**Containerization**

**General cargo**

Up until the 1970s, there was basically only one type of general cargo ship at sea. It was narrow in proportion to its length and had cargo holds, each with small hatches, serviced by derricks or cranes. Cargo was lifted in slings or nets into or out of vessels in loads of about one tonne each. These vessels came in all sizes from 150 dwt. to over 20 000 dwt. Cargo stowage was an art requiring knowledge and experience. Safe stowage of cargo was the responsibility of the vessel’s master (the chief officer). Large numbers of men were employed, mainly from the shore, to carry out cargo-handling operations. These ships could go almost anywhere as long as there was enough water to float them.

Ports, as we know them, grew where there was a lot of trade, but basically a port was any place that ship could safely anchor or go alongside to handle cargo. Seaborne trade increased dramatically during the 1950s and 1960s. Port capacity was strained and labour costs began to rise. A general inflation affected ship-operating costs making it necessary to reduce unprofitable idle time in port. Innovation was clearly needed and a group of innovations developed during and after World War II were adopted.

**Pallets**

The first step was palletization. Ship construction was improved and ships modified to facilitate the loading and unloading of palletized cargo. However, there were limitations: palletization could only be effectively used alongside a wharf, and not all cargoes were palletizable. At places where the tidal range was high, and because relatively few ships had stern and side doors, hoisting of relatively light loads over the ship’s rail was not eliminated.

**Containers**

Although containers were used extensively by the US Army in World War II, their use was not fully developed until the mid-1950s. Initially, containerization took the form of a sea bridge to link parts of the rail and road systems of the USA. Containers were first carried on deck, but in the late-1950s, ships were adapted to carry them below deck in special cells with guide rails to facilitate stacking. New construction of specialized ships commenced in the early 1960s when services from the US to Europe and the Far East were initiated, and the system rapidly caught on, although some countries and ports appeared to bury their heads in the sand, probably hoping it would go away.

By 1964, the Alaskan trade between Seattle and Anchorage was containerized, and in 1966, the international container trade commenced with the Sea Land service between North Atlantic ports and Europe.

Growth in the expansion of the container concept continued at an ever-increasing pace. In spite of the enormous cost of equipment and containers, ship-owners promoted the concept, if only to stay competitive. The needs of shippers were met in the reduction of transit time, safety of goods, and associated costs were minimized.

Within 6−7 years after Sea Land commenced its North Atlantic container service, all major trade routes connecting North America, Europe, Japan, and Australia had been containerized.

**Containerization Concepts**

Identification and control

The container system has a number of well-known advantages over other systems. These include:

* less damage to cargo
* less pilferage
* lighter packaging
* consolidation of shipments
* no contamination
* easy handling
* simplified transshipment.

However, it was found in the 1960s and early 1970s that container terminals were operating well below expected operational productivity. Analysis at that time showed that in many cases conventional cargo-handling techniques needed to be changed to accommodate containerization. To maintain efficiency, it was found that the container operation needed far more control than did the old break-bulk system. This control function involved detailed planning, and a rigorous system of recording cargo movements and making this information available. Each container came from a specific spot in the vessel and was stacked in a position, which had to be noted on a container record. Every time the container was moved, the record had to be updated so that the exact whereabouts of the container in the terminal was known at all times.

Ship capital and operating costs increased and container handling equipment become more sophisticated in order to reduce ship time in port. Shore base cranes capable of lifting 35 tonnes at a radius of 30 metres became the norm rather than the expectation. Planning of operation was needed to a degree never before experienced.

Containers the majority of which were the same shape and size, could only be identified by their numbers—the old system of port mark was gone and the colour of the container had nothing whatever to do with the identification of the container, where it came from where it was going, or its status. It became apparent to terminal operators that container movements had to be authorized, tracked, and recorded from a central area. From this two information rules developed:

* no container can be moved without a container-movement instruction specific to that container
* container movements can only be ordered by a centralized control room.

**Standardization**

Containers are transported by various means including cellular container vessels, railway wagons, and road transport. Therefore standardization is extremely important to ensure that the many companies involved in multimodal transport have equipment that can handle each other's containers. Transportation equipment is designed to handle containers of specified dimensions and with a specified weight.

The International Standards Organization (ISO) specifies standards for containers in their standards document Specification for Freight Containers. This document specifies:

* Dimensions
* types of containers and their terminology
* corner fittings and other handling components
* coding, identification, and markings
* safety issues (consolidated data plate).

**ISO specifications for dimensions**

The standard ISO container dimensions are:

* cross-section 8 × 8-ft. high (2.4 × 2.4 m), 8 × 8½-ft. high (2.4 × 2.6 m), and 8 × 9½-ft. high (2.4 × 2.9 m). Half-height containers have cross-section 8 × 4¼-ft. high (2.4 × 1.3 m) for carrying very dense cargo such as steel rods
* lengths may be 10 ft., 20 ft., 30 ft., and 40 ft. (3.0, 6.1, 9.1, 12.2 m). The most widely used is 20 ft. (6.1 m).

**Non-ISO-standard sizes of containers**

There are containers whose length and/or height deviate from the ISO standard dimensions. For example, many US containers are based on the sizes of US domestic truck trailers or have extra-large capacity.

Examples of common non-standard containers include:

* containers of Sea-Land Service Inc.

1. length 35 ft. (10.7 m); height 8 ft. 6½ in. (2.6 m)
2. length 40 ft. (12.2 m); height 8 ft. 6½ in. (2.6 m)
3. length 40 ft. (12.2 m); height 9 ft. 6½ in. (2.9 m)

* containers of US Matson Navigation Co.

1. length 24 ft. (7.3 m)
2. ength 28 ft. (8.5 m)

* containers of American President Lines:
* length 45 ft. (super cube box, 13.7 m)

Newly constructed 45-ft. containers may have gross weights up to 32 tonnes. Standardized lifting equipment can be used for these various containers because the containers are fitted on both top and bottom with a double set of corner fittings. For example, a 45-ft. container may be equipped with extra corner fittings located where corner fittings of a 40-ft. container can be found.

**Types of containers**

General-purpose (GP), end-loading containers are used for general, non-specialized cargo. They have access through the end doors, with internal securing points at appropriate places.

**Insulation and refrigeration**

One important way of classifying containers is by the thickness of their “skin” and their degree of insulation and refrigeration. The choice depends on the cargoes’ needs for protection against temperature changes:

* regular, thin-skinned containers have no real insulating effect— they merely protect against weather and pilfering
* insulated containers have no system of temperature control but are thick-skinned with material that reduces heat losses and heat gains—these protect cargoes that sweat, or dry out, or become frosted in cold conditions
* Refrigerated containers (reefers) are well insulated and temperature controlled. Some are connected to the ship’s refrigerator system, or, on land, to small refrigeration clip-on units. Others are self-contained, needing only a supply of electricity to operate. The refrigeration unit reduces the internal dimensions of the container, and may give rise to difficulties in restraining cargo.

**Other special containers**

Others particulars of container design depend on their intended cargoes. The following types of special containers are in regular use:

**Top-loading:** For carrying large, heavy, or awkward cargoes. The roof and the header bar above the door can be removed to allow cargo to be swung in through the door opening and the roof.

**Half-height:** For use with heavy, dense cargoes such as steel pipes and tubes. A full-height container stuffed with these dense materials would exceed the normal weight of a container.

**Open-sided:** These are especially suited for hazardous cargo. They fitted with a fixed roof and have open sides fitted with wire mesh. Also used for over-width cargo.

**Open-top:** For carrying over-height cargo Gondola For carrying over-height, over-width cargoes.

**Flat rack:** Basic platforms with removable boards at each end. They are used to move heavy, bulky, and awkward cargo. There are lashing points for strapping down the goods in transit.

**Dry bulk (bulktainer)** For carrying granular cargo and dry powders.They have three loading hatches. A dischargedoor at the front end is used to empty thecontainer by tipping it on a tipping trailer.

**Ventilated** These have ventilating ports on ends or sides and are used for heat-generating cargoes or cargoes requiring protection from condensation damage.

**Tank (tanktainers)** For carrying bulk liquids. These have a tankenclosed within a frame with the dimensions ofa standard container.

**Automotive:** For carrying vehicles.

**Livestock:** Configured for the particular livestock carried.

**Collapsible** Configured for stowage when not in use.

**Standard container components**

The side, end and roof panels of containers may be made of steel or aluminium. Stainless steel is best, being rustproof and strong, but it is more expensive than aluminium.

In some containers where full access to side-loading is desired, side panels can be demounted, slotting into position after loading to give weather protection and to restrain the load for greater security. The floor must be strong enough to take the weight of a fully loaded forklift truck. The bottom frame also has recesses in the sides of the framework.

These permit the grappler arms of giant forklift trucks to operate, lifting it onto road and rail vehicles. Some containers have a recess at one end (usually the front) to accommodate the raised portion of a gooseneck chassis. In certain types of containers, these gooseneck tunnels are fitted at each end.

**Corner fittings**

The most important parts of the container are its corner fittings, which are used to handle and secure the container. ISO containers have hollow castings at each corner with holes. These engage with special T-headed twistlocks on trucks or rail freight wagons. These twistlocks can be turned through 90° to clamp the container securely to the vehicle. They can also be used to clamp adjacent containers together for added security.

The same hollow castings on the top of the container engage with lifting platforms lowered on to the container by container cranes and straddle carriers. This allows the container to be lifted by all four corners at once to transfer it from road vehicle to rail, or from ship to shore and vice versa.

**Specialized fittings**

Many types of specialized fittings to suit the requirements of regular consignors are offered by manufacturers. Their installation inhibits the use of the container for other traffic and makes it specific to the class of goods for which it has been designed.

**Developing Countries**

Containerization brought major problems to many developing countries:

* the need for major capital investment
* the lack of skilled personnel
* inadequate internal transport infrastructure
* lack of containerizable export cargoes
* the large existing labour force.

Those that delayed soon recognized that they would lose access to direct international trade and would be served only by feeder vessels.

Faced with this prospect many developing countries have invested huge sums borrowed from international banks to construct container terminals.

**Container-Handling Equipment**

The most commonly used container terminal handling and storage systems in operation today are the:

* chassis (trailer) storage system
* heavy-duty top-lift truck system
* straddle-carrier system
* gantry-crane system.
* Forklifts
* Empty / Loaded Container Handlers
* Rubber Tire Gantry Cranes

There are also combination systems at individual terminals.

**Chassis (trailer) storage system**

In this system, the import containers discharged from a ship by crane are placed on a road chassis, which is towed to an assigned position in the storage area by a terminal tractor where it remains until collected by a road tractor. Chassis carrying containers for export are placed in the storage area by the road tractors and towed to the ship-loading crane by a terminal tractor.

The containers are stored, one high on each chassis, requiring a large storage area. Limited surface improvement is required due to the low surface loading. This is a very efficient system because every container is immediately available for removal by a tractor unit. The disadvantage is that it requires a large terminal storage area and thousands of chassis, entailing considerable expense. This method is therefore normally used only when a shipping company provides the chassis and either operates at a leased or reserved berth, or has access to a special chassis compound. The chassis storage system is generally unsuited for use in multi-user terminals. The chassis locations have to be frequently checked, as the terminal has to rely on the road tractor driver for export chassis/container location for exports. As a rough rule of thumb, for every 2000 TEUs,9 a container storage area of 10 hectares (25 acres) is required.

**Top-lift truck system equivalent**

A heavy-duty top-lift truck with a capacity of 42 tonnes and a top-lift spreader beam is capable of stacking fully loaded 40-foot containers up to four high. A lighter truck with a side spreader beam (commonly called a side-loader or rack) can be used for empty containers. Empty containers can be stacked five high. This system places heavy loading on the surface of the terminal and adequate surfacing must therefore be provided. Top-lift trucks can transfer containers from the ship cranes to the stacking area or vice-versa, or terminal tractor-trailer units can be used for this transfer which would reduce the number of forklift trucks required. Typical aisle widths in the stacking area are 18 metres for 40-foot containers and 12 metres for 20-foot containers.

As a rough rule of thumb, for every 2000 TEUs, with an average stacking height of 2.5 boxes, a container storage area of 4 hectares (10 acres) is required.

**Straddle-carrier system**

Straddle-carriers can stack containers three or four high, move them between the ship crane and the storage area, and load or unload them to or from road transport. There are a variety of designs but they essentially consist of a powered mobile portal frame with four steering wheels on each corner. They lift, stack, and transfer containers, which makes them flexible and versatile.

In the past, these machines have had a poor reliability record, poor visibility, high maintenance costs, and a short life. Leaks from joints in the hydraulic system and oil spillage from damaged pipework caused highly slippery surfaces, broke up asphalt paving, and necessitated continual renewal of the white lines and numbers essential for marking out the stacking area. Safe operation demanded that straddle-carriers should operate within a fenced restricted area, and that workers on foot should be kept out of the working area. The fact that, despite these drawbacks, the straddle carrier is so widely used is a testimony to its flexibility and its ability to meet peak requirements. Furthermore, major improvements have been made in the design of straddle-carriers, and most of their poor maintenance record resulted from a lack of preventive maintenance and the excessive use of the equipment for overlong transfer operations.

A variant of this system is the use of tractor-trailer units for the transfer between quayside and storage area, only using straddle carriers within the storage area for stacking and selecting containers.

As a rough rule of thumb, for every 2000 TEUs, with an average stacking height of 2.5 boxes, a container storage area of 2.5 hectares (6 acres) is required.

**Gantry-crane system (transtainers)**

In this system, containers in the storage area are stacked by rail mounted or rubber-tyred gantry-cranes. Gantry-cranes can stack containers up to five high. Rubber-tyred gantry-cranes (RTGs) normally stack containers 6 or 7 wide and rail-mounted gantry cranes stack up to 13 wide. Tractor-trailer units carry out the transfers between quayside and storage area. The frame may be of the portal type (containers are only lifted between the wheels like the straddle-carrier), or it may be a wider cantilever design able to move the containers out to either side.

This system is economical in land use because of the relatively high stacking, and is suitable for varying degrees of automation. Gantry cranes have a good safety record, are reliable, and have low maintenance costs and a long life in comparison with straddle carriers. They are far less flexible, but to offset this, gantry-cranes (particularly the rail-mounted type) are better suited for automation.

In the longer term, the need to economize in land is likely to be very important, and this favours the use of gantry-cranes. This system is especially useful where exports are a substantial proportion of the total traffic, but perhaps less than optimum where import cargoes constitute the major portion of the traffic. This is because random access of individual import containers is required by road transport and to a lesser extent by rail. With high stacks many import containers may have to be moved to access the required container. Gantry-cranes require a higher level of planning and control of operations due to the higher stack heights.

As a rough rule of thumb, for every 2000 TEUs, a container storage area of 1.5 hectares (4 acres) is required with an average of 3.5-high stacking.

**Rubber Tire Gantry Cranes**

The rubber tired gantry crane (RTG) is a common container handling system at the world's largest terminals. In large container terminals RTGs can be used stack containers higher and wider than other systems allow.

**Empty / Loaded Container Handlers**

Handling empty containers is a fast-paced job because the containers need to be moved or stacked quickly and efficiently. The empty container handler stacks the containers high and close together to utilize the available land area.

The heavy-duty loaded container handlers are designed for ports and terminals to handle tough productivity demands and high quality operations. The loaded container handler equipment has a lifting capacity between 36 - 45 tons, and have the ability to stack 20'-40' containers up to five high.

**Forklifts**

For your most demanding material handling operations rough terrain forklifts from Kalmar have capacities ranging from 11,000 lb to 115,000 lb.

**Terminal Operations**

There are two types of planning for container terminals:

* planning of infrastructure and purchase of container handling equipment
* planning of the daily operations.

1. **Import Operations**

* berthing a vessel
* discharging containers from a vessel
* moving containers from ship side to stack positions
* stacking containers in the CY prior to delivery
* shifting containers within the stack so as to get at the containers to be delivered to importers
* loading containers (imports) to rail
* stripping containers
* storing empty containers and/or delivering empty containers to exporters

1. **Export Operations**

* receiving containers for export from rail
* stacking containers in the CY at time of receiving for export
* stuffing containers
* moving containers from stack to ship side
* loading containers to a vessel
* consolidating stacks so as to provide working area for the next vessel
* deberthing a vessel.

With all these activities going on the need for control is obvious. Control can only be achieved when operations are carried out in orderly manner.

**An Example Import Planning**

The task of planning for the discharge of a container vessel falls into three main activities:

* preparation of import sequence sheets
* preparation of import “T” cards
* Preparation of order of work and ETF.

We will explain these terms as we go along.

**Import Sequence Sheets**

The import sequence sheet specifies the order in which the containers are taken off the ship. Before commencing the job of preparing import sequence sheets, it is necessary to first carry out a number of checks. Terminal operators are responsible for handling all containers in an efficient manner therefore need to be sure that the information that they are working with is accurate. The following should therefore be cross-checked and any discrepancies brought to the attention of the vessel agent and where necessary, to the senior management of the terminal.

* check that total number of containers shown on the bay plan is the same as that shown on the outline plan. The only way to do this is to count them
* check with the agent that the total agrees with his manifest total
* check that the number of LCLs agrees with the agent’s count

The next job is to mark on the bay plans and the outline plan (or their electronic equivalents) those containers to be discharged. At this stage, special containers such as over-heights (OH) and over-widths (OW).

Important sequence sheets can now be written up from information contained on the bay plans. Separate sequence sheets are required per bay for:

* on deck
* under deck (port side)
* under deck (starboard side)
* under deck (centre)
* all 20-ft. containers together
* all 40-ft. containers together.

The order in which containers are discharged from a vessel is controlled by practical considerations. On deck, it is normal for workers to walk on top of the containers in order to remove “fittings”. It is therefore sensible to provide a “working” platform, and this is done by discharging containers one complete tier at a time from deck stows. A further consideration is that crane-operator visibility is enhanced by working systematically from the side closest to the shore toward the outboard side of the vessel. The first container discharged from deck should therefore be from the top tier and the row closest to the quay.

When sequencing discharge from under deck, containers should be sequenced in vertical order, tier by tier in the same cell. Taking a group of cells under the same hatch lid, containers should be sequenced on the basis of the cells in the row furthest from the centerline working toward the centre row. The practical aspect here is that by keeping to one cell at a time the crane driver can better “spot” the spreader into the cell. Another factor is that by commencing furthest from the centerline, more weight is kept toward the centre of the vessel so improving stability and therefore lessening the listing moments.

**Preparation of T Cards**

T cards are one system for tracking the movement of containers. Each container has a card, which is moved from one position on a rack to another position on a rack in parallel with the actual movements of the container.

**Calculation of Estimated Time to Finish (ETF)**

Good management of container terminal operations depends to a large extent on knowing when various activities occur and being able to take corrective action when things go wrong. To exercise this degree of management, it is necessary to prepare a working plan even if it is known that circumstances will change as the vessel's container exchange progresses. To calculate when a vessel will complete her exchange and what the sequence of work should be in order to complete work at a particular time, it is necessary to consider the:

* type of vessel being worked
* distribution of containers on the vessel
* number of hatch covers to be handled
* number of cranes available for ship to shore work
* number of “special” (out-of-gauge) containers to be handled
* average number of container movements per hour.

The most important factor in determining the time of completion of a container discharge operation is the number of cranes that can be used and for how long each can be operational. This depends to a large extent on:

* the distribution of containers on the vessel
* where each crane starts work
* the work programme of each crane.

The step-by-step process to calculate the ETF of container operations is as follows:

* determine the number of containers stowed on deck and under the deck at each bay
* from the ship plan determine position of hatch lids in relation to the container to be discharged
* estimate time required for various activities such as removing a hatch lid, long travel between bays, boom up/down, spreader change, and decide on the number of containers that will be handled per hour
* decide where to start work with each crane by calculating the numbers of hours work at each bay (number of containers divided by productivity plus time for handling of hatch lids)
* Draw up a plan of work for each crane, calculating the number of hours required so that both cranes complete work as close to the same time as possible. Do not forget that shore-based cranes cannot normally work closer than two bays apart due to the length of the wheel bogey.

**Ship Working**

Although terminal staff are not normally responsible for ship stowed planning, the safety requirement of the vessel should be kept in mind when designing the work plan and calculating the ETF. Considerations are stability, trim, stress, and list:

* **Stability**

When discharging containers, ensure sufficient containers are taken off the deck before discharging large quantities from under deck at a different hatch

* **Trim**

Care should be taken to ensure containers are discharged so as to maintain fore and aft balance. If too much weight is taken from one end of the vessel, the vessel will tilt longitudinally thus making entry of container spreader into cell guides difficult and slow. This is termed “down by the head or stern”

* **Stress**

To avoid undue stresses, care should be taken that adjacent hatches are not fully discharged when others are fully loaded

* **List**

A vessel remains upright due to equal weight distribution on each side of the centreline. Thus, if containers on the port side are discharged, the vessel will list to starboard (and vice versa).

Excessive list can result in the vessel’s superstructure coming into contact with the shore crane legs and also makes latching of the crane spreader onto containers extremely difficult.

**Planning Of Import Stacks**

It is not necessary to plan where each container will stack in the container yard, rather it is normal to delegate a general area, say, block “B”. Rows 27 to 35. As containers are stacked, the position is noted either immediately or at short regular intervals, and the information is then used to update “control system”. A practice in many ports is to permanently allocate certain areas of the terminal to individual shipping lines, which is fine provided the terminal has the space to keep the area well separated. Before deciding to stack containers in a particular position, any remaining containers in that area should be “consolidated” into a small stack. A worksheet is drawn up in this event showing which container is to be moved to where.

**General Zoning Principles for Import Containers**

Zone containers according to:

* sizes—whether 20s, 35s, or 40s
* status—whether empties, or loaded FCL, or LCL
* import or transshipment
* shipping line or operator
* types—whether reefer or dry
* IMO Class for hazardous containers
* over-heights (OHs), over-widths (OWs), or uncontainerized

With experience, operators learn different major importers delivery requirements, for example, those who collect import containers as they become available, those who require specific containers, the usual dwell times (time in storage), and so on. It is good practice to stack according to the known or expected needs.

**Export planning**

This lesson is devoted to an example of export planning at a container terminal. Not all terminals use the same methods, and not all terminals use the same planning tools, but the functions that have to be performed are pretty much the same everywhere.

The job of export planning is not easy. The planner has to deal with a number of unknowns and therefore his or her judgments and experience plays an important part in determining the effectiveness of terminal operations. In order to plan loading operations it is necessary to know:

* the number of containers to be loaded per port of discharge
* the classification of container by weight and contents (general, reefer, out-of-gauge…)
* required stowed position in vessel
* availability of space in the CY for receiving exports prior to loading
* constraints of the vessel by way of weight limitations on hatch lids or on tank tops.

It is more often than not difficult to obtain reliable information as to detail of the containers to be received and loaded to a vessel. As a general rule, booking lists supplied by agents should be treated with caution since they are nothing more than advice documents. A “booking” is not a contract between the shipper and the ship owner and therefore can be changed at will. Normally, the container terminal operator cannot be sure of containers to be loaded until they have actually been received into the terminal and released by relevant authorities for export.

The main skill of export planning is in anticipating the number and classification of containers to be received for export; having them stacked in such a position in the CY that any classification can be loaded with minimum interference with another; and determining the order of loading with minimum interference with port per classification so as to meet the requirements of the vessel.

The task of export planning can be broken down into four steps:

* deciding where export containers will be stacked. This is known as zoning
* preparation of export sequence sheets (order of moving containers from the CY to the vessel)
* calculation of ETF
* preparation of order of work.

**Yard Address of Containers**

There are a number of ways that the position of a container in the CY can be identified. Different ports have different system; however, whatever the system it must provide for a practical way so that the operator of a truck or internal transfer vehicle (ITV) can proceed to the correct loading position.

First the operator must know which block to proceed to; let us say block “B”. Next the operator must proceed along the block to a certain position. Then, the container will be closest to the roadway, or furthest from it, or somewhere in the middle. Lastly, it must be known if the container is on the bottom, in the middle, or on top.

**The sequence of yard address is therefore:**

* block number
* row number (how far along the block)
* bay number (how far from the roadway)
* tier.

**Planning the export stack (zoning)**

The way the export stack is laid out can have a big effect on the speed of loading. The variety of destinations and types of box make it difficult to achieve the optimum plan, but there are nine rules of zoning. Unless you have a lot of space, or a very small shipload, you are not likely to be able to keep them all. The rules are:

1. Keep separate zones for boxes for different ships.
2. Keep separate zones for each port of discharge.
3. Keep separate area for 20s and 40s and never mix 20s and 40s in the same transtainer bay or straddle row.
4. Keep heavies, mediums, and lights for the same port in the same transtainer bay or straddle row, in that order. The reason for this is to keep the transtainer gantry in the same bay for as long as possible to avoid long travel when loading or to keep the straddle driver going back to the same row as long as possible so as to work up tempo. Ship stowage is usually heavies lowermost, lights uppermost.
5. Segregate 8-ft., 8½-ft., and 9-ft. boxes. The majority are usually 8½-ft. boxes.
6. “Spreading”: If there are more than about 12 boxes of a type, split them into two zones, preferably well separated, of roughly equal size.

This ensures that operations are not interrupted by:

* equipment interference (two transtainers or two straddle getting in each other’s way when trying to load containers from adjacent stack positions)
* all boxes for a ship bay being blocked if equipment breaks down in the only zone allocated to a particular type. Containers are usually stowed this way too—one batch of containers split between two well separated ship bays in order to speed up ship operations in each port.

1. Allocate enough space for the expected numbers of each type on the basis of one below the maximum stacking. This means that capacity of a zone is calculate on: transtainer export 3 high straddle export 2 high

This gives some flexibility if more containers than were in the preliminary forecast arrive, and it is not too wasteful if they do not because average stacking heights will typically be: transtainer export 3.5 high straddle export 2.5 high

1. Put specials (reefers, hazardous goods…) in the areas designated for them.
2. Avoid having too many small zones as this makes operations complicated.

When planning a straddle-carrier stacking, you must also consider “spreading” the stack, that is, a spread of containers for each port over several equipment paths if numbers are sufficient. This ensures that operations are not interrupted either by:

* two straddle-carriers getting in each other’s way when they are trying to load similar containers
* all boxes for a ship bay being blocked if a straddle-carrier breaks down in the only zone allocated to a particular type.

**Spreading can be achieved in two ways:**

* when there are large numbers of boxes of a type, using a wide zone of several short rows
* using two separate zones for the same type.

The zone plan is linked to the sequence list. A bad zone plan can be overcome by the sequencing list, but this will mean that the straddle carriers are hopping about all over the stack, making mistakes and working slowly.

**Export Outline Plan**

The export outline plan is made up from the agent’s instructions and the booking list information. It should show all the parameters that affect the way that the containers are to be loaded:

* bays where containers for specific port are to be placed
* weight category and distribution (light / medium / heavy containers)
* height (8 ft., 8½ ft., 9 ft., 9½ ft.)
* commodity
* size (20 ft., 40 ft.)
* special units (open tops, over-height, over-weight…)
* hazardous and reefer containers
* any special instructions.

**Loading Sequence**

The planning supervisor can now prepare the export loading sequence list, which reflects the actual position into which containers are to be placed on the vessel. In making this decision, the planning supervisor must be aware of:

* + - shipping lines requirements as to the disposition of containers/hazardous containers on the vessel based on the stowage instruction
    - disposition of export containers in the CY
    - special instructions regarding stowage of refrigerated containers/hazardous containers or break-bulk cargo
    - the distribution of containers on the vessel from other ports in order to “butt-on” to existing stows
    - height of containers already stowed on deck at previous ports in order to ensure final deck stow is level for the fitting of bridge clamps.

The information appearing on the export loading sequence list is:

* + - terminal position
    - container number
    - port of discharge
    - weight and size
    - commodity
    - ship stow position
    - ship’s name and voyage number.