Norfolk Southern and Spotfire: 6 use cases for better railway management

~25%

REDUCTION IN TIME TO MARKET

Norfolk Southern is one of 10 North American Class 1 railroads, which have revenues of $250 million or greater. Its traditional business was the transport of bulk commodities, raw materials, and heavy finished goods. Pivoting to capitalize on significant growth in consumer goods shipped via containers (intermodal), the company would also face strong competition from trucking as well as highly service-sensitive customers. Two company leaders describe the technology journey to digital business to enable lower costs, excellent customer service, real-time visibility, and benefits from the railroad IoT and predictive analytics.

Challenge

Fred Ehlers, vice president of information technology at Norfolk Southern, begins, “As the backdrop to our digital drivers, it’s really important to understand that Norfolk Southern, any railroad, is very asset-intensive. We have a lot of expensive assets that we have to manage, monitor, and carefully steward for efficiency. The other thing is that our business is going through tremendous change, and with that change, that growth, comes demand from our customers to know where their product is and that it’s going to get to its destination on time.”

60M

EVENTS GENERATED & ANALYZED

The company had several drivers that were helping define its technology strategy:

- Markets are increasingly service sensitive and time critical. Norfolk no longer measures delivery in days, but in hours and minutes.
- Customer supply chains require a highly accurate, constant stream of data. Customers want constant updates on arrival times and any information on plan deviations.
- While this is great business, it is also generally lower margin, so the team needed a strategy that efficiently provides a high level of service.

"This isn't revolutionary," Ehlers says, "but the pace has shifted our priorities. Previously, we had a spider web of data flows between our legacy applications. While we tried to keep it as organized as possible, it was not an ideal situation. When we disseminated information outside of our production systems, we used our data warehouse, which was never real time and rarely provided the user with the best possible information."

"Three years ago we embarked on a journey to build a 'transportation event processor' (or TEP), which centralizes operational events from legacy silo applications. We also built asset state models to create a coherent, highly accurate real-time view of the railroad focused on important assets and resources. Everything we build sits on this foundation. And now we are building next-generation operations applications," Ehlers states.

Robert Miller, manager of enterprise architecture at Norfolk Southern states, "Our technology objectives in support of the business were to modernize our key systems. We wanted a common view of the core data around the assets: railcars, locomotives, crews, and the locations where work is done. We needed to bring the data together and create a single version of the truth for those applications. We also wanted to create a platform that made that data easy to access."

The plan was to build a near real-time current state of transportation information data service that would:

- Provide automated business monitoring and issue notifications
- Enable root cause analysis and collaboration
- Enable automated or managed resolution
- Improve data quality (accuracy and timeliness) for operational and master data
- Create a central event model to understand, manage, and optimize operations, which was the fundamental technology requirement

Transformation

"To promote a single version of the truth across applications, data would be controlled by business rules," continues Miller. "We would capture business telemetry from across the enterprise and provide value-added services that would clean, transform, aggregate, correlate, and publish. We needed to utilize streaming analytics to maintain asset data on states and location and to generate alerts, alarms, and triggers. And we needed to provide information to applications in near real time and transform data to the format needed by each application."

"We leverage the Spotfire platform for forecasting future demand against capacity to support better allocation of resources."

—Fred Ehlers,
VP of IT, Norfolk Southern

Integration

"Capturing data about transportation events across the network is accomplished through an enterprise shared services integration approach," says Miller. "Data published by locomotives, wayside sensors, line of business applications, customer and industry data interchanges, and external sources are captured by the integration gateway. Once captured, the events are transformed from their original application format to a canonical data format that abstracts the data from the specific application that produced it and represents a more generic business entity: trains, railcars, locomotives, and crew members."

Ehlers says, "Locomotives have become mobile computing platforms, and we pull in a wealth of data—from GPS location, to on-board operational information, to mechanical health. Our trackside devices are becoming part of the Internet of Things, and we pull in not only information on their state, but the state of the trains rolling by them."

"We pull information from legacy applications indicating train arrival and departures from yards and stations, train consist (rail vehicles making up a train), and precise information from our signaling systems on train location, route detail, and estimated time of arrivals," continues Ehlers, "We pull information from our customer and industry clearing house on traffic coming in and leaving our yards, and the state of our railcars and locomotives as they move on other railroads. We also pull information from external sources like the National Weather Service."

Streaming analytics

"The State of Transportation application subscribes to events and maintains a state model for each railcar, locomotive, crew, and train. Operating locations are also maintained for asset tracking. As state and location transitions occur, they are published as updated events that are subscribed to by strategic applications and maintained as a single source of enterprise data across all business domains," explains Miller.

Benefits

Intermodal terminal operations

"Increasing the efficiency of Norfolk Southern's 42 intermodal terminals lets us both reduce contractor costs and increase capacity," explains Ehlers. "The function of an intermodal terminal is basic. We unload inbound trailers and containers from trains, trucks, or ships and load them on the next mode of transportation, the outgoing trains or trucks that take the freight to the final destination.

"Though the function is basic in concept, it is complex in execution. There are many moving parts with inbound and outbound trucks and trains carrying hundreds of containers. Every day it is a different permutation of the 'puzzle.'

"We are making intermodal terminals more efficient by providing increased data accuracy and visibility, using a mobile application for real-time communications with truckers, optimizing models feeding the electronic work order system for hostlers (yard engineers) and cranes, and improving planning algorithms for train loading/unloading and yard operations."

17

LINE OF BUSINESS APPLICATION FEEDS CAPTURED & ANALYZED

Empty car distribution

"Hauling finished automobiles is good business for Norfolk Southern," says Ehlers. "Unless you live close to the manufacturing facility or inbound port, there is a good chance your automobile was transported by rail.

"In North America, there are 65,000 specialized railcars for hauling finished automobiles and trucks, and at an acquisition cost of $100,000 a piece, they are a very expensive $6.5 billion asset. And they are just an example of a couple dozen different car types. This is why it is so important that we optimize their movement. For the most part, they move loads one way—from plant and port to destination, and the empties move in the opposite direction—so triangulation opportunities are very important.

"Like our intermodal terminals, automotive terminals are basic in concept, but complex in operation. Inbound automobiles are delivered daily from plant or ship to a terminal for sorting and dispatch to the various destinations and then unloaded and moved the 'last mile' to the final destination.

"We provide detailed location information to optimize the loading and dispatching of cars. It's helping increase asset turns and fully utilize capacity so we can avoid railcar rental fees and defer capital expenditures. We have a detailed tracking model for all railcars and projections for supply and demand. We are optimizing assignments of railcars to customers so we get the right car at the right time. And we are managing customer loading and unloading times to make the best use of scarce assets."

2,600

TRAINS MONITORED DAILY

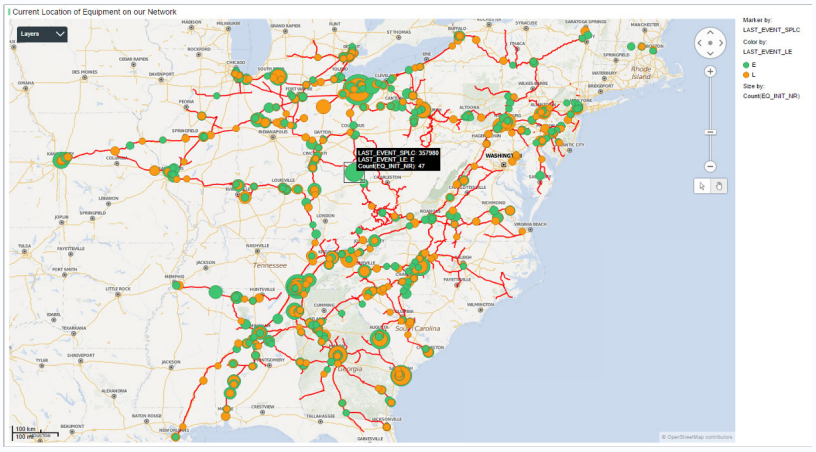


Figure 1: Railcar state and location graphic via Spotfire

Customer portal

"We are also overhauling our customer portal, AccessNS, to keep pace with the business environment," continues Ehlers. "This project directly leverages our success with TIBCO. It consolidates multiple streams of data into coherent, realtime information that allows customers to track shipments and receive alerts when a schedule deviates from plan. The information is real time, very detailed, and highly accurate. The portal is tightly integrated with the customer system through APIs."

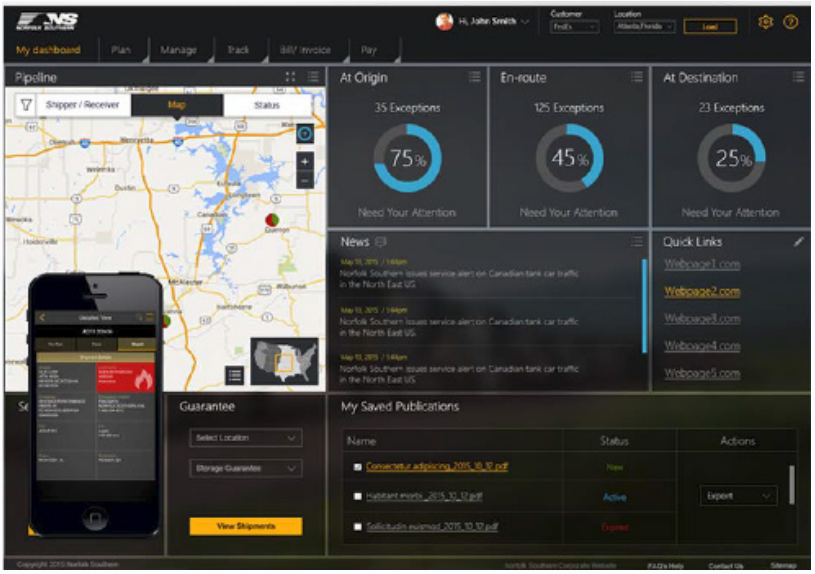


Figure 2: Norfolk Southern's AccessNS customer portal

Internet of things (IoT)

“Leveraging Spotfire and our own Internet of Things, we will expand our state models to signal systems, switches, and trackside defect detectors,” says Ehlers. “Not only can we enhance the efficiency and reliability of the railroad, we can also use the information from these devices to monitor their health.

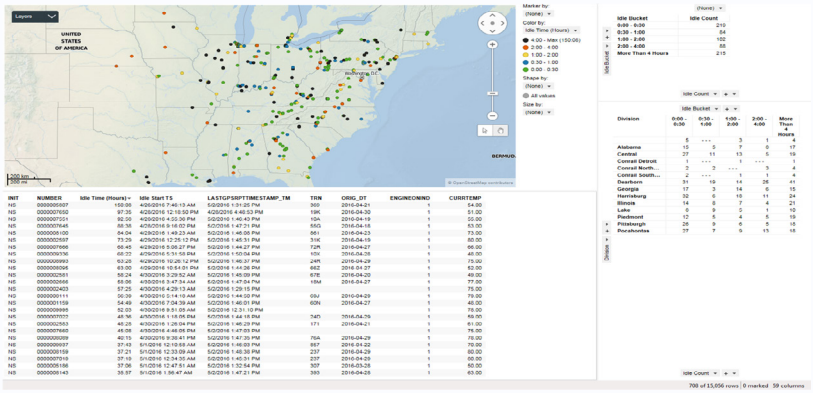
“Bad wheel bearings on freight cars are a great example of what we can detect and trend to alert the crew before we have a catastrophic bearing failure. Besides the obvious safety issues, a failure on a busy section of track can cause significant network issues.”

Real-time analytics

“We are already building visualizations, but we intend to take this further,” says Ehlers. “While we have always had robust historic analytics, using Spotfire we can now leverage real-time analytics and better monitor and take action on train delays and service failures as they happen. Obviously, the best service disruption is the one you avoid.

“We can monitor assets like locomotives that are idling and haven’t moved in 30 minutes, bring external weather data into the analysis, and change the business rules for locomotive idling.”

Figure 3: Idling locomotives via Spotfire



Norfolk Southern serves every major container port and operates about 20,000 rail miles and the most extensive intermodal network in the Eastern US.

Improved operational forecasting

"Taking network management one step further, we can leverage the Spotfire platform for forecasting future demand against capacity to support better allocation of resources. Yard operations are a great example.

"Think of those 170,000 railcars that we have online at any given time. Using Spotfire to manage all the detailed trip plans for those cars, and then formulating the data on a location or yard basis, we can project into the future where every car will be in 12, 24, 36, 48 hours, and we can set up alerts when and where we will encounter over capacity and under capacity situations. Then we can reroute traffic or move resources to better handle fluctuations."

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