CHAPTER 6

Inland Intermodal Terminals and Freight Logistics Hubs

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**Abstract**

Transport planning and land use management are intricately engaged in the spatial design of nodes and links from origin to destination in the supply chain. The focus of this chapter is on inland facilities and it starts with defining terminology and concepts, followed by a framework for the planning of these facilities. The typical planning hierarchy used in supply chain management with the four levels of strategic, structural, functional and operational is used. The design of inland terminals and logistics hubs are normally done on structural level although much input is needed from the respective logistics functions such as transport, warehousing and materials handling on a functional level. Some operational aspects of inland intermodal terminals and freight logistics hubs such as logistics flows, conceptual design, value adding activities and the role of stakeholders are covered. A South African view on inland terminals and logistics hubs from the National Freight Logistics Strategy and the National Development Plan is also presented.

*Keywords: Aerotropolis, dry port, hinterland, hub, inland port, intermodal, logistics activity zone, logistics campus, logistics cluster, logistics park, port, port of entry and terminal.*

1 Introduction

1.1 Setting the scene

Transport planning and land use management are intricately engaged in the spatial design of nodes and links from origin to destination in the supply chain. Christopher [1] states that leading-edge companies have realised that the real competition is not company against company but rather supply chain against supply chain.
This implies that the location of the nodes and links are important to ensure that logistics costs are minimised in the supply chain.

The nodes consist mainly of intermodal terminals and freight logistics hubs which provide intermediate locations where logistics value is added to the movement of containers and freight in bulk or break-bulk. The links usually consist of road, rail, inland waterways or air that connect the respective nodes. The nodes and links form the mobility fabric that is of particular importance on freight logistics corridors that connect sea ports with hinterland origins and destinations.

The chapter starts with definitions and concepts related to the establishment and operation of inland intermodal terminals and freight logistics hubs. The next section suggests a suitable framework for the planning of these facilities and then operational aspects receive attention. The numerous stakeholders that should be engaged to ensure that the planning is integrated within the broader regional land use plans are discussed and product flows examined to understand the purpose of the facilities. A typical layout and conceptual operations of an intermodal facility are also provided.

South Africa has exceptionally high logistics costs and in recent years took the trouble in developing a national freight logistics strategy as well as in approving a national development plan that highlights the importance of efficient supply chains. The contents of these planning guidelines are briefly discussed as well as comments provided on the freight logistics industry in South Africa.

The subtitle of this textbook refers to an international perspective and the next section of this chapter investigates inland intermodal facilities in Europe, North America and Asia. The status and use of the facilities are covered as well as examples discussed of facilities that could be used as benchmark case studies. The characteristics of successful logistics clusters and the role of the government are also explained.

The final part of this chapter provides information on a South African case study of the Durban—Free State—Gauteng corridor where multiple inland intermodal terminals and freight logistics hubs have been identified as strategic integrated projects that are currently prioritised and supported by the national government.

A suitable summary is provided in the conclusion and a list of references indicates the sources of information explored.

1.2 Definitions

Inland intermodal facilities and freight logistics hubs are the nodes where logistics value is added to the movement of containers and freight in bulk or break-bulk. It makes sense to start with defining logistics and Fig. 1 provides a diagram which is useful in explaining the concept.

The inbound side is referred to as ‘supply management’ (originally called materials management) and includes the sourcing of raw materials, mostly handled in bulk and in large loads by rail or sea vessels. These raw materials are converted to work-in-progress in production facilities and transformed into finished goods that
are moved to central or regional distribution centres or local warehouses and depots. The outbound journey is referred to as ‘distribution management’ (originally called physical distribution) and includes storage and transport to the final customer or consumer.

The typical logistics functions or elements include transport, warehousing, inventory management, information systems, procurement, materials handling, order management, customer service, packaging and reverse logistics.

Supply chain management is the integration of all these logistics functions or elements from the suppliers of your suppliers upstream to the customers or consumers of your customers downstream. This implies integration across companies from origin to destination in the supply chain to ensure seamless and cost effective movement through the supply chain.

The most cost effective supply chain network is where total logistics costs are minimised, which implies usually in the case of centralised distribution, higher transport costs, but lower warehousing and inventory carrying costs, and in the case of decentralised distribution, lower transport costs but higher warehousing and inventory carrying costs.

The intermediary locations where logistics value is added include transport terminals, freight logistics hubs, logistics clusters and related facilities. Table 1 provides definitions for the most common terms.

It is clear from the list of definitions that the appropriate name for a facility such as an inland intermodal terminal or freight logistics hub should relate to the activities and functions performed at the facility. However, there seems to be no standardisation of terminology and not all facilities are accordingly defined.

In conclusion of this section, it is important to mention that the development of an inland intermodal terminal to a full-fledged integrated inland container port is
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<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>Aerotropolis</td>
<td>Analogous in shape to the traditional metropolis made up of a central city and its rings of commuter-heavy suburbs, the aerotropolis consists of an airport city and outlying corridors and clusters of aviation-linked businesses and associated residential development.</td>
<td>Aerotropolis [3]</td>
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<tr>
<td>Dry port</td>
<td>A dry port is an inland intermodal terminal directly connected by road or rail to a seaport and operating as a centre for the transhipment of sea cargo to inland destinations. In addition to their role in cargo transhipment, dry ports may also include facilities for storage and consolidation of goods, maintenance for road or rail cargo carriers and customs clearance services. The location of these facilities at a dry port relieves competition for storage and customs space at the seaport itself.</td>
<td>Wikipedia [4]</td>
</tr>
<tr>
<td>Hinterland</td>
<td>The remote areas of a country away from the coast or the banks of major rivers.</td>
<td>Oxford Dictionaries Online [5]</td>
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<tr>
<td>Hub</td>
<td>A central airport or other transport facility from which many services operate.</td>
<td>Oxford Dictionaries Online [5]</td>
</tr>
<tr>
<td>Inland port</td>
<td>The term inland port is used in two different but related ways to mean either a port on an inland waterway or an inland site carrying out some functions of a seaport.</td>
<td>Wikipedia [6]</td>
</tr>
<tr>
<td>Intermodal</td>
<td>Involving two or more different modes of transport in conveying goods.</td>
<td>Oxford Dictionaries Online [5]</td>
</tr>
<tr>
<td>Logistics activity zone</td>
<td>A zone where industrial or economic activity takes place, kept relatively separate from the other port zones and generally devoted to the logistics of sea-based cargoes.</td>
<td>Spanish State Ports Agency [7]</td>
</tr>
<tr>
<td>Logistics campus</td>
<td>Special type of logistics park with tightly coordinated operations by a single entity.</td>
<td>Sheffi [8]</td>
</tr>
<tr>
<td>Logistics cluster</td>
<td>Amorphous agglomeration of companies and facilities with logistics-intensive operations with fuzzy borders and no central management.</td>
<td>Sheffi [8]</td>
</tr>
<tr>
<td>Logistics park</td>
<td>Clearly defined ownership and geographic property boundaries.</td>
<td>Sheffi [8]</td>
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(Continued)
often done in phases rather than from green field to an integrated facility in one attempt. It is possible to start with an inland road based container terminal (single mode), then to add a rail siding over time and convert operations to intermodal service offerings, then to apply for port of entry status to be able to operate bonded warehousing and have customs officials on site, and eventually integrate all primary and secondary (or peripheral) value adding logistics services in one integrated inland container port.

1.3 Inland intermodal terminal concept

The inland intermodal terminal concept has been developed to integrate various individual components in adding logistics value at a facility that acts as an intermediary in the supply chain. This concept works on a ‘hub-and-spoke’ principle, where containers are received from various origins by unit or block trains to the central hub, and distributed to the destinations, usually by road. Benefits accrue to all parties by offering consolidation services for both imports and exports, as well as utilising the unit or block train concept, which streamlines the rail transport side significantly.

The rail service provider benefits by reduced down time on rolling stock, and increased efficiency, while the customer receives much better service levels. In addition, cost savings can be passed back to the end user in the form of contract or preferential rates. Peripheral services at an inland intermodal terminal can include the following:

- Container repair and refurbishment;
- Container cleaning and maintenance;
- Empty container storage;
- In-bond warehousing;
- Specialised warehousing (e.g. refrigerated, high security, liquid/bulk handling and storage);

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<tr>
<td>Port</td>
<td>A town or city with a harbour or access to navigable water where ships load or unload.</td>
<td>Oxford Dictionaries Online [5]</td>
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<tr>
<td>Port of entry</td>
<td>A harbour or airport where customs officers are stationed to oversee people and goods entering or leaving a country.</td>
<td>Oxford Dictionaries Online [5]</td>
</tr>
<tr>
<td>Terminal</td>
<td>The end of a railway or other transport route, or a station at such a point.</td>
<td>Oxford Dictionaries Online [5]</td>
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• General warehousing for less-than-container loads (LCLs);
• Cartage, delivery and pickup;
• Groupage (consolidation of loads);
• Shipping line container parks; and
• Specialised services such as export packing.

These value adding logistics services and more are depicted in Fig. 2 as spherical surfaces extending outward from the core infrastructure. The basic logistics services include intermodal transfer, loading and unloading and warehousing while value added logistics services include groupage, stuffing and destuffing of containers, clearing and forwarding insurance and container maintenance and repair. Once these services are available, commercial and financial services follow almost by default since it is required to sustain and serve the value added logistics services.

Benefits to the terminal operation occur because the terminal serves as the central point or hub around which all container movements and operations gravitate within the area. The flow of containers to and from the target area becomes more cost-effective and thus benefits the importer or exporter, making them more competitive in the global markets.

Figure 2: Value adding logistics services around the core infrastructure.
The terminal in itself is usually not a highly profitable business as the operation and equipment are very capital and volume sensitive. But the peripheral services linked to the terminal and its inherent efficiencies are those that can create significant return on investment.

Benefits to the main stakeholders include:

- **Freight managers:**
  The ability to get cost effective and reliable service at affordable rates. This allows for improved freight planning, resulting in reduced need for carrying stock, less carrying costs and reduced demurrage charges.

- **Container managers:**
  Centralised control of containers within the target area increases the possibility to reduce to total number of containers needed in the area to satisfy the demand. The central hub allows concentration of container movements, specifically for receiving empty containers and preparing them for export movements. It also facilitates container repair, maintenance and cleaning services to be centralised at the terminal.

- **Transport service providers:**
  The terminal makes it easier for the transport service providers, both on rail and road, to achieve economies of scale by operating from one central hub. This reduces unnecessary shunting with significantly improved turnaround times for rolling stock as well as road equipment, as the central hub allows for efficient loading or off-loading of the container.

- **Terminal facilities:**
  Integration of the supply chain from hub to hub is achieved by greater co-operation and pre-planning for consignments.

The cost of developing the facilities to facilitate the mentioned benefits obviously has to be balanced with the perceived value of increasing service levels and other quantifiable benefits.

### 1.4 Extended gate concept

Veenstra and Zuidwijk [9] mention that in 2004/2005 when the unpredicted surge of containers from China reached Europe, various container terminals became so congested that the drastic idea emerged of pushing blocks of containers away proactively to alleviate congestion. This idea was developed into the extended gate concept which is now implemented in many locations across the world.

The benefits of inland intermodal terminals have been discussed in the previous section but it has found another very useful application in the extended gate concept. Busy ports such as the Port of Rotterdam, Port of Antwerp and the Port of Durban are increasingly suffering from serious congestion of road trucks. Even rail services are struggling to handle the volume of containers.

It does not help to only increase handling capacity at the quay or even back-of-quay when volumes increase. Capacity has to be provided along the supply chain because the increased number of road trucks and trains that have to move containers to and from the quay have to be accommodated. Generally the current access
roads and railway lines as well as the entrance gates cannot cope with increasing volume rather than the quay or back-of-quay.

One solution is to shuttle the imported containers as fast as possible with road and/or rail away from the port to an inland intermodal terminal where the usual port functions and value added logistics activities can be performed. The gate of the port is then moved away into the hinterland where road trucks can pick up the containers destined for destinations inland. Rail shuttling is obviously the best to achieve economies of scale but road trucks with three twenty foot containers on interlink combinations can also work. Barges can also be used very successfully where inland waterways permit.

The same concept applies for export containers which are dropped at the inland intermodal terminal and then in effect taken into stack for shuttling to the quay when the vessel arrives. The central idea is to extend the delivery point along the corridor to the hinterland and to receive containers at the same point for controlled transfer of the export containers to the port. This concept has proved highly effective in alleviating not only congestion in the port precinct, but also locating secondary (peripheral) value adding logistics services such as warehousing and container depots at the extended gate to free up premium property in the port precinct for land use better suited for the primary activities at the port.

The extended gate concept is discussed in more detail by Konings et al. [10] and referred to as bundling of cargo (or containers) between two nodes in the supply chain. The feasibility of bundling systems in hinterland container traffic depends partly on the level of concentration in the port as well as the spread of origins and/or destinations in the hinterland. This concept applies to all three most common modes of transport for containers, namely road, rail and barges.

Notteboom [11] takes this concept further and suggests that seaport-hinterland interaction plays an increasingly important role in the provision of seamless supply chain solutions from origin to destination. He investigates port developments and logistics dynamics in Europe and addresses the different relationships between market players, port authorities, shipping lines, terminal operators, transport operators and logistics service providers. The conclusion is that competition between ports will increase and the role of terminal facilities, both seaport and inland ports, is expected to increase in the supply chain.

The extended gate concept is currently being implemented at many ports around the world and there seems to be much merit in moving the gate of the port inland to alleviate the congestion challenges in the port precinct.

1.5 Aerotropolis concept

A special form of intermodal terminal (inland or coastal) exists where the terminal is located next to or close to an international airport. At least three modes of transport are present, namely road, rail and air, but sea could be included if located at a coastal airport. Before we discuss the concept in more detail, it is important to understand the interaction of the different transport modes and where integration is possible and should be encouraged. Figure 3 provides the typical (albeit very
much generalised) relationship between load, distance and speed for the four most common modes of transport.

It is clear that road transport should be used for relatively small loads over relatively short distance, at relatively fast speed. Air transport provides very fast speed for small loads over medium to long distances. Rail transport is best suited for large loads over medium to long distance at moderate speed while vessels at sea are most suited for medium to very large loads over medium to very large distances, but at a relatively slow speed.

This relationship is fundamental to understanding the possible interaction of transport modes in intermodal terminals in general and in an aerotropolis in particular. The characteristics of road and rail allow overlap in suitability for relatively small loads over short to moderate distances. The same possibilities exist between rail and sea and to a lesser extent between road and sea. The interaction between those three modes is also reinforced by the role of road as feeder mode to rail and sea, and rail as feeder mode to sea.

The integration between air transport and the three modes is slightly different because of the very fast speed service that air transport provides. There would be little reason to take freight from a vessel or rail truck and fly it onwards, if it could have been flown from the start. The same applies for taking air cargo onwards by rail or sea. However, road definitely acts as feeder service for air and this is the most important intermodal interface to be considered.

Dr John Kasarda from the University of North Carolina’s Kenan-Flagler Business School is undoubtedly the most well-known specialist in developing the aerotropolis concept. Figure 4 provides a schematic presentation of the concept.
Figure 4: Aeropolis schematic [3]. Source: Dr. John D. Kasarda © aeropolis schematic.
The diagram shows the integration of various land use types such as logistics and industrial parks, warehousing and distribution centres, business parks with office space, retail, residential and manufacturing around the core airport city. The best example of such an aerotropolis is at the Schiphol International Airport hub in Amsterdam. This is currently being planned around the OR Tambo International Airport in Kempton Park as well as at the King Shaka International Airport as part of the Dube Tradeport in Durban, South Africa.

Kasarda [3] is of the opinion that the true challenge is proper planning to get the aerotropolis right and in the absence of appropriate planning, the airport area development will be spontaneous, haphazard, economically inefficient and ultimately unsustainable. He suggests that the aerotropolis model brings together airport planning, urban and regional planning, and business-site planning, to create a new urban form that is highly competitive, attractive and sustainable.

The aerotropolis concept provides for an interesting new perspective on the integration of transport planning and land use management. Previous development around major international airports could have been perceived as random or haphazard but the areotropolis concept brings structure and focus to this important node in the supply chain.

2 Planning Framework

2.2 Background

Inland intermodal terminals and freight logistics hubs have been established historically as extensions to existing facilities and in locations determined by previous land use patterns and developmental requirements. However, proper planning for developing such facilities has become a necessity for ensuring coherent and integrated development that will support and enable efficient supply chains.

Stock and Lambert [12] propose a useful framework for logistics planning in general and network design (including locating terminals and hubs) in particular. It is important to understand that not all decisions are taken at the same planning level with the same implications, and this framework is based on a hierarchy of decisions that suggests logistics decisions are made hierarchically in an iterative manner, starting on the highest level and then cascading down to the lowest level as indicated in Fig. 5.

The most important logistics functions or elements are shown in the diagram at the specific level where appropriate, starting with the strategic level, then structural level, functional level and finally the operational level. Some prefer to combine the structural and functional levels into a tactical level, but the four levels work well in logistics and supply chain management.

2.2 Strategic planning level

Planning should start at the strategic level where customer service determines the required service levels such as order lead times, service frequency, delivery lead
times, unit sizes and various other key performance indicators (KPIs) that impact the satisfaction of the customer. The timeframe for these decisions is multiple years (longer than three years) and usually taken with a long-term horizon in mind. Business objectives, marketing strategy also fits on this highest level. In the case of inland intermodal terminals and freight logistics hubs, these KPIs are important to inform the location decision and service to be expected from the facilities.

2.3 Structural planning level

Once the business objectives and customer service levels are known and agreed, the next level of decisions include make or buy preference (channel strategy decision such as outsourcing), number, size and location of depots, warehouses and other facilities as well as the design of the appropriate network for the particular supply chain. The timeframe is medium to long and usually covers one to three years. This is the level where decisions regarding location and functioning of inland intermodal terminals and freight logistics hubs should be taken and implemented.

2.4 Functional planning

The chosen structure in terms of channel strategy and network design defines the role and responsibility of the respective logistics functions of inventory management, warehousing, procurement and transport management. This suggests that inventory deployment can only be optimised once a particular channel strategy and network design has been adopted. The same applies to the warehouse strategy (centralised or decentralised), procurement strategy and transport management decisions, which are all dependent on the chosen channel strategy and network design. The planning horizon for the functional level is usually not longer than one year.
2.5 Operational planning

Operational planning is the short term (daily or weekly) decision horizon with agility and flexibility as inherent characteristics to ensure quick changes to the strategy. This includes decisions regarding support systems, loading, routing and scheduling, operating policies and procedures, materials handling, administration and control procedures. It is clear that operational issues can only be addressed once the functional planning has been done and clarity given on how the respective functions should operate.

3 Operational Aspects of Inland Intermodal Terminals

3.1 Stakeholders

Some of the stakeholders that are involved in the development and operation of an inland intermodal terminal have been mentioned in the earlier section on the definition of the concept but it is sufficiently important to justify a separate discussion on the various stakeholders. The most important and relevant stakeholders are shown in Fig. 6.

The public sector and relevant authorities represent the formal stakeholders that enforce legislation and also provide the economic environment conducive to efficient land use development. The public sector includes the national Department of Transport, local municipalities, National Roads Agency and the different provincial governments. Other authorities include customs, police services, different government departments responsible for *inter alia* health, environmental affairs, agriculture, fisheries and forestry as well as the Department of Trade and Industry.
National government should facilitate collaboration and clarify the roles and responsibilities of different stakeholders. However, implementation should occur at provincial and local government levels with support from the national government for the establishment of the core infrastructure as well as in providing a favourable tax regime such as free trade zone benefits.

The private sector is represented in the form of property owners, developers, consultants, contractors and civil society. Logistics service providers include clearing agents, transport companies, warehousing, vehicle repair facilities, empty container parks and cartage services.

All these stakeholders have a larger or lesser interest in the development and operations of the inland intermodal terminals and it has become virtually impossible to proceed with the development and implementation if the various stakeholders have not been engaged. One of the most important and potentially sensitive engagements could be with the Department of Environmental Affairs who are supposed to approve environmental impact assessments.

Experience showed that sufficient time should be allowed for stakeholder engagement as it usually takes much longer with more meetings with civil society than originally anticipated. However, the importance of stakeholder engagement should not be underestimated and done properly to ensure smooth implementation.

3.2 Role and function of dry port as intermodal node

Jaržemskis and Vasiliauskas [13] provide valuable background to the development of the dry port concept as intermodal node and they explain different terms used such as inland clearance depot, inland container depot, intermodal freight centre, inland freight terminal and inland port. Their definition of a dry port is similar to the definition given in Table 1 namely ‘a port situated in the hinterland servicing an industrial/commercial region connected with one or several ports by rail and/or road transport and is offering specialised services between the dry port and the transmarine destinations. Normally the dry port is container and multimodal oriented and has all logistics facilities, which are needed for shipping and forwarding in a port’.

The function of transport terminals, their location and terminal governance are covered by Rodrigue et al. [14] where they explore the role and importance of terminals with specific attention to port sites, airport sites, rail terminal sites and the difference between hinterland and foreland. They are of the opinion that there is a clear trend involving the growing level of integration between maritime transport and inland freight transport systems.

Jaržemskis and Vasiliauskas [13] suggest that the increasing problem of transporting goods to and from the port through the city, together with the expensive costs of establishing new docks have created preconditions favourable to establish hinterland terminals or dry ports. The activities and product flows of such dry ports are explained in Fig. 7.

Imported goods have to be consolidated in intermodal transport flows and exported goods have to be collected and consolidated into international transport.
Figure 7: Product flow diagram [13].
This implies that the dry port (or inland container terminal) has to provide hinterland warehousing, management of container flows (full and empty containers), reduced transport costs due to consolidation and various value adding logistics services usually offered at the coastal port.

In conclusion, dry ports have clear and definite roles to perform both for import and export of products to and from destinations located in the hinterland. The intermodal interface facilitates smooth transfer of goods and contributes towards cost reduction in the supply chain.

### 3.3 Conceptual design and layout of dry port

UNESCAP [15] presented a paper on the technical and operational issues related to the development of dry ports at the Regional Expert Group Meeting on the development of dry ports. It provides useful guidance on the main functions and classification of dry ports according to the function and services rendered at the respective facilities. It also provides guiding principles for the development and operation of dry ports and stresses the need for standards in design and layout. The physical layout often depends on the intended design capacity and transport modes that are engaged but the paper suggests a typical layout for rail-based dry port, as shown in Fig. 8.

Road trucks enter and leave through the entrance gate where receipt or delivery operations take place. A container freight station (CFS) provides for stuffing and destuffing of containers and facilities are provided for customs and other examinations. The container yard area includes a CFS shed and workshop with container repair area as well as the usual space allocated to empty, full and specialised containers.

The paper discusses import and export flow processes, operational requirements, suitable cargo and container handling equipment with specific reference to tractor-trailer system, lift truck system (front-end loaders or reach stackers), rubber tyred gantry crane and rail mounted gantry crane system.

This proposed layout can be recommended as it reflects the typical operations of a dry port sufficiently accurate. There could be need for customisation of specific operations due to topographical restrictions, design capacity and available modes, but in principle this can work well.

Technical design standards and operational procedures and guidelines affect the performance of dry ports and careful analysis and evaluation is needed to design the most effective system for the volume and type of containers to be handled. Figure 9 shows the typical operation of a rail mounted gantry crane in combination with a reach stacker.

This operation is used in most of the recently developed dry ports although it is important to note that rubber tyred gantry cranes and straddle carriers in addition to reach stackers are also used. Some smaller terminals work with trailer operations where containers are not stacked but kept on skeletal trailers however high volumes prevent this application.
INLAND INTERMODAL TERMINALS AND FREIGHT LOGISTICS HUBS

Figure 8: Typical layout of a dry port. Source: Adapted from UNESCAP [15].
4 South African Perspective

4.1 Freight logistics costs

The CSIR [16] found in their annual State of Logistics Survey for South Africa that logistics costs as a percentage of gross domestic product (GDP) have increased from 11.9 percent in 2010 to 12.6 percent in 2011. The trend is expected to continue with an estimated increase to 12.8 percent in 2012 due to largely the upward trend of transport costs. The figure of 12.6 percent in 2011 is significantly higher than the 8.5 percent in 2011 for the United States of America (USA) [17]. A breakdown of the components of 2011 logistics costs in South Africa is as follows:

- Transport: 61.0%
- Warehousing: 14.9%
- Inventory carrying costs: 12.2%
- Management and admin: 11.9%
- Total logistics costs: 100.0%

The transport costs of 61.0 percent are alarmingly high compared to the global average of less than 40 percent of logistics costs in 2010 [18]. Part of the reason could be that rail transport costs are relatively high in South Africa and a significant portion of freight is carried by road rather than rail. Rail was responsible for 29.3 percent and road for 70.7 percent of movements (calculated in ton-km) during 2011. The cost difference is just too small to justify switching modes.

This reality of relatively high logistics costs in general and transport costs in particular are of concern and the South African government is addressing the matter in the National Freight Logistics Strategy and the National Development Plan.

Figure 9: Intermodal container terminal operation.
4.2 National freight logistics strategy

The Department of Transport [19] has recognised a major shift from rail to road over the past decades and the National Freight Logistics Strategy has suggested that a corridor approach should be followed to optimise the freight logistics system. The important links between major production centres, points of entry and exit into the country and traffic consolidation points should be focused on because these will have the most significant effect on the freight logistics system. Inland intermodal container terminals and freight logistics hubs are typical traffic consolidation points and as explained in this chapter, are indeed useful concepts that can be used to optimise the freight logistics system.

It is important to note that the Department of Transport is currently considering updating of the National Freight Logistics Strategy. This will ensure that the strategy remains aligned with global trends and local freight logistics requirements.

4.3 National development plan

The National Development Plan [20] for South Africa is a plan for the country to eliminate poverty and reduce inequality by 2030 through uniting South Africans, unleashing the energies of its citizens, growing an inclusive economy, building capabilities, enhancing the capability of the state and leaders working together to solve complex problems. Chapter 8 of the plan deals with transforming human settlement and the national space economy and specifically refers to the development of a national spatial framework and the importance of a national competitiveness corridor.

This corridor of logistics hubs, road, rail, fuel and other infrastructure, including and connecting Gauteng and Durban, is vital to the future of the national economy, and should be designated as a national competitiveness corridor. It accounts for about 46 percent of GDP and should be integrated as part of the North-South Corridor stretching from Durban to Dar es Salaam.

Similar to the National Freight Logistics Strategy, the role of inland intermodal container terminals and freight logistics hubs has been recognised and specifically mentioned as a ‘corridor of logistics hubs’. It is clear that the importance of the mentioned facilities is understood and the way forward with development in South Africa will indeed include the effective implementation and operation of these facilities as part of infrastructure development. This is discussed in more detail in Section 9.

5 International experience in Europe

5.1 Status and use of intermodalism in Europe

The European Commission [21] published a White Paper on European transport policy for 2010 in which the linking up of modes of transport is discussed in great detail. They proposed the launch of a large scale program (Marco Polo) to support
intermodal initiatives and alternatives to road transport in the early stages until they become commercially viable. Intermodality will also require rapid introduction of a series of technical measures, particularly on containers, loading units and the profession of freight integrator (clearing and forwarding). Specific focus should be placed on maritime transport and inland waterways to reduce congestion of road and rail infrastructure.

The White Paper shares some interesting anecdotes of successes with the ‘Pilot action for combined transport (PACT)’ such as a new combined rail/sea link between Sweden and Italy, via Germany and Austria. This service takes some 500 000 ton per year off the busy roads and improves journey times significantly (by up to 48 hours). Another example is the rail/air services between Schiphol (Amsterdam) and Milan airports that have already taken the equivalent of 45 air freight pallets per week off the roads in their first year of operation. One last example is of the rail/sea service between Spain and Germany that avoids approximately 6 500 truck journeys per year on congested roads.

Konings et al. [22] suggest that the way forward for the development of intermodal transport in Europe is the combination of the top-down approach (European Commission policies and legislation) and a bottom-up approach, which is the identification of the needs of the intermodal transport market. A framework under which freight infrastructure investment can take place should be produced. Investment decisions in facilities (such as inland intermodal terminals) should be made by public bodies in collaboration with experts. The development of intermodal transport in the European Union is a long-term exercise but it is clear that intermodality is regarded as a priority in Europe.

5.2 Zaragoza logistics cluster

There are many examples of inland intermodal terminals in Europe but currently the best is probably PLAZA (Plataforma Logística de Zaragoza) in Spain. This is the largest logistics platform in Europe, managed by a joint venture whose main participant is the regional government of Aragón, which has the support of the Zaragoza City Government and two commercial banks. PLAZA is based on an intermodal transport centre (railways, roads and air routes) to provide a combination which makes Zaragoza one of the most important logistics cities in Europe, with connections to the most relevant European production and consumer centres.

This intermodal functionality reinforces the value of location and centrality of the premises, open to businesses which participate in activities related to logistics and who could benefit from common services which increase the profitability of its location. It also implies decisive synergies in the supply chains which are needed by all operators.

Sheffi [23] discusses the development of PLAZA and he investigates and explains the dynamics of this important logistics cluster in much detail. The first two major companies located in PLAZA were Zara, the fashion company and Caladero, the fresh fish company. Zara and Caladero operate their global logistics distribution
centres as major hubs which receive products from all over the world and dispatch it again in different form or consignments to destinations across the globe.

The regional government of Aragón and the municipal government of Zaragoza persisted with their mission to get political approval for the development of a logistics park next to an old military airport and today it is one of the best success stories with more than 10,000 direct jobs created in the logistics park, more than 160 companies already operating and a further 250 companies under contract.

South Africa is currently planning the development of inland intermodal facilities at locations in the hinterland where local economic activities will undoubtedly justify the investment. However, this benchmark in Spain clearly shows what is possible outside the traditional reliance on local or regional activity. It is indeed a world class example of the successful development of an inland intermodal terminal at a location which would normally not have been considered for this purpose.

6 International Experience in North America

6.2 Status and use of intermodalism in North America

The Annual State of Logistics Report of the CSCMP [24] reports a small decrease of 1 percent in ton-miles of rail transport in 2012 but intermodal volume was the second highest on record. Intermodal traffic is the growth sector in freight transportation in the United States with strong competition from road transport keeping the dates down on 2012. The previous Annual State of Logistics Report of the CSCMP [25] quotes Brian McDonald from Union Pacific who said ‘shippers are moving to intermodal because rail can deliver constant reliable service that is truck competitive, assure available capacity, ensure price stability and increase the efficiency of their supply chain’.

This opinion is shared by Carver, et al [26] who observed a definite growth in the development of inland ports, obviously as a result of increased use of intermodal transport. They suggest two trends that make inland ports increasingly viable:

- The fastest growing mode of transport in the United States has been intermodal. It is likely that rail and intermodal transport will continue to increase in popularity as economies of scale continue to improve for rail transport with rising fuel costs; and
- The trucking industry is taking strain with increasing fuel prices as well as shortage of drivers.

Major retailers such as Walmart and Home Depot have been able to save money by consolidating multiple distribution centres into smaller number of hubs with adequate logistics capacity located close to or at inland ports. The authors are further of the opinion that the expansion of the Panama Canal due for completion in 2014 will increase the need for moving containers promptly and in larger volumes to inland destinations closer to the markets. Inland ports will continue to evolve and grow as they provide the needed efficiencies in the supply chains.
6.2 Memphis logistics cluster

Sheffi [27] discusses the logistics cluster in Memphis as a good example of an inland intermodal terminal located next to the Mississippi river. Historically, the river provided a natural channel for bulk commodities such as petroleum, corn, wheat, soybeans, cotton, wood, coal and iron carried to and from the port of New Orleans on the Gulf of Mexico. Today Memphis continues as the barge and rail logistic hub and has grown to be the second largest inland port on the Mississippi river. It is also home to more than 400 trucking terminals but the relocation of the Federal Express in 1973 placed Memphis literally on the global map.

Memphis was a good choice for the establishment of a global hub for FedEx as it is centrally located halfway between the east and west coasts. This enables them to offer end-of-day pickup and beginning-of-day delivery. Air freight from the east coast leaves in the evening and arrives in Memphis during the early part of the night in local time. West coast air freight leaves in their evening and arrives late at night in local time, facilitating staggered arrivals with little congestion around Memphis airport and spreading the load on the sorting hub. It is also important to note that the weather in Memphis is mostly moderate as it is located far enough south to avoid severe winters but far enough north to avoid the hurricanes and tornados from the Gulf.

Geography is indeed important but the role of national, regional and local government should not be underestimated. Most of the success stories have much credit due to cooperation between all stakeholders to ensure smooth public and private partnerships needed for the development. FedEx moved from Little Rock in Arkansas to Memphis because of the apparent refusal of Little Rock airport authorities to expand their airport while the authorities at Memphis cooperated.

Similar to the Zaragoza logistics cluster, Memphis logistics cluster is typical of the broader phenomenon that is appearing in economies of more communities globally. Some are linked to clusters of industry but in most cases, logistics service companies locate operations in those industrial clusters to serve manufacturers, and in the process make the region more attractive to other manufacturers and value adding service providers.

7 International Experience in Asia

7.1 Status and use of intermodalism in Asia

UNESCAP and the Asian Institute of Transport Development (AITD) [28] published a monograph on the study towards an integrated transport network in Asia. Integrated intermodal transport has been a major policy issue of concern to the governments in Europe and North America for years but more recently, this approach has also been adopted by an increasing number of countries in Asia and the Pacific region.

The report quotes for example, the Chinese Tenth Five Year Plan and 2015 Long-term Programs of the Railway Scientific and Technological Development
specifies objectives and key tasks for the major role that Chinese railways are envisaged to play in the development of a national integrated transport system. It emphasizes the building of strategic research and development capacities in high-speed freight and passenger railways and covers the construction of new networks, improvement of efficiencies, development of IT and new management methods, achievement of social and safety objectives, as well as addressing the environmental protection issues.

India agrees with this approach and explicitly mentions the aim of following the Chinese example and foresees the development and integration of dedicated rail corridors, provision of multimodal service and high-speed services for freight and passengers, integration with urban transport systems, and highlights the major environmental benefits from the pursuit of a national integrated transport system.

The concept of intermodal connectivity has been promoted in Asia and the Pacific, through ESCAP’s Asian Land Transport Infrastructure Development project since the early 1990s. One of the outcomes of the ‘Seoul Declaration on Infrastructure Development in Asia and the Pacific’ of November 2001 was the agreement by the Ministers that they considered it essential that ‘Governments take a leading role in more effectively integrating the different forms of transport in order to develop sustainable intermodal transport systems that deliver efficient domestic transport services and at the same time provide access to international markets and wider hinterlands’.

Much has happened in Asia since this declaration and it is clear that Asia has caught up with Europe and North America in support of intermodalism. The global economic centre-of-gravity is moving to Asia and intermodal transport will become increasingly important to ensure efficient supply chains between production centres and the global markets.

7.2 Singapore logistics cluster

The previous international examples in Europe and North America were located inland but this example of Singapore was chosen as a world class benchmark of a freight logistics hub located on the southern tip of the Malaysian peninsula. Sheffi [29] shares some interesting facts about this logistics hub and mentions that it boasts of the world’s busiest transhipment port with about 85 percent of the containers never officially entering the country. A significant part of their economy comes from logistics activities built around the port and airport with by far the majority of goods flowing ‘through’ Singapore and not ‘to’ Singapore. This became a major logistics hub in the global trade networks because of geography, weather, culture and continuous investment by the government.

From a geography perspective, Singapore is very well located between the East Asian economies on the Pacific Ocean (China, Japan, Korea, Taiwan and Vietnam) and the South Asian and Western countries (India, Middle East, Europe and Africa). Historically, this was the hub for trade in Chinese silk, porcelain and iron with Indian and Arab textiles, glass and incense as well as Malaysian pepper and dyes.
The equatorial location guarantees reliable transport with almost no extreme weather, and from a cultural perspective, the cosmopolitan character reflects the reality of a multi-ethnic nation with English, Malay, Mandarin and Tamil as official languages. The city’s only reason for existence from the beginning was international trade.

Finally, it is important to mention that the government of Singapore undertook various infrastructure projects such as filling in beachfront space for road access, built breakwaters, replaced wooden piers with concrete, dredged deep channels and ports for larger vessels and filled in the sea between small outlying islands to create larger, more functional land. This resulted in an efficient freight logistics hub with advanced technology systems in place that facilitates the fast turnaround of deep sea vessels that tranship their cargo in this world class best practice facility.

8 Characteristics of Successful Logistics Clusters

Sheffi [30] concludes his discussion on logistics clusters with the following summary of the six attributes that are found in successful clusters:

- Favourable geography because of the economics of transport with origins and destinations that follow very specific geographical patterns;
- Supporting infrastructure because the cluster is as good as its transport network infrastructure;
- Supportive, efficient government because they are the main providers of public infrastructure such as roads, railways, ports and airports;
- Education, research and innovation because all economic clusters depend on qualified and competent people to do the work efficiently and effectively;
- Collaboration and unity of purpose amongst all stakeholders; and
- Value-added services that extend beyond moving and storage functions to include transformation or modification of goods.

The role of government has been mentioned a few times throughout the chapter and Table 2 provides a perspective of the role of government in the establishment of logistics clusters.

It is clear that government on national, provincial and local level has a significant role that should not be underestimated in the successful development and implementation of logistics clusters.

9 South African Case Study

This section provides an overview of the recent Infrastructure Plan that the South African government has approved. The content is based on a presentation by the Presidential Infrastructure Coordinating Commission (PICC) [31] at a Provincial and Local Government Conference on April 13, 2012. This case was chosen as it provides an excellent example of the importance of inland intermodal terminals
and freight logistics hubs on the most important freight corridor between Durban and Gauteng.

The Infrastructure Plan intends to transform the economic landscape of South Africa, create a significant number of new jobs, strengthen the delivery of basic services to the people of South Africa and support the integration of African economies.

PICC has done much work to assess the infrastructure gaps through spatial mapping which analyses future population growth, projected economic growth and areas of the country which are not served with water, electricity, roads, sanitation and communication. Based on this work, seventeen Strategic Integrated Projects (SIPs) have been developed and approved to support economic development and address service delivery in the poorest provinces.

This case study looks at SIP 2, the Durban–Free State–Gauteng Logistics and Industrial Corridor. The purpose of this project is ‘to strengthen the logistics and

Table 2: Role of government in the establishment of logistics clusters.

<table>
<thead>
<tr>
<th>Collaboration facilitator</th>
<th>Investment facilitator</th>
</tr>
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<tbody>
<tr>
<td>• Business case development for industry use of logistics hubs;</td>
<td>• Marketing and promoting of logistics hub area investment opportunities;</td>
</tr>
<tr>
<td>• Investigations to determine risks and facilitate an environment conducive to new trade and investment; and</td>
<td>• Facilitating required government processes and procedures;</td>
</tr>
<tr>
<td>• Promotion of supply chain development, local industry collaboration and cluster formation.</td>
<td>• Enabling access to information and pro-actively communicating with potential investors and stakeholders to enhance understanding of risks and opportunities; and</td>
</tr>
<tr>
<td></td>
<td>• Providing incentives.</td>
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<tr>
<th>Development facilitator</th>
<th>Building partnerships with development facilitation companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Road and municipal services planning and infrastructure investment;</td>
<td>• Establishment of partnerships with companies that have experience, financial and technical skills of facilitating large scale logistics and distribution developments involving multiple stakeholders.</td>
</tr>
<tr>
<td>• Land use and development management; and</td>
<td></td>
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<tr>
<td>• Information provider regarding local government town planning procedures and requirements, land availability, technical and planning constraints.</td>
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<th>Performance management convenor</th>
<th>Investor</th>
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<td>• Facilitate the systematic and regular measurement of the performance of intermodal service providers.</td>
<td>• Invest in infrastructure, including roads, water and electricity supply and supplementary urban management services jointly with the private sector.</td>
</tr>
</tbody>
</table>

Source: Adapted from working papers of the National Freight Logistics Strategy [19].
transport corridor between South Africa’s main industrial hubs, improve access to Durban’s export and import facilities, raise efficiency along the corridor and integrate the Free State Industrial Strategy activities into the corridor and integrate the currently disconnected industrial and logistics activities as well as marginalised rural production centres surrounding the corridor that are currently isolated from the main logistics system’.

The content of the draft SIP 2 Integrated Business Plan [32] might change but currently inland freight terminals that could serve Gauteng and countries to the north of our border are identified as key components of the SIP 2 corridor.

The business plan suggests that most of the projects in the corridor should be clustered around the various intermodal hubs (inland and port) that populate the corridor, as shown in Fig. 10.

Currently, the projects are clustered in the following three regions:

- Northern Region (Gauteng);
- Central Region (Free State); and
- Southern Region (KwaZulu-Natal).
All projects except the Conurbia Integrated Settlement project can be classified as intermodal terminals or freight logistics hubs. Two projects that are not part of SIP 2 but have an impact on the SIP 2 corridor are shown in grey (SIP 11 and SIP 17). Reference is also made to the electricity transmission, multiproduct pipeline, the rail corridor and the N3 highway which are obviously not terminals or hubs. However, it is clear that the SIP 2 corridor is dominated by intermodal container terminals and freight logistics hubs.

Most of the facilities are in the planning stage although Dube Trade Port and upgrades in the Port of Durban have already started. Tambo Spring mega hub in the northern region, Harrismith logistics hub in the central region and Cato Ridge dry port in the southern region are probably most advanced in planning and implementation may start soon.

It is important to note that the characteristics of the project clusters are different and the business cases for the respective projects will be different. Table 3 provides an indication of some of the salient features of the terminals and hubs in the different regions.

This case study is an example of how a collection of various terminals and hubs should be integrated on one corridor to achieve lower logistics costs, smooth supply chain integration and provide the opportunity of making South Africa more competitive in global trade.

10 Conclusions

The purpose of this chapter was to investigate and discuss the role of inland intermodal terminals and freight logistics hubs. The different terms and concepts were defined and special attention given to the extended gate concept and the aerotropolis. A planning framework was suggested and operational aspects of stakehold-
ers, flow of products, layout and conceptual design covered. A South African perspective on freight logistics with reference to policy and planning guidelines explained current relevance and then some international examples on intermodalism in Europe, North America and Asia were considered with some characteristics of successful logistics clusters and the role of government. Finally, the intermodal facilities along the Durban–Free State–Gauteng corridor were shown as a good example of the development of inland intermodal terminals and freight logistics hubs in South Africa.

References


