# Rail Fleet Planning

## Introduction

Rail transportation is a very important component of the logistics strategies of large scale process manufacturers. Shippers have committed significant capital in their rail car fleets to achieve the shipping cost advantages of rail for high volume products. Consequently, ensuring the proper fleet size is an important component in attaining operational excellence. Since most rail cars are leased, an upward move in interest rates as the economy improves can have a significant impact on total shipping costs.

Assessing the proper size of a rail fleet to support operations is complicated by several factors, mainly:

- Relatively long transit times,
- Significant transit time variation,
- The need to coordinate both customer consumption and the source plant's production with rail car availability, and
- The closed loop nature of the rail car life cycle.

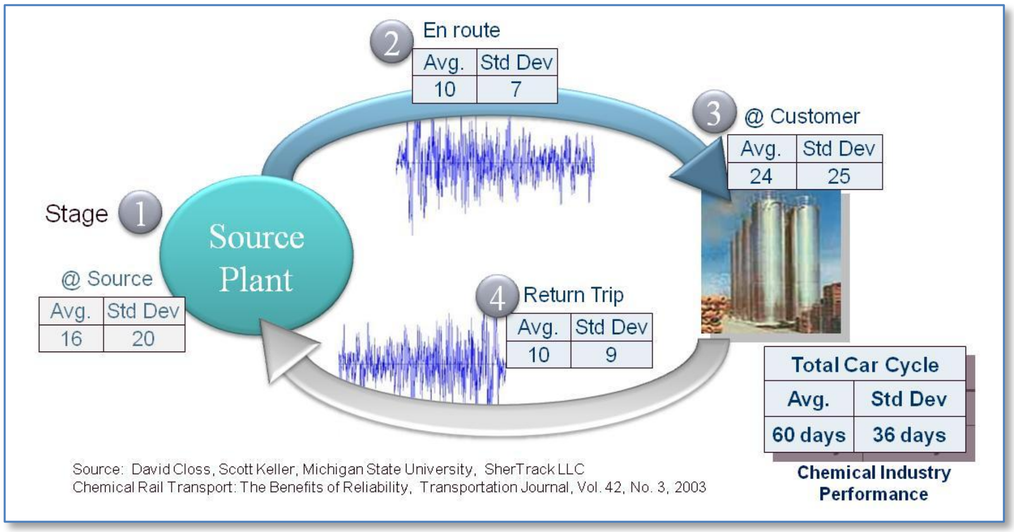
## Background

SherTrack initiated and sponsored fundamental research on chemical industry rail car behavior that was led by Dr. David Closs, Eli Broad Professor of Logistics at Michigan State University. Four leading chemical and plastics manufacturers participated in the research and over 62,000 rail car cycles were studied. Some of the insights from this work have been published in "Chemical Rail Transport: The Benefits of Reliability", Transportation Journal Vol. 42, No. 3*, 2003*

SherTrack has combined its knowledge from this research with its predictive modeling expertise to develop methodologies and tools for the effective planning of rail fleets.

## The Rail Car Life Cycle

A rail car has four distinct deployment stages while it is in service. The first stage is while it is empty at the plant site waiting to be filled prior to transport. The second phase is en route to the customer transporting cargo. The third phase is sitting at the customer yard waiting to be unloaded and the fourth and final stage is after it has been released by the customer empty and it is on its return trip to the source plant. Figure 1 illustrates this cycle as well as the average transit time and standard deviation of transit time for the chemical and plastics industry.




Source: David Closs, Scott Keller, Michigan State University, SherTrack LLC
Chemical Rail Transport: The Benefits of Reliability, Transportation Journal, Vol. 42, No. 3, 2003

Across the chemical industry, a rail car is transporting its cargo or returning to be refilled for approximately 1/3 of its life cycle. It sits waiting to be used two thirds of its time.

In the rail car life cycle, the performance of the rail network determines the amount of cars required for stage 2 and stage 4. Transit time variation is a significant contributor to both stage 2 and stage 3 requirements. The MSU research team explicitly analyzed the impact of transit time variation on rail car requirements. Table 1 shows the impact of transit time variation for a route with a constant mean transit time of 10 days and constant daily demand.

**Table 1: Effect of Transit Time Variation of Buffer Rail Car Stock at Customer Site**

| **Standard Deviation of Transit Time** | Std Dev. of Supply at Customer | Order Quantity | Required Safety Stock | Average BHC* | **% Fleet Reduction** |
|---|---|---|---|---|---|
| 7 days | 7.9 BHC | 3 | 22 | 24 | |
| 6 | 6.8 | 3 | 20 | 21 | (12) |
| 5 | 5.9 | 3 | 17 | 18 | (25) |
| 4 | 5.1 | 3 | 14 | 16 | (33) |
| 3 | 4.4 | 3 | 12 | 13 | (46) |
| 2 | 3.7 | 3 | 10 | 12 | (50) |
| 1 | 3.3 | 3 | 9 | 10 | (58) |

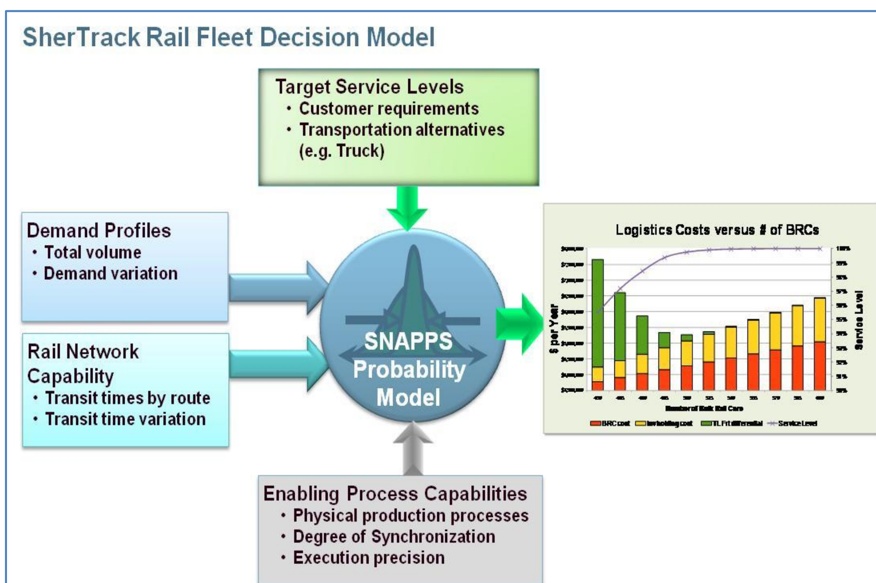
*BHC = bulk hopper car

Transit time variation is a significant factor in the amount of safety stock cars customers require to ensure continuous supply to their operations. However, the capability of the customer's enabling processes and the degree of synchronization with their suppliers supply chain network are usually the largest contributors to stage 3 car usages. Stage 1 (plant site) car usage is a function of the producing plant's production processes and its enabling processes. In addition, it is the site where excess cars tend to pool.

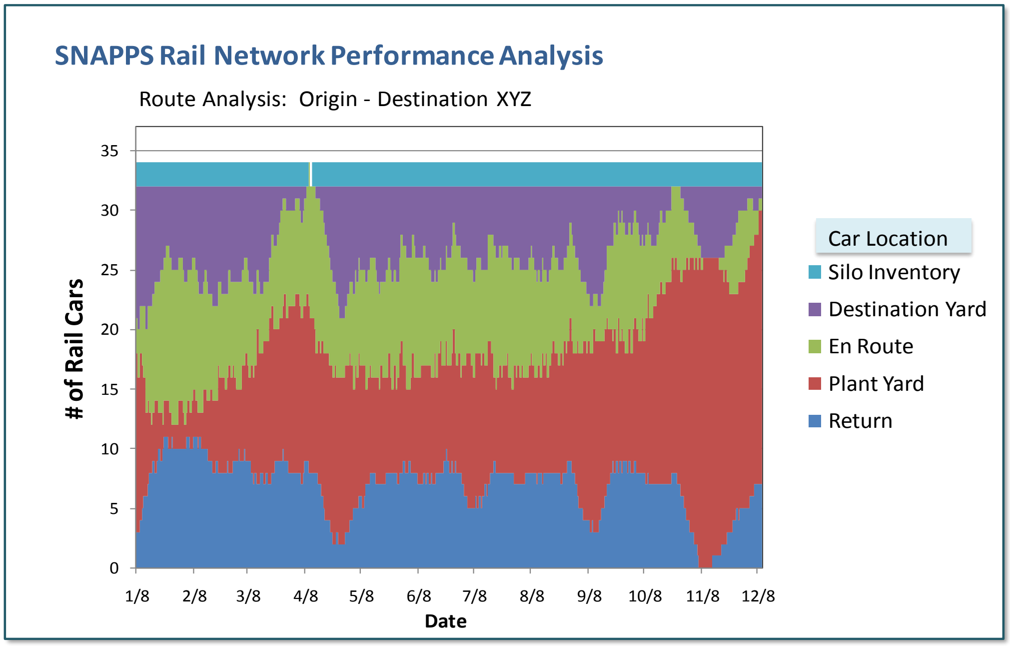
## SherTrack Rail Fleet Planning Model

In order to determine the proper fleet size, all of the major factors affecting rail car usage need to be considered and their interdependencies analyzed. The major factors that drive rail car requirements are:

1. Demand Shipment Profiles
    - Quantity to be delivered
    - Variation of demand
2. Target Service Levels
    - Origin – destination specific service levels
3. Rail Network Capabilities
    - Route transit times
    - Route transit time variation
4. Enabling Process Capabilities
    - Customer production process needs (cycle times, raw material consumption)
    - Degree of customer synchronization with supply logistics
    - Source plant process (cycle time, degree of demand synchronization, production service levels (i.e. available-to-ship on time %)

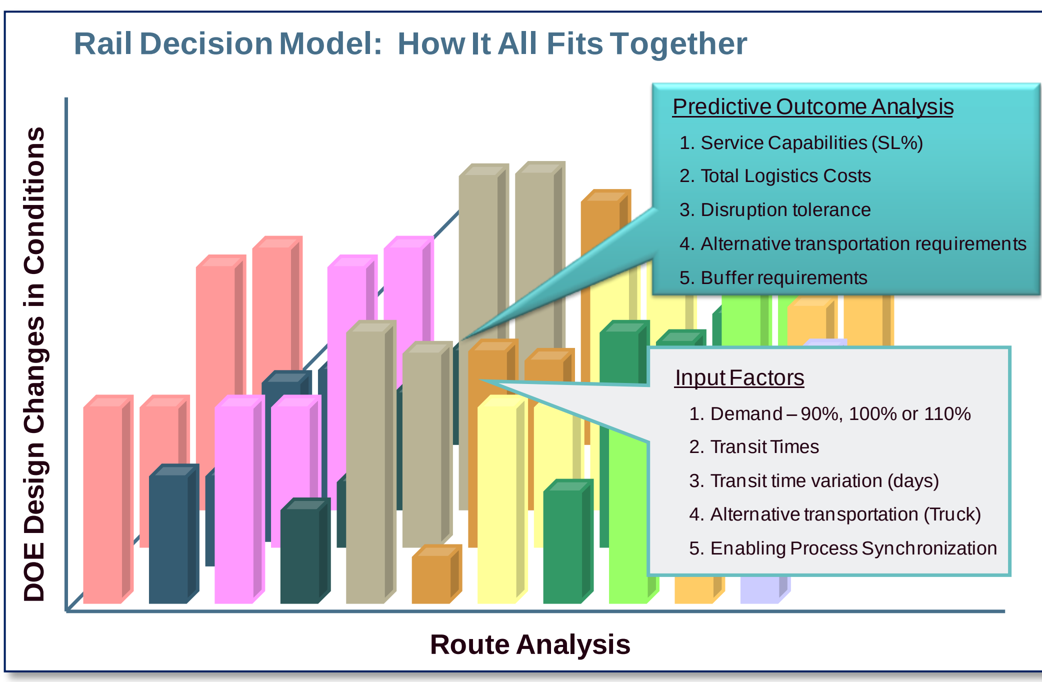


To determine fleet requirements, a digital model of the rail network for each fleet is built in the SNAPPS™ probabilistic modeling environment that captures the major nodes for the rail fleet. The digital model is then exercised via discrete event simulation to assess the performance capabilities of the fleet over a range of conditions. Stress points are identified and various business scenarios evaluated (e.g. weather related shipping disruptions) to assess performance capabilities.

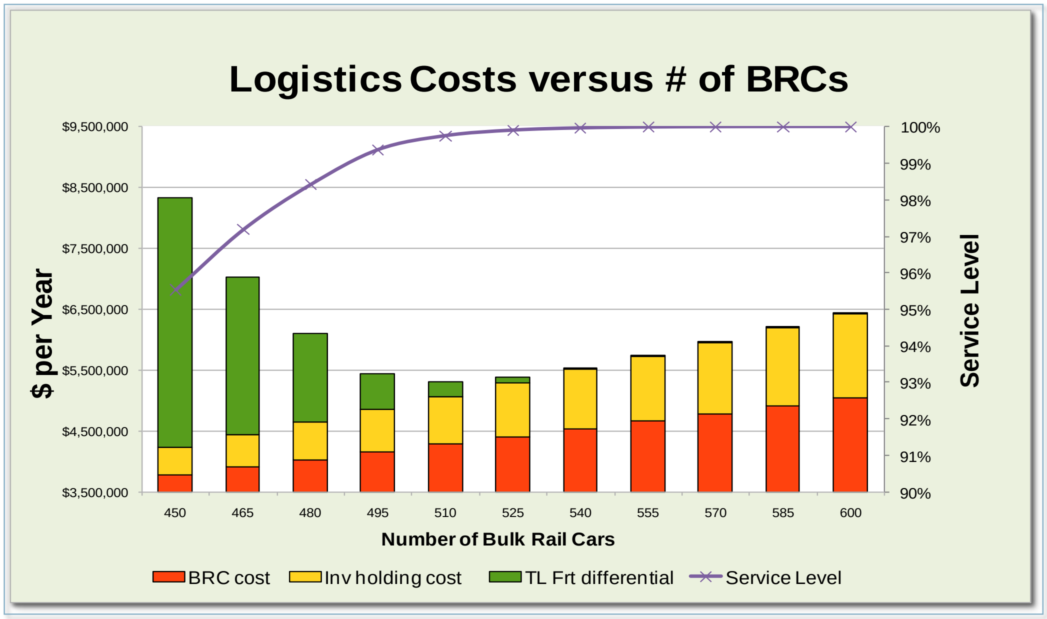



## Fleet Analysis

The fleet's performance is measured under a wide range of conditions using [design-of-experiment](#) (DOE) techniques. These performance profiles are then mapped by configuration to reveal the fleet's capabilities by configuration.



The final stage is to consolidate the analysis on the basis of overall system economics. The cost of service failure is a key consideration and different customers have different options for coping with supply issues. Predictive modeling allows different strategies to be evaluated and the best approach(es) selected. In the analysis below, the cost differential between full truck load shipments and the variable rail rate was used to monetize the cost of service failures at the customer site.




## SNAPPS Value

For rail fleet owners, SherTrack Rail Fleet Planning provides a robust environment for determining the optimal fleet size and configuration to achieve their business goals. SNAPPS unique probabilistic solvers and its integrated discrete event simulation environment can determine the expected performance of the rail fleet over the entire planning horizon. Scenario evaluation provides effective management tools for mitigating operational risk.

SNAPPS digital modeling supports sophisticated Lean – Six Sigma improvement initiatives that are vital for achieving operational excellence.

## More Information

For more information, call SherTrack at (734) 462-6220 or visit us at www.SherTrack.com