

**STRUCTURING SOUTH AFRICAN MARITIME SUPPLY CHAINS FOR
HIGHER EFFICIENCY**

by

**YOLANDA FOURIE
920320507**

Thesis submitted in fulfilment of
the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

TRANSPORT ECONOMICS

in the

FACULTY OF ECONOMIC AND MANAGEMENT SCIENCES

at the

UNIVERSITY OF JOHANNESBURG

**Promoter: Prof J Walters
Co-Promoter: Prof GC Prinsloo**

**Johannesburg
April 2006**

ACKNOWLEDGEMENTS

Thank you to Profs Jackie Walters and Gerrie Prinsloo, my study leaders, for their guidance and support.

Thank you to the Department of Transport and the UJ Department of Transport and Logistics Management for their funding of the study.

Thank you to Mr Bernal Floor for mentorship during my post-graduate studies.

A sincere thank you to my family and loyal friends whose interest and support inspired me during my studies.

With love



Yolanda

OPSOMMING

Die vooruitgang van die Suid-Afrikaanse ekonomie is grootliks afhanklik van die inkomste uit fisiese uitvoere deur middel van internasionale skeepvaart, wat op sy beurt weer toenemend afhanklik is van die mate van mededingendheid in wêreldmarkte van die maritieme aanvoerkettings wat ons land gebruik. Mededinging in wêreldmarkte word al hoe strawwer namate produksiemiddels op 'n globale grondslag verwerf word en derhalwe geskied die mededinging tussen die doelmatigheid van hele aanvoerkettings eerder as net produksiekostes. Suid-Afrika het dus groot belang daarby om te verseker dat sy maritieme aanvoerkettings met die beste praktyk in die wêreld vergelyk. Onder andere vereis daardie praktyk dat 'n maritieme aanvoerketting so gekonstrueer moet word dat dit as 'n eenheid aan slegs die een logistiese doel van die aanvoerketting moet voldoen, dit wil sê, dat dit nie skakels moet bevat wat uit afsonderlike vervoerbesighede bestaan nie. In die praktyk beteken dit dat vervoertake wat tradisioneel deur derde partye in die aanvoerketting gelewer is, in een onderneming saamgesmelt moet word, sodat daardie take dan slegs kostes en nie ook winsbejag inhou nie. Sulke geïntegreerde maritieme aanvoerkettings sal noodwendig slegs deur die toetrede van kettingleiers tot stand kom.

Die belangrikste Suid-Afrikaanse maritieme aanvoerkettings vir grondstowwe sowel as verwerkte goedere word ontleed om sodoende die bestek vir die samesmelting van die skakels te bepaal, ten einde meer doelmatige 'geheel kettings' tot stand te bring. Kenmerke van verskeie maritieme aanvoerkettings wat die buiteland bedien en wat as voortreflike voorbeelde vir die struktuur van plaaslike maritieme aanvoerkettings kan dien, word ook geïdentifiseer.

Die rol van Transnet in die funksionering van die bestaande maritieme aanvoerkettings in Suid-Afrika ooreenkomstig regeringssbeleid word ondersoek. Aandag word gevestig op die gebrek aan voldoende belegging in spoor- en hawe-infrastruktuur oor die afgelope twee dekades, wat tot die agteruitgang van die maatskappy se prestasie bygedra het. Regeringsbeleid wat ingestel is op die skepping van openbare-privaatvennootskappe eerder as volkome privatisering ten

einde die probleme te oorkom, word bespreek, met die doel om te bepaal of dit wel die oplossing bied. Die beplande besteding van R40bn op infrastruktuurprojekte deur Transnet word veral oorweeg en aandag word daarop gevestig dat dit nie al die probleme sal aanspreek nie.

Tans word die seevervoerskakels in die Suid-Afrikaanse maritieme aanvoerkettings deur internasionale maatskappye verskaf. Die oorgrote meerderheid van Suid-Afrika se massavraguitvoere word vry-aan-boord verkoop, wat beteken dat beheer oor die prys van die afgelewerde produk deur Suid-Afrikaanse produsente aan buitelanders afgestaan word. Die redes hiervoor is ingewikkeld, maar die huur van skepe deur Suid-Afrikaanse uitvoerders om sodoende beheer oor daardie prys te behou is nie maklik uitvoerbaar nie, ofskoon dit reeds deur die vrugtebedryf in Suid-Afrika gedoen word. Dit word ook gedoen deur uitvoerders van ystererts in Australia, wat met Suid-Afrikaanse uitvoerders meeding. Skeepseienaarskap deur Suid-Afrikaners sal wel nuwe wetgewing vergemaklik om sodoende die markaandeel van landsburgers in die in- en uitvoere van Suid-Afrika te vergroot, maar die mark sal kostegewys moeilik wees om binne te dring en dit is te betwyfel of uitvoerders van hulle dienste gebruik sal maak. In die lynvaartbedryf is die tendens dat lynvaartmaatskappye hawedienste en landvervoerskakels by hulle dienste integreer en die effektiwiteit van die Suid-Afrikaanse houeraanvoerkettings sal op dieselfde manier aangespreek moet word.

Die samesmelting van die afsonderlike skakels in die belangrikste maritieme aanvoerkettings in Suid-Afrika word gemotiveer op grond van die kostestrukture van daardie skakels en die voordele wat dit sal inhou. Die noodsaaklikheid dat kettingleiers van die privaatsektor afkomstig moet wees en dat Transnet sy belang daarby tot deelname aan 'n openbare-privaatvennootskap moet beperk, word verduidelik. Voorstelle word gemaak van hoe geïntegreerde maritieme aanvoerkettings vir die uitvoer van ystererts en steenkool geskep kan word en hoe 'n doelmatige houeraanvoerketting bestaande uit die beplande houerterminaal in Ngqura-hawe en 'n houerspoordiens tussen Coega en Gauteng tot stand gebring kan word. Dit word beklemtoon dat die houeraanvoerketting aan die verkeer van 'n besondere lynvaartmaatskappy toegewy moet word, terwyl daardie maatskappy die ontwikkeling van die aanvoerketting moet lei.

Die gevolgtrekking wat gemaak word, is dat die huidige rol van Transnet ooreenkomstig verklaarde regeringsbeleid nie tot die ontwikkeling van doelmatige maritieme aanvoerkettings volgens die beste wêreldpraktyk sal kan bydra nie. Die afleiding word ook gemaak dat die doelmatigheid van die aanvoerkettings volgens daardie praktyk verhoog kan word mits regeringsbeleid en die rol van Transnet aangepas word om vir openbare-privaatvennootskappe onder privaatsektorleiding te voorsien.



ABSTRACT

The progress of the South African economy relies heavily upon earnings from physical exports, which depend increasingly upon the competitiveness in global markets of the maritime supply chains that serve the country. Competition in world markets is becoming increasingly stronger as production resources are obtained globally and subsequently the competition exists between the effectiveness of whole supply chains rather than only production costs. South Africa therefore has great interest in ensuring that its maritime supply chains compare with world best practice. Amongst other things, this world best practice requires those chains to function as entities structured to serve their logistical purpose, i.e. that it should not include links consisting of separate transport businesses. In practice, this requires that links traditionally provided by third parties be structurally integrated as cost centres instead of profits centres in the chains. Such integrated maritime supply chains will inevitably only be developed by the intervention of chain leaders.

South Africa's major supply chains conveying commodities and manufactured products are examined in order to determine the scope for the integration of their links as a means of raising their efficiency as 'complete chains'. Features of selected maritime supply chains serving other countries that could serve as models for the structuring of South Africa's are identified.

Transnet's role in the existing maritime supply chains in accordance with the policy of the Government is examined and attention is focused on the under-investment in recent years that has led to the deterioration in the company's performance. The rejection by the Government of the privatisation of the core assets of the railways and ports in favour of public-private partnerships, as a means of overcoming the problems, is considered in order to conclude whether a solution will be forthcoming in that manner. Special consideration is given to Transnet's proposed spending of R40bn on infrastructure projects and attention is focused on the fact that this will not address all the problems.

The marine links in South Africa's maritime supply chains are currently provided by foreigners. Virtually all South Africa's bulk exports are sold free-on-board, which concedes control over the shipping of the cargo to foreign importers. Reasons for such arrangements are complex and chartering by South African exporters in order to maintain control is often not feasible, although it is done in the fruit trade and by Australian exporters of iron ore competing with South African exporters. Ship owning by South Africans will facilitate new legislation to increase the market share of citizens in the country's exports and imports, but price-wise market entry will be difficult and it is debatable whether exporters will make use of their services. In the liner trades, the trend is for shipping companies to integrate port and overland links into their services, and the efficiency of South Africa's container supply chains will need to be raised in that manner.

The criteria for determining maritime supply chain efficiency and the integration of the links of particular South African chains based on their cost structures, as well as the leadership needed to pursue such development, are motivated. Proposals are also made for the integration of the links of the iron ore and coal supply chains under the leadership of public-private partnerships, as well as for a container supply chain incorporating both a dedicated terminal in the Port of Ngqura and the railway between Coega and Gauteng, under the leadership of a liner shipping company or consortium of companies.

The conclusion is reached that the present role of Transnet in accordance with the declared policy of the Government is not conducive to improving maritime supply chain efficiency through the structural integration of the links. It is also concluded that the efficiency of the chains could be raised through private leadership with public participation, subject to a change in the Government's policy towards the role of Transnet in order to allow such leadership.

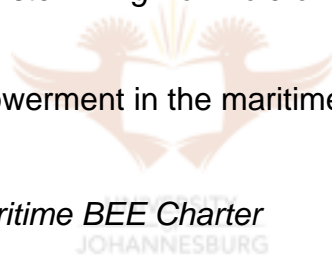
TABLE OF CONTENTS

	Page
Acknowledgements	ii
Opsomming	iii
Abstract	vi
List of Tables	xvii
List of Figures	xix
List of Abbreviations	xxi
Chapter One: Introduction	1
1.1 Background	1
<ul style="list-style-type: none">• <i>Need for international maritime supply chains</i>• <i>Profits of marine carriers</i>• <i>Railways and road transport</i>• <i>Bulk and containerised cargo</i>• <i>Government intervention</i>	
1.2 Issues in South African supply chain development	6
1.3 International challenges	7
1.4 Motivation for thesis and scope	9
1.5 Objectives of the study	10
1.6 Methodology	12
1.7 Outline of thesis	13

Chapter Two: Evolution of supply chain concepts	15	
2.1	Origins of the supply chain concept with definitions	15
	<ul style="list-style-type: none"> • <i>Brief historical background</i> • <i>Definitions of physical distribution</i> • <i>Logistics</i> • <i>Supply chains</i> • <i>Supply chain management</i> • <i>Integrated supply chains</i> • <i>Intermodal transport</i> • <i>Integrated intermodal supply chains</i> • <i>Value chain constellation</i> 	
2.2	Links, elements and participants in maritime supply chains	41
2.2.1	Basic supply chains	41
2.2.2	Container supply chains	42
	<ul style="list-style-type: none"> • <i>Extent of chain</i> • <i>Consignors (senders/suppliers) and consignees (recipients)</i> • <i>Container depots</i> • <i>Container terminals</i> • <i>Terminal operators</i> • <i>Cargo handlers</i> • <i>Road haulers</i> • <i>Rail transport operator</i> • <i>Seaports</i> • <i>Port service providers</i> • <i>Shipping lines – ocean transport</i> • <i>Suppliers of marine services</i> • <i>Supplier of goods for marine purposes</i> • <i>Documentation</i> 	
2.2.3	Bulk supply chains	55
2.3	Review	57



Chapter Three: Government stakeholding and intervention in the development of South African maritime supply chains	60
3.1 Introduction	60
3.2 Present role of Transnet	62
• <i>Brief history of Transnet Ltd</i>	
• <i>Problems experienced by Transnet and proposed solutions</i>	
• <i>Function in the future development of maritime supply chains</i>	
3.3 Prospects for privatisation of assets of Transnet	74
• <i>Importance of overseas trends and statements of policy</i>	
• <i>Motivation for privatisation of state assets</i>	
• <i>Government policy towards privatisation</i>	
• <i>Essence of problems stemming from role of Transnet</i>	
3.4 Black Economic Empowerment in the maritime industry	79
• <i>Background</i>	
• <i>Objectives of the Maritime BEE Charter</i>	
• <i>Scorecard</i>	
• <i>Scope for BEE in the liner industry</i>	
• <i>Influence of BEE on supply chains</i>	
3.5 National Freight Logistics Strategy	85
3.6 Overview	86



Chapter Four: South African maritime supply chains	88
4.1 Introduction	88
4.2 Bulk supply chains	89
4.2.1 Overview of bulk sector	90
• <i>Impact on the economy</i>	
• <i>Technical description</i>	
4.2.2 Sishen-Saldanha iron ore supply chain	95
• <i>Description of chain and the participants</i>	
• <i>System ownership and management</i>	
• <i>Future developments</i>	
4.2.3 Coal line	104
• <i>Brief description of chain and the participants</i>	
• <i>Ownership and management</i>	
• <i>Future developments</i>	
• <i>Challenges for bulk supply chain development</i>	
4.3 Manufacturing supply chains	110
• <i>Exports and imports of automotive industry</i>	
• <i>Motor vehicle terminals</i>	
• <i>Nissan imports and exports</i>	
• <i>BMW imports and exports</i>	
• <i>Development of supply chains for motor vehicle exports and imports</i>	
4.4 Container supply chains	119
4.4.1 Introduction	119
4.4.2 Overview of container logistics	120
• <i>Technical description</i>	
• <i>Container terminals at ports</i>	
• <i>Participants in container supply chains</i>	

•	<i>Achievement of integrated management</i>	
•	<i>Challenges</i>	
•	<i>Potential role of rail transport</i>	
4.5	Fresh fruit supply chain	130
4.5.1	Introduction	130
•	<i>Description of the chain and the participants</i>	
•	<i>Overall efficiency</i>	
4.6	Conclusion and review	135

Chapter Five: Trends in privatisation of ports and railways and maritime supply chains overseas **138**

5.1	Introduction	138
5.2	Trends in the privatisation of ports and railways	139
•	<i>Meaning of privatisation</i>	
•	<i>Extent of private participation in 100 ports</i>	
•	<i>Private participation in national railways</i>	
5.3	Examples of integrated management of rail and marine links in Europe	147
•	<i>Deregulation of rail transport</i>	
•	<i>European Rail Shuttle (ERS) – The Netherlands</i>	
5.4	Freightliner – United Kingdom	152
5.5	The Banana link	154
•	<i>Background</i>	
•	<i>Participants and description</i>	
•	<i>Efficiency and problems</i>	

5.6	Australian bulk mineral chains	158
	<ul style="list-style-type: none"> • <i>Background to bulk supply chain development</i> • <i>Pilbara Iron</i> • <i>Australian exports of mining products</i> • <i>Significance for South Africa</i> 	
5.7	Overview	162
Chapter Six: International shipping links		164
6.1	Introduction	164
6.2	Industry regulation, international conventions and IMO codes of practice	165
	<ul style="list-style-type: none"> • <i>Institutions that regulate international shipping</i> • <i>International conventions and protocols</i> • <i>IMO Codes and unilateral measures by the USA</i> • <i>Effect of USA Port and Maritime Security Bill on international maritime supply chains</i> • <i>International Ship and Port Facility Security Code (ISPS Code)</i> • <i>Implications for international conventions and security codes</i> 	
6.3	Bulk shipping	182
6.4	Liner shipping	186
	<ul style="list-style-type: none"> • <i>Conference shipping</i> • <i>Shipping lines – feeder and coastal services</i> • <i>Ship sizes</i> • <i>Landside container logistics</i> • <i>Liner services and port development</i> 	
6.5	Review	199

Chapter Seven: Structural improvement of South African maritime supply chains	202
7.1 Restructuring constraints	202
7.2 Supply chains considered	203
7.3 Integration of marine links	203
7.4 Management of maritime supply chains as entities	203
7.5 Supply chain efficiency	204
7.6 Lack of theories of supply chain or logistical management	208
7.7 Motivation for integrating cost structures	209
• <i>Integrated and autonomous links</i>	
• <i>Purpose of supply chain operation</i>	
7.8 Cost structures of links in bulk supply chains	211
• <i>Overland links</i>	
• <i>Marine links</i>	
• <i>Marine services in ports</i>	
7.9 Integration of mining operations in supply chains	217
7.10 Cost structures of links in container supply chains	218
• <i>Cost structures of links</i>	
7.11 Container supply chain integration	221
• <i>Lack of networks of container supply chains</i>	
• <i>Efficiency of container supply chains</i>	
• <i>Unit of cargo and revenue unit</i>	
• <i>Conclusion on integration of container supply chains</i>	

7.12 Supply chain leadership	223
7.13 Public-private participation in maritime supply chains	225
7.14 Private operation of container terminals	226
7.15 Independent container terminal operation	228
7.16 Feasibility of supply chain integration	229
• <i>Sishen – Saldanha iron ore supply chain</i>	
• <i>Mpumulanga – Richards Bay Coal line</i>	
• <i>Sale of Transnet’s assets in iron ore and coal supply chains</i>	
• <i>Container supply chains</i>	
• <i>Fruit chain</i>	
7.17 Models of supply chain restructuring	241
7.18 Land ownership	246
7.19 Benefits of maritime supply chain restructuring	246
7.19.1 Basis for benefits	246
7.19.2 Benefits – bulk supply chains	248
• <i>Investment linked to market demand</i>	
• <i>Black economic empowerment</i>	
• <i>Productivity</i>	
• <i>Model for development</i>	
• <i>Macro-economic benefits</i>	
• <i>Current State intervention</i>	
7.19.3 Container supply chains	251
• <i>Port of Ngqura – Gauteng container supply chain</i>	
• <i>Port of Durban – Gauteng container supply chain</i>	
• <i>Transport cost savings</i>	
• <i>Black economic empowerment</i>	



• <i>Reduction in inventory costs</i>	
• <i>Security</i>	
• <i>Potential impact on the GDP</i>	
7.19.4 Extent of agreement with National Freight Logistics Strategy	255
7.20 Conclusion	257
Chapter Eight: Conclusion	260
8.1 Conclusions	260
8.2 Recommendations	273
• <i>International competitiveness of South Africa’s maritime supply chains</i>	
• <i>Extent to which equity should be taken into account</i>	
• <i>Attributes of a public-private partnership for maritime supply chains</i>	
• <i>Container supply chain incorporating a terminal in the Port of Ngqura</i>	
• <i>Effect on the GDP</i>	
List of sources	276
Addendum A	
Addendum B	



LIST OF TABLES

Table 2.1: Supply chain schools of thought	28
Table 3.1: Examples of results of delays at link interfaces in ports	72
Table 4.1: Domestically produced and imported motor vehicles: 2000-2005	112
Table 4.2: TEUs handled in South African ports during 2005	121
Table 4.3: Major road hauliers of containers operating in South Africa	124
Table 4.4: Present and feasible capacities of existing container terminals and current throughput (TEUs)	126
Table 4.5: Rail capacity on route between Durban and Gauteng (713km)	127
Table 4.6: Rail capacity on route between Port Elizabeth and Gauteng (1101km)	128
Table 5.1: Control, ownership and operation of port assets and services in top 100 ports worldwide (Percentages of ports)	141
Table 5.2: Providers of value-added services in top 100 ports (Percentages of ports)	142
Table 5.3: Claimed advantages and disadvantages of private sector participation in ports (Percentages of ports)	143
Table 5.4: Aims of privatisation and preferred methods (percentages of 100 ports)	144
Table 5.5: Railway restructuring/privatisation models in seven countries	146
Table 5.6: Global exports and imports of organic bananas during 2003 ('000 tonnes)	155

Table 6.1: Top fifteen registers of ships by flag (at 1 January 2004)	166
Table 6.2: Main international conventions and protocols applicable to shipping links in maritime supply chains	170
Table 6.3: Bulk cargo handled in South African ports 2005	183
Table 6.4: Annual growth in real GDP	187
Table 6.5: Slot capacity operated by the top 15 liner carriers	188
Table 6.6: South African shipping services	189
Table 6.7: Composition of South African conferences, July 2005	193
Table 6.8: Container ship sizes on routes to and from South Africa	195
Table 6.9: Maximum permissible draughts in South African commercial ports	196
Table 7.1: Existing and alternative structures of South Africa's major supply chains for the export of minerals and ores	244
Table 7.2: Existing and an alternative structures of South Africa's major container supply chains	245



LIST OF FIGURES

Figure 2.1: Types of supply chain complexity	32
Figure 2.2: Value-driven chains	40
Figure 2.3: Schematic movement of cargo in a container supply chain	45
Figure 2.4: Four basic functions of a marine container terminal	47
Figure 2.5: Typical cost increases over distance for road and rail transport	50
Figure 2.6: Elements in the bulk transport system	57
Figure 3.1: Transnet's company structure	70
Figure 4.1: Major export commodities of South Africa (2000/02)	91
Figure 4.2: Tonnage of freight transported in South Africa	92
Figure 4.3: Physical features of a bulk supply chain	94
Figure 4.4: Physical features of the OREX supply chain	96
Figure 4.5: Map of iron ore supply chain	96
Figure 4.6: Map of railway lines in South Africa, showing the two bulk railways	106
Figure 4.7: Participants in Nissan import manufacturing supply chain	115
Figure 4.8: Fresh fruit commodities	131
Figure 4.9: General configuration of a fresh fruit export supply chain	132

Figure 5.1: Routes served by ERS	150
Figure 5.2: Containers moved by ERS from 1994 – 2004	151
Figure 5.3: Activities in banana supply chains	155
Figure 5.4: A typical bulk supply chain in Australia	160
Figure 6.1: Role of ISPS officers	177
Figure 6.2: Market share of container shipping lines	188
Figure 6.3: Import trading routes to South Africa	190
Figure 6.4: Export trading routes from South Africa	190
Figure 6.5: Mergers and strategic alliances on the trade Europe – Far East	192
Figure 6.6: Coastal and feeder services to and from South Africa	194
Figure B1: Link in supply chain	e
Figure B2: Adjacent link in supply chain	e

LIST OF ABBREVIATIONS

BEE	Black Economic Empowerment
BOT	Built-operate-transfer
c.i.f.	Cost-insurance-freight
CBU	Completely built-up unit
CD	Chart Datum
CKD	Completely knocked-down unit
CLM	Council of Logistics Management
CNR	Canadian National Railways
CPR	Canadian Pacific Railways
CSCMP	Council of Supply Chain Management Professionals
CSI	Container Security Initiative
CSIR	Council for Scientific and Industrial Research
CSO	Company Security Officer
C-TPAT	Customs Trade Partnership Against Terrorism
DCT	Durban Container Terminal
DOT	Department of Transport
DTI	Department of Trade and Industry
dwt	Dead weight tonnes
EDI	Electronic Data Interchange
ERS	European Rail Shuttle
ESAC	Europe – South Africa Conference
f.o.b.	Free-on-board
FA	Ferrocarriles Argentinos
FLC	Full-container-load
GDP	Gross Domestic Product
GPS	Global Positioning System

ILO	International Labour Organisation
IMO	International Maritime Organisation
ISCOR	Iron and Steel Corporation of South Africa
ISM	International Safety Management
ISO	International Standards Organisation
ISPS-Code	International Ship and Port Facility Security Code
IT	Information Technology
ITF	International Transport Federation
JNR	Japanese National Railways
LCL	Less-than-container-load
LEO	Length overall
LSC	Liner Shipping Company
MSC	Mediterranean Shipping Company
NPA	National Ports Authority
OSU	Ohio State University
P&I Clubs	Protection & Indemnity Clubs
PFSO	Port Facility Security Officer
PPECB	Perishable Product Export Council Board
PPP	Public-private partnership
PSO	Port Security Officer
RBCT	Richards Bay Container Terminal
RDP	Reconstruction and Development Programme
SAECS	South Africa – Europe Conference Service
SAPO	South African Port Operations
SAR&H	South African Railways and Harbour Administration
SATS	South African Transport Services



SLA	Service Level Agreement
SOLAS	Safety of life at sea
SSA	Ship Security Assessment
SSO	Ship Security Officer
SSP	Ship Security Plan
STCW	Standards of Training, Certification and Watchkeeping for seafarers
TEU	Twenty-foot equivalent unit
TOC	Transport Operating Company
UNCLOS	United Nations Convention on the Law of the Sea
UNCTAD	United Nations Conference on Trade and Development
UNF	University of Florida

