

Next Generation Intermodal Roadmap



A white paper addressing
security and efficiency
improvements within
intermodal transportation

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Introduction

The information technology revolution and increasing market pressure for real time shipment locations, lower prices, and quicker and more accurate delivery time windows has provided concrete goals that the transportation industry must reach.

This paper highlights points of efficiency gain at the various levels of a container's movement, resulting from modifications at the container, ocean vessel, port, rail yard, freight train, and trucker levels. Restructuring the convoluted container transportation process into a dynamic system of unified parties will provide the shipper and consignee increased supply chain visibility and additional corporate profits from decreased cost and increased container volume. The additional benefits of a seamless transportation system would include theft deterrence and stolen goods recovery. Currently, estimates of annual cargo theft are \$30 - \$50 billion.¹ Leaving this problem unchecked will result in higher insurance costs and lower profits and continue to hamper an economic resurgence.

Following the current trend towards paperless international trade, where bills of lading and letters of credit no longer need to be mailed or faxed but can be transmitted via EDI or XML, containers must evolve to meet the automation demands of governments and carriers looking to minimize security gaps and maximize efficiency. The capital investment in revamping 20ft/40ft containers into "smart boxes" is long overdue in light of the rapid information technology revolution that has sped past the 1950's container model. With the establishment of a standard intelligent container, an intelligent supply chain infrastructure will evolve at all points of the shipment's journey, particularly at inter-modal and import/export transitions. The highest costs, in both time and money, accrue at these junctures due to the inter-party manual data transferal, which plays host to errors, security holes, and other transportation retardants. By removing these sources of delay, transportation will decrease labor, insurance, and time costs.

In the end, the system, whose visibility will extend beyond the freight train or NVOCC and focus on individual containers, will become a seamless process where transportation time will become limited only by the speed of the vehicle.

The Container

In developing the next generation of transportation systems, the initial focus must rest upon the new container design, as this architecture will guide the development of the macroscopic systems present at ports and rail yards. The container itself will constantly monitor security, environmental conditions, transportation information, times, and such data while immediately reporting any aberrations to the closest authoritative system (ship, port, train, rail yard). Authorized handheld devices can retrieve the contents and status of each container at close range, while larger systems can search an entire ship or yard for a specific container based on an electronic identifying radio frequency.

Upon sealing of the container for shipment, an internal diagnostic check executes a container wide examination:

- Electronic seal
- Impact sensor
- Container hull damage
- Temperature, humidity, barometric pressure
- GPS
- HAZ
- B/L and routing data

Depending on the status of the diagnostic check, an external light will adjust its color to signify a successful check or a problem with one of the system tests. Any warning lights will result in an investigation by one of the handheld or yard wide scanners. A warning light check will also occur at any point of ownership transfer, which, in the event of a problem, narrows the area of responsibility to the party with current ownership. Should onboard sensors note rapid changes in any environmental or unauthorized seal breaks, the warning light will turn on and flag the container as tampered. Any second party

¹ ICCs International Maritime Bureau, 20 July, 2000

should refuse receipt of a flagged container, unless they wish to bear complete liability for any damage to the container or goods within.

Several implementations of ownership transfer are possible, but are beyond the scope of this white paper. It is sufficient to state that electronic ownership transfer occurs after a valid diagnostic check, and that only the computer systems of the newly authorized owner group can access the container's data log once transfer is complete.

Designing a robust container requires insight into various issues, but it is undoubtedly feasible. Creating infrastructure systems that seamlessly communicate with one another and any other container on the market presents a more daunting task. This includes any of the medium size systems on trains or ships and the larger systems at port, rail yards, and airports. At these larger locations, numerous complications and incompatibilities will emerge between existing systems and layouts that will force tailored implementation for yard based systems. Maintaining the interoperability of the trucks, boats, and rail with their respective yards represents one of the larger challenges in construction of a nationwide and global intermodal transportation network.

Ship

Containerized shipping has continued to expand at unprecedented rates and has fueled the design of vessels with capacities hitting 15,000 TEU. It is unlikely that this growth will subside in the future. A smart container system, in which a shipman can monitor the state of each container from a centralized point, reveals the value of active container management.

At the loading port, each crane reassigns container ownership to the carrier it is currently loading, so that once at sea, the crew may easily check status of all the present containers without physical examination. As stated before, if an illicit container opening occurs, the container may signal the ship or be signaled by the ship through a radio ping. However, due to the

high concentration of metal, this radio signal may not penetrate the top level of containers. To remedy this problem, each smart container must be capable of relaying the ping to the containers beside it and below it. As such, the ship initiates a chain reaction of pings between the levels of containers stored above and below deck. The located container acknowledges location and status, and responds following the initial locator signal path.

Port

With so few national access points that can handle massive quantities of containerized cargo, enabling ports to unload and stack containers rapidly decreases the delay and systematic uncertainty for consignee delivery dates and times. In addition, by installing a cargo moving system, not as closely dependent on unionized labor and clumsy lifting equipment but precise in its movements, U.S. ports can use high-speed positioning of containers and prevent unnecessary holdups.

Track System

The primary modification to the port landscape will be the addition of an AGV rail-based container movement system (see Figure 1). Each container sits atop (or hangs from) a platform that carries it around the port at high speed. Rail tracks enforce

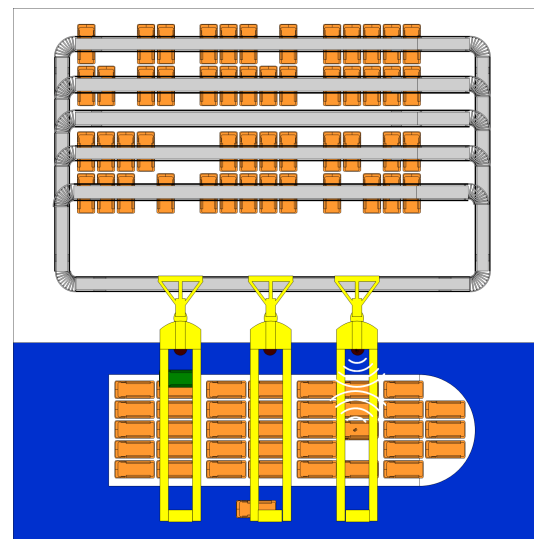


Figure 1

the alignment between container and carrier platform and alleviate the time wasted by lining up boxes with chassis. The platform follows the container's ping signal and adjusts position dynamically below the lowering spreader, stopping exactly underneath. By ensuring consistency in the platform positioning, cranes can lower freight at higher velocities, decrease the time to (un)load a ship, and allow ports to service more ships per day.

The tracking layout covers the entire port facility and so dispenses with the standard roadway environment of trucks moving between the dock and stacks. Carrier platforms circulate at high speeds throughout the container yard without endangering the safety of any personnel or loading vehicles that would normally cover the dockside. These platforms slide among the stacks and regroup at a one-track queue, where they wait in line for a crane to lower the next container. When the time comes to load a vessel, the port reverses the direction of movement and the platforms deliver freight to the loading crane.

With such a track system, there can be two possible implementations: 1) in-ground rail and 2) elevated tracking. Though both will accomplish the movement tasks, it is necessary to shed light on the specific design benefits.

In-ground

- Simple and relatively cheap to install in-ground rail tracks
- In-ground tracking is more stable, thereby allowing for faster cargo movement

Elevated

- Port does not lose real estate
- Stackers not required; in effect, one multi-directional gantry crane

Crane

Loading onto the ground may be easier with the track installation, yet ports still face the bottleneck created by crane unloading speed. Currently, container ships may take eight hours or more to unload, depending on weather conditions, the speed of the crane, and dockworker productivity. Unfortunately, weather control is a pipe dream. When

winds are over 45 mph, the increased container sway creates a hazardous environment for both dockworkers and cargo.

Cargo cranes of today have two particular weaknesses that inhibit the rapid unloading of ships: the first being that the cabling, when extended, provides flimsy support for lateral sway, and second that only one container may be lifted per trip. Significant time is lost due to these situations.

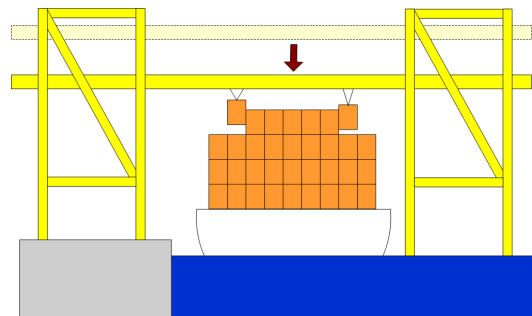


Figure 2

To address the problems, ports need to install a more flexible crane system with an adjustable structure (see Figure 2). Similar to a gantry crane, the main lifting truss spans the entire width of the vessel. Steel beams on the dock and in the bay support the structure. The spanning beam may move up and down, depending on the height of the ship's current container level, thereby minimizing the slack needed for the spreader unit to move. Of course, the decrease in up/down time will be a benefit, but more optimization possibilities exist. Instead of moving boxes in serial, a parallel approach can tremendously decrease the (un)loading time of a vessel.

For example, assume a standard crane can unload a box every 90 seconds (40 boxes/hour). Estimate that the decrease in slack time mentioned before will save 10 seconds (total time 80 seconds). Now say that this crane is able to run 5 spreaders on two parallel tracks by having them move out to the ship on one track and back to the dock on another. The port unloads five containers every 80 seconds or equivalently one container per 16 seconds (82% time decrease).

In addition to the mechanical crane modifications, the crane will interface with the container's ping beacon as the spreader lowers and adjusts its position for a clean grab. Not only is a radio connection between the crane and container simpler to implement than complex video alignment systems, but inclement weather will not affect the precision, and hence speed of lifting the container.

The unloading process begins before the ship docks. The ship transmits the final destination and routing information for each container, allowing the port to prepare for the ship's docking. Whether it needs to be placed onto a truck waiting at the gate or sent on a spur track to a railway yard, the container moving system has pre-planned the internal port routing, so that the cargo has the best chance of leaving the port on schedule.

The crane system lifts a container while verifying its electronic identification number with the one listed by the ship. Prior to each lift, the ship will release ownership of the current container via the onboard relay system, thereby allowing the lifting crane to accept ownership on behalf of the port. This aligns the physical ownership of a crate with that registered in the container's identification system.

Rail Yards and Trucks

As the development of this national information system progresses, the time differential between anticipated arrival and actual arrival will quickly decrease. Rail yards will have clearer visibility in both directions allowing them to optimize the freight order on trains. For example, a rail company assembles a train into sections by city and then by destinations within that city. In these situations, the rail carrier with a yard on a city's north side could detach a line of cars headed to the south side and hand the cars over to a rail carrier with a yard in that area. The key is having the cars ordered so that decoupling requires one or, at most, two connections to be broken. This example clearly illustrates one of the key benefits of a unified system: increased cooperation. Intermodal-transportation is an

inherently team-oriented business, and nurturing that unity produces cost savings.

Intra-rail collaboration, in particular using competing lines to "steel wheel" containers instead of trucks, decreases roadway congestion and the pollution from truck exhaust. In large port cities, like Los Angeles, and large rail hub cities, like Chicago, citizens and local officials will ardently support any program that decreases these externalities.

The information flow must also reach the end customers and the trucks that bring the cargo to those customers from rail yards and ports. These locations will forward a train's scheduled arrival time and the unloading time of the actual container to requesting freight forwarders and/or truck dispatchers, who in turn will alert the truck drivers about the precise gate time to expect containers. A truck notification system should transmit a simple, no frills message via e-mail or SMS (Short Message System) to the truck's cab installed message receiver.

Increases in railway punctuality will convert into better organization of a truck driver's daily schedule. Wait time at the rail yard gates for late trains and overcrowding of trucks will decrease. Upon pickup, the trucker will send a reply back to his dispatcher, which will inform the recipient of the cargo's precise arrival time. Through the increase in communication, all involved parties will minimize wasted time.

Most of the advances discussed in the previous Ship section will apply to trains and Port to rail yards. These advances will be overlooked with the intent of avoiding redundancy.

Conclusion and Closing Points

This system described has failed to gain agreement and adherence from the major transportation modes. The lack of leadership is preventing the assimilation of intermodal modernizing opportunities. The only entities with the legal power to engage a course of action leading to the improvements mentioned are the Departments of Transportation and

Homeland Security with the assistance of the United States' largest trading partners. A global plan of attack by the U.S. government ensures that this system will not face encumbrance from a myriad of competing technologies. These benefits and responsibilities span further than New York and Los Angeles, and therefore must include other nations' assistance. The U.S. Department of Homeland Security has taken the first steps toward increased security for our nation, but greater strides remain.

Security

Progress towards more efficient systems epitomizes the U.S. frame of mind, yet the government is equally concerned with preserving the status quo (i.e. stability and peace). After witnessing the acts of terror on September 11, 2001 and the ensuing destruction, it becomes necessary to ask if our current border checking processes are secure enough to prevent a conventional weapon from entering our country. The attacks of last September cost the United States \$40.2 billion. How much damage would a weapon of mass destruction cost our nation? Could our crippled economy take such a direct financial shock? Verifying the contents of the millions of containers that pass through U.S. ports is impractical, but electronically monitoring freight containers is well within U.S. Customs' abilities.

The Inevitable Change

Regardless of the benefits gained from a national/global information system for transportation, there will undoubtedly be protest. The longshoreman unions will express concern for their jobs and livelihoods, and understandably so. It is self-evident that these new systems will absorb, but also create new opportunities, and so this paper will not discuss this conflict of interest. More importantly, union workers should understand the force of international economics: the group operating with the lowest cost (highest efficiency) will lead the market and convince the remaining competitors to follow or expose them to economic extinction. Just view the supply chain industry, which has gone from regarding partners above and below in apathy to sharing data and providing supply visibility all the way back to raw materials' procurement. The cost savings compelled

suppliers to alter their strategies, and those that did not are most likely on the edge of their market, awaiting the final push from a competitor into bankruptcy. The change in transportation carries no less momentum, nor any less direction. Economic reform drives like a Mack truck: stepping on board is the only way to avoid being flattened.

When is the Time?

Some argue that the government should not increase the budget deficit past certain limits, because of the notion that owing money is not sound financial policy. To a degree, this is correct, but in the current economic state of the U.S., it is a dangerous assumption. The Federal Bank has attempted to jumpstart the economy by lowering interest rates in the hopes of stimulating more investment. For two years now, there has been little result.

Perhaps the correct solution is not enticing corporate investment through low borrowing rates, but direct investment by the U.S. taxpayer. A drive to redesign the intermodal transportation system will create numerous jobs and pour a significant dollar amount into an ailing economy. Due to the overarching reach of transportation, these benefits spread over many industries, such as construction, engineering, information systems, and shipping. With prices hitting lows, the cost of designing and implementing this infrastructure is well below the cost levels in times of economic strength. U.S. firms are starving for cash inflows and are willing to stretch their bills to cover more work than before.

The potential for growth in national security, corporate profits, transportation efficiency, and assisting economic recovery reflect the opportunity of intermodal redefinition. Throughout this paper, possible solutions to restraining problems have been addressed, but they are not the only answers. To find the best responses, a group wielding the authority to instill change and advised by transportation experts needs to take the reins. However, the two most critical questions remain. Who is to lead this evolution? When is the time?