Norfolk Southern Internship – Final Report

ENGI 499 Exhibit B

Forrest Null

Liberty University

2 May 2014

Abstract

This report documents my learning experience as an intern with Norfolk Southern Corporation during the Spring 2014 semester, in order to fulfill Exhibit B of the internship requirements. Topics addressed include an overview of the rail industry, how Norfolk Southern plays a part in this industry, and the skills I learned and refined while working there.

Railroads have been a critical link to the development and economic success of the United States since their inception in the mid-19th century. For the most part, railroads still remain the best option for freight transportation. Railroads will have a prosperous future, due to technology improvements and increasing shipment volume.

Norfolk Southern (NS) is a Class I railroad operating in the eastern U.S., formed over time through the gradual mergers of 20 predecessor railroads dating back to 1827. With over $11 billion in annual revenue, NS is one of the largest transportation companies in America, and will continue to be successful due to its unwavering commitment to safety and service.

As an intern with NS's Industrial Engineering team, I collected and analyzed statistics, created forecasts, performed simulations, capacity analysis, and data mining. I strengthened my existing IE skills, learned new railroad-specific skills, and continued to develop professional skills and connections.

This internship has been an excellent learning experience. I feel that working at NS has made me a better student, better engineer, and better job candidate. Norfolk Southern has a productive work culture and I am considering returning for future internships and/or permanent employment.

About the Freight Rail Industry

Industry History

Railroads are an important part of America's history and success. In the early history of the United States, transportation was either done by ship (if the origin and destination had navigable waterways) or by horse and wagon (if the load was lightweight and small, and there were not steep mountains). This severely limited the locations that could be settled.

In the early 19th century, Americans observed ideas from England and began to envision their own railroad systems. The Baltimore and Ohio (B&O) railroad opened for business in 1830, at only 13 miles long, but it would eventually connect Baltimore with Pittsburgh and Chicago. The same year, the South Carolina Canal and Railroad Company operated its first railroad at only six miles, but it too would rapidly grow. Early railroads were only a few miles long, and the tracks varied widely in material and gage, making interchange of cars difficult. A shipment would have to be moved between railcars of different gages several times before it reached its destination. (Armstrong, 2011, p. xxiii).

With the outbreak of the Civil War, military leaders realized how essential it would become to have one standardized nationwide rail transportation system. Congress provided land grants to railroads that would standardize, and by 1869, rail stretched all the way to California, helping to establish the standard North American gage of 56½″. Train couplings and air brake connectors were also standardized. A shipment or passenger could now make its entire journey (perhaps thousands of miles) on one railcar - without being unloaded. (Armstrong, 2011, p. xxiv).

With a seamless nationwide passenger and freight transportation system, America began a rapid westward expansion. America's rail system "became the envy of the world, and helped

establish the United States as the world's dominant economic power. Wherever minerals, oil, seeds, and grains could be mined, extracted or grown,… they were assured efficient rail transportation to factories, milling, consuming points, and exporting points. Various manufactured goods could be moved long distances (at relatively low prices) for assembly, sale, and export." (Armstrong, 2011, p. xxvi)

America's rail infrastructure is unique in the world because it is privately owned. Entrepreneurs invested billions of dollars into the private construction, maintenance, and operation of the rail network. "Railroads were America's first large corporations… In 1891, the Pennsylvania Railroad was the nation's largest single employer, with one-third more workers than the federal government… By 1906, some 85 percent of the bonds and 50 percent of the stocks traded on the New York Stock Exchange were those of railroad companies." (Armstrong, 2011, p. xxvi).

As America's rail network continued to grow and prosper, competing railroads laid their tracks parallel to one another, between the exact same cities. This resulted in over-competition and maintenance inefficiencies. Eventually, these railroads merged to save operating costs. Many mergers over time left thousands of miles of abandoned track.

With advances in technology, rail companies began switching from coal and wood-fueled steam locomotives to diesel-electric locomotives. The transition began as early as the 1920's and took several decades. Diesel-electric locomotives are cleaner, more fuel efficient, and safer to operate than their steam predecessors.

With the taxpayer-funded creation of the US Interstate Highway system in the 1950's, and a growing air transport system, many passenger and freight shipments took to the roads and skies instead of the rails. During the 1970's, Congress began to revitalize railroads by removing

some of the strict financial regulations. This helped keep the freight railroads competitive and profitable.

However, passenger railroads remain unprofitable, due in part to competition from airlines that could move people further faster. In 1971, America's bankrupt passenger railroads were combined into a federally-managed company called Amtrak, which still operates America's passenger train system.

Current Industry Outlook

Undeniably, the physics of rail shipment make it far more efficient than truck or air shipment. A recent Washington Post article pointed out that the coefficient of friction for rubber-on-pavement (trucks) is between 0.006 and 0.010, while the coefficient of friction for steel-on-steel (trains) is 0.001 (Palmer, 2014). In order to overcome air resistance, "Every vehicle has to 'punch a hole in the atmosphere,' explains Christopher Barkan, executive director of the rail transportation and engineering center at the University of Illinois at Urbana-Champaign. Once a tractor-trailer has punched its way through, that hole closes. The next truck must punch a new hole. Trains can carry more than 100 trailer-size containers. When the locomotive punches its hole in the atmosphere, each car that follows can sneak into that same hole, saving a tremendous amount of energy. The faster a vehicle travels, the more significant these aerodynamic effects become." (Palmer, 2014).

The article also quoted Illinois researcher Tyler Dick, mentioning to the improved fuel efficiencies of rail transportation. "Between 1980 and 2013, the number of ton-miles moved by railroads has doubled. But the amount of fuel they are using has remained relatively constant." (Palmer, 2014).

The article concluded by stating that modern "trains can move a ton of freight more than 450 miles on a gallon of fuel. … In 1980, that distance was only 235 miles. While freight trains have doubled fuel efficiency over the past few decades, tractor-trailers remain nearly as inefficient as they were in the 1970s. The average semi got 5.6 miles per gallon in 1973, and today that has improved to just 6.5 miles." (Palmer, 2014).

Putting physics aside, the recent shortage of truck drivers and high cost of diesel fuel makes trucking a less and less feasible shipping option. Because of this, shippers rely (and expect to continue relying) heavily on railroads to move their goods affordably and safely. Cars, chairs, chemicals, copper, crude, cattle, computers, coal, cabbage, concrete, cheese, carpet, and corn – nearly every product imaginable, at some point in its lifecycle, is shipped by train.

According to the U.S. Energy Information Administration (2014), coal provides roughly 40-45% of America's electricity. For most of their existence, freight railroads' bread and butter has been the transport of coal. In addition to domestically used coal, a large amount of coal is exported to Asia. Trains from Appalachian coal mines make their way to the sea in Norfolk, VA, where Norfolk Southern operates the largest coal exporting facility on the east coast, with an annual capacity of 48 million tons (Norfolk Southern Corporation).

Despite a recent drop in domestic coal shipments due to clean energy initiatives, railroad revenues continue to grow as a result of a strong intermodal and general merchandise business. The Wall Street Journal reported that in 4Q2013, Norfolk Southern's general merchandise segment rose 12% and their intermodal segment rose 5.8%, while coal decreased 2.4% (Mason, 2014).

In 1937, a frustrated trucker named Malcolm McLean began thinking about a way to make shipping more efficient. A 2014 Kansas City Star article reported that "McLean pioneered

the universal implementation of intermodal shipping containers… Those 20-, 40- and 53-foot containers are the building blocks of the global economy… McLean's innovation took off, and now 14 million containers are being shipped around the world." (Collison, 2014).

The Star continued "Before containers came on the scene it was very expensive to ship goods…Containers made it possible for businesses to have supply chains around the world and made it possible for people in the middle of America to have cheaper goods from around the world." (Collison, 2014).

Intermodal freight works by loading the goods into standard size metal containers (typically 8 feet wide, 8 to 10 feet tall, and 20, 40, or 53 feet long). Once a container is loaded, it is placed onto a truck and taken to a rail yard. Containers are lifted by crane onto a rail car, where they can be stacked two high, making each foot of track twice as efficient as a conventional boxcar. The railroad moves these containers anywhere, where they are picked up by another truck for the final leg of their trip. A container doesn't need to be opened until it reaches its final destination.

If the containers need to be exported, the railroad can take them to a seaport. The containers are loaded onto a ship, where they can be stacked three or more high. Many goods produced in Asia are transported in intermodal containers via ship to the American west coast, via rail across the U.S., and via ship to Europe where they are consumed, thus forming the so-called American land bridge. (Armstrong, 2011, p. 233).

The railroad industry remains committed to continuously improving safety. Thanks to government regulations and voluntary industry-initiated safety standards, rail safety has been improving. "From 1980-2012, the train accident rate was reduced by 80 percent and the

employee injury and illness rate fell by 85 percent. 2012 was the safest year ever for railroads." (Norfolk Southern Corporation).

Industry-sponsored public education programs such as Operation Lifesaver have made a serious effort to increase the public's awareness of the dangers of trespassing on train tracks. Train tracks are private property, and trespassing on them is illegal and extremely dangerous. Because of trains' massive weight, high speed, and low coefficient of friction, it can take trains a mile or more to stop. Operation Lifesaver is dedicated to spreading the word about train safety through an aggressive advertising campaign.

Future Industry Outlook

Railroads built America, and have been a part of America's infrastructure for almost 200 years, and will continue be a critical link in the global economy and transportation system for some time to come. The benefits of fuel efficiency, safety, environmental friendliness, and reliability make railroads a top-notch option for shipping.

With hydraulic fracturing ("fracking") technology creating an oil boom in the American Midwest, more and more oil is being shipped by rail. So much, in fact, that manufacturers aren't able to keep up with the demand for new tank cars. Chicago Business News reported that there were 48,000 unfulfilled tank car orders as of October 2013 (Knight, 2013).

Those who support the proposal of extending the Keystone pipeline (from Canada down to the Gulf of Mexico) contend that shipping oil by pipeline would be safer and cheaper than rail. However, investigative journalist Curtis Tate reported that railroads are a much better option for oil shipment:

"A pipeline can take years to approve and build, and can cost billions of dollars. Rail uses an existing network that can handle the product with relatively minor modifications… A pipeline

also goes only from point A to point B, whereas the rail system goes just about everywhere. While more expensive, it's faster and more flexible. Shipping in unit trains, where every car contains the same product, helps bring the costs down." (Tate, 2014).

With a number of recent oil train accidents, there is growing concern over the safety of shipping oil via rail. The latest such accident was the derailment of a CSX unit train in downtown Lynchburg, VA (only 5 miles from Liberty University) on April 30, 2014. According to WDBJ news, "12 – 14 CSX tanker cars carrying crude oil were involved in the train derailment in Downtown Lynchburg causing extensive flames and dense black smoke." (Saunders & Singh, 2014). No injuries were reported, and minimal environmental impact is expected.

Clearly, oil train safety is an issue that needs improvement, and the industry is working on it. However, Tate found that pipelines aren't necessarily any safer than railroads. "Pipeline failures have resulted in large spills, fires and fatalities, too. An Enbridge oil pipeline ruptured in Michigan in 2010, spilling nearly 850,000 gallons… into the Kalamazoo River, and it's still being cleaned up. That same year, a… natural gas pipeline exploded in San Bruno, Calif., killing eight people and destroying more than 100 homes. An Olympic pipeline ruptured in Bellingham, Wash., in 1999, spilling 237,000 gallons of gasoline and igniting a fire that killed three people." (Tate, 2014).

He continued by saying that Keystone XL, "if approved and built, would be completed long after… companies made major investments in rail infrastructure, including loading and unloading terminals, tank cars, locomotives and track." And even if the pipeline was built, lots of oil would still move over the rails. "North Dakota is producing a million barrels a day, nearly three-quarters of which move by rail, and could produce 2 million barrels a day in a few years.

At most, Keystone would move 100,000 barrels of Bakken crude a day, barely a dent in the production. What's more, it would reach only Gulf Coast refineries, not the ones on the East and West coasts." (Tate, 2014).

In addition to hauling the crude oil *away* from the oil fields, railroads haul supplies *to* the oil fields: the sand necessary for fracking, and the diluent necessary for shipment. Oil crude must be diluted (somewhere between 30% and 50%) in order to be viscous enough to flow through the proposed 1,700-mile pipeline. But if shipped by rail, the crude only needs to be diluted 17%. (Fielden, 2014).

Railroads, especially recently, have had a dedication to safety that is uncommon in any other industry. In the wake of several recent accidents, Congress has required Class I railroads to implement a Positive Train Control (PTC) system by the end of 2015. If a train's engineer fails to properly operate the train (i.e. runs a red light, travels above speed limit, etc.), the PTC system would automatically take control and bring the train to a stop, thus resulting in fewer accidents. Having fewer accidents will not only improve the railroads' safety records and saves money, but it results in better overall efficiency of the rail network – every accident delays at least one train, and usually more.

In order to implement PTC, railroads must install antennae every few miles along the track, and equip each locomotive with PTC hardware. The American Association of Railroads estimates that 63,000 miles of track will need to be upgraded, as well as thousands of locomotives (Norfolk Southern Corporation). It is unlikely that the implementation will be completed by the federal deadline. However, being ever committed to improving safety, the railroad industry is and has been tirelessly working to install the PTC system.

A February 2014 Forbes article reported a strong future outlook for the railroad industry. "Since 2009 Union Pacific's weekly carloadings have increased from 133,000 to 180,000, helping the company achieve record earnings every quarter since the beginning of 2010. Since 2009 its stock price has surged 350%." (Muller, 2014).

The article also described several indicators of the railroads' success – in the past five years, railroad industry revenues have risen 19%, created 10,000 new jobs, with a total annual payroll topping $21 billion. Railroads will haul 22% more freight by 2035, according to Federal Railroad Administration estimations quoted in the article. (Muller, 2014).

MIT rail expert Carl Martland said "It's hard to imagine a scenario where there is not [railroad] growth. People are going to continue to eat, heat our homes, buy cars. If everything else is outsourced, that means all the products are going to be coming into the United States at a port in containers. How are they going to get where they're going? They're going to Chicago, Memphis, everyplace else by rail." (Muller, 2014).

Muller also discussed how railroads are harnessing new technology: "Trains snaking across undulating terrain are like Slinky toys. On the way up a hill the cars pull apart; on the way down their tendency is to crunch together. GE Transportation's new Trip Optimizer is a smart cruise-control system that knows the slope of the hill, the length and weight of the train, its contents and its braking ability. It then automatically regulates the train's speed to maximize its efficiency and consume the least amount of fuel." (Muller, 2014).

Speaking of fuel savings, "GE is focused on fuel, rolling out a new line of locomotives that can operate on liquefied natural gas and reap up to 50% savings over diesel (of which the freight-rail industry uses 3.5 billion gallons a year)." (Muller, 2014).

Besides saving fuel, GE's Trip Optimizer can increase overall network speeds. "Norfolk Southern estimates that an increase in network velocity of just one mile per hour will save the company over $200 million a year. GE is also piloting new technology that will help rail yard managers get the right railcar on the right train more quickly. Currently railcars sit idle in a rail yard about 40% of the time." (Muller, 2014).

About Norfolk Southern

Norfolk Southern in the Freight Rail Industry

Norfolk Southern Corporation (NYSE:NSC) is one of seven Class I freight railroads operating in the United States, and is headquartered in Norfolk, Virginia. According to the company's website, "Norfolk Southern operates 20,000 route miles in 22 states and D.C., supports international trade with service to every major Eastern seaport, 10 river ports, and nine lake ports, and operates the most extensive intermodal network in the East." (Norfolk Southern Corporation).

As with most railroads, Norfolk Southern was formed through a series of mergers and acquisitions over centuries. The current Norfolk Southern Corporation was formed in 1982 and includes 20 predecessor railroad companies, the oldest of which was South Carolina Canal and Railroad Company, originally chartered in 1827. Today, Norfolk Southern is an industry leader, employing 30,000 people, 4,000 locomotives, and 87,000 railcars, in order to move 7.1 million annual shipments totaling 192 billion ton-miles. (Norfolk Southern Corporation).

Norfolk Southern remains dedicated to being a safe, sustainable, and environmentally friendly railroad. According to its website, NS is 40% complete with a $5.6 million reforestation project involving the planting of 6 million trees in a 10,000 acre area of the Mississippi Delta. In

addition, NS donated 12,000 acres near Charleston, SC to conservation agency, permanently protecting the unique and diverse wildlife existing there. (Norfolk Southern Corporation).

Norfolk Southern is not ashamed to remind people that the railroad "industry invests in its infrastructure more than 40 cents of every revenue dollar earned… While trucks, barges, and airlines operate on infrastructure paid by taxpayers, freight railroads operate almost exclusively on infrastructure they own, build, maintain, and pay for with their own money—not taxpayers." (Norfolk Southern Corporation).

I would be remiss to not mention Norfolk Southern's extreme obsession with safety. NS's philosophy is that if it can't be done safely, it can't be done. Trains can be dangerous, and as an industry leader, NS is committed to keeping railroads safe. Safe business is profitable business, because treating injuries and repairing damage from accidents is expensive. Value stream mapping involves removing everything the customer is not willing to pay for. No customer is willing to pay for injuries and accidents. In addition, injuries and accidents delay at least one train, which often has a cascading effect, delaying other trains.

Current Mission

Norfolk Southern's mission statement, according to its own website, is "to be the safest, most customer-focused, and successful transportation company in the world. NS is committed to providing an injury-free work environment, delivering customers' products efficiently and reliably, and being a good corporate citizen." (Norfolk Southern Corporation).

Future Vision

Norfolk Southern is already positioned as an industry leader, and expects to continue leading the freight rail industry with excellence. The massive rail boom underway (as noted earlier in this report) has placed NS in position to experience major growth and profitability. The

company's website says that Norfolk Southern expects to remove 1.3 million trucks from interstates and reduce 1.9 million tons of annual CO_2 emissions by 2030. (Norfolk Southern Corporation).

As previously mentioned NS is committed to safety and service above all else. Toward that end, Norfolk Southern has implemented a top-down "behavior based leadership" program based on positive reinforcement. This involves employees at all levels *being* the change they want to see in others around them, and then giving them positive feedback for safe and productive behavior.

Norfolk Southern "provides behavior-based safety training to help improve safety and customer service. The training emphasizes using positive reinforcement to sustain safe workplace habits and support continued safety process improvements." (Norfolk Southern Corporation).

When employees thank one another for a job well done, it subconsciously associates a positive psychological sensation with doing work well and safely. NS has seen tremendous results with this behavior based leadership program, and expects this to continue well into the future. I can tell you firsthand that I enjoy being in a workplace which embraces this culture. I have worked for several different companies, and Norfolk Southern is the first to take something like this seriously.

About My Work

Job Description

I worked for Norfolk Southern as an intern with the Industrial Engineering (IE) at their office in Atlanta, GA, for 18 weeks during the Spring 2014 semester (1/6/14 – 5/9/14). The IE team (along with Operations Research and Quality Management) exists within the Process

Engineering group, which exists under the Strategic Planning office, which is a part of Norfolk Southern's Technology and Planning department. As an IE team member, I supported a variety of different functions, including data collection, data mining, capacity analysis, statistical analysis, simulation, forecasting, and value stream mapping. I attended weekly IE team meetings, and provided a weekly written report to Liberty University on what I accomplished that week. I typically worked over 40 hours per week for an estimated total of approximately 680 hours. This internship was credited as ENGI 499 for three credits at Liberty University.

Job Duties Relating to NS Mission

Norfolk Southern's mission statement demands a safe, reliable, and efficient railroad. This cannot be accomplished apart from carefully analyzing the network to remove all waste – that is, to make it lean. NS's customers have come to expect a high level of reliability. Therefore, industrial engineering is critical to the success of the company.

The entire railroad is one massive network flow problem. There are millions of shipments moving millions of miles continuously. Making this enterprise efficient requires mastery of industrial engineering techniques and technologies, knowledge of railroad operations and laws, and knowledge of customers' unique needs.

Skill Development

During my four months with Norfolk Southern, I learned new skills and sharpened skills I had already learned. Some of these skills are discussed below. More specific details on what I did on a weekly basis are available in my attached weekly reports.

I learned a lot about simulation. Rail Traffic Control (RTC) is the industry standard railroad simulation software. RTC users can build very extensive, very detailed network models, using the fundamental node-and-link framework taught in Liberty's ENGI 340. There are several

IE team members at NS solely dedicated to building RTC models. I was glad to get the opportunity to learn how to use RTC.

Part of building track models in RTC involves knowing how to read track charts. Track charts are thick books that show every single detail about a given segment of track, including its direction, distance, milepost, speed limits for different types of trains, grade, elevation, curvature, alignment, track condition and age, road crossings, bridges, tunnels, signals, switches, sidings, etc. A track chart contains so much detail that only 5 miles of track can be documented on one page.

I learned some other railroad-specific software as well. One was Universal Train Control Systems (UTCS), which shows the live movement (or plays back the historical movement) of trains across the NS network. I also learned how to look up information in the Norfolk Southern mainframe, such as train schedules and operating stations. I learned how to collect track inventory reports through Thoroughbred Yard Enterprise System (TYES).

I also learned a lot about Microsoft Access. I have been familiar with MySQL and Oracle databases for a number of years. However, I had not used Access until this internship. Learning the quirks of a new database is a valuable skill. Piecing together what I already knew, in addition to some online information I looked up, I was able to harness the power of Access in a number of different situations.

I also refined my technical writing skills which I learned in ENGR 270. I had to write documentation for a database, in addition to a weekly report for Liberty University. I also had to create graphs and spreadsheets on a regular basis, which must communicate information clearly.

If one thing is for certain, it is that I am confident of my Excel skills. I was already very familiar with Excel, because I have been using it for a variety of purposes for about 10 years.

Excel is also critical to most of the IE coursework at Liberty. Even more so, Excel is critical to IE at the railroad. We regularly push Excel to its limits in an effort to generate information which can help us make decisions to improve the railroad.

But perhaps most importantly, I made some professional connections. In today's socially connected workplace, the phrase "it's not what you know, it's who you know" has become truer than ever before. Especially in engineering, a technical basis of knowledge is required. Nevertheless, in order for that knowledge to transform into a job, a professional network of colleagues is essential. I have made several valuable connections at Norfolk Southern, and I feel that this internship and these connections have made me a much better job candidate in general, but at NS in particular.

Relevance to Learning Experience

The objectives identified on my internship application were: (1) to apply knowledge of computing/math/engineering appropriate to discipline, (2) to function effectively on a team to accomplish a common goal, and (3) to use current techniques, skills, and tools necessary for engineering practice.

I definitely applied my knowledge of engineering at this internship. Specifically, material from the following classes was salient: statistics (ENGR 210), production systems (ENGI 230), information systems (CSCI 110 and ENGI 360), technical writing (ENGR 270), facilities design (ENGI 330), and operations research (ENGI 340). I applied my knowledge of spreadsheets, statistics, databases, network flow problems, web development, simulation, data mining, capacity planning, light programming, and forecasting.

In order to accomplish tasks as large as the ones found on the railroad, it is necessary to work with a team. I found myself working with various IE team members on a weekly basis.

Frequently, teamwork is helpful because each team member brings their own knowledge and experience to the table. Other team members observed things that I didn't see, and I observed things they didn't see. Working together, teams can be more productive than individuals. I have become comfortable as either a strong independent worker or a good team player.

Using current techniques at a railroad is an interesting topic. Because railroads are so massive, and have been around for centuries, change occurs slowly. In addition, railroads with different techniques have merged over time. Some things have never been standardized. Despite these challenges, within the Industrial Engineering team, we use current IE techniques such as 5S, Lean, Six Sigma, simulation, value stream mapping, Total Quality Management, and others.

Conclusion

In conclusion, this internship was a fascinating learning opportunity and provided an excellent channel for me to actively participate in very large-scale real-world applications of industrial engineering. Although it delayed my graduation date by a year, this internship was well worth it for the experience I have gained, and connections I have made. I strongly feel that this internship made me a better engineer, a better student, and a better job candidate. I am considering returning to Norfolk Southern for future internship and/or potential permanent employment. I have truly enjoyed my time at Norfolk Southern Corporation and learned a lot of practical information about industrial engineering.

References

Armstrong, J. H. (2011). *The Railroad: What It Is, What It Does* (5th ed.). Omaha, Nebraska: Simmons-Boardman Books.

Collison, K. (2014, January 13). Shipping container makes world smaller, KC and world economy bigger. *The Kansas City Star.*

Fielden, S. (2014, April 1). *Railbit Train to Natchez – First Unit Railbit Train From Western Canada to the Eastern Gulf*. Retrieved May 1, 2014, from RBN Energy, LLC: https://rbnenergy.com/railbit-train-to-natchez-first-unit-railbit-train-from-western-canada-to-the-eastern-gulf

Knight, M. (2013, October 28). Oil boom is creating years-long backlog for tank cars. *Crain's Chicago Business*.

Mason, E. (2014, January 22). Norfolk Southern Profit Jumps on Strong General Merchandise, Intermodal Business. *The Wall Street Journal*.

Muller, J. (2014, February 10). All Aboard: Why America's Second Rail Boom Has Plenty Of Room To Run. *Forbes*.

Norfolk Southern Corporation. (n.d.). *About NS*. Retrieved May 1, 2014, from Norfolk Southern Corporation: http://www.nscorp.com/content/nscorp/en/get-to-know-norfolk-southern/about-ns.html

Norfolk Southern Corporation. (n.d.). *Balanced Regulation*. Retrieved May 1, 2014, from Norfolk Southern Corporation: http://www.nscorp.com/content/nscorp/en/get-to-know-norfolk-southern/impact/where-we-stand/balanced-regulation.html

Norfolk Southern Corporation. (n.d.). *Infrastructure*. Retrieved May 1, 2014, from Norfolk Southern Corporation: http://www.nscorp.com/content/nscorp/en/get-to-know-norfolk-southern/impact/infrastructure.html

Norfolk Southern Corporation. (n.d.). *Lamberts Point Coal Terminal, Norfolk, Va.* Retrieved May 1, 2014, from Norfolk Southern Corporation: http://www.nscorp.com/content/nscorp/en/ship-with-norfolk-southern/shipping-options/coal/transload-facilities/lamberts-point-coal-terminal-norfolk-va.html

Norfolk Southern Corporation. (n.d.). *Positive Train Control*. Retrieved May 1, 2014, from Norfolk Southern Corporation: http://www.nscorp.com/content/nscorp/en/get-to-know-norfolk-southern/impact/where-we-stand/positive-train-control.html

Palmer, B. (2014, March 3). Let's make an effort to move more freight by rail and less by road. Trains are more efficient. *The Washington Post*.

Saunders, T., & Singh, N. (2014, April 30). Train carrying crude oil derails in Lynchburg. Lynchburg, Virginia: WDBJ-7.

Tate, C. (2014, April 25). The reasons - and risks - behind shipping crude oil by rail. *McClatchy DC*.

U.S. Energy Information Administration. (2014, April 22). *Table 1.1. Net Generation by Energy Source: Total (All Sectors), 2004-February 2014.* Retrieved May 1, 2014, from Electric Power Monthly: http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_1_01