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1. THE CHARACTERISTICS OF AND EFFICIENT INTERMODAL TERMINAL

This note examines the physical requirements and operational characteristics that are essential to the success of an intermodal terminal.

1.1 Terminal characteristics

Each intermodal terminal is different, yet all have common features:

- the differences between terminals arise from the nature and volumes of the freight that passes through the terminal, how the freight is handled and the extent of value adding activities that take place while the freight is within the intermodal terminal;
- the commonality between terminals arises from the need to perform similar process such as loading, storage and transfer.

1.1.1 Defining characteristics of intermodal terminals

The defining characteristic of intermodal terminals is the transfer of non-bulk freight between rail and road transport. The core services offered by an intermodal terminal include, but are not limited to:

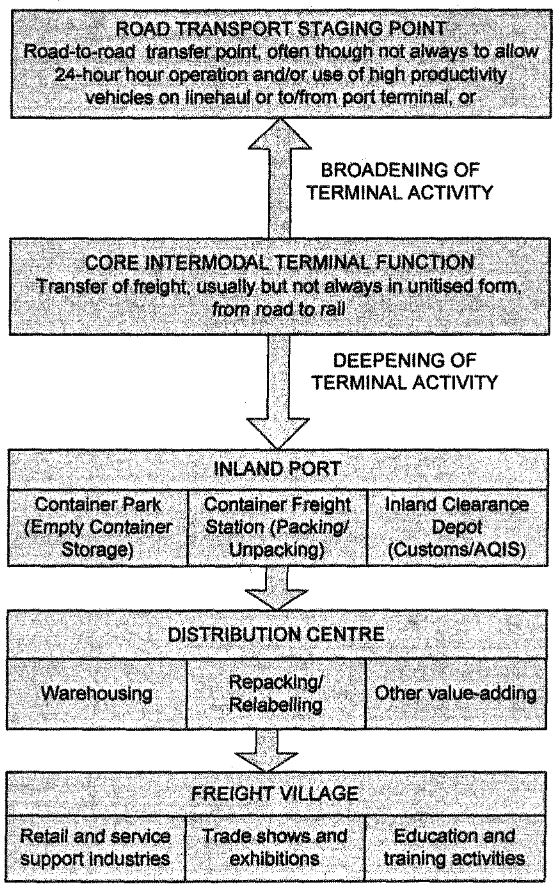
- a rail siding, spur or loop
- road access for trucks carrying containers
- working areas to allow containers and/or units to be removed from or loaded out to rail wagons
- hardstand for short term storage of empty or full containers
- provision and operation of the lifting equipment required to transfer containers to/from rail transport to the storage area (and in the case of inland terminals, from trucks to storage)
- management of both hard and soft infrastructure to facilitate the seamless movement of goods and containers through the facility. This includes a number of necessary support activities that take place at a terminal such as, maintenance of the infrastructure and machinery used on the terminal, traffic management associated with the road and rail (for a road/rail intermodal terminal) operations, control of access and egress by vehicles, and accepting, processing and generating transit and other documentation.

1.1.2 Scope of activities

Simple intermodal terminals confined to the core services above play an important role in facilitating the efficient movement of freight and in helping to achieve broader objectives of government such as encouraging greater rail participation in the freight task.

However, the range of activities that are undertaken in or in conjunction with, an intermodal terminal is potentially much wider. Figure 30 shows, this can entail both the broadening and deepening of the role of the terminal (or terminal-focussed complex).

FIGURE 1 OPTIONS FOR BROADENING AND DEEPENING INTERMODAL TERMINAL ACTIVITY



1.2 Design success factors

Irrespective of the particular set of ancillary activities that are co-located with intermodal terminals, there is no doubt that an increasing trend is to intensify the use of the terminal and its surrounding land for mutually beneficial economic and *sometimes* social activities. A number of characteristics are becoming increasingly common in the design of intermodal facilities. These include:

- positioning the rail siding, spur or loop so that it is capable of accessing nearby warehousing and distribution facilities
- having facilities for storage and handling of perishable goods
- co-locating road-to-road cross-docking activities to facilitate the dispatching of consignments into smaller loads for local delivery
- co-locating at the site, train support functions such as wagon storage, fuel, and maintenance, cleaning and crew facilities
- providing customer support services that reduce cargo handling and increase supply chain efficiency.

Other important factors are discussed in the following sections.

1.2.1 Availability of adequate area of land

Just as it is important to locate an intermodal terminal near to existing transport and logistics activities and other complementary industrial activities, it is also important to ensure the intermodal terminal has enough land to enable these parties to establish their operations either on site or nearby.

When land is made available to relevant markets, there is a tendency for industrial operations and other transport and logistics operations to gravitate to an intermodal terminal. Local examples of this phenomenon are seen at places such as Acacia Ridge and Kewdale (and the neighbouring areas of Forrestfield and Cannington), where Woolworths and Coles have established their distribution centres, or at Fishermans' Wharf where the land surrounding the Brisbane Multi-Modal Terminal – a near - dock rail facility – has been exploited for the development of a very broad range of complementary transport and logistics activities.

1.2.2 Co-location of ancillary logistics activities

The reciprocal attraction of trade through an intermodal hub and the co-location of activities that benefit from the proximity of the hub facilities are well documented. Take for example the comments below from a UK based study[1] on intermodal hubs:

"Rail linked warehousing allows for raw materials and finished products to be moved by rail for storage, processing and onward distribution. They may be used by single companies such as retailers, or as part of a logistics operation serving a range of customers. Onward distribution from the Strategic RFI can be by rail, but is most commonly by road.

There are economic benefits in businesses being located at Strategic RFI, by taking out the 'last-mile cost' - being the expense of the road link from the Strategic RFI to the warehouse or factory. The transport economics of businesses connected to rail at one or both ends of the freight movement are materially improved, significantly reducing the economic minimum rail trunk distance which businesses will find commercially acceptable."

1.2.3 Encourage road to road interchange

There are two reasons for attracting road to road interchange activities to an intermodal hub.

The first and most direct is to provide truck to truck staging facilities. These are important in helping freight forwarders and the port to better control the flow of freight between the port and the origin or destination of the freight. The intermodal hub acts as a staging post for temporarily storing large imported freight loads before they are transported in smaller consignments to disparate metropolitan destinations or moved to the port in time for shipment. Sometimes the staging post is a way of alleviating the difficulties that arise from differences of hours of operation. Although this use of the hub could involve extra handling and storage costs, these can be offset by higher truck utilisation, and greater predictability in pick-up and delivery times, and a smoothing out of the time profile of trucks in and around the port area.

[1] Strategic Rail Authority, *Strategic Rail Freight Interchange Policy*, UK, 2004, page 11

2. PHYSICAL AND OPERATIONAL REQUIREMENTS OF AN INTERMODAL TERMINAL

2.1 Topography

The preferred topography for an intermodal terminal is flat, well drained ground because rail tracks and gantry crane runways must be maintained perfectly level and container pavements should be flatter than 1:500.

The site should be geologically stable as any areas requiring filling may cause problems with differential settlement. Settlement will cause ongoing maintenance problems for the site owner and intermodal terminal operators.

2.2 Rail site layout

The rail terminal area is best placed if parallel/adjacent to the main line so that in the longer term it can be connected at both ends to main line. Connection at both ends is important to allow for rail operational flexibility and avoid a bottleneck at the main rail entrance. It also ensures that maintenance/failures of the turnouts at the main entrance don't close down terminal operation.

2.3 Container handling equipment

For a high throughput terminal the turnaround time for trains is critical. There is little that can be done to reduce arrival and departure shunting durations, therefore the pressure will be on reducing the unloading/loading duration.

The most efficient method of processing containers off and onto the train is by using gantry cranes. There are two types of gantry cranes; rail mounted gantry (RMG) cranes and rubber tyred gantry (RTG) cranes. The limitation with RMGs is that the runway rails must be perfectly straight and level. Therefore the sidings beneath must also be straight and parallel. Although RTGs have the advantage that they can operate along a curved alignment and even on slight gradients (up to 1:100 in extreme situations), recent advice from some terminal operators is that they want to avoid RTGs if at all possible because of their inherent higher maintenance requirements and longer down time.

The handling rate of RMGs can vary significantly depending on how sophisticated the equipment is and the efficiency of the rail operation and ancillary container delivery/removal processes.

It is possible to use heavy forklift trucks for smaller container volumes provided access is available to each rail siding. If there are two sidings with access from one side only then heavy lift reach stackers can be used. The time taken to process containers using either of these types of vehicles is much greater than Gantry Cranes. When train turnaround time in the terminal is not critical then forklifts and reach stackers can be used efficiently as they can also transfer containers to the warehouse and to the storage area.

2.4 Loading and unloading area configuration

The configuration of the loading/unloading area is dictated by:

- train length
- number of sidings

- area required for transitional container stacking, area required for road vehicle access
- area required for container manoeuvring for transfer to warehouse or storage area.

Typical train lengths for efficient operation in various intermodal submarkets are:

- Inter-state (~70%) - 1800m
- Inter-state (Expresses ~30%) - 1200m
- Intra-state (some also 800m) - 600m
- Port Shuttle - 300m

There are varying views on the most efficient loading/unloading area length. From a container handling point of view when interfacing to a warehousing facility the optimal length is approximately 600m. However, when considering that the predominant inter-state train length will be 1800m, a 600m length would require splitting the train twice. This is highly undesirable, particularly when rapid turnaround is required. It is not unusual to split 1800m trains into 2 rakes and therefore 2 sidings are required. As 30 per cent the inter-state trains are 1200m long and splitting them into 2 parts is undesirable, the siding lengths should ideally be 1200m.

Another advantage of providing 1200m sidings is that they can accommodate two 600m (intra-state) trains. It is therefore highly recommended that the site selected for unloading trains allow for 1200m long straight rail sidings. By providing double ended sidings intra-state trains can depart in any order. As there are presently both standard gauge and narrow gauge intra-state trains at least some of the sidings should be dual gauge. Therefore the overall length for the loading/unloading area will need to be approximately 1600m to allow for the sidings and the connecting track work.

Typically RMG operation requires the outgoing containers to be stacked under the RMG prior to train arrival and an isle available to stack incoming containers. Also a corridor is provided under the RMG for road vehicle access to allow direct transfer from train to truck. To allow for a combination of inter-state and intra-state trains with overlapping arrival and departure times and to achieve optimal throughput of the loading/unloading area, three sidings are required under the RMG.

A reasonable overall width of the loading/unloading area is approximately 60m. This is based on the following typical cross section:

- 20m wide container transfer isle (between container storage area and RMG leg)
- 8m wide isle for short term container holding area, stacked 2 wide by 3 high under RMG (allows space for RMG leg)
- 3m wide truck pavement
- 3m clear from edge of truck pavement to siding track centreline
- 4.2m between siding track centrelines
- 4.2m between siding track centrelines
- 3m clear from track centreline to RMG leg
- 4m from RMG leg to run-around track centreline (allows space for RMG leg)
- 3m clear from run-around track centreline to edge of maintenance access road

- 4m wide maintenance access road (allows for parking and unloading tools etc. from maintenance vehicle)
- 1m drainage/clearance to external security fence/boundary.

The loading/unloading area will therefore require a site approximately 10ha (58m x 1600m = 9.3ha). A 10ha site may also provide a small area for a refuge siding for defective wagons or other ancillary rail infrastructure. This area must be level so that all rail tracks are level to avoid run away wagons etc. and to minimise problems with shunting operations also to optimise container handling operations.

2.5 Arrival and departure tracks and relationship to main line

The interaction between terminal internal train movements and the main line should be minimised. It is also important that trains can move completely off the main line without delay and with minimal interaction with other activities in the container handling areas. This is best achieved by providing an arrival track long enough to accommodate the maximum train length (1800m). The most efficient arrangement is for the loading/unloading sidings to connect to the south end of the arrival track, via a ladder road / track fan.

A separate run-around track is desirable to avoid run-around movements on the main line (often such movements are not permitted). The run-around track would need to extend for the full length of the arrival road connecting to it at both ends. The run-around track would also need to extend to the south end of the loading/unloading sidings providing connection to the sidings and main line.

The arrival track and run-around track functions can be interchanged by using appropriate track arrangements. This then also allows for the arrival of a train on one track whilst preparing a train for departure on the other. Therefore they are often designated as a pair of arrival/departure tracks. To accommodate the predicted high numbers of intra-state trains, particularly narrow gauge trains heading south from the terminal, a pair of 800m long arrival departure roads will be required. All arrival/departure tracks should be dual gauge consistent with operating narrow gauge intra-state trains.

The corridor width for the arrival/departure tracks needs to be at least 22m. This will allow the two tracks at 6m centres along with vehicle access roads on either side. This spacing is necessary to accommodate signalling, drainage, access for track and rolling stock maintenance vehicles and inspection of the departing train from both sides. Additional width will be required if topography dictates cut or fill batters within the corridor.

As these are long narrow corridors (north end approx 2.2km long, south end approximately 1.2km long) there may be an opportunity for part or all of their width to be accommodated within the rail corridor. These tracks do not need to be straight and therefore can closely follow the main line alignment so long as they are level or as close as possible to level.

2.6 Intermodal Terminal Site Layout

A schematic layout of a large intermodal terminal with a capacity of 600,000 TEU per annum including the arrival and departure rail links, container storage and warehousing is shown below.