# Port Performance Measures

## Identification, Summary and Assessment of Port Fluidity and Congestion Measures

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## Executive Summary

Larger ships carrying more cargo and creating cargo surges in ports is expected to set a 'new normal' for traffic flows across the berths and through terminal gates of container ports with impacts beyond the terminal gate landside. Outbound, growth in bulk exports and 'oil on rail car' shipments also alter the efficiency and effectiveness of Canadian port-centric supply chains. Addressing fluidity in supply chains through Canadian ports remains critical if Canadian ports are to continue to serve as efficient and effective gateways to/from North America.

This research report identifies, summarizes and assesses Port Performance Measures, specifically those that address congestion, responsiveness and fluidity across the port system as it serves the global supply chains of Canadian economic interests. It explores how port performance is measured in Canada, what is done elsewhere and, in particular, how the measurement of fluidity is undertaken.

The objectives of the research are to address:

- port performance in the context of a broader multi-modal transportation system;
- the specific port performance assessment of congestion and fluidity and appropriate approaches to such measures in times of cargo surge capacity;
- the role of the federal government in performance metric measurements;
- global and national trends relevant to transportation performance metrics including those to address congestion, responsiveness and fluidity across the system;
- gaps in approach and/or information and identify possible next steps to help ensure the national port system has the capacity and nimbleness to support trade interests and economic activity across all sectors over the short, medium and long term; and
- where there may need for interventions (by federal government).

The report does not draw port-specific conclusions for action as these would fall outside of the scope of the research. It draws conclusions, both general and specific, on the state of port performance measurement in Canada and identifies possible next steps. It serves to inform the Canada Transportation Act Review process in this area critical to Canada's economy and competitiveness.

The introduction to the report defines the major terminology used in the report, focusing on the critical differences in thinking about efficiency versus effectiveness metrics and how global value chains and global supply chains are differentiated. The focus is on taking apart the physical flow of supply chains through ports. It is assumed that Canadian and foreign multinationals have already reorganized their value chains to optimize production, distribution, labour and capital and that their supply chains need to be fluid for the Canadian part of the value chain to contribute most effectively to the country's economy.

## *Key Background to Understanding Goods Movement through Ports*

Section 2 of the report presents the background of global and national trends relevant to transportation performance. It discusses the relationships between the various players in the movement of goods (first bulk and then container movements) to illustrate the flows and bottlenecks where performance measurement can be undertaken with the aim of diagnosing and monitoring fluidity. Any assessment of port performance needs to measure the flow time between bottleneck points, benchmarking it against free flow time, as well as the dwell or processing time at the bottleneck points. Using a flow and dwell approach (Table 1), the report suggests illustrative fluidity metrics for each flow and dwell point in the supply chain.

The section concludes that vertical separation, defined as the use of imported inputs in producing goods that are exported, will likely continue to be a factor in Canada's export growth. If so, a focus on export fluidity is too narrow; fluidity improvements inbound are also critical some imports support Canadian export activity. This means that for both bulk and container analyses, performance data should be collected both inbound and outbound and reported separately.

## *A Framework for Thinking about Performance Measurement*

Section 3 of the report presents the Griffis et al. (2007) framework as suitable for identifying the most critical metrics for any organization to collect for its circumstances and goals. This generic performance measurement tool has been varied to reflect the language used in the supply chain industry and is used in this section of the report to structure the discussion on the various ways/options that government and industry can measure performance, and in particular fluidity. The goal of fluidity is set out in the 2007 Strategic Gateways and Trade Corridors Policy and the related transport policy established by Section 5 of the *Canada Transportation Act* (discussed in section 6 of this report) under review.

It is concluded that, for each of the eight goal combinations possible from this three-dimensional goal matrix, any government or port or inland transport operator should choose to collect one or more indicators. Some indicators need to be collected system-wide while others are port-specific, depending on the goal. Table 3 of the report proposes illustrative examples of fluidity benchmarks and timing for each of the eight goal dimensions, and focuses on the fact that efficiency measurement is only part of a holistic port performance measurement program, the other four goal dimensions being related to effectiveness measurement. Many Canadian ports measure their efficiency (with varying degrees of quality) but, while some Canadian ports conduct customer surveys, they are few in number and there is no substantive effectiveness measurement program currently underway. Many ports see their results in isolation and are not benchmarking against others. Given the law of diminishing returns from an efficiency-only benchmarking process, the section on effectiveness measurement deserves a closer look. The need for 'big data' collection and analysis in support of efficiency goals, and for market research in support of effectiveness objectives is noted. The strategic actions for ports arising from an effectiveness measurement program are also discussed.

This section of the report ends by demonstrating the challenge all ports face in addressing the cargo surge like the one that has accompanied the increase in container vessel size, by undertaking a headline analysis of the impact of the 2014 cargo surge on U.S. west coast ports and the response of the U.S. government to that poorly managed surge. The section concludes that without the basic reporting of key efficiency and effectiveness indicators, what surfaces in the media is anecdotal evidence driven by media speculation on government failings and little scientific evidence of the quality of ports' services in the eyes of their customers or users. The availability and analysis of quality, objective-driven data is key to future success for Canadian ports in both identifying a surge and knowing how to manage it well.

## *Port Performance Developments Globally*

The fourth section of the report explores developments in Europe, Australia, and the United States. It evaluates these situations and the programs they have, and identifies that neither the Europeans nor the Australians offer a model for Canada to follow, although the programs they undertake offer some insights. The conclusion drawn from the exploration of the U.S. situation is that there is an emergent interest in corridor fluidity analysis, expertise in congestion measurement to be drawn on, and, in particular, a renewed focus with legislation on addressing existing port performance measurement deficiencies. The takeaway for Canadian ports and their supply chain partners is that they should be careful not to become complacent given they have a significant lead over most U.S. ports in benchmarking performance. The section concludes with a review of the American Association of Port Authorities 2012 and 2014 Port Customer Service Initiatives, and the model they offer to Canada to collect effectiveness metrics.

## *Port Performance Measures*

The fifth section delves into the scholarly literature on port efficiency and effectiveness metrics since the 2007 *Port Performance Benchmarks and Indicators* report completed by Dalhousie University for Transport Canada. With respect to efficiency metrics, it is concluded that there is limited new contribution from the literature (a few exceptions are discussed); when there is primary data collection in this research record, much of it is for one port or a set of regional ports and suffers from being a one-time effort. This means that the instruments and measurement constructs fail to be validated by a second round of research. On the metrics to measure port effectiveness, the primary effectiveness research effort has been under the auspices of the Port Performance Research Network (PPRN) at Dalhousie University; through three pilot studies and two separate data collection exercises (AAPA Port Customer Service Initiative 2012 and 2014), the PPRN has identified what factors are critical to effectiveness evaluation in North American ports. Some of these are fluidity/congestion relevant.

This section also discusses the efforts of the Texas Transportation institute to measure urban congestion in the U.S., and lessons relevant to fluidity measurement, and in particular landside fluidity, in Canada.

Most important, however, is a detailed examination of Transport Canada's current fluidity metrics and its fluidity web portal. Through the use of screen captures from the fluidity portal, the section discusses what metrics are currently collected, which ports participate, and whether or not the metrics being collected could be improved. The section notes that

> *In the seven years since the decision to re-orient the government's transportation policy focus to the key competitive element of fluidity, significant progress has been made. … Transport Canada's annual report does not reflect the true depth of coverage that currently happens in Canada.*

What is missing from the web portal are the 'exception reporting' boundaries to indicate the likelihood of a coming surge so that planning adjustments are triggered and Transport Canada automatically notified of an impeding situation. Also missing are best and worst practice scores for some of the metrics. The detailed discussion points to specific recommendations for Transport Canada to consider. The section concludes that

> *The strongest contribution of the fluidity portal is its diagnostic approach to Canadian supply chain performance through its analysis of Canadian supply chain structure and usage. … Having structured the fluidity analysis this way, Transport Canada is in a strong and world-class position to monitor the situation and determine the best way it can assist industry in a market-driven way.*

Updating and making measurement activities more inclusive are the key challenges in measuring fluidity going forward. Such efforts dependent on the ports cooperating with Transport Canada, and not all do. This is a critical factor for the Canada Transportation Act Review Panel to consider as ports benefit from landside infrastructure funding assistance through the Building Canada, Gateways and Border Crossings and other infrastructure funding programs yet do not always cooperate on measures needed to determine if those funds are well-spent by providing fluidity metric data feed. It was concluded that the level of effort to date by Transport Canada reflects global leadership by government as no other government has gone this far in port performance metric development, and execution of the program but not in reporting to the public.

The section concludes by looking at individual port efforts in performance measurement and explores third party data availability to round out the search for evidence on port performance measurement, including a discussion about scoreboards, dashboards, webcams and AIS input to performance improvement.

## *Performance Report Considerations*

The sixth section of the report returns to the fundamentals of what Canada's transportation policy is, as set out in Section 5 of the Canada Transportation Act. It considers what the current policy as expressed in the act is, and notes that current efforts in port performance fluidity measurement are in keeping with the existing legislation. In Table 12, it reports the existing metrics collected, both container and bulk, and suggests additional metrics not currently collected by Transport Canada. These are (metric type with target and goal – efficiency or effectiveness):

- Availability of dockworkers (as perceived by shipping lines, an effectiveness indicator)
- Berth availability (an effectiveness indicator as perceived by shipping lines)
- Crane availability (an effectiveness indicator as perceived by shipping lines)
- Gate accessibility (as perceived by supply chain partners, an effectiveness indicator)
- Maritime fluidity (between two geo-fenced channel points or from anchorage to berth approaches, an efficiency indicator)
- Timeliness of port services (pilotage, mooring, etc, an effectiveness indicator as perceived by shipping lines)
- Vessel turnaround time (an effectiveness indicator as perceived by shipping lines as opposed to the actual efficiency measurement in hours)

Furthermore, this section then proceeds to explore whether metric data collection should be voluntary or mandatory once suitable metrics have been chosen, and discusses the importance of confidentiality to port supply chain partners; it concludes that Transport Canada has put very few of its fluidity metrics into the public domain. While there are confidentiality concerns for competitiveness reasons, more metrics are possible to share publicly and some can be aggregated or disguised. Finally, equipment and labour availability deficiencies can lead to congestion or bottlenecks in goods flow yet neither of these measures affecting fluidity is collected currently.

There is good participation in Transport Canada's fluidity portal by some container and most bulk ports, but adoption of the concept has not happened across the board. Transport Canada does not have a complete picture on the use of Canadian taxpayer-owned assets, as port management may not choose to participate. Benchmarking only some ports against global competitors leaves others behind when it comes to making the case for investment, and raises questions about whether they are truly strategic assets owned by Canadians. While governance of ports is beyond the scope of this research, it does have a bearing on Canadian taxpayers and Canadian transportation policy.

Transport Canada has made good progress over the past seven years and there are really no grounds to change the current data collector in favour of a third party arrangement for efficiency metrics. In conclusion, efficiency metric data collection is best left with the current department, Transport Canada, while (a) third party supplier(s) could be used for the missing effectiveness measurement component of a holistic port performance measurement program.

## *Conclusions*

Canada is not alone in facing the challenge of container mega-ships and the surge in container traffic volumes at ports that result (ITF, 2015). While Canada has many options for addressing surges, congestion and delay, they all depend on quality data for decision-making and decision-makers having access to the data they need without having to make special requests.

The 2007 *Port Performance Benchmarks and Indicators* project concluded that the state of the art of metrics for ports in general was fragmented and that much of the research available was inadequate for the challenges faced by Transport Canada and Canadian ports at the time. A wide range of metrics is available to measure efficiency and effectiveness at Canadian ports, and Transport Canada implemented a program of fluidity measurement incorporating some of that advice.

Efficiency and effectiveness are not necessarily trade-offs made by customers and users but are complementary constructs in a program of supply chain performance measurement. Port efficiency measurement in Canada needs minor improvements (see conclusions below) and broader adoption of the program while effectiveness measurement in Canadian ports needs a considerable program development. This report provides a solid foundation of research on which to build that program. Whether government conducts the activities associated with an effectiveness program or organizes the governance of the activities such that the effectiveness measurement is undertaken appropriately by a third party is a separate decision and options available for implementation are explored in this section.

While the process of encouraging and maintaining supply chain fluidity was not the mandate of the research, there are a number of elements that must be present, the most important of which is consistent measurement of all time components in the supply chain in a pre-defined and consistent manner. Table 1 provided a flow/dwell breakdown for a port-centric supply chain as a first step. Measuring port performance requires a plan for working with all supply chain partners willing to measure time, and a plan to encourage those unwilling to reconsider the program. Transport Canada recognized that a singular focus on dwell time in the supply chain pipeline was a good place to start any diagnosis of fluidity challenges, but ultimately benchmarks for performance need to be set and performance reported against targets.

The report makes the following general conclusions (with associated next steps) and these are discussed in more detail in the body of section 7.

> **Conclusion 1:** Transport Canada has established a world-leading fluidity monitoring program and has the right metrics for the task. However port participation does not include all Canada Port Authorities or the largest non-CPA ports. All CPAs should participate in the bulk program, and in the container program if relevant. A CPA port that argues it is too small to participate

should have its CPA status reviewed as CPAs are those ports considered to be of strategic national interest. Those that choose not to participate in any component of a fluidity measurement program should be required to disclose why they have made such a decision in the port's Annual Report. **Associated Next Steps:** In the short-term, Transport Canada should define a minimum set of metrics for all CPAs to include in their reporting requirements to Transport Canada. Transport Canada should establish the nomenclature for the metrics collected and the frequency of collection. In the next five years, the status of all CPA ports not participating in the fluidity program should be evaluated on their reasons for non-disclosure.

**Conclusion 2**: Transport Canada's Fluidity Web Portal has established access to trade interests to understand the efficiency metrics for their trade flows against current average flow times. Small changes in reporting are required however:

- Participants should be able to see the best practice data and the reliability of the data. This suggests a small change in automated reporting practices to be more appropriate for the needs of decision-makers by including the best practice or free flow data, the average (as is currently reported), and the 95$^{th}$ percentile for reliability of the data.
- Citizens of Canada see only the Shanghai–Toronto fluidity and very basic statistics in the Transport Canada Annual Report. The conclusion drawn by those citizens is one of 'not much happening.' Transport Canada needs to be encouraged to share more with Canadians on what it is doing in the Annual Report and mount a marketing effort to advise Canadians of its progress.

**Associated Next Steps:** In the short-term, Transport Canada should develop a communications plan to communicate to interested parties (1) what they are doing, (2) what they expect of Canada Port Authorities, and (3) why Canadian ports should choose to participate in fluidity benchmarking.

**Conclusion 3:** There is a need to increase the participation rate in the fluidity measurement program and to broaden its scope to more bulk and container ports, and to address the shortcomings identified in export container performance measurement. **Associated Next Steps:** (1) In the short-term, Transport Canada should identify appropriate thresholds for participation in fluidity measurement programs and be prepared to establish a minimum set of data expected of any CPA. Additional desired metrics could be made voluntary. (Examples of minimum metrics include tonnes per year by commodity class, tonnes per berth hour and average vessel turnaround time are just a few possibilities.) (2) In the short term, Canada Border Services Agency should identify target thresholds for border administration times and work with Transport Canada to both improve border administration times and explain why ETI and LPI targets are met or not met. Performance of border administration dwell time should be reported and deviances from acceptable practice explained. (3) Within three years, export container performance data should be able to be viewed by participants in the fluidity program. (4) In the medium term, both Transport Canada and CBSA should be reporting to the citizens of Canada their outcomes for the fluidity measurement program.

**Conclusion 4:** Canada is not just a nation of large businesses. This demands that some fluidity metrics be shared more broadly and transparently so that small businesses are also included in the program. **Associated Next Steps:** An active effort by Transport Canada to enrol more partners needs to be made a key medium-term priority. Such an increase in expected effort also needs to be appropriately funded.

**Conclusion 5:** Port trucking is the most difficult component of measuring and managing port fluidity as there are many players and the industry is much more fragmented. **Associated next steps:** In the short-term, it is proposed that Transport Canada establish a research project using the capabilities of Canada's university research programs in industrial engineering/computing science to identify the extent of ‘big data’ collection needed for GPS data to address this reliability challenge.

Efficiency metrics are mostly complete but their adoption has not happened at all Canada Port Authorities or the largest non-CPA ports (who might like the opportunity to participate).

**Conclusion 6:** Maritime fluidity efficiency metrics are not currently collected. This is only relevant for those ports where there is a concern about the ability to handle a cargo surge. **Associated next steps:** In the short-term, the identification of ports where there is concern about a cargo surge is needed. It is currently an appropriate time to diagnose (through a pilot project) the ‘free flow’ time via AIS data collection and analysis, and then begin a monitoring program via regular sampling to identify channels or sea lane locations where there is a threat to maritime fluidity. A large port like Vancouver or Montreal would be more appropriate than a smaller port where congestion is less likely to create delay.

**Conclusion 7:** Efficiency metrics with respect to labour availability and deployment are currently not collected; with the exception of ‘lifts per full-time employee’ or ‘tonnes per full-time employee’, all available models for collecting such data are from the developing as opposed to developed world ports. **Associated next steps:** As there are no efficiency metrics currently collected for labour availability or deployment, it might be best to start by incorporating labour availability perceptions in the proposed measurement of effectiveness thereby diagnosing the perceived state of port labour issues. A second option could be to collect from shipping lines the number of times stevedores are requested but not available. Armed with that knowledge, a working group could address how labour availability or deployment might be measured for Canadian ports and terminals. This is a short-term decision on the best way forward and implementation plan, and a medium-term execution for the implementation plan.

**Conclusion 8:** Efficiency improvements can be spurred through ‘level of service’ (LOS) agreements and the incorporation of incentives and penalties in them but the implementation of these is currently fragmented throughout port-related supply chains. CPAs should be encouraged, if they have not already done so, to include ‘level of service’ incentives and penalties into port tariffs, lease agreements and supply chain partner access arrangements. **Associated next steps:** In the short-term, Transport Canada could identify the level of service agreements already in place between CPA ports and their supply chain partners and customers, and work over the next 3-5 years to help other ports put such agreements in place. As LOS agreements tend to be confidential, a process for auditing and reporting in aggregate form needs to be developed. As terminal lease agreements can run for 20 years or more, this is both a short- and a long-term strategy.

There is a serious gap in port performance data collection on the **effectiveness** Canadian ports.

**Conclusion 9:** The real gap in port performance data collection is that there is no comprehensive third-party or Transport Canada evaluation of effectiveness of service delivery to all customers, users and supply chain partners of ports. There is NO assessment of whether ports supply the services expected or whether that service improves or deteriorates over time. This should be rectified, for the largest ports, for a complete fluidity program. **Associated next steps:** As the evaluation of effectiveness requires a substantial participation by supply chain participants, it is important to roll out effectiveness assessment at Canada’s largest ports with multiple customers and users in the short-term. Significant findings are otherwise unlikely, as participation rate will determine the usefulness of the findings. Over the medium term, smaller ports can be added and then the process can be extended along the supply chain to other partners.

All conclusions and next steps are consistent with the principles expressed in Section 5 of the Canada Transportation Act. Section 5 imparts that regulation is only appropriate when market forces fail. As Canada Port Authorities are entrusted with the management of taxpayer-owned assets, they should be held accountable though their Annual Report.

This review of port performance measures and Canada's fluidity measurement program under the Strategic Gateways and Trade Corridors Policy of 2007 has found that progress towards a complete program of port performance measurement is good, that Transport Canada has made the program a win:win program for participants, but that while Canada has been world-leading on this front, the time has come to raise the bar and make the fluidity program complete and world class consistent with market-driven solutions, and to extend it over time to a wider range of Canadian businesses.

In the short-term, all existing **efficiency** metrics need to be confirmed against objectives, and new objectives for maritime fluidity and labour availability/deployment developed. A program for collecting **effectiveness** metrics needs to be initiated, along with deciding who should collect that data. Given that effectiveness metrics can damage reputations for ports not succeeding in being effective, implementation of that program could be done in a manner similar to that currently available via the American Association of Port Authorities. This is not an expensive option; market research capability is strong in Canada and many industry associations can be contacted to supply supporting participants.

In the medium term, all CPAs not participating in Transport Canada's fluidity program need to carefully consider why they do not participate, and make a clear case for taking such a position. Those seeking infrastructure funding from the Government of Canada should be expected to be cooperative in measuring fluidity so that the Government of Canada can evaluate the efficacy of its infrastructure spending plans. Transport Canada will need to report to Canadian taxpayers more of the results of the program than is currently the case.

A complete program of port performance measurement for export containers as well as import containers as well as bulk exports should be in place and extended along the supply chain by the long-term.

Currently, Transport Canada and the Department of Foreign Affairs, Trade and Development appear to be aligned in a transportation strategy that is trade driven. Continued alignment focused on improving fluidity and making Canadian port and supply chain performance truly world class is appropriate in improving Canada's trade surplus (deficit) and economic prospects in these turbulent times.

Given the high level of uncertainty about Canada's role in global trade as the world trading patterns restructure, it is important to make the right long-term port and hinterland infrastructure investment decisions in this environment that has an increasingly volatile nature of demand. Good investment decisions by both government and industry require better data be collected, and that all Canadian businesses and governments have the right data for future investment decisions. Funding in support of improving port performance data collection may be required in the short term to help Canadian companies compete globally in the long-term.

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## Identification, Summary and Assessment of Port Fluidity and Congestion Measures

## 1.0 Project Introduction

As global supply chains have become more complex, and as container shipping companies invest in ever larger vessels, ports have found it difficult to handle the ever-increasing volume of traffic associated with a single vessel call. Over the history of ship design and technological improvements, ports have sometimes struggled to address the step-wise changes in ship size in both bulk and container trades. In the case of tanker and dry bulk shipping, the limits to economies of scale in vessel size were met in the early 1980s, but in container shipping the limits of economies of scale have not been reached and new designs are introduced ever more frequently. There have been a number of step changes since the inception of containerization in the 1950s, as new vessel configurations have been designed and purchased by shipping lines. As a result, there is considerable uncertainty as to when the limits of scale will be reached in container ships and ports will be better able to know what core infrastructure is needed to handle the particular flow of traffic.

Not all ports have been ready or willing to adapt to the needs of their customers, reflected by a failure to invest or to offer the services the lines require. This is understandable in the bulk sector because a ship offers services on an ‘as needed’ basis to customers. In the container sector, a shipping line makes decisions every few years on ports of call to add or drop from their networks, while ports are making infrastructure investment decisions with a life of 20-50 years. Furthermore, uncertainty has impacts not just within the port perimeter and channel approaches, but also throughout the landside infrastructure network serving the port. When U.S. west coast ports faced labour challenges in the last year, it was very difficult for Canada’s ports to make decisions not knowing how long the benefits of capturing the resulting surge might last; traffic for inland destinations like the U.S. Midwest might permanently be captured by Canadian west coast ports or the surge could reflect a short-term re-routing by unhappy shippers. Mounting shipper dissatisfaction with U.S. west coast port options led east coast ports to expect increased traffic via Panama Canal and Suez Canal routing options and Canadian ports of entry saw traffic increases. The uncertainty over the west coast situation is likely to continue for the next few years, i.e., the very near future from a port investment perspective, as ports grapple with whether they need new capital investment to handle a ‘new normal’ high in traffic volumes. Discussion about the future of North American trade with Asia dominates the trade press discussion. This situation therefore provides the context for this study on how port performance is measured in Canada, what is done elsewhere and, in particular, how the measurement of fluidity is undertaken.

In 2007, Transport Canada, as part of its Gateways and Corridors policy developments, contracted Dalhousie University for a literature review on port performance benchmarks and indicators and, based on this research and consultation with industry, introduced its fluidity measures. The principal investigator for this research was Dr. Mary R. Brooks, who founded the Port Performance Research Network (PPRN) in 2001. Since 2007, a number of research projects have been undertaken by Dr. Brooks, including work for the American Association of Port Authorities and PORTOPIA, Europe’s user perspectives program, to evaluate port performance (Dr. Brooks provides advice to Working

Group 6 of that initiative, spearheaded by the University of the Aegean). This report builds on these experiences.

## 1.1 Purpose and Scope

The purpose of this research project is to address the measurement of port congestion and fluidity by looking at what has been measured, is being discussed and is likely to emerge in the next few years. It reviews the relevant literature produced since 2007 as well as emerging best practices in benchmarking port performance. The research identifies, summarizes and assesses Port Performance Measures, specifically those that address congestion, responsiveness and fluidity across the port system as it serves the global supply chains of Canadian economic interests. It does not draw port-specific conclusions for action as these would fall outside of the scope of the research. It identifies possible next steps and informs the Canada Transportation Act Review process in this area critical to Canada's economy and competitiveness.

This report uses secondary sources in the public domain, supplemented by limited investigations via personal interview with a few key players in the port performance measurement realm. Other than an informal approach to the Port of Montreal, Canadian Port Authorities (CPAs) were not contacted unless there was a point of clarification about what was available in those secondary sources. To approach CPAs would have been a different study.

## 1.2 Objectives and Definitions

The objectives of the research project are to address:

- port performance in the context of a broader multi-modal transportation system;
- the specific port performance assessment of congestion and fluidity and appropriate approaches to such measures in times of cargo surge capacity;
- the role of the federal government in performance metric measurements;
- global and national trends relevant to transportation performance metrics including those to address congestion, responsiveness and fluidity across the system;
- gaps in approach and/or information and identify possible next steps to help ensure the national port system has the capacity and nimbleness to support trade interests and economic activity across all sectors over the short, medium and long term; and
- where there may need for interventions (by federal government).

Before beginning the process of thinking about what might be measured and how, it is important to provide a few definitions:

An **indicator** is a signal; its purpose is to provide guidance. For example, the indicator 'ratio of import tonnes to export tonnes' may signal a shift in the direction of a port's trading balance or refrigerated containers' share of total containers may indicate a growth or decline in agricultural or seafood imports/exports. Indicators are not necessarily appropriate for measuring performance, but they may provide context for understanding a port's use of strategic assets.

> **"Benchmarks are related to the objectives desired.**

**Benchmarking** is a process by which an organization seeks to evaluate the various aspects of its business processes in relation to those of the best in its industry or against others with similar functions. Benchmarks are the 'best in class' values for a performance metric in an industry. Benchmarking is a process for determining those best-in-class values and may be done by third parties like Drewry or *Journal of Commerce*. Benchmarks are related to the objectives desired. Benchmarking to the industry average is a common mistake made by companies; in other words, it is a recipe for mediocrity. Benchmarking Canadian port activities against the best in the industry may or may not be appropriate. For example, it is not appropriate to benchmark an occasional container move by crane in a small coastal port against the expected fast container move by a super post-Panamax crane in a state-of-the-art robotized container terminal. Benchmarking can also be used to establish exception targets for automated monitoring; for example, if truck gate turn time is benchmarked at 30 minutes for a best practice terminal, and the mean time at a particular terminal is 38 minutes, with a standard deviation of 8 minutes, terminal management may set a monitoring system to trigger an exception report for opening an additional gate at one standard deviation above the mean or 46 minutes using management labour. Benchmarks can compare one port against another in a gap analysis, or one port against itself in a year-over-year management assessment, and so are very useful.

Indicators and benchmarks are often called **metrics** because they measure something specific. Throughout this report, metric is more frequently used.

Measurements can be of two types: those that are **absolute** data elements, and those that are **perceptual**. As an example of the former, we can find input at a ‘small data’ level as is commonly found in spreadsheet and manual data entry systems. Absolute data also includes that found in ‘big data’ analysis, data that gets collected, for example, from Global Positioning System tools and satellites, and using geo-fencing techniques to define the scope of the data. Absolute data is defined by a commonly agreed set of defining elements, or nomenclature, and often used to report efficiency. On the other hand, perceptual data are usually collected via market surveys; customer surveys ask customers and users to reveal their thoughts about purchases, processes and services. As will be seen in the discussion on goal-setting in performance measurement, both types of data have their uses.

To this point we have used the term **fluidity** without adequately defining it. It is not commonly found in the scholarly literature, except in the fields of hydrodynamics and hydrology. Freight flows have often been compared to water, as they take the path of least resistance. Given this analogy, the ability of trade ‘to flow without friction or viscosity’, e.g., ‘seamlessly’, is a goal for those seeking economic gain in time-based competition. Transport Canada, in the process of implementing the Government of Canada’s Gateways and Corridors Strategy, has promoted the evolution of fluidity into being a recognized transport word. As transport modes compete on the basis of time, and Canada has a competitive geographic advantage by virtue of location, Canadian modes, routes and networks compete successfully and globally for traffic destined to the centre of the continent (Brooks, 2007). Whether they are competitive on the basis of cost and reliability demands the measurement of these components on a selected number of corridors. Fluidity is related to time in the supply chain network and therefore delay, bottlenecks, infrastructure investment and resulting congestion (if investment in infrastructure is either inadequate or poorly maintained) are all related components (Transportation Research Board, 2014). Fluidity deteriorates when congestion increases or the management of dwell time is poorly executed. For those with high-value goods or just-in-time manufacturing or distribution systems, deteriorating fluidity results in consequential business losses that may result in an inability to compete for global market share. As congestion and delay are the antitheses of fluidity, research focused on finding potential improvements in fluidity must therefore identify factors that lead to congestion (bottlenecks) and resultant delay. The measurement of fluidity in a supply chain is essentially the measurement of time in a flow (movement) or time in dwell (at rest). **Reliability** of that time is of two types: (1) x minutes late for the delivery window (suitable for perishables and just-in-time cargo, and (2) delay of y hours such that a consequential business loss is incurred (Brooks et al., 2012).

Finally, there needs to be clarity of thought on the subject under discussion: is the measurement of port performance and fluidity relevant to global supply chains or global value chains or both? The next section discusses these and so the definition of each is relevant. Many confuse the concepts of global supply chains and global value chains. They are very different and distinct. Firms seeking to use **global value chains** identify the different stages of design, production, marketing and distribution processes and locate the related activities across different countries by restructuring their operations internationally through outsourcing and offshoring of activities. On the other hand, a **supply chain** is the physical flow and associated processes of getting goods moved around the globe between buyers and sellers. So when a supply chain is decomposed, you can look at the individual parties who supply transport, documentation, insurance and financial services, and what their role is in making trade happen and, for the purposes of this report, happen more quickly and seamlessly. When a value chain is decomposed, the individual functions assessed are the research, development, design and production of a product, the marketing and finance needed to make that production and distribution happen and where each of the related activities happens. Most important, when global value chains are decomposed, the elements requiring intellectual property (IP) protection often happen where IP legislation is strongest, the production of basic components where labour is cheapest, and the marketing and finance where education is best and capital markets strongest. In this report, the focus is on taking apart the physical flow of supply chains. It is assumed that Canadian and foreign multinationals have already reorganized their value chains to optimize production, distribution, labour and capital and that their supply chains need to be fluid for the Canadian part of the value chain to contribute most effectively to the country's economy. This is aligned with the thinking behind Canada's Strategic Gateways and Trade Corridors Policy introduced in 2007.

# 2.0 Key Background to Understanding Goods Movement through Ports

As trade and manufacturing value chains have grown in complexity, so too have global supply chains. This section presents the background of global and national trends relevant to transportation performance. It then explores the relationships between the various players in the movement of goods to illustrate the flows and bottlenecks where performance measurement can be undertaken with the aim of diagnosing and monitoring fluidity.

## *2.1 Background of Global and National Trends*

While it has been argued that Malcolm McLean's conception of containerization in 1956 was the inception of the modern supply chain, and irrevocably changed the way most manufactured goods are transported, Levinson (2006) pointed to Mattel's 'all-American' Barbie as the beginning of globalized value chains. She was anything but all-American: her plastic body, clothes and hair came from factories in Japan, Taiwan and China. Created in 1959, Barbie was relatively inexpensive and could withstand the cost of transport; she was made half-way around the globe and was still affordable as a toy purchased for a generation of female baby boomers. Transport costs have dropped steadily since the end of World War II, and containerization advanced the pace at which freight rates fall. Asia's competition on wages established the skeleton of the globalization movement while declining transport costs, the deregulation of telecommunications and advent of the Internet, and the development of global capital markets all put meat on those bones to get the integrated trade and transportation network we see today. In the three decades after Barbie's debut, the rate of growth in merchandise trade consistently outstripped the rate of growth in world GDP and commodity output. In the last decade, outsourcing to even more countries and the re-shoring to Mexico from Asia have altered the North American economy even more. This means that it is difficult to contemplate the measuring of port performance in Canada without its U.S. and Mexican trading partners, and border congestion is an integral element of continental trade and transportation flows.

Competition for port business is not limited to land- and marine-based routings. As the value of goods rises, the importance of transport cost as a function of delivered price diminishes and the value of transport time rises (inventory carrying costs are a function of time and interest rates). In this case, high-value goods of low density and small shipment volumes become targets for air cargo providers (Hummels, 2009). So not only do Canadian ports and their road and rail inland connections need to be concerned about the fluidity of their own international/inland flows in comparison to those of other ports, but for high value, low density products Canadian ports compete with Canadian and U.S. airports for business.

The critical challenge in examining Canada's trade and transportation flows is that trade flows serving the U.S. and those serving Canada are so intertwined. In the mid-2000s, there was considerable discussion about North American gateways and the Canadian Government introduced its Strategic Gateways and Corridors Strategy in 2007 with the view that Canada cannot solely serve its own small markets when there is a wider continental advantage to be seized. There has not been any adjustment to that policy foundation since.

## *2.2 Identifying Critical Flows for Fluidity Measurement Planning*

Any assessment of port performance needs to measure the flow time between bottleneck points, benchmarking it against free flow time, as well as the dwell or processing time at the bottleneck points. To do so is critical if overall competitiveness of Canadian supply chains is to be enhanced, or even maintained at an acceptable level. As the old adage says, "You can't manage what you don't measure."

> **"You can't manage what you don't measure.**
>
> A management adage

**Figure 1: The Basics of Goods Movement and Fluidity Impediments—Bulk Cargoes**

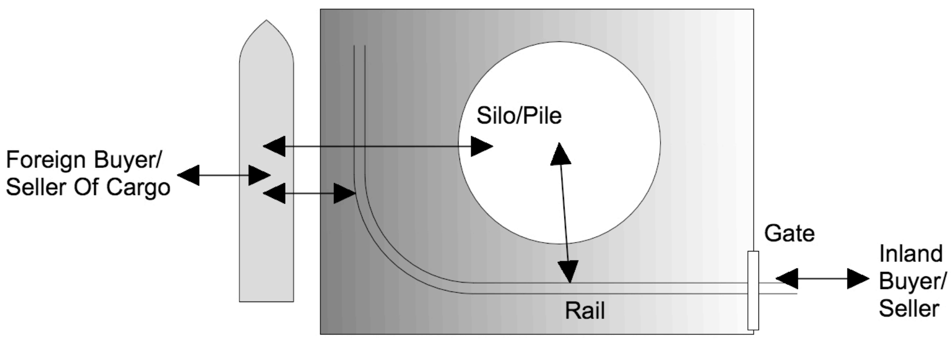
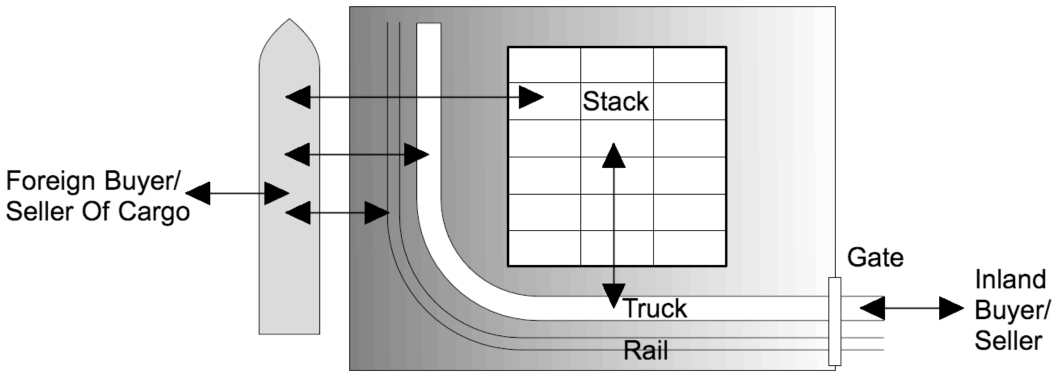



Figure 1 illustrates graphically the basic flow of liquid (tanker) and dry bulk internationally and provides a focal point for a discussion of bottlenecks possible in the movement of both cargoes. The discussion is organized inbound (reading the graphic left to right), but is equally applicable outbound. The foreign seller may load a bulk cargo on a ship and when that ship arrives in port, the first bottleneck point may be that no berth is available, the channel is not deep enough or the vessel has to wait for a rising tide to berth. The second bottleneck affecting fluidity occurs when the cargo is offloaded, and may result from inadequate labour or yard equipment or silo/pile space at the terminal or supplied by the inland transport operator. The third bottleneck is often the documentary processes that happen at the gate, and can include, for inbound shipments, inspections required by Canada Border Services Agency, Agriculture Canada, or other agencies.

In bulk shipping, it is not that common that vessels need to wait for the tide to berth at Canadian ports. The primary exception is Saint John (given the high variation in tide levels in the Bay of Fundy), but in most ports tidal variation is not a critical matter. Silting is also not a critical problem given the geomorphology of Canada. The same cannot be said for many U.S. east coast ports that fight a constant battle with river silting that leaves them dependent on dredging to maintain channels. The port situation for most deep-sea bulk ship operators is relatively stable. The ports may have a number of captive customers and economies of scale in vessel size have been reached; the largest tanker built was the *Seawise Giant* in 1980. The shipment of dry bulk is not especially different, and bottlenecks in the system are mostly seen on the landside of the port system. That does not mean there is no case for including tankers and dry bulk vessels in measuring maritime fluidity, but the analysis of dwell time in silos or piles is likely less relevant as many cargo owners use port or private terminals as warehouses to hold the cargo until it is purchased.

**Figure 2: The Basics of Goods Movement and Fluidity Impediments—Container Cargoes**




To illustrate the basic flow of container cargoes through a port, Figure 2 identifies flows and potential bottlenecks for this cargo. The foreign buyer or seller may purchase space on a container ship and when that ship arrives in port, the first bottleneck point may be that no berth is available, the channel is not deep enough or the vessel may have to wait to berth. Therefore, the measurement of maritime fluidity will be an important component in measuring port performance. The second bottleneck is when the cargo is offloaded, and delays can result from inadequate labour or yard equipment or stack space in the container yard. Congestion in the container yard can also occur if the inland rail operator provides an insufficient number of rail cars or there is a shortage of truck drivers.[1] If the yard has insufficient stack space, the terminal operator may be forced to stack boxes higher than optimal for the yard operations, resulting in more moves to get at some of the boxes to be processed. Unlike bulk cargoes, container yard dwell is a more critical component of fluidity for container cargoes. The third bottleneck is often the documentary processes that happen at the gate and may include, for inbound shipments, inspections required by Canada Border Services Agency, Agriculture Canada or other agencies. Finally, the fourth critical impact point is congestion and resultant delay of the inland flow, which may compete for highway or track with domestic operations and/or commuters. It is important to note that shipping lines, in contemplating a port's competitiveness, are also concerned about the costs of their containers if the cargo is not transloaded at the port, as inland time loss influences bottom line profits (losses) if container costs are not managed efficiently by supply chain partners (van den Berg and de Langen, 2015).

In the case of inland moves to/from the terminal, trucks compete for highway space with commuters while containers compete against grain and coal for valuable track space. In Canada, barge operations are not as common as in Europe and short sea shipping is limited, so most ports have a bi-modal rather than tri-modal split for inbound and outbound cargos.

While much of the focus on fluidity comes from the manufacturing sector or for perishable goods, bulk goods often are rendered uncompetitive if the trade-off between inventory levels and transportation costs are not optimized. If the transportation component does not deliver agricultural products or

[1] The shortage of truck chassis was a major challenge for some U.S. ports in the recent surge, but most trucking operators in Canada supply the chassis so the situation at Canadian ports is not comparable.

commodities in the time frames expected, the absence of fluidity can result in demurrage charges, and the future loss of customers to suppliers in other countries, and the like.

Whether the goods are bulk goods or containerized ones, the elements that should be measured are presented in Table 1. Here the concepts of movement of goods through the port discussed above are translated into a set of metrics for each stage of flow and dwell. The use of the metric in the table is for illustrative purposes as each organization undertaking performance measurement determines the metrics that best serve its objectives in the situation. As noted by Yuen et al. (2012), “in a port ‘transport supply chain,’ users incur delay costs not just at ports but also at other points in the chain, and hence, overall congestion is dictated by the weakest link (or node).”[2] This weakest link has migrated over time from being at the port and considering crane and berth investment, to port labour, and now frequently to the state and condition of inland connections. The entire supply chain requires scrutiny and therefore metrics similar to those identified in Table 1.

**Table 1: Stage of Flow and Illustrative Fluidity Metric**

| Stage of Goods Movement (Flow/Dwell) | Illustrative Fluidity Metric |
|---|---|
| Ship Arrival in Port Jurisdiction to/from Berth Tie-Up (Flow) | Average time at anchor; Vessel on-time performance (%); Vessel time from pilot to berth (in hours) |
| Vessel at Berth (Dwell) | Average vessel turnaround time (in hours) |
| Container/Cargo Loading/Unloading (Flow) | Gross berth productivity (in tonnes per berth hour), Container lifts per crane hour |
| Cargo Dwell in Port (Dwell) | Average tonnes per vessel call (1)<br>Average container dwell time at terminal (in days) |
| Truck or Rail Equipment Dwell in Port (Dwell) | Average truck turnaround time (in minutes)<br>Average rail car dwell (in hours) |
| Cargo Flow to/from Port (Flow) | Average transit time to specified inland destination (in minutes or hours) |

Note: (1) Time measurement is not as relevant for bulk cargoes given considerable use of stockpiles and silos for port storage until sale.

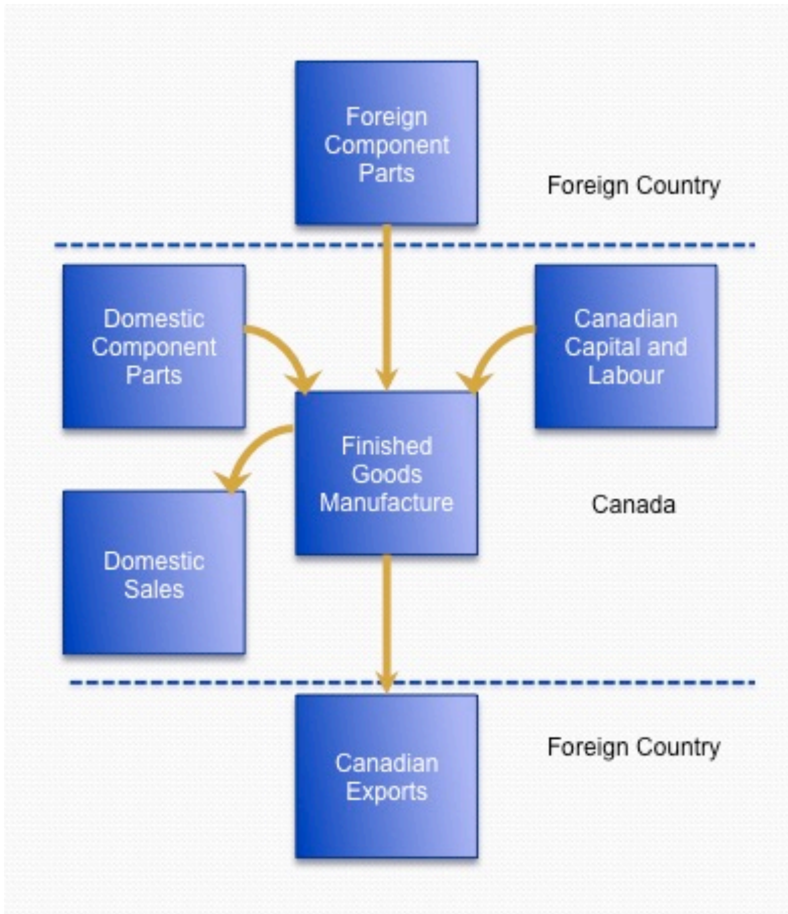
Finally, the Canadian policy of supporting export competitiveness seems to be built on a preference for fluidity in export flows with less emphasis on fluidity for imports. This might have been a solid strategy two decades ago but fails to reflect the disaggregation of global value chains over the past 20 years from a Canadian perspective. Because global value chains have been well designed by the world’s most successful multinationals and the principles emulated for competitive advantage, many successful Canadian exports of a manufactured nature (and therefore most likely transported in a container) are dependent on imported parts and components before final or partial assembly and export. Consider Figure 3. The fact that many Canadian exporters are dependent on imports for their export success means that a competitive and fluid supply chain needs to serve both import and export types of flows.

Vertical separation is defined by Hummels et al. (2001) as the use of imported inputs in producing goods that are exported; it is therefore imperative that (a) production occurs in at least two countries,

[2] Yuen et al. (2012), Port competitiveness from the users perspective. An analysis of major container ports in China and its neighboring countries. Research in Transportation Economics 35, 34-40, p. 34.

and (b) goods-in-process cross at least two borders for vertical separation to exist. Classic examples of global products featuring vertical separation include the iPod, Nike shoes and Boeing airplanes.

**Figure 3: Vertical Specialization is a Key Factor in Canada's Export Success**




Note: This is an interpretation of Canada's vertical specialization based on Hummels et al. (2001), Figure 1 p. 78.

For Canada, cars, transportation machinery and other industrial products commonly have value chains featuring vertical separation. Because the statistical trail for bills of lading and waybills are broken when an import container is transloaded into a domestic trailer (three import 40' boxes can fit into two 53' trailers), the estimation of vertical separation in any economy becomes one of estimation dependent on input-out tables and dollar values (and likely bear no resemblance to the number of containers moved). Using input–output tables, Hummels et al. (2001) estimated that Canada's growth in exports due to vertical separation over 1970-1991 was 50.9%, the highest of the 13 countries (including four emerging economies) they examined. For the U.S. it was only 14.1%. Restructuring of the auto sector was a critical element in Canada's participation in vertical restructuring while for the U.S. it was due to vertical separation in industrial machinery. Hummels et al. (2001) concluded that such vertical separation activity has a lot to do with Canada's relationship with developed countries and that it was possibly driven by reductions in the costs of

> **"in some industrial sectors, imports are critical to our export success.**

transportation and reduced tariffs, as high transport costs and tariff barriers diminish the potential for vertical separation. For more information on the use of imports in Canadian exports, see Baldwin and Yan (2014).

To conclude, it is possible that vertical separation will continue to be a factor in Canada's export growth and, if so, fluidity improvements need to be both inbound and outbound as some imports support Canadian export activity. In both bulk and container analyses, performance data should be collected in both directions and reported separately.

# 3.0 A Framework for Thinking about Performance Measurement

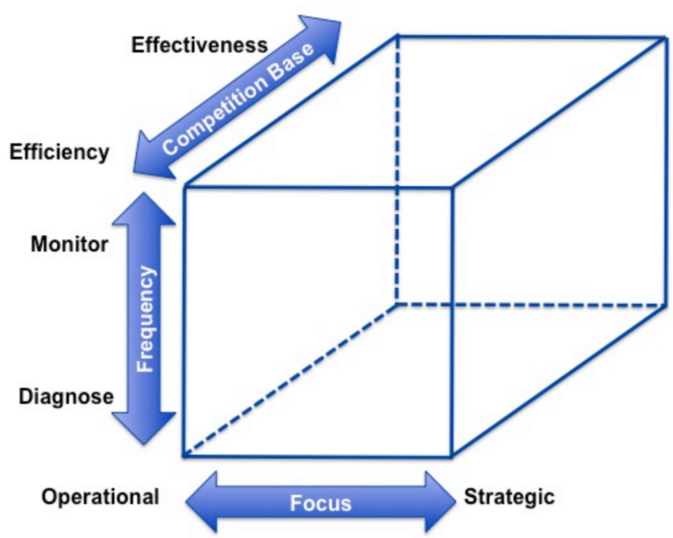
This section begins by exploring a framework for identifying critical metrics for collection and analysis in keeping with organizational objectives. It explores how those metrics might be considered against goal dimensions. It concludes by demonstrating the challenge all ports face in addressing the cargo surge that has accompanied the increase in container vessel size, by undertaking a headline analysis of the impact of cargo surge on U.S. west coast ports in the fall of 2014.

## *3.1 Goal Dimensions for Benchmarking Performance*

Griffis et al. (2007) provide a framework suitable for identifying the most critical metrics for an organization to collect, and to ensure that they are matched to organizational objectives. This generic performance measurement tool has been varied to reflect the language used in the supply chain industry and is used in this report to structure the discussion on the various ways/options that government and industry can measure performance, and in particular fluidity. The goal of fluidity is set out in the 2007 Strategic Gateways and Trade Corridors Policy and the related transport policy established by Section 5 of the Canada Transportation Act (discussed in section 6 of this report).

**Efficiency** has been noted as "doing things right" while **effectiveness** is "doing the right things." In the marketing literature, effectiveness is often considered to be **customer responsiveness**, and this was the term used by Griffis et al. (2007). Using the framework to understand the objectives for collecting performance metrics enhances the probability of choosing appropriate indicators, a full set of indicators, and not too many indicators. These three goal dimensions are illustrated in Figure 4.

**Figure 4: A Framework for Choosing Performance Indicators**




Source: Adapted from Griffis et al. (2007), p. 41 by Mary R. Brooks.

The use of this framework helps define the broader objectives for the performance measurement activity and assists those contemplating a program of performance measurement to understand how the various options for measurement fit into a holistic program for the supply chain through a port.

The three goal dimensions illustrated in Figure 4 are:

- The Measurement Purpose (or Focus, represented by the horizontal scale of the cube) poses the question: Is the metric intended to provide longer-term strategic guidance or evaluate timely operational performance?
- The Competitive Dimension (represented as the depth of the cube) is the degree to which the metric is focused on evaluating efficiency or customer/organizational responsiveness (sometimes called effectiveness).
- The Measurement Frequency (represented by the vertical scale of the cube) poses the question: Is the metric designed to be a regular, continuous, possibly real-time performance monitor, or serve a more infrequent but important diagnostic purpose? In other words, can those looking at it find it in a timely fashion as an input to decisions now or is it being reported annually or even biennially to track the progress of strategic initiatives?

For each of the eight combinations possible from this three-dimensional goal matrix, any government or port or inland transport operator should choose to collect one or more indicators. Some indicators need to be collected system-wide while others are port-specific, depending on the goal.

Sometimes indicators are not particularly valuable unless seen in the context of other indicators. To use an example, if the goal is to develop a maritime access fluidity indicator measuring vessel access time to port (for monitoring purposes), the access time may initially be diagnosed via a pilot project to define a free-flow target benchmark. In subsequent periods, the indicator may be presented in a different format for monitoring operational purposes, such as real-time GIS plots for daily operational purposes or monthly exception reports to indicate days when free-flow rates were exceeded by a target threshold. However, its best use may be realized when it is put into the context of port pilot availability so that solutions are better interpreted strategically. With any of the chosen indicators, it is the combinations of inputs, outputs, timing and purpose that identify the best indicators for the purpose to be served.

Furthermore, regulators likely seek different monitoring and strategic indicators from those sought by industry but, in cases where industry already collects the data, it can be productive if the government is able to assist in the harmonization of such collection efforts or seek agreement on how indicators are defined so that if they are aggregated or compared, they have meaning to those using them. This raises a series of questions to be discussed:

- Who are the necessary collaborators that need to participate?
- Is a mandatory or voluntary regime appropriate?
- Who should collect the data?
- Should the data be in the public or private domain?

These questions will be returned to in section 6 after all of the evidence is collected that is pertinent to these decisions.

## *3.2 Measuring Efficiency in Port Operations*

Efficiency is defined as a ratio of outputs achieved for a given level of inputs provided. The measurement of efficiency at ports is not a new idea. UNCTAD (1976) specifically proposed that ports examine:

- Service: Ship waiting time, Ship's time in port
- Utilization: Berth occupancy, Berth working time
- Productivity: Cost per tonne of cargo handled.

Early scholarly research efforts focused primarily on issues like container throughput per hectare or berth occupancy or volume of traffic throughput per metre of quay—common operational efficiency and asset utilization measures. While ports have, in general, been late to the activity of benchmarking performance, there is a well-established tradition of research efforts to identify and execute port efficiency performance benchmarking, beginning with the research of Roll and Hayuth (1993). This efficiency-focused research has been best summarized by Gonzales and Trujillo (2009), Beresford et al. (2010) and Cullinane (2010). A review of the meta-analyses by both Beresford et al. (2010) and Cullinane (2010) demonstrates that the majority of port performance research has focused on efficiency measurement for diagnostic purposes and subsequent operational improvement.

Efficiency metrics are of so much interest to researchers because they are (a) easy to measure at their simplest level, (b) easy for port directors to understand, and (c) offer 'low-hanging fruit' in port improvement efforts. Table 2 presents a selection of efficiency metrics and explains their relationship to productivity improvements at container terminals. The challenge today, however, is that with excess port capacity most of the time but woefully inadequate capacity some of the time, more than just addressing 'low-hanging fruit' is needed. The port market has become quite competitive and many shipping lines have become masters of their capacity to generate and interpret 'big data.' This leaves ports to try to develop new ways to be better at what they do for their customers.

**Table 2: Measuring Efficiency at Container Terminals**

| Sample Metrics | Impact on Productivity? |
|---|---|
| Land in hectares<br>(TEUs per hectare per year) | Container stacks mean more TEUs per hectare can be processed; wheeled operations mean less. (Partial offset: Larger stacks mean more containers must be moved to access those at the bottom of the stack.) |
| Berth Length (TEUs/berth metre) | Insufficient berth length can limit ability to handle vessel calls and leave some vessels at anchor waiting for a berth. |
| Cranes and Lift Capacity (Lifts per crane hour) | More can increase vessel turnaround, number of containers and ships handled. Older cranes operate at lower speeds =fewer lifts per hour. |
| Labour Hours<br>(TEUs per gang hour) | Container terminals operating 7/24/365 have much higher throughput capacity than those with only one or two shifts, with fixed start/stop times, fixed break times, etc. |
| Gate Hours (Gate hours per year; trucks/gate hour) | Limited gate hours mean fewer containers can be processed. Gate appointment systems and webcams to provide dray dispatch information can increase. |
| Cargo Type (Export/Import TEUs per year; Average Tonnes per TEU; % of boxes grounded) | Refrigerated containers require more land per container, decreasing TEUs per hectare. Trade lanes with greater cargo variety and more heavy boxes usually have higher grounding rates if a direct to rail operation is offered, decreasing productivity output. |
| Throughput (TEUs per year; average dwell time per container) | Demurrage policies: The amount of free time allowed by operator directly affects turnover in yard slot allocation. Terminals with tight demurrage policies –>higher throughput. |

Source: Brooks, Mary R. (2011). Seaports, *Intermodal Transportation: Moving Freight in a Global Economy*, Chapter 9 in L. Hoel, G. Giuliano, and M. Meyer (Eds), Washington: Eno Transportation Foundation, Inc, 270-301. Table 9.6 p. 279 is condensed and slightly restructured for the purposes of this report.

As an example, the Port of Dar es Salaam has identified four efficiency factors related to fluidity in its performance measurement program: (1) ship turnaround time, (2) truck turnaround time, (3) container dwell time and (4) availability of equipment. Using the last as an example, the port identifies the units of equipment it has, and then what is available when called, to calculate a monthly percentage availability indicator. For example, it has nine mobile harbour cranes and in January 2012 those nine cranes were available only 69% of the time while in May 2012 there was 100% availability.[3] Dar es Salaam has set a target of 90% equipment availability in any one month. In 2012 it reached that target only one month in the nine reported. These data provide guidance on whether additional investment in cranes is needed to ensure fluidity at the rate desired.

The example of Dar es Salaam underscores the need for efficiency indicators like these to identify where there are bottlenecks or problems in the system and whether the standard met is adequate. Therefore, it is not just about identifying which indicator will be chosen, but also how it will be used and be reported as well as what the target threshold of acceptable outcomes is. In this case, tracking equipment availability indicates to the Port of Dar es Salaam that it needs to investigate whether (a) more mobile harbour cranes are needed or (b) better management of existing cranes is required. Obviously, tracking availability of equipment is a fundamental element in fluidity measurement and continuous improvement in this area. The Port of Dar es Salaam supplies the same information for reach stackers and tractors. As a Canadian equivalent it would be possible to ask each port or each terminal, depending on who is responsible for operations, to provide the times that the equipment was called for and was unavailable. It would also be possible to ask each shipping line to report when it had requested an additional crane of a terminal and one was not provided.

For each of the eight dimension combinations possible from this three-dimensional matrix, any government or port or inland transport operator may choose to collect more than a single indicator. It is the combinations of inputs, outputs, timing and objectives that will identify the best indicators for the situation. Regulators will likely seek different indicators than those sought by industry, but in many cases industry collects the data already, but may not collect it in a uniform way.

To provide some examples of each of the above possibilities, Table 3 illustrates the focus, frequency and competitive base of each dimension, the timing/frequency of data collection, and a likely purpose for the benchmark with an illustration of a benchmark that might be used. As specific benchmarks have not been discussed yet, these are just examples of how to think about these dimension combinations and making sure that all dimensions are addressed in metric design, collection, evaluation and reporting.

### *3.3 Measuring Effectiveness in Port Performance*

There are two types of measurement—the measurement of actual Key Performance Indicators (KPIs, e.g., lifts per crane hour) and the measurement of perceived KPIs—and both are valid. How well a port is perceived to perform is a different type of measurement and therefore a different type of performance indicator. Effectiveness measurement is intended to validate or refute negative anecdotal evidence and provide strategic insights into user and customer relationships. After all, ‘where there is smoke, there is likely fire.’

> **“effectiveness measurement is intended to validate or refute negative anecdotal evidence.**

Effectiveness evaluation in transportation services began with research on transport carrier choice using service attributes in the 1970s and early 1980s (e.g. Saleh and LaLonde, 1972; McGinnis, 1978; Brooks, 1985) and migrating from choice attributes to service provision and improvement as relationships between carriers and

[3] Data are from the presentation by Hebel J. Mwasenga to 2012 UNCTAD Ad Hoc Experts Meeting on Port Performance, http://unctad.org/meetings/en/Presentation/dtl_ttl_2012d11_Mwasenga.pdf

shippers grew more complex and the nature of relationships changed. Publicly owned ports missed being the focus of this type of carrier- and choice-focused research until more recently. Effectiveness in port performance, therefore, was much slower to develop as a stream of research and has only come into its own in the last decade. Early efforts here were also more focused on port choice (e.g., Hao, 2007) rather than on the actual effectiveness of service delivery, confusing port choice with port performance evaluation.

**Table 3: Goal-setting and Examples of Benchmarks**

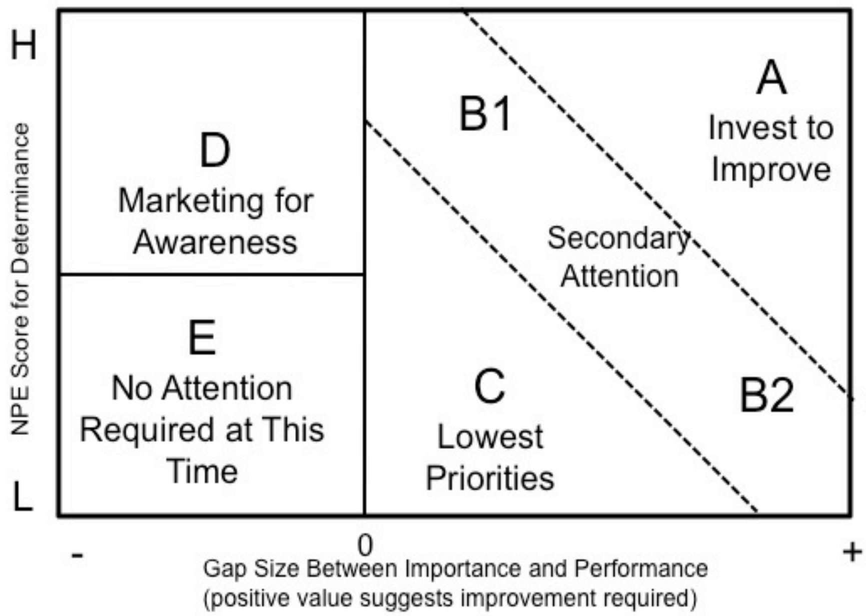
| Goal Dimension | Timing; Data Type | Illustrative Benchmark Collected |
|---|---|---|
| Efficiency/Diagnosis/ Operational | Beginning of benchmarking; Data defined by nomenclature. | Examples: Container dwell time this month (in hours) and Truck turnaround time at gate (in minutes) as a percentage of best practice in North America. |
| Efficiency/Diagnosis/ Strategic | Beginning of benchmarking; Data defined by nomenclature. | Example: Total ‘free flow’ transit time on a specific route. |
| Efficiency/Monitoring/ Operational | Regular intervals, as short as seconds but may be annual; Data defined by nomenclature | Examples: Container dwell time this month (in hours); Truck turnaround time at gate (in minutes). |
| Efficiency/Monitoring/ Strategic | Regular intervals, annually or less frequent; Data defined by nomenclature | Example: Total average ‘free flow’ transit time on a specific route this year compared to base year, indexed. |
| Effectiveness/ Diagnosis/ Operational | Beginning of benchmarking; Perceptual scale, may be indexed | Example: Performance score by supply chain partners of gate accessibility to terminal (like 5.4 on a scale of 1-7, where 1=very poor). |
| Effectiveness/ Diagnosis/Strategic | Beginning of benchmarking; Perceptual scale, may be indexed | Example: Market share held by Canadian gateway ports of Canadian and U.S. ports this year for use as a base for future comparison. |
| Effectiveness/ Monitoring/Operational | Regular intervals, often annual or bi-annual; Perceptual scale, may be indexed | Examples: Performance score by supply chain partners of gate accessibility to terminal (like 5.4 on a scale of 1-7, where 1=very poor); Enabling Trade Index for Canada on ‘time predictability of import procedures’ and ‘Efficiency and Transparency of Border Administration’. |
| Effectiveness/ Monitoring/Strategic | Regular intervals, often five years apart; Perceptual scale, may be indexed | Example: Market share by Canadian gateway ports this year compared with five years ago. |

The rationale for evaluating effectiveness is embedded in the concept of customer service quality. Improvements in efficiency have limits, and the law of diminishing returns is coming into play. Meanwhile, the port customers—the shipping lines—have leapfrogged with technology into a new set of demands that many ports are simply ill prepared to handle. The result in the container shipping part of the market has been fewer, larger vessel calls and even more volatile freight flows through terminals. The bigger gains today will accrue to ports that truly attempt to understand their customers and the value proposition(s) they create for them. Cue the need for market research and ‘big data’ analysis.

“Cue the need for market research and ‘big data’ analysis.

Also needed by ports is a means of distinguishing possible strategic paths for analyzing such data. For this second purpose, Schellinck and Brooks (2014) developed a Determinance-IP (Important-Performance) Gap Space (Figure 5) tool for reconciling conflicting results arising from the use of three common approaches to understanding customer needs. A port that uses only Importance market research will miss the critical Performance element.

**Figure 5: Proposed Strategies for Determinance–IP Gap Space Analysis**




Note: Gap Size is calculated as Importance minus Performance. A positive number is therefore indicative of poorer performance.

Source: Schellinck and Brooks (2014), Figure 1, p. 333.

Port managers need both performance (P) and importance (I) scores to set priorities, and remediation efforts should focus on those criteria where the evaluation criterion is important to the user/buyer/customer (e.g., importance is high) but the organization's performance is low, i.e., there is a large I-P gap. Faced with a large I-P gap, the port manager seeks to allocate appropriate resources to improve performance. With only the I-P gap to respond to, however, the manager may allocate resources to items that are not deterministic in customer behaviour and may allocate insufficient resources to marketing those elements where there is an IP gap in the port's favour.

There is also the question of what criteria are determinant in a port's score on the desired performance dimension (this might be satisfaction, competitiveness or effectiveness in service delivery). The marketing literature has long found that if you wish to be seen as effective in delivering a service, you should focus your efforts on those factors that are determinant of that effectiveness performance score. To provide perspective to port managers, Figure 5

> **Some Canadian ports conduct customer surveys but they are few in number.**

identifies five actions they can take, depending on the data picture that is painted by analysis of perceptual scores on customer surveys. The challenge is that while some Canadian ports conduct customer surveys, they are few in number so those that do so see their results in isolation and are not benchmarking against others. This means that in addition to port efficiency data, port managers need programs to collect data on the quality of their service delivery (e.g., effectiveness), over time (for initial diagnosis and then monitoring progress on continuous improvement) and for both short-term operational improvements and long-term strategic planning. Use of effectiveness monitoring this way will require determining if operational adjustments to specific elements result in changed perceptions of port performance.

These questions have not been researched in a cogent and significant way:

- What is the service quality provided by Canadian ports?
- Does it meet the expectations of service delivery by Canadian manufacturers and retailers?
- Does it meet the expectations of Canadian port users and logistics service suppliers, like those in trucking and rail companies?
- Does it meet the requirements of foreign flag shipping lines?

Without the basic reporting of key efficiency and effectiveness indicators, what surfaces in the media is anecdotal evidence driven by media speculation on government failings and little scientific evidence of the quality of ports' services in the eyes of their customers or users.

## 3.4 Measurement in Times of Cargo Surge

What is a surge? A surge occurs when volumes exceed the average demand expected for the period and the capacity to handle the surge is inadequate (or poorly managed) so that those not served in one time period cascade into the following time period. In transportation, seasonality is managed through the evaluation of buffer time and data analysis to understand demand management opportunities with the customer. Surges are seen during peak seasonal demand when capacity becomes unavailable because natural disaster, weather or excess demand causes the cascading to happen. Most people can relate to the challenges of managing a surge when they think about booking their holidays well in advance; airlines, knowing that capacity will be stretched, raise prices, impose blackout periods on loyalty program purchases, and the like to moderate demand and stretch it out over a longer time. If a major weather event occurs near the beginning of the holiday season, flights are cancelled and a surge happens that may or may not be managed effectively.

Table 4 illustrates how a container shipping surge unfolded in the media. This becomes every port's greatest fear; port management is happy to stay below the media radar screen because bad news headlines reverberate around the world to customers and users.

The shipping industry has long had the unfortunate characteristic of having both seasonality and surges that are not always predictable. The key question for most ports and governments is: how to address the surge without over-investment in infrastructure? This question, on the flip side, is seen by cargo interests as: How can I get my product to market during a surge or peak season without being (a) penalized for late or no delivery, and (b) with sufficient planning via a buffer calculation that my buyer accepts delivery as meeting the contract.

The ports under pressure in a surge are those where capacity is already strained or those where labour is less collaborative and supportive of the port. To use an example, the Port of Oakland on the west coast has a long history of labour unrest and of a citizen base that is willing to disrupt port activities. Such lack of social license has made it hard for the port to keep shipping lines interested in continuing service. The same may be said of the Port of Portland, whose congested landside infrastructure has tested the patience of local commuters. The loss of Hapag-Lloyd in April 2015 caused an 80% reduction in the port's container business,[4] at a time when west coast ports were still struggling with the residual effects of the surge of 2014-15.

**Table 4: Handling a Surge: Headline Timeline**

| Date | Source | Headline | Critical Content |
|---|---|---|---|
| 6 October 2014 | Journal of Commerce | LA-LB volume up 1%, ILWU hours up 20% | Port congestion is beginning to have a significant impact on port competitiveness |
| 7 October 2014 | Journal of Commerce | From the Editor (Mark Szakonyi) | A shipper survey suggests the railroads could have converted even more from highway to rail if not for poor service. … shippers expect to ramp up their modal shift to intermodal rail but network fluidity isn't expected to get back to normal |
| 7 October 2014 | Journal of Commerce | Congestion worsens at LA-LB port complex with no relief in sight | The story continues … |
| 8 October 2014 | Journal of Commerce | Long Beach enters 'crisis mode' to attack congestion | The Port of Long Beach begins action … |
| 9 October 2014 | Journal of Commerce | Large U.S. railroads required to report weekly metrics following service problems | The Surface Transportation Board intervenes seeking performance metrics (all Class I railroads to issue detailed weekly performance metrics for each major freight type, including intermodal). |
| 14 November 2014 | Journal of Commerce | From the Editor (Grace Lavigne) | [in advance of the known coming peak season] the Pacific Maritime Association [management] has called upon the ILWU [labour] to immediately agree to a temporary contract extension in order to end job actions in Los Angeles–Long Beach and Seattle-Tacoma |
| 14 November 2014 | Journal of Commerce | Some LA-LB drayage drivers agree to stop striking but not all | Trucking industry is involved in job actions in Los Angeles–Long Beach |
| 14 November 2014 | Journal of Commerce | West Coast port chaos drives up air charter business | [in advance of the Christmas retail season] shipping loses customers to air cargo |

[4] *Port Technology Daily* (2015), Hapag-Lloyd Drops Port of Portland, 9 April. http://www.porttechnology.org/news/hapag_lloyd_drops_port_of_portland?utm_source=Port+Technology+Newsletter&utm_campaign=54f775e312-PortTechnology_Daily09_04_2015&utm_medium=email&utm_term=0_89349292d5-54f775e312-235015637

| Date | Source | Headline | Critical Content |
|---|---|---|---|
| 17 November 2014 | Lloyd's Loading List | Lines impose U.S. west-coast congestion surcharges + Transpacific shippers hit with new charges of up to $1,000 per FEU from today | Shipping lines seek redress from customers for port problems |
| 17 November 2014 | Lloyd's Loading List | Long Beach opens new box area to ease congestion | The port removes empty containers to a new container depot to free terminal space |
| 17 November 2014 | Daily Shipping News (HK) | U.S. Federal Maritime Commission doubts legality of congestion surcharge | The regulators intervene … |
| 21 November 2014 | Daily Shipping News (HK) | Carriers suspend US$1,000/FEU congestion surcharges in face of feedback | The regulators succeed in preventing backlash on customers for shipping line frustration with port performance |
| 24 November 2014 | Drewry Research | Insight: U.S. Port Congestion | Metrics for Monitoring congestion and traffic flow would have picked up the issues before they became media fodder |
| 5 December 2014 | Daily Shipping News (HK) | LA-LB congestion has wider impact on global schedule reliability | The West Coast surge has impacts around the globe on reliability of the maritime mode. In California, schedule reliability and container delivery declined by 24%. |
| 13 February 2015 | Daily Shipping News (HK) | U.S. imports rise despite threat of west coast port closure | East coast ports have been the beneficiaries of west coast labour disputes |
| 28 April 2015 | Daily Shipping News (HK) | West coast congestion brings fed-up shippers to Ohio's Rickenbacker field | Rickenbacker International Airport, Columbus, OH, has seen a nearly six-fold increase in Q1 volume due to impatient shippers unwilling to suffer delays on the U.S. west coast |
| 12 May 2015 | U.S. Senate Commerce, Science, and Transportation | Press Release: Senators Introduce Port Transparency Bill in Wake of Prolonged West Coast Ports Strife | S. 1298 will "shine a light on what's happening at our nation's ports before a labor dispute erupts and threatens our economy." |
| 20 May 2015 | Drewry Carrier Performance Insight | Containership reliability reaches new high as congestion and alliance issues fade | While carrier reliability on the Transpacific is back to rates of June and July 2014, that high is an average of 54%! |

Source: Selectively compiled from the headlines of four news feeds (the second column).

It is also important to remember that ports with excess capacity are not as challenged when a surge occurs. The Port of Halifax has excess container handling capacity at both its container terminals and no shortage of berth length or channel depth; its challenge, if faced with a surge, will be whether

Canadian National will add additional trains to carry away the capacity. The challenge of managing a surge is very port-specific.

The critical questions are: How does a port know a surge is building? How does a port handle a cargo surge? Can and should a port prepare to handle the peak of a surge? These are questions that ports consider part of their core business strategic thinking and so indicators of a building surge are a key component of a fluidity-driven metrics development program.

Finally, the surges of the past few years can be connected, in the container part of the market, to the massive ordering of larger ships with more frequent calls coupled with shipping line decision-making focused solely on cost reductions and not on customer service (for the most part).[5] The world economy is slowing, but the container industry shocks of redeployment of larger vessels have yet to be fully realized, so there will be continued pressure on some ports as rationalization of sailing schedules continues and a few ports succeed in attracting the business. Cargo owners on the other hand will be ever more interested in fluidity as shipping lines cease to consider the importance of inventory carrying costs to this group. As for bulk, the surge of 2014 in the grain market was a combination of strong harvest volumes and constrained capacity railside. Measuring fluidity metrics here is important as well, as effectiveness will be seen as mostly a port and rail service issue.

In conclusion, the first challenge for ports is to recognize the precursors to a surge. The second is the formulation of plans to handle a surge. Both of these require good data and a carefully planned program of data collection and management. The availability and analysis of quality, objective-driven data is key to future success for Canadian ports in both identifying a surge and knowing how to manage it.

“ the first challenge for ports is to recognize the pre-cursors to a surge.

5 Even Maersk has cancelled its premium customer service product, Daily Maersk, to focus on a strategy of ocean cost minimization. In a recent presentation, *Changing Landscape of Container Shipping*, Ron Widdows indicated that container lines have ceased to respond to reliability, transit time and service in favour of cost minimization. http://globalmaritimehub.com/custom/domain_2/extra_files/attach_529.pdf

# 4.0 Port Performance Developments Globally

## *4.1 Europe's PORTOPIA Initiative—A Port Observatory*[6]

In 2012, PPRISM (Port PeRformance Indicators: Selection and Measurement) reported its research findings to the European SeaPorts Organisation (ESPO, 2012). The report identified activities taking place within the port, but did not provide individual ports with a clear understanding of their own performance on these activities against the services their own users consider important and relevant. Since then, due to a change in ESPO leadership, the ESPO Dashboard has become focused on environmental metrics (and not on either port efficiency or effectiveness ones).

Under its Framework 7 program, the European Commission has supported PORTOPIA (PORTs Observatory for Ports Indicator Analysis) initiative, as phase 2 of the PPRISM initiative. The PORTOPIA team is examining measuring maritime access fluidity, hinterland access and connectivity, and exploring port dashboards and user survey approaches, among other activities.

PORTOPIA has established a mock dashboard that will allow ports to see their data in comparison with other ports' data. The belief is that port performance benchmarking must be port-centric; in other words, if ports are not cooperative, then imposing the desired performance measures will not be successful. The data are only as good as what the port chooses enter into the system. There is agreement, however, that a single indicator is not enough.

One working group (WG4) within PORTOPIA is looking at measuring connectivity; it proposes to measure intermodal connectivity by the number of connections by road and by rail with the port. The challenge is that this does not capture indirect connectivity and transhipment is common in global supply chains. It also has the difficulty that the ports are not enthusiastic about supplying such connectivity information because it costs a lot in time and manpower for them to collect the data.

PORTOPIA is developing a northern corridor performance dashboard to measure fluidity in the supply chain. Objective assessment through the use of GPS is being examined, but user assessment has not been adopted in principle. There have been challenges with the adoption of GPS as installed GPS has not proven to be acceptable to the land transport suppliers. As a result, the proxy of using WAZE data[7] (from smartphones) to measure speed is under consideration. The challenge is that WAZE has no historical data capacity, but could collect data for future model development.

Also under WG4, a maritime fluidity pilot project has been constructed for Bremerhaven. Using Marine Traffic AIS data, the research team can measure the time elapsed while the vessel travels between two geographic points in the channel. The team excludes anchor points and where the pilots board the ships in order to get a more accurate metric for vessel free flow. It has also decided 'the number of ships waiting at anchor' as an indicator does not truly reflect congestion as ships may be parked by their owners/operators for other reasons.

As for collecting expert opinion (effectiveness perceptions) by port users in support of a responsiveness goal (Working Group 6), this has not been well received by the ports, and after two years Pallis and Vaggelas (2015) have only been able to identify a long list of criteria for deployment but have not managed to do the data collection necessary to develop a short list as was done by the American Association of Port Authorities (see Section 4.3.2). This effectiveness measurement effort has been expanded to separate feeder container operations from deep-sea and to include seven of

6 The content of this section is a summary of conversations with a number of PORTOPIA scholars and so should be considered anecdotal only.

7 https://www.waze.com

eight port services: Towage, Pilotage, Port Reception Facilities, Mooring, Bunkering, Dredging and Ice-breaking.[8] There is discussion within PORTOPIA about using a variant of the AAPA survey tool SEAPORT (discussed in Section 5.3.2) that would allow ports to plug in modules from an existing menu. This would mean that ports can choose the criteria that matter to them (not necessarily those important to or determinant of customer ratings), and contact those customers they wish in order to undertake a strategic analysis of the type discussed in Section 3.3. Such a set-up is anticipated to be contingent on the existence of a firewall preventing the European Commission from having access to the data and further regulating the industry.

## 4.2 Port Performance in Australia

Australia was a pioneer in efforts to development efficiency metrics, as the Australian government sought to assess its waterfront reform initiatives in the late 1980s and early 1990s (Bureau of Industry Economics, 1993). The government wished to understand port performance in terms of operational efficiency and the customer requirements of timeliness and reliability; it collects basic efficiency data for the key national ports and reports that data annually.

The Bureau of Infrastructure, Transport and Regional Economics issues a quarterly report, *Waterline* (BITRE, 2015), providing data on container traffic at five Australian major port terminals: Brisbane, Sydney, Melbourne, Adelaide and Fremantle. The *Waterline* report covers the basic efficiency input data collected (see Table 5) and its interpretation; labour productivity data is compared via indexing to the broader Australian economy while port costs are compared to the GDP deflator.

Ports Australia, the industry association representing the ports of Australia, reports basic statistics for its member ports: tonnes, TEUs (import and export, full and empty in each of these two groups), and vessel calls by size and type. The statistics are available on the Ports Australia web site, but are of such a basic nature that they do not provide a foundation on which management insight can be built by port managers but serve an ‘annual reporting’ function only.

In addition to government initiatives, some ports are investing individually in marketing research (Whittle, 2012) and adopting a marketing perspective for providing customer service. This means a shift toward understanding and better efforts at meeting customer needs. This goes beyond basic efficiency towards effectiveness by recognizing that different customer or user segments could have different criteria for determining satisfactory service. In 2010, preliminary discussions with Ports Australia about an effectiveness benchmarking program were not well received; it was the view of Ports Australia that each port should understand its own customer satisfaction research if it wished and that many Australian ports already had their own market research programs. In such an ‘each port on its own’ approach, ports do not gain the benefits of being able to benchmark against best practices for the country or of the cost spreading that occurs when customers and users are only approached once annually to collect the data. Collaborating to compete is not the Australian approach.

8 Cargo-handling, passenger services and environmental services are reported as three of the eight port services by PWC and Panteia (2013) while PORTOPIA has ice-breaking on the list and combines the remainder into port reception services. Measuring satisfaction is a key element of their approach and they note the dissatisfaction found in EU ports with pilotage and towing. What is disconcerting about the PWC and Panteia approach is that the ports are treated as stakeholders in the analysis, somewhat akin to asking the fox to evaluate the security at a chicken farm.

**Table 5: Efficiency (Throughput) Indicators Collected in Australia (frequency of reporting, data source)**

| Wharf-side Container Throughput (quarterly, stevedore) | Landside Throughput Indicators (quarterly, not indicated) |
|---|---|
| Unitized cellular container ships handled | Number of trucks used in VBS/TAS operations |
| Total containers handled | Total number of containers transported by trucks and rail |
| Total TEUs handled | Total number of containers transported by trucks (1) |
| 40-foot containers as percent of all containers handled | Number of containers by rail (2) |
| **Whole of port throughput indicators (six-monthly, port authorities)** | Total number of TEUs transported by trucks and rail |
| Total cargo throughput | Total number of TEUs transported by trucks (1) |
| Non-containerised general cargo throughput | Number of TEUs by rail (2) |
| Total number of TEUs exchanged | **Whole of container terminal throughput indicators (quarterly, port authorities** |
| Number of TEUs: Full import | Total number of container ship visits, as reported by Port Authorities |
| Number of TEUs: Empty import | Total number of containers (lifts) exchanged |
| Number of TEUs: Full export | |
| Number of TEUs: Empty export | |

Notes: The term stevedore refers to a company, which manages the operation of loading or unloading a ship. VBS = vehicle booking system TAS = truck appointments system. (1) This data is discontinued due to data reporting inconsistencies. (2) This data is reported differently for the Sydney than for other ports.

Source: BITRE (2015). Waterline 56, May, pp. 1-2.

## 4.3 U.S. Approaches (Government, Ports and the AAPA)

### 4.3.1 The U.S. government agency concerns

The U.S. does not have an explicit national ports policy (Fawcett, 2007). However, it is at least moving towards a national freight policy.

> *With the enactment of Moving Ahead for Progress in the 21st Century (MAP-21), state and metropolitan transportation agencies must adopt performance-based planning and programming that embraces measures and targets for travel time reliability along with safety, infrastructure condition, congestion reduction, sustainability, freight movement and economic vitality, and reduced project delivery delays.*[9]

As part of the MAP-21 legislation, the U.S. Department of Transportation Maritime Administration (MarAd, 2015) is charged with creating a national freight policy to improve the performance of the U.S. freight network and develop a freight conditions and performance report that requires measuring the conditioning performance of that system. One of the goals of MAP-21 is to reduce congestion. MarAd recognizes there are many contributors to congestion; its focus has been predominantly on capacity-related matters and on an adequate channel and berth dimensions, with less focus on gate hours at terminals, seasonal demand, or regulatory and administrative procedures. As a result, the measures being considered for collection are delays in queue, wait time, percent of capacity utilization, turn time, percent of utilization in container yard, and percent deliveries made on time. This is significantly more than what is currently collected—mainly basic traffic and berth statistics.

Bureau of Transportation Statistics collects vessel calls and vessel deadweight tonnage (DWT). Data sources of those under consideration are currently ports, port directories and the AAPA. Furthermore, U.S. data collection efforts do not use commonly agreed methods or standard definitions, and data are collected by different entities with different interests and requirements.

The U.S. challenge is that a "lack of complete data on U.S. international freight continues to hamper research and analysis of trends in international freight movement and its impact on transportation activity within the United States."[10] Moreover, the U.S. Census Bureau—the agency responsible for reporting U.S. merchandise trade data—does not collect data on the export shipment weight for goods transported by truck or rail. Furthermore, the MarAd has gone on record that the lack of a national standard for performance measures and a reporting process have "stymied its attempts to measure the efficiency of major U.S. ports."[11]

The U.S. government has formed the Federal and Industry Logistics Standardization (FILS) committee, a collaboration effort between industry and government agencies, to adopt uniform nomenclature in order to improve accuracy and efficiency when electronically sharing common data. Building on the work of the Transportation Research Board (2012), with its focus on interstate cooperation and the development of supply chain knowledge, there has been considerable interest in building supply chain fluidity in the U.S. since the passage of MAP-21. Several U.S. states have

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9 Cambridge Systematics (2014), Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes: Final Report, Strategic Highway Research Program, Washington, DC: Transportation Research Board p. vi.

10 U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics (2009). America's Freight Transportation Gateways 2009, Washington, DC: U.S. Department of Transportation, p. 17.

11 National Cooperative Freight Research Program (2014). Performance Measures for Freight Transportation (NCFRP Report 10), Washington, DC: Transportation Research Board, p. 126.

begun to measure reliability in specific freight corridors, including Washington State and Minnesota (Cambridge Systematics, 2014), and there is urgency in a number of states to improve freight corridor congestion measurement. Cambridge Systematics (2014) has highlighted the contribution of Lam et al. (2005), who concluded that truckers will take more circuitous but reliable routes if they need reliability in delivery time; Cambridge Systematics concludes there is, in the U.S., a need for reliability technical analysis as there is a high interest in reliability and the measurement of congestion but considerable difficulty in incorporating reliability in transportation planning. At least in Canada, there are fewer provinces and organizations to include in planning freight movements and in developing a system for congestion measurement.

More recently, Bryan (2014) has noted that Parsons Brinckerhoff has received a contract for a study on the I-95 corridor, the charge being to

> *advise the Secretary of Commerce on the necessary elements of a comprehensive, holistic national freight infrastructure and a national freight policy designed to support U.S. export growth and competitiveness, foster national economic competitiveness, and improve U.S. supply chain competitiveness in the domestic and global economy.*

The study outlines what must be done to identify links, nodes and pain points in U.S. end-to-end supply chains. The metrics proposed to be collected begin with a port arrival and end at a retail store, collecting transit time, dwell, cost, reliability and safety. The Parsons Brinckerhoff study does not contemplate bulk moves, export moves, maritime fluidity or sea leg costs; however, the funder, the Federal Highway Administration (FHWA), is working to implement the MAP-21 vision and to resolve fluidity issues landside and to make it part of the Freight Transportation Conditions and Performance Report under MAP-21 and the National Freight Policy. Finally, the FHWA with the support of MarAd expanded its Intermodal Connectors study, being done by Cambridge Systematics and due out in the summer of 2015, to include an evaluation of intermodal connectors at selected U.S. ports.

As a result of the problems U.S. ports had handling the recent surge on the U.S. west coast (described in Table 4), on 29 May 2015, the U.S. Senate introduced the Ports Performance Act (S. 1298: *A bill to provide nationally consistent measures of performance of the Nation's ports, and for other purposes*). The purpose of the bill is to create 'a new level of transparency and accountability' for ports by requiring the Bureau of Transportation Statistics to establish a port performance statistics program and report annually to Congress on the performance and capacity of key ports, those that are subject to federal regulation or receive federal assistance. On 25 June 2015, the Senate Committee on Commerce, Science, and Transportation indicated that it be reported as amended. Whether it will pass the Senate, pass Congress, gets signed by the President, and receive adequate appropriation of budget for its execution are substantive remaining hurdles.[12]

Government agencies and university scholars are not the only ones interested in mapping U.S. freight flows. Tomer and Kane (2014), as part of the Global Cities Initiative of The Brookings Institution and JP Morgan Chase, have begun the process of mapping the top corridors, trading regions and most

[12] The Committee-passed bill calls on the U.S. DOT to establish a working group, would include one representative from the port management industry, to develop the metrics specifics. The bill calls for metrics related to capacity, cargo volume, crane lifts per hour for containers, vessel turn time, dwell time, port storage capacity and utilization, truck time at ports and rail time at ports, in other words, fluidity. The AAPA has declared its concerns with the bill as being too prescriptive and seeks, in its letter of 1 July 2015, the formation of a working group to identify the right metrics to be collected (AAPA, 2015a). AAPA (2015b) notes that the bill will be attached to the surface transportation bill, which will be considered by the Commerce Committee and is expected to move quickly through Congress.

important flows given that many flow through major urban centres. Metropolitan Planning Organizations (MPOs) have become very key players in the issues of the city-freight interface.

On the other hand, the Bureau of Transportation Statistics (2014) appears to have absented itself from the data collection activity; the only intermodal indicators reported for the freight sector are rail freight revenue ton-miles and vehicle miles traveled. The data are not timely; as of June 2015 the most recent report has an August 2014 date.

> "Canadian ports and inland supply chain partners should be careful not to become complacent.

All that can be concluded at this point is that Canada's collection of transportation performance metrics is well ahead of those of the U.S. government and individual states, but many states and MPOs are working hard to catch up and exceed efforts found in some Canadian provinces. Therefore, the U.S. does not supply a model for the Canadian government to emulate but good research is happening that can be monitored. Given the recent federal focus on this issue and legislative authority through MAP-21 and the international leadership of the Texas Transportation Institute's research on congestion measurement, Canadian ports and inland supply chain partners should be careful not to become complacent.

#### 4.3.2. The American Association of Port Authorities Port Customer Service Initiative

In 2012, the Port Performance Research Network housed at Dalhousie University worked with the American Association of Port Authorities on a **Port Customer Service Initiative** (performance effectiveness measurement by industry) to use this research to establish a baseline of knowledge on users' perspectives of service in seven North American container ports (Port Performance Research Network, 2012). The AAPA initiative is an Internet survey approach, which contacts port customers and users, and is aimed at assessing port effectiveness.

Through this initiative, all participating ports were provided with an individual report on their own performance along with the best practice score on that element and a range of scores, and the AAPA received a 'state of the ports' report on the overall situation (without naming the ports involved). To kickstart the initiative, participating ports each provided more than 550 names in total of people in container shipping lines, manufacturers and retailers, freight forwarders, trucking and rail companies and other supply chain partners that used their ports. The study team removed duplicate names and identified potential respondents from the same organization to ensure that each office location did not receive more than one survey, but if the person receiving the survey did not respond, another person in the same office could be approached. The intention of this approach was to avoid survey fatigue and bias from too many responses from one organization.

Six studies have resulted from the data collected and are all accepted for publication but all are not yet in print. Using this study, Schellinck and Brooks (forthcoming) have created a new tool—SEAPORT (Service Effectiveness Assessment for PORT managers—for measuring port effectiveness for three user groups (container shipping lines, cargo owners and freight forwarders, and local trucking rail and warehouse companies). The tool was validated in the 2014 AAPA Port Customer Service Initiative, with the results delivered confidentially to participating ports. (While the ports were happy in 2012 to pilot test the tool, by the 2014 repeat of the initiative, they wished to have only their own results and a best practice score so no report was prepared for the AAPA.) The tool has been translated into French and Spanish, but is not yet validated in these languages.

# 5.0 Port Performance Measures

## *5.1 Port Efficiency Measures Found in the Literature*

In 2007, Transport Canada, as part of its Gateways and Corridors policy developments, contracted Dalhousie University to produce a literature review on port performance benchmarks and indicators. More than 80 journal articles and studies published between 1993 and 2007 yielded a list of efficiency and effectiveness performance metrics, which were organized into financial, non-financial (e.g., safety, security) and operational efficiency metrics as well as a set of effectiveness metrics for Transport Canada to consider. From these, Transport Canada determined which criteria it was interested in exploring further with the ports.

From the perspective of this report, only three articles from the 80 were found to measure congestion, delay and fluidity in a port-centric supply chain. Lirn et al. (2003) defined congestion as 'Port berthing time length.' Sánchez et al. (2003) defined congestion as ship waiting time and yearly total for such time. Tiwari et al. (2003) concluded that congestion influences port choice but did not identify how congestion was measured.[13] Time and availability of inputs are critical components of measuring fluidity. Without a standard validated definition found in the literature at the time, it is not surprising that there was little for the Dalhousie team to recommend to Transport Canada for immediate use in measuring fluidity.

Since the development of this 2007 comprehensive assessment of peer-reviewed scholarly publications, the research field has proliferated with more scholars and even more research, much of it less relevant to the task at hand than expected. Therefore, this section seeks to be relevant rather than aiming to be comprehensive. A search of the more recent literature (2008-2015) for transport content on the themes of congestion, delay and fluidity identifies a tsunami of trade (magazine and newspaper) literature, including a lot of discussion of the surge on the west coast as noted previously, and a dearth of scholarly literature on the topic. There were 45 new scholarly articles identified as possibly contributing new insights into the measurement of transport supply chain fluidity or congestion. Each of these articles was examined for what it contributes to understanding of the overall state of practice in port performance more generally, and then specifically to the challenge of congestion and subsequent loss of fluidity in goods movement. Of the 45, 10 focused on effectiveness (and will be discussed in the next section), 13 provided no contribution of significance for this report, and 8 were either so general as to be not useful or so theoretical as to be not relevant to the discussion. Nine are discussed elsewhere in this report, at points where they make a contribution. The remainder are discussed below.

One research paper (not mentioned elsewhere) reinforces the existing efficiency measurement strategy of focusing on congestion and fluidity. Leachman and Payman (2011) provides particularly insightful arguments in favour of the need for congestion measurement and dwell time measurement in U.S. ports and conclude that

> *Some of the melt-down events [on the U.S. west coast in the period up to 2007] came as a surprise to industry managers and governmental officials. We believe this reflects a lack of practical analytical tools that can be used to predict container flow times as a function of volume, infrastructure and staffing.*[14]

[13] As their indicators were statistics such as TEUs handled, water depth and number of cranes, but with no measures including a time element, their contribution is discounted for the purposes of this report.

[14] Leachman and Payman (2011), p. 992.

They conclude that no single efficiency indicator can measure and then predict container flow as a function of the surge volume, the equipment and berth space availability and the labour availability. Fan et al. (2012) recommend the use of average waiting time in days as a port congestion measure but such a measure merely confirms a surge exists if it is more than zero. Moon and Woo (2014) underscores the importance of measuring idle time in port; they propose three elements as critical to measure if seeking to improve port efficiency: (1) first line to pier to beginning of cargo handling, (2) end of cargo handling to last line let go, and (3) anchor in to anchor out if anchoring is a significant factor in port operations. Where maritime fluidity is identified to be a challenge for a port, these would be appropriate measures to consider implementing.

Perhaps the greatest contribution to understanding fluidity in the supply chain from a port perspective comes from Suárez-Alemán et al. (2014); while the authors decompose the time-based issues for short sea shipping operations, the process used in this study could easily be applicable to all port operations and is consistent with the theoretical approach discussed above in section 2 and Table 1. Moini et al. (2012) evaluate cause and solutions to container dwell in ports and note the importance of demurrage policies in managing dwell. Finally, Suárez-Alemán and Hernández (2014) suggest that if port inefficiency is identified, incentives can be used to reduce vessel or cargo dwell, and recommend that ports introduce a subsidy per inefficiency-reducing unit of activity.

In summary, the situation seems little improved since 2007, indicating that evidence is anecdotal, research draws on data that are readily available in secondary sources rather than seeking to collect the appropriate data. When there is primary data collection, much of it is for one port or a set of regional ports and suffers from being a one-time effort. This means that the instruments and constructs fail to be validated by a second round of research. Much of the primary data that are available to port managers and to governments continue to be either (a) available for purchase from third party suppliers, or (b) proprietary and collected by ports themselves, for their own use and not shared.

## *5.2 The Measurement of Port Effectiveness*

Very little of the literature pre-2005 focused on customer responsiveness and the concept of customer satisfaction and loyalty, e.g., where ports were effectively delivering the services required by their customers and users. Most of the literature focused on the technical performance and efficiency of the use of port assets such as land, cranes, berths and labour. While ports may argue that they are efficient and therefore competitive, users may perceive that the port is or is not serving them well. If the port, and its tenants and partners, are able to deliver the services required and the delivery of services matches expectations, the port is seen as effective. If a port assumes it is effective, it does not truly know whether it achieves that goal without an effectiveness measurement program. In other words, assuming a port is effective because it is efficient is illogical but the current practice.

Much of the literature since 2007 was driven by Port Performance Research Network efforts in North America and Europe. The only research stream identified that was not related to PPRN or PORTOPIA research (discussed in Section 4.1) was Yeo et al. (2008, 2011). This study looked at using a factor analysis to evaluate 34 items using the expert opinion of customers in China. Like so many other scholarly studies, this was a one-off study that has only recently replicated in another market, Taiwan (Yeo et al., 2014). This effort however has not led to the development of port effectiveness measurement tool as the PPRN and PORTOPIA initiatives have considered to be the path forward. The PPRN series of studies, discussed in the next paragraph, identified the critical measures of effective port service delivery through three pilot studies to arrive at an instrument that could reliably collect effectiveness data for all but two customers and users; it has not yet been tested for bulk shipping companies or for providers of port services (pilotage, tug, bunkering and the like) as proposed by PORTOPIA.

The three pilot studies (Brooks et al., 2011a, 2011b; Schellinck and Brooks, 2014) not only reduced the relevant effectiveness criteria to a manageable list, and validated a methodological regime, but also repeated the research to conduct confirmatory analysis. The process also found that satisfaction and effectiveness in service delivery are highly correlated constructs. Through two separate data collection exercises (AAPA Port Customer Service Initiative 2012 and 2014), the PPRN has identified what factors are critical to effectiveness evaluation in North American ports. Some of these are fluidity/congestion relevant and so will be discussed in Section 5.3. The AAPA Port Customer Service Initiative identified determinant criteria (Table 6) for three user groups:

1. **Cargo interests**, defined as those responsible for the purchase of some of the transportation services for (a) goods they sell/buy or (b) on behalf of some importer and/or exporters.
2. **Shipping lines**, defined as companies supplying container ship services that call ports with container-handling facilities.
3. **Supply chain partners**, defined as (a) warehouse operators that service port(s) with container handling facilities, (b) asset-based logistics service suppliers that use port(s) as part of the services provided and/or (c) trucking or rail companies that service port(s) with container-handling facilities.

**Table 6: Change in the Number of Determinant Criteria Incorporated into AAPA Effectiveness Tools**

| User Group | Statements in AAPA 2012 | Statements in AAPA 2014 |
|---|---|---|
| Shipping lines | 19 criteria | 13 criteria |
| Cargo owners & cargo agents | 11 criteria | 8 criteria |
| Supply chain partners | 15 criteria | 8 criteria |

The AAPA data collection effort provided sufficient data to assess effectiveness from the perspective of three user groups (Brooks and Schellinck, forthcoming, 2015; Schellinck and Brooks, 2016), the overall approach to be taken (Brooks and Schellinck, 2013), and the scales for deployment in 2014 (Schellinck and Brooks, forthcoming). While the SEAPORT instrument has only just been validated, and that validation demonstrates that an every two-year effort to assess effectiveness is adequate for ports to evaluate strategic investments, it is now ready for broader use.

## *5.3 The Measurement of Congestion and Mobility/Fluidity*

An individual's perception of congestion and the actual measured congestion often do not agree; in fact, people often believe that trucks make up a greater volume of traffic on the road than is the case and that the delay is longer than it really is (Le et al., 2012). The Texas A&M Transportation Institute (TTI) is considered a national leader in the U.S. in providing congestion and mobility information. Its approach to measuring congestion provides a good model for the port access element of a port performance measurement system. TTI measures congestion in terms of the time (days, hours, minutes or even seconds) of the delay resulting from traffic volume, speed and travel time and creates congestion indices to reflect the variance of the congested time relative to ‘free flow’ time. All of these inputs to congestion can be measured (and seen as impacting efficiency), as can the perceived congestion (which goes to the measurement of effectiveness). While IBM publishes an annual study on the attitudes of commuters from across the world on their daily travel (known as the Commuter Pain Survey), in Canada less is known about the congestion resulting from commuters as opposed to from freight than is desirable. The TTI publishes an annual Urban Mobility Report that measures urban mobility based on public and private traffic data for highways, streets and transit. There is not a comparable program in Canada.

In the U.S., trucks account for 7% of vehicles on the road but bear 22% of the cost of congestion.[15] What are the comparable numbers for Canada's gateways? Congestion and delay are critical components of fluidity and yet their roles are not entirely clear. Most important to consider is that, even if Canadians knew their congestion indices, would they know how it affects particular Canadian supply chains? Therefore, how will it affect them? Schrank et al. (2012) provide some very interesting thoughts about the reporting of travel time and why reporting average travel time is inadequate.[16] Lomax et al. (2012) extends the previous TTI research program and delves into the relationship between congested freight corridors and urban space. This foundational research allows U.S. cities and policy analysts to look more closely at arterial street operations and mobility. It proposes to change the definition of "free-flow speed," and improves the estimates of congestion and its costs. Finally Farzaneh et al (2012) developed a framework and methodology to address the issues of freight sustainability at the transportation corridor level (highways and rail facilities). Performance measures were developed for both urban and rural corridors and a methodology for evaluating individual performance measures for a specific transportation corridor. While their focus was to develop an aggregate sustainability indicator, there is much research here of use in evaluating Canadian landside corridors that pass through congested urban spaces.

McKinnon (2015) provides an excellent summary of the reasons why landside congestion is so important to Canadian competitiveness:

> *First, the impact of congestion on logistics performance is not so much a function of the average delay as of the variability around this average. Where congestion is regular, stable and reasonably predictable, companies can build extra slack into their delivery schedules to maintain service standards, admittedly at a significant resource cost. Where a highway network is nearing full capacity, however, the vehicle flow becomes unstable and much more vulnerable to accidents, breakdowns, roadworks and bad weather. The resulting loss of delivery reliability not only increases the direct, on-the-road cost of traffic congestion; it also imposes indirect disruption costs on production and logistical activities at the destination and possibly several other downstream links in the supply chain. Few attempts have been made to quantify these 'consequential costs' of traffic congestion.*[17]

As insight into fluidity demands knowledge about the reliability of travel time, this critical element will be explored more deeply in the discussion of what currently happens in Canada (in the next section).

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15 Schrank, D.L., W.L. Eisele, T.J. Lomax (2012). 2012 Urban Mobility Report, Texas Transportation Institute. http://mobility.tamu.edu/ums/, p. 9.

16 Schrank, D.L., W.L. Eisele, T.J. Lomax (2012). 2012 Urban Mobility Report, Texas Transportation Institute. http://mobility.tamu.edu/ums/, p. 12.

17 McKinnon, Alan (2015). Performance measurement in freight transport: Its contribution to the design, implementation and monitoring of public policy (Discussion Paper 15-03), the Roundtable on Logistics Development Strategies and their Performance Measurement of the International Transport Forum of the OECD in Queretaro, Mexico in March 2015. http://www.internationaltransportforum.org/jtrc/RoundTables/2015Logistics/index.html, p. 18.

## 5.4 A Look at Transport Canada's Fluidity Web Portal

> *In response to the increase in trade and the resulting impact on the transportation system, the Government of Canada released the National Policy Framework for Strategic Gateways and Trade Corridors in July 2007. This Framework was developed to improve the capacity and efficiency of the country's transportation system to support international trade, thereby advancing the competitiveness of the Canadian economy. The Framework provides focus and direction through a government-wide approach that fosters further development and optimization of the transportation system that is fundamental to Canada's success in international trade.*[18]

The efforts by Transport Canada to develop and expand its fluidity web portal as a direct execution of this 2007 policy. In the seven years since the decision to re-orient the government's transportation policy focus to the key competitive element of fluidity, significant progress has been made.

> *Transport Canada (TC) measures the fluidity and performance of supply chains to follow through on its commitment to support the Asia-Pacific Economic Cooperation's (APEC) goal of increasing supply-chain efficiency by 10 percent by 2015. In 2013, the average end-to-end transit time for container imports from Shanghai to Toronto via the Asia-Pacific Gateway increased by 2.9 percent to 24.3 days. The increase was due to unfavourable weather conditions and was partly offset by the relative stability of ocean transit. The increase in average end-to-end transit time was also due to early- and late-year operational setbacks at west coast ports and inland transit.*[19]

The above quote summarizes the public reporting of Transport Canada's measurement of fluidity. This is a very high level and sanitized approach to reporting performance. Transport Canada's annual report, *Transportation in Canada*, does not reflect the true depth of coverage that currently happens in Canada.

> **"Transport Canada's annual report does not reflect the true depth of coverage that currently happens in Canada.**

As noted in Section 3, Canadians should expect that Transport Canada would have a comprehensive plan for measuring port performance in keeping with the government's policy goals on three dimensions. This raises the question: What is the government's over-arching goal for port performance measurement? Transport Canada's report to the International Transport Forum (2012) says its goals are to collect "objective fact-based metrics" that are transparent and "respond to anecdotal claims of (un)reliability, provide reliable and objective benchmarks for industry, and market and promote Canada's gateways efficiently."

To meet this goal, Transport Canada established the fluidity web portal where those participating in the program can see data aggregated in the months after the data are collected. Transport Canada (2013) provides a detailed walkthrough of its web portal (for those without access to the portal)

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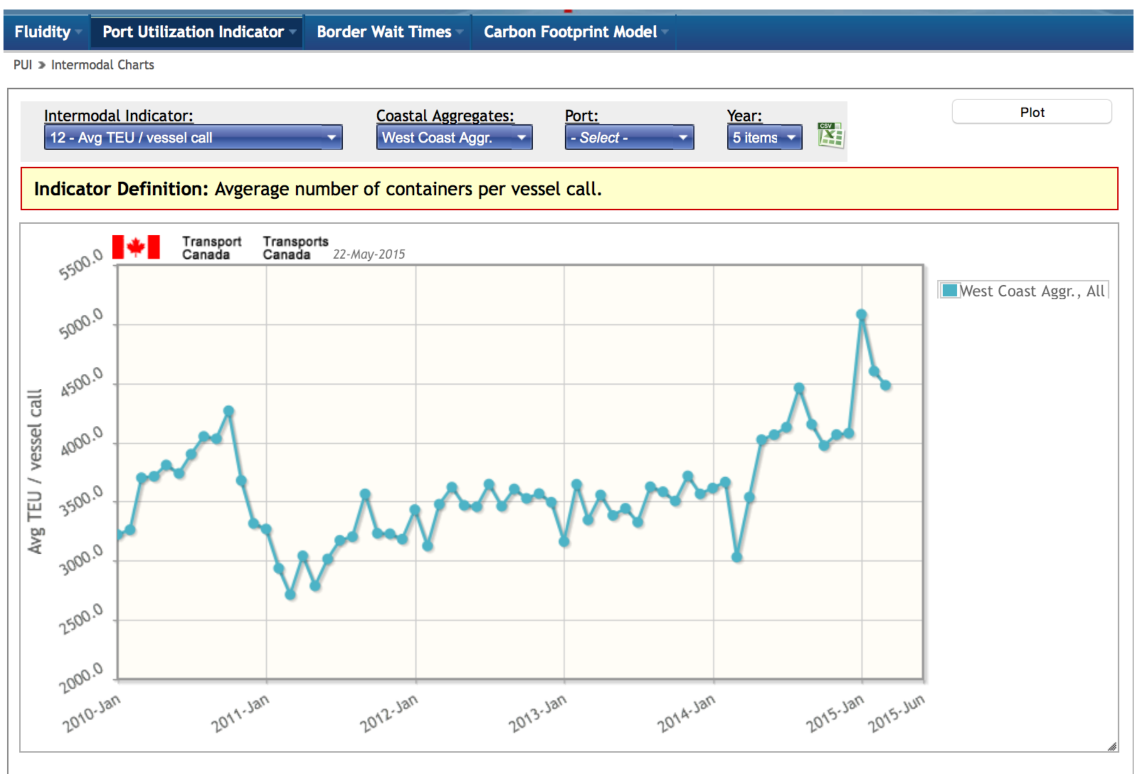
[18] Chapter 11, Transport Canada (2011). https://www.tc.gc.ca/eng/policy/anre-menu-3023.htm

[19] Transport Canada (2014). Transportation in Canada 2013 (TP14816), p. 29.

identifying what is collected and what is possible to discover from the web-based tool; access to the portal requires registration and authorization by Transport Canada staff and the depth of access granted is commensurate with the contribution of data to the portal's database. To write this report for the Canada Transportation Act Review Panel, access was granted to the most general tier and queries about deeper level content were responded to by Transport Canada staff. The screen captures used in this report were taken, with permission, from the most general tier of the portal.

Transport Canada's current fluidity metrics have focused on container imports and bulk exports, with container exports currently in development but more challenging to set up. (There is not the same lead-time on export data as is the case with import containers.) In order to set up this fluidity index, Transport Canada has entered into partnerships with those manufacturers and retailers who have asked; this is not at an industry association level but specific manufacturers and retailers may request to participate. So cargo interests provide their support by granting permission to use the Canadian Border Services Agency (CBSA) data, specifically the container number, and that number is used to track the container through the supply chain. Dwell time data is captured by the port using the container number. For grain dwell, the fluidity index uses data supplied by the Canadian Grain Commission.

**Figure 6: Container Traffic via Canadian West Coast Ports**



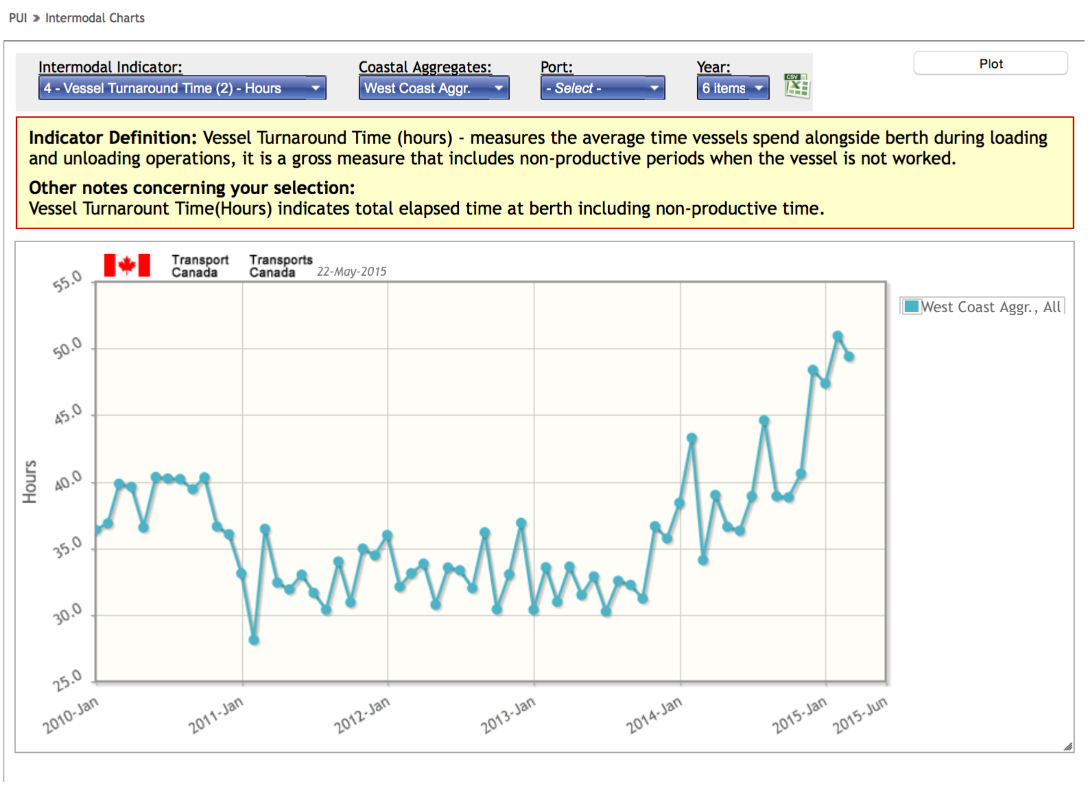

Source: Transport Canada (2015) web portal screen capture taken 22 May 2015.

In 2010, Canadian west coast ports were faced with a container surge (see Figures 6 and 7). The average number of containers per call stayed above 4,000 for three months (during the summer build-up for back-to-school retail inventories). For the next three years, the 4,000-container threshold was not crossed, but then in 2014 the former peak was not only reached but exceeded by more than 20% as the U.S. west coast service 'meltdown' occurred (already captured in Table 4). Figure 7 demonstrates how the surge in containers per vessel call translated into longer vessel turnaround times.

Looking at rising vessel turnaround time (Figure 7), the use of exception reporting would have flagged the surge before it grew to become unmanageable. For example, Figure 7 illustrates the nature of one surge that happened in the fall of 2014, a cascading into Canadian ports of unmet demand at U.S. ports where labour strife was causing cargo owners to consider less risky routing options. Add to this a trucking dispute in Vancouver and handling the surge became a significant challenge for the Port Metro Vancouver. The result is now a 'reputational' challenge to be managed.

What is missing from Figures 6 and 7 are the 'exception reporting' boundaries to indicate the likelihood of a coming surge so that planning adjustments are triggered and Transport Canada automatically notified of an impeding situation. This is not much different from the exception reporting instilled in airline pricing algorithms; when seats sold in advance of the day of the ticket cross a threshold number, an exception flag is triggered so that the pricing analyst can determine by how much the price needs to be raised.

**Figure 7: A Cargo Surge Becomes Apparent**




Source: Transport Canada (2015) web portal screen capture taken 22 May 2015.

It is normal practice for ports to build capacity to serve the market state between the normal peak in demand and the average demand. Port investment is 'lumpy' investment; that is, you build for more than you expect in the medium term but less than the long term because you only get the social license to build significant new investments rarely and the capital investment takes years to execute. Because the port has not built to meet the medium-term peak, it plans, in a surge, to use off-peak incentives to even out the demand from shipping lines while shipping lines use a number of demand management tools to try and spread the demand, capturing the high-value cargo from other lines (high-value cargo pays more under the detailed commodity pricing approach used by container lines) and providing poorer service to low-value commodities so that they are encouraged to go with a competitor if the tariff they pay is below cost. The only exception here is if the shipping line has substantial excess capacity and prices the low-value products above marginal cost. Because ports offer a common tariff to all for harbour dues, wharfage and berthage, there is little pricing freedom available to apply demand management principles to port choice. Terminals have greater pricing freedom as they negotiate with the lines for a terminal handling charge that is confidential.

Looking at Figure 7, the decision taken would be to provide port capabilities to meet the ability to turn a vessel in some time between 40 hours (the maximum draw on capacity) and about 33-34 hours (the average turn). To provide greater capacity would result in the port's capacity being idle (unproductive) too much of the time; that is, costing funds but not generating compensating revenue. All ports live in fear of a 'build it and they will come' approach becoming a 'build it and they don't come' outcome. To have infrastructure below that needed to turn the vessel in a timely way, as may be done at other ports, is asking for your potential customer to choose another port option. Therefore, the floor capacity on offer is that which exists above the mean, but well below the maximum or peak. The strategy is to get customers and users to choose to spread their business to even out the peak. Getting the balance right is not easy. The challenge is to give the customer enough information about market conditions to get it to (a) decide that the traffic is critical enough to pay more, which it can bear, or (b) buy sooner or later but not at the peak, so as to even out traffic volumes and pay less, e.g., be incented to move less valuable or less urgent cargo to off-peak pricing. Customers can't make these decisions in isolation from data, e.g., they can't manage their traffic without transparent performance metrics. This is in contrast to the prevailing practice of terminals to keep their metrics confidential and only used for the 'confidential' meetings with shipping line customers. Why ports with more than two terminals keep their metrics confidential is unclear.[20]

Critical to the ability of Canadian trading interests to understand the fluidity of Canadian gateways is the ability to assess not only average transit times, but also the range or variability in transit times. Taking a page from the Texas Transportation Institute's playbook, the keys are the setting of a 'free flow' rate, an average rate 'indexed to reflect the measure of congestion' and the 95% variability rate (the boundary below which less than 95% of traffic is handled. (There will always be exceptional circumstances induced by natural disasters, accidents and the like.) The web portal explanation is clear that Transport Canada is reporting (at a more secure level than experienced in this research) using these best practice principles. To quote:

> *Average transit times only tell part of the fluidity story. Shippers and other stakeholders also look at the variability of freight flows.*
>
> *The usual measure of variability is the Standard Deviation, but this applies to distributions that are "normal", or symmetric. In the case of long supply chains transit time distributions are, generally, skewed to the right because there is a lower bound to how early a transit can be and late arrivals can sometimes be very late. Thus, a different measure of variability is required, and for this we developed the Buffer Index (B.I.). For most shippers, when they use a mix of ocean and rail or truck transport they look at receiving their shipments within a 5% margin of change. Thus, explaining why in this case the 95 percentile is often used as a yardstick. In the case of air*

20 A port with one or two terminals risks revealing the terminal's competitive information by public reporting. With one terminal, the data for port and terminal are the same; for two terminals, one can subtract its own from the combined data to get its competitor's. With more than two, the aggregation reduces the leakage of private data.

*transport the 99 percentile would be used since shippers require a greater accuracy of deliveries.*

*Seasonal Adjustment*

*Given the harsh winter operating conditions for northern climates such as Canada, there are seasonal factors that affect the month to month comparison of transit time throughout the year. For example, transit time analysis for summer months may not be directly comparable to winter transit times as the operating environment can be completely different.*

*Seasonal adjustment of the B.I. separates out some of the recurring weather related issues and allows for analysis of the underlying trends in the transit time. This allows us to determine the efficiency of the transportation network, irrespective of recurring weather elements that are for the most part unavoidable.*

Buffer index is calculated for each component separately. To understand how the buffer index delivers 95% accuracy based on real-time data, the Total Transit Buffer Index calculation is conveyed as Total Transit Buffer Index = Total Transit 95th percentile minus Total Transit Mean divided by Total Transit Mean. If Total Transit Mean = 23.1 days and Total Transit 95th percentile = 29.6 days, then the

> Total Transit Buffer Index = Total Transit 95th percentile minus Total Transit Mean divided by Total Transit Mean = (29.6 – 23.1)/23.1 = 0.28

In this case, shippers are assured that 95% of the time (a level of statistical significance), given current conditions, their cargo will arrive in 29.6 days, with an average of 23.1 days. While the buffer analysis and variability are not available on the public fluidity portal screen, the information is made available by Transport Canada upon request. The challenge is that participating shippers must request the variability data when it would be more desirable to automate the delivery via exception reporting.

Table 7 introduces Transport Canada's current set of port utilization metrics. These efficiency metrics are a solid first set for a monitoring program. Other landside indicators that would be suitable and are not currently found on the web portal are:

- Truck congestion factor (for a specific set of route segments, measured for the fastest 95% of trips between defined points, where 100 = the free flow time, measured as the time a truck travels on the same route between midnight and 4 AM, an efficiency indicator)
- Growth (or decline) in the truck congestion index, each month
- Mean and standard deviation for Inbound customs clearance time (for cargo not requiring a physical inspection)
- Mean and standard deviation for Inbound customs clearance time (for cargo pulled for secondary inspection)

> **"The challenge is that participating shippers must request the variability data when it would be more desirable to automate the delivery via exception reporting.**

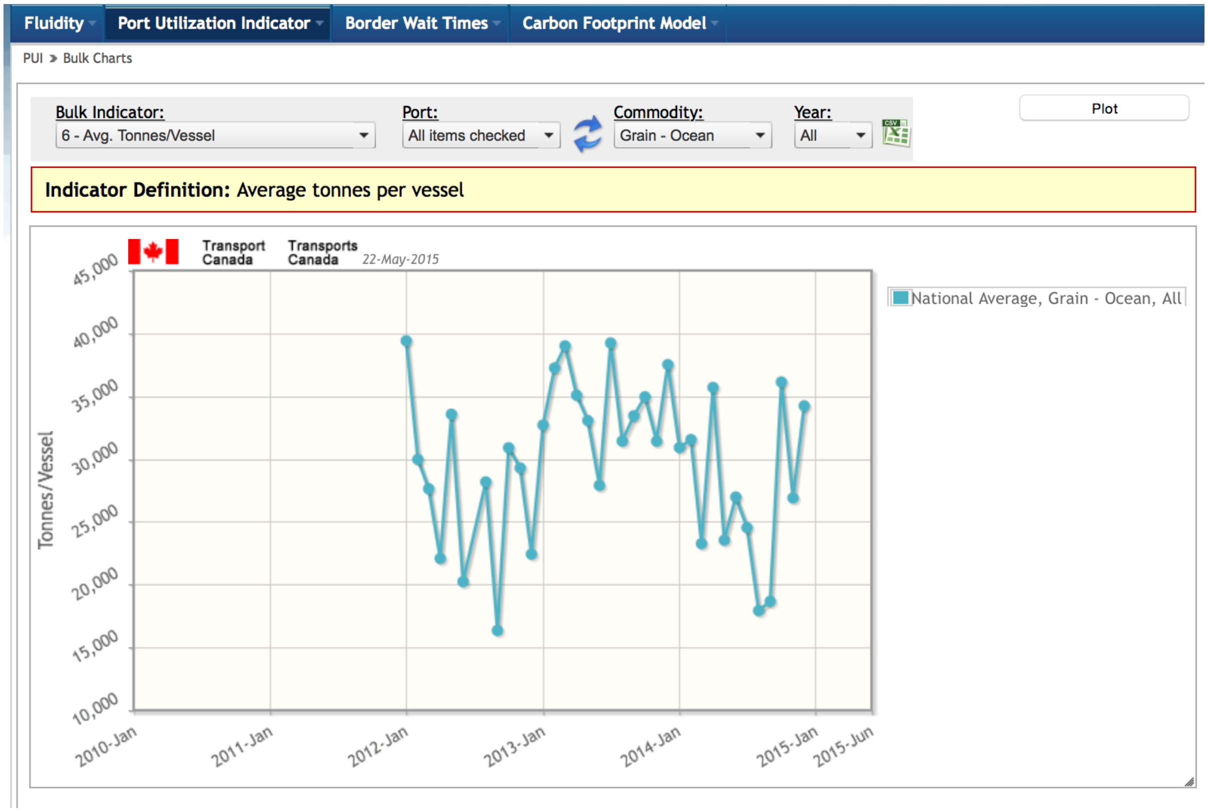
**Table 7: Indicators of Port Utilization in Transport Canada's Fluidity Index**

| Intermodal Indicators (containers) | Bulk Indicators |
|---|---|
| Average truck turnaround time (in minutes) | Average vessel turnaround time (in hours) |
| Berth utilization (in TEU per metre of workable berth) | Berth occupancy rate (%) |
| Vessel turnaround time (in seconds per TEU) | Gross berth productivity (in tonnes per berth hour) |
| Average truck turnaround time (in minutes) | Total tonnes |
| Vessel turnaround time (in hours) | Number of vessel calls |
| Average container dwell time (in days) | Average tonnes per vessel call |
| Dwell target (% under 72 hours) | Average time at anchor (Vancouver only) |
| Port productivity (in TEU per gross hectare) | |
| Vessel on-time performance (%) | |
| Crane productivity (in lifts per hour) | |
| Number of vessel calls | |
| Container throughput (in TEU per month) | |
| Average TEU per vessel call | |

Source: Transport Canada (2015) web portal. Each port chooses the indicators desired; for example, Average Time at Anchor is a Vancouver only metric.

For some sections of the portal, users can export comma-separated values (CSV) data aggregated by month for their own use (by clicking on the spreadsheet icon on the screen); they can also capture plots of data for the variables they choose (by clicking on the plot symbol to get the data). Figure 8 is a screen capture of the demand for grain transport through all participating ports 2012-2014. The volatility of the demand is substantial and makes port planning difficult. Exception reporting would not be useful under these circumstances. Exception reporting makes more sense for container traffic rather than bulk traffic.

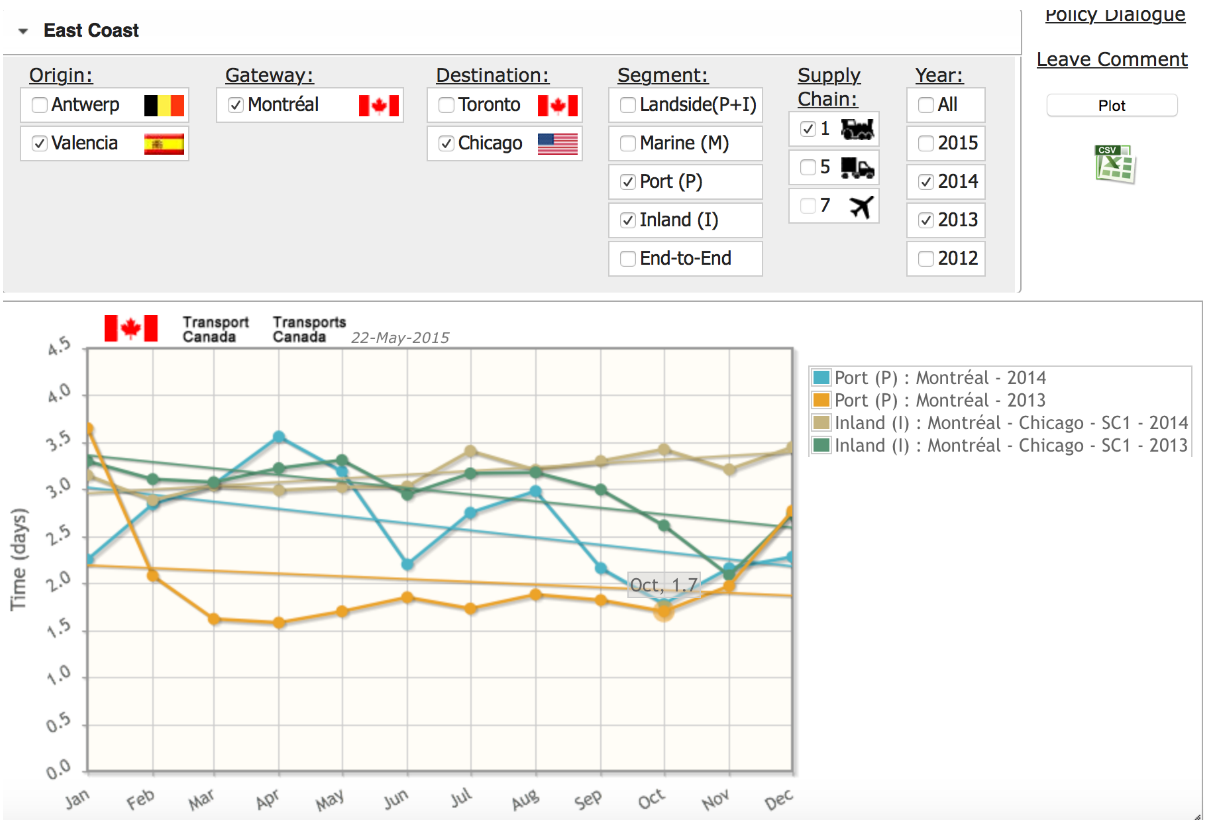
**Figure 8: Grain Tonnes per Vessel Plot for All Years All Ports Participating**




Source: Transport Canada (2015) web portal screen capture taken 22 May 2015.

The strongest contribution of the fluidity portal is its diagnostic approach to Canadian supply chain performance through its analysis of Canadian supply chain structure and usage. This is the critical contribution that has been so difficult for the Europeans and Americans to design and implement and the challenge most transport observatories have yet not resolved in designing their programs. Transport Canada established eight supply chain combinations; six of these are marine and two are air. (Figure 9 illustrates the Fluidity Portal for examining specific origins and destinations, and supply chain type 1 (direct rail) is chosen to create the figure.) The various chain types are evaluated year-to-year to understand how Canada's supply chain patterns evolve. From a public policy perspective, this approach assists a government in understanding how the market structure of the supply chains is evolving as users evaluate and re-evaluate their supply chains and determine best ways to serve their own needs. Having structured the fluidity analysis this way, Transport Canada is in a strong and world class position to monitor the situation and determine the best way it can assist industry in a market-driven way.

**Figure 9: Fluidity Sample Screen for Containers Arriving from Valencia Destined for Chicago Using Supply Chain Type 1 (Direct Rail) 2013 and 2014**




Source: Transport Canada (2015) web portal screen capture taken 22 May 2015.

On the bulk side of Canadian cargo operation, a number of bulk parts are participating in Transport Canada's fluidity project. These are listed in Table 8. The efficiency indicators used follow Transport Canada's nomenclature, but effectiveness indicators do not appear to be collected by any of the ports unless it is done by the port for its own management decision-making.

**Table 8: Bulk Ports Participating in the Transport Canada Fluidity Program**

| Commodity | Participating Ports |
|---|---|
| Coal | Port Metro Vancouver, Hamilton Port Authority, Port of Belledune |
| Dry Bulk | Port of Trois-Rivières |
| Forest Products | Nanaimo Port Authority, Port Alberni |
| Grain | Port of Montréal |
| Iron Ore | Hamilton Port Authority, Port of Sept-Îles |
| Liquefied Natural Gas | Port Saint John |
| Logs | Nanaimo Port Authority, Port Alberni |
| Petroleum Coke | Port of Belledune, Port of Sept-Îles |
| Potash | Port Metro Vancouver, Port Saint John |

Source: Transport Canada (2015), Fluidity Web Portal, accessed May 22, 2015.

Is the portal complete? The short answer is not quite. The fluidity portal and the evolution of fluidity metrics are a work in progress, but one that is well underway and has resulted from seven years of continued effort. The fluidity project is not just limited to ports but includes landside connectivity and border time; border wait times are reported for 14 Canada–U.S. border crossings. Border wait time is measured in minutes and the data is presented not only for the mean but also the standard deviation and 95$^{th}$ percentile.

Updating and making measurement activities more inclusive are the key challenges going forward. Such efforts are likely resource constrained and dependent on the ports cooperating with Transport Canada. This is a critical factor for the Canada Transportation Act Review Panel to consider as ports benefit from landside infrastructure funding assistance through the Building Canada, Gateways and Border Crossings and other infrastructure funding programs yet do not always cooperate on measures needed to determine if those funds are well-spent by providing fluidity metric data feed. The gaps may be difficult to backfill without complete port cooperation. On the other hand, there are four component tools to Transport Canada's toolbox: SQL for query analysis, SAS for generating reports and automating processes, ESRI for GIS analysis and a simulator tool for scenario planning is in development. It can be concluded that the level of effort to date by Transport Canada reflects global leadership by government as no other government has gone this far in port performance metric development, and execution of the program, but not in reporting to the public. Here the U.S. is much more transparent with data collected.

To summarize, the most difficult data challenge in fluidity measurement to date is measuring road congestion, given the high volume of GIS data and the need to address how such 'big data' can be used without straining resources significantly. Here GIS analysis by some Canadian universities has been of substantial use; examples of this work were presented in Montréal at the 2015 Canadian Transportation Research Forum (for example, see Hussein et al., 2015; Chowdhury and Arsenault, 2015). Conceptually the path is absolutely the right one for performance measurement purposes. Why? The key segments to be monitored are identified; the approach to data collection in terms of elements is well conceived, mapped and mostly complete (with the exception of measuring effectiveness), but the execution is still a work in progress. However, efforts remain incomplete and there is still have some way to go to serve Canadian interests; whether this is due to inadequate resources, capital or human, is not clear, but supply chain performance measurement is a priority that can be supported. The likelihood of a significant surge in the coming peak season, before the panel reports, is very high and the tools to evaluate options by industry are likely to be inadequate again this year. They are, however, better than what other governments have available to date to the knowledge of this consultant.

> **"the most difficult data challenge in the fluidity measurement to date is the landside using the road mode.**

## *5.5. Port-Level Performance Measurement Efforts*

Port performance data collection efforts vary widely by port. The most in-depth effort occurs at Canada's largest port, Port Metro Vancouver (PMV); their very intense data collection and monitoring system for container traffic will be discussed later in Section 5.7 but it is concluded that the core execution of PMV's fluidity measurements is consistent with Transport Canada's approach explored in the previous section. Vancouver and Prince Rupert's efficiency data are aggregated for reporting purposes on the fluidity portal.

On the east coast, Montréal produces a *Business Intelligence Monthly* report, which is circulated confidentially to directors and management. For the time being, it is shared with some key stakeholders, notably those providing data. The Montréal report is particularly interesting because it provides a mix of relevant headlines, a ‘competitor watch’ table with statistics from competing ports and, most important, its intermodal efficiency metrics (with targets) with a red / yellow / green symbol to indicate those indicators which are performing more than 10% below target, within 10% of target, and at or above target respectively. The definitions for Montréal’s report are consistent with Transport Canada nomenclature. There are two traffic indicators from Montréal: monthly volume in TEUs and the number of container ship vessel calls. There are six terminal indicators: (1) terminal dwell time for direct to rail imports in days, (2) terminal dwell time for direct to rail imports (as a percent under 48 hours), (3) terminal utilization rate as a percent of design capacity, (4) container truck volumes defined as the number of unique trips per working day, (5) truck turnaround time in minutes, and (6) berth productivity in lifts per hour. These eight are supplemented by two hinterland indicators: Rail transit time from Montréal to Chicago in days, and total transit time Antwerp–Montréal–Chicago in days, making 10 performance indicators in total. Montréal does not provide a similar report for bulk movements, but does report its grain handling metrics to Transport Canada.

The Port of Halifax does not participate in the Transport Canada fluidity metric program for either containers or bulk traffic. It has its own initiative called *Halifax Gets It There*, focused solely on container traffic. *Halifax Gets It There* has route maps to assist customers in seeing the port’s connectivity, and five components supporting its calculation of transit time for any potential customer to consider. The first of these, ocean transit time, is calculated using data supplied by BlueWater Reporting. So this can be seen as lagged time data. The second element is load terminal dwell; this is the average number of days a container sits on the terminal before it is loaded onto the export vessel and is sourced from Drewry Maritime Research (it is not clear if this is data that is updated regularly, or was a one time purchase). It can be concluded that this indicator is not Halifax specific, and therefore not a metric to measure Halifax’s performance. The third element is rail terminal dray and this is calculated as the average number of days a container takes to be transferred from the mainline rail head to the container terminal. The fourth element is the inland rail time as published by CN rail for ramp to ramp service; published train times are not a performance metric as published times are not actual times. The fifth item is the inland truck time, a calculation of the intercity truck miles divided by a speed of 100 kilometers an hour, taking into account the hours of service regulatory limits for truckers. This too is not a performance metric. In conclusion, the only two of these items that can be seen to be performance metrics are the rail terminal dray and the ocean transit time. Furthermore, the maintenance of the data presented is unclear as the web site is undated; the question likely asked by web site visitors is: when were the components last updated? The conclusion drawn is that Halifax is not measuring port metrics at a level equivalent to those participating in Transport Canada’s fluidity project.

The other container ports in Canada—Québec, St. John (New Brunswick), and St. John’s (Newfoundland and Labrador)—are not posting performance metrics on their websites.

## 5.6 Third-Party Performance Measurement

This section explores the third party measurement programs of the Journal of Commerce (section 5.6.3) and other suppliers (section 5.6.4) but begins with effectiveness metrics collected by the World Bank (Logistics Performance Indicator [LPI]) and the World Economic Forum (the Enabling Trade Index [ETI]) as the effectiveness metrics of the AAPA and its Port Customer Service Initiative have already been discussed. As maritime connectivity is not seen to be time-based competition but route-based competition (a related factor), the Liner Shipping Index published by UNCTAD is not proposed to be examined in depth; for those interested in this efficiency variant (much more suitable for examining remote ports), the publication showing its application in the case of the Port of Durban, South Africa is recommended reading (International Transport Forum, 2014).

### 5.6.1. Logistics Performance Index (LPI)

Logistics performance is viewed by The World Bank as being strongly related to infrastructure development, service quality and trade facilitation efforts. In 2011, The World Bank released its first Logistics Performance Index, which identifies six pillars of logistics performance. From a fluidity perspective, two pillars are particularly important—Logistics Quality and Competence, and Timeliness (defined as the frequency with which shipments reach their destination within scheduled or expected time). The latest release is 2014's LPI. In 2012 the LPI report discussed in Box 3.1 (p. 31) the Canadian fluidity assessment efforts, and concluded it to be a more in-depth effort than the LPI to look at root causes in logistics performance both domestic and international. This note also indicates that Canada and Australia are cooperating on a model for use within the Asia-Pacific Economic Cooperation region but no details about this cooperation are found in the public domain.

The LPI methodology is a perceptual index (e.g., an effectiveness one) based on gathering a series of performance indicators from surveys of freight forwarding professionals. It does not distinguish its metrics by mode. Ojala and Celebi (2015) note that, because of the nature of those surveyed, the LPI is biased towards measuring the logistics performance of manufactured commodities rather than bulk commodities, and more useful for systems dominated by higher-valued goods. In the Canadian case, this means that the LPI paints a more useful picture for Canadian container imports, and specifically the following indicators: Clearance Days (without physical inspection) and Clearance Days (with physical inspection). Table 9 explores how well Canada performs overall and on selected LPI indicators.

**Table 9: Logistics Performance Index**

| Indicator | Canada's Score (Rank, % of Best Practice) | Best Practice Score (Country) |
|---|---|---|
| Overall | 3.86 (12, 91.5%) | 4.12 (Germany) |
| Pillar 4: Logistics Quality and Competence | 3.94 (10, 94.0%) | 4.19 (Norway) |
| Pillar 6: Timeliness | 4.18 (11, 88.7%) | 4.71 (Luxembourg) |
| Clearance Days (without physical Inspection) (1) | One day | One day (Germany) |
| Clearance Days (with physical Inspection) (1) | Three days | One day (Germany) |
| Percent of import shipments inspected (1) | 2% | 3% |

Note: (1) These are not scores but the actual data reported. Comparison is made with Germany for these items.

Source: The World Bank (2014), Data compiled from Appendices (pp. 34, 44).

The 2014 LPI data are based on a survey conducted between October and December 2013, answered by 1,000 respondents at international logistics companies in 143 countries. First, the rating of each country comes from interviewees outside the country for which the LPI is calculated. Second, it represents the views of those who purchase transport services on behalf of cargo owners. It does not therefore represent the views of those who own the cargo and make their own transport decisions. This is an important distinction because Brooks and Schellinck (forthcoming) identified in their port performance research that cargo owners and international logistics providers differ in the effectiveness elements they use in evaluating port performance. These are port security, the cost of rail/truck/warehousing and the overall cost of using the port; on the other hand, perceptions of terminal operator responsiveness to special requests are significantly more likely influence a forwarder's evaluation of a port's overall service performance. While Canadians use forwarders less frequently than many other nationalities (Lieb and Bentz, 2005, Table 4), it is important to identify the requirements of both user groups in the beginning and the LPI misses an important one..

The LPI also tracks 'Export Time and Costs' and 'Import Time and Costs', but these are not fair comparisons given the size of Canada, its population dispersion, geographic profile, and the dispersion of economic activity; therefore these indicators have not been added to Table 8 in spite of their significance in the discussion of fluidity. In this case, of countries indicated to be high income OECD, advanced countries in the World Economic Forum (2014) report, the more appropriate comparators would be the United States and Australia as large countries in this group of similar economies. Canada scores better on both factors ('Export Time and Costs' and 'Import Time and Costs') than either of these countries for Port or Airport Supply Chains; Australia is a substantially higher cost country while the U.S. has a longer export lead time by a day and costs that are enough higher that they are likely significantly different. So from the fluidity perspective, time and costs are probably competitive.

In conclusion, the LPI is not a comprehensive third-party effectiveness metric, but one that serves a strategic effectiveness monitoring goal for a specific user group: freight forwarders. It does not capture the effectiveness of Canadian gateways for bulk exports or for imports controlled by Canadian manufacturers and retailers booking their own cargo. Therefore it cannot be a sole indicator serving this goal.

### 5.6.2 Enabling Trade Index (ETI)

The World Economic Forum's Enabling Trade Index (World Economic Forum, 2014) is another perceptual index (effectiveness) based on the World Economic Forum's Executive Opinion Survey (EOS) and comprises a basket of 23 indicators. It is a very large survey, with more than 13,000 respondents over 148 countries. Canada ranks 14$^{th}$ in 2014 (p. 23):

> *With 89.4% of imports entering the country free of duty, Canada's domestic market is one of the most accessible among advanced economies (4th out of 34).*

The ETI also collects from the EOS executives' perceptions of export and import costs. Here there is considerable variance from the LPI. Executives of companies surveyed viewed Canada as expensive, respectively 95$^{th}$ and 106$^{th}$ in terms of cost to export and cost to import. (The U.S. rankings are 61$^{st}$ and 66$^{th}$ for comparison.) The ETI also reports some elements of the LPI as inputs to their evaluation and where they have already been included in Table 9 they are not repeated in Table 10.

The Enabling Trade Index is highly relevant to benchmarking whether Canada's Strategic Gateways and Trade Corridors strategy is surfacing in the mindset of global traders. Its key challenge is that it is a very high-level, coarse measure of strategic progress. Explaining why Canada's score for the ETI has changed over time would be a positive improvement to Transport Canada's Annual Report, *Transportation in Canada*.

**Table 10: Enabling Trade Index**

| Indicator | Canada's Score (Rank) | Best Performer (Value) |
|---|---|---|
| Overall (for High income OECD, Advanced) (1) | 5.0<br>(14) | 5.3<br>(Netherlands) |
| Pillar 3: Efficiency and Transparency of Border Administration | 5.7<br>(20) | 6.3<br>(Singapore) |
| Item 3.04: Number of documents to import (2) | 3 documents<br>(3) | 2 documents<br>(2 countries) |
| Item 3.07: Number of documents to import (2) | 3 documents<br>(3) | 2 documents<br>(2 countries) |
| Item 3.10: Time predictability of import procedures (1) | 4.3<br>(48) | 6.0<br>(Finland) |
| Item 3.11: Customs transparency index (3) | 1.00<br>(1) | Shared with 35 countries (including Netherlands, Germany, U.S. and Australia, but not Singapore or Finland) |

Notes: (1) The score is on a scale of 1-7. The top performer overall, all economies is Singapore (high-income, advanced) while the Netherlands (high-income OECD, advanced) is ranked 3rd.

(2) Raw data not a scale item.

(3) Scale is 0 or 1.

Source: World Economic Forum (2014), Data compiled from individual country appendices and p. 47 for Customs Transparency Index data. Canada's profile is found on pp. 94-95.

### 5.6.3 Journal of Commerce

The Journal of Commerce's (2014) annual *Port Productivity* report ranks the top ports and terminals based on data from more than 150,000 port calls at 771 container terminals in 483 ports in three regions (Americas, Asia and Europe–Middle East Africa). The report measures port productivity (actually berth productivity) as gross moves (on, off or repositioning) from 'lines down' to 'lines up'. Table 11 provides the annual scores reported for North American container terminals; therefore the 88.5 score for the APM Terminal in Port Elizabeth, NJ, means that 88.5 containers were moved per hour for the hours the ship was moored at the berth. The Journal of Commerce measure sets a third-party benchmark that is useful for comparing relative performance, but does not address how much time the vessel may have waiting to reach the berth, or whether the berth was not available when the vessel wished to use it because (a) labour was not available until the start time of a shift, or (b) there were not sufficient cranes to handle the vessel to meet a target rate. It does offer the advantage that it acquires its data from ocean carriers representing 75% of the global container shipping capacity and provides unbiased input for evaluation. As Canada's other major container terminals are not reported in Table 11, it is not possible to know how well they fare in the publicly released document.

Perhaps even more important from a Canadian perspective, the bulk market is not covered by this index.

**Table 11: North American Berth Productivity Scores 2014**

| Terminal | Port | Country | Berth Productivity |
|---|---|---|---|
| APM Terminals | Port Elizabeth | U.S. | 88.5 |
| Global Gateway South Terminal (APL Terminal) | Los Angeles | U.S. | 83.5 |
| Pacific Container Terminal - Pier J | Long Beach | U.S. | 83.1 |
| Total Terminals International - Pier T | Long Beach | U.S. | 82.6 |
| Lazaro Cardenas Terminal Portuaria de Contenedores | Lazaro Cardenas | Mexico | 76.9 |
| Evergreen Container Terminal-Los Angeles | Los Angeles | U.S. | 72.1 |
| APM Terminals Houston | Houston | U.S. | 70.9 |
| Prince Rupert Fairview Container Terminal | Prince Rupert | Canada | 68.1 |
| Deltaport | Vancouver | Canada | 66.3 |
| Bayport Container Terminal | Houston | U.S. | 65.6 |

Source: Journal of Commerce (2014), JOC Port Productivity.

### 5.6.4 Other Metrics

As for other third-party metrics, those available for purchase are many but some suppliers were uncommunicative with this consultant when queries were made. Transport Canada advises that the following third-party data suppliers are used: Drewry Container Freight Rate Insight,[21] Lloyd's Seasearcher,[22] Zepol,[23] Piers,[24] trucking GPS Data from Shaw Tracking[25] and, in partnership with ports, Transport Canada buys CargoSmart[26] and GT Nexus.[27] What seems missing from this list is a new product, Drewry Carrier Performance Insight,[28] a ship reliability measurement product. Otherwise

21 https://www.drewrycfri.co.uk

22 http://info.lloydslistintelligence.com/our-channels/seasearcher/

23 http://www.zepol.com

24 https://www.piers.com; this Journal of Commerce product is sufficiently aggregated and sanitized that its usefulness is dubious. Previous experience with this database has led to this conclusion.

25 http://www.shawtracking.ca/about-shaw-tracking

26 CargoSmart was introduced in 2011 and focuses on schedule reliability for ocean carriers. https://www.cargosmart.com/en/default.htm

27 http://www.gtnexus.com

28 http://www.drewry.co.uk/publications/view_publication.php?id=313

the list is very comprehensive and allows Transport Canada to evaluate performance, both operational and strategic.

One additional data source worth investigating is INTTRA's OceanMetrics, which provides a simple to use graphical representation of common, consistent and validated measurements. On-time delivery measurements do not appear to offer more than the fluidity web portal but may add the benefit of benchmarking Canadian ports against others, depending on how the data is presented. Indicators used are:

- Percentage of containers that arrive on the day expected
- Percentage of containers that arrive 1 day early, on the day expected, or 1 day late
- Average number of days early when containers are more than one day early
- Average number of days late when containers are more than one day late

OceanMetrics is based on actual transactions (over 2 million per month) sent to over 30 carriers through the INTTRA network. It is unclear whether this would be a useful additional third party data source and whether it is still offered as promised on the website.[29]

## *5.7 Scoreboards, Dashboards, Webcams and AIS*

### 5.7.1 EU Transport Scoreboard

The EU transport scoreboard (Commission of the European Union, 2015) offers European transport interests the opportunity to explore indicators for each Member State (or all EU countries), four modes (air, road, rail and water) and five categories: (1) single market, (2) infrastructure, (3) environmental impact, (4) safety, and (5) infringements. In addition, three categories (logistics, innovation and transposition) are available across modes.

Figure 10 was created by seeking data for a combination selecting water plus infrastructure across EU (subtracting motorway density and quality of air transport infrastructure).

However, by selecting all modes, logistics and a single country, the data view is similar. In other words, modal split is the output metric, while area, population, Nominal GDP, Expenditure per capita on transport and allocation of funding in absolute Euros over 2007-2013 were the inputs. There is no analysis or discussion of the results on the website. No matter what is selected, the end result is the same; inputs are listed and the output of modal split is generated. Conclusion: The EU Scoreboard is a work in progress and reflects the goals of the EU, that is, that more freight is moved by barge and rail than currently and that the road share of traffic should decrease.

The site also contains, for public view, the current legislation, policy themes and statistics available both as PDFs (an annual Statistical Pocketbook) and downloadable spreadsheets. Again, the term 'performance' is used when discussing tonne-kilometres (tkm) and other data elements. This is just data, performance analysis is more than just presenting the raw data elements. A tkm is defined as the number of tonnes carried a single kilometre, so if you move a 1,000 tonnes 1,000 kilometres to market, you have generated a million tkms. As an output metric, it does not reflect what inputs (capital investment, labour employed and the like) were used to generate that output. The other challenge is that the Statistical Pocketbook presents the data elements but not the analysis, so the need for

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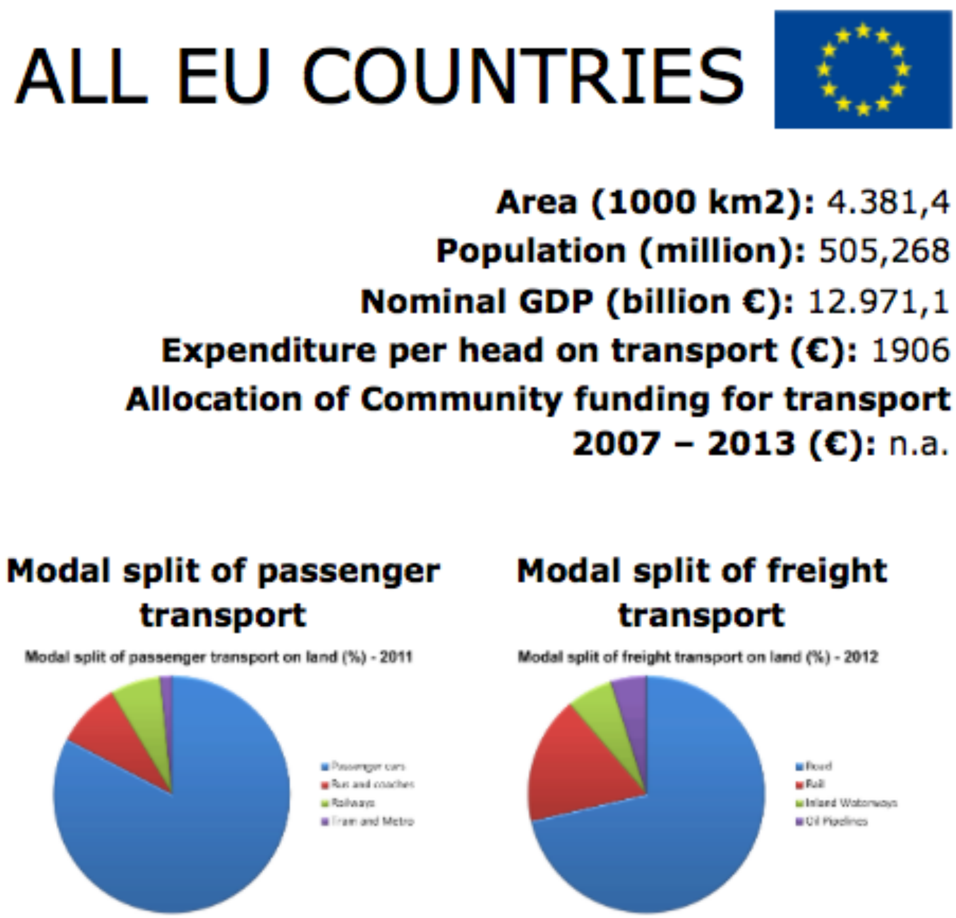
29 INTTRA (2015). OceanMetrics, http://www.inttra.com/oceanmetrics-launch?msc=omad, last accessed May 12, 2015. It is unclear if this data supplier is still offering this data as the web site indicates that data **will** be available in 2012. The website itself is still active.

independent analysis is clear. The Statistical Pocketbook[30] has no measure of congestion or reporting on real-time data.

**Figure 10: EU Scorecard for Transport**

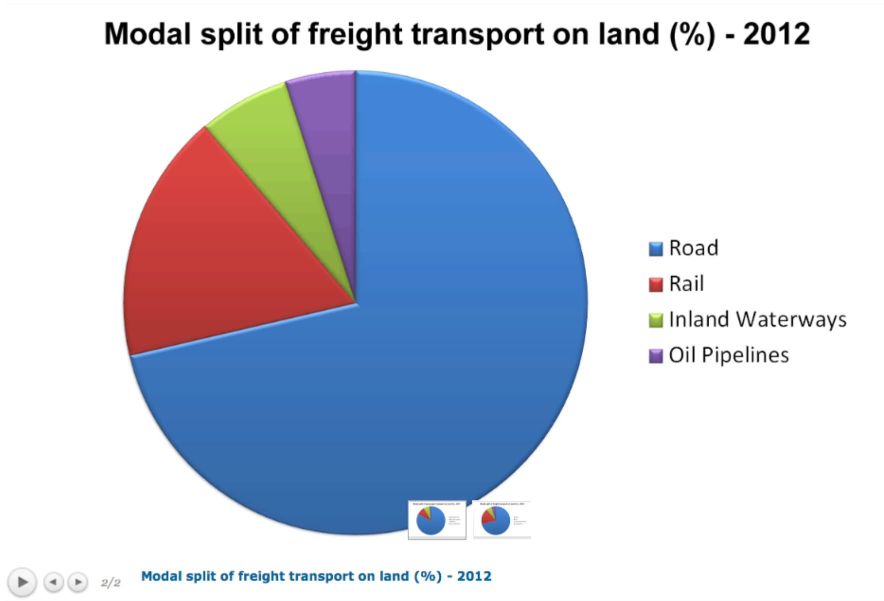



Source: Screen capture from http://ec.europa.eu/transport/facts-fundings/scoreboard/index_en.htm, taken 21 April 2015.

The European Commission offers the ability to enlarge the data to demonstrate the freight share by mode, as seen in Figure 11. As the purpose of the European policy is to encourage modal shift, its usefulness to fluidity measurement is very limited.

[30] Its website: http://ec.europa.eu/transport/facts-fundings/statistics/doc/2014/pocketbook2014.pdf

**Figure 11: EU Modal Split 2012**




Source: Screen capture from http://ec.europa.eu/transport/facts-fundings/scoreboard/index_en.htm, taken 21 April 2015.

### 5.7.2 Port Metro Vancouver Gateway Dashboard

Port Metro Vancouver has made a considerable effort to encourage growth through performance measurement; the efforts include a licensing system for trucks, a GPS monitoring system (with participation by up to 1,000 trucks), a gate appointment system, a penalty fee system for excess waiting, and a $300 per container fee to pay costs associated with the licensing system. Such a combination of 'carrots and sticks' is important to making improvements in fluidity. Two important elements are (1) the penalty when gate access doesn't measure up,[31] and (2) the reporting on wait time progress in terms of delay percentages and reliability.

The Port Metro Vancouver's (PMV) supply chain strategy is focused on fluidity as a key theme for growth:

> *Port Metro Vancouver's Supply Chain Strategy is a multi-year, Port stakeholder-supported series of initiatives developed to achieve sustainable growth in all cargo sectors by coordinating development of the most reliable and consistent supply chain in North America.*

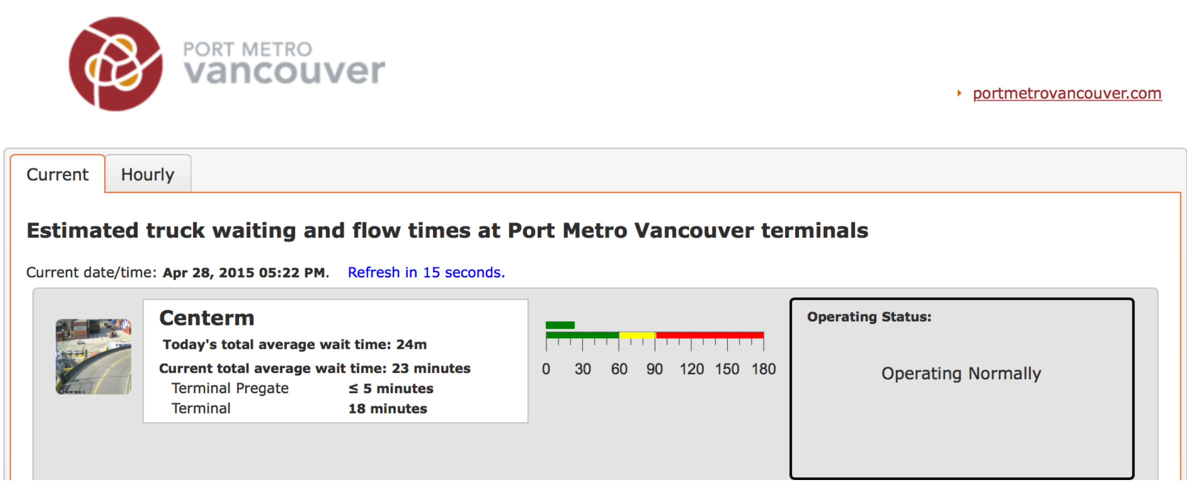
[31] Terminal Gate Efficiency Fee program requires container terminals to pay $30 per transaction for any trip by a trucker that exceeds 120 minutes, as measured by Port Metro Vancouver's GPS tracking efficiency system. Port Metro Vancouver (2015b), Supply Chain Initiatives—Supply Chain Strategy, http://www.portmetrovancouver.com/en/portusers/SupplyChainInitiatives.aspx, last accessed 15 May 2015, p. 4

> *The Supply Chain Strategy Program consists of three principal themes: measure and monitor service performance, lead and influence new operating practices, and invest and participate in the network.*[32]

The Port Metro Vancouver Dashboard[33] is one of the most advanced in port performance measurement. Posted on the PMV website, it presents data that are publicly available and refreshes very frequently so that any truck driver or port user can see the current waiting time measured in minutes in three locations: on the roadway, in the staging lanes outside the gate, and on the terminal along with a total wait time. The wait time for each is provided at a date and time, with a refresh indicator available for those wanting to know the next refresh; webcams show the viewer the real-time traffic picture for each terminal. There are 28 deep-sea and domestic marine terminals participating in the Dashboard program. Reporting on GPS results for gate wait time is a critical element in port performance reporting. In 2014, at the time of the 2014 trucking dispute, PMV reported that

> *Current GPS data suggests 63% per cent of container trucks wait less than one hour at port terminals while less than five per cent wait more than two hours. Port Metro Vancouver is actively working to reduce wait times.*[34]

**Figure 12: The Vancouver Dashboard**




Source: Port Metro Vancouver, screen capture from website, http://www1.portmetrovancouver.com/COGS_Chart/GPSTruck/pmvindex, accessed 28 April 2015.

Figure 12 demonstrates the publicly available estimated wait times for terminal gates and within terminal yards. This figure illustrates the situation at Centerm. Real-time average wait times are updated once each minute and report the average wait time of operations that have completed trips within the last 30 minutes. Total average wait times are also refreshed once a minute and report the

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32 Port Metro Vancouver (2015b), Supply Chain Initiatives—Supply Chain Strategy, http://www.portmetrovancouver.com/en/portusers/SupplyChainInitiatives.aspx, last accessed 15 May 2015.

33 Port Metro Vancouver Gateway Dashboard, http://www.portmetrovancouver.com/docs/default-source/port-users-trucking/port-users-trucking-gps/how-to-use-the-new-gps-dashboard.pdf?sfvrsn=0. This website explains how the PMV dashboard works. The website itself is found at: http://www1.portmetrovancouver.com/COGS_Chart/GPSTruck/pmvindex

34 Port Metro Vancouver (2014), Container trucking 101: Port stakeholders and the 2014 trucking dispute, March 20. http://www.portmetrovancouver.com/docs/default-source/trucking/2014-05-05-backgrounder---trucking.pdf?sfvrsn=2, p. 3.

total average wait time of transactions completed on the day. The Dashboard is publicly accessible via the Internet and so is useful in assisting driver planning and illustrates a best practice approach.

### 5.7.3 Webcams

A number of ports have installed webcams to enable local community stakeholders to see current activities and traffic levels at ports. The TSI webcam can be found at http://www.tsi.bc.ca/content/cameras. Container terminal webcams seem less effective than the PMV Dashboard approach particularly as many drivers have smartphone access to the Internet.

There are alternative approaches to webcams; Blaine (WA) border wait times northbound and White Rock BC wait times southbound on the Pacific Highway are also reported via the Internet but use a graphical illustration rather than a webcam approach to providing real-time traffic data. Now that the investment has been made in webcams in a number of ports, it seems worthwhile to contemplate their contribution to managing fluidity and assess whether they provide a better outcome than Dashboards.

### 5.7.4 AIS for Diagnosing and Monitoring Maritime Fluidity

Maritime fluidity is an important component of measuring overall supply chain fluidity. How can it be measured?

(a) Port turnaround time as 'lines down' to 'lines up' is one of the inputs for the Journal of Commerce berth productivity metric,
(b) Berth productivity is a terminal-generated metric and is sometimes used as a proxy, or
(c) AIS (Automatic Identification System) data can be used as an input to calculate a port turnaround time.

The first option does not contemplate the impact of pilotage time, anchorage time or the timeliness of the movement from the 3-mile limit (to pick an arbitrary point on approach) to the berth or anchorage. As for the second, container shipping lines already provide the berth productivity information to the Journal of Commerce, but the Journal or the lines may not be willing to share without compensation. It also does not cover the bulk sector of the shipping industry. Also, terminal operators often resist providing the second option (time-series data on ship arrivals and the corresponding berth occupation), arguing there is a bias if the indicator is low in times when vessel sizes are increasing, but the number of vessel calls has declined. They are also concerned about the data being shared with competing terminals.

The third option has promise if significant investment in restructuring vessel traffic operations is being considered or if channel congestion or pilotage delays are known challenges for a particular port. There are lots of data on existing real-time vessel traffic available through AIS. The information is not confidential and available for all ports, allowing for comparisons with ports having like characteristics.

As the last option can provide the most comprehensive approach, and enable comparison with similar ports elsewhere in the world, let's explore it further. The three critical components of fluidity are identifying points of congestion, incidence and extent of delay, and normal rate of free flow and the variation in that rate. One supplier, MarineTraffic, uses AIS to evaluate congestion (vessel bunching), locations of delay and rate of flow, not unlike the GPS monitoring of truck traffic that Transport Canada is currently undertaking in Port Metro Vancouver. MarineTraffic operates the largest network of AIS stations globally, collecting data from third parties including ORBCOMM and Lloyd's List (a partner). Because they have geo-fenced more than 7,000 ports, and use the data to show arrivals and departures, they can measure in real time how many vessels are anchored, how long they wait, and can make the data available by the size and type of the vessel. Their approach could be particularly useful if a Canadian port faces a situation of bunching in vessel arrivals as was the case faced by the ports of Los Angeles and Long Beach in the fall of 2014. In best practice benchmarking, it is important to have the context provided by other ports to compare with the existing data.

As Canada's AIS system is controlled by the Canadian Coast Guard, it would be possible to evaluate maritime fluidity in Canadian port approaches to complement Transport Canada's current efforts at evaluating terminal fluidity and inland fluidity. The Canadian Coast Guard has already invested heavily in AIS and has stated:

> *Ships travelling near our coasts are required to automatically transmit AIS data, such as position, course and speed, in the Very High Frequency maritime band, which has a range of about 50 miles. The Coast Guard has successfully implemented the national AIS project, building AIS shore infrastructure so that vessel data is now collected for virtually the entire east and west coasts and the Great Lakes – St. Lawrence Seaway. As a collateral benefit to enhanced vessel traffic management, this data is fed to other government departments with an interest in national security, providing an enhanced awareness of vessel movements and actionable marine intelligence for all of Canada's primary waterways.*[35]

While an interest in national security is not the driver here, this source of vessel movement data coupled with data from like ports elsewhere (comparison is possible across so many international ports), provides Canada with the ability to continue to enhance fluidity through Canadian ports. Think of AIS as GPS for ships. Consider a vision of optimizing flows and minimizing wait times finally improving fluidity on the last unexposed element of the supply chain. By working with shipping lines on the decision where to geo-fence the maritime approaches, it would be possible to measure the maritime bottlenecks that could be waiting for pilotage services or berths and identify channel issues.

The MarineTraffic contact if further discussion is of interest is:

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mobile +44 (0)790 3636 296

> **"Consider a vision of optimizing flows and minimizing wait times finally improving fluidity on the last unexposed element of the supply chain .**

[35] Canadian Coast Guard (2011) Maritime Security Contributions, Ottawa: Fisheries and Oceans, p. 5

# 6.0 Performance Report Considerations

## *6.1. Decisions in Keeping With Policy Perspectives*

Decisions on appropriate port performance measures will need to be considered in keeping with Canada's National Transportation Policy (Exhibit 1) unless that policy is changed through the implementation of the Canada Transportation Act Review Panel report.

**Exhibit 1: National Transportation Policy**

*5. It is declared that a competitive, economic and efficient national transportation system that meets the highest practicable safety and security standards and contributes to a sustainable environment and makes the best use of all modes of transportation at the lowest total cost is essential to serve the needs of its users, advance the well-being of Canadians and enable competitiveness and economic growth in both urban and rural areas throughout Canada. Those objectives are most likely to be achieved when*

*(a) competition and market forces, both within and among the various modes of transportation, are the prime agents in providing viable and effective transportation services;*

*(b) regulation and strategic public intervention are used to achieve economic, safety, security, environmental or social outcomes that cannot be achieved satisfactorily by competition and market forces and do not unduly favour, or reduce the inherent advantages of, any particular mode of transportation;*

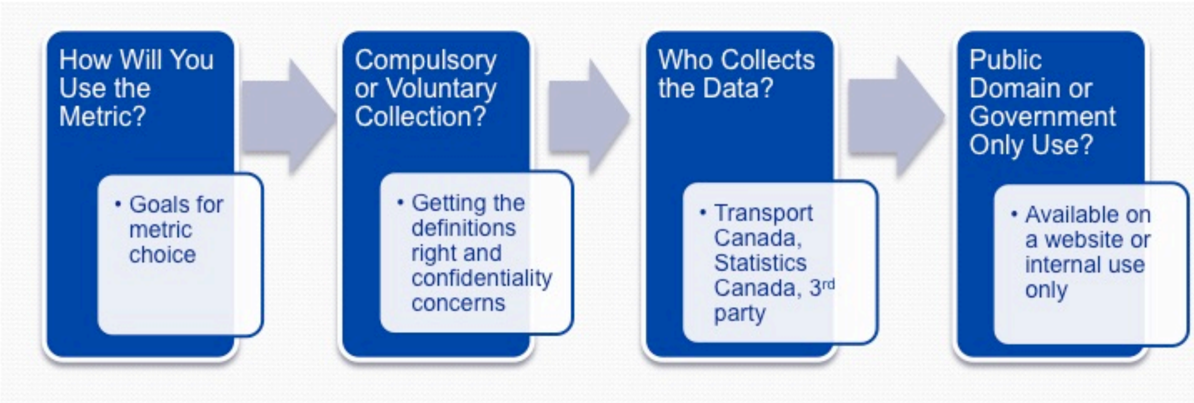
*(c) rates and conditions do not constitute an undue obstacle to the movement of traffic within Canada or to the export of goods from Canada;*

*(d) the transportation system is accessible without undue obstacle to the mobility of persons, including persons with disabilities; and*

*(e) governments and the private sector work together for an integrated transportation system.*

The current transportation policy charges government to seek market-driven solutions and to work with the private sector in an integrated way. This section of the report is organized along the cascading decisions, presented in Figure 13, that are relevant to the implementation of a Port Performance Measurement Program.

**Figure 13: Cascading Decisions for Port Performance Measurement**

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## *6.2 How Will You Use the Metric?*

How you use the metric encompasses so much more than just matching metrics possible to goals as done in Table 3. There is also the question of which metrics, how will they be collected and how many are needed? Governments always have a toolbox, and many tools are better than just one. On the other hand, there is no pointing in collecting metrics that will not be used. Given the resources that data collection demands, smaller ports should be able to choose to use fewer metrics than larger ones.

### 6.2.1 Efficiency Metrics

Almost all Key Performance Indicators (KPIs) can be gamed except those of a 'big data' nature and so caution in interpreting metrics is warranted and examining the details of what is collected and how it is collected is always a good plan. Transport Canada has provided a common nomenclature for the collection of efficiency metrics for monitoring operations, and should be congratulated for the quality of the effort over the past seven years. McKinnon (2015) would agree with the effort; he explored delay due to traffic and due to other causes and his research concludes:

> *The main message from research on this topic is that efforts to improve reliability should not concentrate solely on infrastructural deficiencies but be based on a more holistic analysis of variability in transit time and logistical cycle time.*[36]

The only strategic publicly reported metrics used by Transport Canada are market share of North American traffic over Canadian gateways and the lapsed time end-to-end transit time for containers moving Shanghai to Toronto (reported in Table 14). The additions that could be contemplated to supplement their operational dimension would be (1) an effort to first diagnose and then monitor maritime fluidity (as suggested in Table 12, column 3); and (2) to broaden the participation in the current effort beyond those ports and companies already participating.

[36] McKinnon (2015), p. 19.

**Table 12: Additional Indicators of Port Utilization in Transport Canada's Fluidity Index**

| Intermodal Indicators Currently Collected | Bulk Indicators Currently Collected | Possible Future Indicators Not Currently Collected |
|---|---|---|
| Average truck turnaround time (in minutes) | Average vessel turnaround time (in hours) | Gate accessibility (perceived by supply chain partners, an effectiveness indicator) |
| Berth utilization (in TEU per metre of workable berth) | Berth occupancy rate (%) | [Perceived] availability of dockworkers (an effectiveness indicator for shipping lines) |
| Vessel turnaround time (in seconds per TEU) | Gross berth productivity (in tonnes per berth hour) | [Perceived] timeliness of port services (pilotage, mooring, etc, an effectiveness indicator for shipping lines) |
| Average truck turnaround time (in minutes) | Total tonnes | [Perceived] vessel turnaround time (an effectiveness indicator for shipping lines) |
| Vessel turnaround time (in hours) | Number of vessel calls | Maritime fluidity (between two geo-fenced channel points or from anchorage to berth approaches, an efficiency indicator) |
| Average container dwell time (in days) | Average tonnes per vessel call | [Perceived] berth availability (an effectiveness indicator for shipping lines) |
| Dwell target (% under 72 hours) | Average time at anchor (Vancouver only) | [Perceived] crane availability (an effectiveness indicator for shipping lines) |
| Port productivity (in TEU per gross hectare) | | |
| Vessel on-time performance (%) | | |
| Crane productivity (in lifts per hour) | | |
| Number of vessel calls | | |
| Container throughput (in TEU per month) | | |
| Average TEU per vessel call | | |

Source: Columns 1 and 2 match those in Table 7. Column 3 proposes new indicators that are not currently collected and address a gap in current data coverage.

On the bulk commodity side, Canada launched a Commodity Supply Chain Table on 26 June 2014 to provide a forum for those involved in rail issues to contribute to commodity-specific performance measures, including those at ports. The mandate and objectives (presented in Exhibit 2) are in keeping with the discussion to date on where port performance measures need to go, particularly on the efficiency component of the matrix.

**Exhibit 2: The Commodity Supply Chain Table Mandate and Objectives**

- **Mandate**: Provide a consensus-based, multi-modal, national forum for producers, shippers, service providers, and supply chain partners involved in the movement of commodities by rail to identify and address transportation system issues to improve the reliability, efficiency, and effectiveness of the supply chain.

- **Objectives**:

    - promote strategic exchanges on logistical and/or capacity issues affecting supply chain efficiency for commodities shipped through Canada's gateways;

    - provide a forum to assess evolving domestic and international trade and market trends for commodities, including anticipated future demand and system needs;

    - explore, assess, and identify potential solutions to system inefficiencies through enhanced collaboration across the supply chain; and discuss the development and implementation of evidence-based performance metrics to increase the visibility of the supply chain and improve performance.

In conclusion, Transport Canada is working well with possible supply chain partners to grow and develop a comprehensive approach to supply chain fluidity measurement. Given that metrics serve both government/regulator purposes and port strategic management purposes, the question of what to collect has been mostly answered. The fluidity efficiency measures currently being collected cover most but not all bases.

### 6.2.2 Effectiveness Metrics

While Transport Canada has the goal of improving fluidity in Canadian international supply chains, determining if Canadian and foreign port customers and users receive the fluidity they expect is not part of the current fluidity program vision. That is, Transport Canada has not developed an effectiveness diagnosis and then monitoring program for either operational or strategic purposes.

Two possible effectiveness metrics that are not part of Transport Canada reporting are The World Bank's Logistics Performance Index and World Economic Forum's Enabling Trade Index. Investigation as to why Canada is not a best practice performer on the relevant fluidity components of these indices would be a useful exercise. What can Transport Canada, Department of Foreign Affairs, Trade and Development and the Canada Border Services Agency do to improve Canada's performance on these two indices.

Table 12 column 3 also proposes some possible effectiveness metrics for evaluating fluidity. Additional ones proposed by Leachman and Payman (2011) of shipping lines could be: the availability of equipment (cranes), berth space availability and the labour availability. Schellinck and Brooks (forthcoming) have validated both dockworker availability and vessel turnaround time as appropriate indicators.

Analysis of the correlation between effectiveness in the delivery of port services and individual items in the 2012 container shipping line ratings of container ports in North America with more than 250,000

TEUs leads to some interesting possibilities for an effectiveness construct for Canadian Container Ports for Transport Canada. Schellinck and Brooks (forthcoming) further assessed these effectiveness data to reduce the criteria set through Variance Inflation Analysis for the 2014 SEAPORT instrument and validated these for future use. While Table 13 suggests some indicators for each of two port user groups, the shipping line indicators have not been validated for use with bulk shipping lines, but this does not mean that there is not an opportunity to further Canadian standards development by making this part of a future effectiveness program implementation.

**Table 13: Some Possible Effectiveness Indicators for Third Party Collection**

| Possible Shipping Line Indicators | Possible Cargo Interest Indicators |
|---|---|
| Incidence of delays | Capability of employees (can they accommodate our needs?) |
| Availability and capability of dockworkers | Terminal Operator responsiveness to special requests |
| Provision of adequate, on-time information | Port Authority responsiveness to special requests |
| Speed of stevedore's cargo loading/unloading | Provision of adequate, on-time information |
| Timely vessel turnaround | Connectivity/operability to rail/ truck/ warehousing |
| Availability of storage capacity | |
| Connectivity/operability to rail/ truck/warehousing | |
| Terminal Operator responsiveness to special requests | |
| Port Authority responsiveness to special requests | |
| Timeliness of maritime services (pilotage, mooring, etc.) | |

Note: These 'time' and 'availability' related indicators are those significantly correlated with effectiveness scores in the 2012 AAPA Port Customer Service Initiative. They are ordered by the strength of correlation.

Source: Selected from a more complete list of indicators from Schellinck and Brooks (forthcoming).

As policy implementer, Transport Canada also needs to be able to evaluate the effectiveness of the port system in meeting the needs of the Canadian trading community and Canada's national economic interests; the missing element of current data collection is the strategic assessment of regular performance effectiveness through biennial expert panel surveys of shipping lines, cargo owners who look after their own bookings, and freight forwarders serving Canadian manufacturing and retail interests. A modified version of SEAPORT coupled with partnership agreements with the Shipping Federation of Canada, Canadian Manufacturers & Exporters and the Canadian International Freight Forwarders Association would meet this need. There is no substitute for the insight that comes from 'own port comparison' with other similar ports, particularly U.S. competitors.

## 6.3 Confidentiality Issues

Other than listing the fluidity measures it collects (Table 7) and the results of their end-to-end transit time analysis of Shanghai to Toronto by rail (Table 14), Transport Canada has put very few of its fluidity metrics into the public domain. The fluidity web portal itself is not in the public domain because it does not meet federal guidelines for Government of Canada websites. The tool is made available to Department of Foreign Affairs, Trade and Development trade commissioners during training, and the most important elements of the fluidity portal, the origin–destination transit time calculations, are available to Canada's trade commissioners in overseas markets. This helps sell the Canadian gateways to foreign exporters and importers.

**Table 14: End-to-End Transit Times from Shanghai to Toronto via British Columbia Ports Using a Direct Rail Model, 2010–2013**

| | Number of days | | | | |
|---|---|---|---|---|---|
| **Month** | **2010** | **2011** | **2012R** | **2013** | **% Change 2013/2012** |
| January | 23.0 | 22.8 | 24.5 | 23.4 | (4.6) |
| February | 21.2 | 23.4 | 23.9 | 25.5 | 6.4 |
| March | 21.0 | 22.7 | 22.3 | 25.3 | 13.2 |
| April | 21.6 | 22.6 | 23.5 | 24.3 | 3.5 |
| May | 22.1 | 21.7 | 23.1 | 23.6 | 2.5 |
| June | 22.1 | 21.1 | 25.0 | 23.4 | (6.4) |
| July | 22.4 | 20.6 | 23.8 | 23.4 | (1.9) |
| August | 21.3 | 21.3 | 23.2 | 24.3 | 5.0 |
| September | 21.4 | 22.9 | 22.8 | 24.5 | 7.2 |
| October | 22.8 | 22.2 | 23.5 | 24.6 | 4.8 |
| November | 22.2 | 22.5 | 23.7 | 23.9 | 0.7 |
| December | 22.8 | 23.4 | 23.8 | 25.1 | 5.8 |
| **Year Average** | **22.0** | **22.3** | **23.6** | **24.3** | **2.9** |

Source: Transportation in Canada 2014, Addendum Table M31, page A102.

A significant number of performance metrics will be seen as confidential by the privately managed terminals within Canadian port boundaries. On the other hand, there is a pervasive sense in the Canadian business community that not enough is being done when that is far from the case. To address the second perspective, more data elements could be published without damage in aggregate form. Also, best practice benchmarks can and should be made available. The existing limits on data publication appear overly cautious.

There is also the question about whether ports want to be measured or compared against others; Transport Canada's approach allows each port to see its own performance and the average. In behavioural economics, it is a better practice to allow all to see own individual performance in the context of the average as well as the best practice and the worst performer. That way, those who perform very poorly know how far down the ladder they are and how far they must climb, while those who are at the top of the ladder work harder to maintain that leadership position. As a result, average performance improves over time. Without knowing the best practice benchmark, complacency is more likely to set in and innovation less likely to happen.

**"Without knowing the best practice benchmark, complacency is more likely to set in and innovation less likely to happen.**

Finally, it may not be a problem of confidentiality but one of priority. Equipment and labour availability deficiencies can lead to congestion or bottlenecks in goods flow. This has been demonstrated as critical in ports; for example, the Asia Pacific Gateway Skills Table (2013) has developed an understanding of the trucking labour requirements at Port Metro Vancouver in an effort to address fluidity challenges at the Vancouver Gateway and currently has projects looking at the situations in Montreal, Halifax and Saint John. However, labour availability is not always an easy data input to acquire. While Port Metro Vancouver understands how many trucks and how many truck drivers are available in the lower Mainland of British Columbia, for example, through its port trucking licensing program, the situation is not clear in other jurisdictions. Neither the Province of Nova Scotia nor the Province of New Brunswick could identify for this consultant how many Class 3 trucks or how many truck drivers were licensed in either province. The data are simply no longer published by Statistics Canada and so the provinces are not necessarily tracking it or reporting it. In Nova Scotia, the data are known to the Department of Motor Vehicles (part of Access Nova Scotia) but not known to the policymakers in either the Department of Transportation or the Department of Finance (responsible for gathering provincial statistics for Statistics Canada). Surely such simple data is not of such a competitive nature so as to be subject to non-disclosure.

## 6.4 Voluntary or Mandatory?

There are many ports and terminals globally that fear the availability of transparent and open data. While behavioural economists would argue that you get better outcomes when data are known and presented in a way that encourages new behaviours, there is also the argument that quality of data is more important than quantity of participants, willing or otherwise. Hence the saying “You can bring a horse to water, but you can’t make him drink.”

One of the most important roles for government is getting the definitions right and addressing the confidentiality of industry partners. If the data collection is to be made mandatory, the data element definitions need to be uniform across all ports. Examining the approach used by Port Metro Vancouver offers insight into common definitions that are shared across ports.

To this point, Transport Canada has decided that it is better to have voluntary cooperation and quality data than to require mandatory participation by ports in its programs. As the Europeans have noted based on their PORTOPIA experience, if ports do not wish to cooperate, the data obtained will not be of sufficient quality.

As you can’t manage what you don’t measure, ports that choose not to participate will ultimately be left behind as they will fail to keep innovating, acquiring new business and knowing when to make strategic investments that are appropriate to their market and customer circumstances. Those that choose not to participate have more to answer, as is the current practice for publicly traded companies who choose not to follow the Toronto Stock Exchange (2014) 14 ‘good governance’ principles. An Annual Report is already required of Canada Port Authorities charged with looking after ports deemed to be of Canadian strategic interest. A requirement of that Annual Report could be to ask port management to answer why they choose not to participate in the national fluidity program; such a requirement would put port directors in the spotlight for their management choices.

“ports that choose not to participate will ultimately be left behind…

There is good participation in Transport Canada’s fluidity portal by bulk ports (Table 8), but the same cannot be said across the board. Container ports participating are fewer—Port Metro Vancouver and Prince Rupert on the west coast, and Montreal on the east coast, with Saint John, NB, in the process of developing capability. Notable by their absence are Halifax and St. John’s, NL. Ultimately, it would be best if all CPAs came into the program for all traffic. Where traffic data are confidential, aggregation conditions are certainly negotiable.

The issue of voluntary or mandatory is a political one. In the current situation, the critical challenge is one of balance; Transport Canada is the regulator and yet the Canada Port Authorities are still dependent on the Minister of Transport for approval of Board appointments and the like. The relationship is one where there is potential for conflict of interest. Ports do not have the independent governance regime that airports in Canada enjoy; if the regulator is making the provision of data compulsory, then it will be seen as a source of friction; yet, if voluntary and undefined, Transport Canada does not have the complete picture on the use of Canadian taxpayer assets, as port management may not choose to participate. Benchmarking only some ports against global competitors leaves non-participants behind when it comes to making the case for investment. This is a challenge for the panel beyond the scope of this study.

## *6.5 Who Collects the Data?*

Transport Canada has been developing fluidity metrics since the 2007 study done by Dalhousie University on benchmarks and port performance indicators. The current status of Transport Canada's efforts includes 98% data coverage of ocean transport movements (bulk and container) with Lloyd's List providing vessel transit times from origin to berth tie-up time. 100% of the port container dwell time is captured as is 100% of rail transit through the west coast ports of Prince Rupert and Vancouver and the east coast container port of Montréal. Rail terminal dwell is known in those ports that choose to participate. It is clear that where there are ports that agree to the fluidity concept, the current data collection is well done. Therefore, there are really no grounds to change the current data collector in favour of a third party arrangement for efficiency metrics.

While Statistics Canada could be the government agency tasked with collecting any data deemed mandatory by the review panel, its best role is capturing basic input data rather than expert opinion effectiveness data. Given Statistics Canada's removal of 'Shipping in Canada' data[37] from its data collection program, and its inability to secure the future of the long-form census data collection program, its ability to protect important data collection programs is in doubt. Port performance and fluidity data are simply too important to Canadian economic competitiveness to be left to Statistics Canada whose budget for important data collection is repeatedly under pressure. The mistrust of the scientific community on the issue of data collection by Statistics Canada simply reinforces the notion that the existing data collection program is with the right government department and that Statistics Canada serves as a suitable portal for the presentation of that data.

In conclusion, efficiency metric data collection is best left with the current department, Transport Canada. While third party supplier(s) could be used for the missing effectiveness measurement component of the Figure 3 framework, the answer about where to locate that data collection effort comes from the moral suasion question: Can the active involvement of Transport Canada and partnerships with relevant industry associations garner greater participation from port customers, users and supply chain partners or would a third party research agency get better participation from industry because it is seen as independent?

[37] The last Shipping in Canada report (54-205-x) was published by Statistics Canada in 2012, reporting on 2011 data.

# 7.0 Conclusions and Next Steps

The specific impacts of mega-ships on ports is expected to set a 'new normal' for traffic flows across the berths and through terminal gates, albeit on the west coast only for the near-term future. (There will also be ports for which existing infrastructure is over-built as there will also be losers in the coming restructuring.) Furthermore, growth in sale of Canadian commodities like grain and oil will add additional stress to landside rail networks, as noted in a recent Conference Board of Canada report on Saskatchewan's grain export future (Gill et al., 2015). The importance of addressing fluidity in supply chains in Canada remains critical if Canadian ports are to continue to serve as key gateways to North America. In this section, conclusions begin with the general conclusions, move to those focused on efficiency metrics and end with those related to effectiveness assessment. The time frames propose a short-term of 1-5 years, a medium term of 5-10 years and a long-term of greater than 10 years.

## 7.1 General Conclusions

As noted by the International Transport Forum (ITF, 2015), Canada is not alone in facing the challenge of mega-ships (and the surge in container traffic volumes at ports that result). Therefore, the ITF recommends that countries:

> ***[Recommendation 3] Provide policy support to ports to enhance supply chain productivity and innovation***
>
> *Policymakers should work with ports and terminal operators to enhance productivity, so as to make best use of their assets. This could include:*
>
> - *Innovation, technical development, workforce training and skills upgrading. Where possible, public policies could reform labour practices and procedures to enhance workforce flexibility.*
> - *Optimise the use of infrastructure capacity, e.g. by truck appointment systems and incentives for port truck moves during night or at weekends.*
> - *Release peaks at port terminals via dry ports, where space in ports is constrained.*
> - *Consider upsizing of hinterland transport modes, such as allowing for larger trains, double stacking and larger trucks.*[38]

While Canada has many options for addressing surges, congestion and delay, they all depend on quality data for decision-making and decision-makers having access to the data.

The overall objective of the Dalhousie University 2007 Port Performance Indicators and Benchmarks project was to develop a methodology and metrics to assess the efficiency and productivity of the Canada Port Authorities by Transport Canada's Economic Analysis Directorate. It was hoped that the proposed metrics could be used to spur productivity improvements as well as to assess the productivity of the Canada Port Authorities in the context of the unfolding Strategic Gateways and Trade Corridors strategy. The process could become a win:win proposition as ports would benefit in their ability to make managerial decisions and Canada could take a leadership role in port

[38] International Transport Forum (2015), The Impact of Mega-Ships, Paris: International Transport Forum of the OECD, http://www.internationaltransportforum.org/Pub/pdf/15CSPA_Mega-Ships.pdf, p. 11.

benchmarking by setting the standards by which ports globally benchmark their activities and measure the performance of Canadian ports against American and European counterparts in future.

The 2007 Port Performance Benchmarks and Indicators project concluded that the state of the art of metrics for ports in general was fragmented and that much of the research available was inadequate for the challenges faced by Transport Canada and Canadian ports at the time. A wide range of possible metrics is available to measure efficiency and effectiveness at Canadian ports, and Transport Canada implemented a program of fluidity measurement incorporating some of that advice. Efficiency and effectiveness are not necessarily trade-offs made by customers but are complementary constructs in a program of supply chain performance measurement.

What is an appropriate role for government? Having set the policy of Canada's transportation network as supporting Canadian trade interests through a Strategic Gateways and Trade Corridors Policy, the port-centric measurement of port efficiency and port effectiveness for the goals of diagnosing and then monitoring both strategic and operational activities involved in those supply chains to fulfil that policy goal is required. Whether government conducts the activities or organizes the governance of the activities such that the measurement is undertaken appropriately by a third party is a separate decision already noted.

How can supply chain fluidity be encouraged and maintained? A number of elements must be present:

- There must be consistent measurement of all time components in the supply chain, in some pre-defined manner. Table 1 provided a flow/dwell breakdown for a port-centric supply chain as a first step.
- Measuring port performance requires a plan for working with all supply chain partners willing to measure time, and a plan to encourage those unwilling to reconsider the program.
- Any opportunity for supply chain partners to reduce the numbers of transfers between carriers or between modes of transport should be carefully examined. Transloading can have significant benefits in balancing flows and addressing supply chain inefficiencies but needs careful management analysis of the time components.
- A singular focus on dwell time in the supply chain pipeline is a good place to start any diagnosis of fluidity challenges, but ultimately fluidity in flow time must also be diagnosed as well and benchmarks for performance set (e.g. targets are needed).
- The use of programs like C-TPAT, FAST, and NEXUS (known shipper, known carrier, known driver) to reduce the likelihood of regulatory delay at border crossings is a critical element in Canadian gateway development.
- Finally, the ITF (2015) notes that container mega-ships require more labour flexibility[39] and yet Canada does not collect, in its fluidity metrics, any labour data for container flows.

The challenges faced by PORTOPIA are indicators of considerable mistrust currently existing between the European ports industry and the European Commission regulators. While mistrust between regulators and ports is not uncommon around the globe, any Canadian 'next steps' need to be mindful that ports view themselves to be independent of government and wary that government will release commercially harmful data. The fact that much data from GPS and AIS sources is already leaking into the public domain sphere via Waze, Google and AIS tracking makes it only a matter of time before the data transport suppliers want to keep confidential is unlikely to remain so. Therefore, it is the better choice to have Transport Canada continue to control data access but to broaden the

[39] International Transport Forum (2015), The Impact of Mega-Ships, Paris: International Transport Forum of the OECD, http://www.internationaltransportforum.org/Pub/pdf/15CSPA_Mega-Ships.pdf, p. 54.

content in the public domain so that Canadians see it is a reasonable choice to have it remain government-collected.

Transport Canada's current approach to fluidity efficiency metrics is one of win:win.

**Conclusion 1: Transport Canada has established a world-leading fluidity monitoring program and has the right metrics for the task. However port participation does not include all Canada Port Authorities or the largest non-CPA ports. All CPAs should participate in the bulk program, and in the container program if relevant. A CPA port that argues it is too small to participate should have its CPA status reviewed as CPAs are those ports considered to be of strategic national interest. Those that choose not to participate in any component of a fluidity measurement program should be required to disclose why they have made such a decision in the port's Annual Report.**

**Associated Next Steps: In the short-term, Transport Canada should define a minimum set of metrics for all CPAs to include in their reporting requirements to Transport Canada. Transport Canada should establish the nomenclature for the metrics collected and the frequency of collection. In the next five years, the status of all CPA ports not participating in the fluidity program should be evaluated on their reasons for non-disclosure.**

The current practice by Transport Canada of making data available to participating partners with authorization via a password-protected Statistics Canada web portal will make some progress towards desired improvements, but is not moving as quickly as desired. The philosophy of 'slow and steady' has not displaced Transport Canada's efforts from being seen as world-leading. World class is a goal, but not yet attained.

Those supply chain partners who agree to supply data through granting permission to use the CBSA data based on the container number get to see their own performance against the average. However, they do not see all they should see via the fluidity portal. While variation (reliability) is critical to most cargo interests, the challenge is not either defining the metrics or reporting the basic efficiency metrics to most participants, it is getting broader participation and reporting more to the public at large.

**Conclusion 2: Transport Canada's Fluidity Web Portal has established access to trade interests to understand the efficiency metrics for their trade flows against current average flow times. Small changes in reporting are required however:**

- **Participants should be able to see the best practice data and the reliability of the data. This suggests a small change in automated reporting practices to be more appropriate for the needs of decision-makers by including the best practice or free flow data, the average (as is currently reported), and the 95$^{th}$ percentile for reliability of the data.**
- **Citizens of Canada see only the Shanghai–Toronto fluidity and very basic statistics in the Transport Canada Annual Report. The conclusion drawn by those citizens is one of 'not much happening.' Transport Canada needs to be encouraged to share more with Canadians on what it is doing in the Annual Report and mount a marketing effort to advise Canadians of its progress.**

There is a marketing challenge here. Canadians will not support those activities they do not understand.

**Associated Next Steps: In the short-term, Transport Canada should develop a communications plan to communicate to interested parties (1) what they are doing, (2) what they expect of Canada Port Authorities, and (3) why Canadian ports should choose to participate in fluidity benchmarking.**

As noted in Section 5.4, Transport Canada's fluidity web portal has yet to execute the export container elements of the fluidity program and not all major bulk ports participate. As bulk ports often have a few captive customers, the importance of bulk exports is often lost on the 'priorities list'.

**Conclusion 3: There is a need to increase the participation rate in the fluidity measurement program and to broaden its scope to more bulk and container ports, and to address the shortcomings identified in export container performance measurement.**

**Associated Next Steps: (1) In the short-term, Transport Canada should identify appropriate thresholds for participation in fluidity measurement programs and be prepared to establish a minimum set of data expected of any CPA. Additional desired metrics could be made voluntary. (Examples of minimum metrics include tonnes per year by commodity class, tonnes per berth hour and average vessel turnaround time are just a few possibilities.) (2) In the short term, Canada Border Services Agency should identify target thresholds for border administration times and work with Transport Canada to both improve border administration times and explain why ETI and LPI targets are met or not met. Performance of border administration dwell time should be reported and deviances from acceptable practice explained. (3) Within three years, export container performance data should be able to be viewed by participants in the fluidity program. (4) In the medium term, both Transport Canada and CBSA should be reporting to the citizens of Canada their outcomes for the fluidity measurement program.**

Fluidity can be stratified by the 'type of delay' when it comes to improving border administration. Some consideration could be given to targets set by the Canada Border Services Agency to optimize fluidity without damaging security. For example, the current metrics are average border wait time or average container dwell time. To reconfigure the metrics, they could be changed to Average Time for all Containers Going Only to Primary Inspection. If 96% of containers go to primary and 4% go to secondary, then the data would report, for the first group, 96% of containers clear customs within x hours and 4% of containers clear customs within y hours with a variability of z (minimum–maximum) days. The x, y and z values are reported regularly, say monthly.

The Transportation Research Board (2014) noted that

> *Based on the experience in Canada, it was suggested that small to medium businesses would benefit from the fluidity information, as large companies devote resources to monitoring and measuring supply chains and system performance.*[40]

**Conclusion 4: Canada is not just a nation of large businesses. This demands that some fluidity metrics be shared more broadly and transparently so that small businesses are also included in the program.**

**Associated Next Steps: An active effort by Transport Canada to enrol more partners needs to be made a key medium-term priority. Such an increase in expected effort also needs to be appropriately funded.**

**Conclusion 5: Port trucking is the most difficult component of measuring and managing port fluidity as there are many players and the industry is much more fragmented.**

[40] Transportation Research Board (2014), p. 48.

While 100% of port trucks contributing GPS data for the management of fluidity in terminal access and in routes to major distribution centres and hubs is desirable, it is not realistic. What is realistic is to have enough trucking companies cooperating to get a realistic picture of the bottlenecks to be addressed and to have enough data to make decisions about their remediation. An incentive program to encourage cooperation on data collection is more likely to work than a penalty approach.

**Associated next steps: In the short-term, it is proposed that Transport Canada establish a research project using the capabilities of Canada's university research programs in industrial engineering/computing science to identify the extent of 'big data' collection needed for GPS data to address this reliability challenge.**

## *7.2 Efficiency Metrics*

Efficiency metrics are mostly complete but their adoption has not happened at all Canada Port Authorities or the largest non-CPA ports (who might like the opportunity to participate).

**Conclusion 6: Maritime fluidity efficiency metrics are not currently collected. This is only relevant for those ports where there is a concern about the ability to handle a cargo surge.**

**Associated next steps: In the short-term, the identification of ports where there is concern about a cargo surge is needed. It is currently an appropriate time to diagnose (through a pilot project) the 'free flow' time via AIS data collection and analysis, and then begin a monitoring program via regular sampling to identify channels or sea lane locations where there is a threat to maritime fluidity. A large port like Vancouver or Montreal would be more appropriate than a smaller port where congestion is less likely to create delay.**

**Conclusion 7: Efficiency metrics with respect to labour availability and deployment are currently not collected; with the exception of 'lifts per full-time employee' or 'tonnes per full-time employee', all available models for collecting such data are from the developing as opposed to developed world ports.**

**Associated next steps: As there are no efficiency metrics currently collected for labour availability or deployment, it might be best to start by incorporating labour availability perceptions in the proposed measurement of effectiveness thereby diagnosing the perceived state of port labour issues. A second option could be to collect from shipping lines the number of times stevedores are requested but not available. Armed with that knowledge, a working group could address how labour availability or deployment might be measured for Canadian ports and terminals. This is a short-term decision on the best way forward and implementation plan, and a medium-term execution for the implementation plan.**

**Conclusion 8: Efficiency improvements can be spurred through 'level of service' (LOS) agreements and the incorporation of incentives and penalties in them but the implementation of these is currently fragmented throughout port-related supply chains. CPAs should be encouraged, if they have not already done so, to include 'level of service' incentives and penalties into port tariffs, lease agreements and supply chain partner access arrangements.**

**Associated next steps: In the short-term, Transport Canada could identify the level of service agreements already in place between CPA ports and their supply chain partners and customers, and work over the next 3-5 years to help other ports put such agreements in place. As LOS agreements tend to be confidential, a process for auditing and reporting in aggregate form needs to be developed. As terminal lease agreements can run for 20 years or more, this is both a short- and a long-term strategy.**

## *7.3 Effectiveness Metrics*

There is a serious gap in port performance data collection on the **effectiveness** end of the matrix (Figure 3). While Canada has a geographic disadvantage in terms of moving goods across long distances, it does not appear to the world that Canada takes its border administration and logistics timeliness seriously. The LPI takes a 'top box' approach to measuring perception of quality of transport infrastructure and transport services, e.g., a reporting of those acquiring scores in the high or very high quality quintiles. The ETI provides a second look at Canadian effectiveness and too does not come up with Canada as a best practice country.

**Conclusion 9: The real gap in port performance data collection is that there is no comprehensive third-party or Transport Canada evaluation of effectiveness of service delivery to all customers, users and supply chain partners of ports. There is NO assessment of whether ports supply the services expected or whether that service improves or deteriorates over time. This should be rectified, for the largest ports, for a complete fluidity program.**

Industry associations (such as the Shipping Federation of Canada or similar shipowner associations in other countries, International Freight Forwarders Association, or the like) could adopt the Service Effectiveness Assessment tool for PORT managers (SEAPORT) as a member benefit opportunity and the association commissions an independent survey administrator to ensure confidentiality and neutrality. Other executing agencies could include the Canadian Association of Port Authorities or the American Association of Port Authorities or Transport Canada or an independent third party in Canada; any of these would prompt improvement investments and more strategic marketing efforts by ports as well as the ability of CPAs to benchmark against others rather than get only their own results.

While the Port Performance Research Network–implemented methodology is based on the cooperation of ports that supply the contact names of their customers, users and supply chain partners, this is not the only methodological approach that would work. If ports wish to have their own results, the existing methodology works as ports supply user contact data for the invitations to participate in the Internet survey, and the existing survey meets all Tri-Council ethics approvals. If ports do not choose to cooperate, the methodology could be adapted; the alternative is to establish industry panels that rate ports biennially and seek the support of industry associations to be in compliance with Canadian Anti-Spam Legislation regulations. Here the process can be managed by an independent market research firm to ensure confidentiality to respondents and aggregation of data so as not to harm port efforts to compete. As PORTOPIA has concluded, it is better to have ports opt in to a 'plug and play' approach by choosing the modules they wish to have reported to them than to face the proverbial 'brick wall' of non-cooperation. In either methodology, the choice of ports offered to the respondent may contain more ports than just those that choose to participate.

Why is every two years proposed rather than annual data collection? The AAPA Port Customer Service Initiative found that ports needed time to implement programs and see results before the next survey round was undertaken. Every two years gives adequate time; annually would be too frequent and every five years not timely for feedback on program implementation.

If a slower approach is desirable, a program of effectiveness measurement could be put in place for shipping lines and cargo interests, and later it could be expanded to include supply chain partners and port services. The perceived value of Canadian gateway ports is as important to communicate as their efficiency. 'Perception is reality' as the old marketing adage goes.

**Associated next steps: As the evaluation of effectiveness requires a substantial participation by supply chain participants, it is important to roll out effectiveness assessment at Canada's largest ports with multiple customers and users in the short-term. Significant findings are otherwise unlikely, as participation rate will determine the usefulness of the findings. Over the**

**medium term, smaller ports can be added and then the process can be extended along the supply chain to other partners.**

## *7.4 Final Thoughts*

All conclusions and next steps are consistent with the principles expressed in Section 5 of the Canada Transportation Act. Section 5 imparts that regulation is only appropriate when market forces fail. As Canada Port Authorities are entrusted with the management of taxpayer owned assets, they should be held accountable. This review of port performance measures and Canada's fluidity measurement program under the Strategic Gateways and Trade Corridors Policy of 2007 has found that progress is good, that Transport Canada has made the program a win:win program for participants, but that while Canada has been world-leading on this front, the time has come to raise the bar and make the fluidity program complete and world class consistent with market-driven solutions, and to extend it over time to a wider range of Canadian businesses.

In the short-term, all existing **efficiency** metrics need to be confirmed against objectives, and new objectives for maritime fluidity and labour availability/deployment developed. A program for collecting **effectiveness** metrics needs to be initiated, along with deciding who should collect that data. Given that effectiveness metrics can damage reputations for ports not succeeding in being effective, implementation of that program could be done in a manner similar to that currently available via the American Association of Port Authorities. This is not an expensive option; market research capability is strong in Canada and many industry associations can be contacted to supply supporting participants.

In the medium term, all CPAs not participating in Transport Canada's fluidity program need to carefully consider why they do not participate, and make a clear case for taking such a position. Those seeking infrastructure funding from the Government of Canada should be expected to be cooperative in measuring fluidity so that the Government of Canada can evaluate the efficacy of its infrastructure spending plans. Transport Canada will need to report to Canadian taxpayers more of the results of the program than is currently the case.

A complete program of port performance measurement for export containers as well as import containers as well as bulk exports should be in place and extended along the supply chain by the long-term.

Currently, Transport Canada and the Department of Foreign Affairs, Trade and Development appear to be aligned in a transportation strategy that is trade driven. Continued alignment focused on improving fluidity and making Canadian port and supply chain performance truly world class is appropriate in improving Canada's trade surplus (deficit) and economic prospects in these turbulent times.

Given the high level of uncertainty about Canada's role in global trade as the world trading patterns restructure, it is important to make the right long-term port and hinterland infrastructure investment decisions in this environment that has an increasingly volatile nature of demand. Good investment decisions by both government and industry require better data be collected, and that all Canadian businesses and governments have the right data for future investment decisions. Funding in support of improving port performance data collection may be required in the short term to help Canadian companies compete globally in the long-term.

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# Business Statement—Mary R. Brooks Transportation Consulting

As a transportation expert, my practice focuses on understanding my clients' needs and helping them create value for those they serve. This may range from conducting credible research, acting as an expert witness, seeking answers to "too hard" questions, running a focus group or providing corporate education in the transportation management and international marketing fields. As an educator, I delight in helping companies bring staff skills in middle and senior management to a higher level of critical thinking.

My consulting work focuses on transportation and global supply chain management, and I am particularly interested in the relationships between the buyers and sellers of transportation services. With a passionate interest in how to make Canadian supply chains better, and keen enthusiasm for the world of shipping and ports, I founded the Port Performance Research Network in 2001 to examine how to make ports more effective in adding value to their users' supply chains through governance reform and benchmarking.

A list of current and former projects for Mary R Brooks Transportation Consulting may be found at

http://maryrbrooks.ca/index.php/clients-and-projects/

## About Mary R. Brooks

Dr. Mary R. Brooks is Professor Emerita at the Rowe School of Business, Dalhousie University, Halifax, Canada. She is the founder and chair of the Port Performance Research Network, a network of more than 50 scholars interested in port governance and port performance issues. She has completed consulting projects for a number of governments and companies on shipping and port matters, including chairing the OECD's roundtable on **Port Investment and Container Shipping Markets** in 2013 and reporting on **Situational Analysis of the Container Trucking Sector at the Port of Halifax**, commissioned by Transport Canada. Furthermore, she was the principal investigator on the **American Association of Port Authorities 2014 Port Customer Service Initiative**, and held the same role for its 2012 Initiative.

Dr. Brooks is the Editor of *Research in Transportation Business and Management*, an Elsevier imprint. She was Membership Secretary and Treasurer of the International Association of Maritime Economists from 1994-98. She chaired the IAME International Scientific Steering Committee for 2013-2014. She has been actively engaged in the work of the Transportation Research Board (Washington, DC) since 1993; chaired the Committee on International Trade and Transportation from 2002 to 2008; served on the Committee for Funding Options for Freight Transportation Projects of National Significance from 2007 to 2009, and currently serves on the Publication Board of the *Transportation Research Record*. She was appointed to the Marine Board of the U.S. National Academies of Sciences for six years beginning November 2008, taking over as Vice-Chair in 2014. In 2012, she published, with A.A. Pallis, *Classics in Port Policy and Management* (Edward Elgar Publishing).

Dr. Brooks received her undergraduate degree from McGill University, her MBA from Dalhousie University and her PhD in Maritime Studies from the University of Wales.