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# Selecting Container Handling Equipment for Growth

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**ABSTRACT**

This paper is intended as a review of the more common handling equipment from the standpoint of the developing ports.

The paper first looks at the uneven development of container terminals and identifies categories of ports in terms of their growth potential. The characteristics of the feeder or secondary ports are discussed. A review of the various containers handling equipment is carried out and their relevance to these ports is examined.

Tropical issues and basic parameters relating to equipment selection by developing ports are also discussed. Quite often, such basic parameters have not been given sufficient consideration by the buyer, resulting in equipment ill-suited to the operational needs. The role of manufacturers in influencing the ports' choice of equipment is also a critical one.

Recent recovery in shipping freights will soon put pressure on feeder terminals to improve the ship turnaround time so that shipping lines could achieve better utilization of their vessel. Through proper selection of quay side and landside equipment, these ports could rise to the challenge of containerization and emerge to be the mini-load centres of their surrounding region.

## 1. PORT DEVELOPMENT AND GROWTH RATES

### 1.1 General View

Port development around the world is proceeding in a rather lop-sided pattern. On the one hand, throughputs at mainstream parts are growing by leaps and bound every year, while on the other, the fledgling feeder ports are, in the main, struggling to cope with containers. The picture today consists of well developed hub ports, but with rather weak links or spokes to its surrounding region. Further, the hubs also correspond to countries with high economic growth rates. This means that an increasing proportion of the world's container throughput is handled by these hubs or load centres vis-à-vis the feeder ports. The mainstream ports or terminals will have strong buying power and will certainly dictate the development of container handling equipment. The needs of smaller ports may therefore be neglected simply because it is not economical to develop equipment tailored to the specific needs of these ports. It can also be costly for manufacturers to market their existing range of products and to provide after-sales service to such ports because of the low volume of business and the scattered market.

The rates of growth of container traffic vary significantly between one port and another (see Fig 1). Since the volume of traffic and the anticipated growth rate is an important consideration in selecting the correct handling systems and equipment, I will identify certain categories of ports/terminals in terms of their TEU throughput and their growth rate. Roughly, following categories can be distinguished:

Group A - Terminals of less than 40,000 TEU per annum; slow growth rate. Examples are Belawan Port (Indonesia), Kota Kinabalu (East Malaysia) and Kandla (India)

Group B - Terminals with throughput between 40,000 and 250,000 TEU per annum; moderate growth rate.
Examples are Penang Port, Madras Port & Surabaya Port

Group C - Terminals of more than 250,000 TEU per annum; high growth rate.
Examples are Colombo Port, Port Rashid, Tanjong Priok.

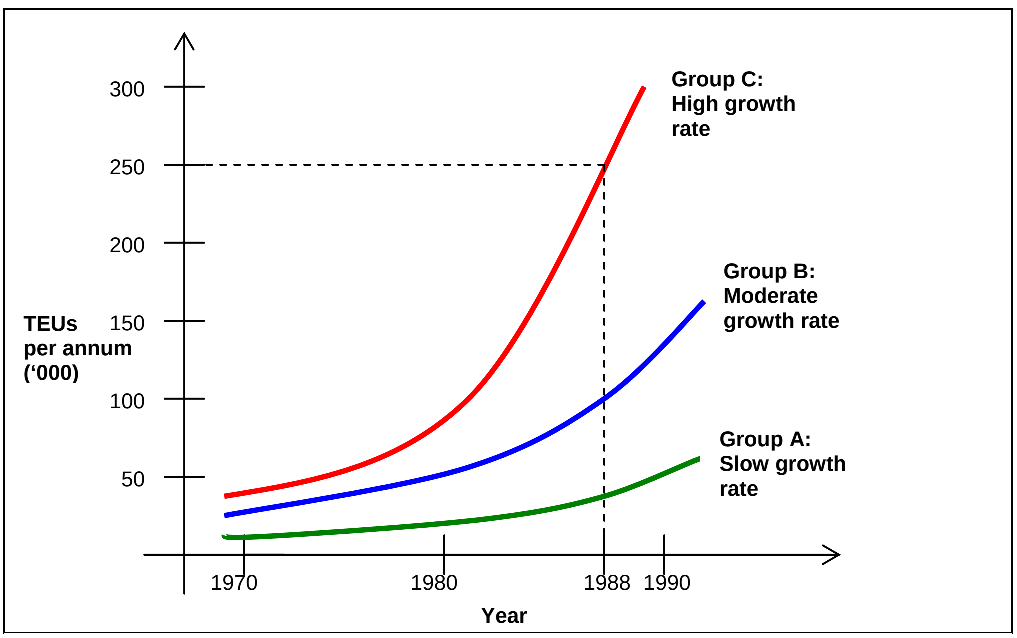


Fig 1: Rates of growth of container traffic

By way of definition, Group A and B ports are typically ports or terminals in various stages of development while Group C ports have normally matured as container terminals and have evolved their own system of handling and day to day operation. We would, thus, focus on the first two Groups of ports and examine issues and problems related to the selection of handling system and equipment for these ports.

1.2 Characteristics of Group A Ports

The level of 40,000 TEU/year is chosen as the upper limit mainly because this seems to be point beyond which terminals will find it necessary and economical to invest in a quay side rail mounted crane. Below this level, terminals normally do not have shore based cranes, but rely on shipboard cranes for the quay side handling of containers. Of course, there are exceptions like Bangkok Port which handle 600,000 TEU in 1987 without any shore gantry cranes.

Typical characteristics of ports in this category are:-

- strictly a feeder port, ships plying there are normally equipped with cargo handling gears. Growth rates are low and are limited to the economic growth of its hinterland, being without the benefit of any transshipment cargo.
- Lack of physical infrastructure such as container berth, stacking yard etc, to accommodate wheel loading of container handling equipment.
- Lack of inland distribution system such that containers are normally stuffed and unstuffed within the port areas.
- Imbalance between import and export containers resulting in many empties being handled.
- Lack of efficient information distribution system such as shipping schedule, consignees arrival etc, thereby rendering planning of resource scheduling and allocation a difficult task.

1.3 Characteristics of Group B Ports

These are ports with varying proportions of feeder containers and mainline containers. They have gone through the initial phase of containerization. Many are already equipped with rail mounted quay cranes and in-terminal handling equipment. Some are tractor/railer and rubber tyred gantry (RTG) operations such as Madras Port, others run a straddle carrier type of operation such as Kelang Container Terminal, yet others have a mixture of different equipment such as fork-lifts, RTGs and straddle carriers.

These ports have therefore developed their own preference for a particular handling system, although further growth of traffic may sometimes force the terminal to change to a system that makes more effective use of land area. The main concerns of these ports with regards to equipment are:

- To provide a high level of equipment availability. This could be an uphill task in view of bureaucratic red tape and motivational problems owing to outmoded practices that rewards seniority rather than competence.
- To strike a balance between obsolescence and introduction of new technology. An example being whether to continue specifying the Ward Leonard motor generator drive or to switch over to static converter drive and digital control.

Bearing in mind the background of the developing ports, we will review each of the following equipment and examine their suitability to the ports.

There are basically 3 distinct processes in the handling of containers in the terminal, viz: ship to shore handling, in-terminal transfer between quayside and stacking yard and yard handling.

## 2. SHIP TO SHORE HANDLING

As pointed out earlier, many ports try to cope without any shore cranes up to 30,000 – 40,000 TEU per annum by relying on ship's gear to load and unload containers.

### 2.1 Shipboard Cranes

#### 2.1.1 Shipboard Slewing Jib Crane (Fig 2)

Most shipboard cranes are of the jib, slewing type, hydraulically driven. They are pedestal mounted, often to one side of the ship instead of along the ship's centre line, in order to gain effective outreach and increased visibility on quay side. These cranes may be fitted with fixed beam semi-automatic spreaders or with more sophisticated telescope spreader equipped with gravity point adjustment. Speed of handling per crane ranges from 8 to 12 containers per hour.

Containers are often lifted from the ship and set down on the quay instead of being loaded directly on the trailers. This is due to inherent difficulty of slewing crane to control sway and also to the sea conditions which make it cumbersome and time consuming to land the containers directly onto trailers.

Forklifts are normally used to transfer the container from the ground onto the trailer.

Fig 2: Shipboard Slewing Jib Crane

### 2.1.2 Shipboard Gantry Crane (Fig 3)

Some ships are equipped with shipboard gantry cranes which can travel along the length of the ship. The crane's top girder has an articulated boom which extends over the shipside and enables containers to be lowered on to the shore. Other design incorporates a slewing boom which could be fixed pedestal mounted on the gantry or trolley mounted for cross travelling on top of the gantry. Shipboard gantry cranes have a higher handling capacity of 20 to 25 boxes an hour.


Fig 3: Shipboard Gantry Crane

### 2.1.3 Pros & Cons of Shipboard Crane

Advantages of Shipboard Cranes

- No need for shore cranes and the resultant capital investment in civil works.
- The port is spared the task of maintaining the shore cranes.

Disadvantages

- Since only geared ships can call at the port, the type of shipping activity is limited and the port's throughput level is to a large extent dependent on the availability of geared ships. Competition tends to be limited, resulting in higher freight rates which the economy of the country will eventually have to absorb.
- As throughput and number of container moves per ship increases, the handling rates of these shipboard cranes will no longer be sufficient. During the period of shipping slump and excess tonnage, a long turnaround time at berth may be easily absorbed by shipping lines. However, as shipping companies will want to make better use of their ships to generate revenue, a very high freight rate may be imposed if turnaround time cannot be improved.

## 2.2 Shore Cranes

When one speaks of container cranes, most people would think of the huge container gantry cranes commonly seen in the bigger ports. In fact, this need not be the case. Many options are available to the small container ports.

### 2.2.1 Quayside Gantry Crane (Fig 4)

This may not be a suitable crane for the small growing port (of less than 30,000 TEU per year) to start with because of following:

- at a price tag of US$3.5 to US$4.0 million, it is a hefty investment, and with a corner load of 8 x 40 tons, further heavy investment is required in the civil works to take the wheel loading.
- Type of ships calling at such ports consists of feeder vessels which have mast and derricks that can interfere with the boom of the gantry crane. Containers are sometimes stowed askew on deck, which make it impossible for shore gantry crane to engage those containers.

Fig 4: Quayside Gantry Crane

2.2.2 Lattice Boom, Light Weight Gantry Cranes (Fig 5)

Examples of this type of crane are the Tango and Samba Series of Sea Container design. Lift capacities of Tango and Samba cranes are respectively 30t at 24.3m and 35t at 35m outreach with smaller corner loads, viz, 6 x 26 ton for Tango and 8 x 23.5 ton for Samba, there is less need for expensive civil works.

Fig 5: Light Weight Gantry Crane

Another benefit of this crane type is its shorts delivery period and its pin-jointed construction makes for easy transportation and fast erection. The crane could be dismantled in future if required and moved to where it is needed.

A disadvantage though is that these cranes require a rail span of 100ft, which increases cost of civil works and offsets savings from the smaller wheel loads. Though it can be argued that the space in between can be used for staking containers, a wide quay apron capable of withstanding high container stacks is often not found in small ports, unless it has been intentionally planned for.

The Tango crane, however, may be too slow as a shore crane, having a hoisting speed of only 11.59 m/min full load. Its eddy current speed control does not give as good a control as the step-less DC control, and may render spotting of containers more difficult. Owing to its limited lift capacity of 30t, it is more suitable for feeder terminals handling mostly 20ft containers.

The Samba crane has a better performance and is comparable to a standard container gantry crane.

Both the above cranes are particularly useful for terminals facing congestion problems and requiring quick temporary solutions.

2.2.3 Multipurpose Slewing Cranes (Fig 6)

This is a slewing portal jib crane that is designed for 3 different modes of handling: hook duty (general cargo), spreader duty (containers) and grab duty (bulk cargo). For the crane to be effective in all three duties, the hoist rope reeving of the crane must be capable of being switched over quickly into the appropriate configuration

Handling capacity of different modes:

| | |
|---|---|
| Hook | - 40 ton at 37m |
| Container | - 30.5t/35.5m, average rate of 15 to 20 containers an hour. |
| Grab | - 16 ton grab, handling rate of 500t/hour. |

Max corner load is at 8 x 32 ton for a rail span of about 15.0m.


Fig 6-Multipurpose Slewing Crane

Advantages

- This crane is ideal for multipurpose terminals which have to handle a variety of cargoes for which purchasing a special purpose crane, such as the container gantry, is not economically justifiable.
- The crane is suitable for handling feeder vessels whose masts and derricks would have been a problem to the gantry crane. The narrow boom of the multipurpose crane allows the cargo stored near these structures to be reached easily.

At a price tag of US$2.2 to 2.5 million, the multipurpose crane may be a suitable crane for a small port to start with and as the container traffic increases to an economic level, a gantry crane may be added.

Best results have been achieved when used jointly with the straddle carrier for landside handling such that containers can be landed on the quay and picked up by the straddle carriers. A handling rate of 25 containers is obtainable.

Examples of developing ports using multipurpose cranes are Johore Port (Malaysia), Mombassa Port (Kenya), Gizan Port (Saudi Arabia).

2.2.4 <u>Mobile Harbour Cranes (Fig 7)</u>

These are specially designed mobile cranes for ship to shore handling and harbour duty. They are usually multipurpose machines capable of being adapted with hook, spreader or grab (Fig 7).

Fig 7: Mobile Harbour Crane

The mobile harbour cranes should not be mistaken with the general purpose mobile cranes which are notoriously unsuitable for ship to shore container handling duty. Mobile crane for harbour duty have a vertical tower and an elevated cab for maximum visibility on shipside as well as shore side. The vertical tower and the elevated jib fulcrum allow the jib to rise above the free board of the ship.

To have a reasonable container handling capacity, a lift capacity of 36m.ton at 32m outreach (from slewing axis) would be required, which gives rise to a maximum corner load of about 120m.ton at an outrigger span of 11m.

Advantages

- Being mobile, it is not confined to working at particular berths but can be deployed to anywhere in the port for quay side and yard duty.
- Wheel loading can be accommodated by most harbours without specially built wharf structures.

Disadvantages

- Setting up the mobile crane to get ready for operation is a time-consuming process as outriggers need to be extended and leveled properly. This reduces the effective average handling rate of the crane.
- Being a diesel-hydraulic machine, there will be a greater need for maintenance work than in the case of rail mounted quay crane.

To be an effective container handler, the crane should be equipped with telescopic spreaders complete with gravity point adjustment and rotator unit. This however increases the complexity of the machine substantially.

The mobile harbour crane is mainly suitable for low volume traffic where number of boxes to be handled per ship do not typically exceed 150 units. Where rail mounted quayside cranes are already present, the mobile harbour crane can serve as a useful back up or it could be deployed to berths not served by the rail mounted cranes.

## 3. IN-TERMINAL TRANSFER BETWEEN QUAY & YARD

### 3.1 Tractor-Trailer/Forklift (Fig 8)

A most common practice among Group A ports is that containers are set down on the quay by the ship's crane and then picked up by forklifts to be loaded on the trailers. The trailers units which are quite often on-highway prime mover units. The containers are then unloaded by forklifts and stowed in the yard.

In the early 70's when mainstream ports in the Far East were in their early stage of containerization, first generation straddle carriers were commonly used for in-terminal transfer. However, this gradually gave way to the tractor-trailer and rubber tyred gantry operation as traffic volume increased.

Tractor-trailers are now the predominant means of in-terminal transfer in the Far Eastern ports, even in cases where straddle carriers are employed.


Fig 8: Tractor-Trailer

The tractor/ railer combination at a cost of US$50,000 to US$60,000 a piece is an economical means of transportation equipment.

3.2 Straddle Carrier (Fig 9)

The straddle carrier is a highly versatile machine which is capable of both the vertical and horizontal transfer of containers. It combines the functions of the tractor-trailer and the stacking crane or the FLT, all within one machine. It is able to travel fully laden (40T) at a speed of 24.0 km/hour and stack 1 over 2 x 9ft 6in containers high. Present generation straddle carriers are a lot more reliable that the early generation machines. It is therefore possible for a terminal to purchase just a fleet of straddle carriers to completely satisfy all its landside handling needs. Consider a group A terminal with a throughput of about 30,000 TEU per annum, a fleet of 2 straddle carriers would be sufficient for all landside handling.

This is roughly equivalent to a combined fleet of three 40T FLT and three tractor-trailers.

Cost of 2 straddle carriers = 2 x US$550,000 = US$1,100,000

Cost of 3 FLTs + 3 tractor-trailers = 3 x (US$350,000 + US$55,000) = US$1,215,000.

The above comparison shows that the straddle carrier has a slight cost advantage over the FLTs. Even in the more conservative comparison of 3 straddle carriers versus 4 sets of FLTs/ tractor-trailers (which include a spare unit each to cater for breakdowns), the straddle carrier still compares very well with the FLTs.  Further, the straddle has many operational advantages:

- better utilization of land area for container stacking.
- Able to cope with high traffic volume of the future, for which the FLTs will not be suitable.
- Less spares to stock since only one type of equipment is used.
- Fewer men are required to operate the equipment.
- Much smaller wheel load.
- Inherently stable and greater safety.
- Greater manouvrability, visibility and ease of operation.

Fig 9: Straddle Carrier

Though there are compelling reasons for small terminal's to subscribe to the straddle carrier system, in practice it has not been so.  Some possible explanations are as follows:

- the straddle carrier still carries still carries the stigma of poor service record from the first generation machines.
- The wide spread use of tractor-trailer/rubber tyred gantry handling systems in the mainstream ports tend to encourage the use of similar machines in the small ports, rightly or wrongly.

- Tractor-trailers and forklifts are common everyday machines; the concepts behind which are easily accepted by users. Whereas straddle carriers are special purposes machines and are more difficult to gain acceptance. Maintenance of the machine requires higher level of skill and strict discipline.

Many of the straddle carriers in service in the Far East today are of the early generation type. They are aged and hence downtime may be quite substantial. Straddle carrier manufacturers have not done enough promotion to the developing ports on the improved reliability of their new generation of equipment.

I believe that with the correct marketing approach and a good service back-up, it would be possible to see a wider use of the straddle carriers particularly in the developing ports.

3.3 Container Mover

This is in fact a mini-straddle carrier, having the same concept of lifting a container and moving with it. It therefore has the same operational advantages as the straddle carrier over the FLTs. At a price tag of US$210,000 per unit (excluding tractor unit), it may have a cost disadvantage in a comparison of 3 container movers versus a fleet of 1 FLT and 3 tractor-trailers.

The disadvantages of the container mover are:

- It is not designed for stacking containers on top of each other, having a lift height of 1800mm for trailer loading
- Handling speed is lower, at an average of 15 containers per hour for ground to ground transfer.

Advantages are:

- simpler machine, less maintenance and higher availability than the straddle carrier.
- able to enter warehouses, CFS, Ro-ro vessels to pick up 40 foot containers whereas FLTs and straddle carriers may have problems.

In the Far East context, the concept of container movers would be relevant to low volume terminals where there is plenty space and growth rate is likely to remain low, Ro-ro terminals, particularly, will find the container movers as "useful equipment".

3.4 Self-Loading Trailers (Fig 10)

This machine performs the functions of loading, unloading and on-highway transportation. Since it is a self-contained unit, it can work independently of cranes and FLTs and hence could be deployed to remote destinations where unloading equipment are not available. The self-loading trailer is therefore ideal equipment for container haulage companies located in the less developed countries. In these countries, most of the receivers and shippers of goods do not have elevated platform for stuffing and unstuffing chassis mounted containers. The self-loading trailer unloads the containers on the ground and goes on to make another delivery, while the receiver could take his time to unstuff the container, using it as a warehouse temporarily.


Fig 10: Self-Loading Trailer

Self-loading trailers could also serve as an in-terminal transfer and stacking equipment. It is able to stack containers 2 high, load load/offload adjacent rail wagons or a chassis. Each loading or unloading cycle takes about 4 to 5 mins, under one-man operation. With a handling rate of 8 to 10 containers per hour, the standard on highway self-loader may be too slow for terminal handling. Off-highway type self-loading trailers have been developed by some manufacturers to cater for the need for shorter cycle time.

Port authorities in developing countries could encourage the use of self-loading trailers among the haulage companies as a means of easing congestion in the yard and restricting the habit of unstuffing containers in the port limit.

The economics, however, is not quite in favour of the self-loading trailers in the Far East. At about US$100,000 a piece, it cost 10 times the price of a chassis. Container haulage operators, being pragmatic businessmen, will always be discouraged by high capital investment even though there are substantial benefits in terms of better utilization of prime movers and reduced logistic problems.

To tap the potential market in the developing countries, manufacturers will have to produce equipment which will give a quick return on investment for the user. Local manufacturing may be considered as a means of lowering productions and freight cost.

## 4. CONTAINER YARD HANDLING EQUIPMENT

### 4.1 Forklift Trucks (FLTs)

As discussed with earlier, the FLT is an ubiquitous machine employed by the small ports, ICDs, CFS and container repair yards. Its simplicity in operation and maintenance, coupled with users being already familiar with the small range of FLTs, give the machine easy acceptance among users.

Some drawbacks of the FLTs:

- of all types of stacking equipment, it is the least efficient in utilizing the available land area.
- High wheel load form the front axle often cause great damage to the yard surface.

Therefore as traffic volume builds up, the developing port may find it necessary to use one of the following equipment systems and employ the FLTs as a useful back up equipment.

### 4.2 Rubber Tyre Gantries (RTG) (Fig 11)

RTGs are becoming a popular means of yard handling among the small ports. Many such ports are operating with 2 or more units of RTGs long before they acquire a shore crane. Examples are Cochin Port, Surabaya Port Rangoon Port (2 RTGs to be delivered in 1989)

The RTGs are used in conjunction with the tractor-trailers. Because of its high stacking capability (1 over 3 or 1 over 4), the RTG offers a more effective use of land area. Critics of the RTG would always point to the lack of selectivity (owing to the high stacking), as an operational disadvantage. However, they should bear in mind that stacking height could be varied according to the amount of yard space available. It is certainly a lesser evil to live with lack of containers selectivity than to turn away containers because of shortage of yard space.

Fig 11- Rubber Tyre Gantry

Advantages of the RTG crane:

- high stacking density.
- low maintenance cost compared to the straddle carrier.
- more flexibility as compared to the rail mounted gantry as the RTG is able to cross travel and access all containers stacked within yard.

Its limitations are:

- it is purely a stacking machine. It is not recommended to travel with a fully loaded container and has therefore to be used in conjunction with the tractor-trailer.
- Relatively high wheel load ie 48 ton for 4-wheel machine. 8-wheel machine can be specified to reduce wheel load to 28 ton.

Cost of an RTG is about US$750,000. Each machine can typically cope with a traffic volume of between 30,000 to 50,000 TEU per year.

Expensive investment in reinforced concrete yard can be avoided by adopting the gravel bed construction for the stacking area and concrete slabs for the crane runway. This has the advantage of easy drainage, though some maintenance may be required from time to time to correct for the settlement of the runway concrete slabs by leveling it. Such a yard construction has been successfully used in Cyprus Port Authority and in Penang Port Commission.

The RTG/tractor-trailer system should be recommended for ports with an overriding concern of maximizing the use of limited yard area and for ports that foresee a rapid growth of container traffic in the near future, that will put pressure on land use.

4.3 Medium Span Gantry (MSG) (Fig 12)

MSGs are typically diesel hydraulic machines spanning 2 or 3 containers plus 1 roadway. Lift height usually do not exceed 1 over 2 containers. The MSG is a considerably lighter machine than the RTG, weighting only 45 MT as compared to 110 MT in the latter. At a full load of 30 MT, the max wheel load is at 25 MT. In practice, the crane can be driven over any hard surface and is not confined to travelling along its run ways only.

The MSG provides a stacking density that is between a straddle carrier and a wide span RTG. Maintenance of the machine is simpler than the RTG, however frequent maintenance work is required owing to its hydraulic drive machineries. Capital cost of about US$350,000 to US$400,000 per unit gives a quick payback for the buyer.


Fig 12- Medium Span Gantry

The MSG is therefore a suitable machine for the following terminals:

- terminals with a small budget for equipment and yard development such as the ICDs and the CFS.
- Terminals where a high degree of planning is not possible as in the ICDs which are primarily serving the trucks from haulage companies, hence requiring high selectivity.

4.4 Reach Stackers (Fig 13)

The reach stacker has the body of the FLT, but is fitted with a telescopic boom that has a telescopic spreader. The reach stacker is able to stack 4 high in the front row and 3 high in the second row. It has following advantages over an FLT:

- greater stacking density because of its ability to reach containers in the second row.
- Its ability to rotate spreader 90 degree allows it to pass through a narrow aisle.
- Better visibility and stability.

The reach stacker is particularly suitable for intermodal terminals where two or more rail lines running in parallel could be accessed by the reach stacker form the side, a feat which the FLT is not able to emulate.


Fig 13: Reach Stacker

The reach stacker has so far been popular only in Europe. Its use in the developing ports in the Far East is limited. This is due to the lack of marketing effort and promotion by the manufacturers. At about US$350,000 per unit, the reach stacker is in the same price range as a 40m.ton FLT. Its operational advantages could really give the FLT a good run for its money. However, the reach stacker and the FLT are not necessarily in competition but could be complementary to one another. A combination of both machines may achieve the best results for some terminals or ICDs.

4.5 Rail Mounted Gantry RMG (Fig 14)

RMGs are typically used in well-developed or special purpose terminals. It normally has a span of more than 10 containers wide and stacks 1 over 5 high. It is confined to move along the rail and is not able to cross gantry travel or perform pivot turning like an RTG. Its flexibility is therefore limited and is therefore not a suitable equipment for the small terminals, where a high degree of planning is not present.

However, many small span RMGs are in used in railway containers to and from rail wagons. The increase in rail transportation of containers will lead to a wider use of the small span RMG as a special purpose machine for rail terminals.

Fig 14: Rail Mounted Gantry

4.6 Special Purpose Gantry for Empties

In land-scarce countries such as Singapore, Hong Kong, high stacking rail mounted gantries have been used by ICDs to stack empties up to 9 high. One such machine has a span of 13 containers wide plus an over hand of 13.0m on each side and a height of 1 over 9 boxes. Owing to the lower value added in handling empties, the crane has to be of simple design and low cost. The crane has demonstrated the feasibility of high stacking on budget of US$450,000. Effectiveness of the machine could however be further enhanced through more careful planning of yard storage, to reduce the need for shifting containers.

## 5. BASIC PARAMETERS IN EQUIPMENT SELECTION

We have thus, in the foregoing, reviewed the operational characteristics of each equipment and examine its suitability to the small developing container terminals. What is evident is that there is no general rule dictating which type of equipment for what size of terminal. No two terminals are exactly similar in the various characteristics such as the physical layout, labour relations, level of maintenance skill, pattern of trade, types of shipping and the interface with other modes of transportation. What is good equipment for one port may not necessarily be so for another of the same size.

### 5.1 Nature of Operation or Duty Cycle

A time study is to be made on the various stages involved in the handling of containers from the quay side to consignee delivery. If for example, in a particular terminal using the straddle, the stacking yard is located at 800m away from the quay, assuming an average travelling speed of 20 km/hour for the straddle carrier, then a total travelling time to and fro would be 2 x 0.8/20 x 3600 = 288 sec = 4.8 min. The travelling time in this case forms a major proportion of the total cycle time of 6 min. It is obviously not economical to use the straddle carrier for the transportation part of the cycle as the tractor-trailer, a much cheaper alternative, could perform just as well. The straddle carrier could in this case be limited to the role of yard handling of containers.

Duty cycle analysis can also be use to dimension the KW ratings of motors, gear boxes and other components in the drive train. Very often, purchaser's specification only states requirement on the speeds of the major motions and the lift capacity. This information, however, do not fully determine the rating of the motors and other drive machineries. The purchaser will need to define as well the duty cycle of the machine in terms of number of cycles to be performed per hour and the path travelled by the load in each cycle. Only them would manufacturers be obligated to give adequate ratings for the various machineries.

Duty cycles is an important consideration especially the view of increasing traffic volume year by year which requires equipment to be worked harder and more frequently. Hence what has worked well in the initial stages of containerization may not be so anymore, as volume increases in later years.

### 5.2 Level of Maintenance skill and Degree of Sophistication of equipment

To keep machines running with high availability requires competence, sustained discipline and motivation among the maintenance staff – a situation not often found in the developing ports. Sophisticated power electronics are fine provided the terminals have the necessary technical expertise. There is no sense in seeking, for instance, a 5% improvement in performance when as a result of the increased sophistication and lack of a particular type maintenance expertise, availability goes down by 10%. Most developing ports, today, do not have power electronics engineers or technicians among their engineering staff.

It is of foremost importance when specifying equipment to keep simplicity in mind and do away with the frills as far as possible. An example can be given of the RTG crane for which varying degree of complexity and redundancy has been written into the specification of the machine, quite often without realizing their full implications. Many features have been adapted from the quayside gantry crane and are indeed superfluous for the RTG operation. Examples are:

- hydraulic flippers have often been specified for RTG spreaders while fixed guide arms would have sufficed.
- anti’s way systems with its hydraulics and complicated rope reeving may sometimes be dispensed with.
- Slewing, trimming mechanisms add considerable components and complexity to the hoist system.
- Auto steer systems for gantry travelling are often found to be out of order in many ports, resulting in the crane being driven manually.

### 5.3 Obsolescence Versus Advancement in Technology

One question that is increasingly being faced by developing ports is that of crane drive control for their quay cranes and RTG cranes. Static converter drive using thyristors fitted with microprocessor control (see Fig 15) are certainly making in-roads into container terminals. While large terminals have little qualms in switching over to the digital thyristor control, the small and medium sized terminals are faced with a dilemma whether to follow suit.

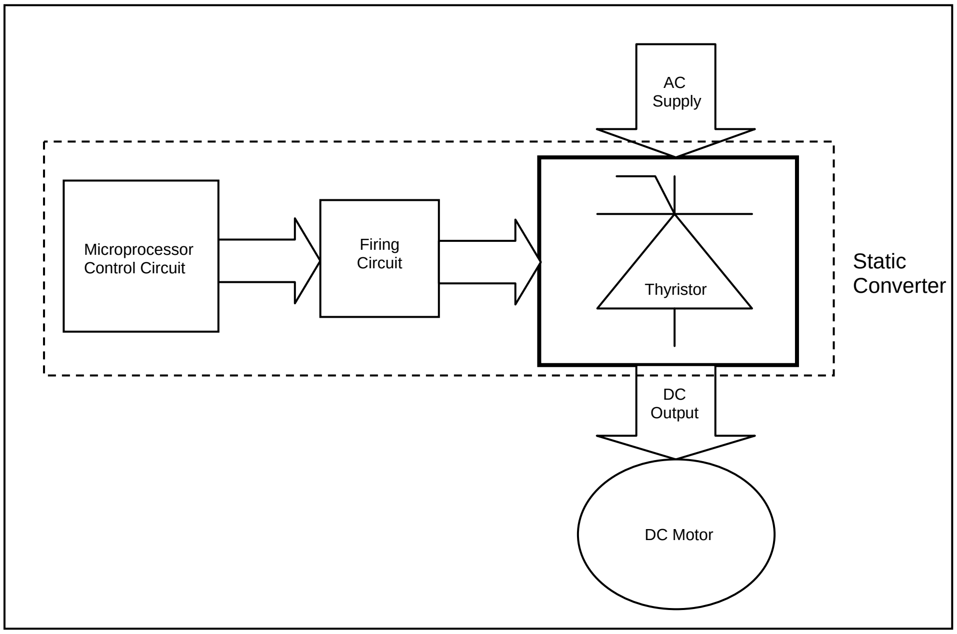


Fig 15: Static converter drive using thyristors fitted with microprocessor control

There are, no doubt, substantial benefits to be derived from the use of digital thyristor control:

- Less moving parts, therefore less maintenance and stocking of spare.
- More powerful and comprehensive diagnostics.
- Greater flexibility for future development, such as on-line data communication, and automation.

However, maintenance skill required will be of a higher level including the ability to conceptualise problems and diagnose faults.

Manufacturers of DC electric drive are, today, more in favour of promoting their digital static drive than the traditional Ward-Leonard Motor-Generator drive. I believe that in the long run, it would be more expensive to produce the Ward Leonard Motor-Generator drive than the digital static drive and hence there will be increasing pressure from both the crane manufacturers and the DC drive manufacturers on the users to switch over to the static drive. There is therefore a danger of the Ward Leonard Motor-Generator drive becoming obsolete and spare parts would be difficult and expensive to procure.

This is a trend which must be monitored closely by the developing ports and terminals. Electronics invasion of the container terminals is inevitable. It would be prudent for developing ports to strengthen their capability in electronics by retraining their staff or by means of recruitment.

5.4 Rational Analysis and Standardization

When specifying equipment for procurement it is important to critically examine each feature and relate it to the needs of terminal operation. Standardization is an important factor to be considered in purchasing a particular equipment so as to reduce the need to stock too many different spares and retrain the operation. However, standardization must be based on rational consideration. There is no sense in standardizing new equipment with the existing equipment when the latter is of the early generation type and may have features which are superfluous and ill-suited to the operation.

For example, I often come across RTG cranes equipped with a head block when there is hardly any need or any occasion to disconnect the spreader from the head block. The spreader on RTG crane is seldom subject to the same severe duty as on the quayside gantry crane, hence obviating the need for frequent replacement. It is in the interest of the user to reduce the live-load of the equipment as for as possible. A light weight spreader of 7.0m.ton as compared to a spreader/head block combination of 10.0m.ton gives a weight saving of 3m.ton. This saving is significant considering that the average weight of containers in most ports is only about 12m.tons. This weight saving can be translated directly into fuel saving and longer life of the machine.

Owing to the intense competition in the market today, equipment prices have been extremely depressed. Manufacturers are under tremendous pressure to price their products cheaply and then having secured a contract, they will be forced to source for the cheapest components in order to stay within the budget. This does not angur well for the end-user as quality of the equipment will be compromised. Furthermore, the all too frequent practice of licensee manufacturing or local subcontract manufacturing could also give rise to many quality problems.

All this means that specifications need to be more tightly written to reflect end user’s preference for particular makes of components. This would ensure that the end user could standardize on components of reputable makes.

6. MANUFACTURER’S ROLE IN INFLUENCING EQUIPMENT CHOICE

Manufacturers themselves play a key role in determining whether a particular handling system or concept would be widely adopted by the various terminals around the world. Much has to do with the marketing strategy used by a company in promoting the product. Many a good product does not take off in the market place because of incorrect marketing approach. Marketing to the developing ports could be a costly exercise for the manufacturer owing to low volume, scattered market and a long deliberation period in decisions. To succeed in the market, following conditions must be present:

- the price must be right. This means the product must be able to generate the necessary returns on investment for the buyer.
- Container handling, being a specialized field, requires specialized knowledge in selling to the end-users. Quite often, general trading companies have been appointed as local agents for specialized container handling equipment. This is often incorrect choice in selecting local representative.
- Local availability of spares, after-sales service and product support is a vital factor as the lack of such support would mean lengthy downtime for the equipment whenever a breakdown occurs.
- A great deal of patience and the commitment to work for long term goals is pre-requisite.

## 7. CONCLUSION

The quest for productivity and turn- around time improvement will no longer the concern of just the mainstream ports alone, but will also be that of the feeder ports. Full economics of the hub and spokes pattern of container shipping cannot be realized unless containers can be efficiently handled at both the load centers as well as the feeder terminals. Further, the worst of the shipping slump seems to be behind us. Recovery in shipping freight is likely to put pressure on the developing feeder ports to shorten the turn-around time of the ship so as to cut down the unproductive stay in port and increase its revenue generation.

Developing feeder ports could, on the other hand, take a more active role in influencing the shipping activity and shaping the pattern of shipping and interface with inland distribution. Many feeder ports have the potential of becoming mini-hubs or mini-load centres. Proper choice of container handling equipment that fulfils operation needs and yet able to live with the limitations of the developing port, need to be made. The correct choice of equipment is often not made by merely emulating the mainstream port on a reduced scale. No doubt, many lessons can be learnt from the success and failure of other ports in the use of particular type of equipment. Each port nevertheless needs to address fundamental issues and factors in the light of their own peculiar context and limitations.