Container Tracking System – Dwell Time and Transit Time Management at the Port of Halifax

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1. Port Description

The Port of Halifax is a full service port, and offers a variety of facilities for bulk, breakbulk, roro and container cargo, as well as modern cruise facilities. Halifax is Canada's third largest container port, with container operations located in its South End and Fairview Cove container terminals.

The Port of Halifax is the only seaport on the east coast deep enough to accommodate fully laden, post-Panamax vessels. Closer to Europe than any other east coast port of call, the first destination for carriers sailing from Asia through the Suez Canal, and with seamless intermodal connections to and from the heartland of North America, the Port of Halifax is Canada's Atlantic Gateway to the world.

The Halifax Port Authority (HPA) is an agent of the Government of Canada created in 1999 pursuant to the Canada Marine Act. The mandate of the HPA includes: the administration of Halifax Harbour; the regulation of port operations; the management and development of port facilities; the provision of port services; and, the promotion of trade through the Port of Halifax.

2. Introduction

As a key gateway port, the Port of Halifax moves a significant volume of cargo inland by rail. Concerned with the quality and consistency of the service provided to its customers, the Halifax Port Authority (HPA) initiated a Service Standard Report to monitor two key performance indicators: container dwell times; and transit times. With thousands of containers moving each year, the task of capturing movement event data required for dwell time and transit time monitoring was nearly impossible to perform manually.

The HPA, working in cooperation with its stakeholders, has now developed a Container Tracking System (CTS) to automate the data collection process, measure and monitor dwell times and transit times, and make the container movement event data available to its stakeholders for the purpose of tracking import containers from the port to their ultimate destination.

Since implementing this system, container dwell times have been reduced by over 37%, and are much more consistent. Customers of the Port of Halifax are now able to track detailed event information for each import container at each stage of its inland journey, further improving their logistics planning capabilities.

3. Goals and Objectives / Business Problem

The Halifax Port Authority (HPA) owns two container terminals within the Port of Halifax. Over 550,000 TEU pass over these terminals each year, with the vast majority of these containers moving by rail to and from inland locations. While the HPA does not operate the terminals, it does have a role to play in bringing this business to the Port of Halifax, and in making sure that customers of the Port remain satisfied with the service they receive in Halifax. Quality of service and consistency of service are of primary concern.

The HPA has worked with its many stakeholders to identify the key metrics related to the quality and consistency of service at the Port of Halifax. Two key measures are: 'dwell time' – the amount of time that an import container sits at a marine terminal (terminal dwell time) or rail terminal (rail dwell time) before commencing its inland journey; and, 'transit time' – the total elapsed time from container discharge to arrival at its ultimate inland destination. Shorter dwell times indicate that terminal and rail resources are being used effectively, and results in inbound cargo being delivered to its final destination more quickly. Accurate transit time metrics allow for improved logistics planning on the part of customers receiving goods through the Port of Halifax.

The HPA, through its "Smart Port" cooperative initiative, worked with its stakeholders to collect and report the key metrics related to dwell time and transit time on a daily basis. A "Service Standard Report" was developed and distributed to interested stakeholders each day. However, the data collection process relied on input from a large number of stakeholders, and much of the collection and reporting process was manual and very labour intensive. As a result, the Service Standard Report was often not produced in a timely manner.

The primary objective of the Container Tracking System (CTS) was to reduce the level of effort required to produce the Service Standard Report by automating the data collection and report preparation and distribution processes. This allows the accurate and timely determination of current dwell times and transit times to ensure that service commitments are being met.

A secondary objective was to collect sufficient empirical data to allow the analysis of dwell time and transit time patterns and trends. This serves as a key tool to identify and investigate the causes of unacceptable dwell times and transit times so that preventive and corrective action can be taken and these times can be reduced.

A final objective was to allow cargo owners the ability to track detailed event information for each import container at each stage of its inland journey. This provides visibility to cargo movements through the Port of Halifax, further improving the logistics planning capabilities of customers of the Port.

4. Discussion

4.1 Background

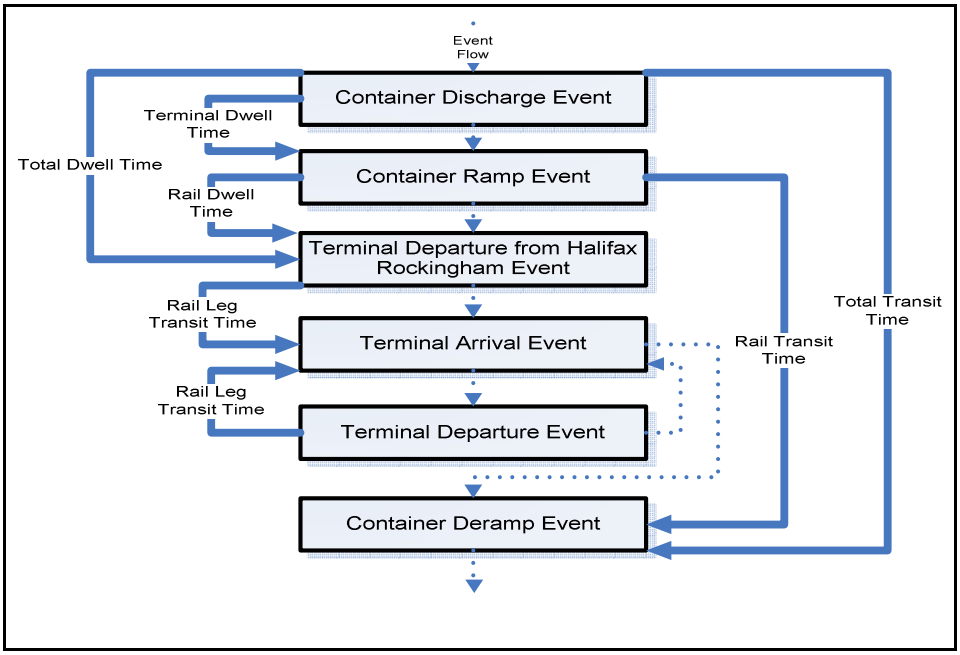
Every import container will have a number of events associated with it as it moves along its inbound journey, from vessel discharge to discharge from a rail car at destination. The events are summarized in Table 1.

Table 1 – Container Movement Event Definitions

Container Movement Event Name	Description
Container Discharge	Container discharges from the import vessel.
Container Ramp	Container is loaded onto a rail car at the marine terminal.
Terminal Departure from Halifax Rockingham Rail Terminal	Rail car carrying the container is made up into a train and leaves Halifax to begin its inland journey.
Terminal Arrival	Rail car carrying the container arrives at an inland rail terminal.
Terminal Departure	Rail car carrying the container departs from one inland rail terminal, destined to another inland rail terminal. Note that there may be several pairs of 'Terminal Arrival" and "Terminal Departure" events as the rail car moves through multiple rail terminals on its journey to final destination.
Container Deramp	Container is finally unloaded from the rail car at destination.

The relationship between the container movement events and dwell times and transit times are illustrated in Figure 1.

Figure 1 – Events, Dwell Times and Transit Times



The Container Tracking System is designed to capture each movement event for each container, and to make this event data available for container status inquiries and dwell time and transit time calculation, analysis and reporting.

4.2 Objectives and Methodology

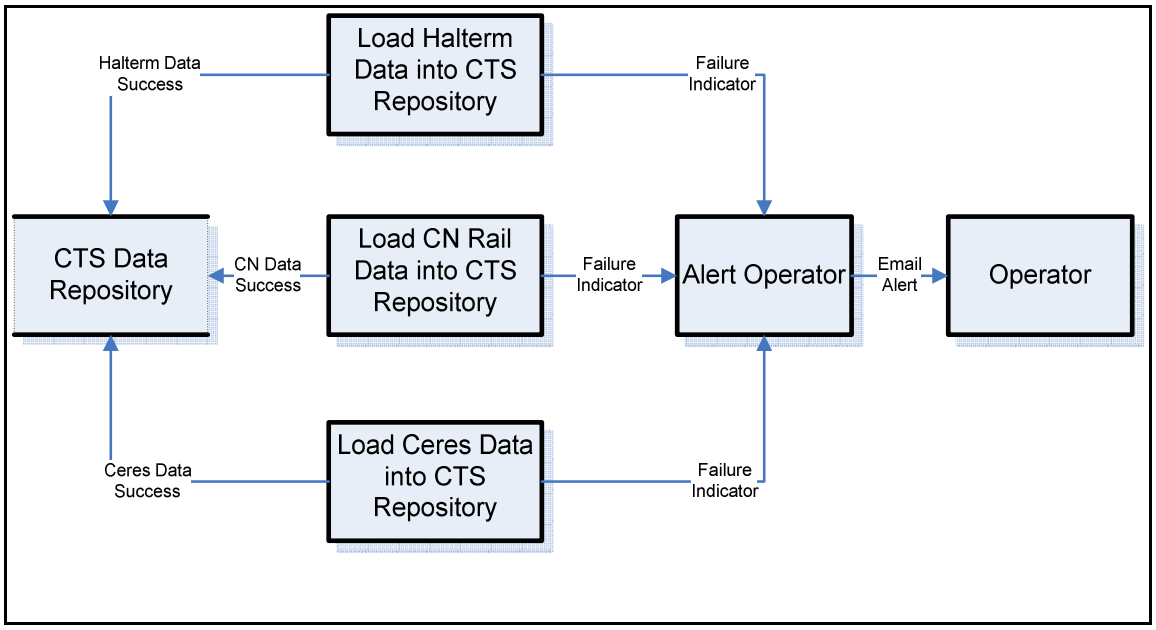
The Container Tracking System (CTS) application was developed to support the objectives of the Service Standard Reporting initiative. To do so, the following capabilities were required:

- Gather import container movement event data, from vessel discharge to arrival at inland destination rail terminal and discharge from rail car.
- Determine and report patterns and trends in terminal dwell times, rail dwell times, and total transit times for import containers.
- Allow the query and display of container movement event information and related terminal dwell times, rail dwell times, and transit times.
- Maintain a repository data to serve as the basis for rail performance analysis, planning and reporting.

To provide these capabilities, the HPA has worked closely with its two terminal operators, Ceres and Halterm, and with its rail service provider, CN Rail. Ceres and Halterm now provide an automated data feed to the CTS using the ANSI 322 Terminal Operations Activity EDI message. These messages are sent every three hours when a vessel is being worked, and report all containers discharged in that three hour period. CN Rail provides a daily electronic feed to the CTS, reporting all rail movements for that day for every import container originating in Halifax.

The CTS runs as a service, accepting the EDI feeds as they arrive, and processing them into a CTS data repository without any operator intervention. If any data import process fails to complete correctly, an operator is notified by email so that corrective action may be taken. Figure 2 illustrates this architecture.

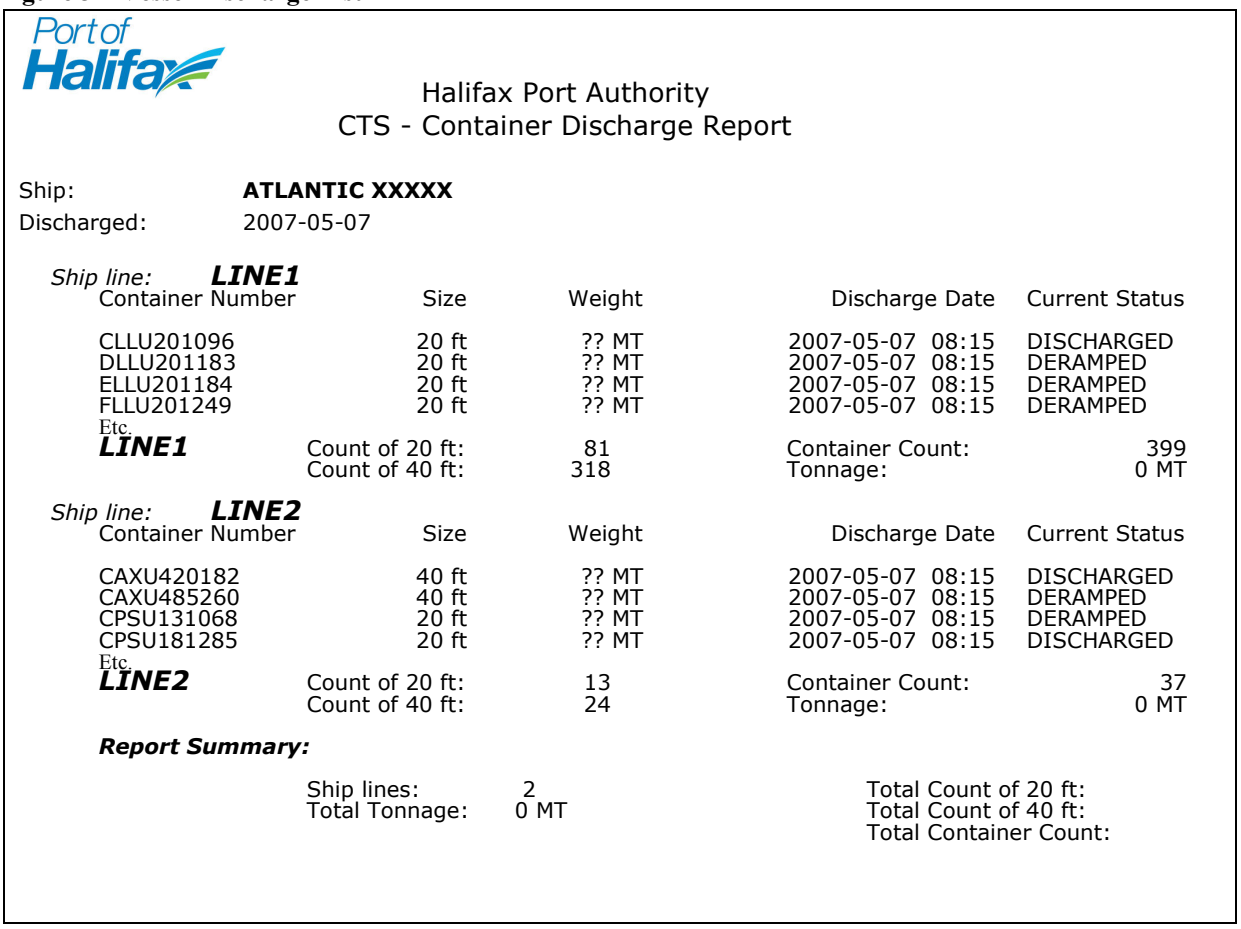
Figure 2 - CTS Service Data Flow



Once the data has been captured into the CTS data repository, it can be used to monitor terminal dwell times, rail dwell times, and overall transit times for import containers moving through the Port of Halifax. A number of standard report types are available, including:

- **Vessel Discharge List** - Lists all containers discharged from a specified vessel on a particular voyage, by ship line. A sample Vessel Discharge List is found in Figure 3.

Figure 3 – Vessel Discharge List



Halifax Port Authority
CTS - Container Discharge Report

Ship: **ATLANTIC XXXXX**
Discharged: 2007-05-07

Ship line: ***LINE1***

Container Number	Size	Weight	Discharge Date	Current Status
CLLU201096	20 ft	?? MT	2007-05-07 08:15	DISCHARGED
DLLU201183	20 ft	?? MT	2007-05-07 08:15	DERAMPED
ELLU201184	20 ft	?? MT	2007-05-07 08:15	DERAMPED
FLLU201249	20 ft	?? MT	2007-05-07 08:15	DERAMPED

Etc.

LINE1 Count of 20 ft: 81 Container Count: 399
Count of 40 ft: 318 Tonnage: 0 MT

Ship line: ***LINE2***

Container Number	Size	Weight	Discharge Date	Current Status
CAXU420182	40 ft	?? MT	2007-05-07 08:15	DISCHARGED
CAXU485260	40 ft	?? MT	2007-05-07 08:15	DERAMPED
CPSU131068	20 ft	?? MT	2007-05-07 08:15	DERAMPED
CPSU181285	20 ft	?? MT	2007-05-07 08:15	DISCHARGED

Etc.

LINE2 Count of 20 ft: 13 Container Count: 37
Count of 40 ft: 24 Tonnage: 0 MT

Report Summary:

Ship lines: 2
Total Tonnage: 0 MT
Total Count of 20 ft:
Total Count of 40 ft:
Total Container Count:

- **Analysis Reports** – Calculate and report dwell times and transit times for specific areas of interest to facilitate further dwell time analysis and comparison. The following analysis reports are currently available:

    - Dwell Time Analysis Reports (Terminal, Rail and Total Dwell Times)
    - Rail Leg Transit Time Analysis Reports
    - Total Transit Time Analysis Reports

The Analysis reports are available on-demand, and can be based on a number of user selectable report parameters, including date ranges, originating terminal, destination, ship line, and vessel. All analysis reports are available in both a black and white and a colour version, and can be displayed on-screen, printed to any available printer, converted to a PDF or Excel file, or directly emailed to any recipient as a PDF attachment. In addition to being available on-demand, the CTS system has the ability to automatically generate analysis reports on a designated schedule and to email these reports to designated recipients as PDF attachments.

A typical Analysis Report Parameter Selection screen is shown in Figure 4 and the resulting report is shown in Figure 5.

Figure 4 - CTS Analysis Report Parameter Selection Screen

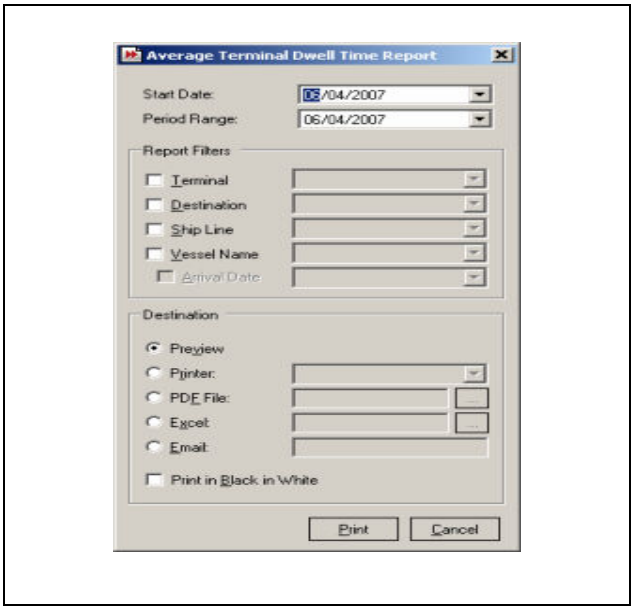


Figure 5 – Sample CTS Dwell Time Analysis Report

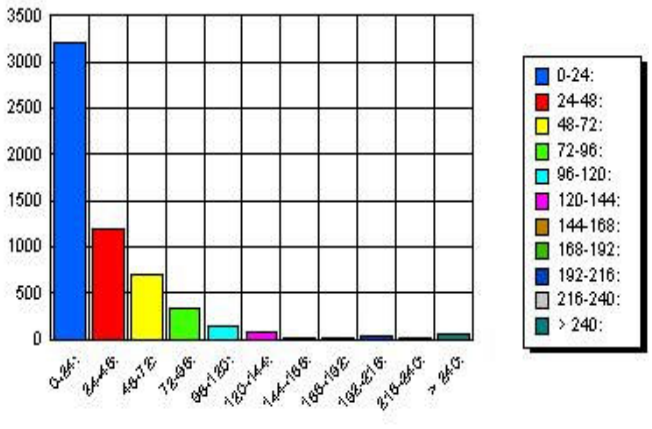
Halifax Port Authority

Average Terminal Dwell Time Report

Report Parameters: Start Date: 01/01/2007 -- End Date: 01/31/2007 -- Terminal: All -- Destination: All -- Ship Line: All -- Vessel: All -- Arrival Date: All

Average Terminal Dwell Time:

Hours	Count	% Total
0-24:	3,212	(55.26%)
24-48:	1,184	(20.37%)
48-72:	703	(12.09%)
72-96:	335	(5.76%)
96-120:	150	(2.58%)
120-144:	73	(1.26%)
144-168:	16	(0.28%)
168-192:	18	(0.31%)
192-216:	36	(0.62%)
216-240:	21	(0.36%)
> 240:	65	(1.12%)
Total:	**5,813**	



- **Trend Reports** - Calculate and report dwell times for specific areas of interest over given periods of time to facilitate the determination of patterns in dwell times for further analysis and comparison. The following trend reports are currently available:

    - Average Dwell Times (Terminal, Rail and Total Dwell Time) – Last four weeks, last twelve months.
    - Percentage of containers departing within 72 hours – Last four weeks, last twelve months.

The trend reports are available on-demand, and can be based on a number of user selectable report parameters, including date ranges, originating terminal, or ship line. All trend reports are available in both a black and white and a colour version, and can be displayed on-screen, printed to any available printer, converted to a PDF or Excel file, or directly emailed to any recipient as a PDF attachment. In addition to being available on-demand, the CTS system has the ability to automatically generate analysis reports on a designated schedule and to email these reports to designated recipients as PDF attachments.

A typical Trend Report Parameter Selection screen is shown in Figure 6 and the resulting report is shown in Figure 7.

Figure 6 - CTS Trend Report Parameter Selection Screen

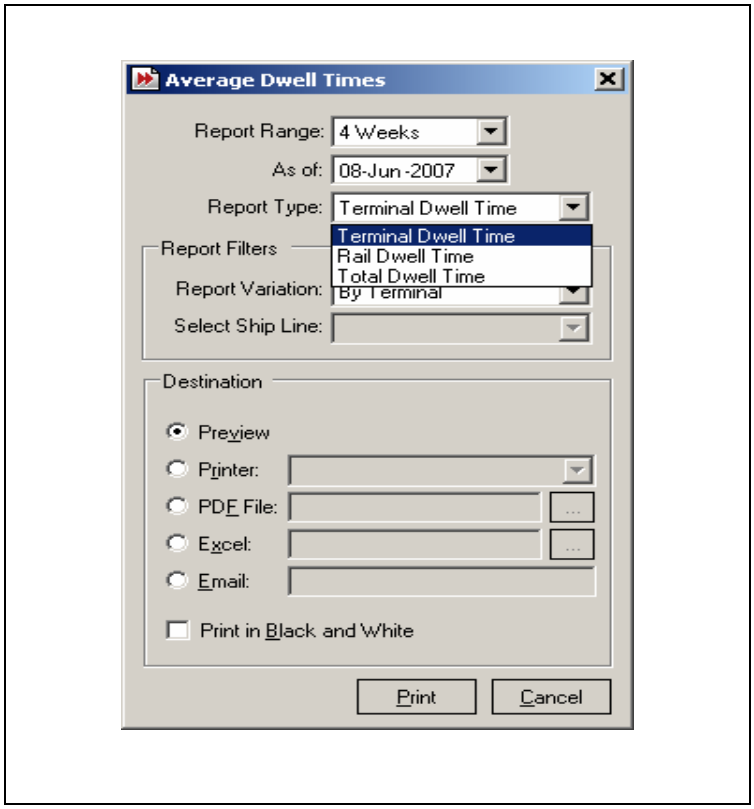
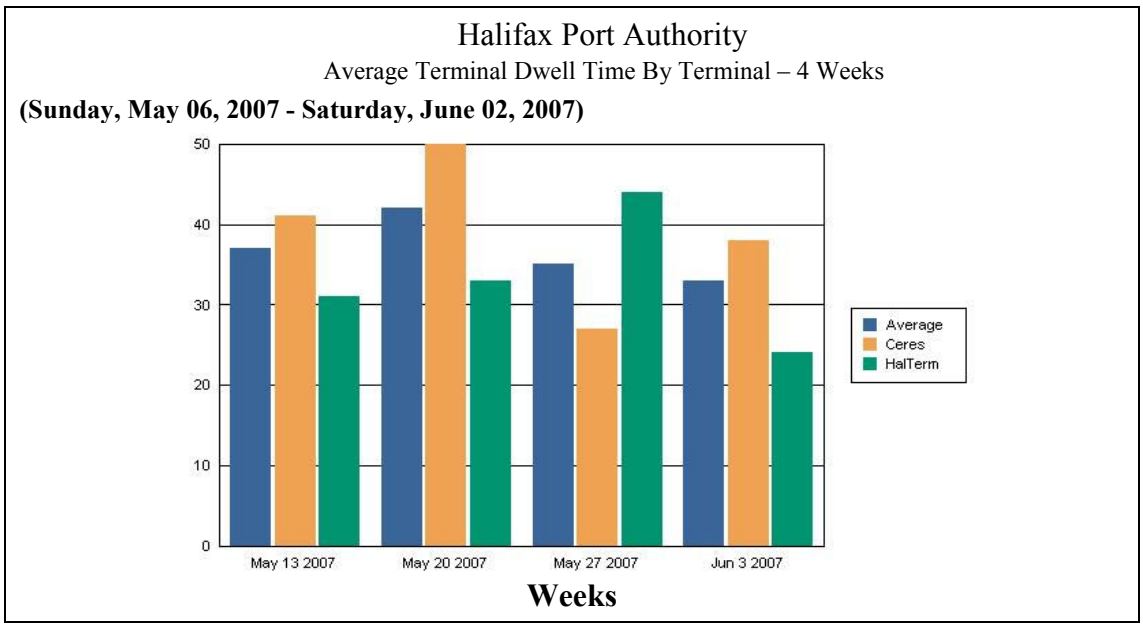


Figure 7 – Sample CTS Dwell Time Trend Report



- **Container Movement Status and History Query** – The CTS has the ability to perform queries on individual container numbers, or to browse vessel discharge lists for a specific container, and display its last reported location and status, and a history of its movements. Figures 8 and 9 illustrate the browse and query screens from the CTS application.

Figure 8 - CTS Browse Screen

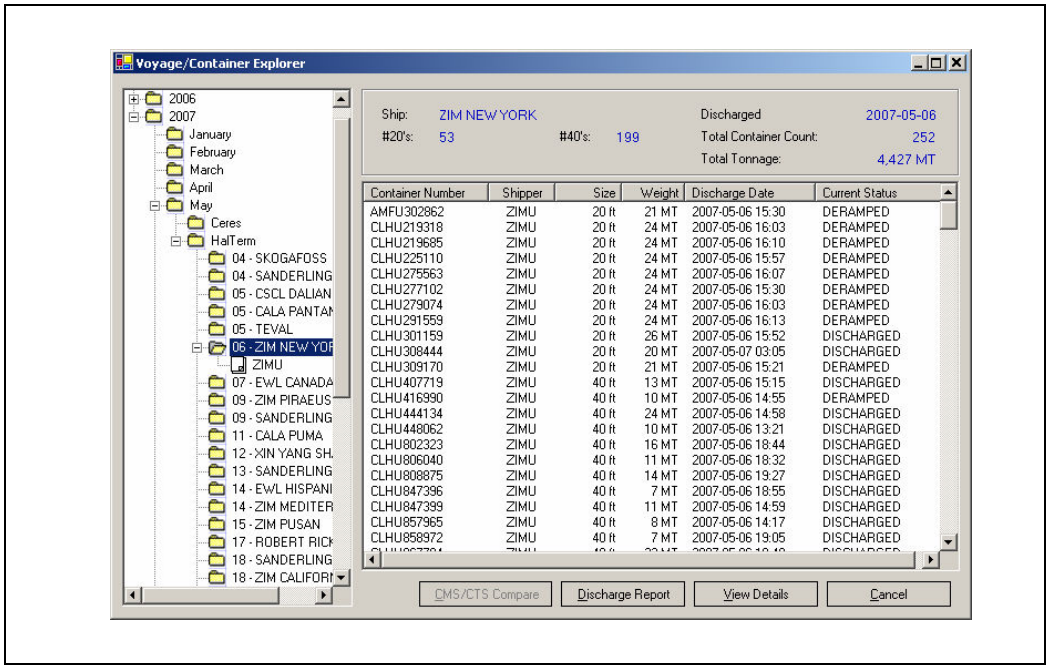
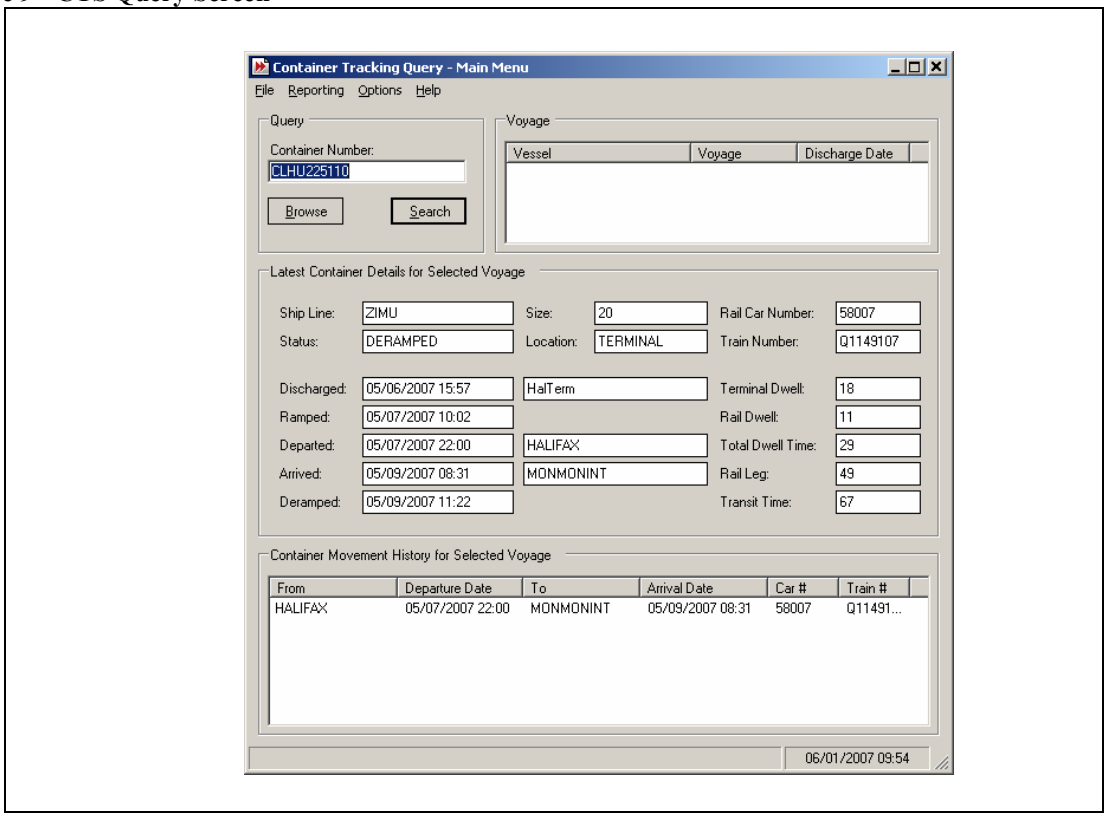


Figure 9 - CTS Query Screen



- **Web Based Container Movement Status and History Query** – The CTS application is currently only available on HPA's internal network. The existing Container Movement Status and History Query capability is now being upgraded to accept more comprehensive container queries and to make this capability more broadly available via a web interface.

The approach being used is to maintain a small subset of the CTS data base on HPA's public web site. This data base is updated each night with the most recent data available from the primary CTS data base. A web based query application has been developed to allow visitors to HPA's public web site to query the web CTS data base for the most recently available status information for the containers of interest. This upgrade is scheduled to be moved to the production environment in late June 2007. A beta version of this feature can be found at http://www.portofhalifax.ca/english/portataglance/ContainerStatusAndMovements.html.

The web query capability will allow the web based user to enter and edit a list of container numbers, and to retrieve a grid of container status information. Clicking on any container number from this main status grid will cause detailed dwell time and movement information to be displayed for the selected container. A sample web based query selection screen is shown in Figure 10, and the results screen is shown in Figure 11.

Figure 10 – Web Container Query

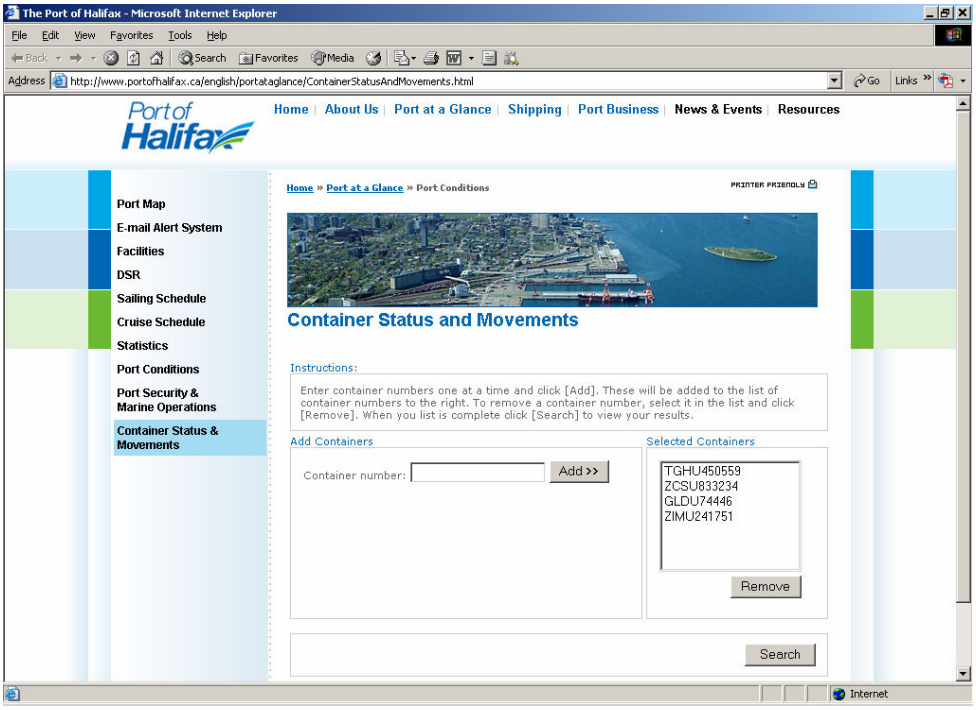
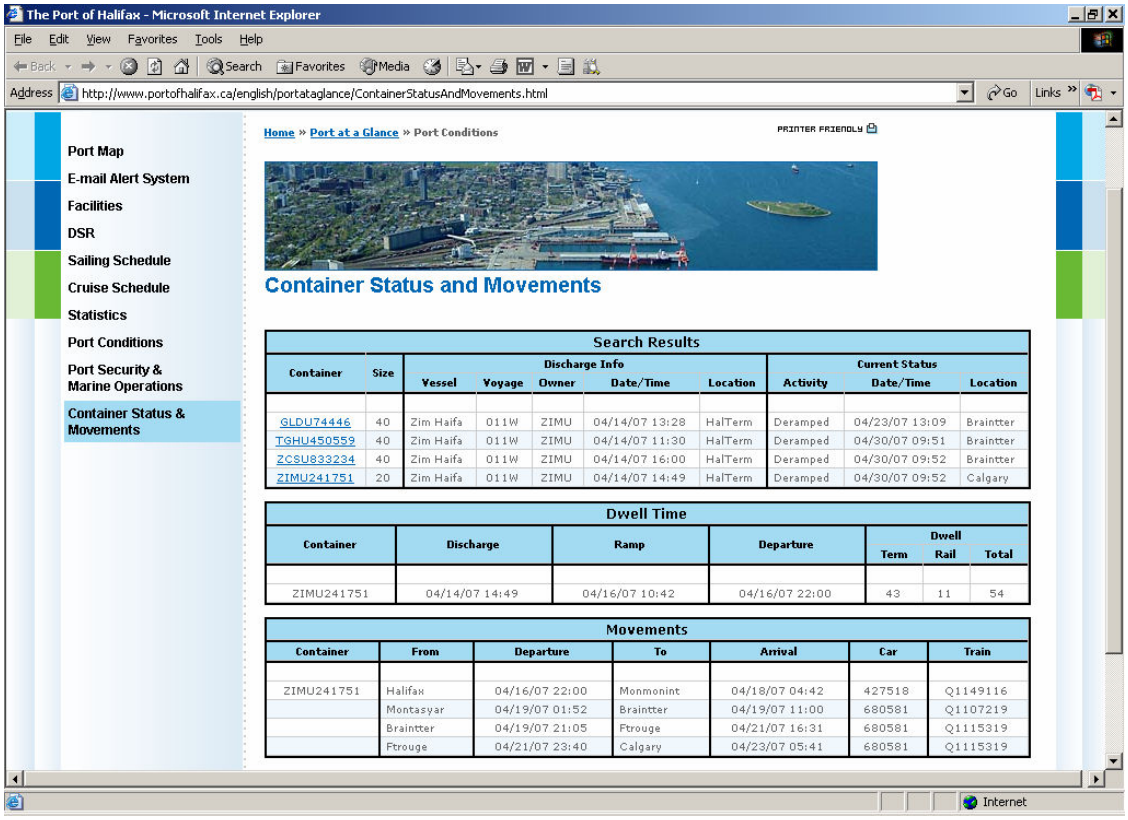


Figure 11 – Web Query Search Results and Status Screen



The web query capability will be made freely available on HPA's public web site. However, future planned enhancements to this feature will be offered to our customers on a subscription basis only. The planned enhancements include the ability to save and manage lists of containers of interest, so customers can visit the web site at some future time and get a recent update for the same group of containers. In fact, it will be possible for any given customer to create and manage multiple lists. Customers will also be given the option of subscribing to an event notification service for any containers they have entered. Such a service will provide notification to the customer whenever the status of any selected container is changed. The notification will be by email, or potentially through an RSS feed. These enhancements are currently in the planning stage and should be in place later in 2007.

4.3 Hardware and Software

The Container Tracking System was developed for the HPA by its development partner, Nicom IT Solutions. At its core, the Container Tracking system is a .NET based application written in Visual Basic.NET and using the SQL Server 2000 database platform.

There are several unattended services that handle the data import, consolidation and reporting functions written as services that execute on the Windows Server platform.

The web-based functionality is implemented using ASP.NET 2.0 and uses cutting edge technologies to ensure a pleasant, efficient and well functioning user interface. Technologies such as AJAX, Prototype and CSS are used in innovative ways to offer superior satisfaction and functionality.

Communication services are provided through custom developed ftp scripts and through the use of the *eForward*™ EDI transfer protocol from Corvedia Inc.

4.4 Project Costs

The Container Tracking System has been evolving over the last two years, with a total development cost of less than $50,000CDN. The CTS utilizes existing hardware and infrastructure and so there were no incremental costs in these areas. Ongoing operating costs are minimal.

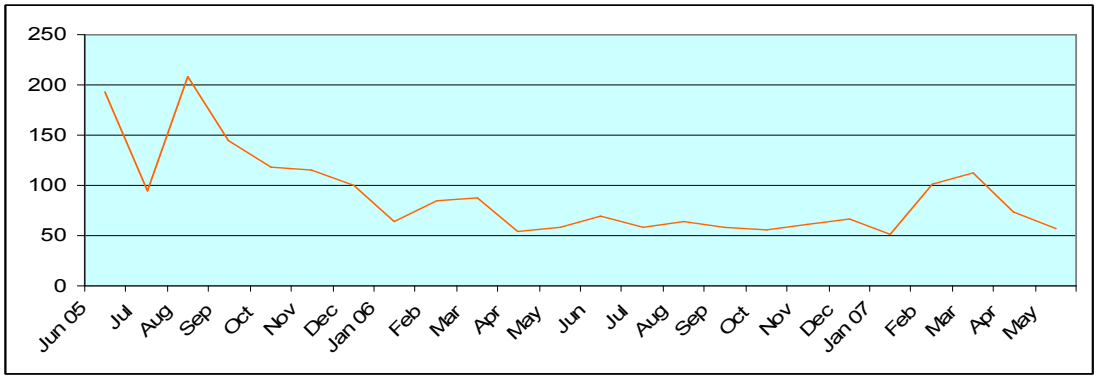
4.5 Performance Measures

The Container Tracking System has met its objectives and has positioned the Port of Halifax to provide a much higher level of customer service than was possible in the past.

The CTS has automated the collection of key operating metrics, freeing HPA staff of this onerous task. The Service Standard Reports are now prepared and distributed automatically, and in a more timely manner. One staff member, previously dedicated to this task, is now able to focus their attention on higher value customer service activities, including predictive and preventive measures.

Since the implementation of the CTS, the Port of Halifax has seen continued improvement in meeting service commitments. As seen in Figure 12, average total dwell times have dropped from 110 hours for the period June 1 2005 through May 31 2006, to 69 hours for the period June 1 2006 through May 31 2007, an improvement of over 37%. Dwell times have generally become much more consistent (with the exception of February and March 2007 when poor weather and labour issues caused dwell times to rise). While not all of this improvement can be directly attributed to the CTS, clearly, having the ability to accurately measure dwell time in near real time has raised awareness of dwell time issues and improved responsiveness in resolving them.

Figure 12 – Dwell Time Trends: June 2005 – May 2006



Moving toward a web based self-serve model for container status and movement history queries will add another dimension to the service offerings for customers using the Port of Halifax. This service is being deployed in response to customer requests, and is expected to greatly improve their logistics planning capabilities when using the Port of Halifax.

4.6 Award Criteria

- **Level and nature of benefits** – The Container Tracking System has provided an immediate and direct benefit to the HPA in the form of improved staff productivity and effectiveness. The benefits of this system extend far beyond the HPA however. Container dwell times directly reflect the productivity of a port and its service providers. The ability to accurately and quickly measure dwell times provides the opportunity to identify problem areas, take corrective action, and determine the impact of those actions. This is a significant capability, providing benefits which directly impact customers, who get their shipments more quickly, and port service providers, who are able to make more effective use of their resources. While these benefits are difficult to quantify, given a documented 37% reduction in average total dwell times since the CTS tool was put in place, it is safe to assume that there are considerable service and monetary benefits.

- **Creativity of solutions** – The CTS is based on a simple concept: that by collecting some basic container movement event data, we can measure key performance metrics and provide enhanced logistics planning information to our customers. While many organizations provide some level of container tracking, the CTS implementation in Halifax is somewhat unique in that it offers a single gateway for tracking import containers from vessel discharge to deramping at destination, regardless of which ship line, terminal or railway is used. Another unique feature is the ability to leverage the event data to provide timely container dwell time monitoring, and to make this information readily available to those who are in a position to respond to issues.

- **Apparent project results** – The CTS has met its primary objective. The effort required to produce the Service Standard Report has been greatly reduced, and the HPA has been able to redeploy staff to perform higher level customer service activities. The CTS has also met its secondary objective. An analysis of dwell times at the outset of the implementation of the CTS, compared with more recent dwell times, shows very clearly that the CTS serves as a key tool in helping to manage dwell times. The final objective was to allow cargo owners the ability to track detailed event information for each import container at each stage of its inland journey, thus providing visibility to cargo movements through the Port of Halifax and further improving the logistics planning capabilities of customers of the Port. This feature was developed based on customer request. While it may be too early to determine exactly how this will in fact benefit the Port's customers, we have at least demonstrated that we are listening to them and responding to their immediate needs. Once this feature has been fully implemented, we will be in abetter position to evaluate the results.

- **Cost effectiveness of the program** – The relatively low development and operating cost of the Container Tracking System, combined with the manpower savings related to the preparation of the Service Standard Report and with the efficiency improvements we have noted, makes for a very appealing value proposition. Once the system is in place, there are no incremental operating costs.

- **Transferability of the technology or idea to the port industry** – The concept on which the CTS is based is very simple, and the technology with which it is built is readily available and reasonably priced. From this perspective, it could easily be adopted by any port. The challenge lies in its implementation. This is not so much a technology challenge as it is an exercise in seeking concensus and cooperation from the many stakeholders who are involved in the process. Implementing the CTS in the Port of Halifax required the direct involvement of the two container terminal operators and the rail carrier serving the Port, and the indirect involvement of every ship line serving the Port, whose permission was required to provide their import discharge container lists to the HPA. The data collected by the CTS has the potential to highlight very specific problem areas which could lead to 'finger pointing'. However, through its Smart Port cooperative initiative, the Halifax Port Authority was able to gain the participation of all parties, and the use of the CTS tool has brought benefit to all. Implementation is challenging but is within the means of any port with the cooperation of its stakeholders.

5 Conclusion

The Container Tracking System (CTS) developed by the Halifax Port Authority is an example of an innovative approach to the use of technology for the effective tracking of cargo from the port of entry to its ultimate destination. Using EDI and communications technology has allowed for much improved data collection, and the reassignment of Port staff to higher value customer service activities. The ability to easily measure and monitor dwell times has provided the opportunity for much better resource management, and since the implementation of the CTS, average total container dwell times at the Port of Halifax have been reduced by 37% and are much more consistent. The CTS also allows for a single gateway for Port of Halifax customers to track import containers from vessel discharge to discharge from rail at destination. The relatively low development and operating costs associated with the CTS, the simplicity of operation, and the high level of benefit it brings makes this system an attractive investment.