

***Executive Summary***

***Analysis of Railway Fulfillment of  
Shipper Demand and Transit Times***

Prepared for:

Rail Freight Service Review

March 2010





# Table of Contents

<b>Executive Summary</b> .....	<b>5</b>
<b>1. General Approach</b> .....	<b>22</b>
<b>2. Order Fulfillment Analysis</b> .....	<b>25</b>
<b>2.1 Forecast vs. Actual Shipment Volumes</b> .....	<b>25</b>
2.1.1 <i>Performance Measurement Framework</i> .....	25
2.1.2 <i>Data Structure and Data Validation</i> .....	26
2.1.3 <i>Forecast versus Actual Shipment Analysis</i> .....	28
2.1.4 <i>Commodity and Volume Characteristics</i> .....	32
2.1.5 <i>Key Findings</i> .....	35
<b>2.2 Railway Car Supply Performance</b> .....	<b>37</b>
2.2.1 <i>Performance Measurement Framework</i> .....	37
2.2.2 <i>Scope of Analysis</i> .....	39
2.2.4 <i>Data Structure and Data Validation</i> .....	40
2.2.5 <i>Grain Car Supply Analysis</i> .....	43
2.2.5 <i>Merchandise Car Supply Analysis</i> .....	52
2.2.6 <i>Daily Car Supply Performance</i> .....	62
2.2.7 <i>Key Findings</i> .....	67
<b>3. Transit Time Performance</b> .....	<b>70</b>
<b>3.1 Approach and Methodology</b> .....	<b>70</b>
3.1.1 <i>Elements of Transit Time Performance</i> .....	70
3.1.2 <i>Performance Measurement Framework</i> .....	74
<b>3.2 Railway Transit Time Performance</b> .....	<b>85</b>
3.2.1 <i>Planned versus Unplanned Variation in Transit Time</i> .....	85
<b>3.3 Performance by Railway, Shipper and Network Characteristics</b> .....	<b>88</b>

3.3.1	<i>Canadian National Transit Time Performance</i> .....	90
3.3.2	<i>Canadian Pacific Transit Time Performance</i> .....	104
<b>3.4</b>	<b>Performance of Traffic to and from Major Terminals</b> .....	<b>117</b>
3.4.1	<i>Vancouver Intermodal</i> .....	117
3.4.2	<i>Vancouver Non-Intermodal traffic</i> .....	119
3.4.3	<i>Montreal</i> .....	120
3.4.4	<i>Halifax</i> .....	122
<b>3.5</b>	<b>Intermodal Terminal Performance</b> .....	<b>123</b>
3.5.1	<i>Detailed Data Validation – Intermodal Terminal Time</i> .....	123
<b>3.6</b>	<b>Transit Performance for Car Blocks</b> .....	<b>127</b>
<b>3.7</b>	<b>Delivery to Shippers at Final Destination</b> .....	<b>131</b>
3.7.1	<i>Data Validation</i> .....	132
3.7.2	<i>Analysis of Railway Performance – Time to Placement at Final Destination</i> .....	133
3.7.3	<i>Delays attributable to Day of the Week Arrival</i> .....	136
<b>3.8</b>	<b>Analysis of Rail Car Loading and Unloading Time</b> .....	<b>138</b>
3.8.1	<i>Detailed Data Validation – Loading and Unloading Times</i> .....	139
3.8.2	<i>Railcar Loading Time</i> .....	140
3.8.3	<i>Railcar Unloading Time</i> .....	143
<b>3.9</b>	<b>Key Findings</b> .....	<b>145</b>
	<b>Table of Figures</b> .....	<b>147</b>
<b>Appendix 1</b>	<b>Data Screening and Validation</b> .....	<b>152</b>
<b>Appendix 2</b>	<b>Car Supply Performance</b> .....	<b>166</b>
<b>Appendix 3</b>	<b>Technical References</b> .....	<b>172</b>
<b>Appendix 4</b>	<b>Representative Flows</b> .....	<b>182</b>
<b>Appendix 5</b>	<b>Transit Time Performance</b> .....	<b>186</b>

# Executive Summary

## *Purpose of the Project*

The Government of Canada is conducting a review of rail freight service in response to concerns raised by stakeholders in the rail freight logistics system regarding the service performance of Canada's railways and as part of a broader initiative which included changes to the shipper protection provisions of the Canada Transportation Act. The general objectives of the review are to examine the performance of the rail freight logistics system in Canada and to identify problems and issues with respect to railway service including those stemming from the operations and activities of stakeholders other than the railways – such as shippers, receivers and logistics partners.

This report is part of the quantitative and analytical stage of the Rail Freight Service Review. It has been prepared in response to the requirements of the Request for Proposals (RFP) covering the "Analysis of Order Fulfillment and Transit Times". As part of the broader review, the objective of this report is to assess the extent to which the railways meet shipper demand for service. There are two main components to this report: firstly an assessment of railways' fulfillment of shipper demand and secondly an assessment of railways' transit time performance.

The choice of these factors for assessment in the quantitative analysis phase of the review - demand fulfillment and transit time consistency - was reinforced by the findings of the customer satisfaction survey conducted by NRG Research for the Rail Freight Service Review.<sup>1</sup> This survey identified car supply (which is a key component of demand fulfillment) and transit consistency as very important factors influencing shippers' satisfaction with railway service.

Furthermore, this report and the service review process in general recognize that the performance of the rail freight logistics system in Canada is not solely a railway responsibility but a joint effort of all key stakeholders in the system. As part of the service review process QGI prepared a report on operating practices in Canada's rail freight logistics system.<sup>2</sup> In that report QGI, using the Supply Chain model of logistics, demonstrated that Canada's rail freight logistics system is a joint responsibility of all supply chain partners. This system requires effective collaboration in the planning and operations activities of supply chain participants including railways, shippers, receivers, shipping lines and their intermodal and bulk shipping partners.

---

<sup>1</sup> The two most important service factors were 'on-time delivery of cars at origin' and 'on-time delivery of cars at destination'. *Survey of Shippers. Prepared for the Rail Freight Service Review* NRG Research Group November 30, 2009.

<sup>2</sup> *Analysis of Operating Practices* QGI Consulting October 2009 Report prepared for the Rail Freight Service Review.

---

## General Approach

For the transit time performance analysis this study reviews railway, shipper and receiver performance in the loading, movement and unloading of rail cars across a number of dimensions of shipper and railway network characteristics including:

- Railway Canadian National (CN) and Canadian Pacific (CP)
- Commodity Broken out by customary classifications such as: Grain Products, Fertilizers, Forest Products, Fuels and Chemicals, Intermodal, Automotive and others.
- Size of Shipper
- Size of Order or Flow Size Represented by the number of cars shipped in a particular shipper/commodity/origin/destination combination.
- Point or Province of Origin and Destination including major border crossings
- Main Line vs. Branch Line Origins
- Short Line vs. CN/CP Origins
- Access to Alternative Transportation
- Length of Haul (LOH)
- Time

The order fulfillment analysis, including both annual forecast demand and weekly car supply processes, are generally based on the same framework of railway and shipper characteristics but due to data limitations do not include as detailed an assessment of performance across all railway and shipper characteristics. Furthermore, as is described in report Section 2.2 - Railway Car Supply Performance, the analysis of railway performance with respect to the supply of empty cars in response to customer car orders is limited to those Merchandise and Grain customers who submit their orders through the railways' electronic car ordering systems.

The analysis in this report is based on data provided by CN and CP for the period from October 1, 2006 to September 30, 2008.

---

## Order Fulfillment Analysis

The order fulfillment analysis examines two distinct aspects of railway performance in meeting shipper demand. First, the analysis of forecast versus actual volumes shipped evaluates the relative success of the railways in meeting shipper demand based on the railways' medium term demand forecasts that are developed as part of their annual planning processes. Secondly the car supply performance analysis examines railway performance in meeting short term (weekly) shipper demand by comparing the actual number of empty cars spotted on a weekly basis against shipper railcar orders and the railways' planned level of empty car supply. This analysis also evaluates the performance of shippers by assessing the degree of volatility in shipper demand – i.e. the frequency and magnitude of changes to shipper car orders.

Annual railway budgets are developed for both revenues and operating costs that are based on the railways' forecast of demand. Railway budgets are constructed using multiple inputs including shipper demand estimates, historical shipment patterns, commodity specific market intelligence and macroeconomic assumptions. The volume forecasts that underlie these budgets are used to determine the necessary investment and maintenance plans for railway assets such as freight cars, locomotives and train crews as well as train service design. In developing their asset and service plans the railways rely on both shipper information and historical traffic patterns to account for seasonal fluctuations in volumes.

In finalizing their planned resource requirements to respond to shipper demand railways will also consider the revenue yield opportunities and capabilities across their traffic base and the level of operating income that may be achieved. As such, railway budgets are not simply a direct reflection of underlying customer demand but rather the level of demand the railways plan to fulfill throughout the year in the pursuit of their broader financial objectives. Therefore the accuracy of railway forecasts should be viewed in the context of how such forecasts are constructed and the many factors that can impact traffic volumes and traffic patterns through the course of a year.<sup>3</sup>

The railways measure their performance against plan as part of their ongoing quarterly and monthly planning processes. These shorter term planning processes are designed to identify emerging changes in absolute demand or the timing of demand that can result from the actions or performance of shippers or other system stakeholders, broader market issues, railway performance or systems disruptions beyond the control of all stakeholders (e.g. weather). The railways look to develop appropriate short term operational and service strategies in response to demand changes that create potential capacity constraints in the railway network. These strategies can include short term leasing of railcars and or locomotives and changes to train design in specific corridors. The measurement of empty car supply performance in this report provides insight into two issues: the level of demand volatility from

---

<sup>3</sup> For a more detailed explanation of railway budgeting and forecasting processes see, *Railway Demand Forecasting and Service Planning Processes* QGI Consulting March 2010. Report prepared for the Rail Freight Service Review.

shippers and the performance of the railways in meeting both stated shipper demand and the railways' own car supply plans.

## Forecast vs. Actual Volumes

### *Methodology and Scope of Analysis*

Prior to the commencement of the railway service review, Transport Canada reached an understanding with the railways that this study would be based on a data sampling approach. QGI worked with both railways and Transport Canada on a sampling methodology to ensure that the study could examine railway service at a sufficient level of detail to provide analysis with reasonable statistical validity. QGI's sampling methodology was based on stratified random sampling.<sup>4</sup> QGI's sample was drawn from traffic data for traffic shipped during calendar year 2007. Both CN and CP encountered difficulties in providing budget data at the shipper-origin-commodity (sample key) level of detail that was requested in QGI's sample due to the budgeting and forecasting practices in place at both railways. Due to this limitation each railway submitted data at varying levels of detail as compared to the sample keys for which data was requested. The analysis for order fulfillment uses simple ratios such as (carloads shipped/budgeted carloads) and variance measures such as (cars budgeted – cars shipped) that provide the necessary performance metrics.

### *Key Findings*

- At an aggregate level for the two year study period, the railways' forecasting processes were accurate in estimating traffic volumes within 10% based on the performance of both CN and CP. For individual years within the study period, variance to plan for the two railways individually ranged between +1% and -8%. For the entire 24 month service review period<sup>5</sup> CN and CP had similar performance with respect to the volume of cars shipped vs. railway forecast with actual shipments for both railways falling short of plan although more so for CN (-6%) than for CP (-2.6%).
- During the study period performance to plan was consistent across the major lines of business for both railways with all business lines performing below forecast levels with the exception of CP's Intermodal segment that was 4.5% better than forecast in Year 1.
- The combined shortfall to plan experienced by CN and CP during the study period represented, for the sample of traffic analyzed, a total of 332,000 carloads with CN accounting for 74% of the shortfall.
- There was a higher degree of variance to plan at the individual commodity subgroup level with annual forecast accuracy varying by as much as 40% reflecting both positive and negative variances to plan.
- There is also significant variance to plan on a monthly basis at the individual commodity subgroup level averaging 36% for the two railways over the course of the study period.
- Variance to plan at the individual shipper origin/commodity flow level varies widely with maximum annual percentage variance ranging from -100% to more than +100% of forecast. For the sample of forecasts analyzed, approximately 42% of the sample keys (46% of carloads) had a variance to forecast of +/- 10% and 70% of sample keys (84% of carloads) had variability of +/- 30%.

---

<sup>4</sup>For more details refer to *Technical Report: Sampling Methodology* QGI Consulting March 2009. Report prepared for the Rail Freight Service Review.

<sup>5</sup>Excluding the month of February 2007 which was removed due to the CN strike.

## Empty Car Supply

The objective of the empty car supply analysis is to determine the degree to which railways meet shipper requirements in the supply of empty rail cars. This car supply analysis is a review of the daily and weekly empty car order and supply process that takes place between shippers and railways. In addition to this short-term process, shippers and railways share information through longer term budgeting and forecasting processes that operate over annual and monthly time frames.<sup>6</sup>

The railways' car ordering processes are designed to encourage shippers to provide the railways with advanced views of shipper demand by allowing shippers to enter their orders a number of weeks in advance. These processes allow for weekly service planning by imposing a cut-off date for order entry typically during the week prior to the week for which cars have been ordered.<sup>7</sup> In assessing the railways' performance in meeting customer demand for empty rail cars, it is important to remember that a railway's failure to supply cars may or may not imply lost sales or lost economic productivity for the shipper. The degree to which an empty car order represents true demand depends in part on whether or not there are economic consequences to the shipper associated with the car order transaction.

As both CN and CP impose financial penalties on shippers for empty railway owned cars ordered and not used and as demurrage charges accrue on empty railway supplied cars - neither railway operates in an environment where car orders can be considered as "unconstrained demand." However, interpretation of the meaning of car order demand remains problematic – particularly in situations and at times where shippers believe that total demand for empty rail cars is likely to exceed available supply.

In reviewing railway performance in supplying shippers' demand for empty rail cars it is important to keep in mind the practical restrictions that face railways in their response to changes in shipper demand. Railway car supply is provided by fleets that are relatively fixed on a month to month basis as opportunities for railways to increase their fleet supply through short term leasing or the use of foreign railway fleets are in most markets quite limited and may carry unacceptable costs to the railway. When railway operations or demand changes cause congestion in the rail network it can significantly affect the short term availability of cars for loading at origin.

For all of the reasons above, caution must be used when interpreting the car order fulfillment statistics that are presented in this report. In order to more fully understand the issues and concerns related to how the railways are fulfilling empty car demand QGI recommends that the data presented herein be used in conjunction with other information sources on this topic. These sources include the results of the railway customer satisfaction study

---

<sup>6</sup> These longer term processes for predicting and planning for rail freight customer demand are examined in a different report that QGI has prepared as part of the Rail Freight Service Review. *Railway Demand Forecasting and Service Planning Processes* QGI Consulting March 2010.

<sup>7</sup> Railway cut-off dates will vary by railway and are different for Merchandise and Grain shippers. The specific cut-off dates for CN and CP's Merchandise and Grain car order programs are discussed in greater detail in Section 2.2 of this report.

undertaken for the Rail Freight Service Review by NRG Research<sup>8</sup> and QGI’s reports on railway car order and supply processes and on railway demand forecasting and service planning<sup>9</sup>. In addition, readers may wish to consider the information provided in any submissions that may be made to the Service Review by shippers, railways, and others.

### Methodology and Scope of Analysis

Not all types of railway shippers or business segments are included in this analysis. The car supply analysis has only been conducted for situations *where the railway controls car supply to the shipper* and excludes intermodal traffic. In addition, situations where cars are supplied without the use of railway electronic car order processes have been excluded.<sup>10</sup>

The data requested from the railways was therefore limited to the Merchandise (including Fertilizer) and Grain products shippers of both railways. The products shipped by these customers include forest products, mine and mineral products, construction materials, agricultural and grain products. The following table provides a breakdown of the proportion of both railways’ non-Intermodal business that is shipped using each of the car types that were included in this analysis.

Car types covered by ordered/supplied analysis<sup>11</sup>

Car Type	Percentage Railway Non-Intermodal Business Shipped by car type
Boxes	14%
Covered Hoppers	28%
Flat Cars	10%
Gondolas	9%
Open Hoppers	< 1%
Total	61%

The original terms of reference for this project did not include provision for the supply by the railways to QGI of any data on empty rail car orders, or empty supply information. QGI, with the support of Transport Canada, entered into discussions with CN and CP to discuss the terms under which the railways would be able to provide empty rail car demand and supply data to QGI and the railways agreed that this data would be provided to QGI but summarized at the weekly level. As a result, this analysis is provided at the weekly

<sup>8</sup> *Survey of Shippers. Prepared for the Rail Freight Service Review.* NRG Research Group. November 30, 2009.

<sup>9</sup> *Railway Car Order and Car Supply Processes and Railway Demand Forecasting and Service Planning Processes* QGI Consulting March 2010. Reports prepared for the Rail Freight Service Review.

<sup>10</sup> The analysis was limited to situations where railways supply cars as there is no car order process that can be subjected to measurement in situations where shippers supply cars – such as in the petroleum and chemical industries. In addition, when cars are supplied through the provision of specially assigned fleets (customer pools) of cars, there is no record of shipper car demand that can be assessed against the cars actually supplied. Intermodal traffic was excluded as the railways do not have reliable electronic data on equipment demand for railway supplied intermodal equipment.

<sup>11</sup> This table estimates the proportion of the total non-Intermodal rail business that is included in the car order and supply analysis based on the sample reference year 2007. The percentages for each car type in this table take into account all of the exclusions from the analysis described in the text with the exception of the traffic that was excluded due to the use of customer assigned pools. For CN, this is a nominal proportion of its traffic. For CP, customer assigned pools are more commonly used. Based on a review of CP data QGI estimates this proportion at approximately 8% of CP’s non-Intermodal business.

level. However, since the issue of daily car supply performance was of great interest to stakeholders, QGI also requested the railways provide data on daily car order performance for a very limited number of shippers and locations. This report contains a brief analysis of daily car supply performance for this small sample of shippers.

QGI validated the railway supplied car order and supply data with a select number of grain and merchandise customers for both railways. These shippers were asked to validate data for a total of 19 origins. While shippers identified some minor anomalies in the timing of order and supply data from week to week all were in agreement that the railway supplied data was representative of their experience and consistent with their own records.

For this railway car supply analysis, simple ratios such as (cars ordered/cars supplied) and variance measures such as (cars ordered – cars supplied) were developed to provide the necessary performance metrics. These metrics are used to assess the railways' car supply performance against both shipper demand (orders) and where appropriate the planned or allocated supply the railways communicate to their customers.<sup>12</sup> In addition to railway performance in the supply of empty rail cars, shipper performance with respect to rail car order activities is reviewed in this report.

## **Key Findings**

### **Grain Car Order/Supply Analysis**

#### *Car Demand*

The empty car order processes for grain cars are quite similar between CN and CP. Between 25% and 30% of grain car orders<sup>13</sup> on both railways are subject to cancellation by customers after the cut-off date for orders and prior to the cars being supplied by the railways. While the number of overall cars affected is much smaller than the number of orders affected, it is still very significant ranging from 11-12% of CP's and 15-17% of CN's total grain cars ordered by shippers. While there was no statistical relationship between overall car order levels and car order cancellation rates, the period of declining overall demand during grain year 2007-2008 did coincide with a period of great volatility in grain order cancellations from week to week, especially during the last half of the grain year when volumes were in decline. Shippers may reduce some or all cars ordered for a particular location prior to railway placement for a variety of reasons including: the cancellation of previously unfilled orders, agreement between a railway and a shipper to shift orders from one location to another to facilitate operations planning for either party, or changes in grain collection or final market outlooks.

---

<sup>12</sup> Measures of performance for planned or allocated supply are not provided for CP's Merchandise business as CP's existing car order process does not provide for electronic communication to their customers regarding the level of empty car supply the railway plans to supply in response to the orders submitted.

<sup>13</sup> A grain car order is defined as an order by a shipper for the placement of one or more empty covered hopper cars at a specific location for a specific week.

### *Car Supply*

At an aggregate level, the two railways' performance in fulfilling shipper demand for empty grain cars was almost the same with CN fulfilling 98% and CP fulfilling 97% of total orders for the service review period from October 1, 2006 through September 30, 2008. On a week to week basis, however, there was significant variability in performance with each railway providing grain shippers with at least 90% of the cars that they had ordered at a specific location only half the time. Furthermore, as with the transit time performance assessment, both railways' weekly car supply performance deteriorated significantly during the winter of 2007/2008.

### **Merchandise Car Order/Supply Analysis**

While the empty car order processes for grain cars are quite similar between CN and CP, the processes for Merchandise cars are quite different. CN offers shippers a Guaranteed Car Order (GCO) program which includes performance penalties for both shipper and railway. CP's car order process does not include a commitment to supply, and there are no financial penalties to CP for failure to meet merchandise car orders placed through its Internet based Delta car order program.<sup>14</sup>

CN's car supply process includes a review of orders and the entry by CN into its car order system of CN's allocation (guarantee) of its projected available empty fleet for each car order. In addition, CN's information systems track changes to car orders that took place between the cut off date for car order and the actual date for which cars were ordered and, as a result, were able to provide QGI with the related information. CP's data only included its final car order numbers as CP's systems do not track changes in the orders between cut-off and actual car order dates and therefore no such information could be provided to QGI.

Because of these significant differences between the two car order programs and the data provided by CN and CP, the analyses of the two programs cannot be directly compared. Consequently the results of the analysis are presented separately for each railway and the analysis of CP car supply processes cannot include an assessment of the volatility of CP's customer car orders.

### *Car Demand – CN Merchandise*

The CN empty car demand analysis showed that 36% of the CN car orders were subject to changes after the cut-off date. The absolute value of the percentage change to car orders for all Merchandise car types was 11% of the cars

---

<sup>14</sup> CP does charge for cars that have been ordered by shippers through its Delta car order program that are not used by shippers and must be pulled empty from a shipper's siding. In addition, for both railways, demurrage charges on empty cars begin to accrue to the shipper after the expiry of the railways' free time provisions for loading empty cars. For a more thorough discussion of the details of CN and CP's car order processes see QGI's report on this topic – [Railway Car Order and Car Supply Processes](#) QGI Consulting March 2010.

ordered for the entire service review period.<sup>15</sup> This change resulted in a 5% net increase in cars ordered (increases minus decreases) after the cut-off date and before the order delivery date. The analysis of car order changes by CN customers suggests that the short term prediction of final demand for empty rail cars is a very dynamic process.<sup>16</sup> Given the demonstrated variation in demand prediction, railway car distribution staff will face challenges in their ability to satisfy customer car orders while maintaining their focus on asset utilization. Changes in car demand from day to day and week to week will be affected by such factors as railway performance in meeting previous demand requirements, final demand changes by the customers' customers, changes in customer operations and upstream logistics and supply processes/performance.

### *Car Supply - Merchandise*

On an annual basis, CN has an average annual fulfillment rate of 86% for Merchandise customer car orders and an average annual fulfillment rate of 95% for the car guarantees made under its GCO program. When considered across size of car order, network/shortline/competitive status and province of origin, there is very little variation in the overall car order fulfillment rate for CN customers.<sup>17</sup>

However, as with grain car orders, CN's weekly performance with respect to car supply is much lower with an estimated 68% of Merchandise customers receiving at least 90% of their car orders on a weekly basis. CN's average weekly performance against its car order guarantees under the GCO program is estimated at 81% (at a fulfillment rate of 90% of cars ordered).

On an annual basis, CP performance against car orders for all Merchandise car types averaged 73% for all customers in the CP sample and the median performance was 79%. When assessed against various network and shipper characteristics, the sample data suggest that CP customers located at competitive origins receive somewhat better car supply than customers without access to direct rail competition.<sup>18</sup> On a weekly basis, an estimated 50% of CP Merchandise customers received at least 90% of the cars that they had ordered for a given week.

### **Daily Car Supply Performance**

While annual fulfillment rates for both grain and merchandise customers that were included in the daily performance analysis were comparable at better than 90%, on a daily fulfillment basis the merchandise customers received significantly better performance than the grain customers. This was true for both CN and CP. Performance for both railways in serving the selected grain customers improved somewhat on a daily basis when performance was examined from the perspective of cars available for loading by the requested day including cars spotted early, as

---

<sup>15</sup> The absolute value of a number is that number expressed only as a positive value. Thus the absolute value of -15 is 15. The use of absolute values permits the analysis of the range of variation of car orders so that decreases in car orders do not "cancel out" increases in car orders.

<sup>16</sup> Appendix 2 includes a more detailed analysis of changes to CN car orders after cut-off, across a number of shipper and network characteristics.

<sup>17</sup> The results of this analysis are in Appendix 5 – CN Overall Car Supply Performance.

<sup>18</sup> This analysis is available in Appendix 2 - CP Overall Car Supply Performance.

opposed to cars spotted for loading on the requested date.<sup>19</sup> On this basis, CP's performance was significantly better than CN's, as CP provided its customers with an average of 83% of planned cars - compared to CN who provided an average of 43% of planned cars.

It is important to note that this performance assessment was limited to nine customers and may not be representative of daily performance in general. It is also important to understand that with the exception of CN merchandise customers, who receive guarantees of daily car supply, the railways do not commit to supply either the planned or ordered cars on a specific day notwithstanding the importance shippers place on this level of performance. The railways' ability to achieve precision in daily car spotting performance can be impacted by a range of factors. These include volatility in week to week demand for cars and shipper order accuracy – especially when car fleets are under allocation. From a supply perspective the smooth flow of empty cars to meet demand is dependent on the railways maintaining fluidity in their networks and other shippers and receivers loading and unloading cars in shared fleets efficiently to maintain a smooth flow of cars in the system. In addition, the performance of connecting carriers in moving empty equipment back without delay to the originating railway can seriously impact the available supply of rail cars.

---

<sup>19</sup> This was done to reflect the common railway practice of pre-spotting empty cars in advance of the order date.

---

## *Transit Time Analysis*

### *Importance of Transit Time Performance*

A key element of railway service is the consistency of the transit time provided to customers. Consistent service may also be termed reliable service. Consistent transit time allows supply chain partners to plan for the movement of the shipments through their supply chains. Unreliable service, as characterized by highly variable transit times, requires shippers and receivers to invest in higher average levels of inventory, storage capacity and product handling capacity than would be needed if transit times were more consistent. Highly variable service also impairs the production planning and marketing activities of railway customers and ultimately affects the competitiveness of Canadian industry.

In addition to the consistency of transit time, the average transit time, which is determined by the speed of rail traffic, is also of importance to shippers. In general, when average transit times are longer, the range of variation of transit times will also be wider than for traffic with higher speed and therefore shorter average transit time.

Therefore, in this report both the average transit time and the range of variation of transit times are examined and compared for a number of railway, shipper and railway network characteristics.

### *Methodology*

#### *Data Sampling, Screening, and Structure*

The sample transit time data provided by the railways was requested using sampling methodology developed by QGI and referenced earlier in the report. This data was reviewed to ensure that it was representative of the overall railway traffic base and was then screened to confirm railway methodology for calculation of time intervals and to remove extreme or unreasonable values due to railway reporting or data errors. In addition, the data was reviewed to identify any periods of special disruption. As a result of this review, all traffic on CN and CP that moved during the CN labour disruption of early 2007 was removed from the analysis.<sup>20</sup>

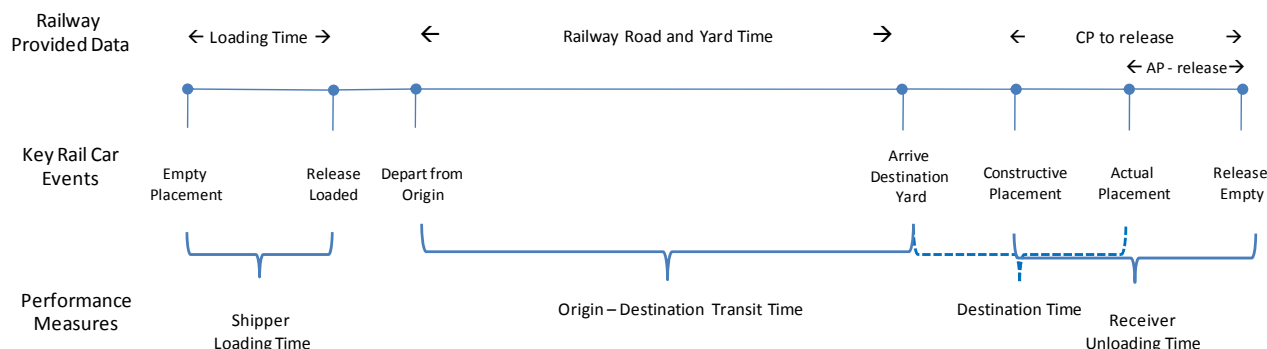
The railways provided QGI with transit time data for individual rail car trips identified in the sample. Each data record contained time intervals calculated by the railways for key trip segments at origin, en route, and at destination. These specific time intervals were selected to allow for the assessment of not only railway performance but also the performance of shippers and receivers for loading and unloading activities respectively.

---

<sup>20</sup> The period for which data was excluded was Feb. 4 through March 3, 2007 (service review weeks 19-22 of service review year 1). Traffic moving during this five week period of winter weather would be expected to have slightly higher average transit times than would be experienced at other times of the year. While CP's average velocity and consistency of transit time were only slightly higher than their annual averages for all traffic during this period, CP's traffic moving during the CN strike was excluded from analysis to ensure that both railways were treated equally in the study.

The following graphic summarizes the transit time performance data provided by the railways and the elements of rail car trips that are examined in this report. The graphic demonstrates that both shippers and consignees have critical roles in the overall logistics chain as they control the time spent in loading and unloading of rail cars.

Railway car events and key performance measures<sup>21</sup>



Two key elements of all rail car trips are the primary focus of assessment in this report – origin to destination transit time, and time at destination.<sup>22</sup> For origin to destination transit time both the average duration and variability of railway performance will be examined. For time at destination, there is a mix of accountability for performance between railways and receivers. In some situations cars can be immediately placed at receiver sidings upon arrival. However, many receivers require railways to stage rail traffic in railway yards at destination locations until customers request that cars be placed on their sidings. Due to the complexity of this issue, time at destination is examined in a separate section of this report.<sup>23</sup>

*Measurement Framework*

While most readers will be familiar with the calculation of averages, measuring transit time consistency requires the use of somewhat complex measures of the variation of performance - such as standard deviation of transit time, and

<sup>21</sup> In the graphic illustrated above, the term “Constructive Placement” (CP) refers to situations where rail cars are held on railway property at customers’ convenience awaiting the customers’ instructions on actual physical placement at their facilities.

<sup>22</sup> Due to data constraints the analysis of intermodal transit time performance examined origin to destination transit time and time at origin intermodal terminal.

<sup>23</sup> For the movement between origin and destination, the railways provided QGI with the total time that each car spent on trains, and the time the car spent in rail yards prior to its arrival at destination. The relative time that an individual car spends moving on trains versus the time spent idle in rail yards depends on a number of factors including; the frequency of scheduled and available train connections between yards, the level of congestion in yards at a specific time, and the availability of train capacity between specific locations. Thus, while the railways provided QGI with both total train time and total yard time for each car, the analysis of transit time does not differentiate between time on trains and time in yards at intermediate locations between origin and destination. In the absence of much more detailed information providing the actual location of delays in specific yards at specific times it was determined that segmenting the analysis into yard time and train time would not provide any useful insight into the performance of the rail logistics system.

the coefficient of variation of transit time.<sup>24</sup> The population standard deviation<sup>25</sup> (Std Dev) is an absolute measure of the dispersion of the values in a population. The standard deviation can also be thought of as the “typical” variation of a random observation from the mean value of the population. It is useful for comparison purposes between populations only when the populations have very similar means.<sup>26</sup> In this report, the key statistic used to measure the consistency of transit time is the *coefficient of variation of transit time (CV)*. The CV simply expresses the standard deviation as a percentage of the mean of a population. For example, if an origin/destination pair had an average transit time of 150 hours with a standard deviation of 20 hours, the CV would be  $(20/150 * 100) = 13.3$ . A lower CV is better.

The transit time for an individual car trip is determined by the length of haul and the speed of movement of the car between origin and destination. This speed is a function of the time that a car spends in rail yards and the time spent on trains and the speed of movement of those trains. *Speed is a critical element of transit time analysis as the range of transit times achieved by a railway will be determined by both the average speed of the traffic and the level of transit time consistency for a particular origin – destination pair.*

#### Transit Time Ranges

For each of the characteristics of railway networks and railway shippers for which service is assessed in this report, typical ranges of transit time performance have been calculated. These performance ranges are used to illustrate directly the actual service levels that are experienced by typical railway shippers. Thus, for each shipper or railway characteristic, a typical range of transit times that represent an estimated 75% of the shipments in that grouping is calculated and displayed in both tables and graphs. It is important to note that these illustrations of railway performance are meant to represent the service that will be experienced by “typical” customers. The individual samples of shippers that were analysed for this report are made up of very different customers whose actual service levels are higher and lower than the averages and who have varying lengths of haul. However, by creating ranges of performance for typical customers the report clearly demonstrates the range of performance that is actually experienced – without readers having to reference the underlying statistical measures in order to understand performance.<sup>27</sup>

---

<sup>24</sup> The calculation of all means, medians standard deviations and coefficients of variation in this analysis is made for each sample key, for each service review year. Service review year 1 is from October 1, 2006 to September 30, 2007. Service review year 2 is from October 1, 2007 to September 30, 2008.

<sup>25</sup> Population standard deviation is customarily abbreviated by the Greek letter  $\sigma$ . In the report the abbreviation Std Dev for the benefit of non-statistics oriented readers will be used.

<sup>26</sup> The standard deviation is the square root of the average of the squared differences between the individual observations in a population and the mean of that population.

<sup>27</sup> For a more detailed explanation of the methodology used to create the transit time ranges, see the section on “Analytical Methods” in the main body of the transit time analysis in this report.

## Key Findings

Many railway customers receive rail service with highly variable transit times. Some level of variability of transit time is expected by railway customers and good performance in both absolute transit time and transit consistency requires investment in railway capacity and operations. The average transit time and the degree of variation of this time (reliability or consistency) are matters that shippers can negotiate with their railway partners. In addition, there are no regulatory or industry standard benchmarks against which railway performance can be compared. Therefore, this report does not seek to define an absolute level of reliability that railways should be expected to achieve. This report does clearly illustrate the levels of reliability that were being provided to shippers during the study review period.

- In general, depending on the traffic characteristics being assessed there were considerable differences in transit time for movements with similar lengths of haul. However, for a number of variables where one might expect there to be differences in performance based on the service or shipper characteristics, there was remarkably little differentiation in service performance. Examples where major systemic differences in performance were **not** found were<sup>28</sup>
  - Shipper size
  - Flow size
  - Access to rail competition
  - Core versus non-core railway origins
  - Shortline versus CN and CP origins
- For both railways, significant deterioration of service is noted during winter months. However, CP was more likely to have more variable transit times outside of the winter period than CN. Railway Intermodal terminal times from in-gate to depart were much worse in winter months and these disruptions to Intermodal terminal throughput during the winter lasted longer for CN than for CP
- At final destination, the time taken for placement of cars at receivers' sidings varies widely based on the type of traffic with bulk traffic generally being placed within 10 hours and merchandise traffic averaging over 40 hours. There were significant differences between CN and CP with respect to the use of "constructive placement" at destination (26% vs. 3% respectively). This much greater use of constructive placement can create the potential for conflict with shippers as this reporting can trigger the beginning of allowable free time for demurrage calculations on railway supplied cars
- The day of week of arrival has a significant effect on the time taken for final placement with traffic arriving on Friday and Saturday taking 23% longer to be placed than traffic arriving on all other days of the week
- Of cars released in a block by shippers, 42% of CN's and 38% of CP's do not arrive at destination in a single block. The average maximum delay between the first cars in a split block to arrive at destination and the last car is 46 hours for CN and 82 hours for CP<sup>29</sup>
- Like transit times, shipper and receiver loading and unloading times are subject to wide levels of variability. The commodity groups with the shortest and most consistent loading and unloading times were grain and

<sup>28</sup> There were some exceptions to this general statement about the lack of differentiation of service levels across these characteristics and where these exceptions are significant they are identified in the body of the report.

<sup>29</sup> In most cases, there is no commitment made by railways that cars released in a block will be delivered as a block at final destination. Railways may choose to consolidate or break-up car blocks based upon the need to either increase or reduce train length to deal with operating restrictions either between origin and destination or at intermediate points in the trip of the car blocks. In addition, car blocks may be broken up and delivered in smaller groups if customers at destination cannot receive and unload the cars in the original car block size.

coal amongst bulk products. In the merchandise group, finished vehicles had the most consistent unloading times. The groups with the longest times and most variable performance are metal products and ores and concentrates at origin and destination, and potash and other forest products<sup>30</sup> at destination unloading points.

**Railway Performance by Commodity Group**

In the report, performance is analyzed across a number of characteristics of the railway and shipper population for both CN and CP. Care must be exercised when drawing conclusions from any of the cross-tabulations of performance but particularly when comparing railways’ performance to each other. While the railways compete directly with each other for many railway customers’ business, the mix of traffic that is handled by each railway is somewhat different. In addition, there are differences in the geographic reach and in the terrain characteristics of the railways’ networks. These customer and network differences can affect railway performance and make direct comparisons between railways difficult. For example, the following table shows the breakdown of carloads handled by each railway by commodity grouping.<sup>31</sup>

Business Unit	Carloads (000s)		Percent Carloads	
	CP	CN	CP	CN
Grain & Fertilizers	573	579	21%	13%
Coal	281	375	11 %	8%
Forest Products	92	511	3 %	11%
Industrial Products	341	1,572	13 %	34%
Intermodal	1,216	1,377	46 %	30%
Automotive	141	201	5 %	4%
<b>Total</b>	<b>2,645</b>	<b>4,615</b>		

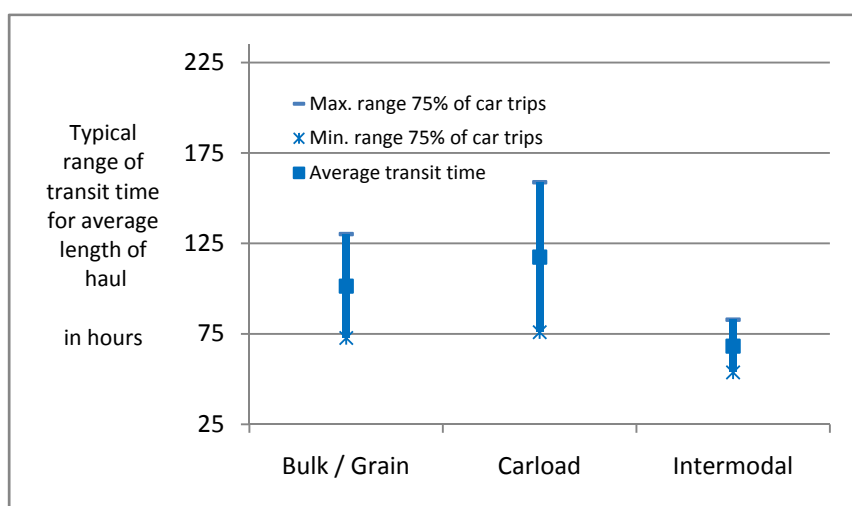
While the Grain, Intermodal and Automotive business volume (carloads) for both railways are very similar, there are large differences in the volume of Industrial and Forest Products - with these two groupings accounting for most of the difference in overall volume between CN and CP. This large base of mixed carload traffic provides CN with advantages in maintaining the frequency of train movement of carload traffic in certain corridors.

<sup>30</sup> The other forest products group in the sample data is primarily made up of pulpwood chips and wood pellets with a smaller volume of logs, poles and ties.

<sup>31</sup> Data derived from *Description of Canada’s Rail Based Freight Logistics System: Prepared for: Rail Freight Service Review*. QGI Consulting 2009  
 Note that in this table, the precise mix of traffic in commodity classification may differ for each railway. For example, CP dry fertilizer traffic is classified within the Grain and Fertilizers group however for CN this traffic is grouped with Industrial Products. In addition, this data includes all traffic handled by both railways including their US originated traffic.

Canadian National

	Bulk / Grain	Carload	Intermodal
Average LOH - miles	1030	1078	1635
Typical Transit Time - hours	101	117	68
Average CV of transit time	24.6	30.7	18.5
Typical range of transit times - hours	57	83	29
Maximum in range – hours	130	159	83
Minimum in range - hours	73	76	54
Percentage of traffic <sup>32</sup>	17%	39%	44%



At a summary level, as is shown in the table and chart adjacent, CN transit time consistency varies widely between the Intermodal, bulk/grain and carload groups.<sup>33</sup> As might be expected, average transit time is lower and the range of transit times is narrower for Intermodal than for either of the other two commodity groupings. This is a function of the higher average speed of Intermodal traffic and due to the difference in the measurement of transit time for Intermodal versus other traffic. Intermodal traffic is measured from the time it departs from a railway intermodal terminal, rather than from a customer’s facility. Therefore, the

time taken for a customer to move a container from their facility and through a railway origin terminal is not included in Intermodal data while the corresponding time for a railway to move a shipper’s car from the shipper’s siding and through their originating terminal is included.<sup>34</sup> As average speed through terminals is expected to be lower than average speed when trains are moving on mainlines, this gives some immediate measurement advantages to Intermodal traffic.

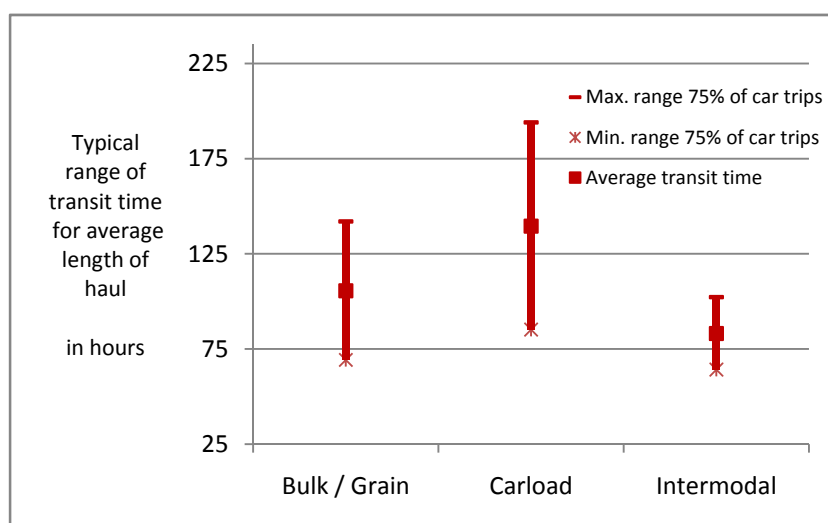
<sup>32</sup> These percentage calculations indicate the proportion of carload and/or intermodal traffic that moved in calendar year 2007 for each railway. Calendar year 2007 was the reference year used for the selection of the sample traffic that was provided by the railways for this study.

<sup>33</sup> Carload traffic included all merchandise, automotive and fertilizer traffic.

<sup>34</sup> For non-Intermodal traffic, transit time for customers originating on shortlines is calculated from the time the car is received in interchange by CN or CP, from the shortline railway.

Canadian Pacific

	Bulk / Grain	Carload	Intermodal
Average LOH - miles	877	754	1739
Typical Transit Time - hours	106	140	83
Average CV of transit time	29.9	33.9	19.9
Typical range of transit times - hours	73	109	38
Maximum in range – hours	142	194	102
Minimum in range - hours	69	85	64
Percentage of traffic	27%	21%	52%



At a summary level, as is shown by the table and graph adjacent, CP shows a similar pattern to CN of variation in transit time performance, across the Intermodal, carload and bulk/grain commodity groups.<sup>35</sup> However, the range of variation in transit times for CP’s bulk/grain and carload shippers are wider than for similar CN shippers.

In particular, CP’s carload shippers experience wide variations in transit time - as is illustrated in the table and graph opposite. For a typical CP carload shipper with a 754 mile length of haul, transit times will customarily vary between 85 and 194 hours or from 3.5 to 8 days. Note that this calculation only covers an estimated 75% of the car trips and 25% of trips will lie outside of

this estimated range of transit times for a typical CP carload customer.

<sup>35</sup> As with the CN analysis, carload traffic included all merchandise, automotive and fertilizer traffic.