TRADE AND TRANSPORT COSTS: THE ROLE OF DRY PORTS IN SOUTH AFRICA

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ABSTRACT

The movement of passengers, goods, and information has always been fundamental components of human societies. It is all related to transport costs as well as to the attributes of what is being transported. However, regulations, laws, and tariffs can influence transportability. Countries around the world have been changing their international trade policies by reducing both tariff and non-tariff barriers. Informal barriers hinder trade and the benefits of export, such as economic growth, that come with the achievement of trade liberalisation. It was found that the impact of transport costs on trade patterns has become an important study. Theoretical and empirical work in international trade only recently began considering the geography of exports as a possible explanation for high transport costs. For instance, factors such as distance, market size, scale economies, and agglomeration affect transportation costs around the world.

Transport costs in South Africa are a relevant issue due to its geographical position. South Africa is situated far from its major trading partners. In addition, the majority of South African exports originate in Gauteng, which is around 600km from the nearest seaport. For South African exports to remain competitive, domestic transport costs must be reduced. One method of cutting costs is by connecting a container dry port with an intermodal transport system to the major seaports (namely Durban, Port Elizabeth, and Cape Town).

The empirical study was conducted in the form an interview-based questionnaire. A total of 18 questions were asked to individuals at a terminal in Gauteng. The purpose of the questionnaire was to gather information on the service delivery of South African inland terminals. This led to the conclusion that City Deep functions well in terms of service delivery and provides extra services to both exporters and importers. Potential problems regarding City Deep's infrastructure were identified. It was found that train and truck

congestion within City Deep is an everyday phenomenon. The existing infrastructure cannot handle the train and truck traffic entering City Deep. It was found that clients prefer road transportation to rail transportation, therefore, the amount of trucks entering and leaving City Deep causes congestion. This not only affects the infrastructure at City Deep, but also that of South Africa. More trucks on the roads excacerbate air pollution and road accidents, and overloaded trucks damage South African roads.

As for more inland terminals or dry ports, the government needs to invest more in the existing infrastructure, as the export volumes do not justify the cost of building a new inland terminal. This answers the question of whether dry ports can lead to a reduction in transportation costs. Dry ports have the benefit of the modal shift from train to truck and focus on containerisation. Therefore, City Deep and the South African logistics system should focus on promoting rail transportation, so exporters and importers will rely on both modes for the transportation of goods. This will also enable South Africa to move onto better and more competitive global transport chains.

Keywords: transportation costs, containerisation, port efficiency, dry ports, inland terminals, South Africa, City Deep.

OPSOMMING

Die beweging van passasiers, goedere en inligting was nog altyd een van die fundamentele aspekte van 'n gemeenskap. Dit het alles te doen met vervoerkostes en die eienskappe van dit wat vervoer word. Regulasies, wette en tariewe kan egter vervoerbaarheid beïnvloed. Lande regoor die wêreld het hul internasionale handelsbeleide begin verander deur beide tarief- en nie-tarief grense te verskuif. Informele grense strem handel en die voordele van uitvoer, soos ekonomiese groei, wat hand-aan-hand met die liberalisering van handel gaan. Daar is bevind dat die impak van vervoerkostes op handelspatrone 'n belangrike studie geword het. Teoretiese en empiriese navorsing in internasionale handel het eers onlangs die geografie van uitvoere as 'n moontlike rede vir hoë vervoerkostes begin oorweeg. Faktore soos afstand, markgrootte, skaalekonomieë en agglomerasiekostes affekteer vervoerkostes regoor die wêreld.

Omdat Suid-Afrika so ver van sy primêre handelsvennote geleë is, is vervoerkostes 'n relevante kwessie vir die land. Daarmee saam kom die meerderheid uitvoerware van Gauteng af, en die provinsie is sowat 600 km vanaf die naaste hawe geleë. Indien Suid-Afrika steeds mededingend wil uitvoer, sal binnelandse vervoerkostes verlaag moet word. Een van die maniere waarop kostes besnoei kan word, is om 'n binnelandse houerhawe met die primêre hawens (Durban, Port Elizabeth en Kaapstad) te verbind deur middel van 'n intermodale vervoerstelsel.

Die empiriese studie is in die vorm van 'n onderhoud-gebaseerde vraelys uitgevoer. 'n Totaal van 18 vrae is aan individue by 'n terminaal in Gauteng gestel. Die doel van die vraelys was om inligting te bekom rondom dienslewering by binnelandse terminale in Suid-Afrika. Hieruit is bevind dat dienslewering by City Deep glad verloop, en dat daar selfs ekstra dienste aan in- en uitvoerders gebied word. Die inligting het egter op potensiële probleme rakende City Deep se infrastruktuur gedui. Daar is bevind dat City

Deep daagliks opeenhopings in vragmotor- en treinverkeer beleef. Die huidige infrastruktuur kan nie hierdie daaglikse verkeersvolumes hanteer nie. Kliënte verkies padvervoer bo spoorvervoer: dit is die rede vir die groot hoeveelhede vragmotors en die gepaardgaande opeenhopings. Dit affekteer nie slegs City Deep se infrastruktuur nie, maar ook dié van Suid-Afrika. Verhoogde vragmotorverkeer vererger lugbesoedeling en padongelukke, en oorlaaide trokke beskadig die land se paaie.

Wat meer binnelandse hawens of terminale betref, moet die regering eerder belê in bestaande infrastruktuur: die huidige uitvoervolumes regverdig nie die kostes wat die oprigting van 'n nuwe binnelandse hawe sou behels nie. Kan binnelandse hawens dus lei tot 'n verlaging in vervoerkostes? Binnelandse hawens het die voordeel van 'n modale skuif tussen vragmotor en trein, en 'n fokus op behouering. Dus moet City Deep en die Suid-Afrikaanse logistieke sisteem eerder poog om spoorvervoer te bevorder, sodat in- en uitvoerders op beide modusse sal begin staatmaak om hul goedere te vervoer. Dit sal Suid-Afrika in staat stel om vorentoe te beweeg na beter, meer kompeterende globale vervoerkettings.

Sleutelwoorde: vervoerkostes, behouering, hawedoeltreffendheid, binnelandse hawens, binnelandse terminale, Suid-Afrika, City Deep

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INTRODUCTION

Transport costs are an inevitable part of any export transaction and have been empirically found to influence exports negatively. Research has also indicated that the impact of domestic transport costs on exports is more severe than international transport costs. One method of minimising domestic transport costs is by means of containerisation. The purpose of this study is to evaluate the South African inland ports service delivery in terms of port efficiency, to reduce inland transportation costs and promote containerised transport. It assesses the role played by dry ports in the South African export infrastructure in order to promote intermodal transportation, which would improve South Africa's competitiveness and integration in the global market.

Transport costs in South Africa are a relevant issue due to its geographical position. South Africa is situated far from its major trading partners. Also, the majority of South African exports originate in Gauteng, which is around 600km from the nearest sea port. For South African exports to remain competitive, domestic transport costs must be reduced. One way of doing this is by linking a container dry port with an intermodal transport system to the major seaports (namely Durban, Port Elizabeth, and Cape Town).

City Deep is the primary dry port in South Africa and is connected to the major seaports in South Africa by an intermodal transport system. City Deep may reduce transportation costs in South Africa, as it provides the transport infrastructure for containerisation. However, significant investments are required to support the existing infrastructure in order to promote port efficiency.

This chapter describes the wider context of the study and delineates the problem (section 1.1) and research objectives (section 1.2). The method (section 1.3) and outline of the study (1.4) is also described.

1.1. PROBLEM STATEMENT

1.1.1. The link between trade and economic growth

The production and export of manufactured goods is advantageous to the economic growth and development of a country (Edwards, 1997). Some of the reasons for this include the benefits that come from greater competition and efficiency (Foster, 2006). However, the movement of goods and services depend on a good and reliable transport network (Rodrigue, Comtois & Slack, 2006). Transportation services and thus, transport costs, are important determinants of trade performance (Chasomeris, 2004). Perkins, Fedderke and Luiz (2005) confirm that infrastructure services, especially ports, railways and roads, promote economic growth in South Africa.

Economic growth, on the other hand, provides the resources and demand for various types of infrastructure projects. Radelet and Sachs (1998) demonstrate that lower transport costs imply faster growth in manufactured export and in the general economy. Limão and Venables (2001) indicate that if transport costs increase by 10%, the country's trade volume reduces by approximately 20%. Naudé and Matthee (2007) provide empirical evidence of the impact of domestic transport costs on both manufactured exports and the spatial location of such exporters. Their key finding was that domestic transport costs increase the further away exporters originate. Thus, domestic transport costs increase with distance. Elbadawi, Mengestae & Zuefack (2001) found that domestic transport costs are a stronger constraint on exports than international transport costs.

1.1.2. Trade, transport costs and infrastructure

The high cost of domestic transport may be an important obstacle to trade, especially to firms trading in manufacturing goods (Limão and Venables, 2001). Steep domestic transport costs are due to manufacturing businesses being far from ports, landlocked provinces, and the lack of an effective transport platform (Naudé and Matthee, 2007). Transport infrastructure fulfils a vital role in linking cities with ports (Anon., 2002). Thus, an effective transport and logistics platform may result in the reduction of transportation costs. This will give companies the opportunity to distribute their products to and from seaports and so obtain economies of scale (Anon., 2002). According to Bougheas, Demetriades & Morgenroth (1999), transport costs are not only a function of distance but also of the availability of public infrastructure. Transport infrastructure plays an important role in landlocked provinces (Limão and Venables, 2001). Infrastructure projects should increase the efficiency of modal shifts from road to rail transport, and decrease the cost of containerised cargo movement.

According to Hoffmann (2002), transport costs are a major component of GDP (gross domestic product) and have risen in relative importance for export competitiveness. According to Micco and Pérez (2001) transport costs make up approximately 5% of the global trade value.

Therefore, it is evident that transport costs are a growing global concern. However, various methods have been developed to minimise the elements of transport costs, like, cargo handling costs and stevedoring costs. The central question of this chapter is, therefore, which factors can contribute to a reduction in transportation costs? The answer is containerisation. Containerisation is responsible for profound mutations in the transport sector: the reduction of handling time and labour costs, allows for considerable increases in speed of rotation (Rodrigue *et al.*, 2006). It all contributes to a reduction in transport costs.

1.1.3. The case of South Africa

Although South Africa is an upper middle-income country, both road and rail, as basic indicators of transport infrastructure performance, show worse performance when compared with other upper middle-income countries. According to Bogetic and Fedderke (2005), transport performance in South Africa is comparatively weaker when compared to other country groupings. South Africa lags behind in all four major infrastructure sectors, especially in electricity and sanitation (Perkins, Fedderke & Luiz, 2005). The services provided by infrastructure, such as transportation services, are fundamental for economic growth in South Africa (Bogetic and Fedderke, 2005). Only 21% of South African roads are paved; this is lower than Sub-Saharan Africa's 25%.

South African railway lines measured 20 796 route kilometres in 2003, and the average annual growth rate was approximately 2%. However, in terms of quality and performance, railway services are lagging behind. For example, the average annual growth rate for railway lines was 29% between 1875 and 1885 (Fedderke, 2005). Limão and Venables (2001) confirm that poor transport and communication infrastructure isolates countries. They estimated that landlocked countries have a lower average GDP than coastal economies.

Transport costs are important for South Africa. South Africa is a halfway-point between the Far East and Europe, and this implies that international transport costs have a negative impact on South African exports (Matthee, Naudé and Krugell, 2006). South Africa's spatial distribution of economic activity is highly uneven. Approximately 70% of South Africa's GDP is produced in only 19 of the urban areas (Naudé and Krugell, 2005). Naudé and Matthee (2007) also examined the spatial distribution of exports in South Africa. They observed that between 70% and 98% of exports from magisterial districts is generated within 100 km from the export hub.

This contrasts with the theory stating that exporters will locate closer to ports in order to minimise transport costs (Matthee *et al.*, 2006). The reason for this is that distance creates transport costs, which in turn influence the location decisions of firms that produce manufactured export goods (Naudé and Gries, 2004). The heart of South African business and finance is concentrated in the Gauteng province, which is an inland province. Gauteng produces 32.7% of South Africa's GDP (Naudé and Krugell, 2005). Gauteng is also 600 km from the nearest seaport, which is the port of Durban. Thus, domestic transport costs to and from Gauteng are a significant component of trade costs.

Since 1994, South Africa has become an active competitor in the global market. The country lies within the top twelve international trading nations, and trade helps to shape economic growth and development. However, the majority of South African manufactured exports have their origin in Gauteng and are exported via seaports. This means that exporters located further from a seaport incur higher costs. Earlier studies have shown that domestic transport costs matter, and influence the competitiveness of exports in South Africa. This gives rise to concept of the dry port as an important inland terminal in aiding the efficiency of intermodal transport, as well as access to and from seaports. This dissertation analyses the role played by dry ports in South Africa's export infrastructure. The question is whether dry ports can contribute to lower domestic transport costs and increase exports.

Martínez-Zarzoso, Gracía-Menéndez & Suárez-Burguet (2003) confirm that distance from seaports is important. Transport costs increase by approximately 0.25% for every 1% increase in distance. However, as stated earlier, transport infrastructure may reduce transport costs. This raises the question: can dry ports mitigate transport costs?

1.2. RESEARCH OBJECTIVES

1.2.1. General objective

The general objective of this research is to investigate the role and evolution of dry ports as part of South Africa's export infrastructure.

1.2.2. Specific objectives

The specific objectives of this research are:

1. To highlight the importance of exports for economic growth
2. To discuss the impact of domestic transport costs on exports with the emphasis on dry ports. Dry ports are seen as a method to reduce domestic transportation costs
3. To discuss elements of an inland container terminal as a means of promoting port efficiency
4. To provide an overview of South Africa's exports and transport infrastructure, including a description of all ports in South Africa and their volumes and roles in trade
5. To provide an overall description of South Africa's dry port (City Deep) and its functioning
6. To formulate an empirical evaluation (i.e. a case study) on dry ports in South Africa, focusing on the advantages and disadvantages. The case study will provide background on operations, and identify advantages and disadvantages of such an operation
7. To conclude and make recommendations

1.3. RESEARCH METHOD

Few studies have been done on dry ports as part of the South African export infrastructure. The aim here is to provide a literature review of the role of dry ports as an important driver for the improvement of port efficiency and the minimilisation of transport costs.

The research will consist of both a literature survey and an empirical study.

1.3.1. Literature study

The literature study will be done against the theoretical background of the impact of transport costs and infrastructure on economic growth, and will include a description of the functioning and role of dry ports around the world.

1.3.2. A case study will be done on South Africa's major inland terminal, City Deep.

The case study is formulated based on an interview with one of the companies operating in City Deep. The company will remain anonymous for the sake of confidentiality. The interview will take place on the company's premises. The operational manager of the company will answer the questions based on the questionnaire described in section 5.3.1. After the question-and-answer session, a tour of the premises will be given. During the tour the advantages and disadvantages of the operational framework will be discussed.

1.4. DEMARCATION OF THE STUDY

In chapter 1, the background and problem statement of this study will be outlined. The link between economic growth and exports, as well as the impact of transportation costs on exports, will be discussed. An overview of transportation costs around the world will be given, along with a discussion of the role of dry ports in the performance of South African infrastructure. The purpose and method of this study will then be outlined.

In chapter 2, the importance of export for economic growth will be highlighted. The theories of trade liberalisation and reduction in trade barriers will be discussed according to the literature available on these topics. This chapter will attempt to focus on transport elements as methods of reducing transportation costs. The role of containerisation in the minimilisation of transportation costs will also be considered. Containerisation reduces cargo-handling costs by consolidating numerous break-bulk parcels into a single unit. Containerisation is responsible for profound mutations in the transport sector, in other words, it reduces handling time of goods, allows for increases in speed of rotation along a circuit, and thus entails a better optimisation of time and money. Transport costs are an inevitable part of any export transaction and have been empirically found to influence exports negatively. Research will indicate that the impact of domestic transport costs on exports is more severe than international transport costs. One method of minimising domestic transport costs is through containerisation. Chapter 2 will come to the conclusion that dry ports provide the transport infrastructure to support containerisation.

In chapter 3 it will become evident that the most appropriate manner of connecting a dry port with a seaport, is with an intermodal transport system, as it reduces domestic transport costs. Chapter 3 will also highlight the elements of an inland container terminal as a means of promoting port efficiency. Insight into inland transportation modes and container terminals will be provided. It will be shown that both multimodal and intermodal transportation systems could be a worthwhile alternative to unimodal transportation.

Multimodal is referred to as the use of more than one transport mode for inland transportation of goods and containers. The main factors behind cost reductions will be indicated as residing in the speed and flexibility incurred by intermodal transportation. However, intermodal transportation incurs social costs. Therefore, the social costs of intermodal transportation will be assessed and the driving factors behind these costs will be discussed.

In chapter 4 the focus will shift to South Africa. The South African economy opened up in 1994 and policies aimed for export-led growth. Transport costs in South Africa are a relevant issue due to its geographical position. South Africa is situated far from its major trading partners. In addition, the majority of South African exports originate in Gauteng, which is around 600km from the nearest seaport. For South African exports to remain competitive, domestic transport costs must be reduced. One method of achieving this is by connecting a container dry port with an intermodal transport system to the major seaports (namely Durban, Port Elizabeth and Cape Town).

Chapter 5 will have a dual purpose. The first purpose will be to provide an overall description of City Deep (South Africa's dry port) and its functioning. The second objective will be to present a case study of City Deep. The case study will provide background on operations, identify the advantages and disadvantages of such an operation, and finally make recommendations on how domestic transport costs can be reduced. In short, City Deep will be discussed as a means of promoting inland transportation of containers and the handling of containerised traffic in order to achieve port efficiency.

Chapter 6 will provide a summary, conclusions and recommendations.

CHAPTER 2

TRADE AND TRANSPORT COSTS

2.1. INTRODUCTION

The movement of passengers, goods and information has always been fundamental components of human societies (Rodrigue, Comtois & Slack, 2006). It is all related to transport costs as well as to the attributes of what is being transported. However, regulations, laws and tariffs can influence transportability. According to Micco and Pérez (2001), countries around the world have been changing their international trade policies by reducing both tariff and non-tariff barriers. Informal barriers hinder trade and the benefits of exports, such as economic growth that come with the achievement of trade liberalisation (Frankel and Romer, 1996).

Porto (2005) studies the impact of informal trade barriers, such as transport costs, on poverty. He finds that for OECD (Organisation for Economic Co-operation and Development) countries, the cost of trading is amongst the most important barrier to trade facilitations. Therefore, the impact of transport costs on trade patterns has become an important study for many (Hoffman, 2002). Theoretical and empirical work in international trade has only recently begun to consider the geography of exports as a possible explanation for high transport costs (Matthee and Naude, 2007). For instance, Matthee *et al.* (2006) explain that factors such as transport costs, distance, market size, scale economies and agglomeration have only recently been incorporated into trade models.

Krugman (1980) makes his contribution to economic theory by modeling the patterns of trade by means of the "home-market" effect. He also finds that transport costs are the determining factor of the "home-market effect". Therefore, by locating near the largest market, industries are able to achieve increasing returns to scale and at the same time minimise their transport costs. The general consensus in literature, from both theoretical and empirical work, is that transport costs affect both trade and economic development (Micco and Pérez, 2001). According to Van Eldik and Viviers (2006), a country's growing exports are able to stimulate economic growth and increase employment and specialisation. A number of notable studies have also focused on the link between exports and economic growth. For instance, Foster (2006) finds that manufacturing exports may be good for economic growth. Nevertheless, the impact of transport costs is on the increase. According to Hoffmann (2002), transport costs are a major component of GDP and have risen in relative importance for export competitiveness. According to Micco and Pérez (2001), transport costs make up approximately 5% of the global trade value.

From this it is evident that transport costs are a growing global concern. However, various methods have been developed to minimise the elements of transport costs. Examples of these are cargo handling costs and stevedoring costs. Thus, the central question of this chapter is; which factors can contribute to a reduction in transportation costs? The answer is containerisation. Containerisation has been responsible for profound mutations in the transport sector. It has brought about reduction of handling time, labour costs and it allows for considerable increases in rate of rotation (Rodrigue *et al.*, 2006). All of this contributes to a reduction in transport costs.

This chapter has two distinct objects. The first determines the extent to which trade liberalisation impacts on manufacturing exports, with specific focus on South Africa as a case in point. Secondly, it gives a theoretical and empirical overview of transport costs with particular emphasis on measures to reduce transport costs. The outline of this chapter is as follows: section 2.2 discusses the link between trade and transport costs with a specific focus on economic growth. Section 2.3 discusses the onset of trade liberalisation with salient features of the changing structure of South African production and trade. Section 2.4 discusses the literature surrounding transport costs theory, section 2.5 discusses containerisation and section 2.6 concludes the chapter.

2.2 THE LINK BETWEEN TRADE AND TRANSPORT COSTS

There is a widespread belief that manufactured exports may be good for economic growth and development (Edwards, 1997). Foster (2006) gives a recent summary of the literature on exports and growth. Knowledge spillovers, knowledge diffusion, and greater competition are argued to benefit exports and thus economic growth.

The poor performance of manufacturing exports in most African countries is often seen as a major reason for the continent's lack of growth performance (Naudé and Gries, 2004). However, disagreements persist in empirical literature, regarding the causal direction of the effects of manufactured exports on economic growth (Awokuse, 2006). Nevertheless, a number of notable studies have indeed found empirical evidence proving that exports lead to significant economic growth (Edwards, 1997; Sachs and Warner, 1997; Elbadawi, 1998; Gylfason, 1999; Naudé and Gries, 2004; Awokuse, 2006).

Awokuse (2006) views export expansion and openness to foreign markets as a key determinant of economic growth because of the positive externalities it provides. For example, Helpman and Krugman (1985), explain that firms in a thriving export sector enjoy the benefits of efficient resource allocation and exploitation of economies of scale, which in turn contribute to economic growth. Naudé and Gries (2004) record a positive link between exports and economic growth. These findings indicate that growth in manufacturing exports and growth in the share of manufacturing in total exports result in positive, overall economic growth.

According to Bloom and Sachs (1998), a lack of sufficient manufactured exports is seen as a major reason for the lack of industrialisation and resulting economic growth in African countries. However, according to Elbadawi (1998), outward-oriented trade policies and trade liberalisation, established to support export growth, have become standard practice in the industrialisation strategies of African countries. South Africa is a prime example of this phenomenon, as the country encompasses the largest manufacturing sector on the African continent (Naudé, Oostendorp & Serumaga-Zake, 2002).

2.3. SOUTH AFRICA'S INDUSTRIAL DEVELOPMENT AND INTERNATIONAL TRADE POLICY

South Africa is a halfway point between the Far East and Europe, and was discovered by the Portuguese in 1488 (Matthee, Naude & Krugell, 2006). Their first intention was to encourage trade between two parts of the world and to use the Cape as a replenishment station (Matthee *et al.,* 2006). However, during this period, the Dutch were the dominant maritime power and took over from Portugal in 1652, continuing to govern the Cape as provision station. Furthermore, during the 1800s, the Dutch utilized Durban as dockyard for ships requiring repair work. The events that followed led to a major shift in the industrial and economic development of South Africa.

2.3.1. Industrial development prior to 1994

During the 1800's, South Africa's settlers were largely involved in agricultural pursuits. However, manufacturing was elementary and mainly directed at supplying only for the needs of the white farming community (ITRISA, 2005). Furthermore, communication between various parts of South Africa was difficult, and the inland transportation system was rudimentary (ITRISA, 2005). However, the discovery of diamonds in Kimberley (1868) and gold on the Witwatersrand (1886) led to the progression from sole reliance on agricultural pursuits to an increasing dependence on mining (Richardson and Van Helten, 1984).

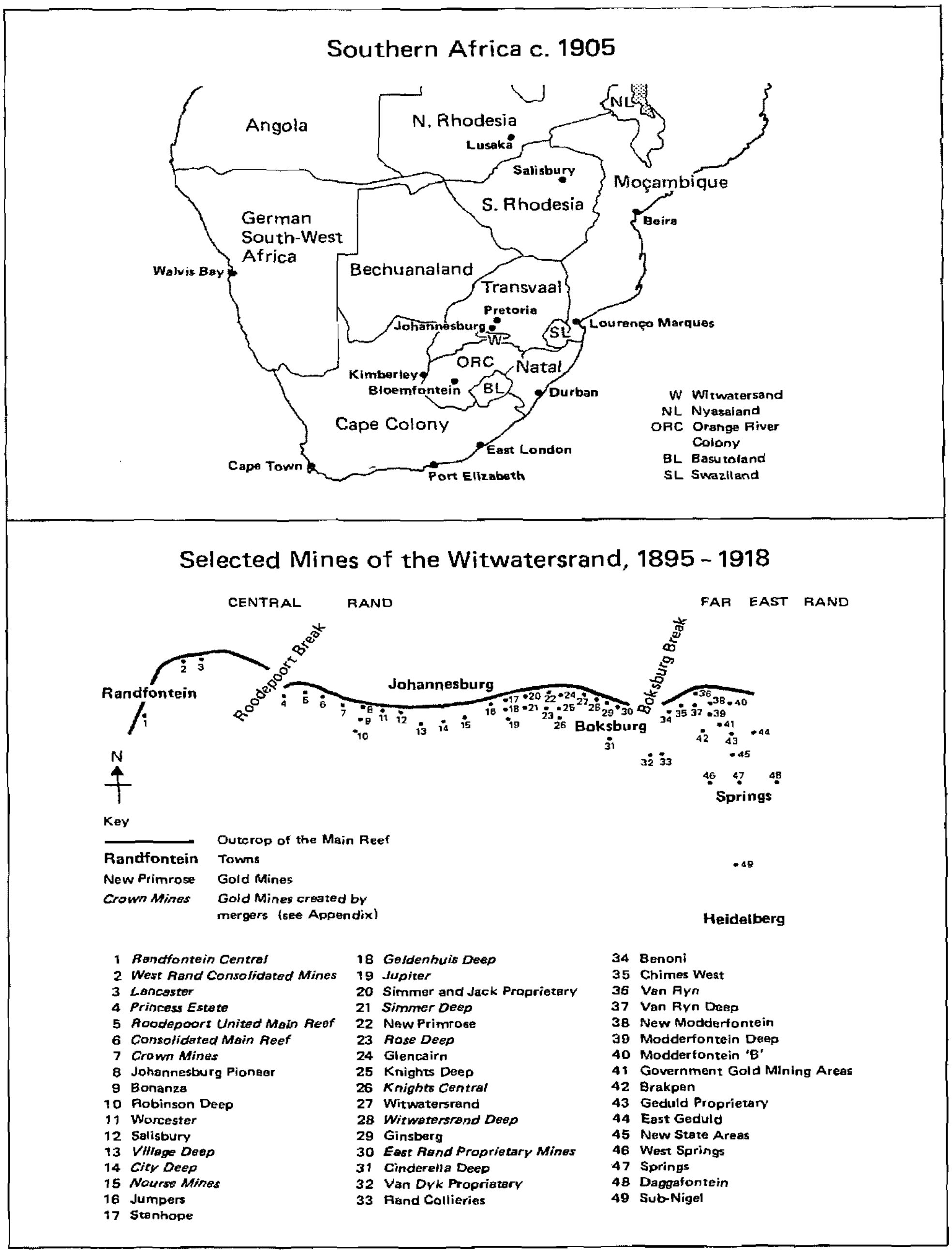
2.3.2. The development of the South African gold mining industry

The discovery of gold on the Witwatersrand in 1886 was historically seen as the most famous discovery of the nineteenth century (Richardson *et al.,* 1984). The gold mines of South Africa, more specifically the Transvaal colony, supplied an increasingly large proportion of the world's mined gold and made the country the largest single producer of gold in the world (Bellairs, 1982). Furthermore, the discovery of gold on the Witwatersrand formed part of the mineral revolution in southern Africa (Richardson *et al.,* 1984). However, the discovery of gold in Kimberley in 1870 was seen as the largest source of diamonds in the world (Turell, 1982).

Between 1895 and 1918, the mining industry in South Africa expanded enormously (Richardson *et al.*, 1984). Several deep-level mining companies started opening their doors for active mining programmes on the Central Rand. For example, figure 2.1 illustrates selected mines of the Witwatersrand between 1895 and 1918. However, during this period, two wars broke out between the British and the Dutch settlers, which led to the establishment of the Union of South Africa in 1910 (ITRISA, 2005).

After the establishment of the Union of South Africa, a variety of new products was being produced in South Africa for the first time. This led to the establishment of five non-manufacturing companies under the control of Rand Mines (see figure 2.1) (Richardson *et al.*, 1984). These companies included the Village Deep, the Robinson Central Deep, the South Nourse Company, the Modderfontein Extension and the New Modderfontein companies. Furthermore, after the establishment of the Union, infrastructural developments in South Africa accelerated and manufacturing got underway (ITRISA, 2005). Nevertheless, South Africa's mining industry dominated economic growth in the country with the export of primary commodities such as gold and diamonds. Therefore, the role of ports became much more important as they handled exports of diamonds and gold (Matthee *et al.*, 2006).

Figure 2.1: South Africa's mining industry, 1895 – 1918



Source: Richardson *et al.*, 1984

After 1920, South Africa emerged into the international community under the rule of Prime Minister Smuts (Matthee *et al.*, 2006). From 1925 until the outbreak of World War II, South Africa embarked on a policy aimed at protecting local industries in an attempt to stimulate growth in manufacturing exports (ITRISA, 2005). These attempts failed, however, as South Africa was excluded from the international community due to Apartheid (Naude and Krugell, 2005).

2.3.3. The development of the manufacturing sector

Until 1930, the agricultural and mining industries remained the dominant forces in the economy. However, the outbreak of World War II in 1939 provided a turning point for the manufacturing sector (ITRISA, 2005). Since Apartheid had led to the isolation of South Africa from international sources, the country was forced to adopt a system of import substitution and accelerated development in manufacturing (ITRISA, 2005). According to Richardson *et al.* (1984) earnings from manufacturing exports were required to meet the demands of a fast-growing domestic market and to supplement the earnings from mineral and agricultural exports.

By the end of the 1960's, South Africa's economy had begun deteriorating. For example, the country experienced a steadily increasing deficit on the balance of payments, a decrease in world demand, a decrease in the price of gold and a devaluation of the Rand (ITRISA, 2005; Matthee *et al.*, 2006). Furthermore, during this period the South African government focused on the development of the manufacturing industry's export potential. That is why, during the early 1970s, the focus changed to a combination of export promotion and import substitution (ITRISA, 2005).

According to Richardson *et al.* (1984), manufacturing was primarily protected by means of tariffs, whereas the agricultural sector was protected by direct quantitative restrictions such as quotas. Due to these measures protectionism provided fledging industries with the chance to flourish and grow. However, during the 1970s prolonged protectionism had a number of negative effects, such as difficulty competing internationally because of high cost inputs (ITRISA, 2005). However, according to Edwards (1997), South Africa has made much progress in liberalising the trade regime since the early 1980s.

Trade liberalisation in South Africa included the removal of quantitative restrictions (Edwards, 1997). But growth in the manufacturing field was still slow and far from transparent. Although the 1994 elections hailed the dawn of a new democracy for SA, the new government also inherited an economic system characterised by declining economic and employment growth (Edwards and Alves, 2006). The policy reforms led to changes such as the transition from a closed to an open economy (Matthee *et al.*, 2006). However, Edwards and Alves (2006) found that South Africa's policy reforms have had mixed results. For example, exports of manufactured goods have increased but not enough to generate an export-led growth boom similar to that of East Asia. Table 2.1 presents South Africa's production and trade trends between 1984 and 1997.

Table 2.1: Production structure and growth

Growth rates of real sectoral gross output				
	1984-88	**1988-84**	**1984-93**	**1993-7**
Agriculture, forestry and fishing	7.8	0.1	3.5	5.0
Mining and quarrying	-1.5	-0.03	-0.7	-1.5
Total manufacturing	0.6	-2.5	-0.9	3.2
Capital-intensive	2.1	-2.4	-0.2	4.7
Intermediate capital-intensive	0.5	-0.3	-1.1	0.9
Ultra-labour-intensive	-0.9	-2.1	-1.4	2.0
Social overheads	-1.3	-0.2	-0.7	2.6
Services	1.1	0.5	0.7	3.3
Total	0.7	-0.9	-0.1	2.9

Source: Edwards, 1997

As shown in table 2.1, output growth during the early 1980's was negative for mining, labour and social overheads. However, although these sectors showed a negative growth during the 1980's, manufacturing shows a relatively poor performance. Yet it is interesting to note the rise in the capital-intensive sector growth as a share of manufacturing growth. The relative decline in mining and quarry growth may be because of the structural shift away from mining and quarrying production towards services during the 1980's. Another possible explanation for this drop may the severe droughts during the 1980's. Table 2.1 shows that since 1993, output growth has recovered for *all* the sectors except the mining and quarrying sector.

In 1994, the South African government started focusing on policies to improve economic efficiencies and raise economic growth (Naude and Gries, 2004). An important effort in this regard included decentralisation of the functions of local and provincial government. However, not all industries could cope with South Africa being an open economy. Many industries were faced with increasing competition and therefore had to close down (Matthee *et al.*, 2006). Moreover, the export-led growth approach did not benefit all industries equally. This led to an unequal distribution of economic activity in South Africa (Naude and Gries, 2004).Therefore, it is important to address the factors that determine manufacturing export performance.

2.3.3.1. Determinants of manufacturing exports

Since 1994, South Africa has become an active competitor in the global market; trade liberalisation has replaced the anti-export bias in order to make way for higher export-lead growth (Coetzee, Gwarada, Naudé & Swanepoel, 1997). According to Roux (2004), manufactured exports have increased from 17% in 1988 to approximately 54% in 1998. Furthermore, Rankin (2001) points out that manufactured exports are becoming an important component of GDP. Nevertheless, the central question is: what factors determine the differential manufacturing export performance?

According to Naude and Gries (2004), the physical location of industries may matter: distance from the nearest port and access to natural resources are important determinants of exports. According to Vanables and Limao (2002), distance and natural resources are relevant determinants of a country's ability to export. Therefore, the Hecksher-Olin model is useful, as this model abstracts from distance and sees a region's comparative advantage as being determined by relative factor endowments.

The Hecksher-Olin model involves the comparative advantage by postulating that a country still has an incentive to trade, even if it can produce the relevant commodities more efficiently than its trading partner (Du Plessis, Smit & McCarthy, 1987). However, Wood and Berge (1997) go further and explain that, although distance and factor endowments are important determinants of exports, skilled workers and the availability of land are also important determinants.
According to Van Eldik and Viviers (2006), export readiness of companies is also an important determinant of export. They argue that a lack of skills and a lack of competitiveness are reasons

for the slow export growth that some countries show in foreign markets. Furthermore, Krugman (1980) explains that the "home-market" effect has a significant influence on the performance of manufactured exports in a country. The "home- market effect" is characterised by the presence of increasing returns, monopolistic competition, and trade costs and this typically give rise to a more-than-proportional relationship between a country's share of world production of a good and its share of world demand for the same good (Krugman, 1980).

According to Krugman (1980), companies will export those products for which there is a large domestic demand. It is important to first note that the "home-market" effect is closely linked to transport costs. Therefore, if companies experience increasing returns to scale (due to exports of products for which there is a large domestic demand) and face transport costs, then these companies will locate in the vicinity of the largest market. In other words, by locating near the larger markets, companies are able to achieve increasing returns to scale and at the same time minimise their transport costs (Krugman, 1980). Therefore, if transport costs were high, trade between countries would not take place, as it is too costly (Krugman, 1991). Thus, transport costs influence trade, high transport costs reduce foreign earnings from exports and increase the price of imports, and this, in turn, elevates production costs (Matthee, 2006). The next section will therefore focus on transport costs by focusing on their role in trade.

2.4. TRANSPORT COSTS AND EXPORTS

Based on the notion that exports are good for economic growth, the movement of goods and services depend on a good and reliable transport network (Rodrigue, Comtois and Slack, 2006). According to Jimenez (1995), a country's transport infrastructure typically exists not for its own sake, but rather to support various kinds of economic activity, thereby promoting economic growth.

A number of studies have found empirical evidence that infrastructure investments are an influential factor of economic growth and overall welfare (Bogetic and Fedderke, 2005). Sanchez-Robles (2001) explores the relationship between infrastructure and economic growth empirically. Public infrastructure is found to be positively and significantly correlated with economic growth. Infrastructure may be important for productivity, transport costs and economic growth (Bougheas and Demetriades, 1995). According to Bougheas, Demetriades & Morgenroth (1999), differences in the volume and quality of infrastructure may be responsible for differences in transport costs, which in turn may account for differences in competitiveness.

The evolution of transport infrastructure has always been linked to economic development. According to Rodrigue *et al.* (2006), transport creates valuable links between regions and economic activities, as well as between people and the rest of the world. However, the movement of exports and imports of both final and intermediate goods carry transport costs (Limão and Venables, 2002). Gallup and Sachs (1999) and Radelet and Sachs (1999) indicate that countries with high transport costs tend to damage their export performance and overall economic growth.

Radelet and Sachs (1998) provide a comprehensive study on the impact of transport costs on a country's international competitiveness. They found that transportation costs are influenced by geographical factors such as distance to markets and access to ports. Limão and Venables (2002) state that transport costs could also be increased by a combination of distance, poor infrastructure and being landlocked by neighbours with poor infrastructure. Rodrigue *et al.* (2006) define transport costs as a monetary measure of what the transport provider must pay to produce transportation services. Transport costs are the costs involved with the movement of people, goods and information (Rodrigue *et al.* 2006; Naudé & Matthee, 2007). Transport costs include both domestic[1] and international[2] transport costs. A wide variety of transport costs can be considered. Table 2.2 describes five types of transport costs that are involved with the movement of goods.

[1] Domestic transport costs are incurred when the movement of goods take place within the borders of a particular country.
[2] International transport costs comprise all the costs involved in the movement of goods outside the borders of a particular country, including the cost of freight handling and insurance.

Table 2.2: Types of transport costs

Type of transport cost	Description
Freight on board (FOB)	Combination of the factory costs and the shipping costs. Costs are covered by the consumer.
Costs-Insurance-Freight (CIF)	Include a combination of the price of the goods, insurance costs and transport costs. This is a uniform price for all consumers everywhere.
Terminal costs	Include costs that are related to loading[3], transshipment[4] and unloading.
Line haul costs	Costs are usually a function of the distance over which a unit of freight is carried.
Capital costs	Include the physical assets of transportation such as infrastructure.

Source: Rodrigue *et al.*, 2006:46

Table 2.2 (above) summarises transport costs that typically occur during the transportation of goods and services. The first type of transport cost includes freight on board (FOB). When one considers a FOB cost structure, customers who locate near ports will typically pay less for the transportation of goods. It is also important to note that the customer pays for the transport costs; therefore, the costs are not included in the quotation (Rodrigue *et al.*, 2006). With a Costs-Insurance-Freight (CIF), the price is uniform and the average shipping price is built into the price of goods.

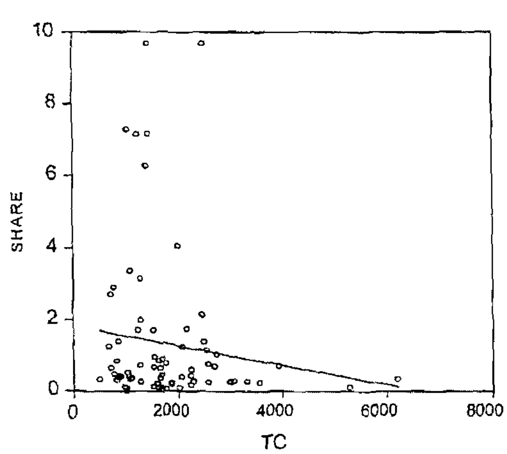
[3] Loading and unloading terminal costs cannot be avoided. The consumer must pay this.
[4] Transshipment (intermediate) terminal costs are avoidable.

Terminal costs include the costs of loading and unloading and, importantly, do not vary with distance shipped (Rodrigue *et al.*, 2006). However, line haul costs do vary with distance. Finally, capital is considered to be the most important type of transport cost. The efficiency and capacity of transport modes and transport terminals have a direct impact on transport costs. According to Rodrigue *et al.* (2006), poor infrastructure implies higher transport costs.

2.4.1. Factors influencing transport costs

Time is money, and distance matters (Evans and Harrigan, 2003). Distance is important for international trade relations (Matthee, 2006), and is also important determinants of a country's ability to participate fully in the world economy (Limão and Venables, 2001). According to Martínez-Zarzoso, Gracía-Menéndez & Suárez-Burguet (2003), a 1% increase in distance increases transport costs by approximately 0.25% (see figure 2.2). This clearly explains why trade volumes decline over distance. In fact, declining trade volumes is not a new phenomenon; international trade around the world takes place between countries which are located within 3 000 km of each other (Anon., 2004). Figure 2.2 shows that as distance increases, transport costs decrease.

Figure 2.2: Transport costs versus distance



Source: Martínez-Zarsoso *et al.*, 2003:184

Carrere and Schiff (2004) examine costs that are associated with distance. They found that the cost per mile[5] can either increase or decrease transport costs. In other words, lower distance costs or cost per mile raise the incentive to trade with more distant locations because a country's relative transport costs are more for closer locations. Thus, regions located closer to each other tend to trade with each other more than regions further apart (Anon., 2004). Venables (2001) conveys elasticities of trade volumes at different distances, relative to their value at a 1 000 km. He finds that trade volumes decrease with distance[6], as shown in table 2.3.

Table 2.3: Economic interactions and distance

Km	**Trade (θ = -1.25)**
1 000	1
2 000	0.42
4 000	0.18
8 000	0.07

Source: Venables, 2001

According to Venables (2001), distance costs can be classified into four types. Firstly, there are direct shipping costs which include the cost of moving goods internationally. The second type is costs associated with identifying potential trading partners, in other words, searching costs. Thirdly, management costs which include control and operational costs and finally, time costs. The latter includes the cost of time involved in the shipping of goods.

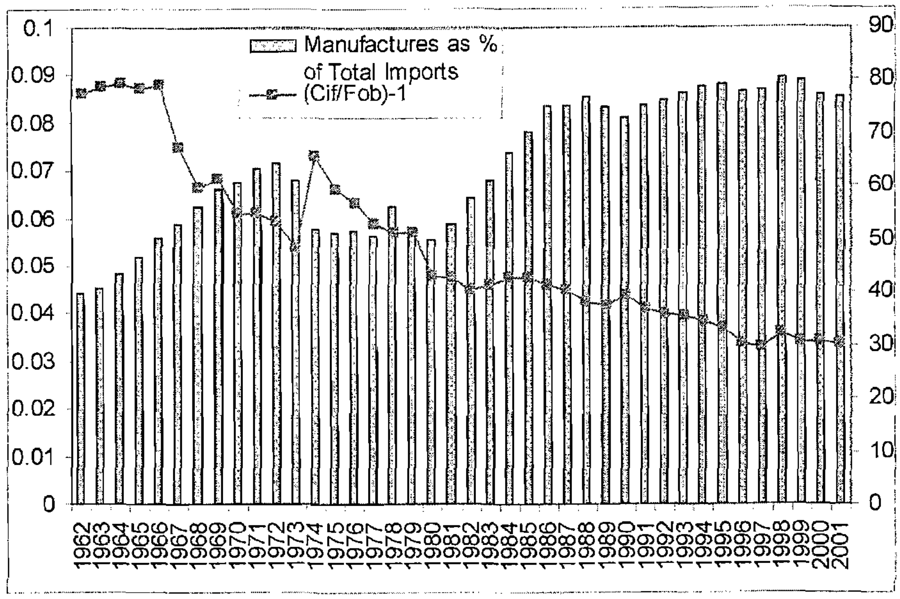
[5] Cost per mile includes fuel costs and other costs on operating ships, including overheads and cost of manning and leasing ships.
[6] Venables (2001) calculates this by: θ (distance) = -1.25, trade volumes are down by 82% at 4 000 km and 93% at 8 000km.

Several research studies argue that most distance-related costs tend to decrease as new technologies develop. Coe and Tamirisa (2002) agree with the above statement in their non-linear specification of the gravity model. They find that the coefficient estimates of distance decline over time. However, Rodrigue *et al.* (2006) state that distance is not time. They argue that, if distance is interchanged with time, this becomes a conceptual error. They also add that distance is a constant factor, whereby time varies due to improvements in transport technology or because of congestion. In other words, distance is a uniform attribute, while time is relative.

Henderson, Shalizi & Venables (2001) use transport costs incurred on traded goods as a direct cost measure of distance. They explain that more direct measures provide a clearer indication of cross-country variations in shipping costs. Direct measures include the CIF/FOB ratio[7]: for example, the CIF/FOB ratio of a country can typically range from a few percent of the value of trade, up to 30% or 40% for the most remote and landlocked economies, as shown in figure 2.3.

[7] The CIF/FOB ratio includes carriage, insurance and freight costs of countries imports.

Figure 2.3: United States CIF/FOB ratios and manufactured imports, 1962-2001.



Source: Chasomeris, 2007

Note:

1. This is the author's own calculations from World Development Indicators, 2003 and International Financial Statistics, 2003 in TIPS, 2005.

According to figure 2.3, there appears to be a negative correlation between manufactures exports as a proportion of imports and US CIF/FOB ratios. This is shown by the downward trend. Although the correlation between manufactures and imports were stable in the period 1962 to 1965, there was a significant downward trend after 1965 which continued until 2001.

Apart from distance, several other factors can also affect transport costs and transport rates.[8] Limão and Venables (2001) studied the determinants of transport costs and showed how transport costs depend both on country's geography and on their levels of infrastructure. Their findings indicate that poor infrastructure accounts for approximately

[8] Transport rates are the price of transportation services paid by their users. These include the negotiated monetary cost of moving a unit of freight between a specific origin and destination.

40% of transport costs for coastal economies and 60% for landlocked countries. Naudé and Matthee (2007) state that being landlocked has a significant effect on raising transport costs. This is because of transiting through various borders, as well as time lost due to border delays. Amjadi and Yeats (1995) found that the poor trade performance and high transport costs in the Sub-Sahara is attributed to poor infrastructure and inappropriate transport policies.

Martínez-Zarzoso *et al.* (2003) prove that the impact of infrastructure on transport costs necessitates investment in new port infrastructure, as a way of fostering trade and income. For example, an improvement in a country's own infrastructure to the level of the best 25th percentile amongst landlocked countries cuts transport costs by 41% (Limão and Venables, 2001). Micco and Serebrinsky (2004) also explain that an improvement in airport infrastructure from the 25th to the 75th percentile reduces transport costs by 15%.

Time has a significant impact on transport costs. Hummels (2001) highlights the importance of the time costs in transit. He finds that the costs of an additional day in transit for manufactured exports are on average 0.8% of the value per goods per day and this is equal to a 16 percent tariff for the average shipping length of 20 days. Rodrigue *et al.* (2006) identify the following as the most significant conditions affecting transport costs and thus transport rates, as shown in table 2.4.

Table 2.4: Conditions affecting transport costs and transport rates.

Conditions affecting transport costs and transport rates	Description
Geography	The impact mainly involves distance and accessibility. The friction of distance can be expressed in terms of length, time and economic costs. Landlocked countries tend to have higher transport costs, as they do not have direct access to maritime transportation.
Type of product	Some products require special packaging and handling. Insurance costs are also to be considered and are a function of the value to weight ratio and the risk associated with the movement of goods.
Economies of scale	This includes the possibility that the larger the quantities transported, the lower the unit cost; for example coal, minerals and grains are suitable for obtaining lower unit costs if they are transported in large quantities.
Trade imbalances	Imbalances[9] between imports and exports tend to raise transport costs. Trade imbalances imply the repositioning of empty containers that have to be taken into account in the total transport costs.
Infrastructure	Poor infrastructure implies higher transport costs, delays and negative economic consequences.
Mode	Competition between different types of transport modes tend to lower transport costs.

Source: Rodrigue *et al.*, 2006

[9] If a trade balance is strongly negative (more imports than exports), transport costs for imports tend to be higher than for exports.

Therefore, it is evident that transport costs are becoming a growing concern, which can hinder international trade. It is therefore important to focus on various methods to minimise transport costs. For example, cargo handling costs and stevedoring costs are amongst the most important elements of transport costs. The next section will seek to address the question of how to minimise transportation costs.

2.5. CONTAINERISATION

Containerisation is a form of unitisation of individual items, packs and palletised loads (ITRISA, 2006). Containerisation reduces cargo-handling costs by consolidating numerous break-bulk parcels into a single unit (Selna, 1969). Containerisation is responsible for profound mutations in the transport sector; in other words, containerisation reduces handling time of goods, allows for increases in rate of rotation along a circuit and thus entails a better optimisation of time and money (Rodrigue *et al.,* 2006). According to Selna (1969), containerisation cuts stevedoring time and costs by approximately 80% per measurement-ton.

Containerisation in South Africa was introduced by the end of 1977, when five container terminals were established at the Ports of Cape Town, Durban, Port Elizabeth and City Deep in Johannesburg (ITRISA, 2006). Containers serve a variety of different purposes and are constructed in many different shapes and sizes. Containers are designed for easy and fast handling of freight and, most importantly, the contents do not have to be unpacked at each point of the transportation network (Steenken, Voß & Stahlbock, 2004). The most common containers used in South Africa are summarised in table 2.5.

Table 2.5: Types of containers

Type of container	Description
General purpose (GP) containers	GP's are made of steel, aluminium alloy or glass-reinforced plastic, and carry both solid and liquid bulk cargoes. They have a wooden floor and are fully enclosed with doors positioned for loading and offloading purposes.
Insulated containers	These containers are made of insulation materials to promote airflow for cargoes that require a temperature controlled environment such as fresh fruit. Fresh fruit are packed in cases and consolidated on standard pallets[10].
Reefer containers	These containers carry frozen goods and are thus fitted with refrigeration units, which are connected to an external supply source. Different temperatures can be set to maintain the required temperature until offloaded.
Bulk containers	These containers include three hatches for loading and offloading. They are designed to carry granular and dry power substances.

[10] Numerous units are stacked on a wooden or plastic pallet: pallets come in standard sizes determined by the International Organisation for Standardisation (ISO) (ITRISA, 2006). According to the ISO, the recommended pallet dimensions include 800mm x 1000mm; 800mm x 1200mm; 1000mm x 1200mm; 1200mm x 1200mm.

Open top containers	These containers carry abnormal cargo such as sheet glass and machinery. The cargo is protected by a tarpaulin cover. These containers are opened at the top to lower the cargo into the container.
Half-height open top containers	These containers are longer than the open top containers. They carry cargoes such as steel bars, pipes and tubes. The container is designed to open at the top for loading and unloading of cargo.
Tank container	A tank container is designed to convey both liquid and dry bulk cargoes and consists of a stainless steel framework.

Source: Department of Transport, 2006

There are two containers commonly used in international trade, namely a 6 metres (20 feet) container and a 12 metres (40 feet) container (ITRISA, 2006). According to Matthee *et al.* (2007) the choice of container used for the transportation of cargo depends not only on the volume, but also the weight of the cargo. For example, a 6 metres container is classified into two types according to the capacity of the container (ITRISA, 2007). Matthee *et al.* (2007) explains that a light 6 metres container has a capacity of approximately 12 000 kg, whereas a heavy 6 metres container has a capacity of approximately 12 000 – 24 000 kg. They also point out that a 12 metres container has a zero – 24 000 kg capacity, thus contains only heavyweight cargo. Furthermore, containers offer three types of services to shippers.

The three types of container services available to shippers include: a full container load (FCL) service, a less than full container load (LCL), and a groupage service (ITRISA, 2007). These will be examined below.

1. Full container load (FCL)

This service is ideal for either a 6 metres container or a 12 metres container. This is usually for the shipper who has sufficient cargo to meet either the weight or the volumetric limitations of a container. For example, if the cargo weighs very little, between 0 – 12 000 kg, but the volume is greater than that of a 6 metres container, the shipper will use a 12 metres container for the transportation of the cargo (Matthee *et al.*, 2007). However, any cargo exceeding 24 000 kg will need special transportation methods, such as abnormal vehicles and automated lifting vehicles (see section 3.4).

2. Less than full container load (LCL)

This service is ideal for shippers whose consignments are not substantial enough to qualify for the FCL, but still benefit from containerisation. This service combines individual consignments from various shippers into one shipment, also know as consolidation. On arrival at the destination port or warehouse, the consolidated cargo is de-consolidated by the destination agent into its original component consignments, and made available to consignees. The next step is to inform the various importers of the arrival of their individual consignments. This service provides the shippers access to better rates because of individual consignments, which are combined into one shipment (Rodrigue *et al.*, 2006).

3. A groupage service

This service also involves consolidation, but consolidation of smaller cargoes into full container loads. This service differs from the LCL service in what is called groupage operators or freight forwarders[11]. The freight forwarders provide a multimodal (see section 3.3.2.) transport service. They specialise in the completion of documentation and customs clearance, all to help the shipper (Rodrique *et al.*, 2006).

[11] Act as an intermediary who arranges for the carriage of goods on behalf of a shipper (Rodrigue *et al.*, 2006).

According to Matthee *et al.* (2007) it is very important that the correct container is used and most importantly, correctly packed. For instance, if the container exceeds its maximum weight or should the cargo be unevenly packed, the transport operator could face fines and penalties imposed by the Road Traffic Authorities (RTA). This could entail higher costs for the chargeable weight in question. There are various factors that should be taken into consideration before loading commences. The most common factors include weight limitation relating to the container, and avoiding the stowage of incompatible cargoes in the same container (ITRISA, 2006). Different factors are involved in calculating the chargeable weight of a container. For instance, the chargeable weight consists of two factors: the volumetric weight and the actual weight. Furthermore, the distances between the exporter, the transport operator and the container depot also play an important role. Based on the cost factors explained, the next section will provide a detailed analysis of the calculations involved in both road freight and rail freight.

2.5.1. Calculating the freight payable

2.5.1.1. Calculating road freight

The freight payable on road freight is calculated either on a rate per freight ton (volumetric weight) or on a fixed charge per truckload (actual weight) (ITRISA, 2006 and UTI, 2008). The most important factor to determine is the chargeable weight, which is then used to calculate the total cost of road freight. The chargeable weight consists of two factors, namely the volumetric weight and the actual weight. For example, the volumetric weight is calculated using the length, width and height of the container. Therefore, L x W x H or 20 x 30 x 10 (UTI, 2008).

The actual weight includes the physical weight of the container in kilograms or tons. For instance if a container weighs 20 kg, that will be the actual weight used to calculate the chargeable weight. Important to remember, is that the largest amount are used to calculate the chargeable weight. In other words, if for instance the volumetric weight is

10 000 kg and the actual weight is 12 000 kg, then the actual weight will be used to calculate the chargeable weight and not the volumetric weight (UTI, 2008). Furthermore, chargeable weight is then used to calculate the freight rate per kilogram and the transporter's levy. Usually there are four costs to be calculated on a quotation .

Firstly, agency and processing fees are calculated. These costs include fees for the processing of documents and custom clearing costs. This is usually a standard cost, for example R 180. Whether the shipper transports one box or decides to transport a whole load, the cost stays the same. Secondly, acquittal and supervision costs are calculated. These costs are usually for a cargo of consignments that requires inspection from the customer for assessments on certain products, such as tyres and alcohol. These costs are also standard, for example R 360 (UTI, 2008).

Thirdly, the freight rate per kilogram/ton is calculated. This is done by using the volumetric weight, as mentioned above, to determine the minimum per shipment (UTI, 2008). Thereafter, the minimum per shipment is multiplied by the chargeable weight to calculate the rate per kilogram/ton. It is important to remember that if, for instance, the volumetric weight is the largest number when calculating chargeable weight, then the actual weight is not to be used in the quotation. Lastly, the transporter's levy is calculated. These costs include petrol price and the distance over which the cargo is to be conveyed. For instance, UTI charges R 0.041 per kg of cargo. These fees can fluctuate depending on the current fuel price. To determine the total transporter's fuel levy (petrol levy), the chargeable weight is multiplied by R 0.041.

As mentioned earlier, the distance between the exporter, transport operator and the container depot matters, as it influences the total transporter's fuel levy. Transport operators generally divide provinces and areas, such as Gauteng and Swaziland, into different zones (Matthee *et al.,* 2007). Therefore, the further the location, the greater the distance and this implies higher costs. Usually the transport operator apply areas as in this example for Swaziland: area 1 lies between 0 and 150 km from the container depot and includes Ezulwin / Matsapha / Manzini / Maklkerns, and area 2 lies between 150 and 300 km from the depot. Any destination outside of these areas will be handled on a case-by-case basis and quotations are based on the chargeable weight relevant to that specific request. Furthermore, dangerous goods such as toxics are subject to a surcharge of 35%.

Matthee *et al.* (2007) conducted a similar study on the measurement of domestic transport costs in South Africa. They examined the rand and cent costs of the transportation of non-hazardous cargo between the client's premises to the Johannesburg and then Durban container depots. They focused on the transportation costs of both rail and road transportation. The study found that it is more cost effective for exporters to transport their cargo (FCL) by road to the City Deep Container Depot in Johannesburg, and then by rail to Durban harbour (see table 2.6). Therefore, multimodal/intermodal transportation seems to lower transportation costs for the exporter (see section 3.3.2.).

Table 2.6: FCL transport costs from the client to Johannesburg Container Depot to Durban Container Depot

	From client to Johannesburg Container Depot (road freight)		Railage rates from Johannesburg to Durban		From client to Durban Container Depot (road freight)	
Pickup from	**6m container**	**12m container**	**6m container**	**12m container**	**6m container**	**12m container**
Johannesburg (0 – 40 km)	2 280	3 085	1 890 Light container	3 828 Light container	4 600	6 000
			3 400 Heavy container	6 874 Heavy container		7 500
Pretoria (40 – 80 km)	3 200	4 695			6 000	10 300
Rustenburg (135 km)	7 800	7 800			10 300	13 500
Nelspruit (355 km)	9 700	9 700			13 500	13 500

Source: Matthee *et al.*, 2007

The first two columns, which indicate transport costs from the client to the Johannesburg Container Depot, implies the sending of an empty container to the client's premises and then returning with the cargo. It is important to note that the cost for transporting both a 6m container and 12m container beyond 80 km will most likely be the same. Matthee *et al.* (2007) explains that it is more cost effective for a hauler to transport two 6m containers on a 12m truck. Therefore, the exporter's transport costs for either a 6m or a 12m container will be the same. The next two columns contain the railage rates for the transportation of a FCL from Johannesburg to Durban Container Depot.

The railage rates include the transport costs for both light (< 12.5 tons) and heavy (> 12.5 tons) 6m and 12m containers. Therefore, the total transport cost for the transportation of FCL from the client's premises to Durban is calculated by adding up the road and rail transport rates. The last two columns contain the transportation cost of a FCL from the client's premises directly to Durban Container Depot, using only road transportation. If one compares the charges provided in the first four columns to the charges in the last two columns, it is clear that, in the case of light 6m and 12m containers, it is less costly to transport cargo to the Johannesburg Container Depot and then rail it to the Durban harbour. However, it is more costly to transport heavy 6m and 12m containers to the Durban harbour using multimodal transportation.

As a result the containers (6m and 12m) contribute greatly to intermodal transportation of merchandise and, therefore, bring about the reduction of handling time, packing costs and labour costs (Rodrique *et al.,* 2006). The next section examines the savings that accrue for each member of the transportation system, through the use of containerised equipment.

2.5.2. *Savings from containerisation*

Containerisation is by far the most common sea freight service used by both importers and exporters (ITRISA, 2006). According to Selna (1969) containerisation offers savings to shippers, the inland carrier and the ocean carrier. These will be examined below.

1. The shipper

One of the largest expenses shippers have is the placing of goods in foreign markets. Containerisation, however, reduces these packaging costs by more than one-third, through the elimination of special export packaging expenses. Furthermore, containerisation protects the shipper against pilferage; thus cargo unloaded at the port is protected against cargo thieves.

2. The inland carrier

Both rail and truck carriers enjoy savings when goods are containerised on the shipper's premises, because this reduces handling costs. Containerisation enables reduction in terminal costs for both rail and truck carriers and substantially reduces cargo damage.

3. The ocean carrier

The ocean carrier enjoys reduced labour costs due to containerisation. The amount of days spent in port is reduced to less than 25%, compared to 60% for the conventional ship. Thus containerisation reduces port fees and increases the number of voyages per year.

According to Rodrigue *et al.* (2006), containerisation permits intermodal movements and addresses the issue of instantaneity (the loading of units by trucks). Furthermore, intermodal transportation is responsible for the movement of containers across land, and involves the use of different modes of transport (ITRISA, 2006).

2.6. CONCLUSION

In recent years, trade liberalisation has lead to the reduction of trade barriers amongst countries. Therefore, trade barriers no longer protect a country's industries, which leads to an increase in global competition. For instance, South Africa transformed from a closed economy to an open economy during the early 1990s, leading to a rise in international trade. Nevertheless, the movement of passengers, goods and information have always been fundamental components of international trade. It is all related to transport costs as well as to the attributes of what is being transported.

In the economic literature, transport costs influence international trade patterns and volumes. A growing number of studies are focusing on establishing the empirical relevance of international transport costs. Therefore, it is evident that transport costs are a growing global concern. However, various methods have been developed to minimise the elements of transport costs, for example, cargo handling costs and stevedoring costs. This chapter attempted to focus on transport elements that reduce transportation costs. It was found that containerisation might minimise transportation costs. Containerisation reduces cargo-handling costs by consolidating numerous break-bulk parcels into a single unit. Containerisation is responsible for profound mutations in the transport sector, in other words, containerisation reduces the handling time of goods, allows for increases in rate of rotation along a circuit, and thus entails a better optimisation of time and money. Furthermore, containerisation cuts stevedoring time and costs by approximately 80% per measurement-ton.

However, containerisation needs an efficient transport system and infrastructure to support it. Infrastructure may play an important role when it comes to productivity, transport costs and economic growth. Containerisation technology is one of the main factors driving the development of multimodalism by means of improved requirements for shippers, such as new designs and technology. Multimodalism provides savings for each member of the transportation system by joining operations with other members in the system.

In short, chapter 2 firstly discussed trade liberalisation as a means of reducing trade barriers amongst countries, and secondly, focussed on transport elements with the purpose of reducing transportation costs. It was found that, in recent years, trade liberalisation has lead to the reduction of trade barriers amongst countries. Therefore, trade barriers no longer protect a country's industries, which leads to increasing global competition. Chapter 2 highlighted the importance of exports for economic growth. Chapter 2 focused directly on the movement of passengers, goods, and information as important components of international trade. It was found that all these components are related to transport costs as well as to the attributes of what is being transported. Chapter 3 will focus on the importance of inland transportation systems and their functions.

CHAPTER 3

INLAND TRANSPORTATION SYSTEMS AND CONTAINER TERMINALS

3.1. INTRODUCTION

Containerisation technology is one of the main factors driving the development of multimodalism by means of improved requirements for shippers, such as new designs and technology (ITRISA, 2006). According to Rodrigue, Comtois and Slack (2006), intermodalism expanded during the late 1960's with the development of containerisation and has since spread to integrate other modes of transportation. Multimodalism has been the result of the growing need within the market place to transport cargo or containers more cost-effectively (ITRISA, 2006).

According to Rodrigue *et al.* (2006), intermodalism is used to integrate separate transport systems. This begs the question of what distinguishes intermodal transportation from multimodal transportation. Multimodal transport involves the use of a least two different transport modes, such as rail and road transport, in a trip from the origin (client's premises or port) to a destination under a single transport rate. Intermodal transport enhances the economic performance of a transport chain by using the different transport modes in the most productive manner (Selna, 1969).

Containerisation is the most common sea freight service used by both importers and exporters, and involves the transportation of standardised consolidated units. Containers are large and relatively heavy and their effective conveyance and processing are dependent on specially designed handling equipment and vessels, and dedicated facilities such as container terminals and container depots. Moreover, multimodalism is the process of proving a dedicated and scheduled door-to-door unitised cargo distribution service.

According to Ricci and Black (2005), intermodal freight transport is defined as the movement of goods in one loading unit. Intermodal transport uses several modes of transport without actual handling of the goods in transshipment between the modes. Intermodalism originated in ports, with the development of the container in the late 1960's, and has since spread to include other modes (Rodrigue *et al.*, 2006). However, according to Janic (2007), the movement of goods through an intermodal system is associated with internal and external costs (social costs). Internal costs are simply the operator's costs of moving goods between the unloading (shippers) and loading (receivers) areas. Whereas, external costs comprise of environmental costs and include costs that networks impose on society.

Nevertheless, the transport network that supports both multimodalism and intermodalism, requires effective container terminals. According to Günther and Kim (2006), container terminals serve as an interface between different modes of transportation, for example, domestic train and truck transportation. Container terminals are divided into seaports, and inland terminals or dry ports. Inland terminals can help promote port efficiency by means of advanced road and rail links to seaports.

The objective of this chapter is to provide an overview and classification of inland transportation systems (multimodal and intermodal). Moreover, based on this classification, container terminals will be discussed on the basis of promoting inland transportation of goods to achieve port efficiency. Therefore, in Section 3.2 multimodal transportation will be discussed and Section 3.3 will discuss intermodalism, with specific focus on intermodal terminals and the types of handling equipment used. Furthermore, Section 3.4 will provide a general overview of the functionality of a container terminal, focussing on physical container movements. Section 3.5 will be dealing with inland terminals, with emphasis on the different types of dry ports around the world. Section 3.6 concludes the section.

3.2. MULTIMODAL TRANSPORTATION

According to Ülengin, Önsel, Topçu, Aktas & Kabak (2006), there is an unsustainable parallel between the growth in road capacity and predicted growth in traffic. Transport problems are expected to worsen, and the movement of goods is expected to increase by 50 percent by 2010. Nevertheless, multimodalism may be a solution to the latter. Multimodal transportation not only guides transportation policy makers in future strategic decisions, but also tends to integrate several transport modes (Ülengin *et al.*, 2006).

Multimodalism provides savings to each member of the transportation system through joint operations with another member of the system (Selna, 1969). For example, truck and rail transport are united into a single transportation package whereby a joint rate is made possible. Other potential benefits from multimodalism include faster delivery of cargo and lower overall cost of delivery through the better use of container capacity (ITRISA, 2006).

It is important to note that multimodalism must be seen as a whole, rather than a series of branches: each transport mode is marked by an individual operation with separate sets of documentation and rates (Rodrigue *et al.,* 2006). The basic tasks of multimodal services include the collection of containers from the origin, and the delivery of containers at the desired point of destination (Duinkerken, Dekker, Kurstjens, Ottjes & Dellaert, 2006). Multimodal transportation is used for both large and small consignments and also for full (FCL) and less than full (LCL) container loads (ITRISA, 2006) (see section 2.5). Groupage is amongst the most common services offered to shippers, and involves a freight forwarder who delivers cargo to various destinations, using either truck or rail transportation (Selna 1969).

In a recent study conducted by Duikerken *et al.* (2006), various transportation systems, for the overland transport of containers, were compared. They found that there is a growing need for container transport between various terminals. As mentioned earlier, multimodalism includes various transportation methods for the transportation of goods.

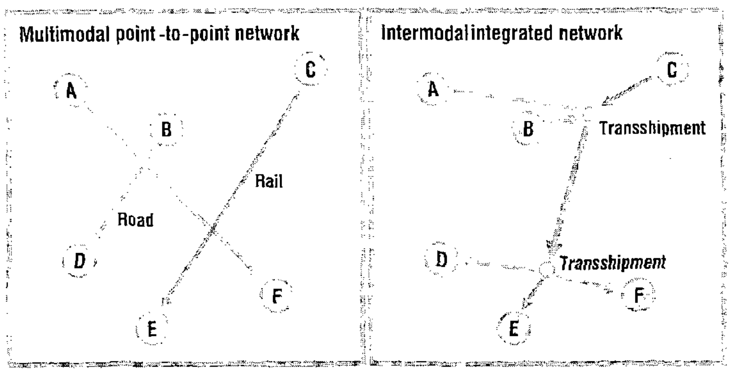
Nevertheless, each transport system is characterised by different types of transport and handling capacity (Duinkerken *et al.*, 2006).

Duinkerken *et al.* (2006) distinguishes three different transport vehicles for the transportation of containers. The first vehicle is a multi-trailer system (MTS). An MTS consists of a train of trailers on which containers can be carried. However, an MTS cannot carry out any process independently, so the train is pulled from its point of origin to the point of destination. Secondly, there is the automated guided vehicle (AGV), which differs from the MTS in terms of mobility. An AGV vehicle can travel by itself from the loading point to the point of destination. Furthermore, an AGV vehicle transports only one load per trip and requires a crane to start and finish its job. The third is an automated lift vehicle (ALV), and is equipped to pick up and set down containers at container terminals (Duinkerken *et al.*, 2006).

It is important to note that all three vehicles are characterised as inter-terminal vehicles. Therefore, all three vehicles have two common tasks to perform. The tasks include, firstly, the collection of containers from the point of origin, and secondly, the delivery of containers to the desired point of origin. Moreover, multimodalism provides a dedicated, scheduled warehouse-to-warehouse unitised cargo distribution service. There are many potential advantages to multimodalism. Three of these benefits are: less packing material is required to protect cargo in transit; delivery time is faster than it would have been in the case of traditional transport, and loadability is improved due to better use of container capacity. The latter, in turn, leads to a lower overall cost of delivery (ITRISA, 2006).

In conclusion, multimodalism uses several modes of transport to distribute cargo from the producer to the consumer, while intermodalism is used to integrate separate transport systems (Rodrigue *et al.*, 2006). Intermodality enhances the economic performance of a transport chain by using the different transport modes in the most productive manner. Figure 3.1 examines both multimodal and intermodal transportation through the use of two different transportation modes and a freight forwarder.

Figure: 3.1: Multimodal and intermodal transportation



Source: Rodrigue *et al.*, 2006:115

In figure 3.1, two alternatives to cargo distribution are illustrated. For instance, the first figure illustrates a multimodal network where A, B and C represent three origins independently linked to destinations D, E and F. For example, assume that point A represents Cape Town, point B represents Durban and point C represents Richards Bay (note that the illustration is not according to scale). In turn, point D represents City Deep, Johannesburg, point E Rustenburg and point F represents Nelspruit.

Figure 3.1 illustrates two transportation modes, namely road and rail transport. If, for instance, containers arrive at Cape Town (A), cargo is transported via road to City Deep, Johannesburg (D) and then via rail to Nelspruit (F). Multimodal transportation also involves the transport of cargo from, for example point C (Richards Bay) via rail directly to Nelspruit (C). In this case, cargo is then distributed to individual clients via road.

The second alternative involves the development of an integrated intermodal transport network. The efficiency of such an integrated transport network depends mainly on the transshipment[12] capabilities of transport terminals. Figure 3.1 illustrates the transshipment of cargo during freight distribution from the origin to the final destination.

[12] Transshipment refers to the transfer of cargo from one carrier to another and/or from one mode to another (Rodrigue *et al.*, 2006).

For example, traffic converges at two transshipment points, usually rail terminals, where loads of cargos are consolidated. According to ITRISA (2006), the client is contracted as the sole carrier of the cargo to its final destination, and therefore only one transport document is issued, namely a combined transport bill of lading[13]. Thus the client can obtain one through rate, despite the transfer of cargo from one mode to another. Furthermore, the bill of lading necessitated a revolution in organisation and information control and, in addition, serves as a receipt for goods (Rodrigue *et al.,* 2006).

Figure 3.1 illustrates the distribution of freight from points of origin A, B and C to the rail terminal. Once the cargo arrives at the rail terminal, it is consolidated,and the transshipment of cargo takes place. However, before transshipment takes place, the transport operator hands the bill of lading to the person in question. The bill of lading is then used for data handling to ensure the safe and cost-effective control of freight movements across different transport modes. Furthermore, the transshipment procedure ensures a higher load factor and higher transport frequency between the terminals (Rodrigue *et al.,* 2006). Thereafter, the cargo is transferred from one mode to another and can be transported to the final rail terminal. Again, transshipment of cargo takes place and the cargo is distributed to individual destinations D, E and F, representing Johannesburg (City Deep), Rustenburg and Nelspruit respectively. From this, it is evident that intermodality is considered as a major potential contributor to solving sustainability problems of the transport sector.

3.3 INTERMODALISM TRANSPORTATION

According to Ricci and Black (2005), intermodal freight transport is defined as the movement of goods in one loading unit. Intermodal transport uses several modes of transport without actual handling of the goods in transshipment, between modes. Intermodalism originated in ports with the development of the container in the late

[13] Bill of lading refers to a document that includes the contract between an exporter and a transport company (Rodrigue *et al.,* 2006).

1960's, and has since spread to integrate other modes (Rodrigue *et al.*, 2006). Moreover, shipping lines in the USA were amongst the first to exploit the intermodal opportunities. They could offer door-to-door rates to customers by integrating rail services and local truck pickup and delivery in a seamless network (Rodrigue *et al.*, 2006).

Intermodalism provides transport for consolidated loads such as containers and semi-trailers by combining at least two modes (Janic, 2007). In Europe, the demand for freight transport has grown by more than 30% during the last decade (Arnold, Peeters & Thomas, 2003). According to Arnold *et al.* (2003), road transportation generates important negative externalities in terms of environmental and social costs. Negative externalities include congestion, pollution, infrastructure damages and road accidents. Nevertheless, intermodal transport is seen as a potentially strong competitor to road transport and is considered to be much more environmentally friendly (Janic, 2007). Moreover, intermodalism offers numerous advantages such as reduced costs (Rodrigue *et al.*, 2006).

Intermodalism has reduced transportation costs significantly. The main factors behind cost reductions reside in the speed and flexibility incurred by intermodal transportation. Transshipment operations are minimal and rapid (Rodrigue *et al.*, 2006). Therefore, it is necessary to assess the current economic performance of intermodal transportation and, more specifically, a detailed knowledge of the costs involved in intermodal transport as well as the driving factors behind these costs.

3.3.1. Intermodal terminals

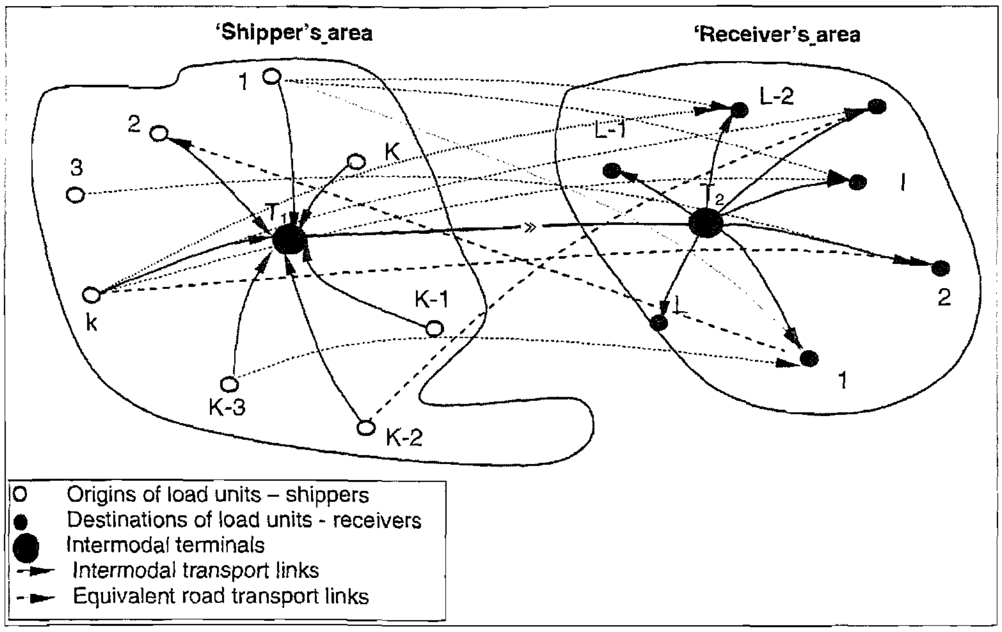
Credible measurements of internal and external costs (social costs) of intermodal transportation are the most common prerequisites for both public policy and private strategy formulation to enhance the competitiveness of intermodal transportation (Ricci and Black, 2005). Moreover, an analysis of the full costs of a given intermodal and equivalent road transport network requires an understanding of a number of important factors. These factors include the size of the network, the intensity of operations, the technology used in intermodal transportation, and the most important factor, the internal and external costs of individual components of the system (Janic, 2007).

According to Ballis and Golias (2001) rail-road terminals provide the space and the operational environment for the transfer of intermodal transport units between different transport modes. According to Sondermann and Ballis (1999), a typical rail-road terminal includes the following elements:

1. Rail sidings for train and wagon storage
2. Transshipment tracks for train loadings and unloading operations
3. Storage and buffer lanes for intermodal transport units
4. Loading and driving lanes for the trucks
5. An internal road network

According to Janic (2007), an internal road network includes a network node which represents the origin and destination of goods. Network nodes represent clusterings of manufacturing plants, warehouses, logistics centres and freight terminals located in shipper and receiver areas. Figure 3.2 shows a simplified scheme of a typical internal road network. The spatial concentration of the shippers and receivers area is divided into zones.

Figure: 3.2: An intermodal and road freight transport network



Source: Janic, 2007

Figure 3.2 involves a number of stages: firstly, goods are collected in the originating zones (zones 1, 2, 3, k, K, K-1, K-2, K-3) and then transported by truck to the origin intermodal terminal located in the shipper's area. Secondly, the transshipment takes place at the origin intermodal terminal from the truck to the trunk-haul. The trunk-haul is also known as the non-road transport mode and includes rail, inland waterways and air transport. Thirdly, line-haul transportation takes place between the origin and destination intermodal terminals by means of the trunk-haul mode. Fourthly, after arriving at the destination intermodal terminal, transshipment takes place in the receiver area from the trunk-haul mode to the selected trucks, and, finally, goods are distributed from the destination intermodal terminal to the destination zone by truck.

According to Daganzo (1999) the movement of loads in a road transport network between the shipper and the receiver areas, is carried out directly by the same truck. Furthermore, the movement of loads are carried out in three steps, namely: collection in the origin zones, line-hauling from the origin to the destination zone, and then the distribution of goods within the destination zone (Daganzo, 1999). According to Ballis and Golias (2002), a rail-road terminal is a complex system where many parameters are strongly interrelated. The parameters in question include the terminal's location in relation to the spatial allocation of production and consumption centres. According to Ballis (1999) the following five basic parameters can be distinguished:

3.3.1.1. The length of the transshipment tracks

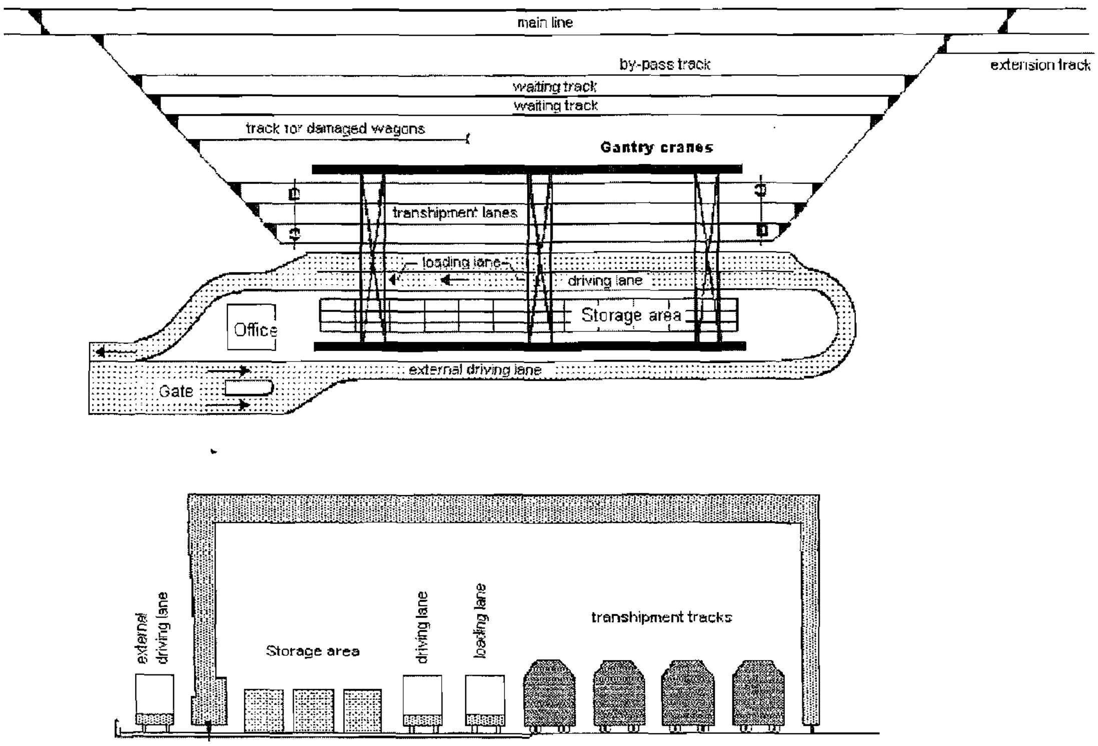
The transshipment tracks are determined by three factors: the length of the train, the land availability, and cost constraints. The length of the transshipment tracks not only affects the terminal dimensions, but also everyday operations. For instance, Ballis and Golias (2002) explain that if the number of incoming wagons per train exceeds the length of the transshipment track, the train has to be shared out over more than two tracks. Moreover, if the capacity of the transshipment tracks is exceeded, certain trains have to be removed from the transshipment tracks after an unloading and loading phase of a few hours. This is done to make space for new inbound trains.

Furthermore, the land availability constraint is explained by historical reasons for first and second generation terminals. According to Ballis (1999) the majority of existing terminals were built without consideration of the growth rate in transport. Historically, it was thought that combined transport had no future, and this in turn explains the low levels of investment in such terminals.

3.3.1.2. Utilisation of the transshipment tracks

According to Ballis and Golias (2002), a transshipment track is simply a railway track that is served by the terminal's handling equipment. In other words, a transshipment track is a railway track under the legs of a gantry crane. Figure 3.3 presents a model of a transshipment track. As shown below, the transshipment terminal (the first illustration), illustrates a terminal where four transshipment tracks and two waiting tracks are identified.

Figure: 3.3: Layout and cross-section of a transshipment terminal with three gantry cranes



Source: Ballis and Golias, 2002.

As shown in figure 3.3, the first two lines (main line and by-pass track) represent the static and dynamic capacity of the transshipment terminal, whereas the waiting track enables only the train dwell in the terminal. The static capacity of the terminal assumes that two trains are served per track per day. For instance, the first train arrives in the morning and there is one outgoing train in the evening. Moreover, the dynamic capacity of the terminal assumes that the terminal can handle more than two trains per day on a given loading track. For instance, the terminal's handling equipment (gantry cranes) are able to serve more trains. However, the trains need to be switched between transshipment (by-pass) tracks and the waiting tracks. Therefore, clearing operations are required during transshipment.

Figure 3.3 shows that shunting locomotives are involved in switching the relevant trains. Additional effort is required for the handling equipment and truck delays, because the handling equipment is used in parallel for truck services (see the second illustration). For example, trucks arrive at a given time, passing through the gate and driving down the external driving lane. The gantry cranes have already cleared the train and moved the goods to the storage area. The truck enters the loading lane for the loading of goods and containers. The goods are loaded and the truck leaves the intermodal terminal. The next parameter explains in detail the arrival patterns of trains and the loading and unloading operations according to truck arrival patterns.

3.3.1.3. Train/truck arrival patterns

According to Sahin (1999), train movements are regulated in a scheduled-responsive railway operation structure, by means of a pre-established and conflict-free schedule. In an intermodal terminal, commercial trains usually travel overnight and are served during the day. As a result, the majority of trains arrive in the intermodal terminal during the morning and leave in the evening (Ballis and Golias, 2002). Moreover, the arrival patterns of trucks are determined by the given train's timetable, the working hours of the intermodal terminal, and by market conveniences. Four phases can be distinguished during the unloading and loading of goods.

The first phase starts with unloading the trains. Although it was mentioned before that trains leave in the evening, some trains return during the same night before the terminal opens for business. Therefore, the unloading starts after the arrival of the train or after the terminal opens in the morning. Moreover, a significant number of trucks are usually already present at the terminal for the loading of goods and containers. For this reason, the unloading operations are concentrated in servicing these trucks (Ballis and Golias, 2002). During the first phase of unloading, transshipment from the wagon to the truck is carried out directly. However, if trucks arrive after the trains, the handling equipment is used to transship the load units to the storage area where the goods and containers are stored for some time, or until the truck arrives for loading.

The second phase also starts with the unloading of the trains. However, this phase can be divided into two operations, namely, direct unloading from the train to the truck, or indirect transshipment. Indirect transshipment is simply the unloading from the train wagon to the storage area (no trucks are present) and then from the storage to the truck (Ballis and Golias, 2002). The third phase imposes the unloading of the wagon into the storage area. Therefore, the third phase is also based on indirect transshipment and thus requires an intermediate storage area.

According to Bose (1983), the fourth phase of the unloading and loading operations implies that the trucks are loaded indirectly from the store. The fourth phase completes train unloading and the trucks are ready to deliver goods to final destinations.

3.3.1.4. Type and number of handling equipment

According to Ballis and Golias (2002), there is a variety of handling equipment in the intermodal transport market, suitable for loading and unloading operations. They found that reach stackers and rail-borne gantry cranes are amongst the most predominantly used equipment. Reach stackers are mobile cranes which are mainly used in relatively small intermodal terminals. According to Ballis and Golias (2002), reach stackers are attached at the edge of the boom with a spreader. These cranes are flexible and low cost due to the fact that they are used in small terminals. Reach stackers are able to lift, handle, transport and stack intermodal transport units/containers. The main difference between rail-borne gantry cranes and reach stackers is that the former is used in high volume combined intermodal terminals.

Rail-borne cranes are operated electrically and straddle one or more railway line, roads or rows of stored transfer units. Figure 3.3 showed a typical rail-borne gantry crane configuration. The crane has a load-carrying capacity of approximately 35 tons and has four transshipment tracks, three storage lanes, one driving lane and one loading truck lane.

3.3.1.5. *Terminal access system and procedures*

According to Ballis and Golias (2002), intermodal terminals should be accessible from both ends; this simply means that trains should be able to enter the terminal from both directions. The loading tracks of the terminal are not electrified, consequently, rail access into the terminal cannot be electrified. This implies that there should be a change to diesel locomotives. The reason for no electrified overhead line, is that goods are lifted by portal cranes or reach stackers. However, the railway line up to the transshipment area is electrified so that the train can enter onto the transshipment track by electric traction.

According to Janic (2007), the movement of goods through an intermodal system is associated with internal and external costs (social costs). Internal costs are simply the operator costs of moving goods between the unloading (shippers) and loading (receivers) areas. External costs comprise of environmental costs and include costs that networks impose on society. The next section will examine the social costs of intermodal freight transport.

3.3.2. The social costs of intermodal freight transport

According to Janic (2007), both internal and external costs can be specified for each stage in the transport network. It was found that these costs generally depend on the nature of the network, the intensity of network activities, the efficiency of services offered, and the prices of inputs. The internal costs of an intermodal transport network are determined by the collection, distribution, line-hauling and transshipment of goods moved within the network (Janic, 2007). However, each step in the delivery process generates burdens on society, such as cost of damages due to air pollution, congestion, noise and traffic accidents; these damages imply external costs (Janic, 2007).

3.3.2.1. Internal costs

According to Janic (2007) the cost of each component, for example the collection, distribution and transshipment of goods, embraces the cost of ownership, insurance, repair and maintenance, toll fees and labour. Therefore, it is important to consider different activities of an intermodal chain. According to Ricci and Black (2005), there are two major activities in an intermodal chain which generate internal costs. The first activity entails the loading and unloading of goods.

The loading and unloading of goods is seen as the first and last step of an intermodal transport network, and involves companies which dispatch and receive goods (Ricci and Black, 2005). For instance, internal costs include costs incurred in the loading and unloading of goods, and storage of goods before leaving for delivery. Moreover, the goods may be stored in containers or trailers which entail further costs (Ricci and Black, 2005). According to Arnold *et al.* (2004), the relative cost of the transportation of goods in an intermodal transport network is a major component of internal costs. It was found that road transportation is better suited for both short and medium distances. Rail transportation, on the other hand, is better suited for long distances, since the relative cost of rail is in fact half the cost of road transportation. Therefore, the economic competitiveness of rail is a major determining factor when considering the choice of transportation used in an intermodal network.

The second activity includes the physical transshipment of goods from one vehicle to another. This may be transshipment to a similar vehicle of the same mode, for example truck to truck, or transshipment to a different mode, for example truck to train (Ricci and Black, 2005). The internal costs involved in this activity include the capital cost of equipment used for transshipment, for instance, handling equipment such as gantry cranes. Internal costs are also incurred in the operation of the transshipment process and the storage of goods (Ricci and Black, 2005). According to Janic (2007), the third activity includes the line-haul between two terminals. The internal cost refers to a terminal-to-terminal journey which is usually performed using rail transportation (Ricci and Black, 2005). The terminal-to-terminal costs include any charges for the use of the rail infrastructure.

Based on the above activities, the generic structure for calculating the internal costs of an intermodal network is summarised in equation 1 below. According to Janic (2007), the variables used in equation 1 are specific for particular steps in the intermodal transport network.

Internal cost:

Transport cost = (Frequency) x (Cost per frequency)
= [(Demand) / (Load factor x Vehicle capacity)] x (Cost per frequency), (3.1)

Time cost = (Demand) x (Time) x (Cost per unit of time per unit of demand), (3.2)

Equation 3.1 signifies the collection and distribution of goods or containers. It is important to note that vehicles of similar capacity and load factor collect the goods and/or distribute goods. Frequency refers to the number of vehicle runs required to collect and distribute a given number of goods or containers. According to Janic (2007), the frequency is proportional to the quantity of units collected and inversely proportional to the capacity of the truck as well as the load factor. According to Ricci and Black (2005), the load factor on all transport modes are characterised as having a load factor significantly below 100%. For example, an empty vehicle has a load factor of approximately 30%, while a loaded vehicle has a load factor of approximately 70%. Furthermore, load factors tend to be much higher on long journeys travelled by road (Ricci and Black, 2005).

The cost per frequency in equation 1 relates to the cost of an individual truck and is expressed on the basis of distance travelled. According to Janic (2007) the distance travelled includes the segments of the vehicle's initial position, for example, the starting point of the vehicle and the first stop. Distance also includes the average distance between successive stops, for example the distance between the first stop and the second stop, as well as the distance between the last stop made and the intermodal terminal. Equation 3.2 refers to the time costs in an intermodal transport network. The time costs depend on the distance travelled by a given truck, the average speed of the vehicle, the anticipated delays, and the time spent picking up and delivering goods (Janic, 2007). The second part of social costs includes external costs (emission rate of pollutants, congestion, noise, etcetera) and their impact on the society and environment (Janci, Reggiani and Spicciareli, 1999).

3.3.2.2. External costs

According to Ricci and Black (2005) components of external costs include the following: the use of machinery and equipment for the loading and unloading of containers and goods in an intermodal terminal, and the movement of vehicles during the transshipment process. External costs impacting on society and the environment include factors such as air pollution, congestion, noise and traffic accidents (Janic, 2007). Air pollution is generated by trucks carrying out collection and distribution activities. These trucks usually burn diesel fuel and cause air pollution.

The components of air pollution may be harmful to people's health and surrounding buildings. The second factor of external costs is the congestion of trucks performing collection and distribution activities. According to Janic (2007) trucks impose delays on other vehicles and, consequently, cause private delays. The noise factor is related to air pollution, as trucks involved in the distribution of goods in a given zone or area cause noise and annoyance. If this persists, it can cause a decline in productivity and have adverse health effects. The last factor is traffic accidents, which may cause damage and property-loss, not only for the intermodal transport network, but also for third parties.

Based on the abovementioned assumptions, the generic structure for calculating the external costs of a given intermodal transport network is as follows:

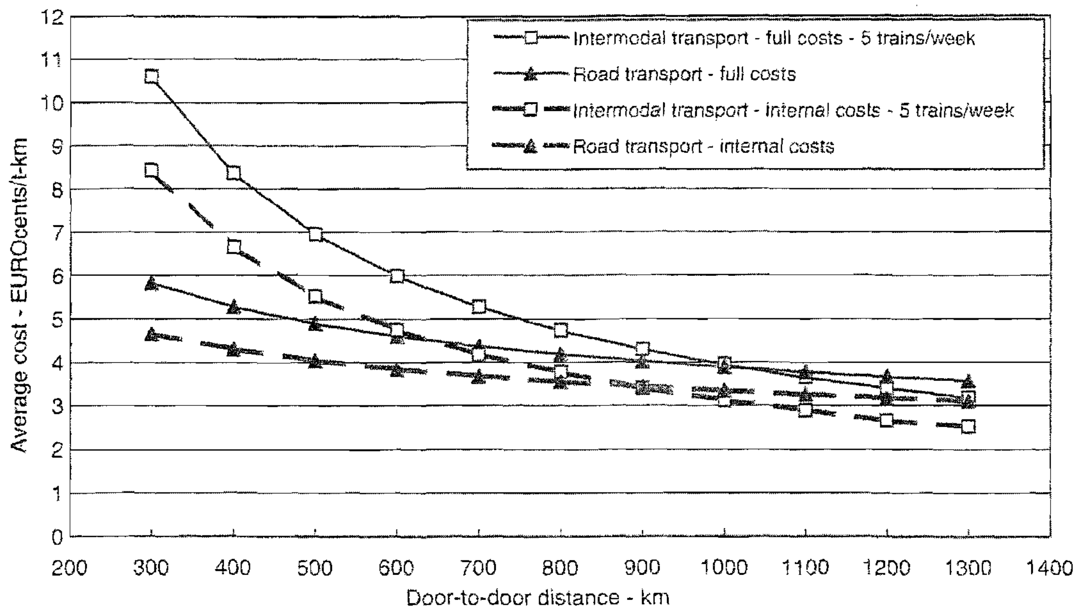
External Cost:

External cost = (Frequency) x (External cost per frequency) (3.3)

= [(Demand) / (Load factor x Vehicle capacity)] x (External cost/frequency)

Frequency relates to the number of vehicles required to collect and distribute goods and containers (the same as with internal costs). According to Janic (2007), the external cost of the collection of goods is proportional to the frequency of the trip. It also depends on the quantity of goods collected, the capacity of the vehicle, and the load factor. Thus, the external cost per frequency depends on the distance travelled by a given truck as well as the costs of individual burdens, such as road accidents, congestion and air pollution. Moreover, although intermodal transportation seems to generate costs, the operational costs of an intermodal transport network is lower than that of road transport over short, medium and long distances. The results are shown in figure 3.4 (Janic, 2007).

Figure: 3.4: The average external, internal and full costs of a given intermodal and road transport network



Source: Janic, 2007.

Figure 3.4 shows that the full costs and internal costs of intermodal transport, are, on average, lower than that of a road transport network. For instance, the internal costs for a given intermodal transport network tends to decline as distance increases. The reason for this may be because an intermodal transport network uses more than one transport mode. As mentioned earlier, rail transportation costs less, on average, than road transport for both medium and long distances. Therefore, the first part of intermodal transport makes use of road transport and then switches to rail transport. Road transportation, however, only uses different trucks for transporting goods and containers (Janic, 2007).

Figure 3.4 illustrates that the average internal costs of both transport networks decrease proportionally more than the door-to-door distance. According to Janic (2007), the latter is an indication of economies of distance. However, the internal costs of an intermodal transport network tends to decrease at a higher rate. This indicates that intermodal transport is currently the competitive alternative to long distance travel. Nevertheless, effective container terminals are required for the transport network that supports both multimodalism and intermodalism. .

According to Günther and Kim (2006), container terminals serve as an interface between different modes of transportation, for example, domestic train and truck transportation. They find that most container terminals are laid out as multimodal facilities; they are directly linked to railway, truck and inland navigation systems. Container terminals are divided into sea terminals, and inland terminals or dry ports. The next two sections focus on container terminals as a means of promoting multimodal and intermodal transportation.

3.4. CONTAINER TERMINALS (Sea terminals)

According to Zhang, Liu, Wan, Murty & Linn (2003), container ports are essential intermodal interfaces in the global transport network. They found that container terminal efficiency reduces transportation costs. According to Steenken, Voß and Stahlbock (2004), more than 60% of the world's deep-sea cargo is transported in containers. This increases the pressure on container terminals, container logistics and encumbers the management of efficient use of technical equipment. According to Tongzon and Heng (2005), port efficiency is an important factor to consider when studying a country's competitiveness. They find that determinants of port competitiveness include components such as the port operation efficiency level, port cargo handling charges, landside accessibility, and the adaptability of the changing market environment.

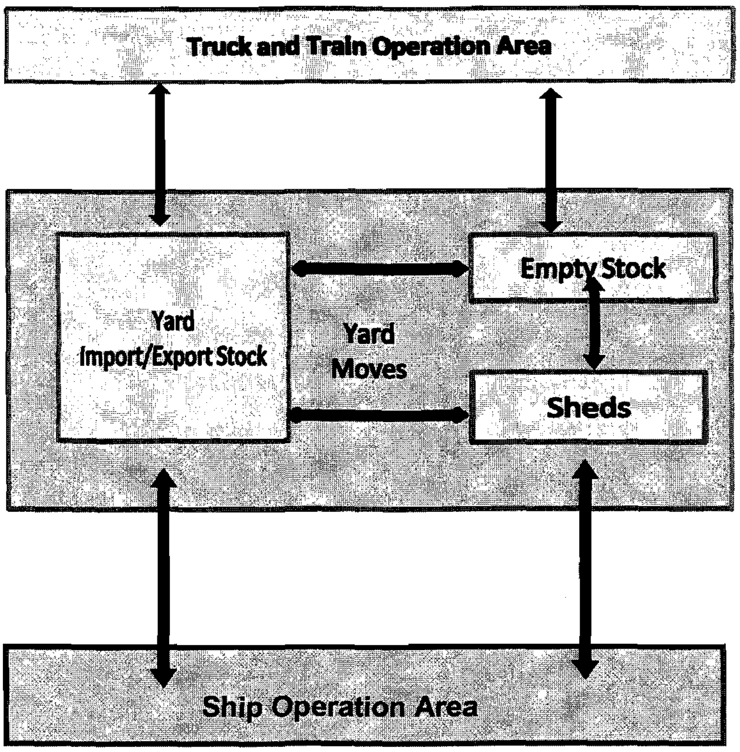
According to Liu (1995), the size of the port is a significant factor when explaining port efficiency. Notteboom, Coeck & Van den Broeck (2000) find that the size of the port has a positive effect on port efficiency. Therefore, ports with larger throughputs have certain performance advantages over their small competitors. Furthermore, the competitiveness of a container seaport is marked by different success factors, especially the transshipment time (the time of ships in the port) combined with low loading rates (Steenken *et al.*, 2004). Therefore, this section provides a general overview of the functionality of a container terminal with the focus on physical container movements.

3.4.1. Container terminal operations

According to Steenken *et al.* (2004), a container terminal can be described as an open system of material flow with two external interfaces. The two interfaces refer to the berthing area or quayside which is equipped with quay cranes for loading and unloading activities, and the landside area where containers are loaded and unloaded on or off trucks and trains (Günther and Kim, 2006). Figure 3.5 illustrates operation areas of a container terminal and the flow of transport. Figure 3.5 shows that both imports and exports are stocked or stored in a yard which is divided into a number of blocks. According to Günther and Kim (2006), sheds are used for the stuffing and stripping of containers or for additional logistics services. Furthermore, some terminals have special stacking areas which are reserved for reefer containers. According to Steenken *et al.* (2004), reefer containers need special electricity supply for cooling or the storage of hazardous goods. The truck and train operation area above links the container terminal to outside transportation systems. The paragraph below describes the chain of operations for a container terminal (see figure 3.5).

After arriving at the container terminal by truck or train, the container is identified and registered according to its contents, origin, destination, and shipping line (Günther and Kim, 2006). Containers arriving by truck or train are then unloaded and handled within the truck and train operation area, while import containers are picked up by internal transport equipment and transported directly to the yard position. For instance, if sheds or empty depots arrive at the container terminal, additional moves are performed. These moves entail the transport of sheds or empty containers between the empty stock block, packing centre and import/export container stocks (Steenken *et al.*, 2004). Moreover, the container storage area is indicated by rows, bays and tiers within the block.

Figure 3.5: Operation areas of a seaport container terminal and flow of transport



Source: Günther and Kim, 2006

According to Steenken *et al.* (2004), specific cranes and lifting vehicles are used to unload the containers and store them in the yard block. After the arrival of the container at the designated block, the container is unloaded by quay cranes onto the vessel at a pre-defined stacking position (Günther and Kim, 2006).

3.4.2. Structure of stacking strategies

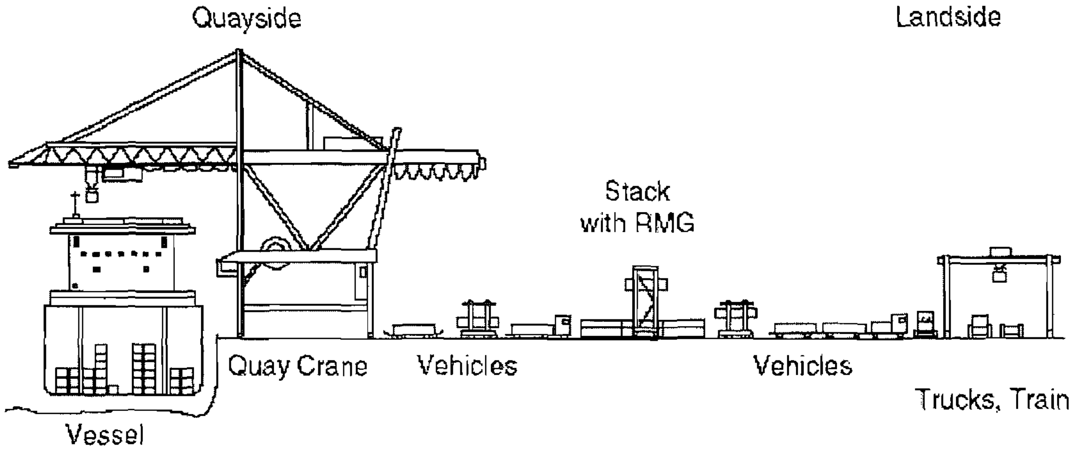
According to Kang, Medina & Ouyang (2008), the handling of containers at container terminals is quite sophisticated. They found that, in general, each container arriving at the terminal may go through one or more of the following three phases: loading, unloading and transfer to other ships or land-based intermodal transport services. However, container terminals provide more than just loading and unloading services for container carriers: a container terminal also serves as a temporary storage space for containers that are between two journeys (Zhang *et al.*, 2003). According to Steenken *et al.* (2004), storage and stacking logistics have become of major importance for carriers, because more and more containers have to be stored in ports as container-traffic around the world increases and space becomes more cramped.

The main objectives of a stacking strategy are the efficient use of the storage space, efficient and timely transportation from the quay to the stack area, and on to further destinations, and the avoidance of unproductive moves for container terminals (Dekker *et al.*, 2006). For example, export containers should be stacked close to the ship on which it will travel, and containers with subsequent departure times should be stacked in corresponding order (Steenken *et al.*, 2004; Dekker *et al.*, 2006). Nevertheless, some containers require special locations, such as reefers which require electricity. Moreover, stacks are separated into import and export parts.

According to Dekker *et al.* (2006), containers that arrive in large containers ships from overseas are classified as import containers. The arrival of import containers are predictable: they often arrive according to scheduled shipping programs and continue to their destination through inland transport. Therefore, the stacking and storing of these import containers are only temporarily. However, export containers arrive via inland transportation, and often arrive somewhat randomly (Dekker *et al.*, 2006). The advantage of export containers are that their departure is usually connected to ship, hence, they can be stacked and stored in a more organised manner.

According to Steenken *et al.* (2004), a detailed stowage plan specifies which export container is to be loaded at which location on the ship. For instance, heavy containers should be stored as low as possible, whereas light containers are loaded on top of each other. This ensures the stability of the ship. However, stacking decisions not only include the size of the terminal and the stack of containers in particular, but also the type of handling equipment used (Dekker *et al.*, 2006). According to Steenken *et al.* (2004), two principal combinations of handling equipment can be distinguished, namely a pure straddle carrier system, and a system using gantry cranes for container storage. Figure 3.6 illustrates a container terminal with a gantry crane for container storage.

Figure: 3.6: Container terminal system with a gantry crane system



Source: Steenken *et al.*, 2004.

Figure 3.6 shows that, as ships arrive at the container terminal, the containers are unloaded from the ship using a quay or gantry crane. Hence, two types of quay cranes can be distinguished, namely a single-trolley crane and a dual-trolley crane (Günther and Kim, 2006). In figure 3.6, dual-trolley cranes are used to unload containers. The trolleys travel along the arm of the quay crane and are equipped with spreaders. Spreaders are specialised devices designed to pick up containers for the ship. Dual-trolleys are used to employ an intermediate platform for buffering the unloaded containers (Steenken *et al.*, 2004). Therefore, after arrival, the container is unloaded from the ship using a dual-trolley crane.

The main trolley then moves the container from the ship to a platform. The container is picked up using a second trolley. This trolley then moves the container to the shore. It is important to note that the main trolley is man-driven, whereas the second trolley is automatic. Different types of vehicles are then used to move the container from the ship to the yard. According to Günther and Kim (2006), the most common types are multi-trailer vehicles with manned trucks, automated guided vehicles, and automated lifting vehicles. Since the latter is automated, it is able to lift a container form the ground by self.

The container is picked up using a vehicle and then transported to a second crane for stacking. According to Steenken *et al.* (2004), the second category of cranes used in container terminals include rail-mounted gantry cranes (RMG), rubber-tyred gantries (RTG), and overhead bridge cranes (OBC). The container terminal in figure 3.6 uses a rail-mounted gantry crane (RMG) for the stacking of containers. Thereafter, the containers are stacked onto a vehicle and then transported to the truck and train operation area. The containers are subsequently stacked onto either trucks or trains and transported to inland destinations. According to Steenken *et al.* (2004), the choice of which equipment to use at container terminals, depends on factors such as space restrictions, economical, and historical reasons.

3.4.3. Port efficiency

According to Notteboom and Winkelmans (2001), container terminals are affected by various new forces driving global competition, including the far-reaching unitisation of general cargo. In this context, one should justify the indicators of port competitiveness and port efficiency. According to Tongzon and Heng (2005), the efficiency levels of container terminal operations are of major importance in terms of competitiveness. They find that the level of efficiency can represent how quickly containers are handled. According to Peters (2001), the higher the efficiency level of a container terminal, the more port users are likely to choose it is as their terminal of call. According to Tongzon (1995), the reliability of container terminal operations are important, as this influences shipping line schedules. For instance, if a container terminal causes delays during the operation, it could result in huge losses for the company (Tongzon and Heng, 2005). Moreover, the efficiency of inland transport accessibility is a crucial factor for the overall future trade growth of a container terminal. Inland terminals can help promote port efficiency by means of advanced road and rail links to seaports.

3.5. Inland terminals (Dry ports)

The concept of dry ports is not a new approach. It is an alternative to free space in port areas, and helps to avoid traffic bottlenecks. Advanced inland container terminals with road and rail links to seaports have gained substantial attention in transport research (Van Klink and van den Berg, 1998; Woxenius, 2004; & Roso, 2005). According to Jaržemskis and Vasiliauskas (2007) the rising demand from manufacturing industries and the globalisation of the world economy are seen as important driving forces behind dry ports.

Since the 1990's, the idea of dry ports has been the subject of extensive theoretical and empirical research. Some of the most important contributors in this regard have been Van Klink and Van den Berg (1998), Woxenius (2004), Jarzemskis and Vasiliauskas (2007) & Roso (2007). The idea of dry ports is based on a container terminal far from a seaport that provides the same facilities as a seaport. Furthermore, an inland container terminal provides a direct road and rail link with one or more seaport.

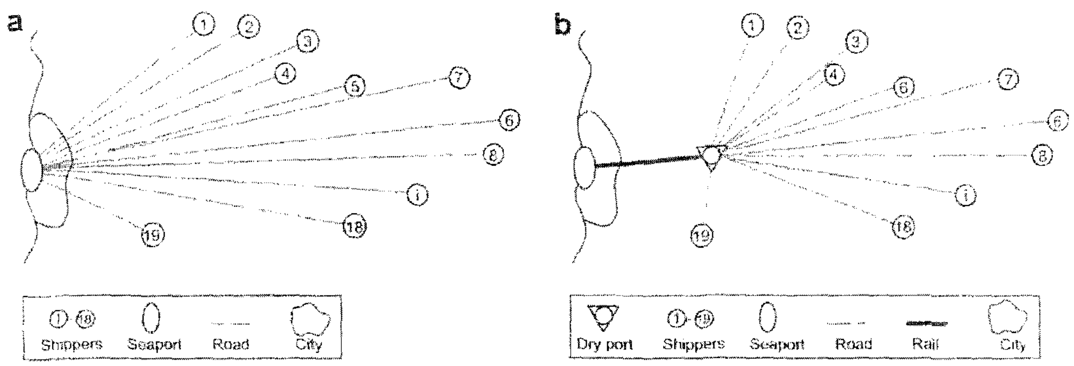
A dry port may be situated in the hinterland or a commercial centre and offers specialised services between the inland terminal and seaport. Dry ports have all the facilities required for shipping and freight forwarding. Dry ports usually expand space in seaports by providing specialised services such as cargo-handling, customs brokerage, and warehousing and cargo consolidation (Roso, 2007).

Dry ports promote intermodal[14] transportation (Rodrigue *et al.,* 2006). According to Rodrigue *et al.* (2006) intermodality enhances the economic performance of a transport

[14] Intermodal transportation involves the use of at least two different modes in a trip from origin to destination under a single transport rate (see section 3.2).

chain by using more than one transport mode. Thus, transport modes are used in the most productive manner to reduce transportation costs. For example, the line haul economies of rail may be exploited for long distances, while trucks can be used efficiently for local pickup and delivery. A reference study conducted by Roso (2007) illustrates that dry ports promote intermodal transportation by achieving better productivity. The reference situation represents the transport of units by truck from the seaport to 19 inland destinations. Figure 3.7a illustrates access to inland destinations without an implemented dry port. However, figure 3.7b demonstrates the system with an implemented dry port. Thus, the movement of units from the seaport to the implemented dry port is now done by both road and rail transportation. Roso (2007) explains that goods are transported from the seaport by rail and then shifted to road transport, which leads to the inland destinations.

Figure: 3.7: Illustration of a transport system (a) without a dry port and (b) with a dry port



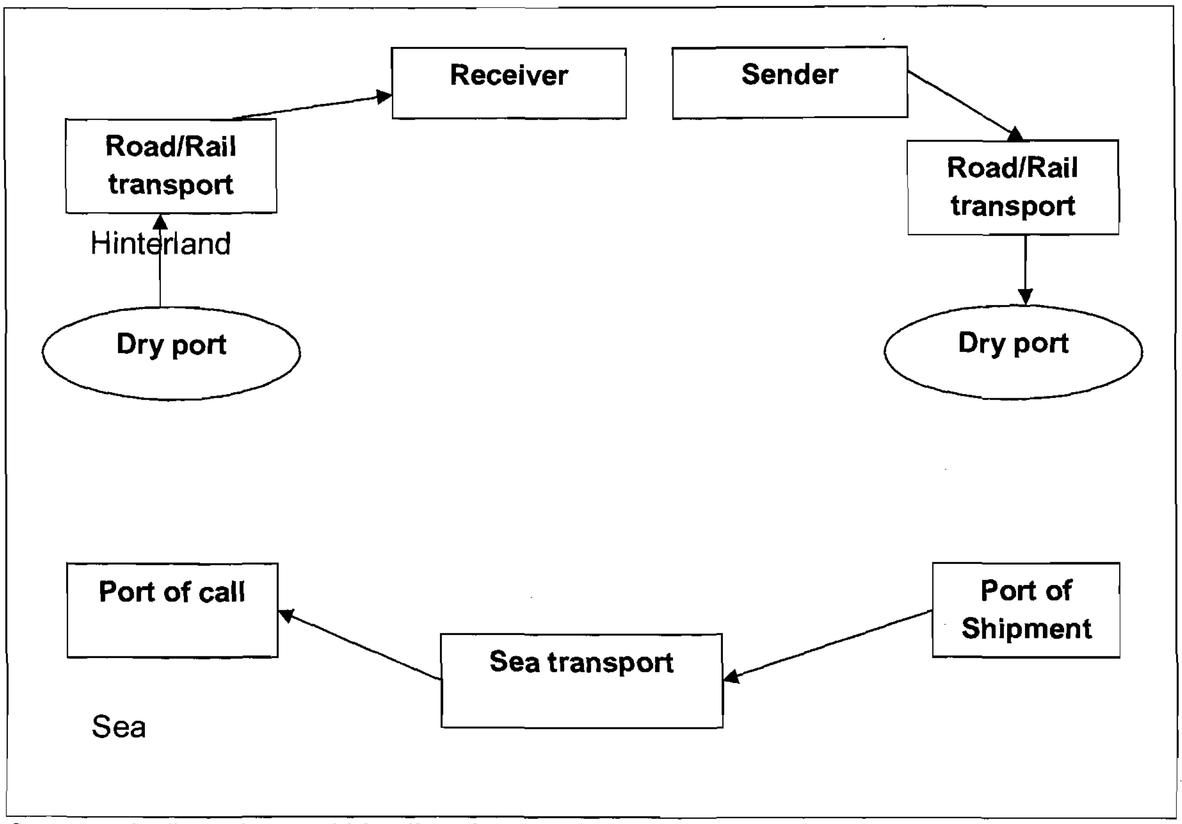
Source: Roso, 2007

Figure 3.7a illustrates a typical container terminal without the use of an inland terminal. Ships arrive at the container terminal and the containers are unloaded from the ship. The containers are then loaded directly onto trucks for delivery at inland destinations. However, this system may impact the surrounding society as well as the environment in terms of air pollution, accidents and congestion caused by trucks. Furthermore, figure 3.7a illustrates 18 shippers arriving at the container terminal. It is not very often that there will be 18 trucks, waiting to pick up containers for delivery. Containers need to be strored somewhere safe until they can be loaded. However, as mentioned in the previous section, space is a scarce resource at container terminals (Roso, 2007).

However, the implementation of a dry port (figure 3.7b) seems to improve container flow operations. This could improve productivity and decrease the environmental impact. Figure 3.7b illustrates that, with an inland terminal, the goods or containers are transported to the terminal via rail, and then to inland destinations via road. Therefore, inland terminals promote intermodal transportation, which could lead to lower overall transportation costs (see section 3.1 and 3.2). As mentioned before, inland terminals operate the same as container terminals; therefore, storage space is available for containers. In short, after the arrival of containers at the container terminal, the containers are stacked directly onto a train for transport to the inland terminal. Therefore, there are no environmental disadvantages and the container terminal is ready for the unloading and loading of new containers.

According to Jaržemskis and Vasiliauskas (2007), growing problems of transporting goods to and from the port through the city, together with expensive transportation costs, have created preconditions for the establishment of dry ports. The development of dry ports is thus an essential tool for the promotion of sustainability and effectiveness of freight transport in sea-related transport chains. Figure 3.8 below shows this by illustrating that dry ports can handle all port-related activities.

Figure: 3.8: Dry ports in the transport chain



Source: Jaržemskis and Vasiliauskas, 2007

Figure 3.8 above provides an illustration of a typical dry port. A dry port provides high capacity mode connections, high capacity cargo storage, consolidation, dispatching, additional services such as truck services, and washing facilities and custom clearance. For instance, cargo is sent via the sender using intermodal transportation. The cargo arrives at the inland terminal where it is either stored or stacked in containers. The containers are then consolidated in an intermodal transport flow to the container terminal where they are then shipped. If, for instance, import containers arrive at the container terminal, the container terminal transports the containers to the inland terminal. After arriving at the inland terminal, the terminal offers specialised services to the shipper.

For example, the terminal manages container flows to different inland destinations by means of an intermodal transportation network (Jaržemskis and Vasiliauskas, 2007). According to Roso (2007), dry ports are classified according to their distance from the seaport. The classification is as follows:

- **Range dry ports:** Range dry ports offer specialised facilities such as warehousing and an interface inclined towards shippers. These dry ports are usually within a few hundred kilometres from the seaport. Range dry ports benefit the transportation network due to the modal shift from road to rail, resulting in reduced transportation costs and potential crises such as truck delays and accidents.

- **Mid-Range dry ports:** Mid-Range dry ports are generally covered by road transport. Shippers can be directed to either the seaport or dry port. Mid-Range terminals are situated within a short distance from the port and serves as a back door for the seaport by relieving stacking areas.

- **Nearby dry ports:** Nearby dry ports are situated within a few kilometres from the seaport. Nearby dry ports increase productivity within the seaport. These dry ports consolidate road transport to and from shippers. Thus door-to-door transport/delivery is the main function of these dry ports.

3.5.1. Nearby dry ports

According to Roso and Lévêque (2002), the creation of a nearby dry port allows the seaport to increase its capacity. The creation of new space gives the port the possibility of sending units directly to the inland terminal. They also state that nearby dry ports is good for the city where it is implemented; there is a reduction of road links from the seaport in favour of a high capacity link.

Figure: 3.9: Transportation system with the implementation of a nearby dry port

a.

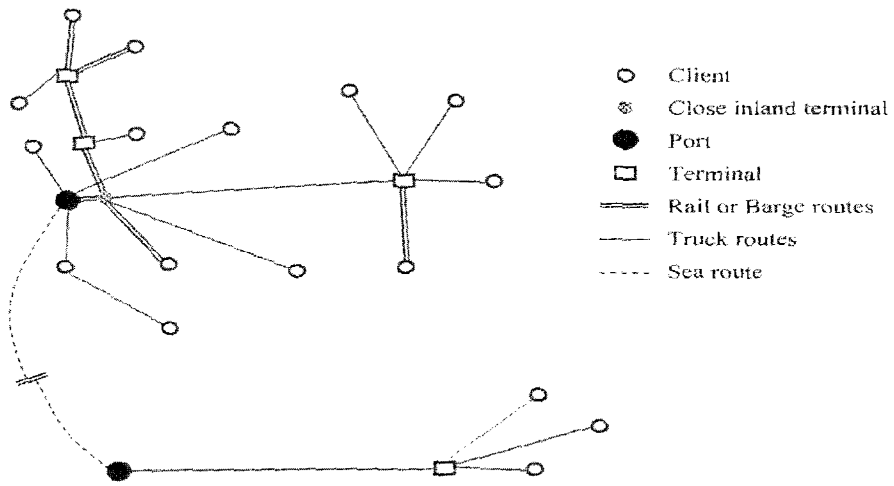


Figure: 3.9a Illustration of a transport system with the implementation of a nearby dry port, beginning activity.

b.

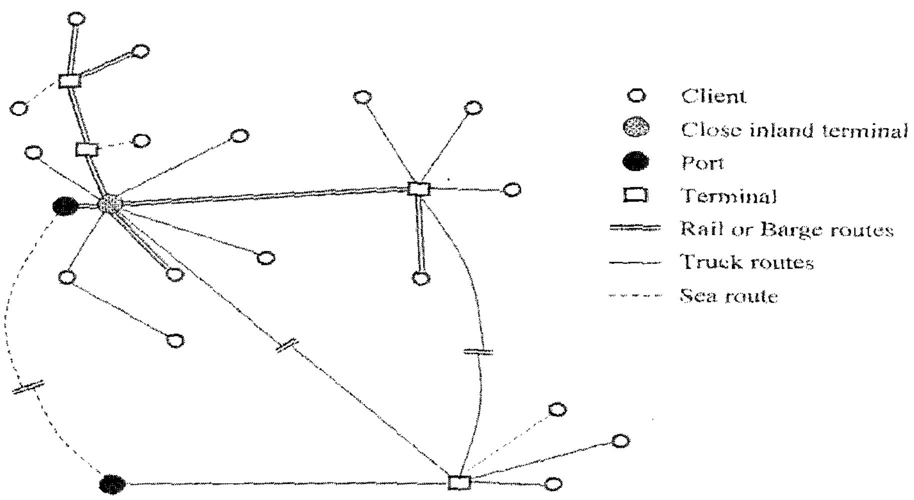


Figure: 3.9b Illustration of a transport system including a nearby dry port after some years.

Source: Roso and Lévêque, 2002.

Figure 3.9 illustrates that nearby inland terminals reduce the number of transportation links from the seaport. For example, with the rise of container transportation, there is an increasing need for trucks to go to the port through the city. However, the implementation of a nearby dry port reduces this, as it is located on the other side of the city. Figure 3.9b shows that the implementation of a nearby dry port reduces the number of transportation links from the seaport. Roso and Lévêque (2002) state that, although nearby dry ports reduce the number of transportation links from the seaport, not every activity is done at the dry port; some goods are still transported directly to and from seaports.

Figure 3.9b illustrates that the implementation of the inland terminal brings about an advanced use of intermodal transportation. For instance, in the beginning there is no direct link from the inland terminal to the container terminal. However, after some time direct links are developed via road and rail transportation. Therefore, inland terminals reduce transportation links by means of promoting intermodal transportation. Moreover, nearby dry ports have the advantage of reducing road maintenance costs. On an infrastructure level, nearby dry ports lead to reduction of cost for road infrastructure development, as well as the reduction of congestion and waiting time for transport operators (Roso and Lévêque, 2002).

However, Roso and Lévêque (2002) identify a few disadvantages. On a transport level, nearby dry ports tend to increase the cost of rail maintenance as well as transit time. Nearby dry ports also tend to add transshipment fees, but the additional cost introduced should be an extra for customers to pay. Roso and Lévêque (2002) explain that these extra costs should not be a problem, as the implementation of a dry port increases productivity.

3.5.2. Mid-Range dry ports

As stated above, mid-range dry ports are dry ports located far from the seaport but within a distance. The most common mode used to transport goods is by truck (Roso and Lévêque, 2002). From a customer's viewpoint, there is a decrease in transportation costs as well as easy access to seaports. Mid-Range dry ports have the advantage of reducing the waiting time for units. However, Roso and Lévêque (2002) explain that, in terms of transit time (including waiting time), customers have the disadvantage of having to wait longer for their cargo. The reason for this delay is that transport from the seaport to the inland destination or mid-range dry port takes longer by train than it would by road. The next category of dry ports is very similar to mid-range dry ports, in terms of advantages and disadvantages.

3.5.3. Range dry ports

Range dry ports are very similar to mid-range dry ports in terms of the basic services provided, as well as its advantages and disadvantages. Apart from the basic services provided by range dry ports, they also tend to offer more specialised and extra services. They also ensure intensification of the transport chain effectiveness, storage, the maintenance and repair of containers, custom clearance, etc. (Jaržemskis and Vasiliauskas, 2006; Roso and Lévêque, 2002).

With the implementation of a range dry port, the congestion at seaports is avoided because trucks can be replaced with more train transportation (Roso, 2007). Roso (2007) reports that, instead of 35 trucks on the road, Europe uses trains. This leads to reductions in road congestion, accidents, road maintenance costs, and local pollution. Roso and Lévêque (2002) state that rail companies benefit from range dry ports in the transportation system, since the aim is to introduce trains as a connection between ports and inland destinations, as shown in figure 3.10 below. It was found that rail transportation is more environmentally friendly, as well as safer over longer distances.

Figure: 3.10: Implementation of a range dry port in a country's transportation system

a.

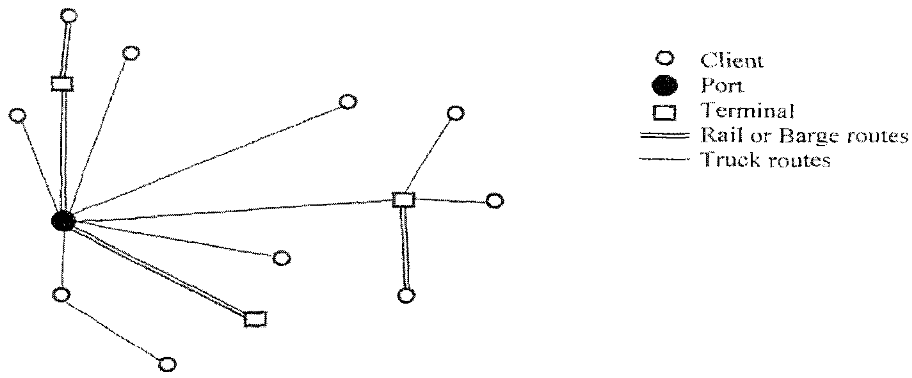


Figure 3.10a .

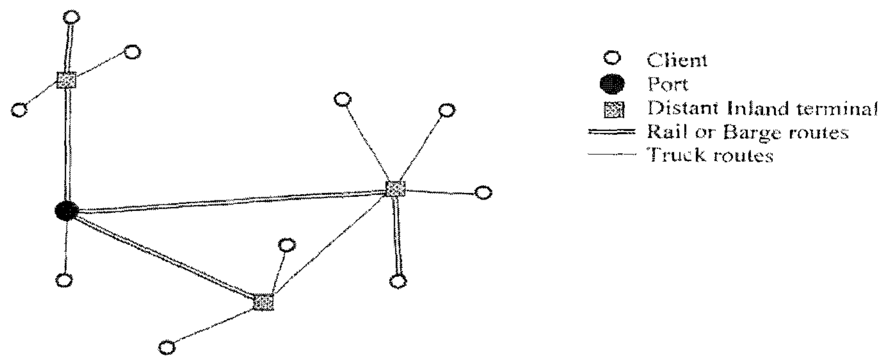


Figure 3.10b

Source: Roso and Lévêque, 2002.

Figure 3.10a represents a transport system without the implementation of a range dry port. One can clearly see that intermodal transportation is not being utilised. However, after some time, intermodal transportation is used at the distant inland terminal. For instance, truck transportation is made use of more often, and there are a significant number of road connections to and from the seaport. Figure 3.10b shows the advantage of a range dry port through the reduction in the number of road connections to and from the seaport. This leads to cargo units being moved closer to customers. After arrival at the seaport, the containers or goods are transported via rail to the distant terminal, where it is then distributed via road to inland destinations. In figure 3.10a, on the other hand, containers are transported using only road transportation and some containers are distributed directly from the seaport. This could, once again, lead to more environmental problems. In the case of a well-developed distant dry port, containers are transported to the distant terminal where distribution takes place. Thus, more space is available at seaports for incoming and outgoing cargo (Roso, 2007).

According to van Klink and Van den Berg (2006), seaports can increase their productivity and generate scale economies to operate cost-effective intermodal transport by using different types of transport facilities. This could be done, for example, by choosing a range dry port and enjoying the benefit of a modal shift from road to rail. Range dry ports have the disadvantage of increasing domestic transportation costs. As noted previously, transport costs increase with distance.

3.5.4. Existing dry ports

Table 3.1: Existing dry ports

Dry port	Function
Insjön dry port, Sweden	Handles the daily container trains with the ports of Gävle and Göteborg, 5000 loaded containers, which are sent to Japan and USA. Dry port is 450 km from the Port of Göteborg, thus classifying as a range dry port
Lyon Port Edouart Herriot, France	Handles containers from the seaport of Marseille and there are around 300 km to cover. Thus a distant dry port.
Coslada-Vicálvaro, Spain	Is situated near the major production and distribution centres, far from the coast. Connected by railway networks to the port of Barcelona. Dry port would serve as a distant dry port as it is 500 km from Barcelona.
Interporti, Italy : Port of Venice Padua and Genoa	Situated in the middle of northeastern Italy and is linked with the national and international rail and motorways. Venice Padua is a nearby dry port whereby Genoa is a distant dry port.
GVZ Bremen, Germany	Situated 5 km to the west of the city centre and close to the port of Bremen. Trains are operated to the main economic regions, like Hamburg and Hannover.
Dry port Muizen, Belgium	This dry port is next to Brussels and

	has direct connections to Antwerpen, Rotterdam and Dunkerque. The connection from the dry port to the seaport is done by rail.
Dry port Mouscron/Lille, Belgium	Dry port Lille is situated next to the French border. This dry port is also connected to rail to the same seaport as Dry port Muizen above.
Virginia inland port, Virginia, USA	It is situated 300 km from the Virginia seaport, thus classifying as a range dry port. It provides a interface between truck and rail for the transport of containers and goods.
Greater Columbus Inland Port, Ohio, USA	It is the crossing point for rail transportation and interstate highways that provides very good accessibility to the USA. Greater Columbus dry port is a good example of a range dry port.
San Antonio Inland Port, Texas, USA	For the transportation and logistics facilities that are involved in the moving of freight into and out of the San Antonio area to destinations around the world.
Dry Port São Paulo, Brazil	This is an example of a nearby dry port, it is located 70 km from the port of Santos.
Dry Port Golas, Brazil	The dry port is connected to rail transportation and is located far from the coasts of Brazil.
Isaka Dry Port, Tanzania	Is connected to 800 km range seaport of Dar es Salaam. This facility is very

	profitable because of the increasing exchange of units done with countries such as Rwanda and Burundi.
Inland Container Depot Embakasi, Kenya	This dry port is located 500 km from Kilindini Port in Mombasa, Kenya, thus corresponds to a range dry port. The connection between the dry port and the seaport is done by rail.
City Deep, Johannesburg, South Africa	City Deep is 600 km from the nearest seaport, the port of Durban. City Deep handles containers from Cape Town, Durban and Port Elizabeth. City Deep is again a good example of a range dry port.

Source: Roso and Lévêque, 2002.

3.6. Conclusion

This chapter has addressed inland transportation systems and their functions. It was found that both multimodal and intermodal transportation systems can be a worthwhile alternative to unimodal transportation. When more than one transport mode is used for inland transportation of goods and containers, it is referred to as unimodal. It was found that the main factors behind cost reductions reside in the speed and flexibility incurred by intermodal transportation. However, intermodal transportation incurs social costs. Therefore, the social costs of intermodal transportation were assessed and the driving factors behind these costs were discussed. Furthermore, container terminals were discussed as by means of promoting intermodal and multimodal transportation. It was found that container terminals are divided into seaports and inland terminals or dry ports. Container terminals were discussed in detail with a specific focus on the container flow operations. It was found that port efficiency is an important component of a country's competitiveness. The efficient use of handling equipment as well as the speed and flexibility of operations may increase competitiveness.

Inland terminals promote intermodal transportation, and intermodality enhances the economic performance of a transport chain by using more than one transport mode. This means that transport modes are used in the most productive manner to reduce transportation costs. For example, the line haul economies of rail may be exploited for long distances, whereby trucks can be used more efficiently for local pickup and delivery. A reference situation illustrates that dry ports promote intermodal transportation by achieving better productivity. The reference situation represents the transport of units from the seaport to 19 inland destinations by truck. Therefore, inland terminals and intermodal transportation may reduce the elements of transport costs. Chapter 4 will examine South Africa's transportation costs, intermodal transportation, exports, and the functioning of container terminals.

CHAPTER 4

SOUTH AFRICA'S EXPORTS AND TRANSPORT INFRASTRUCTURE

4.1. INTRODUCTION

Since 1994, South Africa has become an active competitor in the global market; trade liberalisation replaced the anti-export bias in order to make way for higher export-lead growth (Coetzee, Gwarada, Naudé & Swanepoel, 1997). According to Roux (2004), manufactured exports have increased from 17% in 1988 to approximately 54% in 1998. Rankin (2001) points out that manufactured exports are becoming an important component of GDP. Elbadawi (1998) concludes that outward-oriented trade policies, to support export growth, have become standard practice in economic growth strategies, especially in African countries. However, South Africa has paid insufficient attention to the degree to which different sub-national regions benefit or suffers from such export-oriented growth strategies (Naudé and Gries, 2004).

According to Naudé and Krugell (2005), the internationalisation of South Africa's economy since 1994 has increased the degree of regional specialisation and geographic concentration of industrial activity and therefore, increased spatial inequality. The current situation is that South Africa's spatial distribution of economic activity is still highly uneven (Naudé and Krugell, 2005). Approximately 22 of South Africa's 354 magisterial districts produced approximately 84% of the total manufacturing exports in 2002. Therefore, only 19 of South Africa's urban areas produced approximately 70% of the country's GDP.

According to Matthee, Naudé & Krugell (2006), the geographic location and/or origin of manufactured exports are important. In other words, the physical location of exporters is significant to the extent that the region determines the natural endowments available to, and distances faced by the exporter.

Matthee and Naudé (2007) conclude that regions in South Africa that have experienced faster export growth, are the ones characterised by shorter distances to ports. Nevertheless, the movement of people, goods, and services depend on a good and reliable transport network. This is also the case for manufactured goods. Manufactured goods rely on a good, fast and, most importantly, an efficient transport service to move goods from one location to another. There are four different modes of transport used to deliver goods at a specific location. The different modes of transport are road, rail, sea and air transport. In this chapter the focus will be on road, rail and sea transport.

Therefore, the contribution of this chapter is to identify the degree of geographical concentration and specialisation in manufacturing exports from South Africa, and why some regions or locations export and others do not. This chapter will also indicate that transport is an important distributor of goods, which leads to the development of South Africa's hinterland.

This chapter will be presented in five sections. Section 2 discusses the degree of geographical concentration and specialisation in manufacturing exports from South Africa. The differential export performance of the various magisterial districts in South Africa may be valuable in helping to identify potential interventions, which could allow more magisterial districts to share in the benefits of rising manufacturing exports (Naudé and Gries, 2004). Section 3 discusses South Africa's logistics costs, with specific focus on South Africa's international and domestic transport costs. Section 4 discusses South Africa's transport infrastructure, focussing on the development and the current situation of South Africa's rail, road, and sea transport infrastructure. Section 5 concludes the chapter.

4.2. SOUTH AFRICA'S SPATIAL INEQUALITY AND EXPORTS

Naudé and Matthee (2007) report that transport costs matter for South Africa, since cost minimising businesses aiming to export, prefer to locate closer to a port. However, several exporters are located around 200 to 600 kilometres from the nearest export hub (Matthee, Naudé & Krugell, 2006). For example, table 4.1 provides information on the percentage of exports per sector (nine sectors were included) by distance. From table 4.1, approximately 26% of furniture and other items are located around 200 to 400 kilometres from the hub. Furthermore, the second biggest sector, located around 200 to 400 kilometres from the hub, is textiles and clothing with approximately 19%, and only approximately 1% being wood and wood products. This clearly shows that location is not the only determinant of manufactured exports from magisterial districts in South Africa (Matthee *et al.*, 2006).

Table: 4.1: Percentage manufactured exports per sector by distance

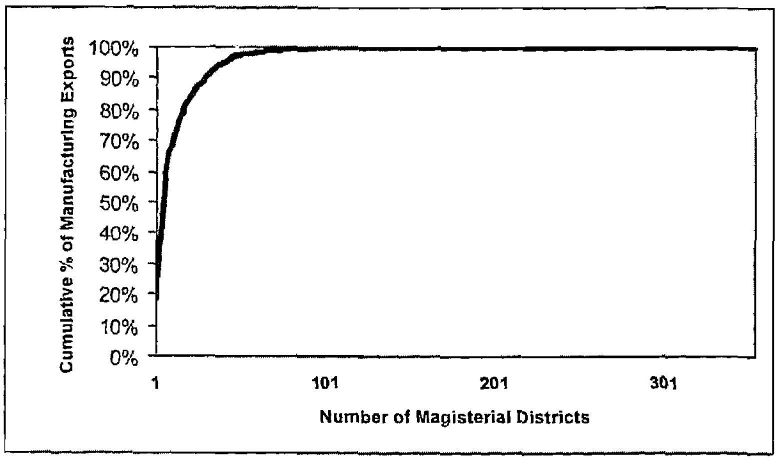
Sector	**Distance from the nearest export hub**				
	200-300 km	300-400 km	400-500 km	500-600 km	600+ km
Food, beverages and tobacco products	4.25	2.76	0.50	0.05	0.02
Textiles, clothing and leather goods	12.50	6.59	0.25	0.01	0.00
Wood and wood products	0.47	0.39	0.12	0.00	0.00
Fuel, petroleum, chemical and rubber products	1.38	2.12	3.56	0.01	0.00
Other non-metallic mineral products	2.19	0.74	0.09	0.02	0.00
Electrical machinery and apparatus	6.05	0.12	0.08	0.02	0.01
Electronic, sound/vision, medical and other appliances	0.32	0.10	0.13	0.01	0.00
Transport equipment	14.36	0.26	0.11	0.06	0.00
Furniture and other items NEC and recycling	1.94	0.82	23.23	0.00	0.01
Metal products, machinery and household appliances	0.84	2.43	0.52	0.01	0.33

Source: Matthee *et al.,* (2006)

Furthermore, South Africa's spatial distribution of economic activity is highly skewed. Naudé and Krugell (2005) conclude that around 70% of South Africa's GDP is produced in only 19 of the urban areas. Therefore, domestic transport costs are a relevant issue in South Africa, especially as the major sources of economic activity and exports are located within 200 to 400 kilometres from the nearest export hub.

Naudé and Gries (2004) examined the geographic concentration of manufactured exports in South Africa. They found that there is greater geographical participation in exports compared to 1996. For example, 187 out of 354 magisterial districts recorded positive manufactured exports in 1996, whereby 208 recorded positive manufactured exports in 2000. However, Naudé and Gries (2004) also report that only 22 magisterial districts generated 84% of South Africa's total exports in 2000 in comparison with 85% in 1996. Figure 4.1 below shows the geographic concentration in manufacturing exports in South Africa in 2000.

Figure: 4.1: Geographic concentration of manufacturing exports in South Africa, 2000.



Source: Naudé and Gries, 2004.

Naudé and Gries (2004) illustrate (figure 4.1 above) that manufactured exports largely originate from less than 50 places in South Africa. Figure 4.1 plots the cumulative percentage of manufactured exports against the 354 magisterial districts in South Africa. More than 80% of South Africa's manufactured exports are generated in less than 50 places. Thus, according to figure 4.1, South Africa's spatial distribution of economic activity is skew. Table 4.2 illustrates this by indicating the percentage of GDP that each of the large agglomerations export.

Table 4.2: Spatial distribution of economic activity

District	Percentage contribution
Gauteng (Johannesburg, Randburg, Boksburg, Germiston and Kempton)	32.7
Durban – Pietermaritzburg	11.32
Pretoria – Brits	7.9
Cape town – Belville	5.98

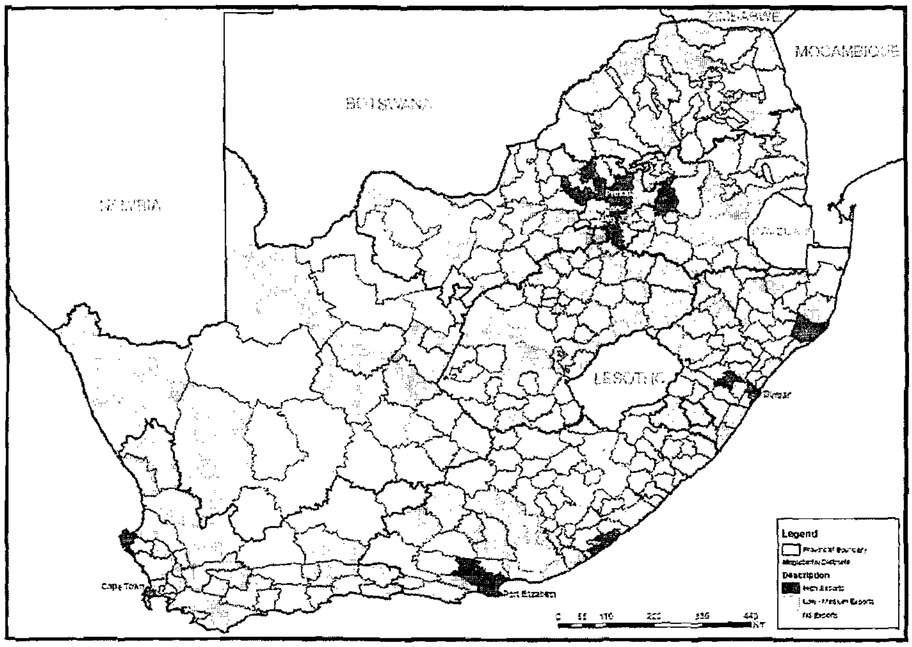
Source: Naudé and Gries, 2004; Naudé and Krugell, 2005.

According to table 4.2, 33% of South Africa's GDP is generated in the Gauteng province. This could be true, as Gauteng is South Africa's economic and business hub (Naudé and Gries, 2004). In contrast, only approximately 6% of the GDP is generated in Cape Town. According to Naudé and Matthee (2007), transport costs affect the export diversity of regions and, thus, businesses. They found that regions with less specialisation and more diversified exports contribute more to overall economic growth in South Africa. They state that export diversity declines as the distance to an export hub increases. In other words, regions located within 100 kilometres from the nearest export hub experience higher export diversity.

A recent study conducted by Matthee and Naudé (2007) includes panel data on manufactured goods, and thus the location of manufactured exports in South Africa. South Africa has 354 magisterial districts, which is divided into 9 provinces. Matthee and Naudé (2007) reported on each of the nine provinces, with their various magisterial districts. The Cape is the largest province as the Western Cape has 42 magisterial districts, the Eastern Cape has 78, and the Northern Cape has 26. This is followed by the Free State, which has 52 magisterial districts, Kwa-Zulu Natal with 52, Mpumalanga and Limpopo with 31 respectively, Gauteng with 24 and lastly North West, which has 19 magisterial districts. Figure 4.2 provides a graphic illustration of South Africa's magisterial districts.

The coloured districts are those that have positive manufactured exports. Figure 4.2 clearly shows that the largest volumes of exports are generated beyond 100 kilometres from a port, and this implies increases in transport costs.

Figure 4.2: Magisterial Districts in South Africa



Source: Matthee, Naudé and Krugell, 2006.

As mentioned above, Naudé and Krugell (2005) state that in 2000, 84% of total manufacturing exports were generated by only 22 of the above 354 magisterial districts. Matthee and Naudé (2007) point out that overall the number of magisterial districts exporting manufactured goods, increased by 15% from 1996 to 2004. Naudé and Gries

(2006) found that magisterial districts with larger economic activity, competitive transport costs, foreign market access, and good institutional quality are able to export manufactured goods more successfully.

4.3. SOUTH AFRICA'S LOGISTICS COST

Logistics costs are important for South Africa, because of the spatial allocation of exporters (see section 4.2). This section provides insight into South Africa's logistics costs.

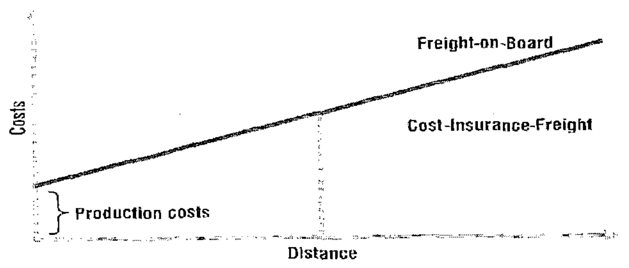
4.3.1. South Africa's international transport costs

Chasomeris (2005) provides an overview of South Africa's international transport costs in terms of its import CIF[15]/FOB[16] ratios. He observes changes in international transport costs in both the pre- and post-sanction periods. For example, the CIF/FOB ratio for the period 1960-1969 (pre-sanction period) was 4.54 and for the period 1990-1999 (post-sanction period) 10.84. This clearly shows an increase in South Africa's CIF/FOB ratio (Chasomeris, 2003). Figure 4.3 illustrates the CIF/FOB ratio of transport costs.

[15] Costs-Insurance-Freight (CIF) includes the price of the goods, insurance costs and transport costs. Average shipping price is built into the price of a product; it implies a uniform delivered price (Rodrigue *et al.*, 2006)

[16] Free freight on board (FOB) includes the factory costs and the shipping costs from the factory to the consumer. The price of a product will vary according to the transport costs (Rodrigue *et al.*, 2006).

Figure: 4.3: CIF/FOB transport costs



Source: Rodrigue, Comtios and Slack, 2005:46

The free freight on board (FOB) cost structure (figure 4.3) indicates that customers located near the factory or port will automatically enjoy lower overall costs, whereby customers located further away will suffer higher overall costs. As noted in footnote 1, the cost structure will vary according to the transport costs, thus indicated by the steep incline. In addition, the customer pays for the freight transport costs, in other words the shipping price is not built into the price of the good received (Rodrigue *et al.,* 2006). The costs-insurance-freight (CIF) cost structure has the shipping price built into the price of the product. Thus, all customers are charged the same price, a uniform price, which is illustrated by the straight line. Under the CIF cost structure, customers located close to the production site subsidise the production costs paid by customers located further away (Rodrigue *et al.*, 2006). Furthermore, international shipping costs in South Africa make up to 60% of transport costs for exports (Naudé 2001).

Elbadawi, Mengistae and Zuefack (2001) found that domestic transport costs have a stronger constraint on exports than international transport costs. Given that transport costs increase with distance, domestic transport costs in South Africa will negatively affect manufacturing exports.

4.3.2. South Africa's domestic transport costs

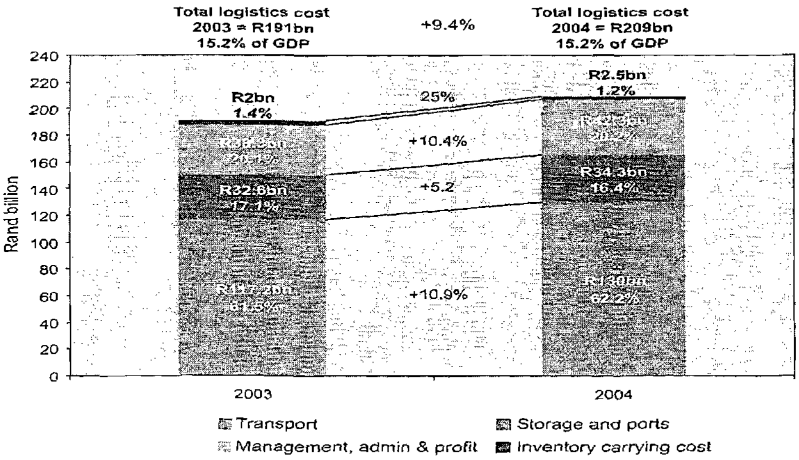
According to Rodrigue, Comtois and Slack (2006), domestic transport costs depend on a variety of conditions related to infrastructure (services and operations), geography (distance of customers and manufactured exports) and most importantly, how freight and passengers are carried. Distance, shipment, and transaction costs[17] are the three major components that impact transport costs (Rodrigue *et al.,* 2006).

Ramos (2005) indicates that South Africa's domestic transport costs accounted for around 13% of the GDP in 2003. This is high in comparison with other emerging markets like, Brazil, where transport costs form only 8% of their GDP. Transport costs increased by 11% over the last five years and the overall logistics costs remained flat at 15.2% of the gross domestic product (GDP) (CSIR, 2004).

According to the CSIR (2004), the biggest driver of logistics costs in South Africa is transportation costs. Figure 4.4 illustrates that transportation costs rose from R 117.2 billion in 2003, to R 130 billion in 2004. This indicates a growth of 0.7% from 2003 to 2004.

[17] Transaction costs imply the cost of doing business, such as gathering information, negotiating and enforcing contracts (Rodrigue *et al.,* 2006).

Figure 4.4: South Africa's logistics stack elements



Source: CSIR, 2005.

Logistics cost is important for South Africa as measurement of logistics cost could help target investment in transport infrastructure, and prepare South Africa for corrective action against past interventions (CSIR, 2004). Logistics cost is the process of designing and managing that part of the supply chain process that deals with transportation, materials at the plant, delivery to warehouses, sorting, handling, packaging and the management of physical products between the point of production to the point of consumption (Rodrigue *et al.,* 2006; CSIR, 2004). Logistics rely heavily on multimodal transportation and containerised freight transport to help decrease logistics cost, and thus transportation costs, in South Africa (Rodrigue *et al.,* 2006). The next section reveals multimodal transport (rail and road transportation) in South Africa, with an emphasis on South Africa's ports.

4.4. SOUTH AFRICA'S TRANSPORT INFRASTRUCTURE

South Africa has one of the most extensive transport infrastructures in Africa. South Africa has 32% of Africa's railway route kilometres and 61% of the continent's rail tonnage (Spoornet, 2008). Furthermore, South Africa has approximately 82% of sub-Saharan motorways and about 15% of their roads. South Africa has a diverse transport network that spoke outwards from the Gauteng province towards the coastal ports (Anon., 2006).

Furthermore, South Africa's diverse transport network uses the following modes identified by the South Africa Business Guidebook to move freight throughout South Africa. According to the South Africa Business Guidebook (2005/2006), the following six modes were identified: firstly, roads for collection and distribution; secondly, roads including line haul; thirdly, railways; fourthly, air transport; fifthly, water, which includes coastal shipping from the point where goods enter or leave the country; and lastly, pipelines.

According to Radebe (2004), South Africa's transport infrastructure is the biggest contributor in both the secondary and primary sector. The primary sector accounts for 12% of GDP and the secondary sector accounts for 78% of GDP. South Africa's transport infrastructure serves as an engine for growth and integrates South Africa's geographically dispersed domestic economy (Department of Transport, 2002).

An international benchmarking of South Africa's infrastructure performance, analysed by Bogetic and Fedderke (2005), highlighted shortcomings in all four major infrastructure sectors[18]. Infrastructure needs to be upgraded in order to promote economic growth. According to Perkins, Fedderke and Luiz (2005), infrastructure is positively related to economic growth, especially in South Africa. Therefore, investment in the transport infrastructure has a long-term influence on the economy. Macroeconomic theory suggests the infrastructure investment such as bridges, roads and ports can create economic growth (Colander and Gamber, 2002).

According to Bogetic and Fedderke (2005), transport performance in South Africa is comparatively less competitive compared to other country groupings. South Africa lags behind in all four major infrastructure sectors, especially in electricity and sanitation

[18] South Africa's major infrastructure sectors include electricity, water and sanitation, information and communication technology, and transportation (Bogetic and Fedderke, 2006)

(Perkins, Fedderke & Luiz, 2005). The services provided by infrastructure, such as transportation services, are fundamental to economic growth in South Africa (Bogetic and Fedderke, 2005). A reliable and high-quality transport infrastructure is an important platform, and crucial for South Africa to compete in the world markets (Moving South Africa, 1998). The following two sections will describe road and rail transport in South Africa.

4.4.1. South Africa's rail network

The South African railway network[19] is controlled by Spoornet and the South African Rail Commuter Corporation (SARCC) (South Africa Business Guidebook, 2005/2006). Historically southern African regions have been heavily dependent on rail transport for economic development (ITRISA, 2006:33). The discovery of diamonds in 1867 in Kimberley played an important role in the development of South Africa's railway network (Perkins, Fedderke & Luiz, 2005).

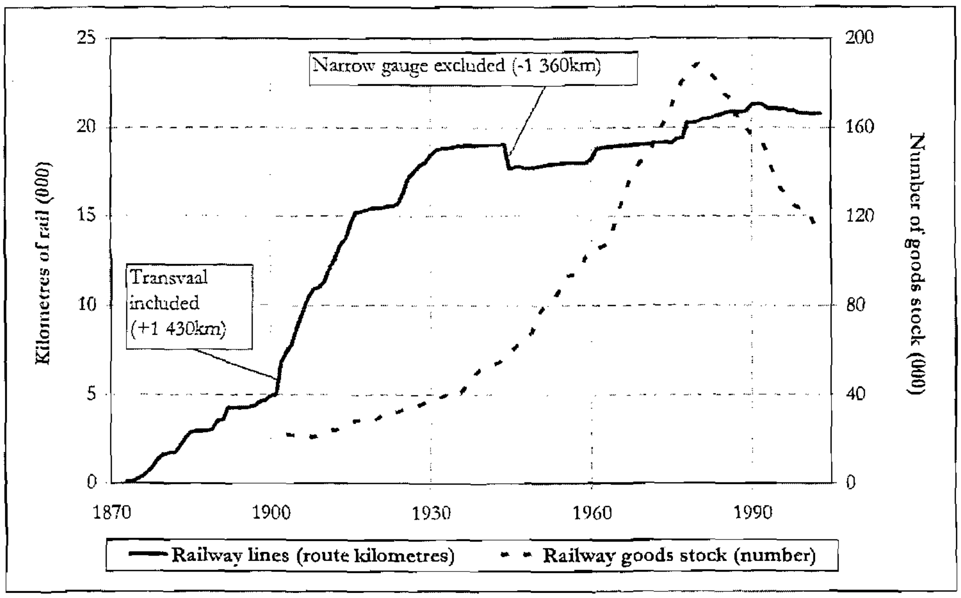
The first public railway opened in 1860 near the port of Durban. This railway ran a short distance from the port of Durban to the centre of Durban. Thereafter, the first railway locomotive was opened in Cape Town (Perkins *et al.*, 2005). This resulted in the construction of approximately 110 kilometres of railway lines in and around Cape Town and KwaZulu-Natal between 1860 and 1867 (Perkins *et al.*, 2005).

Figure 4.5 illustrates the average annual growth rates in railway infrastructure in South Africa between 1870 and 2000. The average annual growth rate of railway lines averaged approximately 5.5% between 1875 and 1910, and 2.2% between 1910 and 1930 (Perkins *et al.*, 2005). By 1930, the railway lines measured approximately 18 445 kilometres. However, growth after 1930 was slow. Figure 4.5 illustrates that the level of railway lines resembled a plateau at the top of a steep mountain. Furthermore, rolling

[19] South Africa's rail network has primary and secondary networks equipped to transport bulk and non-bulk commodities (South Africa Business Guidebook, 2005/2006).

stock grew sharply between 1900 and 1980, but decreased after 1980. The decline in rolling stock was the result of poor overall investment in South Africa, and roads became an important alternative to railway transport (Perkins *et al.*, 2005).

Figure: 4.5: Average annual growth rates in railway lines and railway goods stock



Source: Perkins *et al.*, 2005.

In 2003, the rail network carried approximately 180 million tons of cargo. This contributed to 26% of the total freight transported domestically. South Africa's railway lines measured 20 796 route kilometres in 2003, and the average annual growth rate was approximately two percent. However, in terms of quality and performance, railway services were lagging behind. For example, the average annual growth rate for railway lines was twenty-nine percent between 1975 and 1990 (Fedderke, 2005). Furthermore, the freight cargo of railways dropped by 11% between 1988 and 1990. This indicated that the playing field between road freight and rail freight was not even.

According to the CSIR (2004), South Africa moved approximately 690 million tons of freight domestically in 2003. To this, road freight contributed 74% and rail freight only 26%. Furthermore, road freight grew 4% per annum since 2000, whereby rail freight showed a decline of 1% in tonnages moved. Besides these problems, Transnet Freight Rail is also facing lack of investment and poor management, and therefore little money has been available for reconstruction and repairs on damaged tracks (ITRISA, 2006:34).

Services offered by rail operators in South Africa include a combination of two high-density bulk lines, and a low-value general freight network comprised for bulk cargoes, core lines, and branch lines over long distances (DOT, 1998 and ITRISA, 2006:35). Furthermore, Transnet Freight Rail rail services handles\ bulk[20] and breakbulk[21] consignments, constituting full truck loads (DOT, 1998). Transnet Freight Rail has approximately 60 different types of railway trucks for moving general cargo in southern Africa (ITRISA, 2006:35)

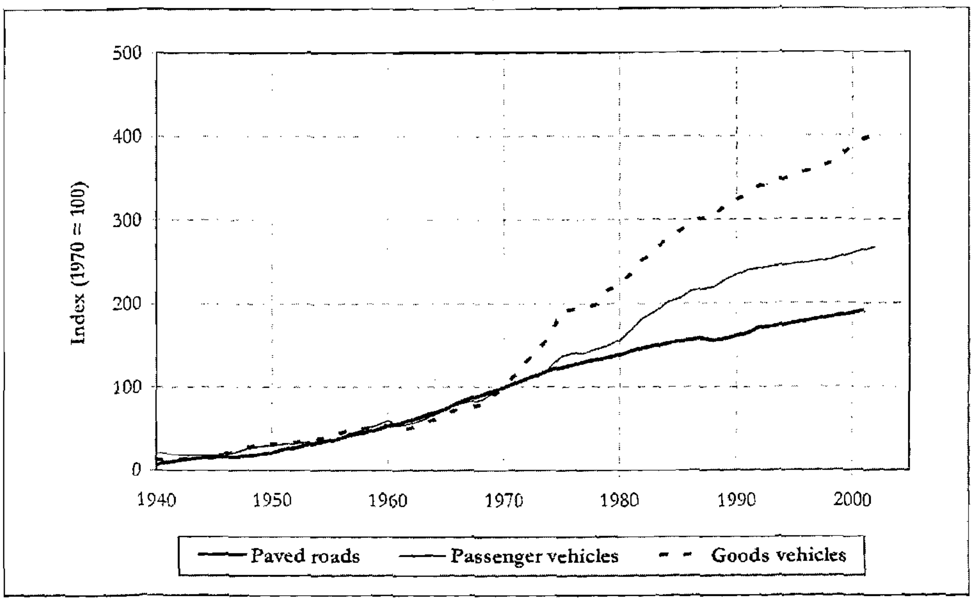
4.4.2. South Africa's road network

Roads in South Africa began as footpaths and wagon tracks, which were subsequently developed into earth roads and, later, gravel roads (Floor, 1985: 14). According to Perkins, Fedderke and Luiz (2005), South Africa's national and provincial paved roads increased from 2 000 km to around 63 000 km between 1940 and 2001.Figure 4.6 illustrates this growth in national and provincial paved roads, passenger vehicles, and commercial vehicles for the transport of goods and services. From figure 4.6, it is clear that the number of goods vehicles (trucks) grew sharply from 1970. This is because delivery to South African destination by road has in the past proved a lot faster than delivery by rail (ITRISA, 2006). Moreover, road transport is usually more expensive than rail transport. However, approximately 75% of South African companies are currently dependent on road haulage for the delivery and distribution of goods and services (Perkins *et al.,* 2005; ITRISA, 2006).

[20] Bulk cargo is consignments conveyed in a loose or unpacked form, usually in large quantities of 100 tons or more (ITRISA, 2006)

[21] Breakbulk cargo refers to consignments which have undergone some form of packing, such as drums and crates (ITRISA, 2006).

Figure 4.6: Average annual growth rates in South African roads since 1940



Source: Perkins *et al.,* 2005.

Today, South Africa has a road network of approximately 264 000 kilometres, of which paved roads make up 30% or 7 200 km (Perkins *et al.*, 2005). Furthermore, of this 7 200 kilometres, dual carriageway and single carriageway freeways make up approximately 1 900 km (Anon., 2006). The approximate extent of the total road network in South Africa is summarised in Table 4.3.

Table 4.3: Approximate extent of road networks in South Africa

Road Authority	Length (km)	Network Split
National Roads	6 700	1%
Provincial Roads	357 000	47%
Unproclaimed Rural Roads	221 000	29%
Metro, Municipal and other	168 000	23%
Total	752 700	100%

Source: National Department of Transport, 2006

According to table 4.3, national roads measure approximately 6 713 km, whereas provincial roads include surfaced roads, gravel roads and access roads. The extent of surfaced roads is approximately 59 464 km, the extent of the gravel road network is approximately 201 142 km, and access roads is approximately 98 531 km. Therefore the total extent of provincial roads is approximately 359 954 km. Unproclaimed gravel and dirt roads, which include access roads, is approximately 221 092 km.

Therefore, South Africa has an extensive road network spanning all nine provinces (Matthee, Grater & Krugell, 2007). According to the (DOT) (2005), between 70% and 80% of all freight is moved by road. The reason for, this is because road transport is more flexible than rail. However, road transport is not without problems. Many companies cut costs by moving their freight on provincial roads in order to avoid the tollgates on national roads (Matthee, Grater and Krugell, 2007). Furthermore, these freight trucks are often illegally overloaded, which causes serious damage to South Africa's road infrastructure (Perkins *et al.,* 2005). According to Spoornet (2006), approximately 25% of all trucks on South Africa's roads are overloaded.

In an effort to resolve the overloading problem, the Road Traffic Authorities (RTA) introduced weigh bridges at specific locations around the country (Matthee, Grater & Krugell, 2007; ITRISA, 2006). The RTA may weigh containers, and vehicles loaded within the legal limits are allowed to continue with their journeys. However, those exceeding the limits could be fined and penalised (ITRISA, 2006). Thus, infrastructure upgrade throughout South Africa, especially road and railway networks to and from seaports, is needed to improve efficiency of imports and exports in order to improve South Africa's overall competitiveness. In other words, effective transport infrastructure is required to transport containers from container depots (ports) and terminals to inland container terminals and dry ports.

4.4.3. South Africa's ports

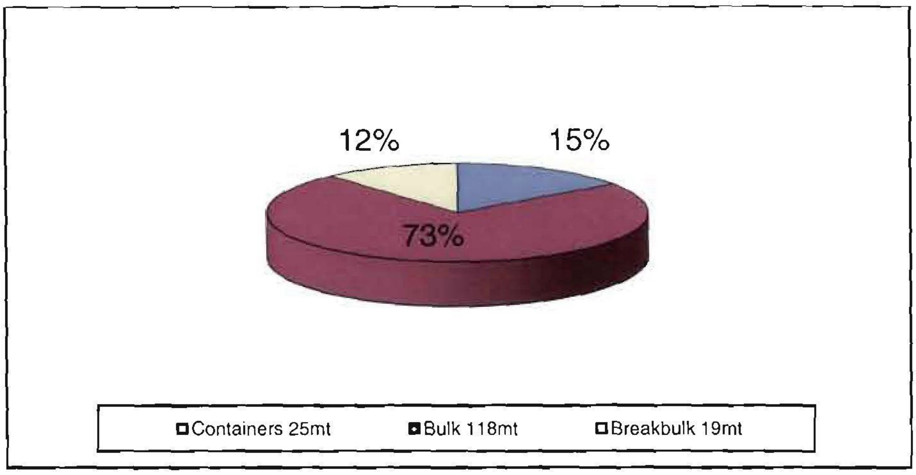
South Africa adopted an outwardly-oriented economic growth strategy in 1996 in its Growth, Employment and Redistribution (GEAR) strategy (Naudé, 2001). Ever since, South Africa's export performance placed the country in the top 12 international maritime trading nations (Chasomeris, 2003a). South Africa has eight major commercial ports, namely, Richards Bay, Durban, East London, Port Elizabeth, Ngqura, Mossel Bay, Cape Town and Saldanha. These ports play a strategic role in trade facilitation and help to shape economic growth and development of the entire Southern African region (Anon., 2006; Chasomeris, 2003b).

According to Van Niekerk (2002), port operations in South Africa have been separated from port authority functions. Therefore, two divisions were created, namely, The National Port Authority of South Africa (NPA) and the Transnet Port Terminals. Furthermore, the NPA acts as proprietor to port operations and provide the marine services, whereas the Transnet Port Terminals operates all the container terminals (Van Niekerk, 2002).

South Africa has become a major sea-trading nation, with about 95% of South Africa's trade volume being seaborne (Chasomeris, 2006a). Furthermore, cargo volumes handled by South African ports doubled between 1970 and 2007 (Van Niekerk, 2002). South Africa is a major exporter of primary products, especially of break-bulk and bulk raw materials (Naudé, 2001). Figure 4.7 illustrates the cargo handled through South Africa's ports in 2001 and 2002. The illustration includes containers, bulk cargo and break-bulk cargo.

Bulk cargo terminals include the ports of Durban, Port Elizabeth and the port of Richards Bay. Port Elizabeth is also a break-bulk terminal. From figure 4.7, it is clear that bulk cargo is handled more often than break-bulk cargo. Bulk cargo makes up approximately 60% of all cargo handled; only 15% is containers handled at commercial ports.

Figure 4.7: Cargo handled through South Africa's ports



Source: Van Niekerk, 2002

According to Van Niekerk (2002), South Africa has no commercially navigable rivers; therefore, there are long inland distances between raw material sources, manufacturing facilities and harbours. Table 4.4 shows the main commodities that are exported through the different ports in South Africa. From table 4.4 it is evident that Richards Bay is primarily responsible for coal, Durban is the principal port for steel, East London handle mostly copper, Port Elizabeth deals with manganese ore and fruit, Saldanha Bay is primarily responsible for iron ore, and Cape Town is the principal port for prepared fruit.

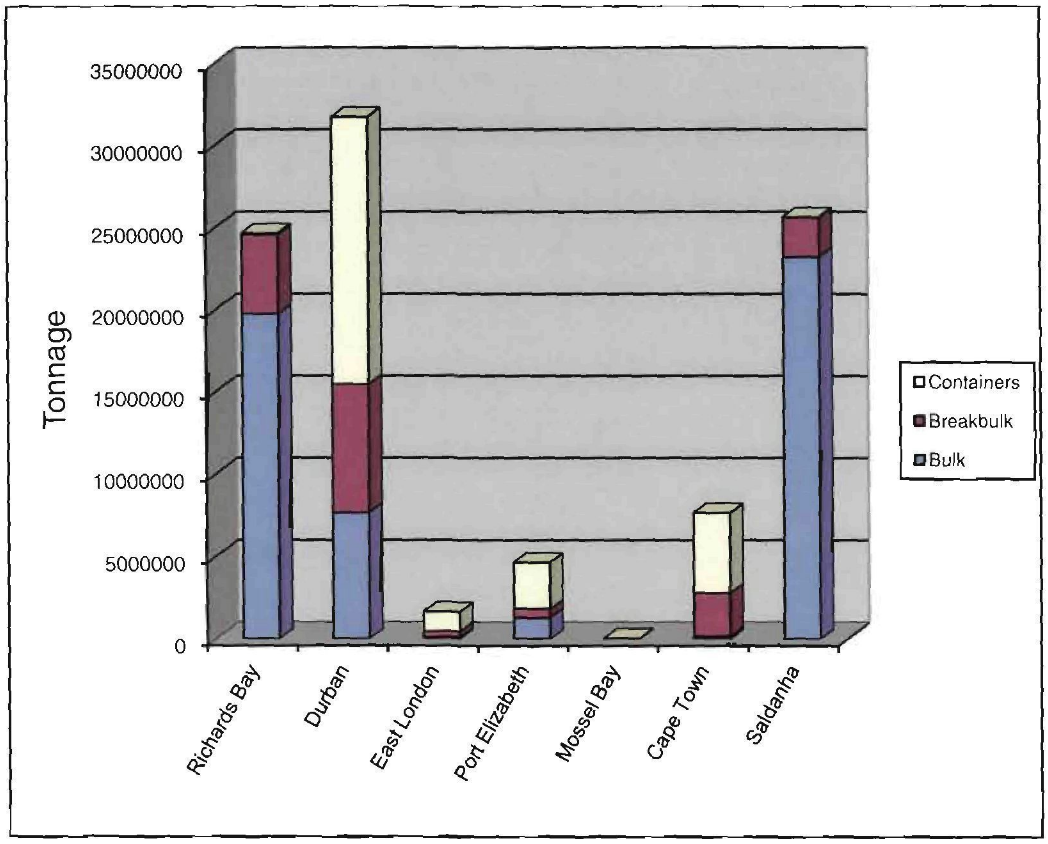
Table 4.4: Bulk commodities exported through South Africa's Ports

Port	**Type of terminal**	**Main Commodities Exported**	**Ton**	**Main Source**	**Approximate distance from origin**
Richards Bay		Coal and Coke	4.9	Welkom	703 km
	Dry bulk terminal	Wood Chips	3.6	Nelspruit	585 km
	Bulk metal terminal	Rock and Phosphate	1.3	Phalaborwa	806 km
	Combi terminal	Chrome Ore	1.1	Rustenburg	721 km
Durban	Dry bulk terminal	Steel	3.2	Middelburg	856 km
	Bulk metal terminal	Timber	1.9	Pinetown	30 km
	Combi terminal	Coal and Coke	1.7	Welkom	546 km
		Chemicals	1.2	Vereeniging	569 km
East London	Combi terminal	Copper	0.1	Prieska	1 420 km
Port Elizabeth	Dry bulk terminal	Manganese Ore	1.4	Meyerton	952 km
	Break-bulk	Fruit	0.3		
Cape Town	Multi-purpose terminal	Prepared Fruit	0.3	Ceres	110 km
Saldanha Bay	Iron ore terminal	Iron Ore	16.6	Sishen	993 km
Mossel Bay		Various	N/a		

Source: Van Niekerk, 2002.

From table 4.4, figure 4.8 illustrates the cargo handled per port. Durban handles mostly containers; moreover, Durban is the largest container terminal in the Southern African hemisphere (see section 3.5.1). Saldanha and Richards Bay handle mostly bulk cargo.

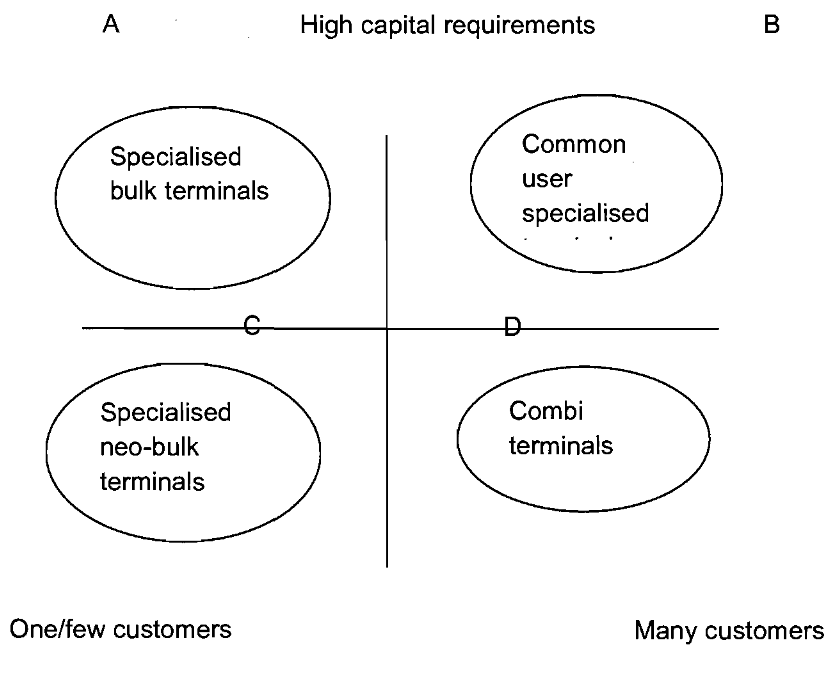
Figure 4.8: Cargo handled per port



Source: Van Niekerk, 2002

Referring back to section 4.3, domestic transport costs matter for South Africa. From table 3.6 it is clear that inland distance from the port to local industries is in fact in excess of 100 km. Therefore, South Africa's transport infrastructure and transport costs may have a significant impact on the competitiveness of these commodities in international markets (Naudé, 2001). According to Radelet and Sachs (1998), the competitiveness of firms affects shipping costs in a country. Therefore, long inland distances imply higher transport costs for South Africa and thus influence shipping costs. According to Naudé (2001), if shipping costs increase in South Africa, firms will have to pay for imported intermediate goods, and will receive less for their exports. However, according to Chasomeris (2003a), shipping costs and thus transport costs can be reduced by means of port efficiency. Port efficiency is related to activities that depend primarily on port infrastructure, such as improved cargo handling. Therefore, South African ports need substantial infrastructure investment. For instance, Van Niekerk (2002) explains that different container terminals or ports require different investments for optimal cargo and container handling. Four types of terminals are identified: specialised bulk terminals, common user specialised terminals, specialised neo-bulk terminals and combi or breakbulk terminals (see figure 4.9).

Figure: 4.9: Categorisation of South Africa's terminals



Source: Van Niekerk, 2002.

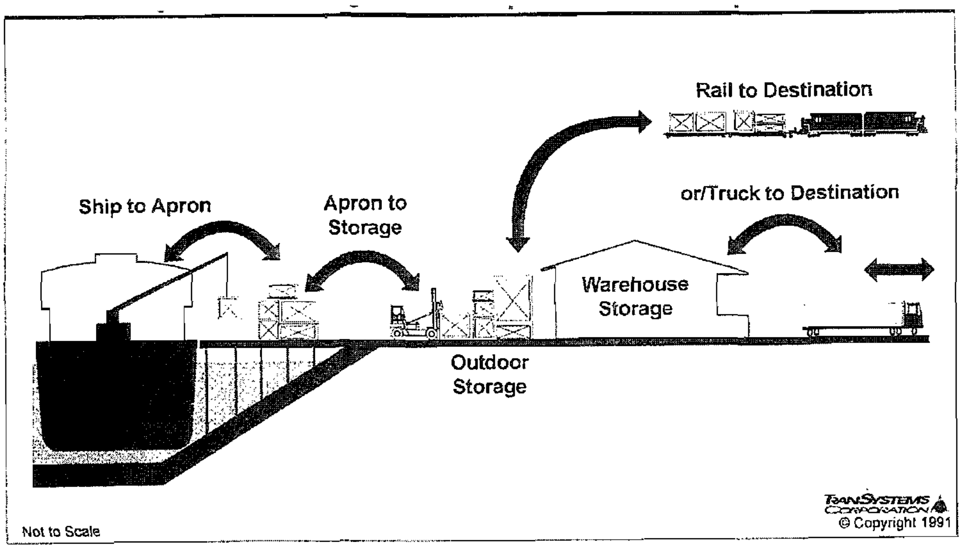
According to figure 4.9, cargo terminals in South Africa are divided into four quadrants. Quadrant A represents the specialised bulk terminals, such as Richards Bay coal terminal and Saldanha Bay iron ore terminal. Specialised bulk terminals are typically installed with specialised cargo handling equipment such as pipelines, conveyors etc. (see figure 4.10). Therefore, such terminals require high capital investments. For example, Saldanha Bay and Richards Bay handle approximately 50% of South Africa's cargo per year.

Quadrant B illustrates the common user specialised terminals, for example the port of Durban. Common user specialised terminals are typically categorised as container terminals and handle valuable cargo (see figure 4.11); therefore, high capital investments are required for successful operations. Container terminals cover approximately 8.5 hectares and have many customers that come and go throughout the day (ITRISA, 2006): these terminals handle approximately 3 000 containers within a 72-hour period. Container terminals are in high demand for private investors. There are various opportunities for concession exits, therefore, returns on investments seem lucrative.

Quadrant C, the specialised neo-bulk terminals, include steel terminals such as Richards Bay and Durban (see figure 4.12). Neo-bulk terminals are high in demand and therefore only have a few customers. These terminals require low capital investments and are therefore of interest to fewer customers. The last quadrant, quadrant D, includes combi terminals such as East London, Durban and Richards Bay. Combi terminals are typically categorised as fruit terminals and are installed for handling liquid or dry commodities, and therefore a substantial amount of capital investment is required for optimal operations (see figure 3.14).

Figure 4.10 illustrates operations at a breakbulk terminal such as Richards Bay and Saldanha Bay. Breakbulk terminals are designed to handle confinements in drums, crates, cardboard cartons or sacks, therefore, referring to cargo that has undergone some form of packing (ITRISA, 2006). Figure 4.10 illustrates the procedures in receiving breakbulk cargo to the point where cargo is distributed to individual destinations via truck or train transportation. However, specialised equipment, such as cranes, is required for loading and unloading operations.

Figure 4.10: Breakbulk cargo terminal operations at a seaport



Source: ITRISA, 2006

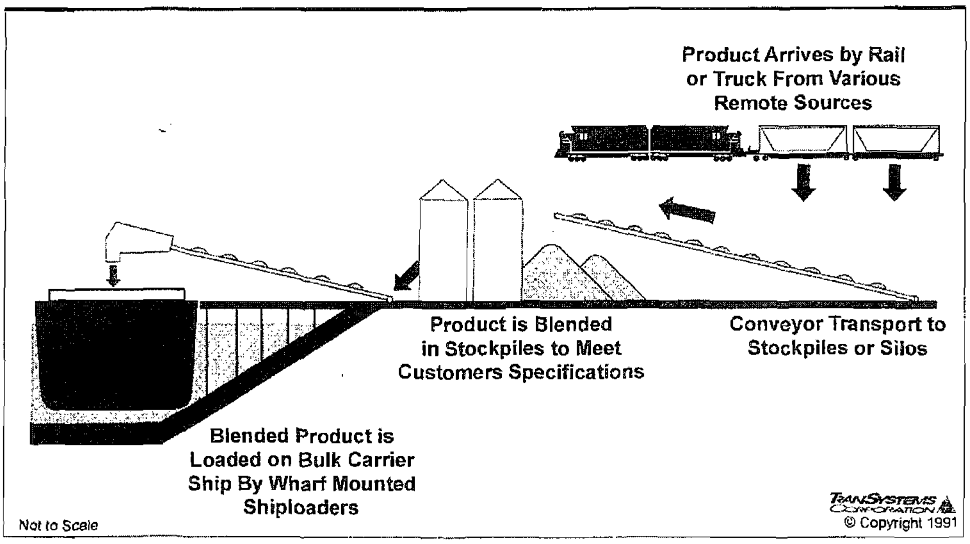
Crates and drums arrive at the breakbulk terminal via ship. Cargo needs to be unloaded and therefore, specialised equipment is required. According to Steenken *et al.* (2004), different types of cranes are used at container terminals. The first category is quay cranes and the second category of cranes includes rail mounted gantry cranes (RMG), rubber tired gantries (RTG), and overhead bridge cranes (OBC). Furthermore, quay cranes are divided into two sub-categories, namely single trolley cranes and dual trolley cranes. Figure 4.10 illustrates the use of an overhead bridge crane (OBC). The overhead bridge crane is mounted on concrete or steel pillars to easily lift crates or drums from the ship (Steenken *et al.,* 2004). Furthermore, the crates or drums are transported from the ship to the outdoor storage.

According to Steenken *et al.* (2004), transport vehicles can be classified into two different types, namely vehicles that are able to lift containers off the ship by themselves, and passive vehicles. Passive vehicles are not able to lift containers by themselves; therefore, cranes do loading and unloading of containers (ITRISA, 2006). Figure 4.10 illustrates a transport vehicle that is able to lift containers by themselves. Furthermore, the latter is called a straddle carrier or forklift. The forklift stacks the containers in the yard and transport operators check whether the cargo needs to be transported via road or rail. For instance, if cargo needs to be transported via rail to the final destination, trucks collect these containers and transport them to rail after stacking. However, if cargo needs to be transported via road transportation, the containers are first stacked into a warehouse for inspection. The reason for this is the possibility of illegal overloading of trucks. Containers first have to be categorised according to destination and weight (Rodrigue *et al.,* 2006).

Figure 4.11 illustrates operations at a dry bulk terminal such as Port Elizabeth, Durban and Richards Bay. According to Rodrigue *et al.,* 2006, dry bulk terminals include transit storage sheds, silos and an extensive open storage area. While breakbulk cargo is handled by forklift trucks, dry bulk cargo generally involves the use of conveyor belting, suction equipment and wagon tipplers which direct cargo straight into the ship's holds (ITRISA, 2006). For example, figure 4.11 illustrates the use of conveyor belting for the unloading of cargo. Conveyor belting is also known as single trolley cranes or wharf mounted ship loaders (Steenken *et al.,* 2004).

The single trolley cranes travel along the arm of a crane and are equipped with spreaders (Steenken *et al.,* 2004). The spreaders are designed to pick up containers and move them from the ship to the shore. Figure 4.11 illustrates the movement of cargo along the spreader to the shore, where the product is blended in silos or stockpiles to meet the customer's specifications. The dry bulk terminal has a coal warehouse capable of storing approximately 200 000 tons of imported coking coal (ITRISA, 2006). The successful implementation of a dry bulk terminal requires close integration of civil engineering and operations management. Therefore, the movement of cargo on the spreaders to the silos needs to be planned systematically to avoid dust emissions into the environment (Anon., 2008).

Figure 4.11: Dry bulk terminal operations at a seaport

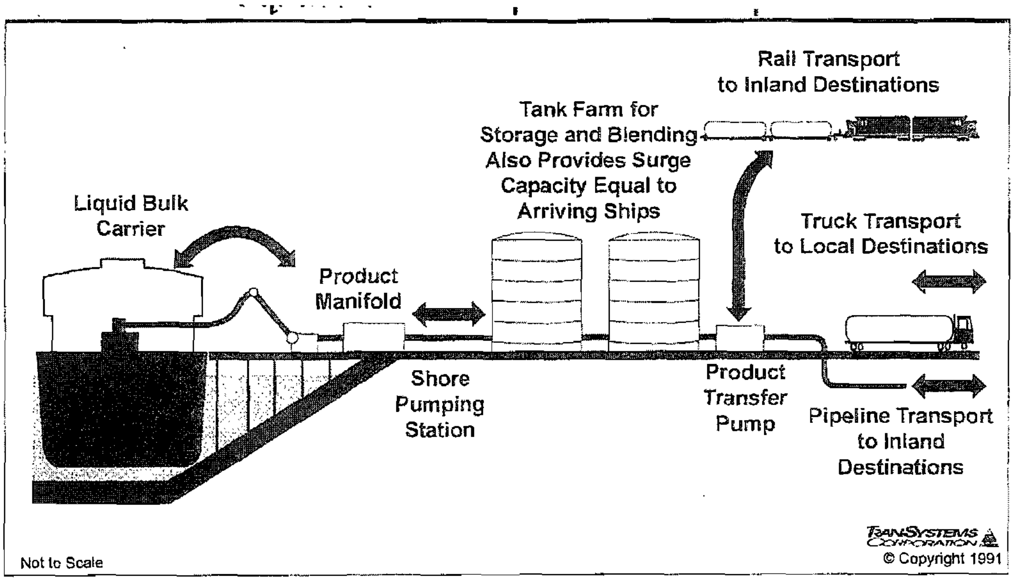


Source: ITRISA, 2006

Furthermore, inland cargo arrivals at the dry bulk terminal are also loaded onto a conveyor belt for transport to the stockpiles or silos. The cargo is then blended in the stockpiles before loaded on the ship for exporting. The dry bulk terminal also has a privately owned phosphoric acid shipping and storage facility and an import dry bulk storage facility for fertiliser (ITRISA, 2006).

Figure 4.12 illustrates operations at a liquid bulk terminal. Liquid bulk terminals cater for the import of bunkers and for both the import and export of chemicals, for example propylene and ammonia (ITRISA, 2006). Liquid bulk terminals differ from breakbulk cargo terminals and dry bulk terminals by means of cranes. Figure 4.12 illustrates that liquid bulk carriers are used to pump the product from the ship directly into tanks for storage. Tanks can either be on shore or underground. An underground tank creates an optimal use of space in ports, and therefore contributes to the safety of the terminal (Anon., 2008). Furthermore, the tankers are used for the conveyance of crude and refined oil and liquefied natural gases such as ammonia (ITRISA, 2006). Crude oil is transported from the tanks through pipelines to either trucks or trains for transport to inland destinations.

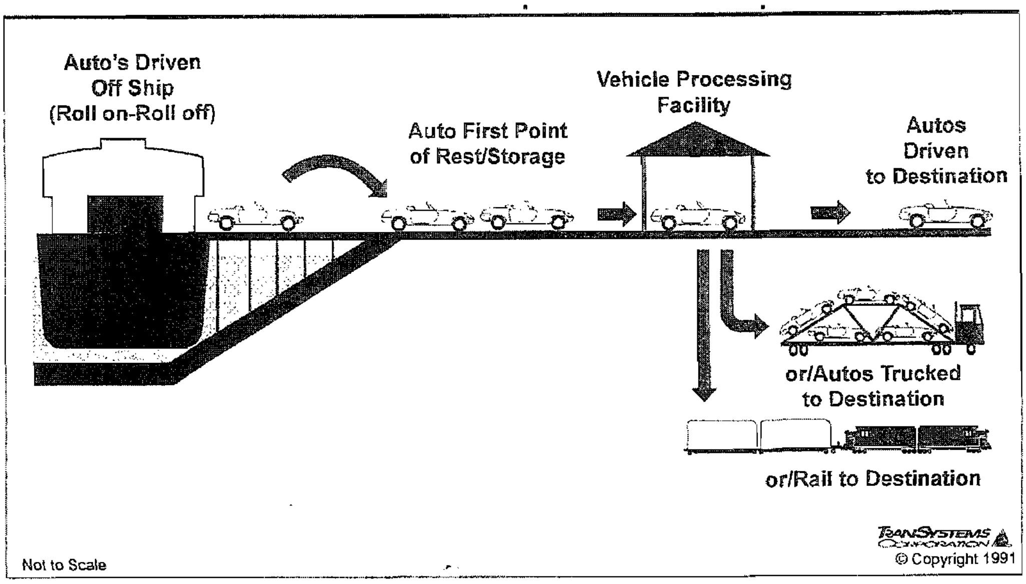
Figure 4.12: Liquid bulk terminal operations at a seaport



Source: ITRISA, 2006

Figure 4.13 illustrates the operations at a neo-bulk terminal. Neo-bulk terminals handle conventional cargo which is carried as full shiploads of the same cargo, and is not containerised. Neo-bulk cargo includes cargo such as cars, therefore, specialised equipment is required to safely unload the cargo from the ship. Figure 3.13 illustrates the use of a ro-ros container spreader. In other words, a roll-on roll-off crane. These cranes are used in the conveyance of vehicular cargo, for example, loaded road haulage vehicles and trailers, or out-of-gauge indivisible loads conveyed on purpose-built trailers (ITRISA, 2006). Figure 4.13 illustrates that the vehicles are driven on and off the ship, or otherwise towed aboard using bow and stern ramps at the berth. This movement allows for quick turnaround of vehicles at ports. Therefore, vehicles are either driven or towed to the vehicle processing facility. The vehicle processing facility enables inspection of all vehicles before sending them off to their final destinations. Figure 4.13 illustrates that the vehicles can either be driven to their final destination, or more commonly, vehicles are loaded onto either trucks or trains for transportation. Both the trucks and trains have ramps for easy loading of vehicles.

Figure 4.13: Neo-bulk terminal operations at a seaport



Source: ITRISA, 2006

This section proves that South Africa's four major terminals play a crucial role in both the economic performance and the development of the entire Southern African region. According to Chasomeris (2007), South Africa's port traffic has doubled from 40 million tons in the late 60's to 80 million tons by 1978.

Furthermore, South Africa's total cargo handled stood at some 190 million tons by 2002 (Chasomeris, 2003a). As impressive as the growth trends in South Africa's port traffic may seem, one needs to investigate beyond the statistics to gain a better understanding of the South Africa's eight commercial ports. The next eight subsections will provide an in-depth overview of South Africa's ports.

4.4.3.1. Port of Durban

The Port of Durban dates back to 1824 when the first European settlers made a landing in the Bay of Natal (Durban Bay) (NPA, 2008). The Port of Durban was first considered as a trading post, however, when the first harbour master was appointed in 1839, and, the Port of Durban was established around 1840 (ITRISA, 2006). The distance around the Port of Durban is approximately 21 kilometres and encompasses approximately 893 hectares of bay area (Anon., 2006). During the 1980's, Durban handled more than 25% of South Africa's imports and exports; this made Durban the busiest cargo port in South Africa (Anon., 2006). Furthermore, the Port of Durban is South Africa's largest container terminal; the Durban Container Terminal (DCT) handles approximately 1.9 million TEU's per year (ITRISA, 2006).

The Port of Durban has four terminals, which are managed by the South African Port Authorities (SAPO) (ITRISA, 2006). The terminals include the Durban Container Terminal (see above), the Durban Multi-Purpose Terminal, the Durban Car Terminal and the Maydon Wharf Multi-Purpose Terminal (ITRISA, 2006). The Durban Car Terminal was launched in 1998, and ever since, South Africa's vehicle imports increased from 19 000 to approximately 220 000 units per month (NPA, 2008). Table 4.5 summarises the cargo handled at the port of Durban for the financial year 2006/2007. The volumes are expressed in metric tons. According to Table 4.5, the Port of Durban handled approximately 3 000 000 metric tons of bulk cargo for the period 2006/2007, of which imports were 2 400 000, exports were approximately 470 000 000, and transshipment totaled 248 metric tons.

Table: 4.5: Cargo handled at the Port of Durban

	Bulk Cargo Handled	Breakbulk handled
Landed		
Imports	2 395 243	460 275
Coastwise	81 514	9
Total handled	2 476 757	460 284
Shipped		
Exports	471 524	206 080
Coastwise	53 294	35
Total Handled	524 818	206 115
Transshipment cargo	248	33 098
Total	3 001 823	699 497

Source: NPA, 2007

Furthermore, breakbulk cargo totalled approximately 7 000 000 metric tons, of which imports were approximately 460 000, export totalled at approximately 200 000 metric tons, and transshipments constituted approximately 33 000 metric tons. The Port of Durban operates 24 hours a day, 365 days a year and has a total of 302 km of rail tracks that extend throughout the port area (NPA, 2008).

4.4.3.2. Port of Richards Bay

The Port of Richards Bay was established in 1976, primarily to export coal from the eastern Transvaal (Anon., 2003). However, by the late 1990's, the port handled over 50% of South Africa's total port traffic (ITRISA, 2006). Richards Bay is a deep-water port located approximately 170 km northeast of Durban and approximately 460 km south of Maputo (Anon., 2003; ITRISA, 2006). The Port of Richards Bay consists of a Dry Bulk Terminal, a Multi-Purpose Terminal and a privately operated Coal Terminal (NPA, 2008). Furthermore, the privately operated Coal Terminal has four berths and several wood chip export terminals (ITRISA, 2006). Coal exports account for approximately 72 million tons and the terminal offloads more than 200 railway trucks of coal daily (NPA, 2008). Richards Bay has a railway line, which connects this port with

Mpumalanga Province and Gauteng; therefore, the port serves the coalfields of both Kwa-Zulu Natal and Mpumalanga (NPA, 2008). Furthermore, the port is also classified as a Multi-Purpose Terminal that serves exporters with granite, forest products and steel (ITRISA, 2006; NPA, 2008). According to ITRISA (2006), Richards Bay is potentially one of the largest ports worldwide: the port occupies approximately 2 157 ha of land area and approximately 1 500 ha of water area.

Richards Bay Dry Bulk Terminal includes transit storage in the form of silos and an extensive open storage area (see Figure 4.11). Furthermore, the Transnet Port Terminals are considering an upgrade of Richards Bay Dry Bulk Terminal, which will be completed by 2010 (Transnet Port Terminals, 2008). Upgrades to this terminal include a new quay crane as well as the acquisition of a new grab ship unloader. Transnet Port Terminals is also planning a new steel terminal for the export of steel, which will provide warehousing facilities offering covered storage of 20 000 m^2. The new steel terminal will also be provided with rail tracks and rail gantries that will be capable of handling all types of steel products. The port currently handles approximately 8 000 tons of coal in an hour (ITRISA, 2006).

Table 4.6 summarises the cargo handled at the port of Richards Bay for the financial year 2006/2007. The port facilities at Richards Bay can accommodate bulk carriers of approximately 250 000 tons. The volumes are expressed in metric tons. According to Table 4.6, the Port of Richards Bay handled approximately 7 500 000 metric tons of bulk cargo for the period 2006/2007, which is approximately 4 000 000 metric tons more than Durban. Imports accounted for approximately 470 000, whereby exports were approximately 6 900 000. Interesting to note is that the Port of Richards Bay does not include transshipment cargo.

Table: 4.6: Cargo handled at the Port of Richards Bay

	Bulk Cargo Handled	Breakbulk handled
Landed		
Imports	473 717	9 761
Coastwise	25 602	-
Total handled	499 319	9 761
Shipped		
Exports	6 938 683	330 272
Coastwise	-	-
Total Handled	6 938 683	330 272
Transshipment cargo	-	-
Total	**3 001 823**	**340 033**

Source: NPA, 2007

Furthermore, breakbulk cargo totaled approximately 340 000 metric tons, of which imports were approximately 9 700, export totalled at approximately 330 000 metric tons, and transshipments constituted approximately 33 000 metric tons. The port of Richards Bay operates 24 hours a day, 365 days a year.

4.4.3.3. Port of East London

The Port of East London is South Africa's only commercial river port and is situated at the mouth of the Buffalo River in the East Cape Province (NPA, 2008). This port handles approximately 6% of the cargo passing through South Africa's ports (ITRISA, 2006). East London is South Africa's smallest port; however, the port has a 75 000 ton capacity grain elevator which is the largest in South Africa (Anon., 2006).

The most common cargo includes agriculture exports, motor vehicles, maize, wheat, sunflower, scrap metals, forest products and crushed coconut kernels (NPA, 2008). East London is the main outlet for copper exports from African countries, such as Zaire and Zambia (Anon., 2006).

East London has good road and rail infrastructure connections with the hinterland, north to KwaZulu Natal, and southwest to Port Elizabeth (NPA, 2008). The Port of East London consists of four terminals, namely a Multi-Purpose Terminal, Container Terminal, Bulk Terminal and a Car Terminal on the West Bank of the port (ITRISA, 2006).

Firstly, the Multi-Purpose Terminal handles an increasing volume of containers and is geared for 90 000 TEU's a year (ITRISA, 2006). East London has a dry dock for repairs on ships and is capable of handling ships of up to 200 m. Furthermore, the dock is equipped with four electric cranes and one mobile crane (NPA, 2008). However, the port does not have any gantry cranes; therefore, the ship's own gear is required for the loading and offloading of cargo (ITRISA, 2006). Secondly, the Car Terminal, opened in September 2000, includes a four-storey parking facility, which is connected by a dedicated road to the adjacent Daimler-Chrysler factory (ITRISA, 2006). The Car Terminal has an annual capacity of approximately 50 000 vehicles and handles more than 55 000 motor units a year (NPA, 2008).

East London's Bulk Terminal primarily handles maize products, which makes East London South Africa's largest grain silo (ITRISA, 2006). East London's grain elevator has a storage capacity of approximately 76 000 tonnes in its silos (NPA, 2008). East London is a common user port, meaning that it usually operates on a first-come-first-served basis (ITRISA, 2006). Furthermore, the port handled a total of 399 ships during the fiscal year 2005/2006 (NPA, 2008). Table 4.7 summarises the cargo handled at the port of East London for the financial year 2006/2007.

East London's port facilities can accommodate bulk carriers of approximately 100 000 tons. The volumes are expressed in metric tons. According to Table 4.7, the Port of East London handled approximately 50 000 metric tons of bulk cargo for the period 2006/2007; this is approximately 250 000 metric tons less than Durban. Imports accounted for approximately 50 000, while the data for exports were not available at the time. Again, the Port of East London does not include the transshipment of cargo.

Table 4.7: Cargo handled at the Port of East London

	Bulk Cargo Handled	Breakbulk handled
Landed		
Imports	1	22 927
Coastwise	52 872	-
Total handled	52 873	22 927
Shipped		
Exports	-	577
Coastwise	-	-
Total Handled	-	577
Transshipment cargo	-	-
Total	**52 873**	**23 504**

Source: NPA, 2007

Furthermore, breakbulk cargo totalled approximately 23 000 metric tons, of which imports were approximately 22 000, export totalled at approximately 577 metric tons. It is clear that the Port of East London is indeed South Africa's smallest port.

4.4.3.4. Port Elizabeth

Port Elizabeth is situated on the south-eastern seaboard, halfway between the Ports of Durban and Cape Town (ITRISA, 2006). Bartolomeus Diaz first recorded Port Elizabeth as a landing place with fresh water in 1488; thereafter, Vasco da Gama discovered a sea route to India around Africa (NPA, 2008). Port Elizabeth achieved port status in 1820 with the arrival of the British settlers, and today, the port is one of South Africa's most important ports for the export and import of manganese ore (Anon., 2006).

Furthermore, Port Elizabeth is a multi-cargo port and the fifth largest port in Southern Africa, as well as the centre of the South African motor industry (ITRISA, 2006). Port Elizabeth encloses a water area of approximately 115 hectares and has more than 3 400 m of quayage for commercial shipping (Anon., 2006). The port is also operated by the South African Ports Operations (SAPO) and is divided into two separate terminals, namely, the Container Terminal and a Multi-Purpose Terminal (ITRISA, 2006).

The Container Terminal enjoys an advantage over other container terminals, which is that cargo is loaded directly onto railway trains for delivery to inland destinations (ITRISA, 2006). Port Elizabeth's most important port activities include agriculture and farming products; moreover, the port is seen as an alternative port of call for container ships whenever the container terminals at the port of Durban and Cape Town are congested (NPA, 2008). Other principal facilities include a mechanical ore-handling plant, with a capacity to process approximately 1 500 tons per hour (Anon., 2006).

Port Elizabeth's Multi-Purpose Terminal incorporates the car terminal and handles an increasing volume of manufactured vehicles for exporting to Europe, Australia and Asia (ITRISA, 2006). The Car Terminal is an important industry in the Eastern Cape, and Port Elizabeth has a leading role operating an open area Car Terminal (NPA, 2008). Furthermore, the Multi-Purpose Terminal handles both breakbulk commodities and breakbulk cargo, which annually amounts to approximately 2 metric tons of bulk (ITRISA, 2006). Breakbulk commodities include manganese ore, whereby breakbulk cargo includes wheat, maize, timber and scrap metal.

Port Elizabeth does not include a dry dock for major ship repairs; however, a full range of ship's handling and stevedoring is available (ITRISA, 2006). The port makes use of a harbour work boat for pilot services; these services are available 24 hours a day and 365 days a year (NPA, 2008). If one considers the port volumes, Port Elizabeth handled approximately 1 400 ships during the financial year 2005/2006, with a tonnage of more than 26 000 000 GT (gross tonnage) (NPA, 2008). Table 4.8 summarises the cargo handled at Port Elizabeth for the financial year 2006/2007.

The volumes are expressed in metric tons. According to Table 4.8, Port Elizabeth handled approximately 260 000 metric tons of bulk cargo for the period 2006/2007, which is more of less the same volumes handled by the Port of Durban. Imports accounted for approximately 115 000 metric tons, while exports were approximately 117 000 metric tons.

Table: 4.8: Cargo handled at the Port Elizabeth

	Bulk Cargo Handled	Breakbulk handled
Landed		
Imports	31 045	45 093
Coastwise	115 218	-
Total handled	146 263	45 093
Shipped		
Exports	117 100	32 927
Coastwise	-	-
Total Handled	117 100	32 927
Transshipment cargo	-	-
Total	**263 363**	**78 020**

Source: NPA, 2008

Furthermore, breakbulk cargo totalled approximately 78 000 metric tons, of which export totalled at approximately 32 000 metric tons. Port Elizabeth has an estimated total volume of containers of approximately 8 000 000 tons. Lastly, Port Elizabeth currently faces losing its manganese ore and petroleum exports to the new Port of Ngqura (see section 4.4.3.8.).

4.4.3.5. Port of Saldanha Bay

The Port of Saldanha Bay was first recorded in 1601 by the Dutch explorer, Van Spilbergen. Unfortunately the lack of fresh water prevented Saldanha Bay from becoming a major port along the south coast of Africa (NPA, 2008). However, the Port of Saldanha's first deliveries of iron ore were exported on the vessel Fern Sea during September 1976, and since then the Port of Saldanha Bay is the largest natural port in Southern Africa (ITRISA, 2006). The Port of Saldanha is best known for the export of iron ore: between 16 and 24 millions tons of iron ore is exported annually (NPA, 2008).
The Saldanha Steel Mill exports more than 1 million tons of manufactured steel to African countries (ITRISA, 2006). The Port of Saldanha is a common user port, which means that it functions on a first-come-first-serve basis, and has a 990 m long jetty containing two iron ore berths, which handles more than 350 000 tons of carriers

annually (NPA, 2008). The port also includes a Multi-Purpose Terminal, including a multipurpose quay for the handling of breakbulk cargo. The port does not handle containers and there are no bunkering facilities (NPA, 2008). Nevertheless, Saldanha Bay has a full diving service available for ship inspection and ship repairs, although limited, because of the nearby fishing industry (ITRISA, 2006).

Table 4.9 summarises the cargo handled at the port for the financial year 2006/2007. Again, the volumes are expressed in metric tons. From table 4.9, it is clear that Saldanha Bay handles mostly bulk cargo, whereby the transshipment of bulk cargo is also included. According to Table 4.9, the Port of Saldanha handled approximately 3 000 000 metric tons of bulk cargo for the period 2006/2007, of which imports were 380 000, exports were approximately 2 000 000, and transshipment totalled 300 000 metric tons. Furthermore, breakbulk cargo totalled approximately 85 000 metric tons, of which export totalled at approximately 84 000 metric tons.

Table: 4.9: Cargo handled at the Port of Saldanha Bay

	Bulk Cargo Handled	**Breakbulk handled**
Landed		
Imports	384 622	-
Coastwise	-	-
Total handled	384 622	-
Shipped		
Exports	2 183 697	84 579
Coastwise	-	-
Total Handled	2 183 679	84 579
Transshipment cargo	299 161	-
Total	**2 867 480**	**84 579**

Source: NPA, 2008

4.4.3.6. Port of Cape Town

The Port of Cape Town is certainly one of South Africa's most beautiful harbours; the port has a magnificent backdrop of Table Mountain and is framed by the mountainous

Peninsular (NPA, 2008). The port also has one of the largest dry docks in the Southern hemisphere, which includes more than 30 berths, including a coal berth (Anon., 2006). The Port of Cape Town is also known for its growing handling of containers in the Container Terminal (NPA, 2008).

The Container Terminal contains five berths for container vessels and general cargo carriers (Anon., 2006). The Container Terminal is South Africa's premier fruit export terminal, with stacking facilities for approximately 16 000 TEU's of general cargo (ITRISA, 2006). The port also includes a Multi-Purpose Terminal, which handles fruit, steel, maize and other general cargo (NPA, 2008). The Terminal handles approximately 1.3 metric tons of breakbulk cargo and provides storage facilities for fish products (ITRISA, 2006).

The Terminal is a key destination for cruise ships; the adjacent Victoria and Basins have a variety of berths available for passenger cruise ships (NPA, 2008). Furthermore, the Terminal contains six 40 ton gantry cranes for larger container ships (ITRISA, 2006). Interesting to note, is that shippers in Gauteng and Mpumalanga choose Cape Town for the departure of goods (ITRISA, 2006). The reason is that, although Cape Town is the most distant of all South Africa's ports, it has the geographical advantage of being at the tip of Africa. Therefore, goods departing from Cape Town for both Gauteng and Mpumalanga arrive at their destinations almost six days earlier than goods dispatched from Durban.

According to the NPA (2008), Cape Town is South Africa's second busiest container port (Durban is first), and handles the largest amount of fresh fruit. Cape Town handled approximately 3 400 vessels during the 2005/2006 financial year, whereby total cargo handled (breakbulk and bulk cargo included) was approximately 3 700 000 tons (NPA, 2008). Table 4.10 summarises the cargo handled at the Port of Cape Town for the financial year 2006/2007. The volumes are expressed in metric tons. According to Table 4.10, the Port of Cape Town handled approximately 400 000 metric tons of bulk cargo for the period 2006/2007, of which imports were 170 000, exports were approximately 170 000.

Table: 4.10: Cargo handled at the Port of Cape Town

	Bulk Cargo Handled	Breakbulk handled
Landed		
Imports	171 643	9 998
Coastwise	-	-
Total handled	171 643	9 998
Shipped		
Exports	59 987	20 782
Coastwise	168 245	1
Total Handled	228 232	20 783
Transshipment cargo	-	7 515
Total	**399 875**	**38 296**

Source: NPA, 2008

Furthermore, breakbulk cargo totalled approximately 38 000 metric tons, of which imports were approximately 10 000, export totalled at approximately 20 000 metric tons, with transshipment of approximately 7 500 metric tons.

4.4.3.7. Mossel Bay Harbour

The Port of Mossel Bay is South Africa's smallest Port; it is supported by the port of Port Elizabeth (ITRISA, 2006). Mossel Bay is a commercial fishing harbour with a developing oil industry, which began in the late 1980's with the Mosgas project (NPA, 2008). Mossel Bay's fishing industry provides an important economic boost to the Southern Cape and the local community; however, the Port handles little other commercial cargo (ITRISA, 2006). Table 4.11 includes the cargo handled at the Port of Mossel Bay for the financial year 2006/2007. The volumes are expressed in metric tons.

According to Table 4.11, the Port of Mossel Bay handled approximately 220 000 metric tons of bulk cargo for the period 2006/2007, of which imports were approximately

90 000 and exports approximately 36 000 metric tons. Breakbulk cargo totaled approximately 6 000 metric tons. From Table 4.11 it is clear that the Port of Mossel Bay mostly handles bulk cargo, and little or no breakbulk cargo is imported or exported from this Port.

Table: 4.11: Cargo handled at the Port of Mossel Bay

	Bulk Cargo Handled	Breakbulk handled
Landed		
Imports	91 630	-
Coastwise	238	3 873
Total handled	91 868	3 873
Shipped		
Exports	36 814	-
Coastwise	97 767	2 184
Total Handled	134 581	2 184
Transshipment cargo	-	-
Total	**226 449**	**6 057**

Source: NPA, 2008

4.4.3.8. Port of Ngqura (Coega)

The Port of Ngqura is South Africa's latest commercial port, 20 km north-east of Port Elizabeth, and is situated at the mouth of the Coega River in Algoa Bay (ITRISA, 2006). Although the Port of Ngqura opened in April 2006, it said to be boosting the economy of the Eastern Cape, although there is still much to do (ITRISA, 2006). For instance, to attract new industrial development to the port, the inner harbour works still requires almost 13.8 million cubic metres of material. The construction of a rail link between Ngqura and the existing Port Elizabeth-Gauteng main railway is still to be completed by Spoornet's project engineers (ITRISA, 2006; NPA, 2008).

The port of Ngqura will have five berths, which will take up approximately 2 km of quay wall and a further berth up to Coega River valley and south-west along the coast (NPA, 2008). The Port of Ngqura plans to transfer to Coega the export of manganese and other bulk commodities, which is currently handled at Port Elizabeth. However, the port could be a serious threat to Port Elizabeth in the near future.

4.5. Conclusion

Since 1994, South Africa has become an active competitor in the global market. Trade liberalisation replaced the anti-export bias in order to make way for higher export-lead growth. The internationalisation of South Africa's economy since 1994 increased the degree of regional specialisation and geographic concentration of industrial activity and, therefore, increased spatial inequality.

It was found that, in 2000, only 84% of total manufacturing exports were generated by only 22 of the 354 magisterial districts. The overall the number of magisterial districts that export manufactured goods increased by 15% from 1996 to 2004. Nevertheless, it was found that magisterial districts with larger economic activity, competitive transport costs, foreign market access and good institutional quality are able to export manufactured goods more successfully. Furthermore, it was found that distance, shipment and transaction costs are the three major components that affect transport costs.

Domestic transport costs depend on a variety of conditions related to infrastructure (services and operations), geography (distance of customers and manufactured exports) and most importantly, how freight and passengers are carried. South Africa's domestic transport costs accounted for around 13% of the GDP in 2003. Transport costs increased by 11% and the overall logistics costs remained flat at 15.2% of the gross domestic product (GDP). For this reason, transportation costs are the biggest driver of logistics costs in South Africa. However, manufactured export relies on a good, fast and efficient transport service to move goods from one location to another. The developments in transport infrastructure have a long-term impact on an economy, and financial resources are needed to implement these developments. With the reduction of trade barriers in the world economy and trade liberalisation taking place, exports from

South Africa have the possibility to improve. The focus is on Container terminals; in specific, inland container terminals. Chapter 5 will discuss South Africa's Inland container terminals or Dry Ports.

CHAPTER 5

A CASE STUDY OF SOUTH AFRICA'S INLAND PORTS: CITY DEEP

5.1 INTRODUCTION

In chapter 2, the importance of export for economic growth was highlighted. Transport costs are an inevitable part of any export transaction and have empirically been found to influence exports negatively. Research has also indicated that the impact of domestic transport costs on exports is more severe than international transport costs. One method of minimising domestic transport costs is through containerisation. Chapter 2 concluded that dry ports provide the transport infrastructure to support containerisation. In chapter 3, it became evident that the most appropriate manner of connecting a dry port with a seaport is with an intermodal transport system, as it reduces domestic transport costs. Chapter 3 also highlighted the elements of an inland container terminal by means of promoting port efficiency. In chapter 4, the focus shifted to South Africa. South Africa's economy opened up in 1994 and policies aimed for export-led growth. Transport costs in South Africa are a relevant issue due to its geographical position. South Africa is situated far from its major trading partners. In addition, the majority of South Africa's exports originate in Gauteng, which is around 600km from the nearest seaport. For South Africa's exports to remain competitive, domestic transport costs need to be reduced. One way to achieve this is by linking a container dry port to the major seaports, by means of an intermodal transport system (namely Durban, Port Elizabeth, and Cape Town).

In this chapter, the purpose is twofold. The first purpose is to provide an overall description of South Africa's dry port (City Deep) and its functioning. The second purpose is to present a case study of City Deep. The case study provides background on operations, identifies advantages and disadvantages of such an operation, and finally makes recommendations on how domestic transport costs can be reduced. In short, City Deep is discussed as a means of promoting inland transportation of containers and the handling of containerised traffic in order to achieve port efficiency. The chapter is structured as follows: section 5.2 comprises the description and functioning of City Deep, section 5.3 contains the case study, and section 5.4 concludes with recommendations.

5.2 DESCRIPTION AND FUNCTIONING OF CITY DEEP

According to Van der Merwe (2008), South Africa must focus more on its high internal logistics costs, inland and cross-border transportation if we want to improve its rankings on the World Bank's Logistics Performance Index. It was found that South Africa is currently ranked 124th out of 150 countries in terms of logistics expenditure. High logistics costs were attributed to inadequate infrastructure and processes at ports and borders (Van der Merwe, 2008). The main logistics challenge to overcome includes border-post delays and the use of road transportation as the main means of transport.

Therefore, City Deep's intermodal network is very important to ensure optimal service delivery and a reduction in transportation costs by means of containerisation. It is important to note that competition is very high in this particular market, clients choose beforehand which company will be used, and therefore, service delivery is crucial to ensure that clients view City Deep as their first choice.

5.2.1 Description

South Africa has six major inland terminals and nineteen satellite depots that are strategically located to connect with South Africa's ports (Spoornet, 2008). South Africa's inland terminals include City Deep (Eastcon and Kazcon), Belcon (Saldanha, Ashton, and Dalcon), Deal Party (East London and George), Pretcon (Phalaborwa, Witbank, Polokwane, Nelspruit, and Piet Retief), Bayhead (Newcastle), and Bloemfontein (Kimberly, De Aar, Kroonstad, Kakamas, and Bethlehem). These inland terminals and satellite depots are controlled by Spoornet. City Deep was the first inland container terminal built in southern Africa in the 1970's. City Deep is situated just to the south of the Johannesburg Central Business District (CBD). City Deep Inland Container Terminal is the largest container terminal in southern Africa, and it handles containers from Cape Town, Durban, and Port Elizabeth.

City Deep can be classified as a range dry port (see section 3.5). City Deep is approximately 600 km from the nearest seaport, the port of Durban. It offers specialised facilities such as warehousing, storage, the repair of containers and customs clearance. It benefits the transportation network by facilitating the modal shift from road to rail, resulting in the reduction of transportation costs and potential crises such as truck delays and accidents. The establishment of City Deep has alleviated congestion at seaports because trucks can be replaced with more train transportation. This, in turn, has been reducing road congestion, accidents, road maintenance costs, and local pollution.

The organisational structure of City Deep is as follows:

The infrastructure is owned and operated by Transnet Freight Rail. However, privately owned companies are allowed to make use of City Deep's infrastructure and facilities. Privately owned companies include Kaserne and SACD (South African Container Depot). Spoornet operates City Deep, whereas Kaserne and SACD are privately operated. Trains arriving in Johannesburg are split into five different sidings. Each siding belongs to one of the above-mentioned companies operating in City Deep. The containers are delivered at the correct siding, as mentioned before; the client decides beforehand which company will handle the loading and unloading of the container. The next section explains the functions of City Deep (i.e. the arrival of containers, the unloading and packing of containers, documents required, custom clearance procedure, and the stacking of containers).

5.2.2 Functions

Containers arriving at City Deep go through a process before the container is ready to be delivered to its final destination. In short, after the arrival of a container, the container moves through City Deep's internal road network (5.2.2.1). The container is unpacked (i.e. groupage containers need to be repacked into single containers before delivery to the client). The container is repacked according to the client's specifications and prepared for shipment (5.2.2.2). City Deep personnel prepare and do security checks to ascertain whether all the required documents are in place (5.2.2.3). Before being loaded onto a truck or train, the container must be custom cleared (5.2.2.4). However, some containers are only due in a few days or weeks, thus the container is stacked in the City Deep yard (5.2.2.5).

5.2.2.1 Arrival of containers at City Deep

Containers arrive at City Deep in a single siding, after which the container enters City Deep's gate and moves through the internal road network. This internal road network includes a network node which represents the origin and destination of goods. In chapter 3 it was found that network nodes represent clusterings of manufacturing plants, warehouses, logistics centres and freight terminals located in shipper and receiver areas (Steenken, Voß & Stahlbock, 2004). The shipper's and receiver's area is divided into zones.

There is number of stages involved in the City Deep intermodal transport network. Containers are unloaded from the siding and moved to the originating zones. Firstly, the containers are collected in the originating zones, upon which they are transported by truck to the origin intermodal terminal located in the shipper's area secondly, the transshipment at the origin intermodal terminal from the truck to the trunk-haul. The trunk-haul is also known as the non-road transport mode and includes the rail network. Thirdly, line-haul transportation takes place between the origin and destination intermodal terminals, by means of the trunk-haul mode. Fourthly, after arriving at the destination intermodal terminal, transshipment takes place in the receiver area from the trunk-haul mode to the selected trucks, and finally, goods are distributed by truck from the destination intermodal terminal to the destination zone (Minnaar, 2003).

It is the same truck that transports loads between the shipper's area and the receiver's area of the City Deep container internal road network. This is why movement of loads are carried out in three steps, namely, the collection in the origin zones; line hauling from the origin to the destination zone; and then the distribution of goods within the destination zone (Transnet Freight Rail, 2008). Thereafter, the containers are stacked onto a vehicle (such as a forklift) and transported to the truck and train operation area. The containers are stacked onto either trucks or trains and transported to the inland destination. A similar process is followed for the export of goods and containers. As soon as an export container arrives at City Deep, security personnel check for the container and client number, the truck in which the container arrived, and the train or truck on which the container will be transported to one of South Africa's harbours. Then they verify the harbour it will be exported from and the name of the vessel or ship on which it is to be loaded. The latter detail must be punched into the register book on arrival (Minnaar, 2003). The container is then transported into the yard and stacked in the export row. Depending on the departure time, the container is sealed with a wire seal and stacked on top of other containers (see section 5.2.2.5). It is important to note that the loading of the container has to be arranged 24 hours before the train or truck departs (Minnaar, 2003).

Before the container is loaded onto a transportation mode for delivery at a port, City Deep must pack it. The packing of containers is a very important element in the safe delivery of international shipments undergoing surface transit.

5.2.2.2 Preparing shipments for surface transit

City Deep's primary concern is that packing materials should be durable and strong as this minimises the potential risks of goods (such as break-bulk cargo) being dropped by handlers or equipment, tampered with by thieves, or soaked in seawater (ITRISA, 2006). Most losses and damage to goods occur during handling. The number of times goods are actually handled, loaded, and unloaded on an export consignment is invariably greater than for a domestic dispatch. Clients often have their own specifications regarding the packing and marking of containers prior to shipping. For example, City Deep has to fumigate pallets before it is shipped to China. It is important that goods fit neatly into a container and that the packed contents are not identifiable by an outsider (Sherlock, 2003). Moreover, the packing protects the goods against damage and pilferage, contains the goods so that they can be handled, even when protection may be less relevant, and bears the marks which enable goods to be identified. Nevertheless, exporters often have their own method of packaging; this may become a problem because of the huge range of methods.

Before City Deep security personnel are allowed to pack containers, the condition of the containers must be assessed. The personnel must check for the following:

1. The container must be free of external dents and bulges that could hinder mechanical handling. They also need to make sure that the container is free of internal splinters and snags.
2. The container doors must lock properly, or in the case of open top containers, the cover of the container should fit securely. This is to prevent spillage or water seepage from damaging cargo.
3. The container must have strong, secure tie-down cleats and rings, as well as ventilators that are open and clear.
4. The container must be spotlessly clean; it should be devoid of foul odours, residues, or signs of insects.

There is a variety of packing methods, which include cartons, cases or crates, bales, drums and sacks. According to Sherlock (2003), cartons are the most widely used type of outer packing. Cartons are available in a range of materials, such as double or triple walled cardboard or fibreboard. Cases are usually made of wood, and consist of a solid box, whilst the crates are composed of a skeleton or slatted structure. As mentioned before, certain markets require the wood to be treated with pesticide and then be certified as such. Bales are used to compress goods before they are wrapped in hessian and banded. Drums are suitable for many liquid and powdered goods and are made from a wide range of materials such as steel. The last method of packaging is sacks. Sacks also come in a variety of materials such as paper and plastic. Sacks are usually used when the containment is more important than the protection. For example, sacks can be used for specialised forms of export packing such as glass containers for corrosive liquids and steel cases for highly pilferable items. After an appropriate packaging method has been chosen, the next step is cargo stowage within the container.

Personnel at City Deep have to pre-plan the loading of goods into containers. This is a very important consideration to ensure the safety of goods. According to Sherlock and Reuvid (2004), the following should be taken into consideration before loading commences:

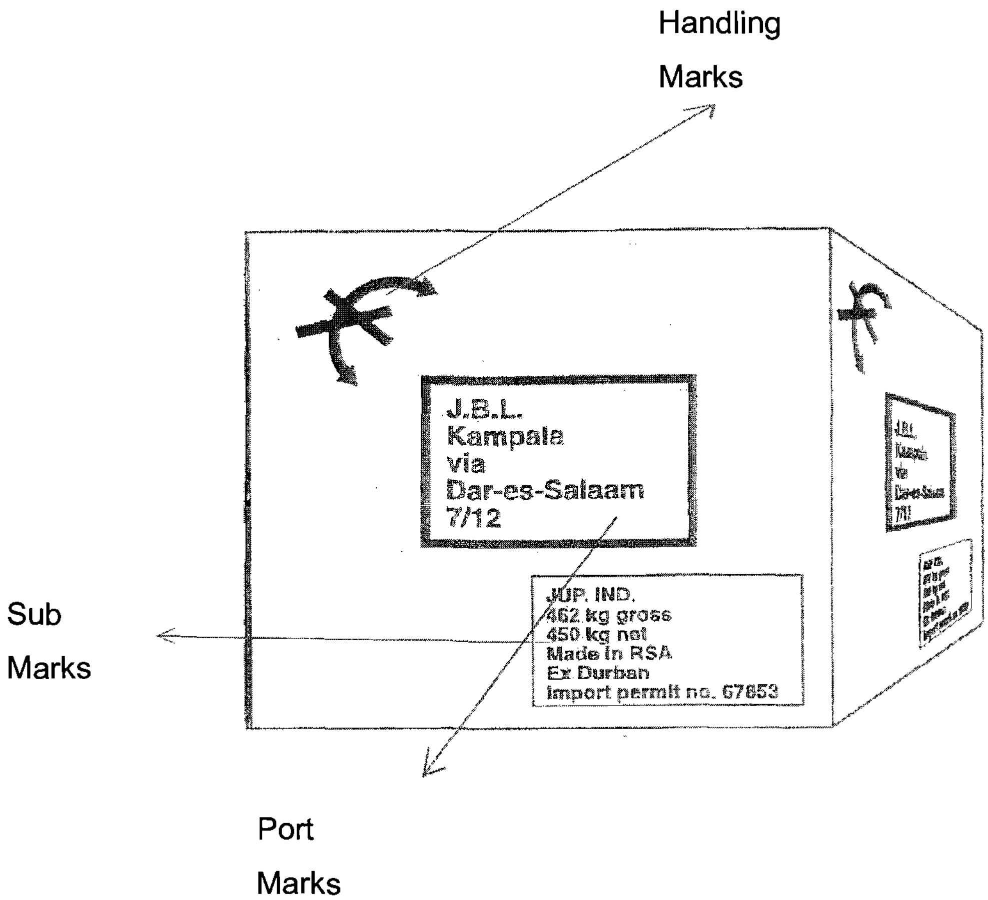
1. Regulations regarding the weight limitations of containers must be adhered to before the container is packed.
2. Special care should be taking concerning the stowage of incompatible cargoes in the same container. For example, anything that is likely to leak or spill, such as perfume, should be kept away from other cargo like food product, in this case, perfume is very likely to have an adverse effect on food.
3. Another important consideration is the weight distribution within the container. Therefore, all cargo, dunnage, blocks, and braces should be available from the outset. For example, the heaviest items should be placed at the base and lighter articles should be loaded on top. This is also very important regarding correct

stacking within the container. Uneven weight distribution within the container is problematic in the case of road transportation, which is subject to weight per axle limitations.

4. Cargo should be placed together firmly; this is to prevent spillage when container doors are opened.
5. Air circulation within the container is very important, therefore, sufficient space should be left at the top of the container.
6. After packing of the container has been completed, security personnel must ensure that the doors of the container are closed properly. They must ensure that all locking lugs are engaged, and that the container seal is firmly in place.

Once City Deep has packed the containers according to the abovementioned specifications, City Deep and the exporter must determine that containers are marked clearly to ensure delivery to the final destinations. In this context, the only rules are those concerning the marking of dangerous goods. According to Sherlock and Reuvid (2004), the correct marking of packs is very important to ensure that cargo reaches its destination. Packs should display both the shipping and cargo handling marks. The shipping marks provide information required by the carrier and customs officials along the route. Cargo handling marks provide information about the cargo that will influence the way in which it is handled at various points along the route. Figure 5.1 illustrates both the shipping handling and cargo handling marks on a typical container.

Figure 5.1: Shipping marks and cargo handling marks



Source: Sherlock, 2003

A range of standardised pictorial handling marks have been established through the International Standards Organisation (ISO) and give clear instructions regarding the handling of goods which are recognised throughout the world. The handling mark on this particular container indicates that the container may not be rolled, whereas the sub-marks includes the gross and net weights in kilograms, dimensions in centimetres, and running numbers that identify the unit number. For example, 7 of 12, or 7/12 would identify case number seven of a total of twelve cases. The port marks contain information with reference to the final destination of the container and the port of discharge is clearly displayed.

In the case of dangerous goods being shipped or transported, it is extremely important that all exporters are aware of the requirements for the movement of these goods. One of the first requirements is that the correct technical name of the product or substance is to be used and not brand or proprietary names (Sherlock and Reuvid, 2004). For example, 2 000 litres of Gramoxone (a brand name of a flammable liquid) would be unacceptable. The goods should be described as 2 000 litres of paraquet dichloride in solution (see appendix I for an illustration of a typical standard shipping note for non-dangerous goods and dangerous goods).

According to Sherlock (2003), the International Maritime Organisation classifies goods into nine hazardous classes. These nine classes are: explosives, gases, flammable liquids, flammable solids, oxidising substances, poisonous substances, radioactive materials, corrosives, and miscellaneous substances (not covered by other classes).

According to Sherlock *et al.* (2004), exporters should consider putting lead marks and port marks at least 7.5 centimetres high and sub-marks at least 3.5 centimetres high. The marks should be permanent and visible in all conditions. At this point it should be clear that the regulations controlling the identification, packing, marking, and declaration of dangerous goods are by no means simple. This is inevitable when one considers the enormous range of goods, and the variety of transport modes by which they are carried.

After the packing of containers, City Deep prepares the documents required for transit. Containers cannot be in transit without the correct documents, and these should always be at the ready for custom clearance.

5.2.2.3 Preparing documentation required for transit

Security personnel at City Deep have to check every document before a container can be cleared by customs. From a business perspective, City Deep's border police are excellent at performing this task: they check every document and oversee the execution of all instructions as set out by the client. The following documents need to be checked at every gate (entry and exit) before the driver is allowed to enter or leave the premises.

5.2.2.3.1 Instruction documents

The instruction documents can be broken down into two categories: firstly, if the exporter or importer is using a freight forwarder, a forwarding instruction document must be completed; secondly, if a freight forwarder is not being used, the shipping instruction document must be completed. In the case of a freight forwarder, the forwarding instruction document is completed by the exporter or importer. The forwarding instruction document provides the forwarder with all the information needed to arrange the carriage and delivery of goods to the specific destination by the required date (ITRISA, 2006).

The instruction forms are pre-printed forms, and include the following information: the name and address of the consignor, consignee and notify party; the ports of despatch and destination; a detailed description of the goods, including the packing and marking information; the type of cargo (for example, bulk, break-bulk, full container loads or less than full container loads); the type of service offered (for example, door-to-door service, consolidated or overnight express); and lastly and most importantly, instructions regarding the payment of goods (Sherlock, 2003).

5.2.2.3.2 Transport documents

The most important international transport convention is the Hague-Visby-Rules, which govern the conveyance of goods by sea (ITRISA, 2006). The Hague Rules place the issue of the carrier's liability firmly under the spotlight. According to ITRISA (2008), under the Hague Rules, carriers have to meet certain minimum requirements. These requirements include the acceptance, handling and discharging of cargo in an appropriate manner. Furthermore, transport documents which apply to sea, road and rail transport include the bill of lading (sea transport), the road consignment note (road transport), and the rail advice note (rail transport). According to Sherlock (2003), the bill of lading indicates the parties involved (for example the shipper, consignee and the notification party), ports/depots of loading and discharge, vessel name, number of the original bills, description of the goods, type of packages, the gross weight (kg) and measurement (M), dates received and shipped, and a reference to payment of freight (prepaid or forwarded) (see appendix A).

According to Sherlock and Reuvid (2004), the most common bills of lading used in international trade can be divided into four different categories. The first is a received bill of lading, which confirms that the goods are in the possession of the carrier, but not that they have been loaded. The second is the combined transport bill of lading: this bill refers to the fact that the typical containerised, sea freight consignment will move from one inland depot of departure to a destination depot. The whole transit will be organised under one contract of carriage evidenced by the bill of lading (see figure 5.7). Thirdly, the transhipment bill of lading is used where the goods are not shipped directly to the port of discharge, but via a third port, using two vessels. In this case it is possible to obtain a bill of lading covering both vessels. The fourth document is the groupage bill of lading: this is used when an exporter cannot provide a full load, for either containers or road trailers. The groupage operator will group or consolidate a number of exporter's consignments into one shipment. The shipment will be covered by a set of groupage bills of lading issued by the shipping line (Sherlock *et al.*, 2004).

5.2.2.3.3 Insurance documents

Cargo insurance policy documents are extensively used in cargo insurance. According to ITRISA (2008), Lloyd's compiled a standard policy document some years ago. Lloyd's is the Underwriters Institute of London and various other parties, and is used extensively throughout the world. A cargo policy document contains an attestation clause whereby the underwriters agree to insure against loss, damage, liability, or expense.

5.2.2.3.4 Customs documents

Customs documents include an export permit and an import permit. In the case of an export permit, the permit prescribes the specified goods that may be exported by the consignor only. Although the export permit is only valid for a maximum of 180 days, the validity date can be extended for up to 90 days. In the case of strategic commodities, for example, arms, military equipment, chemicals and metals etcetera, the export permit must be accompanied by an import certificate. The import certificate is an undertaking by the importer not to divert, tranship, or re-export the goods except in accordance with the export control regulations operating in his own country (Sherlock, 2003).

An import permit is required for the importation of goods and containers into South Africa. The import permit may not be transferred by the holder to anyone else and applies only to the kind and class of goods specified. Import permits differ from export permits on the basis of the validation period. An import permit is issued for a calendar year and may be used for customs clearance of goods shipped on or before 31 December of that year (Sherlock, 2003).

5.2.2.3.5 Exchange control documents

The exchange control documents have nothing to do with cargo movement; however, a South African exporter is obliged to complete the document if he is expecting payment in excess of R 50 000 (ITRISA, 2008). The exchange control document is a declaration from the exporter of the foreign exchange that he will receive payment for his goods.

These documents are also used by the South African Reserve Bank to monitor the repatriation of foreign currency. As soon as payment is received for the consignment, the importer will be required to complete the Customer Offer to Sell Foreign Currency form within 30 days. The latter reflects the details entered on the exchange control document, and serves to acquit the importer from obligation to return the foreign exchange proceeds earned to South Africa (ITRISA, 2006).

5.2.2.3.6 Harbour revenue documents

The harbour revenue document reflects the cargo dues payable to the National Ports Authority in respect of all cargo passing through a South African port. The document also includes the shipping charge payable for shore handling costs as applicable to bulk and or break-bulk cargo (ITRISA, 2006).

5.2.2.3.7 Documents required by importing countries

The documents are required for customs clearance into the country concerned. For example, if an importer wishes to import plants and plant products, a phytosanitary certificate must be used. Other examples include a veterinary health and public health certificate for live animals and an inspection certificate that relates to the quality of the goods imported (Sherlock, 2003).

Examples of the abovementioned documents are available in appendix A. A client expecting the arrival of a container must inform City Deep twenty-four hours before the arrival of the container. The client must ensure that all the documents required for processing are lodged before the container arrives at City Deep. Exporters and importers must apply for a customs code number from the local customs authority. The South African Commissioner of Customs and Excise has the authority to issue such a number. The customs code number must appear on all documentation presented to customs for the clearance of both import and export products (ITRISA, 2006).

5.2.3 Customs clearance

After the arrival of the container at the City Deep Container Terminal, the Transnet Freight Rail security personnel firstly verify if all the required documents are in place. Once the container has been collected, the Spoornet security personnel offload it (see 5.3.2 for a description of the handling equipment used). The seal number is then recorded in the register book. At the same time, the security personnel examine the seal of the container to see whether it has been tampered with. If the seal of the container has been opened or tampered with, the container is taken to a special checkpoint where the contents of the container are inspected. This is done in the presence of the owner of the container and usually a member of the border police. In the event of theft, the owner must fill in claim forms (see section 5.4) to claim for the stolen goods. The container is then resealed, and the information is once again recoded in the registration book. The main purpose of the registration book is to track a specific container on the yard when the owner wants it released for delivery. Therefore, the container receives a stack number before it is released by the security personnel.

It is important to note that no cargo can move without presentation of the relevant documents, which are classified into ten different categories (see section 5.2.3). As soon as all the documents are in place, and verified by security at the City Deep terminal entry gate, the trucks and or trains are allowed to enter. However, some containers require stacking facilities before being delivered to final destinations. City Deep offers stacking of containers for a period of up to three months. If the container is not collected within this period, the container is unpacked and the goods are donated to charity.

5.2.4 Stacking procedure

The main objectives of the stacking strategy at City Deep are to ensure the efficient use of storage space; efficient and timely transportation from the truck and train operation area to the stack area and further destinations; and avoiding unproductive activity by all terminal and handling equipment. For example, export containers should be stacked close to the end of the yard, and containers with an earlier departure time are stacked on top of containers leaving later. As mentioned earlier, some containers require special locations, such as reefers, which need to be supplied with electricity. Moreover, stacks are separated into import and export parts.

Containers that arrive in large container ships from overseas are classified as import containers. The arrival of import containers is somewhat predictable, since they often arrive according to scheduled shipping programs and continue to their destination by means of inland transport, such as trucks and trains. Therefore, the stacking and storing of these import containers is only temporary. However, export containers arrive via inland transportation, and often arrive somewhat randomly. The advantage of export containers is that their departure is usually connected to ship, hence, they can be stacked and stored more effectively. To ensure optimal stability, heavy containers are stored as low as possible, whereas light containers are loaded on top of each other.

After the arrival of a truck or train, the containers are lifted from the truck to the yard using different types of equipment. The container is then picked up using a vehicle and transported to a second crane for stacking (see figure 5.7).

Figure 5.7: Overhead bridge crane for the stacking of containers

Source: Kalmer, 2008

The chain of operations for City Deep Container Terminal can be summarised as follows; after arrival at City Deep by truck or train, the container is identified and registered according to its contents, origin, destination, and shipping line. Containers arriving by truck or train are then unloaded and handled within the truck and train operation area, whereas import containers are picked up by internal transport equipment and transported directly to the yard position. If sheds or empty depots arrive at the container terminal, additional activities are performed.

These actions encompass the transport of sheds or empty containers between the empty stock block, packing centre, and the import and export container stocks. The container storage area is indicated by rows, bays and tiers within the block. Specific cranes, such as the automotive stacking crane, and forklifts are used to unload the containers and store them in the yard block (see section 5.3.2). Sheds are used for the stuffing and stripping of containers or for additional logistics services. Furthermore, City Deep has special stack areas reserved for reefer containers. As mentioned in chapter 3 section 3.4.2, reefer containers need special electricity supply for cooling, or storage of hazardous goods.

5.3 CASE STUDY: CITY DEEP

This section provides the empirical evidence from the case study. First of all, background to the questionnaire is given, as well as the aspects it covers. Secondly, the interview process is explained and thirdly, the results are set out.

5.3.1 Questionnaire

The aim of the questionnaire was to obtain information on City Deep's operations, the advantages of such an operation and to identify problem areas in order to make the necessary recommendations. The questionnaire used was adapted from Roso and Lévêque (2002). A copy of the questionnaire is provided in appendix B. The questionnaire contained 18 questions and was divided into five sections. The five sections are the current economic performance; the terminal's location relative to the spatial allocation of the production and consumption centres (parameters); operational framework of City Deep container terminal; advantages and disadvantages; and the feasibility of establishing more dry ports in South Africa.

5.3.2 Interview for the case study

The case study was formulated based on an interview with one of the companies operating in City Deep. The company wishes to remain anonymous for confidentiality reasons. The interview took place at the company's premises on the 16th of September 2008. The Operational Manager of the company answered the questions based on the questionnaire described in section 5.3.1. After all the questions were answered, a tour was given of the company's premises. During the tour, the operational framework, advantages, and disadvantages were discussed. The individual was very helpful with questions regarding the functioning of handling equipment as well as interesting facts about the terminal.

5.3.3 Results

For purposes of clarification, the company interviewed will hereafter be referred to as City Deep, as the companies operating in City Deep perform more or less the same functions. To provide a broader picture, the interviewee's answers and comments are discussed in combination with other sources such as Spoornet.

5.3.3.1. Current economic performance

This section set out to determine the current economic performance of the terminal. In the first question, the interviewee was requested to specify the economic performance in terms of competitiveness. The City Deep terminal is the largest containerised market in South Africa and handles three categories of containers. These categories are import traffic, export traffic, and domestic traffic. Import traffic includes the management of containers that enter through a South African port, like the Port of Durban, with a domestic or across-border destination. An example of this is containers that need to be delivered to PPC and PPC Lime (domestic destination) or for delivery to West Africa. Export traffic includes the management of containers leaving South Africa through national ports, and domestic traffic includes the management of containers transported within and across South Africa's borders.

The interviewee established that, although South Africa has six inland terminals, City Deep is the only inland terminal that functions as a dry port (see section 3.5), as it is the only inland terminal where customs clearance of goods takes place. The inland terminals, such as Kaserne, handle only domestic traffic, whereas City Deep handles container traffic from abroad and domestically.

5.3.3.2. The terminal's location relative to the spatial allocation of the production and consumption centres (parameters)

In the second question, the interviewee was asked what City Deep's location is in relation to spatial allocations of the production and consumption centres. In other words, what is the major seaport City Deep is connected to? Durban is located 560 km from City Deep and the second closest seaport is Port Elizabeth and then Cape Town. In the third question, the interviewee was asked what major inland terminals City Deep is connected to. City Deep is connected to Kaserne (situated 10km from City Deep). As mentioned in section 5.3.1, Kaserne is not classified as a dry port, only as an inland terminal. In the fourth and fifth questions, the interviewee was asked to specify the transportation mode used to transport containers and goods to and from the port, and the party responsible for the transportation of these goods. It was found that both trucks and trains are used to transport goods from City Deep to the ports and vice versa. The interviewee also indicated that although transportation by train is cheaper, clients prefer to make use of road (truck) transportation. This is because rail (train) transportation takes much longer to deliver the goods. A major problem of rail transportation is theft, which for security reasons makes it difficult to rely on rail transportation. Transnet Freight Rail handles the transportation of goods and containers to and from City Deep; however, clients may choose their own freight hauler for the delivery of containers and goods. This must be pre-arranged by the hauler.

In the sixth and seventh questions, the interviewee was asked if and how the company is connected to other types of terminals (e.g. airports). It was found that if clients prefer, containers can be transported via road to the airport. The nearest international airport connected to City Deep is OR Tambo. The containers are loaded and aired to the client. City Deep is not responsible for the loading of containers at the airport. The clients must arrange with the airport themselves, as City Deep only delivers the goods.

In the eighth and final question of this section, the interviewee was asked to identify the parameters in question. The parameters include the length of the transshipment tracks, the utilisation of the transshipment tracks, train and truck arrival patterns, the loading and unloading procedures, and the handling equipment used to load and unload containers. The responses of the interviewee is integrated with information provided by Spoornet and other sources, to present a more detailed description of the parameters.

1. The length of transshipment tracks (see section 3.3.1.1)

The terminal's transshipment tracks are determined by two factors: the length of the train and the land availability. The length of the transshipment tracks not only affects the terminal dimensions but also everyday operations. For example, table 5.1 illustrates the train wagons of Transnet Freight Rail. As shown is table 5.1, the wagons vary according to various sizes.

Table 5.1: The internal dimensions of Spoornet Rail Service train wagons

Payload (weight of cargo)	Internal dimensions			Door size	
	Length (m)	Width (m)	Height (m)	Width (m)	Height (m)
30 tons	12,051	2,033	2,438	1.595	1,956
44 tons	11,245	2,407	2,283	1.441	1,889
39 tons	13,500	2,438	0,918	-	-
44 tons	13,500	2,438	0,918	-	-

Source: Transnet Freight Rail, 2008

Ballis and Golias (2002) explain, that if the number of incoming wagons per train exceeds the length of the transshipment track, the train has to be shared out over more than two tracks. For example, if the transshipment track at City Deep is 200 m in length, and a 44-ton train enters the terminal with 15 wagons, the capacity of the transshipment tracks is exceeded at the terminal. When this happens, certain trains have to be removed from the tracks after an unloading and loading phase of a few hours to make space for new inbound trains.

2. Utilisation of the transshipment tracks (see section 3.3.1.2)

The transshipment track at the City Deep terminal includes a main line and a by-pass track. Both the main line and by-pass track represent the static and dynamic capacity of the terminal. According to Spoornet (2008), approximately five trains enter City Deep per day from the Port of Durban. Therefore, the static capacity of the terminal is assumed to be five trains served per track per day. For instance, the first train arrives in the morning, one train arrives at 12:00, another at 16:00, then again at 20:00, and the last train enters the terminal at 24:00. The dynamic capacity of the terminal, on the other hand, assumes that the terminal can handle more than five trains per day on a given loading track. For instance, City Deep's handling equipment (gantry cranes) serve more than five trains per day (Minnaar, 2003). Therefore, the trains need to be switched between transshipment tracks (by-pass track) and the waiting tracks, which requires that the clearing operations during transshipment run smoothly and be operated efficiently.

The switching of trains during the transshipment procedure is carried out by shunting locomotives. It is interesting to note that the oldest locomotive at City Deep has been operating for more than 28 years. During the switching procedure, handling equipment is used to service trucks and help deal with truck delays. This is a very important procedure, because if, for instance, the handling equipment is not used to carry out additional tasks, truck delays can cause a blockage in the terminal. Therefore, no trucks can leave or enter the terminal during the transshipment procedure.

For example, trucks arrive in the morning and, after the security personnel have checked all the required documents, the trucks pass through the first gate and drive down the external driving lane. The gantry cranes have already cleared the first train (the morning train) and moved the goods to the storage area. The truck enters the loading driving lane for the loading of goods and containers. The goods are loaded and the truck driver receives an acquittal document. The latter document is a proof of exit (Minnaar, 2003).

The border police or security personnel inspect the proof of exit document, as well as all other relevant documents, description codes, and seals of the container. If all the documents are in place, the container information is recorded on the register book in order to confirm that the seal and container numbers match. The driver of the truck is required to hand over his ID to be copied, upon which his fingerprints are also taken (Transnet Freight Rail, 2008). City Deep terminal also requires that the registration number of the truck be sandblasted in big letters on the front big screen. This is necessary to deter thieves, who have been known to change number plates on stolen vehicles. After all the information has been verified, the container receives a Container Inspection Report, which confirms that all the necessary checks have been carried out (Minnaar, 2003).

The truck is then allowed to leave the terminal. It is important to note that goods in transit must be inspected at every transshipment, up to its arrival at its final destination.

3. Train and truck arrival patterns (see section 3.3.1.3)

Train movements are regulated in a scheduled-responsive railway operation structure by means of a pre-established and conflict-free schedule. Five trains enter City Deep per day from the Port of Durban. Moreover, the arrival patterns of trucks are determined by the timetable of the given train, the working hours at City Deep, and market conveniences. For instance, after 18:00 no one is allowed to enter, therefore, trucks must ensure that they enter City Deep beforehand. However, the client can arrange with City Deep staff for late arrival if a truck is due after 18:00. Staff members are allowed to exit the terminal until 20:00, but only if overtime has been pre-arranged.

4. Loading and unloading procedures

The loading tracks of the terminal are not electrified; therefore, rail access into the terminal cannot be electrified, which implies that there should be change to a diesel locomotive. The reason for not having an electrified overhead line is that the goods are lifted by portal cranes or reach stackers. However, the railway line up to the transshipment area is electrified so that the train can enter onto the transshipment track by electric traction.

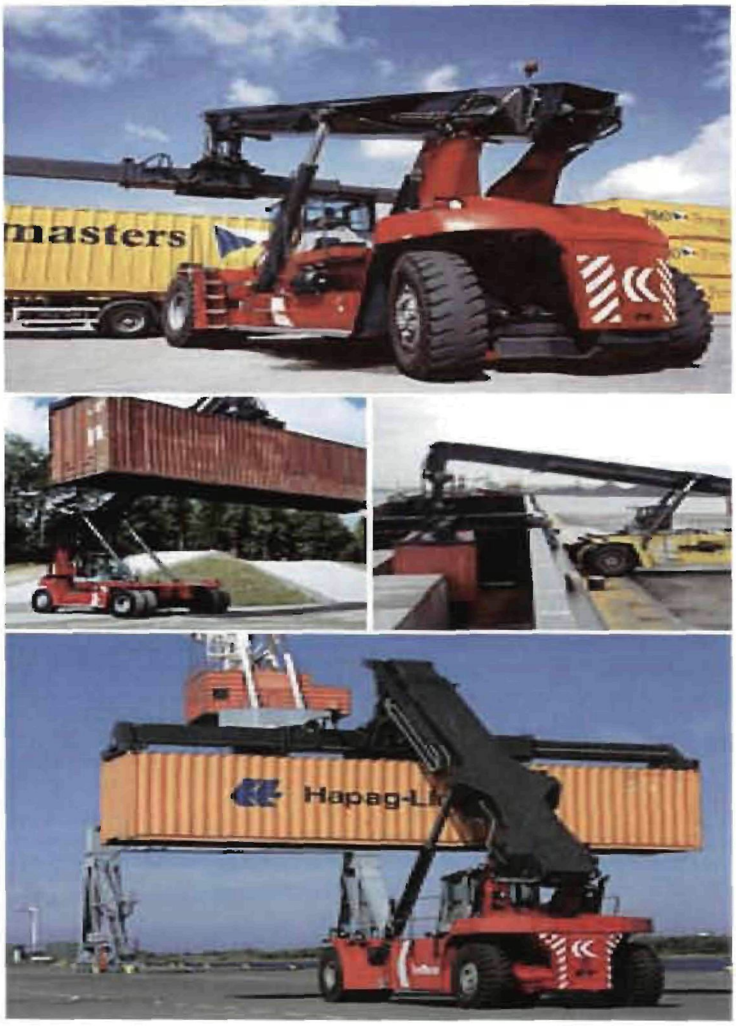
The loading and unloading procedures at City Deep can be divided into four phases. The first phase starts with the unloading of the trains. Trains arrive at City Deep between 06:00 in the morning and 24:00 at night. However, trains arriving after 20:00 in the evening are only unloaded the next morning. A significant number of trucks are usually already present at the terminal for the loading of goods and containers. This means that the unloading procedures must be carried out immediately, before the morning trucks arrive. During the first phase of unloading, transshipment from the train wagon to the truck is carried out directly. However, if trucks arrive after the trains, the handling equipment is used to tranship the load units to the storage area where the goods and containers are stored for some time or until the truck arrives for loading.

The second phase also starts with the unloading of the trains. However, this phase can be divided into two operations, namely, direct unloading from the train to the truck and indirect transshipment. Indirect transshipment is simply the unloading from the train wagon to the storage area (no trucks are present) and then from the storage to the truck. The third phase entails the unloading of the wagon to the storage area. Therefore, the third phase is also based on indirect transshipment and requires an intermediate storage area. The fourth phase of the unloading and loading operations involves trucks being loaded indirectly from the store. The fourth phase concludes the unloading of the train, and the trucks are ready to deliver goods to their final destinations.

5. Type and number of handling equipment (see section 3.3.1.4)

There is a variety of handling equipment used at City Deep, which is suitable for loading and unloading procedures. Reach stackers and rail-borne gantry cranes are amongst the most predominantly used equipment at the terminal (Transnet Freight Rail, 2008). Figure 5.3 illustrates a typical reach stacker used at City Deep.

Figure 5.3: Reach stackers



Source: Transnet Freight Rail, 2008

Reach stackers are mobile cranes, which are attached at the edge of the boom with a spreader. These cranes are flexible and low cost and are able to lift, handle, transport, and stack containers. City Deep is an extremely demanding environment with long shifts, heavy loads and high demands on accessibility. For this reason, forklift trucks are used for heavy-duty handling. Forklift trucks handle heavy and often fragile goods, which places strict demands on the lifting. Forklift trucks have a lifting capacity of up to fifty tons and offer a high level of reliability and a long life span.

Figure 5.4 illustrates a typical forklift used at the terminal for the lifting of heavy goods. Forklift trucks can be divided into 5-9 tons, 9-18 tons and 20-50 tons. However, City Deep uses only the first two categories of forklift trucks.

Figure 5.4: Forklift

Source: Transnet Freight Rail, 2008

The third type of equipment used at the terminal is an empty container handler, also known as an empty container truck (see figure 5.5). Container handlers move or stack empty containers quickly and efficiently. Container handlers are used to stack containers high and close together in order to exploit the available yard area to the full. Empty container handlers differ from reach stackers in terms of height. Reach stackers are used for high, top-lifting and stacking of containers, whereas empty container handlers are used to stack containers as fast and efficiently as possible.

Figure 5.5: An empty container handler

Source: Transnet Freight Rail, 2008

Furthermore, automatic stacking cranes are rail-mounted cranes used for yard stacking and in-stack transportation of containers in the City Deep storage area. Automatic stacking cranes pick up containers from dedicated transfer areas at both ends of the stacked containers. Automatic stacking cranes have the benefit of reducing overall operating costs and increasing the utilisation of the equipment. The storage capacity of the cranes is very high as they offer high stacking density with low labour usage. Figure 5.6 illustrates a typical automated stacking crane.

Figure 5.6: Automatic stacking crane

Source: Spoornet, 2008

5.3.3.3 Operational framework of City Deep Container Terminal

In the third section of the questionnaire, the interviewee had to answer questions regarding the operation procedure of the company. For example, the schedule flow of containers, from arrival to unloading, the stacking of containers, the storage of containers, the movement of containers through City Deep to the point of delivery to inland destinations. Questions regarding City Deep's service delivery and the maintenance of the units were asked. The latter is an important aspect in order to boost City Deep's competitiveness.

In the ninth question, the interviewee was asked to discuss the type of services they offer to clients (both domestic and international clients). The interviewee's company provides the following services:

1. Rail sidings for train and wagon storage.
2. Transshipment tracks for train loading and unloading operations at the terminal interchange zone, from/to a hauler, or when lifted from or placed on a rail wagon at the railhead.
3. Custom clearance.
4. Conveyance between the interchange zone or railhead and the stacking area.
5. Storage and buffer lanes for intermodal transport units.
6. Storage of containers.
7. The handling of containers by means of a container crane and/or gantry crane.
8. Loading and driving lanes for the trucks.
9. An internal road network.

In the tenth question, the interviewee was asked to discuss City Deep's operational framework as well as their information systems. With regard to the operational framework, the answer is summarised as follows. The City Deep container terminal handles approximately 1500 containers of imports and approximately 2600 containers of exports per day. Trains arriving in Johannesburg are split into five different sidings (see figure 5.7). Each siding belongs to one of the companies operating in City Deep. The containers carried on the trains belong to the shipping lines and usually contain imports. The trains deliver the containers at the correct siding (i.e. the siding of the company that is to handle the containers on behalf of the importer). The company then unloads the container as well as the content. Afterwards the container is filled with goods on behalf of an exporter. These goods are to be exported on the shipping lines to which the container belongs. The container is loaded onto the train and railed to the harbour.

Figure 5.7: Five sidings entering City Deep Container Terminal

Source: Transnet Freight Rail, 2008

The border police at City Deep operate on a twenty-four hour basis to control illegal trade in drugs, stolen vehicles, firearms and counterfeit goods. The terminal has three gates: one is for the entry of trucks delivering containers, one is a rail track gate for the entry and exit of trains, and the third gate is an exit gate for trucks. The gates are only opened when a train or truck enters or leaves the terminal. Every gate has a twenty-four hour security guard. Containers of imports arriving at City Deep are subject to a number of import controls. The City Deep border police and customs must inspect all the necessary documents, descriptions codes, seals on the containers, and check that imports comply with the import/export regulations pertaining to South Africa to ensure that no fraud or any other irregularities have occurred.

In the eleventh, twelfth, and thirteenth questions, the interviewee was asked what type of handling equipment is used to transport containers and goods within the yard. The answers to these questions were already discussed in section 5.3.2.

In the fourteenth and fifteenth questions of this section, the interviewee was asked to identify the owner of the infrastructure and whether anyone else is allowed to make use of City Deep's infrastructure and facilities. It was found that Spoornet is the owner of the infrastructure, and Spoornet and its personnel are the only ones allowed on the yard and allowed to make use of the facilities.

5.3.3.4 Advantages and disadvantages

The fourth section evaluated the importance of potential problems and advantages faced by City Deep. In essence, it evaluated both their competitiveness and competitive advantages.

The first part of this section asked the interviewee to identify the advantages of City Deep. The advantages are:

1. City Deep has a specialised team of workers and can therefore pack the clients' goods into shipping containers safely and securely, ready to be transported.
2. City Deep operates on a national as well as an international level. They handle and deliver empty and full container loads to and from anywhere in Central and West Africa, Australia, or the world.
3. Because of City Deep's location, they can ship full container loads straight to the stevedores at the harbour so that they are ready for export as quickly as possible.
4. City Deep is centrally located, as most exporters and businesses are located within a 50 km radius.
5. City Deep offers the client confirmation that the goods are packed in the correct container before the container is loaded onto the train or truck. For example, goods arriving from Africa to South Africa are not packed in containers. The personnel at City Deep pack the containers and take a photograph of the container before it is sealed. The photo is then sent to the client. As soon as the client gives the go ahead, the container is shipped.
6. The personnel at City Deep perform quality control functions. Samples of raw materials are taken to check the quality of the goods. The report is sent to the importer ensuring him that goods of the correct quality have been shipped.

7. City Deep has a maintenance division that repairs broken containers on behalf of the shipping lines they belong to.

The interviewee was also asked to identify potential problems. It was found that systems currently operating at City Deep are open to a certain amount of exploitation. For example, bribery of the official dealing with transhipment documents at the exit port is an everyday risk. The officer will, for example, ensure that the consignment is stamped without being examined at the border post. Other problems also arise such as blockages at the entry gate of the terminal. Container blockages of approximately 5 400 containers can take up to six weeks to clear. Therefore, shipping lines may impose a port congestion surcharge on imports and exports because of blockages caused by container delivery hold-ups.

The custom clearance process of containers is lengthy, and only 10% of South African import traffic is custom-cleared. Tampering with the rail consignment note is a constant problem, especially with goods received by rail from Durban. This is because the three-letter station destination address can be changed to designate an internal instead of imported container.

The interviewee identified potential problems regarding the infrastructure. It was found that train and truck congestion within City Deep is an everyday phenomenon. The existing infrastructure cannot handle the amount of trains and trucks entering City Deep. It was found that clients prefer road transport to rail transport. Therefore, the amount of trucks entering and leaving City Deep causes congestions. This not only affects the infrastructure at City Deep, but also that of South Africa. More trucks on the road increase the amount of air pollution, road accidents, and collisions. Trucks are often overloaded and this adds to the damage to South African roads.

5.3.3.5 Feasibility of establishing more dry ports

In the eighteenth and final question of the questionnaire, the interviewee was asked whether he thinks that South Africa should invest in a new dry port to help alleviate these problems and increase global comeptitiveness. The interviewee responded that a new container terminal would not be feasible. The volumes of trade do not justify the costs involved: for example, one gantry crane costs approximately R60 million. The South African government should rather invest in the upgrading of existing infrastructure, for example, ensuring a sufficient amount of trucks or wagons for trains. This type of upgrading would also serve the overall purpose of promoting rail transportation in South Africa. In chapter 4, section 4.3, it was found that rail transportation is cheaper than road transportation.

Spoornet must also become a more active partner in City Deep. For example, Transnet Freight Rail could make an undertaking that, as the carrier of transported cargo, it will require a declaration from the client that the contents of the container are as described on the form. The Transnet Freight Rail document could then be compared with the customs declaration, and these two independent systems could then be used for cross-referencing and profiling.

5.4. CONCLUSIONS AND RECOMMENDATIONS

The empirical evidence was gathered in the form of an interview-based questionnaire. Eighteen questions were asked to the operational manager at City Deep in Gauteng. The purpose of the questionnaire was to gather information on the service delivery of South African inland terminals. It contained five sections, namely the current economic performance; the location of the terminal relative to the spatial allocation of the production and consumption centres (parameters); operational framework of City Deep container terminal; advantages and disadvantages; and the feasibility of establishing more dry ports in South Africa.

The information gathered was discussed in terms of the importance of exports for economic growth. In chapter 2 it was highlighted that transport costs are an inevitable part of any export transaction and have been empirically found to influence exports negatively. Research also indicated that the impact of domestic transport costs on exports is more severe than international transport costs. The aim of this chapter was to provide empirical evidence on the role of dry ports in terms of minimising transportation costs. One method of minimising domestic transport costs is through containerisation. Transport costs in South Africa are a relevant issue due to its geographical position, since South Africa is situated far from its major trading partners. In addition, the majority of South African exports originate in Gauteng, which is around 600km from the nearest seaport. For South African exports to remain competitive, domestic transport costs need to be reduced. One way of doing this is by linking a container dry port with an intermodal transport system to the major seaports (Durban, Port Elizabeth and Cape Town).

City Deep is South Africa's major dry port and is linked with an intermodal transport system to the major seaports in South Africa. City Deep could reduce transportation costs in South Africa, as it provides the transport infrastructure for containerisation. However, investments should be made to support the existing infrastructure in order to promote port efficiency.

In conclusion, according to the information and discussion, City Deep functions successfully in terms of service delivery and extra services provided to both exporters and importers. It was found that it would benefit City Deep to focus on making Transnet Freight Rail a more active partner in both the logistics and operational processes. Transnet Freight Rail could act as the third party in the logistics process, leading to a reduction in transportation costs. As for the establishment of additional inland terminals or dry ports, the government needs to invest more in the existing infrastructure, as the export volumes do not justify the cost of building a new inland terminal. This answers the question of whether dry ports can lead to a reduction in transportation costs. Dry ports have the benefits of the modal shift from train to truck, and focus on containerisation. Therefore, City Deep and the South African logistics system must focus on promoting rail transportation in order for exporters and importers to focus on both transportation modes for the transportation of goods. This will also enable South Africa to take its place in better and more competitive global chains.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

The movement of passengers, goods, and information has always been fundamental components of human societies. It is all related to transport costs as well as to the attributes of what is being transported. However, regulations, laws, and tariffs can influence transportability. Countries around the world have been changing their international trade policies by reducing both tariff and non-tariff barriers. Informal barriers hinder trade and the benefits of exports, such as economic growth, that come with the achievement of trade liberalisation. It was found that the impact of transport costs on trade patterns has become an important study for many. Transport costs are an inevitable part of any export transaction and have been empirically found to influence exports negatively. Research also indicates that the impact of domestic transport costs on exports is more severe than international transport costs. Theoretical and empirical work in international trade has only recently considered the geography of exports as a possible explanation of high transport costs. For instance, factors such as transport costs, distance, market size, scale economies, and agglomeration affect transportation costs around the world.

It was found that domestic transport costs might be minimised by means of containerisation and dry ports. Dry ports provide the transport infrastructure to support containerisation. It became evident that the most appropriate manner to connect a dry port with a seaport, is with an intermodal transport system, which reduces domestic transport costs. Transportation costs in South Africa are an important issue to consider. Not only is South Africa situated far from its major trading partners, but the majority of South African exports find their origin in Gauteng, which is around 600km from the nearest seaport. For South African exports to remain competitive, domestic transport costs must be reduced. A primary solution is connecting a container dry port with an intermodal transport system leading to the major seaports (namely Durban, Port Elizabeth, and Cape Town).

6.1 Summary

The initial stages of the study (chapter 2) firstly discussed trade liberalisation as a means of reducing trade barriers amongst countries, and secondly, focussed on transport elements with the purpose of reducing transportation costs. It was found that, in recent years, trade liberalisation has lead to the reduction of trade barriers amongst countries. Therefore, trade barriers no longer protect a country's industries, which leads to increasing global competition. Chapter 2 highlighted the importance of exports for economic growth. Chapter 2 focused directly on the movement of passengers, goods, and information as important components of international trade. It was found that all these components are related to transport costs as well as to the attributes of what is being transported.

It was found that transport costs influence international trade patterns and volumes. Therefore, it is evident that transport costs are a growing global concern. Various methods were identified to minimise transport costs, for example, cargo handling and stevedoring costs. This chapter attempted to focus on transport elements to reduce transportation costs. It was found that containerisation might minimise transportation costs. Containerisation reduces cargo-handling costs by consolidating numerous break-bulk parcels into a single unit. Containerisation was identified as being responsible for profound mutations in the transport sector, in other words, containerisation reduces handling time of goods, allows for increases in speed of rotation along a circuit, and thus entails a better optimisation of time and money. Thus it was found that containerisation cuts stevedoring time and costs by approximately 80% per measurement-ton.

It was found that containerisation needs an efficient transport system and infrastructure to support it. Containerisation technology was found to be one of the main driving factors behind the development of multimodalism by means of improved requirements for shippers, such as new designs and technology. Finally, multimodalism was shown to provide savings to each member of the transportation system through joint operations with another member of the system.

In chapter 3, the importance of inland transportation systems and their functions were discussed. It was found that both multimodal and intermodal transportation systems could be a worthwhile alternative to unimodal transportation. Unimodal refers to the use of more than one transport mode for inland transportation of goods and containers. It was found that the main factors behind cost reductions reside in the speed and flexibility incurred by intermodal transportation. However, intermodal transportation incurs social costs. Therefore, the social costs of intermodal transportation were assessed and the driving factors behind these costs were discussed. Furthermore, container terminals were examined as a means of promoting intermodal and multimodal transportation. It was found that container terminals are divided into seaports and inland terminals, or dry ports. Container terminals were discussed in detail with a specific focus on the container flow operations. Port efficiency was indicated as an important component for a country's competitiveness. The efficient use of handling equipment as well as the speed and flexibility of operations may increase competitiveness.

Inland terminals promote intermodal transportation, and intermodality enhances the economic performance of a transportation chain by using more than one transport mode. Therefore, transport modes are used in the most productive manner to reduce transportation costs. For example, the line haul economies of rail may be exploited for long distances, while trucks can be used effectively for local pickup and delivery. A reference situation illustrates that dry ports promote intermodal transportation through achieving better productivity. The reference situation represents the transport of units from the seaport to 19 inland destinations by truck. Therefore, inland terminals and intermodal transportation may reduce the elements of transportation costs.

Chapter 4 aimed to examine South African transportation costs, intermodal transportation, exports, and the functioning of container terminals. Transport costs in South Africa is a relevant issue due to the geographical position of the country: South Africa is situated far from its major trading partners. In addition, the majority of South African exports come from Gauteng, which is around 600km from the nearest seaport. It was found that, since 1994, South Africa has become an active competitor in the global market; trade liberalisation replaced the anti-export bias in order to make way for higher export-lead growth. The internationalisation of the South African economy since 1994, increased the degree of regional specialisation and geographic concentration of industrial activity and therefore, increased spatial inequality.

In 2000, 84 % of total manufacturing exports were generated by only 22 of the 354 magisterial districts. The overall number of magisterial districts that export manufactured goods increased by approximately 15% from 1996 to 2004. Nevertheless, it was found that magisterial districts with larger economic activity, competitive transport costs, foreign market access, and good institutional quality are able to export manufactured goods more successfully. Furthermore, it was found that distance, shipment and transaction costs are the three major components that have an impact on transport costs.

Domestic transport costs were found to be dependent on a variety of conditions related to infrastructure (services and operations), geography (distance of customers and manufactured exports), and most importantly, the manner in which freight and passengers are carried. South Africa's domestic transport costs accounted for around 13% of the GDP in 2003. Transport costs increased by 11% and the overall logistics costs remained flat at 15.2% of the gross domestic product (GDP). For this reason, transportation costs are the biggest driver of logistics costs in South Africa. Manufactured export relies on a good, fast, and efficient transport service to move goods from one location to another. It was also found that developments in transport infrastructure have a long-term impact on an economy and financial resources are needed to implement these developments. With the reduction of trade barriers in the world economy and trade liberalisation taking place, exports from South Africa had the possibility to improve. Finally, for South African exports to remain competitive, domestic transport costs must be reduced. One method is by linking a container dry port with an intermodal transport system leading to the major seaports (namely Durban, Port Elizabeth, and Cape Town).

The empirical study in chapter 5 examined South Africa's inland terminals, focussing specifically on City Deep. City Deep was discussed by means of promoting inland transportation of containers and the handling of containerised traffic in order to achieve port efficiency. In short, City Deep may reduce transportation costs and increase South Africa's competitive ranking in the global market. The case study was formulated based on an interview with one of the companies operating in City Deep. The company wishes to remain anonymous for confidentiality reasons. The interview took place at the company's premises on the 16th of September 2008. The operational manager of the company answered the questions based on the questionnaire described in section 5.3.1. After all the questions were answered, a tour was given of the company's premises. During the tour, the operational framework, advantages and disadvantages were discussed. The individual was very helpful with questions regarding the functioning of handling equipment as well as interesting facts about the terminal.

A total of 18 questions were asked to individuals at a terminal in Gauteng. The questionnaire's purpose was to gather information on the service delivery of South African inland terminals. It contained four sections, namely, the current economic performance, the terminal's location in relation to the spatial allocation of the production and consumption centres (parameters), operation areas of the City Deep container terminal and the flow of transport. The most important question was whether more inland terminals are needed in South Africa. The information gathered was discussed in terms of the promotion of inland container transportation by means of reducing transportation costs, and increasing South Africa's competitive position.

City Deep is South Africa's major dry port and is linked with an intermodal transport system to the major seaports in South Africa. City Deep may reduce transportation costs in South Africa as it provides the transport infrastructure for containerisation. However, sufficient infrastructure investments are needed to support the existing infrastructure in order to promote port efficiency.

6.2 Conclusion and recommendations

In conclusion, City Deep functions successfully in terms of service delivery and extra services provided to both exporters and importers. It was found that City Deep needs to focus on making Transnet Freight Rail a more active partner in both the logistics and operational processes. Transnet Freight Rail may act as the third party in the logistics process, and may therefore lead to a reduction in transportation costs. As for more inland terminals or dry ports, the government needs to invest more in the existing infrastructure, as the export volumes do not justify the cost of building a new inland terminal. This answers the question of whether a dry port can lead to a reduction in transportation costs. Dry ports have the benefit of the modal shift from truck to train and focus on containerisation. Therefore, City Deep and South Africa's logistic system need to focus on promoting rail transportation so that exporters and importers will focus on both transportation modes for the transportation of goods. This will also enable South Africa to move into better and more competitive global chains.

ANNEXURE A

EXPORT CARGO SHIPPING INSTRUCTIONS v2.00

STPRO 1992

A Exporter/shipper — Vat no. GB 123 4567 89
SAID SAINT UK PLC
PO BOX 830
CROYDON
SURREY
CR9 9NZ

Customs reference/status: 12345 - 11821
Booking number: BN001212
Exporter's reference: ST-1182/1
Forwarder's reference: ARG 12491

B Consignee — Vat no.
TO ORDER
BANK OF ARGENTINA
BUENOS AIRES
ARGENTINA

D Other address — VAT no. AR 321 4567 89
CASILLA BOX COMPANY
CASILLA DE CORREIO 6091
BUENOS AIRES
ARGENTINA

If requested, this space may be used for other addresses, e.g. buyer, place of acceptance/identity, additional notify party

C Freight forwarder — Vat no. GB 727 8456 12
FORREST FORWARD COMPANY
VENTURA BUSINESS PARK
STAFFORDSHIRE DE15 4ZY

Country of origin of goods: UNITED KINGDOM
Country of final destination: ARGENTINA

Other UK transport details

E If requested this space may be used for extra addresses or other information

Vessel/flight no. and date: ORCHARD EMPRESS
Port/airport of loading: TILBURY
Port/airport of discharge: BUENOS AIRES
Place of delivery:

Please insure for — Unless otherwise instructed cover will be for ICC classes 'A' and will be charged to A

Shipping marks; container number and type	No. and kind of packages; description of goods	Item No.	Commodity code	Quantity 2	Gross wt (kg)	Cube (m3)	Procedure	Net weight (kg)	Value (£)
STPU287352/5 SEAL: 238754	13 PALLETS CARDBOARD - 13,000 PIECES	1	48081010		16,000	46.00		14,200	
STPU287352/5 SEAL: 238754	1 PALLET ADHESIVE	2	35069100		2,000	4.00		1,800	

Summary declaration/previous document

DANGEROUS GOODS: Refer to IMDG, ADR, RID, IATA, ADN or UN regulations. State hazard class, UN no. and packing group, shipping name, technical name

Identification of warehouse — FREIGHT ▷

◁ DOCUMENTATION

Certificate of origin	
Air waybill	
ECS	A
Consular/legalisation fees	
Other documentation charges	
Insurance/handling: Export	A
Transit	
Import	D

Indicate services required, and to whom charges should be debited, by entering A, B, C, D or E in each box

Inland carriage to: Groupage depot/ICD / UK port/airport	A
Depot/ICD or port charges including unloading	A
Freight to:	A
Depot/ICD or port charges at destination	D
Depot/ICD	
Place of delivery	

Trade Term: CPT
Invoice price: USD 12494.00
No. of containers: 1
Total gross wt (kg): 18,000
Total cube (m3): 50.00

Special instructions

STATUS: Enter T1/T2/Misc or T2L (as appropriate)
Indicate entry port/enters if SCP

Ocean Freight Payable at: TILBURY
No. of bills of lading required: 3 Original 6 Copy

Name of contact and telephone number: A POTTS - SHIPPING CLERK 020 8482 1234

Make out documents as indicated and dispose of as follows:
ALL TO A. TELEPHONE A ON DEPARTURE OF VESSEL

I/We hereby declare that the above particulars are correct and agree to your published Regulations and Conditions, including those as to liability.

Date: CAMBERLEY 01.03.2000

Signature

STANDARD SHIPPING NOTE – FOR NON-DANGEROUS GOODS ONLY v2.00

© SITPRO 1999

IMPORTANT USE THE DANGEROUS GOODS NOTE IF THE GOODS ARE CLASSIFIED AS DANGEROUS ACCORDING TO APPLICABLE REGULATIONS SEE BOX 10

Exporter [1] BATHURST UK PLC PO BOX 830 CROYDON SURREY CR9 9NZ	Customs reference/status [2] 12443 11821
	Booking number [3] BN0012312
	Exporter's reference [4]
	Forwarder's reference [5] ABC 129311
Consignee [6]	
Freight forwarder [7] TORREST FORWARD COMPANY VENTURA BUSINESS PARK STAFFORDSHIRE DE15 4ZY	International Carrier [8] ORCHARD SHIPPING
	For use of receiving authority only
Other UK transport details (e.g. ICD, terminal vehicle bkg ref, receiving dates) [9]	The Company preparing this note declares that to the best of their belief the goods have been accurately described, their quantities, weights and measurements are correct and at the time of despatch they were in good order and condition; that the goods are not classified as being hazardous by reference to relevant national and international regulations applicable to the intended modes of transport [10A]
Vessel flight no. and date: ORCHARD EMPRESS Port/airport of loading: TILBURY [10]	
Port/airport of discharge: BUENOS AIRES Destination [11]	TO THE RECEIVING AUTHORITY – Please receive for shipment the goods described below subject to your published regulations and conditions (including those as to liability)

Shipping marks	No. and kind of packages; description of goods; non-hazardous special stowage requirements [12]	Gross weight (kg) of goods [13A]	Cube (m³) of goods [14]
1409-1412	13 PALLETS CARDBOARD – 15,000 PIECES PART OF A FULL CONTAINER LOAD	16,000	46.00
For use of Shipping company only		Total gross weight of goods 16,000	Total cube of goods 46.00

Container and number / vehicle registration number [16]	Seal number(s) [16A]	Container vehicle size and type [16B]	Tare (kg) [16C]	Total gross weight (incl. tare) (kg) [16D]
STPU 2873535	238754	40' GENERAL STANDARD HEIGHT	2,000	18,000

DOCK/TERMINAL RECEIPT

HAULIER DETAILS	RECEIVING AUTHORITY REMARKS	Name and telephone number of company preparing this note [17]
Haulier's name	Received the above number of packages/containers/trailers in apparent good order and condition unless stated hereon.	A POTTS – SHIPPING CLERK 020 8482 7234
Vehicle reg. no.		Place and date CAMBERLEY 01.03.2000
Driver's signature	Receiving authority signature and date	Name of contact

© SITPRO 1996

DANGEROUS GOODS NOTE

V2.00

Exporter [1]
BATHURST UK PLC
PO BOX 830
CROYDON
SURREY
CR9 9NZ

Customs reference/status [2]
12345 11821

Booking number [3]
BN001212

Exporter's reference [4]

Forwarder's reference [5]
ARC 129311

Consignee [6]
TO ORDER
BANK OF ARGENTINA
BUENOS AIRES
ARGENTINA

DSHA Notification (in accordance with DSHA Regulations as amended) given by: [5A]

Shipper	Cargo agent	Transport operator	Shipping line
	X		

Freight forwarder [7]
FORREST FORWARD COMPANY
VENTURA BUSINESS PARK
STAFFORDSHIRE DE13 4ZY

International Carrier [8]
ORCHARD SHIPPING

For use of receiving authority only

Other UK transport details e.g. ICD, terminal vehicle bkg ref. receiving dates [9]

I hereby declare that the contents of this consignment fully and accurately described below by the proper shipping name, and are classified, packaged, marked and labelled/placarded and are in all respects in proper condition for transport according to the applicable international and national government regulations and in accordance with the provisions shown overleaf. The shipper must complete and sign box 17. [10A]

Vessel / **Port/airport of loading** [10]
ORCHARD EMPRESS — TILBURY

Port/airport of discharge / **Destination** [11]
BUENOS AIRES

TO THE RECEIVING AUTHORITY – Please receive for shipment the goods described below subject to your published regulations and conditions (including those as to liability).

Shipping marks — Number and kind of packages, description of goods [12]	Net weight (kg) of goods [13]	Gross weight (kg) of goods [13A]	Cube (m3) of goods [14]
SPECIFY: Proper shipping "name", Hazard Class, UN No. Additional Information (if applicable) see overleaf for RID/ADR/CDG Road requirements see notes overleaf			
1 PALLET CONTAINING 10X200L DRUMS	1,800	2,000	4.00
ADHESIVES CLASS 3.3, UN1133, PGIII, (23°C)			
PART OF A FULL CONTAINER LOAD			
*Proper Shipping Name – Trade names above are unacceptable			

CONTAINER VEHICLE PACKING CERTIFICATE
I hereby declare that the goods described above have been packed/loaded into the container/vehicle identified below in accordance with the provisions shown overleaf.
THIS DECLARATION MUST BE COMPLETED AND SIGNED FOR ALL CONTAINERS/VEHICLE LOADS BY THE PERSON RESPONSIBLE FOR PACKING/LOADING

Name of Company
BATHURST UK PLC
Name/Status of Declarant
B RICHARDS – LOADING MANAGER
Place and date
CAMBERLEY 01.03.2000
Signature of declarant

Total gross weight of goods: 2,000
Total cube of goods: 4.00

Container id number / vehicle registration number [16]	Seal number(s) [16A]	Container vehicle size and type [16B]	Tare (kg) [16C]	Total gross weight (incl. tare) (kg) [16D]
STPU287332/5	238754	40' GENERAL STANDARD HEIGHT	2,000	4,000

DOCK/TERMINAL RECEIPT

HAULIER DETAILS
Haulier's name
Vehicle reg. no.
Driver's signature

RECEIVING AUTHORITY REMARKS
Received the above number of packages/containers/trailers in apparent good order and condition unless stated hereon.
Receiving authority signature and date

Name and telephone number of shipper preparing this note [17]
BATHURST UK PLC 0181 482 1234
Name/status of declarant
A POTTS SHIPPING CLERK
Place and date
CAMBERLEY – 03.03.1999
Signature of contact

V2.00

COMMON SHORT FORM BILL OF LADING

Shipper Vat no BATHUNT UK PLC PO BOX 830 CROYDON SURREY CR9 9NZ	B/L No. 00120023 Shipper's reference ST-1182/1 Forwarder's reference ARG 1293H
Consignee VAT no TO ORDER BANK OF ARGENTINA BUENOS AIRES ARGENTINA	Name of carrier ORCHARD SHIPPING
Notify Party and Address CASILLA BOX COMPANY CASILLA DE CORRERO 6091 BUENOS AIRES ARGENTINA	

The contract evidenced by this Short Form Bill of Lading is subject to the exceptions, limitations and conditions and liberties (including those relating to pre-carriage and on-carriage) set out in the Carrier's Standard Conditions applicable to the voyage covered by this Short Form Bill of Lading and operative on its date of issue. If the carriage is one where the provisions of the Hague Rules contained in the International Convention for the unification of certain rules relating to Bills of Lading dated Brussels on 25th August, 1924, as amended by the Protocol signed at Brussels on 23rd February, 1968 (the Hague Visby Rules) are compulsorily applicable under Article X, the said Standard Conditions contain or shall be deemed to contain a Clause giving effect to the Hague Visby Rules. Otherwise, except as provided below, the said Standard Conditions contain or shall be deemed to contain a Clause giving effect to the provisions of the Hague Rules.
The Carrier hereby agrees that to the extent of any inconsistency the said Clause shall prevail over the exceptions, limitations, conditions and liberties set out in the said Standard Conditions in respect of any period to which the Hague Rules or the Hague Visby Rules by their terms apply. Unless the Standard Conditions expressly provide otherwise, neither the Hague Rules nor the Hague Visby Rules shall apply to this contract where the goods carried hereunder consist of live animals or cargo which by this contract is stated as being carried on deck and is so carried.
Notwithstanding anything contained in the said Standard Conditions the term Carrier in this Short Form Bill of Lading shall mean the Carrier named on the front thereof.
A copy of the Carrier's said Standard Conditions applicable hereto may be inspected or will be supplied on request at the office of the Carrier or the Carrier's Principal Agents.

Pre-carriage by	Place of receipt by pre-carrier*
ORCHARD EMPRESS	TILBURY
Vessel	Port of loading
BUENOS AIRES	
Port of discharge	Place of delivery by on-carrier

Shipping marks; container number	Number and kind of packages; description of goods	Gross weight	Measurement
	1 X 40' CONTAINER SAID TO CONTAIN		
STPU287352/5 SEAL: 238754	1) 13 PALLETS CARDBOARD - 15,000 PIECES	16,000	46.00M
	2) 1 PALLET ADHESIVE	3,000	4.00M

Particulars declared by shipper

SHIPPED ON BOARD BY ORCHARD EMPRESS
AT TILBURY 11.03.2000

Freight details; charges etc

FREIGHT PREPAID

RECEIVED FOR CARRIAGE as above in apparent good order and condition, unless stated hereon, the goods described in the above particulars.
IN WITNESS whereof the number of original bills of lading stated below have been signed, all of this tenor and date, one of which being accomplished the others to stand void.

Ocean freight payable at	Place and date of issue	
TILBURY	TILBURY	10.03.2000
Number of original B/L	Signature for carrier; carrier's principal place of business	
3	ORCHARD SHIPPING AS CARRIER	

Negotiable only when document used as a through bill of lading

C OF S CSF BL 1967

ANNEXURE B

QUESTIONNAIRE – INTERVIEW: City Deep, Johannesburg

SECTION 1: THE CURRENT ECONOMIC PERFORMANCE

1. It is necessary to assess the current economic performance of the intermodal transportation used in City Deep.

SECTION 2: THE TERMINAL'S LOCATION RELATIVE TO THE SPATIAL ALLOCATION OF THE PRODUCTION AND CONSUMPTION CENTERS (PARAMETERS)

2. What is your major seaport and how far is it?
3. What are the names and locations (distances) of the dry ports you are connected with?
4. How are you connected with the port (rail, road, inland waterways, etc.)?
5. Who is responsible for the transportation from City Deep to the seaport?
6. Are you connected with destinations (terminals, airports, etc.) other than seaport?
7. By what means are you connected to these other destinations?
8. The parameters in question include the location of the terminal relative to the spatial allocation of the production and consumption centres. The parameters include the following:
    a. *The length of the transshipment tracks:* the length of the train, the land availability and cost constraints
    b. *Utilisation of the transshipment tracks:* Layout and cross-section of a transshipment terminal
    c. *Train/truck arrival patterns:* For example, train movements and the unloading of trains

d. *Type and number of handling equipment used for the unloading and loading of trains and trucks*

e. *Terminal access system and procedures:* For example, is the terminal accessible from more than one entrance?

SECTION 3: OPERATIONAL FRAMEWORK OF THE CITY DEEP CONTAINER TERMINAL

9. Which of the following services does City Deep provide?:

- Transportation to and from City Deep
- Custom clearance
- Forwarding
- Storage
- Sorting
- Maintenance of units (containers, swap bodies, semi-trailers, etc.)

10. Discuss City Deep's operational framework
11. What handling equipment do you have (gantry crane, straddle carrier, forklift truck, reach stacker, etc.)?
12. What kinds of units (containers, swap bodies, semi-trailers, etc.) do you handle?
13. What are the units (containers, swap bodies, trailers etc.) you send/receive to/from City Deep? Who is responsible for those units during transportation?
14. Who is the owner of the infrastructure?
15. Do you have any agreements with other companies concerning the sharing of infrastructure and equipment? (For example: Can a company own a terminal inside City Deep as well as equipment?)

SECTION 4: ADVANTAGES AND DISADVANTAGES

16. What advantages did City Deep bring since it was first utilised?
17. What problems do you face?

SECTION 5: FEASIBILITY OF MORE DRY PORTS IN SOUTH AFRICA

18. Is it feasible to establish more dry ports in South Africa?

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