

Attachment 5:
Supplemental Information on Supply Chain
Operations

Supplemental Information on Supply Chain

A5.1 SUPPLY CHAIN

International cargo is moved by a chain of businesses and individuals that stretches from the manufacturer or supplier to the consumer (which may be a manufacturer). In the case of maritime commerce, the key elements of the chain are the:

- **Manufacturer or Supplier** – Produces goods or raw materials and arranges for their sale, whether directly or through an agent. These entities are often referred to as “shippers”
- **Freight Forwarder or Consolidator** – Manages the logistics of freight transport, including preparing paperwork, arranging land and ocean transport, ensuring cargo security and integrity, arranging financing and insurance, preparing cargo for shipment, and coordinating other paperwork and inspections. Either the manufacturer/supplier or the forwarder/consolidator may be the direct purchaser of transportation services, and thus the “shipper” of a container
- **Steamship Line, Vessel Operator, or Ocean Carrier** – Supplies space on cargo ships, either on owned ships or through chartering space on non-owned vessels; operates owned vessels in regular (e.g., weekly) or unscheduled (“tramp”) services; provides shipping containers; and may provide loading and unloading services at marine terminals. Many steamship lines now operate in “alliances,” which are consortia of steamship lines coordinating their vessels and services
- **Origin and Destination Port** – Develops and maintains shoreside facilities including wharves, roads, railyards, and, in many cases, marine terminals in the harbor district; and develops and maintains channels, anchorages, and berths
- **Marine Terminal Operator** – Supplies stevedoring services to load and unload vessels; contracts with longshore, mechanic, and clerk labor; owns and maintains terminal equipment; provides cargo storage and logistic support services to shippers and other supply chain entities. Terminal operators are often private companies that are tenants of the port authority, but some are port authorities and some are subsidiaries of steamship lines
- **Labor Union** – Organizes and supplies labor to marine terminals, railroads, stevedore companies, some trucking firms, and various maintenance enterprises; recruits and trains labor; and negotiates wages and working conditions

- **Railroad or Trucking Company** – Accepts cargo from manufacturers and forwarders; provides and maintains rolling stock, motive power, and sometimes loading/unloading equipment; delivers cargo to warehouses and distribution centers. Railroads also build and maintain rail lines
- **Warehouse and Distribution Center** – Accepts cargo from railroads, trucking companies, and forwarders; delivers cargo to importers, wholesalers, and sometimes retailers; re-packages cargo for distribution or further transport (“transloading”); manages inventory; and coordinates delivery paperwork
- **Importer, Wholesaler, or Retailer** – Sells goods to retailers, wholesalers, or consumers, and is also a shipper; Walmart, Payless Shoes, and Toys-R-Us are examples of shippers who are both importers and retailers

The process of receiving the container begins three or four days before the vessel’s arrival when the shipping line sends an electronic manifest from the originating port to the U.S. customs office at the destination port. The manifest details the origin, contents, and destination of each container. Once U.S. Customs has cleared the vessel and its contents, the terminal’s longshore workers offload the container to the terminal’s container yard.

A5.2 VESSEL OPERATIONS

Modern containerships are huge: the average 6,500-TEU post-Panamax ship is nearly 1,100 feet long, 130 feet wide, and draws over 45 feet of water. The largest containerships, now the 13,500-TEU Emma Maersk is 1,302 feet long, 183 feet wide, and draws nearly 50 feet of water fully loaded.

Each shipping line generally calls at the Ports once a week. Because of demands by shippers, arrivals tend not to be spread out during the week, but rather are scheduled for those days that enable cargo to reach its inland destination at a given time. In the San Pedro Bay ports, the services tend to concentrate their ship calls near the end of the week. The dock cranes unload and load ships at an average rate of 25 containers per hour (some operators can move up to 40 per hour). The ships typically arrive on Wednesday or Thursday and depart on Monday or Tuesday.

A5.3 RAILROAD OPERATIONS

Intermodal containers flow from Asia into North America through nearly every port they can, although given their proximity to Asia the West Coast ports are the most natural gateways. To connect West Coast ports with inland markets, freight often has to move a thousand miles or more, making rail the economical mode of transport over trucks.

Intermodal double-stack (2 containers high) train service features double-stack cars, which feature a platform slung low between the wheelsets, allowing containers to be stacked two-high and still clear most tunnels and overpasses.

Articulated double-stack cars, which have multiple double-stack platforms (two-platform, three-platform, and five-platform cars are common) sharing wheelsets, which decreases rolling resistance. Articulation allows much longer cars – a five-platform railcar can be up to 305 feet long – to negotiate curves, and results in more containers being transported by shorter, lighter trains. A train of 26 five-platform railcars might be a mile and a half long but only requires three or four locomotives to keep it moving.

A5.4 TRUCK OPERATIONS

Short-haul trucking of marine cargo containers (drayage) within 50 miles of the Ports has significant effect on the region's transportation network and the region's air quality. This RFCS is aiming to reduce the short-haul drayage by trucks between the Ports and near-dock intermodal railyards.

At present, trucks excel at serving these markets because they can pick up a container and dray it to its destination the same day, with time remaining to return with a loaded or empty container. In the San Pedro Bay area the two ports, the marine terminals, and the trucking industry have explored a concept known as the Virtual Container Yard that uses the internet to manage empty containers so trucks make fewer bobtail (i.e., unloaded) journeys.

Trucking also plays a role in long-distance transport of international cargo. Often, especially in the western United States, where rail service does not provide the geographical coverage it does in the east but the highway network is efficient, it is cost-effective to haul containers long distances by truck. For example, Denver and Salt Lake City are far enough from the West Coast ports that in theory it should be cost-effective to ship by rail, and both cities are actually on major transcontinental rail lines. In fact, however, the volume of cargo to those cities may not be enough to warrant frequent train service – few eastbound container trains are destined for those cities or even stop to drop off cars. Accordingly, a wholesale wine merchant in Denver who wants timely service may opt to pay a few hundred extra dollars to have the 20-foot container of Australian wines trucked from Long Beach to Denver because the logistics agent cannot find timely rail service.

In addition, the phenomenon of transloading allows shippers to take advantage of one particular feature of long-distance trucking, namely that the cost is a per-trip cost rather than a per-ton cost, so if a larger amount of cargo can be hauled by the same driver, the shipper benefits. This is accomplished by transloading (Figure 3-6), in which international cargo containers, which are typically 20-, 40-, or 45-foot long, are repackaged – transloaded – near the port into larger domestic containers, typically 53-foot or even 58-foot long, that can be hauled by a long-distance trucker for the same cost as the original 20-foot box. Clearly, if five

20-foot international boxes can be transloaded into two 53-foot domestic boxes, the cost of three truck journeys is saved. Most transloaded containers are actually shipped by rail, as shown in Figure 3-6, but the movements of the containers before and after the train trip are still performed by local truckers. Competition in the trucking industry results in low drayage rates, sometimes as low as \$100 from the Ports to the off-dock railyards.

A5.5 TYPICAL CONTAINER TERMINAL OPERATION

Modern container terminals are complex facilities designed to unload and load vessels and transfer containers to and from landside modes of transportation, such as trucks and trains. In the Port of Long Beach (and the Port of Los Angeles) the port authority owns the land and most of the major terminal infrastructure (wharves, container yard, railyard, and buildings). Construction of the facilities is funded through long-term leases with the terminal operators and steamship companies who are responsible for maintaining the facilities throughout the duration of the lease. The lessees usually own the gantry cranes and the cargo handling equipment.

Understanding how marine terminals operate is important to demonstrating the compatibility of your proposed concept or solution. The following describes the components of the marine terminals, the types of equipment used for loading and unloading vessels, and overall terminal operations.

A5.6 TERMINAL COMPONENTS

In general, a modern container terminal integrates a variety of physical components and operational processes. The physical components consist of:

- Dock structures or wharves with large, electric-powered gantry cranes;
- Container storage areas, known as the container yard (CY);
- Entrance and exit gate complexes that include electronic scanners, paperwork management facilities, physical screening facilities (e.g., truck and chassis inspection areas, radiation monitors, and customs facilities), and truck queuing areas;
- Maintenance buildings for terminal equipment and chassis;
- Operations control buildings for the marine and gate operations;
- An administration building;
- For terminals with intermodal capability, a railyard and a rail operations control building;
- Cargo handling equipment, including yard tractors, chassis for containers, light trucks and utility vehicles, and several types of mobile cranes and container handling equipment

The operational processes include loading and unloading ships at the wharves, storing and handling containers in the CY, managing in-terminal railyard operations, dispatching containers

to off-dock railyards, and managing container delivery and pickup by trucks for local destinations.

A5.7 LOADING/UNLOADING OF VESSELS

Import containers arrive at, and export containers depart from, the terminals via container ships. Currently, most container ships range from 700 to over 1,100 feet in length, and have cargo capacities from a few thousand to over 9,000 Twenty-foot Equivalent Units, or TEUs¹. Once the vessel is tied up at the wharf, the containers are loaded and unloaded by the large gantry cranes that lift them onto and off of wheeled chassis. The cranes have steel wheels and are mounted on steel rails so they can move (gantry) along the dock to serve multiple hatches and vessels. The cranes have a boom that is lowered over the vessel; the boom must be of sufficient length and height above the dock to reach over the fully loaded vessel. The boom supports a container-lifting “spreader” with twist-locking corner devices that attach to the top corner castings of the containers to lift them. A crane operator rides in a cab above the spreader and controls the attachment and release functions. These cranes, which include specialized, highly computerized equipment that allows productive operations, can transfer 25 to 40 containers per hour. Typical modern gantry cranes stand approximately 150 feet high when the boom is outstretched and approximately 200 feet high when the boom is lifted, and are mounted on rails set 100 feet apart.

The number of cranes simultaneously servicing one ship can vary from one to five or even more, depending on the size of the ship, the number of other vessels berthed at the terminal, crane size, the availability of cranes, and the ship’s scheduled port time. The amount of time a vessel spends at the berth varies with the amount of cargo to be unloaded and loaded and the number of cranes assigned to work the ship. Typical call durations range from 36 hours for small ships to five days for the largest vessels. Loading and unloading operations usually proceed around the clock.

A5.8 CONTAINER HANDLING

After import containers are unloaded they undergo security inspections. These may occur in the container or intermodal yard but most commonly occur near the exit gate before the container leaves the terminal. Each container is sealed with a metal ribbon attached to the doors, allowing a customs officer to ensure the contents of the container were not tampered with during the voyage by verifying the ribbon is intact. Several techniques are used to screen the contents for contraband, explosives, nuclear material, etc. Most containers are screened with an X-ray device, but every day some containers are inspected manually. Inspectors break the seal, open the doors, have the contents unloaded, handled, and reloaded, then seal the doors with a new aluminum ribbon. This is a time-consuming process, and because of the sheer

¹ Standard containers are: 20 feet, 40 feet, or 45 feet long; 8 feet, 8.5 or 9.5 feet (“highcube”) high; and 8.5 feet wide. The 20 x 8.5 x 8.5-ft container (Figure 3-2) is the basis for the so-called Twenty-foot Equivalent Unit, or TEU, that is the standard measure of containerized cargo volumes (thus, a 40-ft. container is approximately 2 TEU, depending upon its height).

volume of containers there is only enough time to manually inspect a small percentage of containers entering the port. Once off the vessel the import containers are taken to the CY for temporary storage pending pickup by a truck or train. In the terminal the containers are handled by a variety of specialized equipment, including:

- Hostlers (also known as hustlers or UTRs) – off-road tractors used to dray containers on chassis or off-road chassis (bomb carts) within the terminal; typically teamed with the dock cranes to transfer containers from ship to container stack and from stack to ship
- Bomb carts – non-highway-legal trailers pulled by hostlers used to move containers within the terminal
- Chassis – a licensed over-the-road semi-trailer for hauling containers
- Rubber-tired gantries (RTGs) – diesel-powered, off-road machines used to stack containers in rows, six wide and up to six high; in many foreign ports and a few U.S. ports these machines are mounted on rails instead of wheels and are electrically powered, and are termed Rail-Mounted Gantries (RMGs); in foreign terminals some RMGs are remotely operated
- Top picks – diesel-powered, off-road machines that resemble a fork lift and can stack loaded containers up to five high; they can be used to deliver containers into an RTG stack or to load trains and truck chassis
- Side handlers or side picks – off-road machines similar to top picks but lighter, lower powered, and intended only for handling empty containers

Most of the export containers to be loaded are already stacked in the part of the CY nearest the vessel berth and are brought to the cranes by hostlers. Although each terminal operates in its own fashion, most are variations on a common theme. Containers are unloaded and loaded off of and onto the ship by “gangs” (labor and equipment), one gang per gantry crane, consisting of several hostlers that move the containers between the vessel and the CY, at least one top-pick or side handler that lifts containers on and off chassis and bomb carts in the CY, possibly an RTG that manages stacks of containers, and several clerks driving light trucks who direct the equipment operators. The clerks are typically equipped with computers linked via wireless to the central data base, GPS devices, and, increasingly, radio-tag readers. In this way the clerks can quickly locate specific boxes using the terminal’s computerized inventory system.

The containers taken to the CY from the vessel (import cargo) can be stored either “wheeled” (stored on chassis) or “grounded” (stored in stacks off of chassis), but cargo coming from the inbound gate (export cargo) is generally stored grounded. In addition, some portion of the CY typically stores empty containers in stacks. Most terminals are a combination of wheeled and grounded operations. In a wheeled operation, containers are individually stored on wheeled

chassis lined up in rows separated by truck lanes. This system has the advantage of reducing the amount of handling each container needs, and thus the cost of processing the container, as a truck tractor or hostler can move the container without the need for a crane to lift the container on and off a chassis. The disadvantage of a wheeled operation is that it requires a great deal of land, which is expensive for the tenant to rent. In addition, as most container terminal land in San Pedro Bay is reclaimed from the ocean it is expensive for the port to build and its creation requires mitigation for loss of marine habitat.

Grounded containers are stacked up to five high in U.S. terminals (foreign terminals with different labor agreements may stack empty containers up to 14 high). Stacking represents an efficient use of land, but it requires a great deal of labor and equipment to handle the containers. Stacking may be accomplished either by RTGs or by mobile cranes (side picks and top handlers). In either case, a tractor brings a container on a chassis or bomb cart under the crane, which lifts it off the chassis and moves it laterally onto a stack. Later the crane can retrieve the container and place it back on a chassis when it is time for the container to leave the terminal.

The import cargo is shifted to stacks or wheeled chassis locations in the CY. Import containers destined to cross the country by rail (“overland cargo”) may be loaded onto railcars within the terminal, if the terminal has an internal (“on-dock”) railyard. (Railyards inside terminals are called on-dock railyards even though they are not actually adjacent to the wharf that the vessels tie up to). In that case, the containers are stacked or parked near the rail yard. Overland containers not loaded on trains inside the terminal are drayed by on-road trucks to near-dock railyards such as the Intermodal Container Transfer Facility in Carson or the Watson Yard in Wilmington, or to off-dock railyards, such as the Union Pacific and Burlington Northern Santa Fe intermodal facilities near downtown Los Angeles, 26 miles from the port.

A5.9 GATE OPERATIONS

Containers not bound for trains in the on-dock railyard are transported by trucks (Figure 3-6). When an import container arrives in the terminal it is stored in the CY until the import agent arranges with a trucking firm to have a truck pick it up. Containers arrive at and depart from the terminal through the gate complex. The gate interchange is the legal exchange of possession of the container from the terminal to the trucking company, or vice versa.

Computerized interchange documentation, remote inspection systems, and the internet have streamlined the process so a driver seldom exits his or her truck and the process typically takes about two minutes. Many interchanges are “pre-advised”, in other words, the entire transaction is pre-arranged via the internet before the driver arrives at the terminal. Most terminals strive to keep driver “turn times” (the time the driver spends interacting with the terminal) to within 30 minutes. This upgrade in “turn times” in recent years has substantially reduced the time trucks spend idling in the terminals.

Locally-bound import containers are turned over to street-legal tractors (i.e., semi-trailer trucks) that arrive to pick up the cargo. The trucks arrive at the terminal either hauling export cargo or “bobtail” (i.e., a tractor without a trailer) and after presenting the appropriate paperwork are directed to the container’s location. For stacked cargo the truck may need to pick up a chassis and then wait for a crane to load the container onto the chassis. For wheeled cargo the truck can hitch up to the loaded chassis and proceed to the exit gate. Trucks hauling import cargo are processed out of the terminal at the exit gate, which involves passing through a radiation portal monitor, being inspected for road-ability, and clearing customs and brokerage paperwork.

Loaded export containers arriving from California, Arizona, Nevada, and some points farther east typically arrive at the gate on chassis pulled by trucks and are stacked or parked in the CY to await their ship. Export cargo arriving from more distant locations typically arrives at the terminal via rail, either directly at the terminal’s on-dock railyard or at another local rail yard from which it is trucked or drayed to the terminal gate for receiving. Cargo containers are transferred from the rail cars to chassis or bomb carts using mobile cranes or RTGs and hauled by yard tractors to preplanned locations in the yard where the containers are either lifted to grounded spots by another crane or parked on their chassis.

The amount of time a container stays in the CY is an important factor in the terminal’s overall capacity. As that length of time (the “dwell time”) decreases, the terminal’s throughput increases, since the same amount of terminal space can handle more containers per year. Accordingly, terminals try to minimize container dwell time by urging early pickup and late delivery of containers. Shippers, however, often use the terminal dwell time as a way to reduce their own storage and inventory costs, thus representing a force working against improved efficiency.