Railroads Versus Trucks: Global Effects

Saeed D. Foroudastan, Ph.D., Associate Professor
Saxby Dyani, Graduate Assistant

Engineering Technology and Industrial Studies Department
Middle Tennessee State University

Abstract

The paper "Railroads Versus Trucks: Global Effects" investigates the worldwide impact resulting from the shift of freight from railroads to trucks. Facts and statistics pertaining to fuel efficiency, emissions, traffic congestion, smog, and other environmental concerns are compared and addressed. Past and present shipping trends in developed nations are considered as well as ways developing nations can avoid making the same costly mistake of sacrificing the environment in exchange for increased production. In addition, economic factors are examined as well as causes of the shift from rail to trucks and feasible solutions. Finally, benefits and risks of shipping freight railroad versus trucks are evaluated and analyzed globally in both environmental and economical terms.

Introduction

Historically, the United States has been a global leader. Many countries are striving to obtain the same technological success and industrial growth. The Industrial Revolution that took place in this country more than a century ago is currently underway in many developing countries. In striving for prosperity, however, the U.S. has made some mistakes for which it now must suffer the consequences. It has polluted the air and water in exchange for industrial growth contributing to ozone depletion, the greenhouse effect, and acid rain. As a result, the U.S. is now facing a very real crisis that its leaders to no avail are frantically searching for a quick fix. One mistake the United States is suffering from now was its dramatic shift of freight transport from railroads to trucks. According to statistics dating from 2000, people in the U.S. spend approximately 43 billion dollars a year on maintaining highways. Even so it just is not enough. The amount needed to accomplish this is 53 billion dollars per year and in order to keep up with current growth trends, its taxpayers would need to spend a whopping 83 billion dollars annually. [1] That is a lot of gasoline taxes. With so much heavy traffic moving across America's roads, it is inevitable that repair costs will continue to escalate. Anyone who drives a car knows it is a way of life to share the roads with semi-trucks. Hazardous materials and hazardous wastes shipped in these trucks add to the danger of already unsafe and overcrowded roads. One truck only gets fifty-nine miles to one gallon of fuel when shipping one ton of cargo. On the other hand, railroads get 202 miles

to the gallon. [2] When engines are left idling three times the amount of exhaust gases are emitted. [3] Traffic jams are all too common, leaving truck engines to run and higher emissions to further pollute the air. The United States has contributed to this problem by transferring the majority of its freight from railroads to trucks. Other countries are repeating this pattern. With such rapid population growth the demand of goods is certainly not going to decline. In fact many countries are beginning to wonder how they are going to handle it. Even if these countries turn to trucks and expanding the roadways, there is not an unlimited fuel source and sixty-five percent of it is located in a politically unstable Middle East. [4] Even so the most important factor has yet to be examined here, that is the toll this shift has taken on the environment and ultimately public health and safety. The United States as a global leader has some tough choices lying ahead. Future engineering students will have to make some of these choices. They may be in charge of shipping decisions that could very well affect pollution, the environment and public safety. Universities and industries should collaborate in order to develop research on shipping and to educate engineering students. This should be done with the purpose of helping students discover creative ways of shipping that minimize pollution and damage to the environment, as well as reduce dangers to public safety. This paper will investigate the issues of shipping railroads versus trucks with a focus on preventing further degradation to the environment and the world.

Historical background of railroads

It seems ironic that the United States has turned its back on the very commodity that many years ago made it the powerful nation it is today. Railroads enabled America to unite and come together as one nation. It would not have been possible without the railroads. They paved the way to the Industrial Revolution. Without the railroads, the American dream would have been shattered. Like a ghost lingering on miles of abandoned track, railroads now seem to be a thing of the past. How did this happen? As the railroad industry grew, struggle for control became an issue. As a result, the government intervened, setting up a rigid set of regulations that eventually let to their demise. [5] The government's goal was to restrict the railroads so other industry could compete. It is speculated that the automotive industry also played a role in discouraging the use of railroads to promote the use of automobiles instead. Trucks ultimately reaped the benefits. "Since 1920, the federal government has spent 450 billion dollars on the construction and maintenance of a highway network, 21 billion dollars on our inland waterways, and approximately one billion dollars for trucks." [6] These government subsidies have put trucks and barges at an unfair advantage over trains. "Railroads now complain that competing modes of transportation including trucks, barges, and planes, receive considerable government subsidies in the form of facilities and rights-of-way for which they do not have to pay the full costs in user charges." [7] The United States is now seeing the effects of government regulation taken to the extreme. Its interstates are crowded with trucks, traffic is becoming unmanageable, and smog pollutes the air.

The need to divert some freight to rail can no longer be ignored. Whether someone cares about the environment or not, the traffic situation in this country and all over the world is overwhelming. As a result of this urgent predicament, the government adopted The Stagger's Rail Act of 1980 that lifted many of the regulatory mandates previously imposed on the railroads. "Government policy can help the railroads while simultaneously avoiding additional congestion on our highways and waterways, and reducing pollution, fuel consumption, and damage to the

highways." [8] This act essentially empowered railroads to charge their own rates, build their own routes, and charge based on the demand of the market. Railroads are beginning to break free and embark on a new journey. Edwin L. Harper, President of the Association of American Railroads said, "We know we have a long way to go, but we know we can do it… Railroads are responsive to and able to deliver on some of the fundamental concerns of society today. We produce fewer emissions, less pollution to move a ton of freight one mile than any other mode." [9] More important now than the history of railroads is the future potential they demonstrate for alleviating some the pollution and environmental problems plaguing us today. The need to make some serious choices has arrived. Is the world ready for a change, and if not, what is it willing to sacrifice instead?

Hazardous Materials

One of the biggest concerns when considering moving freight is the transport of hazardous materials and hazardous wastes. Not only can spills wreak havoc on the environment, but they can also have adverse or even deadly effects on animals and humans. Overcrowded highways and interstates are dangerous enough without the additional threat of hazardous materials and wastes. The president of the Association of American Railroads, Edwin, L. Harper, in an interview with Traffic Management News talks about an incident that occurred in the Washington area. A tanker truck shipping gasoline was involved in an accident that killed two and injured four. It happened in a very congested area that held up thousands of people. The outcome of course could have been much worse. Harper's initial response to the incident was, "The more hazardous materials we can get off the public right of way and onto the railroads' private rights of way, the better off we'll all be." [9]

Railroads and trucks currently ship equal amounts of hazardous materials. Yet the Department of Transportation statistics indicate that eighty-six percent of all incidents involving hazardous materials in 1999 were by truck, eight percent were by air, and only six percent were by rail. As an additional note, the Department of Transportation also confirms that in the last twelve years, highway accidents involving hazardous materials took one hundred and thirty-two lives. For railroads that number is two. These numbers are particularly significant in that they both ship roughly equal amounts of hazardous materials. [10] The number of deaths as a result of shipping hazardous materials on highways and interstates is unacceptable.

"Trains are ten times less likely than trucks to have accidents involving hazardous materials." [11] Nevertheless, The Associate of American Railroad's Hazardous Materials Emergency Response Training Center has provided training to deal with hazardous materials emergencies to over 10,000 emergency responders including firefighters, public safety agencies, chemical shippers, trucking companies, and of course railroads. The AAR works in collaboration with the Transportation Community Awareness and Emergency Response Program to assist communities in developing emergency response plans nation wide. [12] CSXT, a leader in the industry, have comprehensive training programs, including biennial tests to ensure employees have the skills and knowledge it takes to safely handle hazardous materials and wastes. CSXT has trained hazardous materials professionals that meet with fire, police, and emergency response crews in communities through which hazardous wastes frequent. The company also provides the local emergency

planning committees with extensive training on the types of chemicals shipped through their towns and cities. The numbers of cars that leaked any of their contents because of a derailment has dropped from thirty in 1989 to twelve in 1999. [13]

Railroads are clearly at an advantage over trucks when it comes to protecting the public and the environment from hazardous materials and wastes. If there is an incident, chances are it will not be in the middle of traffic. The incident will be isolated making cleanup safer and more efficient. Hazardous materials and wastes have to be transported; there is no escaping that. There is however, a far greater chance of hazmat release when such materials are shipped by truck than by rail. "Freight railroads have less than eight percent of the hazmat incidents that trucks do despite having roughly equal ton-mileage." [12] Hazardous substances belong on the railroads and off the highways and interstates whenever possible.

Fuel efficiency and pollution control

Like a runner who has fallen behind in a race, railroads are currently working twice as hard to catch up with the competition. Government regulation, in spite of the negative consequences, did accomplish one good thing. It increased the competition factor forcing standards to rise. Think for a moment about what happened to the automotive industry years ago. Car companies overseas forced American car companies to change for the better in order to stay competitive. Railroads are faced with a similar situation today. They are reinventing themselves, while focusing on maintaining a positive public image to attract customers. This includes paying close attention to detail on issues like quality, employee health and safety issues, and in particular the environment. In fact, railroads have more than three times the fuel efficiency as trucks. "If just ten percent of the freight moved by highway were diverted to rail, the nation could save as much as 200 million gallons of fuel per year." [12] This is especially important when considering the amount of diesel emissions released during the process of fuel production, refining, distribution, and dispensing. [14] If the amount of fuel being used can be reduced, it will simultaneously decrease the amount of fuel being processed, thus further reducing air pollution.

Diesel exhaust is a major source of air pollution. It is not uncommon to see a truck spewing out black smoke. In California alone, diesel engines are to blame for forty percent of the nitrogen oxide and sixty percent of the particulate matter from mobile sources. This is primarily because diesel buses and trucks haven't been subjected to the strict maintenance and inspections as other automobiles. [14] Not only do these emissions compromise the aesthetic quality of the environment (think smog), but they are also having a dangerous effect on it. Although diesel fuel fares better from an energy perspective, they often have more serious effects on the environment and health. Compounds such as polynuclear aromatics including benzopyrenes and several hetercyclic organic compounds composed of such elements as nitrogen and sulfur are present in diesel engine exhaust. [15] Yes, it is true that diesel engines emit less CO_2 than gasoline, but studies have shown that they also emit twenty-five to four hundred times the amount of particulate black carbon and soot per mile. New studies suggest that global warming from soot may cancel out the effect of having less CO_2 emissions. According to Mark Jacobson, Associate Professor of Civil and Environmental Engineering at Stanford University, "Whereas carbon dioxide clearly causes most global warming, control of shorter lived constituents, such as black carbon, should have a faster

effect on slowing warming." [16] This so-called global warming is better known as The Green House Effect.

Diesel exhaust also contains nitrogen oxides, carbon monoxide, and sulfur dioxide. All of these contribute to air pollution and adverse health effects. Nitrogen oxides contribute to ground level ozone or smog, and acid rain. [16] NO_x together with hydrocarbons contribute to a major source of ground level ozone air pollution. [17] Sulfur dioxide in diesel emissions is also a contributor of acid rain. "Researchers have found that it was necessary to reduce emissions of nitrogen oxides to reduce photochemical smog and acid rain percursor emissions." [15] Diesel emissions also affect plants and animals. Different species are affected in different ways. For example, white pine is susceptible to damage from both SO_2 and ozone, but the sugar maple is affected only when they combine and is relatively unaffected by SO_2 alone. [15] Aquatic species are highly susceptible to acid rain. As a result, other wild life and humans that depend on them are deeply affected. [15]

The Environmental Canada Transportation Systems Division rated Air, Rail, Water and truck in terms of being the "Best Choice for the Environment." [12] They were ranked in terms of the following pollutants: Oxides of Nitrogen, Volatile Organic Compounds, Particulate Matter, Carbon Monoxide, and Carbon Dioxide. Railroads come in first in all but Particulate Matter (they come in second in this category.)[12] Prominent U.S. ecologist Bary Commoner seems to agree. The following quote was taken from his book, The Closing Circle that "The vast number of automobiles… together with the shift in the transportation of goods from rail to trucks, has significantly increased air pollution." [15] As scientists continue to research the effects of diesel emissions, it becomes clear how detrimental they are to the environment and to one's health. The statistics are shocking and with continued carelessness and abuse they will continue to rise. The following information demonstrates the need to reduce diesel emissions.

Health effects

The World Health Organization estimates that an average of 2.7 million people die each year as a result of air pollution. [16] Mark Jacobson of Stanford University notes that health costs incurring from particulate pollution in industrial countries are 200,000 to 2.75 million dollars per ton. [16] These are statistics that simply cannot be ignored. According to the American Lung Association of California, many scientific studies are now indicating a connection between "cancer, exacerbation of asthma, and other respiratory diseases and premature death." [17] In 1990 diesel exhaust was deemed a carcinogen under California's Proposition sixty-five and in 1998, it was formally put on the list as a Toxic Air Contaminant. [17] NO_x, a major chemical in diesel exhaust in combining with hydrocarbons produces ground level ozone. This type of ozone air pollution has been linked to the following symptoms, "shortness of breath, chest pain, wheezing, coughing, and exacerbation of asthma." It has been labeled by the ALAC as a "powerful respiratory irritant" and may lead to more serious lung conditions. [17] Many particulate materials within the soot are so fine that they easily penetrate lung tissues leading to both respiratory problems as well as cardiovascular complications. [5]

People dwelling in urban areas with highly congested traffic areas are at particularly high risk. Many of the people affected are poor. [5] This is significant since many of those poor people have

inadequate health insurance or even worse, have none at all. With population rates sky-rocketing---especially in the inner cities, the situation is not going to get any better on its own. American society is increasingly becoming reactive rather than proactive. If one gets sick he or she can just go and have a triple by-pass surgery instead of eating right and having a healthy lifestyle. The same example can be applied to air pollution. It is the symptoms that are being treated and not the actual cause. However, as the population increases, and health care costs escalate, that may no longer be an option and for some health care is already non-accessible. Diverting some freight from trucks to railroad might not seem like that big a deal, but it has to start somewhere. By doing so, not only are smog and ozone producing emissions that cause health problems reduced; the highways also become safer and less congested, making driving a more pleasant, less stressful experience. There is an opportunity to become a healthier society. It will take a lot of changes to accomplish this, but the United States are not the only ones with this problem. Air pollution is not limited to one country. The whole world is struggling with these issues and for some the situation is far worse.

The Global Situation

Health concerns, congested highways, smog, and land shortages are all aspects that are forcing the world to take a closer look at how they will transport freight now and in the future. If current trends continue, and conditions such as air pollution become worse, a renewed interest in railroads as a primary mode of freight transportation is probable. This is going to be quite a challenge however, as many countries including the United States have neglected their railroads. Western Europe is still known for its passenger trains, however freight, like the U.S. was primarily shifted to trucks. Between 1970 and 1990 the amount of freight shipped by railroads in fourteen countries plummeted from thirty-one to only seventeen percent. At the same time highways and interstates climbed from fifty-five to seventy-four percent. [18] In addition, the European Commission expects a forty-two percent highway freight volume increase between 1990 and 2010. The fear of "completely unmanageable" highways has influenced the European Community's executive to move toward a shift from trucks back to railroads. [18]

Many developing countries are experiencing problems as a direct result of rapid urbanization. The amount of freight being shipped coincides with population growth. If the United States, one of the wealthiest nations in the world cannot afford to keep up with this kind of growth, how is the rest of the world going to do it? If countries continue to cram interstates and highways full of more trucks, the effects will be devastating. The entire world is experiencing increasing health care costs and loss of life as a result of air pollution. It has not only hit hard in the U.S., but also with the rest of the world. India, one of the more densely populated countries in the world is experiencing a jump in the amount of freight shipped by trucks as a result of rapidly increasing demand. [18] One study showed that Asian cities are being hit the hardest with air pollution being five times greater than other industrial countries. Urban population in these nations is projected to triple from 360 million to over a billion in 2020. [5] Other nations are facing similar situations and many are turning to railroads in order to ease traffic conditions, ship hazardous materials, and reduce emissions. "The threat of environmental damage caused by heavy truck traffic has prompted Austria and Switzerland to seek expansion of their rail capacity on transalpine roads." [18] It is important that these countries educate college engineering students about methods to avoid

such environmental damage. As future industry leaders, their decisions on how freight is shipped will have a major impact on pollution, health, and safety.

The world is beginning to notice the damage inflicted on the environment as a result of current freight shipping trends. In 1925, the U.S. shipped eighty percent of its total freight by railroads. By 1992 that total plunged to thirty-seven percent. Unfortunately, other countries have followed in our footsteps. For example, Japan ships a mere five percent of its total freight by rail. One might reasonably assume the rest is sent by water, but this is not the case. Ninety percent of Japan's total goods travel across this tiny country by truck. Needless to say, its reputation for "just in time deliveries" is going down hill due to extreme traffic congestion. [18] Germany ships 22% of its freight by rail and France 24%. With exponential population growth, the demand of goods is certainly not going to decline. In fact many countries are beginning to wonder how they are going to handle this great demand. [18] Railroads are preparing to take on the challenge.

Innovations

Railroads are emerging as part of the solution to a global problem of congested highways, heavy smog, and air pollution. They are continuously contemplating ways to conserve energy and reduce emissions while simultaneously working with the EPA to ensure they will be able to meet standards. There are numerous ways that railroads are developing technologies and working with government entities to enhance their contribution to pollution control. Listed below are several of the railroads' goals and accomplishments.

- CSXT Transportation Inc. received an award presented this year from EPA for installing the new APU (Auxiliary Pwer Unit) system that allows for emission reductions in locomotives. This year alone CSXT is in the process of installing 800 APU's and will install the same amounts in the years to come. However, they are not only limited to CSXT, but will be extended to the rest of the industry as well. [19]

- Railroads and their suppliers have discovered another fuel saver by introducing a 6,000 horsepower AC locomotive that uses two engines to accomplish what three did in the past. [12]

- Railroads are improving track lubricants to increase fuel efficiency. They have also managed to reduce the weight of rail cars and at the same time increase their capacity. "The average freight car capacity is now nearly ninety-three tons, up seventeen percent in just the past twenty years." [12]

- The state of California has been known as a pioneer when it comes to environmental matters. There has been a recent agreement between The U.S. Environmental Protection Agency, the Burlingon Northern & Santa Fe and the Union Pacific railroads to replace locomotives in the South Coast Air Basin with new locomotives that will reduce the emissions of NO_x beginning in 2010. These reductions will be equivalent to "eliminating the NO_x from about 1.5 million cars and light trucks." [20]

- As a result of the clean air act, the EPA established limits for locomotive emissions. The

standards were greater than the railroads', but nevertheless, the railroads were determined to comply. Spokesperson Richard Russack of Nothern & Santa Fe's railroad said, "though EPA's proposed reductions are greater than the railroads' comprehensive affirmative proposal to reduce emissions, we believe that these further reductions---while difficult to achieve--- are technically supportable and probably avoid the environmental harm that would occur if less freight is shipped by rail because of the cost of compliance." [21] As a matter of fact, railroads are adamant supporters of collaborative research efforts between locomotive manufacturers and government to promote development of fuel saving and emission reducing technologies. [12]

These are just a few of the ways railroads are continually improving. Railroads are being forced to up their standards to the highest level possible so they have a chance at surviving the competition. So far, they have been successful at meeting these higher standards. According to the EPA, railroads make up forty percent of the United States' intercity freight ton-miles but only cause nine percent of the total transportation NO_x emissions and four percent of the total transportation particulate emissions. The American Society of Mechanical Engineers state that 2.5 million less tons of CO_2 would be emitted if ten percent of intercity freight shifted to rails. [12] As railroads continue to raise the bar in terms of protecting the environment and air quality, hopefully responsible businesses around the world will take notice and do their share by diverting some of their freight to rail.

Conclusion

"Other factors than mere cost minimization, such as cargo security, pollution, and the safety of the highways, may dictate a shift from truck to rail." [22] Resources are limited and population growth is not expected to slow down. Conserving resources as much as possible provides several benefits. One way to accomplish this is to use railroads more frequently for the transport of freight as well as hazardous materials and wastes. First, less fuel is used, which in effect reduces emissions from usage as well as fuel production. By doing so, dependency on fuel decreases. Second, the roads become less congested and consequently, more safe. Indirect benefits of this include driving stress and road rage becoming less prevalent. By shipping hazmats on railroads, the opportunity for a serious disaster is greatly reduced. Third, limited land especially in smaller countries like Japan is preserved. By constructing more roads, or expanding existing ones, trees and wildlife habitats could be invaded and possibly destroyed. Finally, by reducing emissions, the air is cleaner, people are healthier, and costs due to health care and lost workdays are lowered.

Air pollution is a serious threat to society and to the environment. One does not have to search extensively to observe the consequences. Thick smog hovers over our cities. Traffic jams have become a regular way of life. It is time to dig deeper and find ways to prevent further environmental degradation. Railroads are of course not a cure all rather they are one way to alleviate problems while preventing additional damage. While railroads are more fuel-efficient and by far the safest mode of transporting hazardous materials and hazardous wastes, they do not offer the precise shipping schedule that businesses are seeking. Many truck and rail companies are recognizing their own limitations and combining efforts in order to overcome certain obstacles. For example, traffic is setting many truck schedules behind, while railroads do not have the option of direct delivery. As a result, some rail and truck companies are collaborating to

develop a system that will be beneficial to everyone. Hopefully responsible businesses will pick up on these new shipping trends. Perhaps it is even more important that colleges and universities begin to take a closer look at current and future shipping practices. Engineering students should have a fundamental knowledge of pollution control technology. With this knowledge they will be able to make sound decisions that are not only profitable, but also beneficial to the environment and public health. Even if people are not moved by the moral argument of helping the environment and public health, surely they will be moved by the astronomical costs of road maintenance and expansion. Advantages of shipping by railroad clearly outweigh the disadvantages. It is time for the world to explore the benefits of shipping by railroads.

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DR. SAEED FOROUDASTAN
Saeed Foroudastan is an Associate Professor in the Engineering Technology and Industrial Studies Department. He received his B.S. in Civil Engineering (1980), his M.S. in Civil Engineering (1982), and his Ph.D. in Mechanical Engineering (1987) from Tennessee Technological University. Professor Foroudastan's employment

vitae includes: Graduate Instructor for Tennessee Technological University (1983-86), Instructor of Mechanical Engineering for Tennessee Technological University (1987-88), Assistant Professor of Mechanical Engineering for Tennessee Technological University, Senior Engineer, Advanced Development Department, Textron Aerostructures (1990), and Middle Tennessee State University. Professor Foroudastan is involved with several professional organizations and honor societies, and has many publications to his name. He also holds U.S. and European patents.