily trafficked arterial roads was analyzed to estimate the health impacts caused by drayage truck emissions of particulate matter (PM) for four different years: 2005, which serves as a baseline for various pollution inventories, as well as 2008, 2010 and 2012. These years correspond to deadlines for the Clean Truck Program (CTP), which was put in place to improve air quality in the Alameda corridor. Results show that the health costs from particulate matter (PM) emitted by drayage trucks exceeded 440 million dollars in 2005. However, these costs decreased by 36%, 90%, and 96% after accounting for the requirements of the 2008, 2010, and 2012 CTP deadlines. These results quantify the magnitude of the social costs generated by drayage trucks in the Alameda corridor, suggest that these costs justified replacing drayage trucks operating there, and indicate that the Clean Truck Program likely exceeded its target.

Key words: Microscopic simulation Air pollution Dispersion analysis Health impacts Freight transportation Drayage trucks

Liao, Chun-Hsiung, Tseng, Po-Hsing, Cullinane, Kevin and Lu, Chin-Shan (2010). The impact of an emerging port on the carbon dioxide emissions of inland container transport: an empirical study of Taipei port, Energy Policy, 38, pp. 5251–5257.

DOI: 10.1016/j.enpol.2010.05.018

Abstract: This study analyzes the changes in carbon dioxide (CO_2) emissions resulting from the movement of containers from established ports through the emerging Port of Taipei in Northern Taiwan. An activity-based emissions model is used to estimate the CO_2 emissions of container transport under four scenarios where there are switches of market share from existing ports to the emerging port. The results show that there are greater reductions in CO_2 when transhipment routes are changed from the ports of Kaohsiung, Taichung and Keelung to the emerging Port of Taipei. The paper concludes that the analytical approach adopted in the paper can help decision-makers understand potential CO_2 emissions reduction strategies in the route selection of inland container transportation and such consideration should provide a broader and more meaningful basis for the socio-economic evaluation of port investment projects.

Key words: Carbon dioxide; Container transport; Ports

MariNova Consulting Ltd. (2006). Halifax Inland Terminal and trucking options study. Halifax Regional Municipality and Halifax Port Authority, Retrieved from http://www.halifax.ca/regionalplanning/publications/documents/InlandTerminalFinalReport.pdf, accessed on 16 January 2013.

DOI: NA

Abstract: The Halifax Port Authority (HPA) and Halifax Regional Municipality (HRM) commissioned the present study to evaluate the role that an Inland Terminal or truck access to the railcut through the Halifax peninsula could play in alleviating some of the challenges presented by trucking activity within HRM. The study includes a site selection evaluation for a terminal to be located within Nova Scotia, an operational analysis of the inland terminal concept and an economic analysis of an inland terminal, as well as an assessment of the feasibility of the railcut option

Key words: Not provided.

Contribution to current research

This was the first study to examine the issue of truck traffic in the downtown core of Halifax. It was suggested that an inland terminal at Rocky Lake, in Bedford, along with a rail shuttle to move containers, would be a more acceptable means of moving cargo through the city. It was determined that the terminal would also serve Ceres, so as not to disadvantage Halterm. One of the benefits of building the terminal was the added capacity it would give the port, since import cargo would immediately move inland, and thus open up more space on the terminal. This concept and its location met with some resistance from nearby land owners. For the subsequent “plan”, the terminal was moved closer to transload activity in Burnside.

MariNova Consulting Ltd., UMA Engineering, Colliers International, CPCS Transcom and Dillon Consulting (2008). Atlantic Gateway Distripark Plan, Halifax Regional Municipality.

DOI: NA

Abstract: The report focuses on the opportunity to leverage transload activities to reduce truck traffic without increasing the overall cost of transportation. It was estimated that a new Distripark could actually reduce the cost of transload container delivery chain through the Port of Halifax.

Key words: Not provided

Pham, Quyen, Huynh, Nathan and Xie, Yuanchang (2011). Estimating truck queuing time at marine terminal gates, Transportation Research Record, 2222, pp. 45–53.

DOI: 10.3141/2222-06

Abstract: Truck queuing at marine terminal gates has long been recognized as a source of emissions problems because of the many trucks that are idling. For this reason, stakeholders have a great interest in lessening the severity of the problem. To assist these stakeholders in addressing the congestion problem, baseline data and predictive models are needed. Unfortunately, data on truck queuing and research on the methodologies that can be used to estimate truck queuing time are limited. With an increasing number of marine terminals offering live webcam views of their gates to manage demand for the terminals, these webcams could be used to gather much-needed truck queuing information and other truck-related data. Data collected from the webcams were used to develop models to predict truck queuing times on an hourly or daily basis. Given the inherent fuzziness of the truck arrival data, this study evaluated the suitability of four predictive models capable of dealing with fuzzy data: multiple linear regression, fuzzy regression, clustering fuzzy regression, and support vector machines. Analysis showed that fuzzy regression outperformed other methods for the given data set.

Key words: Not provided

Contribution to current research
In case data on waiting times for trucks in the Port of Halifax is lacking, this article could provide insights on how to estimate these waiting times (needed to quantify the problem). However, it is not clear if these estimates can only be made based on webcam data and if the results are applicable to the situation in Halifax.

Roso, Violeta (2007). Evaluation of the dry port concept from an environmental perspective: A note, Transportation Research Part D, 12, pp. 523–527.

DOI: 10.1016/j.trd.2007.07.001

Abstract: This study evaluates the dry port concept from an environmental perspective using modelling and simulation. A model of a transport system, with and without a dry port, is created and the results of the simulations compared. The benefits of the dry port implementation are defined from an environmental perspective; calculated CO_2 emissions are approximately 25% lower with an implemented dry port for the chosen case, while congestion and truck waiting times at the terminal are significantly reduced.

Key words: Seaport inland access; Dry port; CO_2 emissions; Traffic congestion

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Steenhof, P., C. Woudsma, E. Sparling (2006). Greenhouse gas emissions and the surface transport of freight in Canada, Transportation Research Part D, 11, pp. 369–376.

DOI: 10.1016/j.trd.2006.07.003

Abstract: Under the Kyoto Protocol, Canada has committed to an average annual reduction of greenhouse gases of 6% below 1990 levels between 2008 and 2012. The transportation of freight contributes to 9% of Canada's emissions. Through the application of decomposition techniques and scenario explorations, we show that since 1990, increasing cross-border trade and a concurrent modal shift towards trucks were the most important determinants in increasing freight sector emissions. Looking toward 2012, a number of new developments are occurring. Trade with Asia is rising rapidly with rail appearing to be rising proportionally as a transportation mode. Federal government initiatives on the US and Canadian sides of the border are stimulating advanced technology, while higher fuel prices are increasing freight rates and encouraging carriers to seek efficiency gains. Based upon the most likely progression of these factors, emissions will rise a further 10% by 2012 and thereby push the sector to be 35% above base year values.

Key words: Not provided

Contribution to current research

The paper provides an interesting analysis of GHG sources and documents the causes; "increasing GHG emissions from freight activity from 1990 to 2003 was primarily influenced by increasing freight activity and modal shifts towards heavy trucks, although this was countered by decreased energy intensities of nearly every transportation mode considered." (Quote is from page 375.) There is no additional contribution to this study.