Logistical Impact of Intermodal Facilities

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Abstract - In today's growing global economy, intermodal facilities have become increasingly popular as a method of increasing efficiency and decreasing costs across the entire spectrum of supply chain operations. In order for a facility to be considered intermodal it must be accessible by more than one mode of transportation such as truck, rail, ship, or plane. Five primary functions are performed in intermodal facilities: transfer of cargo between modes of transportation, freight assembly in preparation of transfer, freight storage, logistical control and distribution of product flows (Slack 1990). These activities are centralized in order to concentrate critical operations in one location thereby providing opportunities for economies of scale. The increased focus on efficiency and cost reduction is a product of current shipping trends. According to the US Department of Transportation Statistics, the typical freight shipment "traveled nearly 40 percent farther in 2002 than in 1993 (Bureau of Transportation Statistics, 2004, p 4)." Increased distance traveled for freight implies that the cost associated with shipping has also increased. Intermodal facilities provide a number of advantages to companies. Thus, this paper presents the state-of-the-art on the logistical impact of intermodal facilities. This is important because strategically placed intermodal facilities within a supply chain provide flexibility to decision makers. These facilities allow operators to select the most efficient method of shipment for each freight container. Increased efficiency implies that less time is wasted on non-value adding activities.

Keywords: Impact, Intermodal, Facilities, Logistics, Environment

INTRODUCTION

In today's growing global economy, intermodal facilities have become increasingly popular as a method of increasing efficiency and decreasing costs across the entire spectrum of supply chain operations. In order for a facility to be considered intermodal it must be accessible by more than one mode of transportation such as truck, rail, ship, or plane. Five primary functions are performed in intermodal facilities: transfer of cargo between modes of transportation, freight assembly in preparation of transfer, freight storage, logistical control and distribution of product flows [1]. These activities are centralized in order to concentrate critical operations in one location thereby providing opportunities for economies of scale. The increased focus on efficiency and cost reduction is a product of current shipping trends. According to the US Department of Transportation Statistics, the typical freight shipment "traveled nearly 40 percent farther in 2002 than in 1993" [2]. Increased distance traveled for freight implies that the cost associated with shipping has also increased.

Intermodal facilities provide a number of advantages to companies. Intermodal terminals facilitate the transfer of standardized shipping units between modes of transportation. Strategically placed intermodal facilities within a supply chain provide flexibility to decision makers. These facilities allow operators to select the most efficient method of shipment for each freight container. Increased efficiency implies that less time is wasted on non-value adding activities. Reduced time means money saved while goods are in transit. Additionally, having a shared intermodal facility allows for less capital expenditure on infrastructure, allowing companies to move more freight with fewer assets. Intermodal facilities also act as a catalyst for economic development in the surrounding communities. For example, Warren County, Virginia has had 11 manufacturing and service companies locating to property adjacent to the Virginia Inland Port, which is an intermodal facility servicing the Port of Virginia [3]. Dollar General broke ground on a $60m distribution center that is expected to employ 550 warehouse workers and 100 truckers in conjunction with the opening of Norfolk Southern's $97.5m Birmingham Regional Intermodal Facility [4]. Thus, many communities see these intermodal facilities as an important economic development tool. Figure 1 shows an example of an Intermodal Facility.

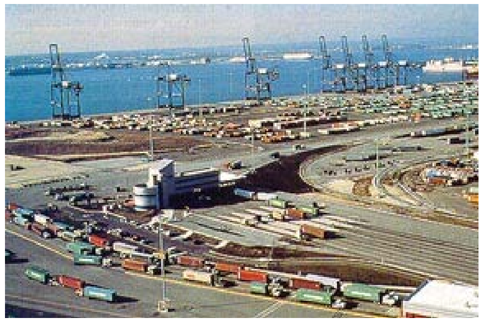

Figure 1: Sample Intermodal Facility

From 1998-2008, world merchandise exports tripled in value from $5.4 trillion to $16 trillion worth of goods [5]. The 2008 recession had a significant impact on the growth of exports severely. However, according to World Trade Organization statistics, trade rebounded and world merchandise exports, about $12.2 trillion in 2009, went up to $14.8 trillion in 2010 [6]. For the 2008-2010 time periods, U.S. freight exports realized a doubling of value from $682 billion to $1.3 trillion. The U.S. also realized a sharp decline in freight exports in 2009 but recovered most of that value by 2010. The steady rise of exports and imports indicate that more freight is shipped globally and that it is being shipped using multiple modes of transportation. This major increase in intermodal activity shows that intermodal facilities will increasingly become more important to the strategic operation goals of local and international companies.

One intermodal solution to meet the growing need for capacity has been an increased interest in satellite intermodal facilities, also known as inland ports or remote hubs. Hinterland facilities have been seen as an opportunity to accommodate future growth of load centers, while minimizing the dislocations on port communities [1]. Satellites terminals are smaller than the terminals that they support, making them easier to develop. The land surrounding freight terminals is generally developed and carries a high land value; therefore in many instances considerable expense would be incurred by developers seeking to expand an existing terminal facility such as an airport or seaport. Intermodal facilities play an important role in transportation which is facing many challenges. The challenges facing the transportation sector include:

1. The growing demand for freight transportation and logistics services, and the ability of the physical and information infrastructure to meet these demands.
2. The sometimes seemingly contradictory goals of meeting freight transportation demand and sustainable transportation strategies.
3. The impact of information technology on goods movement, and the issues surrounding the integration of complex systems in order to increase, rather than impede, transport efficiency.
4. Development of the necessary “connectivity linkages” in a global supply chain in which transportation service providers will increasingly find themselves acting as both competitors and partners on an ongoing basis.

There are several ways to categorize intermodal facilities. This study focuses on freight mobility and does not consider passenger intermodal facilities (e.g., bus stations). A Transportation Research Board guide [7] to intermodal facilities categorized various types of freight facilities by their function:

- Distribution Centers
- Ports
- Intermodal Terminals
- Bulk or Transload Terminals
- Hub Terminals
- City Terminals
- Integrated Logistics Center or Freight Village

The freight village model is popular in Europe and has started to garner attention in the U.S. The New York Metropolitan Transportation Council recently commissioned a freight village feasibility study. Rather than the often serendipitous freight cluster development that is prevalent in the U.S., freight villages are planned distribution, logistics, and warehousing communities built around intermodal hubs with the expectation of exogenous growth. An example of a rural freight village is Promachon on the Greek-Bulgarian border. This program was launched in 2001 and has become the economic basis of the region [8]. The area has attracted retail, warehousing, banking, insurance, hospitality, and transportation related businesses. This study focuses on one type of facility, rail-to-truck intermodal, designed to handle containers. This facility is an option for South Mississippi along the KCS Gulfport to Hattiesburg rail line.

For this study, we are examining sites that function as intermodal terminals located either near a water port or inland. Various nomenclatures are used for these types of facilities. Terms used to describe facilities that handle containerized cargo transfer between modes includes inland port, dry port, container freight station, inland freight terminal, container freight station (CFS), and intermodal freight center (IFC). For the purposes of this study, we will use the term intermodal freight facility (IFF).

An Intermodal Freight Facility (IFF) is a component of the cargo transportation network wherecontainerized goods are transferred from truck-to-rail and from rail-to-truck.

LOGISTICAL IMPACT OF INTERMODAL FACILITIES

Reduction of Congestion

Intermodal facilities strategically located to directly support the operations of a seaport, rail terminal, or airport reduces the number of trucks hauling freight on highways and interstates in the surrounding region. In the current operating environment, freight is received in a central location, a port or large intermodal rail terminal, and then widely distributed via truck. This results in large freight volumes moving in congested urban areas in all directions from large terminals resulting in significant congestion on routes radiating from the ports and terminals. This is important when one considers that heavy trucks cause a greater degree of congestion than passenger cars. For example, the 35,000 truck trips per day at the ports of Los Angeles and Long Beach routinely clog the Long Beach Freeway and other arteries. A study by Washington State Department of Transportation and Washington State University (2012) found that nearly 60 percent of the over 1,000 freight-dependent businesses surveyed indicated that increases in costs due to congestion would be passed on through to the consumer by raising prices on goods and services.

In Gulfport, the watchdog group, the Steps Coalition has raised concerns about the port expansion, which they claim will increase truck traffic of up to twenty times the present amount going through Gulfport. They noted the planned Port Connector Road is slated to carry 60% of the truck traffic from the port to I-10 and highway 49, while the remainder of the traffic will go to highway 90 and other local roads. They have raised vocal concerns about the air pollution and traffic congestion from the truck traffic from the port.

Potentially congestion can be reduced by modifying the supply chain to ship freight from the port and ship containers to an inland port facility via rail. Movement by rail removes many trucks from highways and interstates thereby reducing the amount of roadway congestion. According to the American Association of Railroad, freight trains are capable of carrying loads equivalent of 280 trucks in a single haul making space for 1,000 or more passenger automobiles. Freight rail advocates argue that increased rail freight movement significantly reduces highway infrastructure maintenance and expansion costs. In addition to reducing infrastructure costs, decreased congestion could result in billions worth of savings in travel time and fuel consumption. According to the Texas Transportation Institute, travelers wasted a total of 4.2 billion hours on travel time and 2.8 billion gallons of fuel annually. Figure 2 shows the waste of time and Full from 1985 to 2007

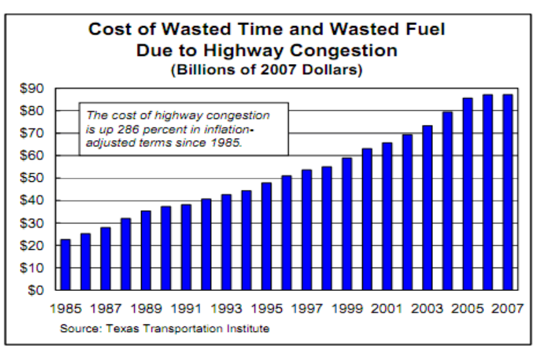

Figure 2: Cost of Wasted Time and Wasted Fuel (AAR, 2010)

Modal shift from truck to rail can result in significant benefits to the overall transportation system by reducing congestion and overcoming capacity limitations on the U.S. highway network. Effective uses of multimodal shipping options can alleviate capacity constraints and improve cost performance and reliability of freight transportation. Rail transportation and water transportation offer competitive advantages to moving freight over road transportation. Mississippi can take advantage of water transportation (Barge) for some of its routes since the state is surrounded by the either natural or manmade waterways. Water transportation not only provides cost per ton-mile advantage but also has lesser impact on the environment. Table 1 compares the Cost, Fuel Consumption, Hydrocarbons, CO and NOx emission of three transportation modesl.

Table 1: Freight Modes Compared (per ton-mile) (*TR NEWS*, 2002)

	Costs	Fuel	Hydrocarbons	CO	NOx
Units	*Cents*	*Gallons*	*Lbs.*	*Lbs.*	*Lbs.*
Barge	0.97	0.002	0.09	0.20	0.53
Rail	2.53	0.005	0.46	0.64	1.83
Truck	5.35	0.017	0.63	1.90	10.17

Improved Freight Velocity

A major attribute of intermodal facilities is that they can increase the velocity at which high volumes of freight move through a given terminal or facility. If freight moves quickly through the transfer process, there is a potential for higher annual capacity. Therefore, the most promising place that overall system efficiency can be realized is within the intermodal facilities themselves. In the case of seaports as much as half of the space in most container berths is devoted to consolidation and storage above and beyond the immediate needs of vessels loading and unloading [1]. Removing these activities from terminals, especially in the case of seaports, would allow for reconfiguration of existing sites with potentially large gains in throughput capacity. Figure 3 shows a ship at during the loading operation.

Figure 3: Sample Loading and Unloading of Containers at the Seaport

The current waste in capacity is due, in large part, to the capacity constraints placed on ports by truck access limitations. Access at major port terminals has become problematic due to congestion and, in many cases, capacity expansion to accommodate truck traffic to service additional volumes is not an easy option [9]. In addition to the accessibility problems of many ports, current law mandates that trucks are able to haul loads up to 80,000 lbs on most highways and interstates. These two limiting factors can have serious implications on the time for freight to move through the supply chain. Relocating freight from the area of port operations to inland facilities reduces the operational bottlenecks resulting from the overlap of high freight import and export volumes. Additionally, highway development costs are less expensive near hinterland facilities. In many cases, port expansion is very difficult because existing ports are congested, over capacitated, and adjacent land is very expensive. Conversely, capacity expansion and building infrastructure is less costly near inland intermodal facilities.

Efficient Customs Handling
When cargo enters a freight terminal from a foreign country, it must go through a prescribed series of steps in order to be cleared for transport and delivery. These steps include: valuation of goods, verification of company information and freight, payment of duties, and physical inspection. All of these processes accumulate non-value adding time in transport and can take anywhere from a couple of hours to several days, depending on the amount of freight waiting for inspection. U.S. Customs and Border Protection clearance can take anywhere from 1-3 business days for air freight and 3-5 business for ocean freight. If freight is selected for intensive inspection the customs clearing process could increase by an additional 5-10 business days. Satellite terminals offer the opportunity for bonded freight to move through a terminal without being inspected until it reaches an inland or adjacent satellite terminal. This process simplification improves efficiency and speed of time critical deliveries [10]. The customs clearing process requires that freight wait for its inspection and clearance on the docks. This space could be devoted to more economical uses if customs clearing procedures were located in inland port facilities.

Enhanced Security
The current global political environment has required companies to step up efforts for increased security of freight shipments. The U.S. and European Union (EU) have increased cooperation efforts to ensure minimum security requirements are met by participating seaports. Initiatives such as U.S.-EU Customs Agreement (2004) have established information exchange networks, setting minimum security requirements for participating seaports, and identifying the best methods for preventing terrorist attacks within the global supply chain. This accord seeks to improve security by ensuring (1) that customs procedures and legitimate trade take security into account and (2) that equal standards apply to both U.S. and EU transport companies [11]. In addition to global efforts for risk mitigation, the Federal Highway Administration (FHWA) has aggressively researched technology to improve freight identification method and increase freight security while in transit. They have tested a number of technologies for future application to include: Electronic Supply Chain Manifest (ESCM), electronic seals, and asset cargo tracking software. These efforts to increase freight security will have several implications for inland port terminals. Inland ports will need to provide adequate security to ensure that cargo and personnel are properly protected while within the confines of the facility. Port officials will need to partner with the appropriate governmental security agencies, such as the Transportation Security Agency and Department of Homeland Security, in order to establish security procedures and protocol.

Since 9/11 there have been calls to inspect 100 percent inspection of all inbound cargo containers for weapons of mass destruction. A RAND study concludes that 100 percent inspection would be warranted only if the threat of damage from potential terrorism was quite high [12]. Another view is that 100 percent screening would be expensive and impractical, not in keeping with the threat and seen as more costly than the potential risk.

The trend in maritime ports is to establish satellite terminals in the hinterland to avoid congestion in coastal areas, the high cost of coastal land, and increasing levels of pollution near the ports. These facilities serve many of the functions traditionally conducted by ports including custom clearance, consolidation, warehousing, and inspection. However, the security and preparedness of these cargo handling facilities, as opposed to the major maritime ports, is uneven. As one security official pointed out, "For the majority of facilities we deal with, we are back in the stone age. Predominantly, the only tools we have at our disposal are lights, fences, locks and general employee vigilance" [13].

Numerous inland ports currently serve major ports and many more are being developed. An example of an existing facility is the Virginia Inland Port located 220 miles from the Port of Norfolk. Examples of satellite facilities being developed include inland ports for the Port of Gulfport, the Port of the Everglades, and the Port of Savannah. There are various management models for these inland ports including being led by port authorities, private land developers, and carriers such as railroads, but all of them face similar security concerns.

There are examples of advanced technology and sophisticated command centers in place for some facilities. The Lazaro Cardenas-Kansas City Corridor Security Screening process is an example where shipments are pre-screened in the foreign port and the shipper is sent advance notification to Mexican and American

Customs with the corresponding “pre-clearance” information on the cargo. Upon arrival in Mexico, containers pass through X-ray and gamma ray screenings, allowing any containers with anomalies to quickly be removed for further inspection. Container shipments are tracked using intelligent transportation systems (ITS) including global positioning systems (GPS) or radio frequency identification systems (RFID) and monitored by the ITS on their way to inland intermodal facility in Kansas City. Union Pacific's Salt Lake City Intermodal Terminal has eight-foot security fencing, remote camera system and lighting to provide a secure, theft-resistant environment for customers' cargo while at the terminal. It also has an Automated Gate System (AGS) with biometric technology employed to expedite ingate/outgate process. These security investments are becoming necessary to ensure customers that their cargo is safe and meet homeland security requirements.

A secure inland port would allow containers to be:

1. "Sealed" as they are offloaded in maritime port
2. Transported via a secure rail to the hinterland facility
3. Offloaded from the rail line in a secure yard to line up for customs
4. "Un-sealed" and released to be loaded onto rails and trucks for transportation elsewhere

In conjunction with this there would need to be

1. A terminal for container scanning and sealing in the maritime port
2. Sensors along the tracks to detect tampering
3. A secure rail yard with matching container scanning technology and customs office
4. A command and control center that links the inland port to the main maritime port
5. Coordination with local law enforcement
6. An educational program to compliment the new corridor

The enhanced freight security presents challenges and opportunities for IFFs that serve sea ports.

Improved Connectivity (Network Analysis)

Strategically placed intermodal hubs provide an opportunity for companies to meet the demand of the market place with flexibility. Companies are able to choose the most efficient modes or combination thereof for transporting goods to customers depending on the shipping requirements. The availability of multiple modes can facilitate more frequent, faster, more reliable, and competitively priced services [10]. This concept becomes critical as manufacturers are increasingly shifting to a time sensitive inventory systems, such as Just-in-time (JIT). JIT is a common production part supply model used to provide the right quantity of quality parts to the assembly line at the right time and in the exact sequence required [14]. Inventory systems such as JIT minimize the amount of inventory on hand for manufacturers and distributors. Minimum inventories on hand emphasize the need for concise shipment timelines and provide only a slim margin for error. Therefore, shipping companies must improve their processes to consolidate freight shipments from far reaching ports of origin. Intermodal hubs serve this function by consolidating flows from the same origin with different destinations with those freight flows that have different origins but the same destinations [15]. Greater supply chain connectivity allows for companies to consolidate and ship freight by most cost effective means.

Intermodal Facility Location

The Transportation Research Board (TRB) has sponsored several projects addressing critical issues in freight transportation. One that is particularly pertinent to this study is the National Cooperative Freight Research Program (NCFRP) Report 13, Freight Facility Location Selection: A Guide for Public Officials [16]. This report addresses location selection criteria, location screening process using those criteria, and the impact of best selection on the economy. As mentioned earlier, a careful selection of an intermodal facility can influence its maximum logistical and economic impact. Intermodal facilities are capable of providing significant economic benefits for companies operating such facilities. However, the selection of facility location is a critical matter for maximizing these benefits. Critical criteria for site selection include cost-to-benefit ratio, environmental impacts, and material flow densities. Potential facility locations must have a combination of assets available in order to provide an ideal location for an intermodal hub facility.

According to NCFRP Report 13 and Poist and Walter study [17], the ideal intermodal facility location must have the following:

- Adequate transportation infrastructure,
- Proximity to primary markets,
- Geographic advantage,
- Presence of larger freight shippers
- State-of-the-art information infrastructure,
- Permitting and regulations
- Adequate support from the surround community to foster growth and propel the facility and surrounding location into further development.
- Highly skilled logistics personnel, which are often found near U.S. military bases, are another consideration.

There are a variety of models for determining the optimal location for intermodal hub locations. The first of which is the agent based model developed by Ferreira, et al. [18]. This model is based on the assumption that location of intermodal hubs is a critical factor in operations success. The agent based modeling theory combines the interest of four dominant agents, namely, hub owners or operators, transport network infrastructure providers, hub users, and communities [18]. Bergqvist and Tornburg [19] approach intermodal hub site selection by combining the interest of public and private entities by focusing on the economic and environmental (noise and vehicle emissions) interests of each. Their approach to site selection focuses on maximizing cost saving benefits while minimizing the environmental impact of the surrounding populous. Ishfaq and Sox [20] derived a purely mathematical model for multiple hub site location. The prevailing themes throughout the models are that investors need to carefully consider the method and desired end results when selecting locations for intermodal hubs. Companies must be careful to maintain the delicate balance of cost effectiveness, efficiency improvement, and environmental concerns.

An example of the types of requirements to be considered in establishing an intermodal hub is given by the process followed by the Norfolk Southern Railroad when they were looking to establish an intermodal facility along the Heartland Corridor in Virginia [21]. These requirements included:

- The railroad needed to be able to build the facility within their budget of $18m, assuming that Virginia would cover another $25m for connecting infrastructure.
- The site needed to be a good railroad location along the east-west rail corridor, not degrade other rail traffic, and have potential to take truck traffic off the highway.
- It needed to be easily accessible to an interstate.
- The railroad wanted 65 flat acres of land and the acreage needed to allow a continuous track contiguous to the main rail line.
- It needed to avoid congested areas, have minimal blocking of grade crossings, and minimize road improvements.
- The region needed the potential of supplying a sufficient balance of imports and exports.
- Finally, the intermodal facility needed to be an effective distance from the port to make rail economical over truck.

Similar site selection criteria were used by NS to select its East Tennessee Terminal: Adjacent to the main line

- Flat or gently rolling and minimally developed land
- Minimal highway/rail grade crossings
- Convenient access to Interstate highways
- Expansion potential for additional economic development

There are several locations that meet all of most of these criteria in the South Mississippi region. Specific types of intermodal facilities have additional requirements. Inland ports or dry ports are intermodal facilities designed to service a maritime port from a hinterland location. They are designed to avoid the bottlenecks that arise from trying to position incoming and outgoing goods near the maritime port. The goal of an inland port is to achieve maximum efficiency for freight cargo by avoiding or bypassing congestion associated with the adjacent roadway and rail systems linking to seaports. These intermodal facilities are typically connected by a dedicated rail line that originates on-dock at the container terminal. The location criteria for these facilities include [22]:

- Market proximity to at least 3 million people within 200 miles.
- A major, direct connection to an American seaport via a Class I railroad. This rail corridor forms the "stem" of the coastal port/inland port barbell, as dedicated container trains—often comprising upwards of 250 double-stack cars—run steadily between the two locations. Some inland ports primarily serve one corresponding seaport, using one Class I railroad.
- FTZ status and privileges.
- An abundance of reasonably priced commercial real estate for warehousing and distribution, relative to the East and West Coasts.
- An overall governing body or at least a consortium of stakeholders collaborating in a cohesive management plan for the overall effectiveness of the inland port.
- A state and local government climate that is enthusiastic about inland port development, and willing to offer strong incentives to participants.

Examples of these inland ports include Dallas/Fort Worth, Chicago, Kansas City, St. Louis, Atlanta, Memphis, Inland Empire, Columbus and Charlotte.

Physical Characteristics of Intermodal Facilities
The physical characteristics of intermodal facilities are directly related to the operations that they support. There is no cookie cutter solution to the optimal design of intermodal hubs. The design must be catered to each specific location and provide adequate infrastructure to accommodate the desired increases in capacity. The Memphis BNSF Intermodal Facility is designed specifically to facilitate the transfer of freight from rail to truck. It features a 6,000 square foot operating building and 32,000 feet of rail for unloading and loading operations. Four inbound lanes serve as an access point by road with an accompanying two lanes for outbound traffic. The terminal is situation on 250 acres in the City of Memphis. There are other facilities in the Memphis area operated by the CN/CSX, the UP, and soon the NS.

Figure 4: Memphis BNSF Intermodal Facility

An example of the infrastructure requirements for an intermodal facility dedicated to the transfer of freight from plane to train in the Global Logistics Park facility located at the Port of Huntsville, Alabama. This facility was recently expanded to 300,000 square feet of receiving, storing, and distributing facilities. The Port of Huntsville performed roughly 40,000 freight rail lifts and handled more than 300 million pounds of freight cargo in 2009. These two examples show why modern intermodal facilities are among the most space-intensive consumers of land in metropolitan areas [23].

The Port of Huntsville and the Memphis BNSF Intermodal Facility are examples of large scale operations that require massive amount of investment capital. In contrast to these massive infrastructure investments, the Virginia Inland Port (VIP) in Front Royal, Virginia boasts a simple three door cross-docking facility located on 161 acres roughly 220 miles from the coast of Virginia. Another intermodal complex that is similar to the VIP is the Port of Quincy in Washington State. The Port of Quincy site is a mere 16 acres with 8,000 feet of storage track and three rail tracks cutting through the site. Facilities like the VIP and Port of Quincy show that intermodal facilities do not have to be built on a grand scale to impact the freight capacity of port within their vicinity.

The size of the intermodal facility depends primarily on volume of freight pass through the facility, value added activities in the facility, freight village presence, location costs of facility, and other related factors. Some of the US intermodal facilities are very large (more than 1000 acres) and many of them are more modest (less than 50 acres). The average size of US intermodal facility is around 100 acres. Table 2 shows the size of some US intermodal facilities.

Table 2: Intermodal Facilities Used for Benchmarking.

Facility	City	State	Size (Acres)
Port San Antonio (Kelly USA)	San Antonio	TX	1,900
Port of New York and New Jersey	New York	NY	1340
Rochelle Global III Intermodal Terminal	Rochelle	IL	1200
(BNSF) St. Paul Intermodal Facility	St. Paul	MN	600
UP: Joliet Intermodal Terminal (Illinois)	Joliet	IL	550
CSX Intermodal terminal in Fairburn	Fairburn	GA	500
UP: San Antonio Intermodal Facility	Von Ormy	TX	300
Hillsborough Compact Freight Village	Hillsborough	NJ	260
BNSF Intermodal Terminal	Memphis	TN	250
Rickenbacker Intermodal Terminal	Columbus	OH	250
CSX Intermodal terminals in Jacksonville	Jacksonville	FL	250
UP: Salt Lake City Intermodal Facility	Salt Lake City	UT	240
UP: ICTF (Long Beach)	Long Beach	CA	233
Virginia Inland Port	Front Royal	VA	161
NS-Savannah Intermodal Container Transfer Facility	Savannah	GA	160
CSX Intermodal terminals in Orlando	Orlando	FL	157
CN's Memphis Logistics Park	Memphis	TN	155
CSX Intermodal terminal in Savannah	Savannah	GA	100
CSX Intermodal terminals in Nashville	Nashville	TN	62
CSX Intermodal terminal Atlanta-Hulsey	Atlanta	GA	60
Port of Montana	Butte	MT	55
CSX Intermodal terminal in New Orleans	New Orleans	LA	50
NS-Simpson Yard	Jacksonville	FL	50
CSX Intermodal terminals in Tampa	Tampa	FL	46.8
UP: Tacoma South Intermodal Facility	Tacoma	WA	40
CSX Intermodal terminal in Charleston	Charleston	SC	40
Auburn Intermodal Facility (Maine)	Auburn	ME	35
Somerset Rail Park	Ferguson	KY	34
CSX Intermodal terminals in Memphis	Memphis	TN	30
(BNSF) Alliance Intermodal Facility	Haslet	TX	30
Stark County Neomodal Terminal	Stark County	OH	28
CSX Intermodal terminal in Charlotte	Charlotte	NC	21
Charlotte Inland Terminal	Charlotte	NC	16
Port of Quincy Intermodal Terminal	Quincy	WA	16
Port of Pasco Intermodal Terminal	Pasco	WA	15
CSX Intermodal terminal in Mobile	Mobile	AL	10

ENVIROMENTAL IMPACT

Air quality is impacted by a combination of several transportation-related factors including the amount of traffic, type of fuel used, and vehicle emission rates. The safe acceptable levels of air pollutants present in the atmosphere are regulated by the U.S. Environment Protection Agency (EPA). The EPA, under the federal Clean Air Act, has identified multiple air pollutants that are detrimental to overall public health and the environment. These pollutants include but are not limited to: carbon monoxide (CO), lead, nitrogen dioxide (NO2), particulate matter, ozone, and sulfur dioxide (SO2). These pollutants are the byproduct of combustion fuels such as coal, natural gas, diesel, and gasoline. Pollutants are directly correlated to fuel efficiency. The more energy required to fuel a combustible engine the more harmful pollutants that are emitted into the atmosphere. If an area has levels of any of these six pollutants that are too high for public health, the EPA mandates that states implement a pollution reduction plan to bring the pollutant levels back to a safe level. Considerable costs could be incurred for implementation of such a plan. A 2011 UCLA study of the 150 acre Long Beach Intermodal Container Transfer Facility (ICTF) determined it was the state's fourth most polluting site and that the 750,000 containers handled in 2008 emitted 24 tons of diesel soot [24]. Adjacent neighborhoods had a cancer rate of about 1,200 per million, some 4,500 times higher than federally "acceptable" rate of 25 per million. The study also found that $400 million in improvements including replacing on-site diesel-powered cranes with electric equipment and improving truck traffic flow would reduce total emissions by 75%. Thus pollution is a consideration for these facilities, but proper design and advanced equipment can significantly mitigate the situation.

Rail and waterborne transportation modes are more energy efficient than trucks and overall energy consumption can be reduced by shifting goods truck to rail or ship. A Texas Transportation Institute study [25] found that a rail car would move one ton of cargo 478 miles per gallon of fuel compared to a truck only 150 miles.

According to EPA data, in 2006 total US greenhouse gas emissions were over 7,000 teragrams of equivalent CO_2 (Tg CO_2 Eq.), with transportation accounting for 28% of the total as shown in the following figure (Association of American Railroads, 2008). Among all modes of transportation railroad is accounted for 2.6% of greenhouse gas emission and waterborne freight is accounted for only 1.5% of greenhouse gas emission as shown in figure 5 and table 3.

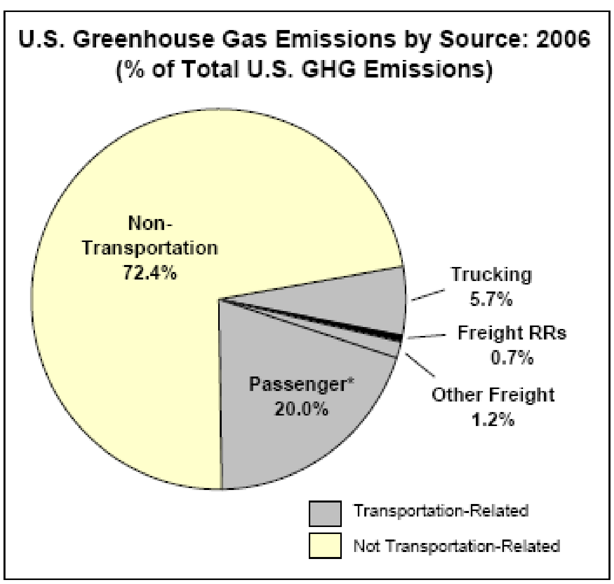

Figure 5: US Greenhouse Gas Emissions in 2006 by Source

Table 3: US Greenhouse Gas Emission in 2006 from Transportation Industry by Modes

U.S. Greenhouse Gas Emissions from Transportation: 2006		
Economic Sector	Tg CO2 Eq.	% of Total
Trucking	404.6	20.8%
Freight Railroads	**51.5**	2.6%
Waterborne Freight	30.2	1.5%
Pipelines	32.4	1.7%
Aircraft	157.4	8.1%
Recreational Boats	17.4	0.9%
Passenger Railroads	6.4	0.3%
Pass. Cars & Light Duty Trucks	1,236.9	63.5%
Buses	12.5	0.6%
Total	1,949.3	100.0%

The uses of satellite intermodal facilities mitigate the pollutants within the areas adjoining freight terminals by reducing the number of trucks on the road. Fewer trucks on the road imply that fewer pollutants are being emitted into the atmosphere as a byproduct on combustible fuel consumption. In 2008, the City of Shafter, California commissioned an air quality study to measure the impacts of a proposed intermodal facility located within the San Joaquin Valley Air Basin. The results showed that air quality was significantly improved with the utilization of an intermodal facility. This immediate improvement in air quality was due to the reduction of freight shipments originating at several California ports from 600 trucks to two trains per day moving through the valley. Figure 6 shows the impact of consolidated shipments on pollutant emissions.

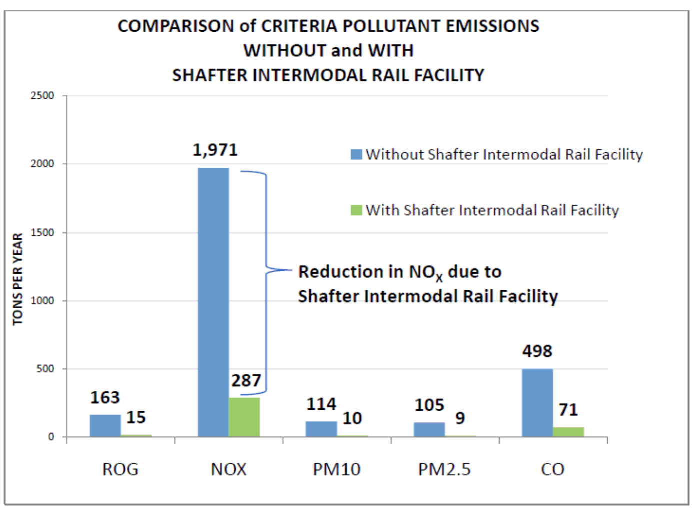

Figure 6: Intermodal Facility Study (WZI, Inc., 2008)

Noise Pollution

Noise pollution is considered any sound that is disturbing or unwanted. This is an important concern to communities surrounding intermodal facilities that may have multiple modes of transportation operating within a relatively small area. The majority of regulation responsibility lies with state and local governments. All Federal regulation established by the Noise Control Act of 1972 and Quite Communities Act of 1982 remain in effect. The Federal Transit Authority (FTA) has established criterion for the assessment of noise within a given community. FTA regulation sets aside categories of noise sensitive properties that could potentially have an impact on intermodal facility operations. These criteria establish acceptable noise and vibration levels for each category. These guidelines should be consulted in order to ensure that all proper noise and vibration requirements are met for communities surrounding intermodal facility operations.

Destruction of Marshland or other Natural Resources

There are two levels of regulation for the protection of marshlands and other natural resources that must be considered by developers of intermodal facilities: State and Federal regulations. There are five separate federal government entities that are charged the responsibility of protecting wetlands and other natural resources: U.S. Army Corps of Engineers, EPA, U.S. Fish and Wildlife Services, the Natural Resources Conservation Service, and National Oceanic and Atmospheric Administration. These government entities serve to identify and govern the protection of the natural resources through regulations such as Section 404 of the Clean Water Act. Prior to site selection for an intermodal facility, it is critical for decision makers to identify and address any issues regarding wetland/marshland protection that may apply to the development of land.

Water pollution is an additional concern. Lawsuits by the states of Washington ,Montana, Idaho, North Dakota and others against BNSF for diesel spills at fueling depots addressed environmental issues related to fuel entering the water supply at locations where refueling is conducted. The large amount of paving associated with the construction of an intermodal facility affects the hydrology of an area. Provisions must be made to insure that an adequate storm water system is in place. A lawsuit filed by environmentalists seeking to block construction of a rail and truck freight transfer facility planned for Edgerton, Kansas was directed at these concerns.

Environmental Review

Intermodal facilities are often owned by privately-held railroads and are not as likely to require federal permits and funding as highway projects, and in the past have not tended to trigger National Environmental Policy Act (NEPA) reviews. However, the railroads have begun to take advantage of government funds so these projects can require a variety of NEPA documents including a Categorical Exclusion (CE), an environmental assessment (EA) or an environmental impact study (EIS). An EA briefly provides sufficient evidence and analysis for determining whether to prepare an EIS.

In the summer of 2011, Burk-Kleinpeter, Inc. (BKI), Brown & Mitchell, and HDR engineering conducted the environmental assessment for the KCS $70m upgrade of the line from Gulfport to Hattiesburg to be completed by 2016. They based their assessment on 8 trains per week and found little negative impact. They found that the regional air shed might actually improve by taking trucks off the road. Existing right-of-way had no impact on wetlands. Noise (i.e., wayside, locomotive, and horns) might actually decrease because trains will move faster. The study found traffic impacts to be severe at only one location (Landon Road near Gulfport). MDOT is doing its own Crossing evaluation project. It is important to note that this study area stopped short of Hattiesburg and did not consider the establishment of an intermodal facility.

Utilization of Green Technology

Many new facilities utilize the latest in gate and terminal automation technology, which shortens the waiting time for trucks entering the terminal, thereby reducing exhaust emissions and improving truck driver productivity. Additionally, state-of-the-art, low-emission cranes help reduce environmental impacts. BNSF has adopted electric wide-span cranes at several intermodal facilities that produce zero emissions on site while generating power each time they lower a load. The wide stance design of these new cranes eliminates as many as six diesel trucks (hostlers) for shuttling containers within the intermodal facility, reducing emissions and improving fuel efficiency. In addition to using new ultra low-emissions, EPA-certified diesel switch locomotives, idle-control mechanisms installed on locomotives reduce air emissions and fuel consumption by automatically shutting down locomotives that are not being used**.** CSX adopted Tideworks Technology, a provider of terminal management and planning software solutions for its operations at its Northwest Ohio intermodal terminal to maximize efficiencies. The 500 acre site promotes its use of cutting-edge technology and green designs, including ultra-efficient electric cranes that lower emissions, optical scanners that reduce truck idle times, and automated car tracking technologies and remote switches that increase operational efficiency. CSX has invested $175 million in the facility that employees more than 200, will service 800 trains per week, and handle an estimated 2 million containers annually.

It is not just the equipment that is incorporating green technology. BNSF's proposed Kansas City Intermodal Facility (KCIMF) will also feature LEED certified buildings. The CSX Baltimore-Washington Rail Intermodal Facility will be developed with alternative energy sources, directional lighting, and the latest in storm water management practices. The NS Birmingham Regional Intermodal Facility was selected to participate in the Sustainable Sites Initiative (SITES) pilot program, a national initiative that seeks to establish and encourage sustainable practices throughout each phase of a landscape's design, construction, operation, and maintenance periods. Green is being incorporated in all aspects of the IFFs.

It is predicted that many new intermodal terminals will move to denser operations and use stacking cranes instead of placing containers on chassis in vast parking lots. Denser, stacked terminals will require different operating systems, including graphical planning and management software for stacked containers, an effective system for tracking containers and equipment, and a system for automatically sending work orders and confirming that the position of moved containers is accurately recorded to operate efficiently.

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