ON THE RIGHT TRACK
Enhancing Operational Efficiency and Customer Satisfaction
Executive Summary

Norfolk Southern Corporation is one of the premier transportation companies in the United States. With a reputation as the “Thoroughbred of Transportation,” its Norfolk Southern Railway subsidiary operates approximately 20,000 route miles, which crisscross 22 states and the District of Columbia.

But Norfolk Southern is not content to reflect on its rich 182-year rail industry history. Working to achieve its vision of being “the safest, most customer-focused and successful transportation company in the world,” the company is galloping ahead of the competition with new business models and supporting technology.

Headquartered in Norfolk, Virginia, Norfolk Southern is a $11.2 billion transportation giant, which operates one of the four largest Class I railroads in the country, moving about 1800 freight trains daily. The company operates the most extensive intermodal network in the East. With more than 30,000 employees, the carrier manages more than $28 billion in assets.

Rail industry deregulation in 1980 created new challenges and opportunities for Norfolk Southern. Becoming a scheduled railroad and negotiating rates directly with customers, the company needed to find new ways to compete based on service. Customers began to demand intermodal transportation to meet their shipping needs. Operating efficiently and promoting service excellence became an even greater priority for Norfolk Southern.

Meeting these needs required more information – accurate, comprehensive operational data that could be used to optimize Norfolk Southern’s operations and allow customers to serve themselves. Although it had transactional information technology systems, the railway needed a new solution: one that could serve as an engine of change.

Norfolk Southern deployed an integrated data warehouse solution from Teradata. Over nearly two decades, the company has used the technology to support innovative applications, most of which were years ahead of the competition. From early marketing and costing solutions to today’s advanced customer service and support tools, Norfolk Southern continues to set the standard in the use of data warehousing, business intelligence (BI), and data mining technologies to meet its business goals.
The original 1TB warehouse has grown to a 34TB warehouse with four-hour disaster recovery capabilities. A solution that once supported only a few analysts is now used by thousands of Norfolk Southern employees, from field workers and business users to executives. More than 14,500 users from 8,000 Norfolk Southern customer organizations access the solution, which delivers 4,500 reports daily.

The benefits derived from these solutions are significant. Quantifiable savings – measured in the millions of dollars annually – have been realized from new efficiencies and reduced errors. Competitive advantages – such as enhanced customer service and satisfaction, improvements in decision making and support for strategic goals – are more difficult to measure but important nonetheless.

Several programs and business areas have delivered the most notable value. This case study focuses on these programs and their results:

> **Early marketing and costing** efforts helped the company understand customer requirements and transportation costs.

> **Analytics, modeling and BI** solutions enable optimization of rail car movements and supported a new business operating plan.

> **Operational effectiveness** applications enhance car management, empty rail car distribution, operational performance, and transportation modeling.

> **Customer service and support** applications are used to optimize trip plans, enable self-service customer information, and deliver real-time shipment alerts.

### AT A GLANCE

#### Company

Norfolk Southern Railway Company is a leading transportation provider, with 20,000 miles of railway and 30,000 employees. The $11.2 billion company moves some 1800 freight trains daily and operates the most extensive intermodal network in the eastern United States.

#### Challenge

To compete more effectively in the post-deregulation railway industry, Norfolk Southern needed more accurate and comprehensive decision support information. For example, executives wanted to improve service by managing trains and cars more effectively, provide real-time shipment information to customers, and improve workforce productivity.

#### Solution

Norfolk Southern deployed a succession of data warehousing and business intelligence solutions with support from Teradata. The current 34TB warehouse includes 4-hour disaster recovery capabilities, delivers 4,500 reports daily, and is accessed by more than 14,500 customers.

#### Results

Norfolk Southern realized quantifiable benefits. Some of the highlights include:

> Created $2.8 million in held-train savings

> Decreased missed connections by 60%

> Improved car connections from 80% to 92%

> Decreased rail car cycle time by a full day

> Reduced financial penalties for late deliveries

> Eliminated the need to hire 47 workers to generate customer reports

The company also increased operational efficiencies, enhanced customer service and satisfaction, and improved decision-making speed and quality.
Background

In the United States, the history of the railway industry tells the story of the country’s growth. For Norfolk Southern, predecessor companies like Norfolk and Western Railway and the Southern Railway System in the 1800s, financiers such as JP Morgan, and a series of mergers and acquisitions laid the track for the company that is now North America’s largest rail carrier of metals and automotive products.

A 1982 merger of Norfolk and Western Railway and Southern Railway, combined with the 1999 acquisition of 51% of the assets of the Consolidated Rail (Conrail) Corporation, created one of the industry’s four key players. Today Norfolk Southern serves every major container port in the eastern United States and provides connections to western rail carriers. (See Figure 1).

For more than a century, the railroad industry was heavily regulated by the U.S. federal government. Rail companies focused on moving shipments from point to point, and Norfolk Southern enhanced its profitability by carefully managing its costs. Managers focused on optimizing the use of rail cars to get the most production out of their fixed assets.

The Staggers Act of 1980 essentially deregulated the U.S. railroad industry. This shift created unprecedented new opportunities for railway companies. No longer was each railway bound to collective rate-making procedures and service offers. Freed from close regulatory restraint, the railroads began setting rates based on service and entering into contracts directly with customers.

Recognizing the new market realities, Norfolk Southern shifted its focus. The company became a scheduled railroad, developing a fixed set of train schedules and routine connections that could move cars among trains and yards. This new business model allowed managers to predict when shipments would be delivered to customers, allowing the company to compete based on its ability to provide superior service.

To meet its business goals, Norfolk Southern needed to deploy information technology that would support the scheduling, management, and optimization of its vast network of railway assets. The company turned to Teradata to develop an integrated data warehouse and deploy the BI tools that would enable smarter management, insightful decisions, and customer service excellence.

The Catalysts for Change

Deregulation of the railroad industry created dramatic shifts in customer behavior, expectations, and service. With the end of federally regulated routes and collective rate-making, customers began using multiple rail carriers to haul goods. Some shippers learned to combine railways with other transportation types, such as trucking, which is known as intermodal transportation.

With mixed-mode transportation becoming more prevalent, Norfolk Southern recognized an increasing customer demand for information. To meet its customer service goals, the company developed methods for answering customers’ shipment questions. When a load was late or missing, service representatives searched voluminous printouts and phoned the customer with answers. Often information discovery and communication took hours. Such a slow, ineffective process quickly became a bottleneck.

To enhance customer service, Norfolk Southern began investigating new ways to deliver shipment information. The company already used transactional information systems that specialized in moving rail cars from point to point, safely and efficiently. But these technologies could not be used to support comprehensive reporting functionality.
They lacked BI and analytics features, and running queries against the production systems threatened to degrade performance.

In order to gain operational insight and compete more effectively in a changing industry, Norfolk Southern needed to enable intuitive access to shipping data. Instead of waiting days or weeks for IT to generate requested reports, business users needed rapid, self-service access to data. What’s more, the company required enterprise-class technology, not desktop tools. Norfolk Southern wanted to deploy solutions that could distribute data throughout the organization, even to the front-line workers making day-to-day tactical decisions.

Norfolk Southern embraced an integrated data warehouse solution from Teradata as an engine of change. Although the integrated data warehouse has delivered long-term value to Norfolk Southern, the greatest impact and results have been realized in four areas: marketing and costing; analytics, modeling and BI; operational effectiveness; and customer service and support.

> **Marketing and Costing** needs were first addressed by the initial data warehouse solution, which helped the company understand customer requirements, shape service offerings, and price transportation offerings.

> **Analytics, modeling and BI** solutions have helped the company use logistics information to optimize the movement of rail cars, improve operations, gain insight, and innovate for the future.

> **Operational effectiveness** applications are used by Norfolk Southern to enhance car management, empty rail car distribution, operational performance, and transportation modeling.

> **Customer service and support** applications are helping the company optimize trip plans, enable self-service customer information, and deliver real-time shipment alerts.

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**Implementation and Results**

**Early Marketing and Costing Solutions**

**AT A GLANCE: EARLY MARKETING AND COSTING SOLUTIONS**

**Challenge**
Improve customer service effectiveness and gain insight into cost of moving goods from point to point

**Solutions**
> 1995: Deployed 1TB Teradata Warehouse, which was used by a few analysts to answer customer questions, review traffic patterns, and evaluate demand patterns

> 2000: Built accessNS application to allow customers to identify shipment locations, review shipment history, and answer questions

**Results**
> Improved internal efficiencies
> Increased time savings
> Enhanced customer satisfaction

In 1995, Norfolk Southern implemented a 1TB data warehouse that allowed managers to access the vast volumes of data produced by its transactional systems. The warehouse was funded by two departments: marketing, which sought reports about customer service effectiveness, and cost, which wanted information about the true costs of moving goods from one point to another.

The first data loaded onto the warehouse was car movement data. Each night, records of the day’s rail car movements, such as arrivals and departures, were loaded into the data warehouse. The data was delivered electronically to the desktops of a few analysts. This information replaced the daily delivery of tall stacks of green bar report printouts, which were wheeled on hand trucks to users. The electronic information helped analysts determine car locations and answer customer questions.
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The company also developed a homegrown workbench application. The tool helped the marketing team determine costing for various shipments. Analysts used the data to review traffic patterns and evaluate demand patterns.

Prior to 2000, customers who needed information would call or fax a Norfolk Southern customer service agent with questions. Answers would be delivered within minutes, hours, or days, depending on the complexity of the request. Behind the scenes, agents placed information requests with IT or navigated difficult-to-use legacy systems in a search for answers. These customer service processes were costly and time-consuming.

The success of the early data warehouse project and the growing customer demand for information encouraged Norfolk Southern to load more data into the Teradata warehouse. For example, the team added details about active railway equipment. Analysts began receiving hourly updates on car movement. This information helped users begin to support operational decisions.

In 2000, the marketing department began to explore using the Internet to phase out telephone- and fax-based customer information services. The goal was to use the data warehouse as a platform for servicing customers. The team built a BI application called accessNS, a secure web portal that allows customers to inquire about their shipments using a Web interface. Soon thereafter, business users began using Brio tools to create standardized reports from the Teradata warehouse. They also began using file transfer protocol (FTP) software to upload the data to a corporate intranet.

For the first time, customers could instantly identify shipment locations and get shipment history, answering such questions as:

> Where did my shipment come from?
> How long did it take to arrive?
> What were the problems along the route?

This departmentally focused application delivered clear, tangible benefits: internal efficiencies, with time savings and improved customer satisfaction resulting from improved information access.

Analytics, Modeling and Business Intelligence Support

AT A GLANCE: ANALYTICS, MODELING AND BI SOLUTIONS

Challenge
Support redesigned operations with business intelligence that allows business users to make more effective decisions

Solutions
> 2002: Created connection dashboard to help field managers analyze trip plans and optimize rail car connection performance
> 2007: Designed new applications under Track 2012 program to improve service, manage fuel use, enhance the use of assets, and increase workforce productivity
> 2008: Upgraded to 34TB Teradata warehouse to increase performance and support 4-hour disaster recovery capabilities
> 2009-2010: Deployed next-generation BI solutions through Norfolk Southern Business Intelligence (NSBI) environment

Results
> Reduced missed connections by 60%
> Decreased rail car cycle time by a full day, creating millions of dollars in annual savings
> Optimized car movements and crew scheduling
> Reduced number of empty cars traveling on track network
> Improved customer service levels
> Expanded access to BI to hundreds of staff members and thousands of customers

As use of the Norfolk Southern data warehousing solutions matured, so did the development of BI and analytics applications.
Thoroughbred Operating Plan

In 1999, Norfolk Southern acquired 51% of Conrail. This move increased the company’s size by nearly 50 percent, while providing direct track lines to the New York and Philadelphia markets and ownership of expanded intermodal capabilities. With this acquisition, Norfolk Southern needed not only a new operating plan; it also required underlying systems and information tools to support the maintenance and the management of the plan.

The result was the 2002 Thoroughbred Operating Plan (TOP) initiative, which redesigned company operations. Prior to TOP, railways like Norfolk Southern would hold or cancel a train if it did not contain enough tonnage. The priority was to minimize labor costs – that is, to operate with the minimum number of engineers and conductors. A car could lose a day or so while waiting to be filled, and in turn impact other trains connected to it. Delivery dates could vary within a window of three to five days.

With TOP, management invested in new transactional systems and processes that used operations research techniques to determine when and how rail cars should move throughout the Norfolk Southern transportation network. The new system optimized inventory and planned trips.

Once Norfolk Southern crafted this optimized operating plan for its rail cars, employees in various capacities needed measures, reports, and tools that would help them manage to the plan. Thus, a TOP steering committee funded a new BI application, which would use data from the warehouse to help the business manage more effectively.

Norfolk Southern developed a dashboard application that used data from the warehouse to graphically depict actual performance against the trip plan, for both trains and connections. Using visualization technology, the application helped field managers more easily interpret the large volumes of data generated by the company’s 160,000 weekly connections. Since this application was implemented, the number of missed connections has fallen 60%. Norfolk Southern also achieved a one-day reduction in rail car cycle time, which translates into millions of dollars of annual savings.

The TOP BI application analyzed trip plans for every shipment. Norfolk Southern used the data to determine which trains would handle a shipment; it also identified how, when, and where connections between the trains would be made. Internal field managers used the insights to help teams stick to the TOP plan. (See Figure 2.)

Norfolk Southern Track 2012

Norfolk Southern has continued to use its Teradata warehouse and BI tools to meet evolving business goals. A recent program, Track 2012, strives to improve service levels and effectively manage costs – especially fuel use, asset turns, and workforce productivity.

Departments across Norfolk Southern – ranging from accounting and human resources to operations and fleet management – have created BI applications that tie into Track 2012 strategies, as shown in Table 1.
As the data warehousing solutions became more integral to Norfolk Southern’s business operations, it became clear that protecting its data assets was essential to continued operations. In 2008, the rail company upgraded its solution to a 34TB warehouse with disaster recovery systems deployed on a Teradata 5550.

“The systems were at capacity and CPU-bound, thanks to the increased usage of the technology, an expanding user community, and a growing number of applications,” explains database administrator Linda Richardson. “We had already added revenue data and other business information to the warehouse. Additionally, we had a business requirement for a four-hour disaster recovery capability.”

The company chose Teradata technology for the upgrade – not only because of its long history with the vendor, but also because it was the most cost-effective solution. “Considering the purchase price and the minimal effort required to upgrade, Teradata was the best choice,” she adds.

The upgrade was installed with the help of Teradata Professional Services, which created automated backup scripts for the production system and backup restore processes for the disaster recovery system. The team deployed and configured an automated NetVault backup and recovery system.

Table 1: Track 2012 Strategies and BI Applications
Source: “Norfolk Southern Travels Along the Track of Business Intelligence Maturity,” Barbara H. Wixom, et. Al.
Next-Generation BI
After nearly 10 years of successfully using BI tools to gain operational insight, Norfolk Southern was ready to take its next steps. Throughout 2009 and 2010, the company began upgrading to a new generation of BI solutions. Business users wanted more intuitive BI tools and they wanted a voice in choosing them. (See sidebar.)

In 2009, the Norfolk Southern Teradata User Group (TUG) began to discuss the need for a next-generation BI tool. The BI Special Interest Group (SIG) was tasked with making the selection. The SIG sent an electronic survey to 3,000 members of the business community. Nearly 300 users responded, indicating their functional, business, and technology requirements.

The IT organization created a request for proposal based on the TUG requirements and then conducted a nine-month evaluation of vendors and products. As the IT organization questioned the vendors about product features and functionality, business users learned more about the available BI products.

When the process was complete, the railway chose the Oracle OBIEE tool, Oracle Interactive Reporting and the Oracle Answers toolset. "Most important, the process brought together the IT and business users in their BI mission," says Mark Myers, IT manager for business intelligence and data warehouse development. "And it allowed the business to choose the solution they wanted."

Using these tools, the company created the Norfolk Southern Business Intelligence (NSBI) environment. (See Figure 4.) NSBI uses upstream operational systems to feed the Teradata relational data warehouse. It writes ETLs and then puts the data back into Teradata into both relational and dimensional forms. This approach increases speed of data access and provides a single source of data to all users.

Figure 4. Norfolk Southern OBIEE Architecture Diagram
To learn how to use the tools, users take an eight-hour in-house course that is customized with their transportation data. Business users typically rely on the Oracle Answers tool, while data mining “explorers” use Oracle Interactive Reporting to perform ad-hoc querying.

Today the company is in the midst of a multi-year rollout of the enterprise data model to more than 25 business units. But benefits of the deployment are already being realized. The dimensional model lets users drag and drop elements while setting up hierarchies and drill paths. “With our old environment, it would take a team an average of 500 hours to create parameterized dashboard,” says Myers. “Now they can do it in two hours, because of dimensional model behind it.”

With the old BI tools, the company had only 100 power users who queried the system. With NSBI, already 800 users are creating their own reports. The number of users is growing, as is the ability to access information and ask even more questions.

“When we started, we thought we were embarking on an upgrade of our Brio tools,” says Myers. “This turned out to be much more. My team grew from 4 to 18 people, even with no budget. But management always puts money where they see value. They saw that the warehousing solutions had value and it helped our business partners meet their goals, too.”

As business users see the decision support information their colleagues are generating, more and more want their own access to the data. “Our Achilles heel is that we’ve been so successful,” says Myers. “And now every department wants us to address their BI needs next.”

**Operational Effectiveness**

The Norfolk Southern data warehousing and BI solutions provide business users with insight into a variety of operational areas, including car management, empty rail car distribution, and rail operation performance.

**Car Management**

The first NSBI application is a car management app that launched in late 2009. Managers need to know where rail cars are at any moment and ensure that cars are efficiently transported to the desired location. In the past, supervisors manually generated car management reports, but this was a time-consuming process that often produced dated information.

“For the first NSBI application, we wanted to create a tool that was core to the business and would score a big win,” says Myers. After IT solicited their input, the car management group created a list of 500 questions that they wanted to be able to answer within the NSBI environment. The IT team grouped the questions into five decision domains and modeled them. The result was a collection of 70 reports and dashboards, which can help the business answer about 200 of the questions.

Management of trip plans is executed in the Teradata production systems. Data is loaded into the warehouse, so queries do not negatively impact production system performance.
Managers get their car management information using a specially designed dashboard. Data is uploaded hourly, allowing transportation managers to change trip plans in response to problems or issues. “That’s really important,” says Myers, “because it gives us the speed, the performance, and the ability to see trends and make changes accordingly. Plus the Teradata box just handles it all so well.”

Another tool, the intermodal dashboard, uses data from the warehouse and production systems to enhance the ability of intermodal yards to manage operations. At Norfolk Southern, the Intermodal Division handles routes that combine shipping and trucking services along with rail. In this way, Norfolk Southern can offer customers a service that originates at a manufacturing plant and ends at a retail location, for example, leveraging various modes of transportation along the way.

The intermodal dashboard is updated every 15 minutes. Frequent data updates help yard workers identify time-sensitive shipments that need to be transported or whose owners need to be contacted. Yard workers can access the dashboard from handheld devices. They can also receive alerts from the system that tell them which container status needs to be reviewed. “This is something we couldn’t do even two years ago,” says Richardson.

Norfolk Southern is also using scanner-based information to provide updates to customers. Customers can sign up for event-based text message alerts to be sent to their mobile phones. For example, when a train passes a scanner, the system sends a text to the customer saying that the train is at the specified location. “It’s a simple text message that says the train went by the scanner at this time,” says Blair Hanna, manager of e-commerce. “But the information is so useful for decision making. It’s a pretty cool function.”

The car management tools deliver true value to Norfolk Southern. Increasing customer visibility into car operations speeds problem-solving. “For example, one customer asked why their routine shipment was being held for two additional days in a classification yard,” explains Hanna. “When we investigated, we realized that there was a new trainmaster in that yard who didn’t realize that the shipment didn’t need to be reclassified. Once we were able to spot that problem and investigate, we restored the previous service level and the customer was satisfied.”

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**AT A GLANCE: OPERATIONAL EFFECTIVENESS APPLICATIONS**

**Challenge**
Gain insight into operations and develop strategies for increasing efficiency and effectiveness

**Solutions**
> 2009: Deployed car management app, which:
- allows transportation managers to identify inefficiencies and change trip plans
- helps intermodal yard managers quickly identify and handle special-needs shipments
- provides employees and customers with scanner-based alerts
> 2009: Launched empty rail car distribution app, which helps managers ensure that empty cars are located where needed
> 2009: Implemented rail operations performance app, which helps field workers measure car connection performance and increase yard worker efficiency

**Benefit**
> Created $2.8 million in savings by reducing the cost of trains held while waiting for crews
> Improved car connections from 80% to 92%
> Increased customer visibility into car operations
> Improved customer satisfaction by providing real-time shipment and empty rail car information
> Enhanced ability of service personnel to solve car management problems
> Reduced financial penalties for late deliveries
> Aligned tactical decisions with strategic initiatives
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SUPPORTING CAR MANAGEMENT EXCELLENCE

With NSBI, business users can answer specific operational questions that allow them to decide whether to take action. Sample queries that can be answered by the system include:

> What cars are currently available in the pipeline to fill a customer’s order?
> How does the pipeline/enroute report compare to the number of cars ordered?
> Where are those cars located?
> What is the estimated time of arrival for those cars?
> What movement instructions are in place to capture, dispose and waybill cars that are being released empty from an industry or being received empty at interchange?
> What cars have been sitting idle that do not have an active waybill?
> Which cars are sitting idle that need to be reviewed with the customer for lack of utilization?
> Which cars are currently bad ordered?

> Where are the bad ordered cars?
> What is wrong with the bad ordered cars and how long will it take to fix them?
> Which cars have been released empty that do not have an active waybill?
> Which loaded private cars or hazmat cars have waybills created, with Norfolk Southern as the destination carrier, that do not have a companion home route record stored correctly?
> Which railroad marked cars, assigned into foreign pools, have been received in interchange, without a proper companion home route record being stored?
> Which Norfolk Southern cars are moving without a pool assignment?

With more current, detailed information comes higher customer satisfaction. “Our goal is to make it easier for customers to do business with us,” says Hanna. “With the information, customers can figure out when something changes, and we can get problems resolved faster. The data makes it easier to resolve issues.”

Because time-sensitive goods carry penalties for late delivery, operational efficiency is good for the bottom line. “With this data, we can help customers get their shipments faster, because we know exactly where each container is,” says Richardson. “Better operations mean higher profitability.”

Empty Rail Car Distribution

On large railroad networks, approximately half of all rail cars travel empty. Rail companies that efficiently move empty cars to the right place at the right time increase profitability. Norfolk Southern used the Teradata warehouse solutions to improve visibility into its rail car distribution decisions.

Replacing a paper-based system that was updated daily, the NSBI tool was used to create an intranet-based, real-time, cross-enterprise tool that supports operational decisions. With the new BI environment, users can produce standardized reports and drill down for additional detail.

“When it’s very easy for users to get the empty rail car information they need,” says Jeff Roton, manager of service support for the customer service center. “We have approximately 80% of the query data in the Teradata warehouse.”
By providing users with standardized query answers, NSBI enhances visibility into rail car locations. “The biggest benefit is that the technology helps standardize the answers you get, so everyone sees one version of the truth,” says Roton. “This helps us focus tactical decisions on our strategic goals. When everyone agrees on the right answer, we can move together toward meeting our goals.”

Executives also receive data that helps enhance empty rail car efficiencies. Dashboards summarize metrics, allow decision makers to drill down and find out why a train missed its connection, and spotlight opportunities for increased efficiencies. With this information, company executives can better align tactical decisions with strategic initiatives.

“With tools like Teradata and NSBI, it’s so easy to make end users smart,” says Roton. “More people – even those who are not analysts or technologists – can accomplish even more with the data.”

**Rail Operation Performance**

A key component of operational effectiveness for Norfolk Southern is the performance of rail operations. Decision makers must know whether trains are operating according to schedule and if yard operations are working as planned.

The NSBI environment provides information throughout the organization. Hundreds of field workers – in yards and division offices – use the tools to measure employee performance and identify opportunities for improvement. Nearly 30 staff workers use the information in weekly calls with field supervisors to determine how they can effectively manage train schedules and yards where cars are switched. Executives receive summary information via PDFs or smart phones.

“When we first started measuring car connection performance, connections improved from 80% to 92%,” explains Donald C. Oltmann, manager of network optimization and former manager of performance metrics. “That let us know where we were having trouble, or even where we needed to reevaluate our strategy and plans. Today, having the data helps us to focus on where we need to improve things. It can be difficult to identify a root cause, but if we can say where the problems are, we know where to start making changes to fix them.”

Norfolk Southern has also improved workforce productivity using the NSBI environment. A new application, “Crew Call,” optimizes employee scheduling, ensuring that crews are at the right train at the right time. By using this application, the company reduced the cost of trains held for crews, creating a $2.8 million annual savings.

Most of the rail operations performance reports are generated daily – some automatically and others on an ad-hoc basis. Field workers in environments with limited bandwidth can get data from the corporate portal or via PDFs. Those who need additional data can use NSBI to view more data or perform diagnostics.

**LOCATION INTELLIGENCE: WHERE IT’S AT**

Norfolk Southern recently upgraded its production systems to Teradata 13.0, which includes sophisticated geospatial functionality. These features can help the NSBI team provide users with more visual, location-based data analysis capabilities that can help business users make decisions.

For example, the HR department wanted to determine where to locate new field service offices to best meet the needs of the company’s 28,000 employees. By combining employee demographic data such as zip codes with geospatial data traditionally used by the engineering group, HR was able to visually map out employee population densities. With this information, decision makers were able to choose optimal service office locations.

In the near future, the company will look for opportunities to use geospatial capabilities for new applications, such as predicting when a rail car will arrive or using visual representations of facilities and assets to improve planning and decision making.
Although many of these users previously used Oracle Interactive Reporting to generate data, most are now using the OBIEE-based NSBI tool to slice and dice data. So far, only about 20% of the user community is actively querying the data warehouse. Yet Oltmann expects this number to grow as users become more sophisticated and the benefits of the data warehouse become better-understood.

“We know that having the data lets us get closer to the desired results,” he says. “We’re not guessing or basing decisions just on experience or instinct. We have more facts driving our decisions than we did a decade ago.”

Looking ahead, Norfolk Southern plans to develop additional BI tools to help measure and improve operational effectiveness. A new connection performance app that measures whether rail car connections are made on time recently went live. A train performance application is currently in user acceptance testing. Applications to measure service measurements and crews are in development.

With each successful new use of the NSBI environment, more business users request special projects so that their organizations can realize the value of the BI tools. “It’s well understood that the Teradata technology is of great value to Norfolk Southern,” says Oltmann. “The technology makes it easy for anyone trying to develop measures, perform analysis, or create reports.”

**Customer Service and Support**

A railroad is essentially a service organization. Pleasing the customer with on-time shipments is essential. But increasingly, as the industry has become more information-centric, providing customers with easy access to decision-making data is equally important.

Most Norfolk Southern customers use multiple transportation providers to ship goods. Although many companies get transportation data from third-party providers, a rail company that can deliver shipment information in one centralized report, on an e-commerce platform, will win – and keep – their business. For this reason, Norfolk Southern has worked diligently to create BI tools that enhance customer service and support.

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**AT A GLANCE: CUSTOMER SERVICE AND SUPPORT SOLUTIONS**

**Challenge**

Increase service excellence and provide customers with intuitive access to decision support data

**Solutions**

- 2010: Enhanced accessNS portal, adding external data and providing access to 3 years of end-to-end trip data
- 2010: Launched text messaging app that notifies customers of a change in rail shipment status
- 2011: Began incorporating new data types – such as sensor, geospatial, and mobile data – into warehouse to improve corporate and customer insight

**Benefit**

- Improved customer satisfaction by allowing them to generate more than 20 shipment reports or generate custom reports with intuitive tools
- Eliminated need to hire 47 Norfolk Southern workers to generate customer reports
- Enhanced customers’ ability to make timely decisions with real-time data updates
- Improved competitive differentiation by giving customers enhanced shipment visibility

“The data we have available is tremendously important to our customers,” says Hanna. “We use the data available to explore transit times, enhance equipment utilization, validate traffic volumes, and perform trend analysis.”

**accessNS**

Norfolk Southern continues to enhance the functionality of the accessNS tool. To create a single comprehensive data source, the company collects data from the Association of American Railroads and adds it to the Norfolk Southern transportation reporting systems maintained on the Teradata Warehouse.

More than 14,500 users from 8,000 Norfolk Southern customers use accessNS to get trip plans, shipment information and other details. These users log into accessNS an
average of 15,000 times a day. Customers can access any of the 20 predefined and custom accessNS reports at any time. They can access current data, which is updated hourly, or they can look at three years of shipment history. Most other railroads provide no more than 13 months of data.

“We can show them the whole trip, from start to finish,” says Hanna. “This is a real value-add for our customers. For any customer that ships or receives by rail, we have current and two-year transit times available, down to the individual moves the shipment made, regardless of whether it was on our railroad.”

In addition, a custom-built reporting wizard allows customers to manipulate over 125 fields of information without writing complex SQL queries. (See Figure 5.) They can modify existing reports or to build new ones. A drag-and-drop interface lets users build queries using sorting, fields, order of columns, limits. The Report Wizard translates the query into program code.

“The users love it,” says Hanna. “It takes most business users only five to 10 minutes to customize their reports, and sometimes new users never need to contact us at all while creating their own reports.”

accessNS also provides alerting and RSS feed capabilities to customers. Using scanner data, Norfolk Southern delivers inbound and outbound pipeline reports. “We offer train inquiries that show which cars are en route in a train, as well as the order the cars are in on a particular train,” says Hanna.

This information is loaded to Teradata on an hourly basis. As a result, the data becomes available to customers within 48 minutes. With such rapid notification, customers can schedule receiving personnel to be available to unload the car at their facility. Customers also can log in to accessNS and query data directly if they need more information.

The application has generated significant cost savings by eliminating the need for customer service representatives to create reports for customers. In fact, accessNS delivers 4,500 reports to users daily. Between 6,000 and 7,000 time-started reports automatically deliver over a million rows of data a day to customers. To send out this current volume of reports using the old manual processes, Norfolk Southern would need to hire an additional 47 staff members.

**Hot Car Text Messaging**

When a rail shipment status changes, Norfolk Southern can immediately notify customers via text messaging. Customers register for text alerts through accessNS, selecting from more than 90 events that the Teradata warehouse can monitor. For each selected event, customers can specify up to three rail cars or pieces of intermodal equipment. They can specify a start date along with the monitoring duration and enter their cell phone contact information.

Each time a specified criterion is met, the “Hot Car Text Messaging” application sends a text alert to the customer’s mobile device. For example, a customer might monitor estimated time of arrival. If the shipment’s arrival time is changed by a Norfolk Southern operation or even by another railroad involved in the transportation route, the application sends the customer an alert.

“By combining faster data access to the Teradata data warehouse with cellular data delivery, the application lets customers manage rail shipments at any time, from anywhere in the world,” says Hanna. “This strategic advantage is critical in the world of just-in-time delivery and has provided customers a better foundation for making timely business decisions.”
The earliest application was designed for any mobile device with texting capabilities. The Norfolk Southern team is currently developing an Android-powered application that allows customers to register with accessNS and track up to 10 pieces of equipment.

“Giving customers enhanced visibility has definitely helped our business,” says Hanna. “Norfolk Southern is the only railroad to currently offer this functionality. This application gives us a strategic advantage over our competitors by increasing customer satisfaction and brand loyalty.”

## Results and Conclusion

Supported by its Teradata Warehouse and BI tools, Norfolk Southern has changed its business model, enhanced its customer relationships, and become an industry leader despite challenging economic conditions. “We are pushing change through the industry,” says Hanna. “As we deploy real-time information, customers realize that this data can help them. Our competitors are scrambling to develop these capabilities.”

The value of the data access – and the insight it delivers – is especially high for customers. Having tremendous volumes of historical customer data available makes Norfolk Southern a trusted resource for companies that ship goods. “Being able to give customers visibility into the data makes it easier to get new business,” says Hanna. “The data makes it easier to serve all customers efficiently. We haven’t been able to put a dollar amount on the value, but we know it helps. Teradata has become a tool that customers cannot live without.”

Quantifying the value is a challenge. “It’s difficult to assign solid metrics to the value that the Teradata solutions have delivered,” says Roton. “But if you look at the increasing operating efficiencies, and you consider the company’s improved financial results, you can infer that the technology has helped Norfolk Southern improve.”

For 2011, Norfolk Southern achieved all-time records for revenues, operating income, net income, and earnings per share. Net income was $1.9 billion, an increase of 28% over the previous year. Railway operating revenues reached $11.2 billion, up 17% over 2010, and income from railway operations climbed 20% to $3.2 billion. Diluted earnings per share increased 36% to $5.45. Total volumes were up 5% over the previous year, and the operating ratio of 71.9, the second best since the Conrail transaction, was up 5% over the previous year.
What’s more, Norfolk Southern has realized dramatic benefits in several areas:

> In marketing and costing, the company improved internal efficiencies, time savings and customer satisfaction
> In analytics, modeling and BI, Norfolk Southern:
  – Reduced missed connections by 60%
  – Decreased rail car cycle time by a full day, creating millions of dollars in annual savings
  – Optimized car movements and crew scheduling
  – Improved customer service levels and access to BI
> In operational effectiveness, the company:
  – Created $2.8 million in held-train savings
  – Improved car connections from 80% to 92%
  – Increased customer satisfaction through improved visibility into car operations
  – Reduced financial penalties for late deliveries
> In customer service and support, Norfolk Southern:
  – Improved customers’ ability to generate BI and make timely decisions
  – Eliminated the need to hire 47 workers to generate customer reports
  – Improved the company’s competitive differentiation

Looking ahead, Norfolk Southern plans to continue deploying new tools and developing new applications. With this approach, the company can put information into the hands of as many users as possible. “We want to continue expanding access to the data,” says Oltmann. “The bottleneck is not the technology; it’s having the people who can access it and use the tools to gain insight.”

One thing is certain: with the volumes of data Norfolk Southern has collected and the processing performance of its technology solutions, users are expecting big things. “We have mountains of data in our Teradata warehouse, and we’re using NSBI to mine and find gold nuggets, quickly and efficiently,” says Myers. “With the success of our projects so far and the interest in new areas of exploration, we’ll never be able to stop the growth!”