HIGH VOLUME TRANSPORT:

Rapid assessment of research gaps in port operations and technical aspects

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Background and introduction

Purpose

Evidence on Demand has been commissioned by Department for International Development (DFID) to conduct a rapid desk based study on research gaps in port engineering, operations and related technical aspects for ports of high volume operations in Low Income Countries (LICs). The objective of the study is to inform DFID's thinking and scoping of future work.

Port System – Harbours and Terminals

A port can range from a small quay for berthing a ship to a very large scale centre with many terminals and a cluster of industries and services. Ports need not necessarily be only seaports. In some countries, the term port denotes multimodal port facilities including seaports, airports and other intermodal facilities such as railway and road connections. In a similar vein, non-sea related activities can also fall under the wider definition of ports, for instance inland ports, intermodal terminals, inland container depots, inland clearance depots, dry ports, free ports, etc. Note that the last three facilities require either a bond or a sealed internal transit regime by Customs and other border control agencies. For the purpose of this study, we will cover both seaports and dry ports. Ports that deviate from commercial ship and cargo handling, e.g. fishing, military, and cruise ports are outside the scope of this Report.

Even within the boundaries of commercial ports, port assets, operations, services and functions, can be broad in scope and nature. Typically, ports are categorised by cargo (commodity) or ship type, for instance dry bulk ports, liquid bulk ports, break-bulk and general cargo ports, etc. Further categorisation divides ports into specialised terminals. Modern port engineering, layout and operating systems are increasingly designed and operated to serve a particular trade, ship or cargo type, e.g. oil terminals, chemical terminals, liquefied natural gas (LNG) and liquefied petroleum gas (LPG) terminals, coal terminals, iron-ore terminals, container terminals, car terminals, etc; although several ports around the world still operate multipurpose facilities. Where relevant, this Report will discuss both common and specific research gaps across and within ports and specialised terminals.

Ports systems can also be divided into three main generic sub-systems: the nautical infrastructure (access channels, breakwaters, jetties, etc.), the terminal infrastructure (quay walls, berths, yards, etc.), and port superstructure (port equipment, vehicles, sheds, warehouses, gates, etc.). Sometimes a port system can be extended to include inland and intermodal facilities and connections, for instance in the case of dry ports and inland container depots. Table 1 provides a generic categorisation of the main port and terminal facilities and services.

Port Infrastructure	Port superstructure	Marine services	Terminal services	Landside port logistics
Breakwaters Entrance channels Port and harbour lights Jetties Dolphins, buoys, mooring points Locks Docks / Piers, Quays Yards and Terminals reception facilities Intermodal connections Pipelines River/ waterway connections	Quay cranes Mobile cranes Yard cranes Pumps, loading arms Conveyors, wagons Shore ramps Trucks and vehicles Storage warehouses Tank farms Refrigeration IT and testing equipment Scanners, security & safety equipment	Conservancy & protection Access & navigation Dredging & maintenance Vessel traffic systems Pilotage and towage Salvage and rescue Ship repair and maintenance Bunkering Chandlers and supply Ancillary services	Berthing Stevedoring Ship loading/ discharging Quay transfer operations Cargo storage & stacking Equipment services Port policing, cargo security HAZMAT & Health control Environmental & waste	Bonding, documentation, customs clearance Processing, sub-assembly, cross-docking, consolidation, break bulk Labelling, palletising/packaging, itemization, unitization, bar coding Postponement, customisation, decoupling Information services, tracking and tracing, port community systems Quality control, testing, sampling, inspection, certification Reverse logistics, recycling & repair

Table 1 Categorisation of main port assets and services (Author)

Too often though, the role of ports exceeds the simple function of services to ships and their cargo. The cross-functional dimension of ports means that their roles can range from a simple berthing facility to a large distribution and logistics hub. Such diverse portfolio may require a redefinition of port's functional attributes in that the port system not only serves as an integral component of the transport system, but also is a major sub-system of the broader production and logistics system. The definition of port core businesses poses a dilemma as to where the demarcation line lies between port and non-port functions, with many ports in the world shifting to more profitable non-maritime business interests such as property developments and recreational activities. The degree to which the port business should be limited to or associated with ship/shore, goods transfer or cargo-flows management still remain key questions.

Port System – Dry ports and logistics centres

In international shipping and logistics, seaports can be treated as maritime logistics centres when they provide logistics services at the seashore and shore-land interfaces. Many ports in the world have an established body of knowledge and experience in providing value-added logistics activities for ship-cargo consignments, but not all ports can claim a logistics centre status. Typical logistics functions of ports include cargo handling and transfer operations, storage and warehousing, break bulk and consolidation, value added activities, information management, and other related services.

Ports may also be seen as inland logistics centres when they operate as nodal interfaces intersecting the different segments of the inland transport system, such as in terms of road/rail, road/road, rail/rail, and even rail/road and air combinations. In recent years, there has been some emphasis on the role of inland ports, where all logistical operations not necessarily requiring to be carried out in the seaport area can take place. Opportunities for developing port facilities that can provide logistics-like services at some distance away from traditional seaport locations arose from several experiences around the world.

The core function of an inland port is to serve as an inland terminal where goods are stored and consolidated/deconsolidated from small/large shipments into large/small ones. Such a terminal can be thought of as a node in a transport network and/or serve other storage or customs purposes. As a result, some new concepts such as distribution centres (DCs), inland terminals, and distriparks have emerged recently. Other generic terms include dry ports and inland clearance depots (ICDs), both bounded by customs presence and common-user service arrangements. Nevertheless, there is no clear-cut separation between all such facilities in terms of spatial dimension, functional or organisational status, but the following categorisation may help underlining some of the differences.

- *Intermodal terminal*: Main function is transferring goods from road /rail to-from another mode (rail, air or water) using interoperable operational and technical standards, for instance by transferring and storing (including related logistics services such as refrigeration) of ISO types of containers.

- *Inland clearance depot (ICD) /Dry port*: Customs and other border control agencies are present, for final clearance of imported goods and release to importers. Customs will require either a bond or a sealed 'internal transit' regime for the transfer of containers from the port inland.

- *Logistics zone/ platforms*: In addition to the above, components received at the terminal are assembled into final products (value added logistics), e.g. packaging, ticketing, customisation, cross-docking, etc.

- *Free trade zone /special economic zone*: Those are logistics zones operating under customs surveillance, so that both inputs and outputs are exempt from import duty

From a spatial and geographical perspective, the relationship between freight flows and port inland development is better understood through the concepts of gateways, articulation points, corridors, and distribution centres.

- *Gateways* are usually defined as locations that bring together different modes of transportation, along with warehousing, freight forwarding, customs broking and related logistics services. Many textbooks separate transport gateways as hubs for major regions, from freight gateways serving smaller regional areas and cities. Inland ports and local seaports may fall under the second category. An illustration of this may be found at the port of NY/NJ being an industrial and logistics hub (freight gateway), joined by the inland port of Albany (transportation gateway) designated to receive freight containers barged from the main hub port.

- A*rticulation points* are nodal locations that interface between different spatial systems and serves as a *gateway* between spheres of production and consumption. It is more than an interchange point since it includes the consideration of terminal facilities, distribution, warehousing, and trading centres. The difference between gateways and articulation points is that the latter are viewed from an urban perspective, whereas gateways do not necessarily need to be located at city-interfaces. In this context, seaports are usually considered as 'hard' terminals since they are 'immoveable', whereas inland terminals dispose of a great degree of locational flexibility.

- *Freight corridors*, opposed to passenger corridors, represent transport links of freight transportation supported by an accumulation of transport infrastructures and activities servicing these flows. Traditionally, flows in freight corridors tended to be fragmented and segmented since each mode tried to exploit its own advantages in terms of cost, service, reliability and safety. Maritime corridors traditionally correspond to geographical trade routes (regional or international), but recurrent changes in global production and logistics systems, such as in terms of hub-spoke and transhipment networks, currently reduce the capacity of freight corridors to accommodate different patterns of maritime transportation.

- *Freight distribution centres* serve as a location for cargo transfer and distribution to regional or extended markets, depending on corridor capacity (facilities) and articulation point links. Conventionally, many distribution centres were located close to central areas mainly as a factor of market proximity, but are currently relocating to peripheral areas. Functionally, a freight distribution is the combination of a freight corridor and an articulation point or a gateway

High Volume Port Operations and Low Income Countries

There is no international standard or definition which demarcates between 'high' and 'low' volume port operations, and it would be almost impossible to do this at the port level given the types and sizes and evolution of ships and cargoes handled. However, it is possible to relate high volume operations to certain thresholds of ships' sizes and cargo throughputs at the level of specialised ports and terminals. Table 2 outlines the main sizes of major ship types and highlights what is considered by the industry as 'high' volume.

	Dry bulk vessels	Oil tankers	Gas Carriers	Container vessels
Low size	Mini-bulkers (<10k dwt[1]) Handysize (10k -35k dwt)	Handy (10k -50k dwt)	<50,000 m^3	<2,000 TEU[2]
Medium size	Handymax (35k -50k dwt) Supramax (50k - 60k dwt) Panamax (55k - 85k dwt)	Panamax (50k - 70k dwt) Aframax (70k- 100k dwt) Suezmax (100k-200k dwt)	50k m^3-150k m^3	2,000 - 8000 TEU
Large size	Capesize (85k - 150k dwt) Largest ship: MS Vale 'Valemax' (>400k dwt)	VLCC (200k - 300k dwt) ULCC (>300k dwt)	> 150k m^3 Largest size Q-Max '(>250k m^3)	>8,000 TEU Largest ship: Maersk Triple E (18,000 TEU)

Table 2 Main sizes of cargo vessels

Unlike in many other transport systems, there is no obvious correlation between the volume of a port's throughput and the level of the country's income. Several factors explain this situation, including:

- Economies of scale and scope in ports favouring large-scale port projects

[1] dwt: dead weight tonnage (Amount of weight a ship can carry without riding dangerously low in the water)
[2] TEU: Twenty-Foot Equivalent Unit (20-foot long standard-size container)

- The deregulation of the port industry (since the 1980s/1990s) has opened the door to foreign and private sector interests to invest in and operate LIC's ports
- Many LIC's are large exporters / importers of low-value commodities
- The predominance of transhipment and hub and spoke services in liner shipping has led to the mushrooming of large transhipment hubs in developing countries
- The consolidation of port operations among few international terminal operators
- Capacity constraints on existing ports and preference for Greenfield port projects

Indeed, many LICs (e.g. Djibouti, Bangladesh) have port facilities, particularly container terminals, which match international standards in terminal operations and technology. Going further, the share of developing countries in port operations (and shipping and international trade) has grown dramatically over the past two decades. As shown in Table 3, the list of top container ports in the world is dominated by ports from developing countries particularly those of China and South East Asia.

Rank	Port	Throughput in TEU					
		2012	2011	2010	2009	2008	2007
1	Shanghai	32,530,000	31,700,000	29,069,000	25,002,000	27,980,000	26,150,000
2	Singapore	31,650,000	29,937,700	28,430,080	25,866,400	29,918,200	27,935,500
3	Hong Kong	23,120,000	24,404,000	23,532,000	20,983,000	24,494,229	23,998,449
4	Shenzhen	22,940,000	22 569 800	22,509,700	18,250,100	21,413,888	21,099,169
5	Busan	17,040,000	16,184,706	14.,157,291	11,954,861	13,452,786	13,261,000
6	Ningbo-Zhoushan	16,830,000	14,686,200	13,144,000	10,502,800	11,226,000	9,360,000
7	Guangzhou	14,740,000	14,400,000	12,550,000	11,190,000	11,001,300	9,200,000
8	Qingdao	14,500,000	13,020,000	12,012,000	10,260,000	10,320,000	9,462,000
9	Jebel Ali /Dubai	13,300,000	13,000,000	11,600,000	11,124,080	11,827,299	10,653,026
10	Tianjin	12,300,000	11,500,000	10,080,000	8,700,000	8,500,000	7,103,000
11	Rotterdam	11,870,000	11,900,000	11,145,804	9,743,290	10,800,000	10,790,604
12	Port Klang	10,000,000	9,377,434	8,870,000	7,309,770	7,973,579	7,118,714
13	Kaohsiung	9,780,000	9,636,289	9,181,211	8,581,270	9,676,554	10,256,829
14	Hamburg	8,860,000	9,021,800	7,900,000	7,010,000	9,737,000	9,900,000
15	Antwerp	8,640,000	8,664,243	8,468,475	7,309,630	8,663,736	8,175,951
16	Los Angeles	8,080,000	7,940,511	7,831,902	6,748,990	7,849,985	8,355,039
17	Dalian	8,060,000	6,400,000	5,242,000	4,552,000	N/A	N/A
18	Tanjung - Pelepas	7,700,000	7,500,000	6,530,000	6,000,000	5,600,000	5,500,000
19	Xiamen	7,200,000	6,460,700	5,820,000	4,680,355	5,034,600	4,627,000
20	Bremen-Bremerhaven	6,134,000	5,920,000	4,876,000	4,667,597	4,487,816	4,312,465

Table 3 Top Container Ports (Alphaliner, 2013)

At the same time, many LICs' ports operate well below international benchmarks both in terms of operational and technical standards. Indeed, in many LCIs a two-tier port system exists: ports which are built, operated and managed by international operators thus benefiting from the latest technological changes and operational standards, and ports being still operated by local operators or governmental agencies thus lagging behind their international counterparts. A common shortcoming across LICs is the lack of capacity and inefficiency of the port's landside system, e.g. intermodal transport, hinterland and infrastructure connections, city-port interface, and this is increasingly interfering with other transport and planning problems most notably urban transport and town planning. In this report, and given the ever increasing consolidation and globalisation of the port industry, we will cover research gaps that address both the port industry globally as well as in LICs countries.

SECTION 2

Approach and Methodology

In this study, the following triangulation approach was used to identify the main research gaps in port operations and related technical aspects:

- Review existing relevant port academic and practical research
- Based on the above, develop a themed approach to categorise research needs
- Identify research gaps by theme and port/asset type
- Review and analysis of contemporary trends and future challenges in the port industry
- Match research gaps to industry needs
- Select and highlight gaps and needs relevant to LIC ports.

Literature Review

The approach used to highlight industry trends, scan existing research and identify possible gaps consisted of the following:

1. Brief review of industry, professional and trade journals and publications in the field
2. Quick scan of the academic literature on the subject of port operations,
3. Review of professional publications including industry and policy reports, and
4. Expert review from the author’s own experience and from colleagues at the Global Port Research Alliance between Imperial College, MISCI, MIT, NUS, the University of Hamburg, the University of Sydney, and the Hong Kong Polytechnic University.

The main sources of data and information used are listed in Table 4. In addition, relevant publications and data from international organisations such as UNCTAD, the OECD, the EU TEN-T, the World Bank, etc. as well as from the proceedings of major academic and professional conferences in the field, e.g. the International Association of Maritime Economists annual conference, TOC annual conferences; have also been reviewed.

Trade Journals	Academic Journals	Conference Proceedings
Marine Coastal News	Ocean Engineering	Int. Ass. of Ports and Harbours
Dredging International	Transportation Planning &Technology	Int. Ass. of American Port Authorities
Port Technology	Ports and Harbours	International Cargo Handling Coordination Ass.
Cargo world	Maritime Engineering & Technology	Port Equipment Manufacturers Ass.
Cargo systems	Maritime Studies	International Maritime Organisation
Fairplay	Marine Engineering Review	European Sea Ports Organisation
Lloyd’s List	Marine Science and Engineering	Int. Harbours Masters Ass.
Port strategy	Int. J of Shipping &Transport Logistics	World Ass. for Waterborne Transport Infrastructure / PIANC
Containerisation International	Maritime Economics & Logistics	Int. Ass. of Ports and Cities
Port Finance International	Maritime Policy & Management	Int. Ass. of Dredging Companies
American Shipper	J. of Transportation Engineering	Int. Chamber of Shipping
Journal of Commerce	Transport Reviews	
Hazardous Cargo Bulletin	Int. J of Production Economics	
Maritime Journal		
Maritime News		

Trade Journals	Academic Journals	Conference Proceedings
Green Port International Freight Weekly Bulk Materials International Cargo Security International Review of Maritime Transport	J. of Transportation Security Transportation Transportation Science Transportation Journal Journal of Transport Geography Transportation Research Parts A & E Naval Research Logistics	Int. Shipping Federation TOC Port Finance International Int. Ass. of Maritime Economists Port Finance and Investment Port Development Summit Port and Terminal Technology

Table 4 Main sources surveyed in this study

Research by Themes

An electronic search of articles with relevant topics for the period 2005-2013 has been conducted, leading to a shortlist of 1582 articles. Further refinement has narrowed down the list of relevant articles to 645. In reviewing this shortlist, the articles and papers have been classified by major and minor theme using an iterative approach. First, articles on the same topic and defined research themes were grouped, as relevant to the scope of this study. For instance, ‘port planning’, ‘terminal operations’, and ‘port technology’, were included, whilst articles on areas such as ‘port policy’ and ‘port governance’ were excluded. The research themes were then clustered in industry-broad categories, for instance ‘transport safety’, ‘transport planning’, ‘Intelligent Transport Systems (ITS)’; such classification is widely used across transport modes and infrastructure sectors.

The above review was based on reviews of the abstract and/or the scanning of paper keyword s and themes of research using such free tools such as Keyword Density Analyser and Google Keyword Tool. The exercise also led to the identification of major themes and sub-themes. Once the sub-themes were defined, the classification and orientation of port research was scrutinised. Table 5 summarises the main outcome of this review exercise. The list of academic references are included in Annex 1 of this Report.

Theme	Sub-theme	Citation
Port planning	Coastal structures	24
	Dredging and channels	26
	Building materials	12
	Terminal design and layout	33
	Equipment manufacturing	40
	Port capacity and resilience	12
	Traffic forecasting	35
Port Operations	Navigation and ship movements	34
	Handling systems	40
	Storage systems	25
	Port performance	55
	Terminal optimisation	35
	Port automation	15
Port Safety	Reliability and risk	16
	Handling of hazardous cargo	11
	Accidents research	08
	Human health and safety	11
	Port security	19
Environmental Management	Environmental impact	21
	Environmental regulation	13
	Marine and industrial pollution	21
	Energy efficiency	07
	Climate change and sustainability	06

Theme	Sub-theme	Citation
Port ICT	Navigation systems	33
	Port community systems	35
	Terminal Operating systems	41
	ITS in ports	17
TOTAL		645

Table 5 Main themes and sub-themes of surveyed port research

The results from table 5 shows the predominance of port planning and port operations themes at the detriment of port safety, port ICT and port environmental themes. Per sub-theme, the less port researched topics are climate change and sustainability, energy efficiency, accidents, human health and safety and the handling of hazardous cargoes, port capacity and resilience, building materials, environmental regulation, port automation, risk and reliability, and ITS applications.

SECTION 3

Research Gaps by Theme

Overview of the Main Trends and Challenges in the Port Industry

In this section, we highlight what is widely considered as the main trends and future challenges faced by the port industry worldwide, with focus on LICs and high volume port operations. In our view, there are 20 main challenges faced by the industry today:

1. Impacts of ship's size and specialisation
2. Impacts of containerisation and standardisation of cargo packaging
3. Impacts of automation and technological change
4. Increased competition due to deregulation and globalisation
5. Changes in port ownership, organisational and institutional structures
6. Consolidation strategies in shipping and ports
7. Shifts in global logistics and supply chain patterns
8. Developments in international waterways and maritime routes
9. Increasing share of South-South trade and regional integration
10. Changing dynamics of port demand and supply balances
11. Rising energy and bunker fuel prices and related operating costs
12. Customer's focus on performance differentials and competitive benchmarks
13. Focus on port landside logistics, intermodal and hinterland connections
14. Port city-interface and development
15. Greater emphasis on maritime piracy, port and supply chain security
16. Increasing concerns and interests in occupational health and safety in ports
17. Impacts of global climate changes and environmental policy agenda
18. Skills Gaps and the lack of specialized and highly qualified workforce
19. Increasing private sector participation through PPP and concession arrangements
20. Recession-led adjustments in port finance, risk and investment

From the above, five key areas are particularly relevant to high volume ports and LICs. Areas which are outside the scope of this study such as dry ports and intermodal connections, institutional reform and port policy, port pricing and regulation, and port finance and investments are not covered herein.

1. *Impact of growing ship's size*: Bigger ships require capital intensive investment, larger and deeper port facilities, and high-technology port equipment and operation processes. The past few years have seen significant changes in ship's sizes (see table 2 above), while many LICs ports are still small or unsuited to modern and large ships. At the same time the economies of size and scale in the international shipping industry has led to the formation of global shipping alliances and consortia, most recently the P3 alliance between the largest three container shipping companies. Consolidation strategies in the shipping and transport industry often lead to changes in transport networks, service routes, and choice of ports of calls. LIC ports have to adapt their planning, design and operations strategies accordingly. An example of the impact of ship's size on port equipment is provided in Table 6 below.

Generation	Ship name	Capacity (TEU)	DWT (Tons)	Dimensions (metres) length x beam x draft	Arrangement (rows) under-below-across
Panamax- Max	Zim Savanah	5,000	67,000	295 x 32.3 x 13.5	8-6-13
Post Panamax I	Rio Negro	5,900	74,000	286 x 40 x 13.5	9-5-16
Psot Panamax II	Sovereign Measrk	8,500	105,000	347 x 42.8 x 14.5	9-6-18
Psot Panamax II	New Panamax	12,500	120,000	366 x 49 x 15.2	10-6-19/20
Post Panamax II	MSC Daniela	14,000	165,000	366 x 51.2 x 15	10-6-20
Post Panamax III	Emma Mearsk	14,500	157,000	396 x 56.4 x 15.5	10-6-22
Malacca-max	Maesrk Triple E	18,000	240,000	396 x 68 x 21	13-8-23

Table 6 Relationship between ship size and port engineering and equipment requirements

2. *Impact of containerisation, automation and technological change:*
Traditionally, LICs have a low than average propensity (or intensity) rate of containerisation (share of containerisation in break bulk and general cargo traffic). As container transport becomes more affordable, both technically and economically, many LICs are witnessing a rise in their rate of containerisation propensity, but this also poses numerous challenges in terms of specialised port facilities, engineering systems, cargo handling equipment, and related IT and operating processes.

Modern terminal operations and processes are now largely automated with a high level of capital and technology resources. On the other hand, no LIC port currently has a fully automated terminal facility and LIC ports have inherited or are still working with conventional manual systems. LICs must therefore adapt their terminal infrastructure, operations, equipment and IT systems accordingly and there is a huge need to train and educate highly qualified and technically specialised port workforce.

Some may argue that port automation may be harmful to LICs in terms of job losses or loss of competitiveness. However, as proven in the 1950s through to the 1980s in developed countries, automation actually creates more jobs and improves economic competitiveness and operational efficiency. Thanks to automation, new jobs would be required for designing, operating, and maintaining port automated equipment and ICT systems. At the same time, LICs have little choice but to embrace port automation as such a trend is being implemented globally as standard models for operations by international terminal operators. LICs would therefore need to invest in the appropriate skills required for port automation, and this would not only improve the quality and earning potential of a port's workforce but also improve a port's efficiency and reduce trade and logistics costs.

3. *Developments in ship size, maritime routes and port efficiency:*
The impact of the new Panama-canal, prospects of a Nicaragua canal, the potential widening of the Suez Canal, and the new possibilities from the North-Sea passage will all have an impact on maritime routes and services, hence offering opportunities but also posing constraints to many LIC ports which have to upgrade engineering capacity and improve operational efficiency to retain existing or gain new market shares. Such developments are coupled with the increase in ship's size and technology and the development of large transhipment and hub-and-spoke systems. The introduction of very large vessels has contributed to a widening gap between few large efficient ports, which benefit from the economies of scale, leaving many LIC ports increasingly relying on feeder services.

At the same time, shipping lines, shippers, freight forwarders and other port customers are now benchmarking ports' efficiency and require from ports higher levels of performance standards. Poor port efficiency is usually embedded in higher ship turnaround time, cargo dwell time, and queuing and congestion time; and translates into additional shipping and port surcharges as well as higher transport and trade costs. LIC ports will have to achieve major leaps in port performance and efficiency and significantly reduce congestion and ship's turn-around times. Many LIC ports particularly those in Sub-Saharan Africa and South Asia are experiencing severe congestions and long delays and unless extra capacity is provided, either through productivity improvement or through new expansion.

4. *Greater emphasis on port safety and security:*
Over the past decade or so, there has been a greater emphasis on port security and most ports around the world should now have security plans, systems and procedures in line with international and local security regulations, most notably the ISPS Code (IMO International Ship and Port Facility Security Code). However, many trading nations and global industry operators require security systems and procedures that go beyond the ISPS Code standards, for instance in terms of secure terminal design and layout, security equipment and machinery, cargo integrity, electronic seals and scanning technology.

In port health and occupational safety, there is no internationally enforceable port safety standard despite growing evidence of risks and incidents from ship's safety in ports, the quality of port pavement and pathways, the handling and storage of hazardous materials (HAZMAT), port traffic hazards, the operations and maintenance of port equipment and machinery, electrical and chemical installations, and excess weight of containers and other cargo packaging units.

In LIC ports, both safety and security incidents are too high and often go unreported. At the same time, many LIC ports are becoming major load and storage centres of bulk commodities such as oil, grain, minerals, and others. Enhancing port safety and security requires adherence to higher levels of infrastructure build, terminal design, equipment and operational standards, IT, human and management processes.

5. *Relationship to landside logistics, hinterland connections, and city-interface:*
Along with the trend of optimisation and standardisation of quay-side operations, physical and capacity constraints at berths and the interplays between freight distribution requirements and urban and city plan, all suggest that more focus must be placed on port inland interface and intermodal connectivity. On the one hand, the increase in trade volumes and the emergence of new distribution patterns, means that the demand on port seashore infrastructure (and the immediate land behind it) is nearing capacity, hence the need to expand land-wise to and connect to hinterland and intermodal systems. On the other hand, reported inefficiencies in ports indicate that landside operations are far behind their optimal efficiency lagging both in intermodal infrastructure, connectivity and interoperability.

In ports, interoperability must be achieved at both operational and technology levels. Operational interoperability refers to the ability of port systems to handle various types and sizes of ships and their cargoes, including for conforming to operating requirements and safety standards. The capability to integrate various intermodal systems (e.g. railroads) is also a key to achieving a high degree of operational interoperability in ports. Communication and IT interoperability between port and intermodal systems can be achieved through the exchange of documentation, data and information in interoperable semantics, communication protocols, and file formats. In LICs, the lack of interoperability between ports and intermodal connections is a major impediment against developing successful port operations.

For LICs, the structure of the economy and the low levels of urbanisation would normally mean that strategies of inland integration, if properly planned and operated, will have less disruptive impacts on land use and urban congestion, waterfront management, and environmental sustainability. The reality though is that in most LICs, ports are embedded in capital or commercial cities resulting into port and city congestions. Port access to and from land transport corridors are poor due to insufficient or inadequate intermodal and hinterland infrastructure and connections. The port-city interface in many LICs is marked by various negative impacts, including on air quality, water, waste, noise, odours and urban and freight traffic. Furthermore, landlocked LICs rely heavily on landside port logistics, including dry ports and transit connections, for unlocking trade and transport bottlenecks and boosting their competitiveness in the international market.

6. *Climate change impacts and policy agenda for environmental sustainability:*
Climate change is one of the greatest challenges facing our societies, economic structures and environmental systems. Climate change risks for ports include accelerated coastal erosion, port and coastal inundation or restrictions on access to docks, increased run-offs and situations requiring further dredging, and deterioration of conditions and problems with the structural integrity of pavements. Many LIC ports, particularly those in small-island developing States (SIDS), are located in sensitive coastal zones, low-lying areas and deltas, an must design and implement appropriate adaptation and mitigation strategies to global climate change risks and impacts.

Typically, climate adaptation in ports can be generically divided into two categories:

- Building capacity for future change through awareness raising, skill development, data collecting, monitoring and research, and
- Implementing adaptation initiatives such as technological, engineering change, planning, design, legal/regulatory, insurance/financial measures and management system change.

Once a port has identified vulnerabilities and risks within both current and future contexts, analysed and evaluated them, it is then possible to propose and assess adaptation options to reduce and/or mitigate environmental and climate change risks. Examples of adaptation actions could include one or a combination of the following:

- Design & Engineering: robust breakwater, quay wall, equipment, etc. port systems
- Planning: Port plans should be flexible and adaptable to different scenarios of environmental and climate change risks.
- Technology: Use of technological advances to predict / mitigate environmental risks, e.g. automation, low emission equipment & operations, ITS & Optical Character Recognition (OCR) systems, etc.
- Management & Insurance: Adapt Occupational Health & Safety (OHS), emergency, risk management and response systems, enrol in and purchase appropriate insurance schemes.

There are however several barriers to climate adaptation in ports, including inconsistency between organisational planning time frames (5 – 15 years) compared with climate projections of 30 – 90 years; and the uncertainty of local climate projections leading to decision-makers delaying action until there is perceived to be more certainty.

SECTION 4

Matching Research Gaps to LICs Port Needs

From the combination of the LICs' needs and challenges above and the research gaps listed in Section 2, we have identified several gap areas in port research grouped into 5 themes and 15 sub-themes as flows:

1. **Port Planning**
   1.1 Port Capacity and resilience
   1.2 Building materials, port protection and maintenance
   1.3 Next generation terminal design and layout

2. **Port Operations**
   2.1 Port efficiency and benchmarking
   2.2 Port and equipment optimisation
   2.3 Intermodal operability
   2.4 Port training and capacity building

3. **Port Technology**
   3.1 Port automation
   3.2 ITS applications in ports
   3.3 Technological interoperability

4. **Port Safety and Security**
   4.1 Port occupational health and safety
   4.2 Port accidents and reporting
   4.3 Port security and supply chain risk
   4.4 Risk modelling and analysis in ports

5. **Port environmental sustainability**
   4.5 Climate change impact and adaptation strategies
   4.6 Environmental regulation and impact of emission control areas (ECA)
   4.7 Energy efficiency and use in ports

Table 7 below outlines how the identified research gaps translate into LICs needs in port engineering and operations.

Theme	Sub-theme	Relevant areas to LIC ports
Port Planning	Port Capacity and resilience	Maritime spatial planning, port rehabilitation (after periods of wars, neglect, etc.), hydrographical surveys, access channels & navigational aids, deep construction dredging, small ports for SIDS, railway and road infrastructure, capacity reliability, resilience to large scale events (terrorist attacks, earthquakes, tsunamis, etc.), design for redundancy.
	Building materials, protection & maintenance	New types / structures of quay walls and jetties, pavement, maintenance dredging, sustainable materials, Environmental impact analysis (EIA), integrated coastal zone management (ICZM).
	Next generation terminal design and layout	Offshore and onshore terminal layout, specialised terminal layout, automated terminals, inland terminal design (incl. dry ports, rail yards, etc.), storage and tank farms, handling and equipment redesign
Port Operations	Port efficiency and benchmarking	Equipment engineering standards, crane efficiency, ship scheduling, queuing systems, operational processing, terminal productivity.
	Port equipment and optimisation	Specialised equipment (e.g. refrigeration), equipment design and maintenance, optimising crane scheduling and operations, path finding, container location, port modelling and simulation, decision support systems in ports.
	Intermodal operability	Port-ship interoperability, port-rail and port-road interoperability, operating requirements and working standards, integrated intermodal systems, seaport and dry port interoperability, interoperable transit systems.
	Port training and capacity building	Port engineers and designers, port planners, quay crane drivers, port automation and optimisation personnel, training for technology applications in ports, port engineering and operations training modules, safety and security training.
Port Technology	Port automation	Automated terminals, automated guided vehicles (AGV) and automated staking cranes (ASC), automated mooring systems, automated gate and intermodal operations, automation control.
	Port ITS applications	Wireless port data and communications, vehicle (equipment) electronics, automatic steering and sensing, Fleet management systems, collision avoidance systems, tracking, tracing and real time location, automated identification systems, telemetry image processing, electronic data transmission and port community systems, GPS and applications in ports, data integration and ERP applications in ports, electronic payments and e-commerce, terminal operating systems (TOS), scanning and security technology.
	Technological interoperability	Enterprise interoperability standardised and harmonized port community systems, interoperable semantics and communication protocols, interoperable software, interoperable intermodal technology (ship-terminal-railroad), VTS and SAR interoperability, e-payment and e-government interoperability.
Port Safety and Security	Port occupational health and safety	Terminal safety, equipment safety, navigation and traffic safety, equipment safety, OHS during port construction and repairs, Port labour OHS, safe operations during extreme conditions,
	Port accidents and reporting	Traffic separation schemes, GIS, GMDSS and DSS systems and connectivity, SAR (search and rescue) facilities & equipment, accident reporting systems, emergency and contingency plans.

Theme	Sub-theme	Relevant areas to LIC ports
	Port security and supply chain risk	Safety and security engineering, infrastructure security, ship security, port and terminal security, equipment security, network security, supply chain security, design of security systems, security standards and processes,
	Risk modelling and analysis in ports	Safety and security threats to port, port vulnerability, models for safety and security assessment, engineering risk analysis, models for port shutdowns and mass evacuation, safety risk management, risk modelling for port security
Port Environmental Sustainability	Climate change impact and adaptation strategies	Models for sustainable infrastructure design and operations, warning systems and applications, climate resilient seaports, adaptation engineering tools and technologies for ports.
	Environmental regulation and impact of ECAs	Emission control and inventory, handling of hazardous cargoes, LNG bunkering, cleaner fuels, environmental protection, equipment and systems to prevent and mitigate marine pollution, port engineering and industrial pollution, port reception facilities.
	Energy efficiency and use in ports	Electrical mooring / unmooring, electrical equipment, technical and operating models, models for reducing energy use, hybrid and electrically powered equipment, equipment retrofitting and rebuilding, reuse of waste waters and dredged materials,

Table 7 Main research gaps and implications for LIC ports

ANNEX 1

Academic References

Arduino, G., Aronietis, R., Crozet, Y., Frouws, K., Ferrari, C., Guihéry, L., Kapros, S., Kourounioti, I., Laroche, F., Lambrou, M., Lloyd, M., Polydoropoulou, A., Roumboutsos, A., Van de Voorde, E., and Vanelslander, T. (2013). How to turn an innovative concept into a success? An application to seaport-related innovation, Research in Transport Economics, 42, pp. 97-107.

Asgari, N. Farahani, R.Z. and Goh, M. (2013). Network design approach for hub ports-shipping companies competition and cooperation, Transportation Research Part A, 48, pp. 1-18.

Bae, M.J., Chew, E.P., Lee, L.H. and Zhang, A. (2013). Container transshipment and port competition, Maritime Policy & Management, 40(5), PP. 479-494.

Bichou, K. (2013). An empirical study of the impacts of operating and market conditions on container-port efficiency and benchmarking, Research in Transport Economics, 42, pp. 28-37.

Cahoon, S., Pateman, H. and Chen, S-L (2013). Regional port authorities: leading players in innovation networks?, Journal of Transport Geography, 27, pp. 66-75.

Cepolina, S. and Ghiara, H. (2013). New trends in port strategies. Emerging role for ICT infrastructures, Research in Transportation Business and Management, 8, pp. 195-205.

Chang, Y-T. (2013). Environmental efficiency of ports: a Data Envelopment Analysis approach, Maritime Policy & Management, 40(5), pp. 467-478.

Daamen, T.A. and Vries, I. (2013). Governing the European port–city interface: institutional impacts on spatial projects between city and port, Journal of Transport Geography, 27, pp. 4-13.

Deng, P. Lua, S. and Xiao, H. (2013). Evaluation of the relevance measure between ports and regional economy using structural equation modelling, Transport Policy, 27, pp. 47-52.

Dooms, M., Haezendonck, E. and Valaert, T. (2013). Dynamic green portfolio analysis for inland ports: An empirical analysis on Western Europe, Research in Transportation Business and Management, 8, pp. 171-185.

Fabling, R., Grimes, A. and Sanderson, L. (2013). Any port in a storm: Impacts of new port infrastructure on exporter behaviour, Transportation Research Part E, 49, pp. 33-47.

Hesse, M. (2013). Cities and flows: re-asserting a relationship as fundamental as it is delicate, Journal of Transport Geography, 29, pp. 33-42.

Homsombat, W., Yip, T.L., Yang, H. and Fu, X. (2013). Regional cooperation and management of port pollution, Maritime Policy & Management, 40(5), pp. 451-466.

Hsu, K. W-K. (2013). Improving the service operations of container terminals, International Journal of Logistics Management, 24(1), pp. 101-116.

Imai, A., Nishimura, E. and Papadimitriou, S. (2013). Marine container terminal configurations for efficient handling of mega-containerships, Transportation Research Part E, 49, pp. 141-158.

Ishii, M., Lee, P. T.-W., Tezuka, K. and Chang, Y.-T. (2013). A game theoretical analysis of port competition, Transportation Research Part E, 49, pp. 92-106.

Knatz, G. (2013). Looking Beyond Cargo and Cruise Ships: Promoting Academic Marine Research and Clean Technologies as an Economic Development Strategy for Ports, Coastal Management, 41(4), pp. 314-326.

Lambrou, M.A., Rødseth, O.J., Foster, H. and Fjørtoft, K. (2013). Service-oriented computing and model-driven development as enablers of port information systems: an

integrated view, World Maritime University Journal of Maritime Affairs, 12(1), pp. 41-61.
Lättilä, L., Henttu, V. and Hilmola, O-P. (2013). Hinterland operations of sea ports do matter: Dry port usage effects on transportation costs and CO2 emissions, Transportation Research Part E, 55, pp. 23-42.
Lee Lam, J. S. and Gu, Y. (2013). Port hinterland intermodal container flow optimisation with green concerns: a literature review and research agenda, International Journal of Shipping and Transport Logistics, 5(3), pp.257-281.
Lee Lam, J.S., Ng, A.K.Y. and Fu, X. (2013). Stakeholder management for establishing sustainable regional port governance, Research in Transportation Business and Management, 8, pp. 30-38.
Lirn, T-c, Jim Wu, Y-C and Chen, Y.J. (2013). Green performance criteria for sustainable ports in Asia, International Journal of Physical Distribution & Logistics Management, 43(5), pp.427 - 451.
Luo, M. and Yip, T.L. (2013). Ports and the environment, Maritime Policy & Management, 40(5), pp. 401-403.
Mclaughlin, H. and Fearon, C. (2013). Understanding the development of port and regional relationships: a new cooperation/competition matrix, Maritime Policy & Management, 40(3), pp. 278-294.
Monios, J. and Wilmsmeier, G. (2013). The role of intermodal transport in port regionalisation, Transport Policy, 30, pp. 161-172.
Ng, A.K.Y. (2013). The Evolution and Research Trends of Port Geography, The Professional Geographer, 65(1), pp. 65-86.
Ng, A.K.Y., Chen, S-L, Cahoon, S., Brooks, B. and Yang, Z. (2013). Climate change and the adaptation strategies of ports: The Australian experiences, Research in Transportation Business and Management, 8, pp. 186-194.
Notteboom, T.E., Pallis, A.A., De Langen, P.E. and Papachristou, A.A. (2013) Advances in port studies: the contribution of 40 years Maritime Policy & Management, Maritime Policy & Management, 40(7), pp. 636-653.
Onwuegbuchunam, D.E. (2013). Port selection criteria by shippers in Nigeria: a discrete choice analysis, International Journal of Shipping and Transport Logistics, 5(4/5), pp.532-550.
Parola, F. and Maugeri, S. (2013). Origin and taxonomy of conflicts in seaports: Towards a research agenda, Research in Transportation Business and Management, 8, pp. 114-122.
Parola, F., Notteboom, T., Satta, G. and Rodrigue, J-P. (2013). Analysis of factors underlying foreign entry strategies of terminal operators in container ports, Journal of Transport Geography, 33, pp. 72–84.
Shen, C-W, Lee, H-C and Chou, C-C (2013). Measuring dynamic competitiveness among container ports: an autoregressive distributed lag approach, International Journal of Shipping and Transport Logistics, 5(6), pp. 637-651.
van Asperen, E. and Dekker, R. (2013). Centrality, flexibility and floating stocks: A quantitative evaluation of port-of-entry choices, Maritime Economics & Logistics, 15(1), pp.72-100.
Vojdani, N., Lootz, F. and Rösner, R. (2013). Optimizing empty container logistics based on a collaborative network approach, Maritime Economics & Logistics, 15(4), pp. 467-493.
Wan, Y. and Zhang A. (2013). Urban road congestion and seaport competition, Journal of Transport, Economics & Policy, 47(1), pp. 55-70.
Wilmsmeier, G., Tovar, B. and Sanchez, R.J. (2013). The evolution of container terminal productivity and efficiency under changing economic environments, Research in Transportation Business and Management, 8, pp. 50-66.
Woo, S-H, Pettit, S.J. and Beresford, A.K.C (2013). An assessment of the integration of seaports into supply chains using a structural equation model, Supply Chain Management, 18(3), pp. 235-252.

Yang, Y-C. and Lin, C-L. (2013). Performance analysis of cargo-handling equipment from a green container terminal perspective, Transportation Research Part D, 23, pp. 9-11.
Yang, Y.-C. and Shen, K.-Y. (2013). Comparison of the operating performance of automated and traditional container terminals, International Journal of Logistics Research and Applications, 16(2), pp. 158-173.
Yeo, G-T, Pak, J-Y and Yang, Z. (2013). Analysis of dynamic effects on seaports adopting port security policy, Transportation Research Part A, 49, pp. 285-301.
Yang, Z., Ng, A.K.Y and Wang, J. (2013). Prioritising security vulnerabilities in ports, International Journal of Shipping and Transport Logistics, 5(6), pp. 622-636.
Anastasaki, E.N. and Moutzouris, C.I. (2012). A new strategy for yacht ports in Greece under present austerity programmes, International Journal Ocean Systems Management, 1(3-4), pp. 420-435.
Barros, C. P., Felício, J. Augusto and Fernandes, R. L. (2012). Productivity analysis of Brazilian seaports, Maritime Policy & Management, 39(5), pp. 503-523.
Barros, C.P. and Peypoch, N. (2012). Productivity assessment of African seaports with biased technological change, Transportation Planning and Technology, 35(6), pp. 663-675.
Beresford, A., Pettit, S., Xu, Q. and Williams, S. (2012). A study of dry port development in China,Maritime Economics & Logistics, 14(1), pp. 1-13.
Bergqvist, R., and Egels-Zandén, N. (2013). Green port dues — The case of hinterland transport,Research in Transportation Business & Management, pp. 85-91.
Bichou, K. (2012). Linking theory with practice in port performance and benchmarking, International Journal Ocean Systems Management, 1(3-4), pp. 316-338.
Brida, J.G., Pulina, M., Riaño, E. and Zapata-Aguirre, S. (2012). Cruise passengers' experience embarking in a Caribbean home port. The case study of Cartagena de Indias, Ocean & Coastal Management, 55, pp. 135-145.
Carmichael, L.L. and Herod, A. (2012). Dockers and Seafarers: What the politics of spatial embeddedness and geographical scale have meant for union organizing in the European maritime trades, Labor Studies Journal, 37(2), pp. 203-227.
Carvalho, P. and Marques, R.C. (2012). Using non-parametric technologies to estimate returns to scale in the Iberian and international seaports, International Journal of Shipping & Transport Logistics, 4(3), pp. 286-302.
Castillo-Manzano, J.I. and Asencio-Flores, J.P. (2012). Competition between new port governance models on the Iberian Peninsula, Transport Reviews, 32(4), pp. 519-537.
Chang, Y.-T., Tongzon, J., Luo, M. & Lee, P. T.-W. (2012). Estimation of Optimal Handling Capacity of a Container Port: An Economic Approach, Transport Reviews, 32(2), pp.241-258.
Chulkov, V.D. (2012). Managing new technology investment for underwater security of ports, Journal of Transportation Security, 5(2), pp. 95-105.
Cruz, C.O. and Marques, R.C. (2012). Risk-Sharing in Seaport Terminal Concessions, Transport Reviews, 32(4), pp.455-471.
Cullinane, K. and Wang, Y. (2012). The hierarchical configuration of the container port industry: an application of multiple linkage analysis, Maritime Policy & Management, 39(2), pp. 169-187.
Da Cruz, M.R.P., Ferreira, J.J. and Azevedo, S.G. (2012). A Strategic Diagnostic Tool Applied to Iberian Seaports: An Evolutionary Perspective, Transport Reviews, 32(3), pp. 333-349.
Da Silva, F.G.F and Rocha, C.H. (2012). A demand impact study of southern and southeastern ports in Brazil: An indication of port competition, Maritime Economics & Logistics, 14(2) pp. 204-219.
Davis, D. M. (2012). Federal transportation divestiture of remote ports and airports in Atlantic Canada: An introductory analysis, Research in Transportation Business & Management, 4, pp. 61-68.

De Langen, P.W., Van Meijeren, J. and Tavasszy, L.A. (2012). Combining Models and Commodity Chain Research for Making Long-Term Projections of Port Throughput: an Application to the HamburgLe Havre Range, European Journal of Transport & Infrastucture Research, 12(3), pp. 310-331.

De Langen, P.W., Van Den Berg, R. and Willeumier, A. (2012). A new approach to granting terminal concessions: the case of the Rotterdam World Gateway terminal, Maritime Policy & Management, 39(1), pp. 79-90.

Del Saz-Salazar, S., García-Menéndez, L. and Feo-Valero, M. (2012). Meeting the environmental challenge of port growth: A critical appraisal of the contingent valuation method and an application to Valencia Port, Spain, Ocean & Coastal Management, 62, pp. 54-67.

Defilippi, E. (2012). Good regulations, bad regulation: a Peruvian port case, Maritime Policy & Management, 39(6), pp. 641-651.

Diaz-Hernandez, J.J., Martinez-Budria, E. and Jara-Diaz, S. (2012). The Economic efficiency in stevedoring determinants industry, International Journal of Transport Economics, 39(3), pp. 369-396.

Dong, J.-X. and Song, D.-P. (2012). Lease term optimisation in container shipping systems, International Journal of Logistics Research & Applications, 15(2), pp.87-107.

Ducruet, C. and Notteboom, T. (2012). The worldwide maritime network of container shipping: spatial structure and regional dynamics, Global Networks, 12(3), pp. 395–423.

Ducruet, C. and Zaidi, F. (2012). Maritime constellations: a complex network approach to shipping and ports, Maritime Policy & Management, 39(2), pp. 151-168.

Fan, L., Wilson, W. W. and Dahl, B. (2012). Impacts of new routes and ports on spatial competition for containerized imports into the United States, Maritime Policy & Management, 39(5), pp. 479-501.

Fan, L., Wilson, W. W. and Dahl, B. (2012). Congestion, port expansion and spatial competition for US container imports, Transportation Research Part E, 48(6), pp. 1121-1136.

Farrell, S. (2012): The ownership and management structure of container terminal concessions, Maritime Policy & Management, 39(1), pp. 7-26.

Feng, M., Mangan, J. and Lalwani, C. (2012). Comparing port performance: Western European versus Eastern Asian ports, International Journal of Physical Distribution & Logistics Management, 42(5), pp.490-512.

Fraser, D. and Notteboom, T. (2012). Gateway and hinterland dynamics: The case of southern African container seaport system, African Journal of Business Management, 6(44), pp. 10807-10825.

Gong, S.X.H., Cullinane, K. and Firth, M. (2012).The impact of airport and seaport privatization on efficiency and performance: A review of the international evidence and implications for developing countries, Transport Policy, 24(1), pp. 37-47.

Hall, P.V. and Jacobs, W. (2012). Why are maritime ports (still) urban and why should policy-makers care?, Maritime Policy & Management, 39(2), pp. 189-206.

Haralambides, H. and Gujar, G. (2012). On balancing supply chain efficiency and environmental impacts: An eco-DEA model applied to the dry port sector of India, Maritime Economics & Logistics, 14(1), pp.122-137.

Hsu, W-K K. (2012). Ports' service attributes for ship navigation safety, Safety Science, 50(2), pp. 244-252.

Iannone, F. (2012). A model optimizing the port-hinterland logistics of containers: The case of the Campania region in Southern Italy, Maritime Economics & Logistics, 14(1), pp. 33-72.

Iannone, F. (2012). The private and social cost efficiency of port hinterland container distribution through a regional logistics system, Transportation Research Part A, 46(9), pp. 1424-1448.

Ke, G.Y., Li, K.W. and Hipel, K.W. (2012). An integrated multiple criteria preference ranking approach to the Canadian west coast port congestion conflict, Expert Systems with Applications, 39(10), pp. 9181-9190.
Lam, J.S.L. and Dai, J. (2012). A decision support system for port selection, Transportation Planning & Technology, 35(4), pp. 509-524.
Laxe, F.G., Seoane, M.J.F. and Montes, C.P. (2012). Maritime degree, centrality and vulnerability: port hierarchies and emerging areas in containerized transport (2008–2010), Journal of Transport Geography, 24(1), pp. 33-44.
Lee, Paul T.-W. and Lee, T.C. (2012). A new lease charging system for Busan container terminals: a historical case study, Maritime Policy & Management, 39(1), PP. 91-105.
Lee, P. T-W. and Hu, K.-C. (2012). Evaluation of the service quality of container ports by importance-performance analysis, International Journal of Shipping & Transport Logistics, 4(3), pp. 197-211.
Li, K. X., Luo, M., and Yang, J. (2012). Container port systems in China and the USA: a comparative study, Maritime Policy & Management, 39(5), pp. 461-478.
Low, M.W.J and Tang, L.C. (2012). Network effects in the East Asia container ports industry, Maritime Policy & Management, 39(4), pp.369-386.
Luo, M., Liu, L. and Gao, F. (2012). Post-entry container port capacity expansion, Transportation Research Part B, 46(1), pp. 120-138.
Mateo-Mantecón, I., Coto-Millán, P., Villaverde-Castro, J. and Pesquera-González, M.A. (2012). Economic impact of a port on the hinterland: application to Santander's port, International Journal of Shipping & Transport Logistics, 4(3), pp. 235-249.
Medal-Bartual, A., Molinos-Senante, M. and Sala-Garrido, R. (2012). Benchmarking in Spanish seaports: a tool for specialization, International Journal of Transport Economics, 39(3), pp. 329-348.
Mokhtari, K., Ren, J., Roberts, C. and Wang, J. (2012). Decision support framework for risk management on sea ports and terminals using fuzzy set theory and evidential reasoning approach, Expert Systems with Applications, 39(5), pp. 5087–5103.
Monios, J. and Wilmsmeier, G. (2012). Port-centric logistics, dry ports and offshore logistics hubs: strategies to overcome double peripherality?, Maritime Policy & Management, 39(2), pp. 207-226.
Monios, J. and Wilmsmeier, G. (2012). Giving a direction to port regionalisation, Transportation Research A, 46(10), pp. 1551-1561.
Montes, C.P., Seoane, M.J.F and Gonzalex Laxe, F. (2012). General cargo and container ship emergent routes: A complex networks description, Transport Policy, 24, pp. 126-140.
Niavis, S. and Tsekeris, T. (2012). Ranking and causes of inefficiency of container seaports in South-Eastern Europe, European Transport Research Review, 4(4), pp.235-244.
Ng, A.K.Y. and Cetin, I.B. (2012). Locational Characteristics of Dry Ports in Developing Economies: Some Lessons from Northern India, Regional Studies, 46(6), pp. 757-773.
Notteboom, T.E. (2012). Challenges for container river services on the Yangtze River: A case study for Chongqing, Research in Transportation Economics, 35, pp. 41-49.
Notteboom, T.E. (2012). Towards a new intermediate hub region in container shipping? Relay and interlining via the Cape route vs. the Suez route, Journal of Transport Geography, 22, pp. 164-178.
Notteboom, T.E., Pallis, A.A. and Farrell, S. (2012). Terminal concessions in seaports revisited, Maritime Policy & Management, 39(1), pp. 1-5.
Notteboom, T. and Rodrigue, J.-P. (2012). The corporate geography of global container terminal operators, Maritime Policy & Management, 39(3), pp. 249-279.
Padilha, F. and Ng, A.K.Y. (2012). The spatial evolution of dry ports in developing economies: The Brazilian experience, Maritime Economics & Logistics, 14(1), pp. 99-121.

Panigrahi, J.K. and Pradhan, A. (2012). Competitive maritime policies and strategic dimensions for commercial seaports in India, Ocean & Coastal Management, 62, pp. 54-67.
Saurí, S. and Robusté, F. (2012). Promoting Incentives: Performance Improvement in Container Port Terminals, Transportation Science, 46(2), pp. 233-246.
Siemonsma, H., Van Nus, W. and Uyttendaele, P. (2012). Awarding of Port PPP contracts: the added value of a competitive dialogue procedure, Maritime Policy & Management, 39(1), pp. 63-78.
Stikkelman, R.M., Minnée, M.G., Prinssen, M.M.W.J and Correljé, A.F. (2012). Drivers, Options and Approaches for Two Seaport Authorities on the Joint Reduction of Bunker Oil Related Emissions, European Journal of Transport and Infrastructure Research, 12(1), pp. 132-145.
Taneja, P., Ligteringen, H. and Walker, W.E. (2012). Flexibility in Port Planning and Design, European Journal of Transport and Infrastructure Research, 12(1), pp. 66-87.
Thai, V.V. (2012). Competencies required by port personnel in the new era: conceptual framework and case study, International Journal of Shipping and Transport Logistics, 4(1), pp. 49-77.
Tran, H., Cahoon, S. and Chen, S.-L. (2012). Quality management for seaports integrated in supply chains, International Journal of Shipping & Transport Logistics, 4(4), pp. 376-392.
Tsamboulas, D., Moraiti, P. and Lekka, A.M. (2012). Performance Evaluation for Implementation of Port Community System, Transportation Research Record, 2273, pp. 29-37.
Veenstra, V., Zuidwijk, R. and van Asperen, V. (2012). The extended gate concept for container terminals: Expanding the notion of dry ports, Maritime Economics & Logistics, 14(1), pp. 14-32.
Wang, J., Pulat, P.S., and Shen, G. (2012). Data mining for the development of a global port–to–port freight movement database, International Journal of Shipping & Transport Logistics, 4(2), pp. 137–156.
Woo, S.-H., Pettit, S., Beresford, A. and Kwak, D.-W. (2012). Seaport Research: A Decadal Analysis of Trends and Themes Since the 1980s, Transport Reviews, 32(3), pp. 351-377.
Xiao, Y., Ng, A.K.Y., Yang, H. and Fu, X. (2012). An Analysis of the Dynamics of Ownership, Capacity Investments and Pricing Structure of Ports, Transport Reviews, 32(5), pp. 629-652.
Yang, C.-C. and Lu, C.-S. (2012). Factors influencing the use intention of port logistics information system by ocean carriers, International Journal of Shipping and Transport Logistics, 4(1), pp. 29-48.
Bichou, K. (2011). A two-stage supply chain DEA model for measuring container-terminal efficiency, International Journal of Shipping & Transport Logistics, 3(1), pp. 6-26.
Bichou, K. (2011). Assessing the impact of procedural security on container port efficiency, Maritime Economics & Logistics, 13(1), pp. 1-28.
De Borger, B. and De Bruyne, D. (2011). Port Activities, Hinterland Congestion, and Optimal Government Policies. The role of Vertical Integration in Logistic Operation, Journal of Transport Economics & Policy, 45(2), pp. 247-275.
De Oliveira, G.F. and Cariou, P. (2011). A DEA study of the efficiency of 122 iron ore and coal ports and of 15/17 countries in 2005, Maritime Policy & Management, 38(7), pp.727-743.
Dekker, S., Verhaeghe, R. and Wiegmans, B. (2011). Economically-efficient port expansion strategies: An optimal control approach, Transportation Research E, 47(2), pp. 204-215.
Di Vaio, A., Medda, F.R., and Trujillo, L. (2011). An analysis of the efficiency of Italian Cruise Terminals, International Journal of Transport Economics, 38(1).

Do, N.-H., Nam, K.-C. and Ngoc Le, Q.-L. (2011). A consideration for developing a dry port system in Indochina area, Maritime Policy & Management, 38(1), pp. 1-9.
Gaur, P., Pundir, S. and Sharma, T. (2011). Ports face inadequate capacity, efficiency and competitiveness in a developing country: case of India, Maritime Policy & Management, 38(3), pp. 293-314.
Haralambides, H. and Gujar, G. (2011). The Indian dry ports sector, pricing policies and opportunities for public-private partnerships, Research in Transportation Economics, 33(1), pp. 51-58.
Haralambides, H., Veldman, S., Van Drunen, E. and Liu, M. (2011), Determinants of a regional port-centric logistics hub: The case of East-Africa, Maritime Economics & Logistics, 13(1), pp. 78-97.
Kaselimi, E. N., Notteboom, T. E. and De Borger, B. (2011). A game theoretical approach to competition between multi-user terminals: the impact of dedicated terminals, Maritime Policy & Management, 38(4), pp. 395-414.
Kaselimi, E. N., Notteboom, T. E., Pallis, A. A. and Farrell, S. (2011). Minimum Efficient Scale (MES) and preferred scale of container terminals, Research in Transportation Economics, 32(1), pp. 71-80.
Lam, J.S.L. (2012). Patterns of maritime supply chains: slot capacity analysis, Journal of Transport Geography, 19(2), pp. 366–374.
Lun, Y.H.V., Browne, M., Lai, K.H., Wong, C.W.Y. and Cheng T.C.E. (2011). Examining the influence of firm performance on business risk-taking and the mediation effect of scale of operations in the container terminal industry, Research in Transportation Economics, 32(1), pp. 64-70.
Marianos, N., Lambrou, M., Nikitakos, N. and Vaggelas, G. (2011). Managing port e-services in a socio-technical context, International Journal of Shipping & Transport Logistics, 3(1), pp. 27-56.
Marques, I., Ribeiro, J.A. and Scapens, R.W. (2011). The use of management control mechanisms by public organizations with a network coordination role: A case study in the port industry, Management Accounting Research, 22(4), pp. 269–291.
Nam, H.-S. and Song D.-W. (2011). Defining maritime logistics hub and its implication for container port,Maritime Policy & Management, 38(3), pp. 269-292.
Núñez-Sánchez, R., Jara-Díaz, S. and Coto-Millán, P. (2011). Public regulation and passengers importance in port infrastructure costs, Transportation Research Part A, 45(7), pp. 653-666.
Pallis, A.A., Vitsounis, T.K., De Langen, P.W. & Notteboom, T.E. (2011). Port Economics, Policy and Management – Content Classification and Survey, Transport Reviews, 31(4), pp. 445-471.
Tran, N. K. (2011). Studying port selection on liner routes: An approach from logistics perspective,Research in Transportation Economics, 32(1), pp. 39-53.
Ubogu, A.E., Ariyo, J.A. and Mamman, M. (2011). Port-hinterland trucking constraints in Nigeria, Journal of Transport Geography, 19(1), pp. 106-114.
Vanelslander, T. (2011). Port and maritime governance and regulation: emerging issues, Maritime Policy & Management, 38(3), pp. 215-217.
Wang, C. and Wang, J. (2011). Spatial pattern of the global shipping network and its hub-and-spoke system, Research in Transportation Economics, 32(1), pp. 54-63.
Wilmsmeier, G., Martinez-Zarzoso, I. and Fiess, N. (2011). Regional hub port development – the case of Montevideo, Uruguay, International Journal of Shipping & Transport Logistics, 3(4), pp.475-493.
Woo S.-H., Pettit S.J., Kwak D-W. and Beresford A.K.C (2011). Seaport research: A structured literature review on methodological issues since the 1980s. Transportation Research A, 45(7), pp. 667-685.
Woo S.-H., Pettit S.J. and Beresford A.K.C (2011). Port evolution and performance in changing logistics environments, Maritime Economics & Logistics, 13(3), pp. 250-277.

Woxenius J. and Bergqvist, R. (2011). Comparing maritime containers and semi-trailers in the context of hinterland transport by rail, Journal of Transport Geography, 19(3), pp. 354-362.

Ablanedo-Rosas, J.H., Gao, H., Zheng, X., Alidaee, B., Wang, H. (2010). A study of the relative efficiency of Chinese ports: a financial ratio-based data envelopment analysis approach, Expert Systems, 27(5), pp. 349-362.

Al-Eraqi, A.S., Mustafa, A. and Khader, A.T. (2010) An extended DEA windows analysis: Middle East and East African seaports, Journal of Economic Studies, 37(2) pp. 208 - 218.

Alix Y., Carluer, F., Slack, B. (2010). The News US 100% Container Scanning Law: Impacts on the International Supply Chain, International Journal of Transport Economics, 37(1).

Asteris, M. and Collins, A. (2010). UK Container Port Investment and Competition: Impediments to the Market, Transport Reviews, 30(2), pp. 163-178.

Bossche, M.V. and Gujar, G. (2010). Competition, excess capacity and pricing of dry ports in India: some policy implications, International Journal of Shipping & Transport Logistics, 2(2), pp. 151-167.

Carvalho, P., Cunha, M.R. and Simues, F.L. (2010). Governance and Comparative Performance of Iberian Peninsula Seaports: An Application of Non-Parametric Techniques, International Journal of Transport Economics, 37(1).

Castillo-Manzano, J.I., López-Valpuesta, L., and Gonzalez Laxe. F., (2010). Political coordination costs in the Spanish port devolution process: A note, Ocean & Coastal Management, 53(9), pp. 577–580.

Cetin, C.K. and Cerit, A. G. (2010). Organizational effectiveness at seaports: a systems approach,Maritime Policy & Management, 37(3), pp. 195-219.

Chen, S-H. and Chen, J-N. (2010). Forecasting container throughputs at ports using genetic programming, Experts Systems with Applications, 37(10), pp. 2054-2058.

Cheon, S. and Deakin, E. (2010). Supply Chain Coordination for Port Sustainability, Transportation Research Record, 2166, pp. 10-19.

Cheon, S., Dowall, D. E. and Song, D.-W. (2010). Evaluating impacts of institutional reforms on port efficiency changes: Ownership, corporate structure, and total factor productivity changes of world container ports, Transportation Research E, 46(4), pp. 546-561.

Chin, A.T.H. and Low, J.M.W. (2010). Port performance in Asia: Does production efficiency imply environmental efficiency? Transportation Research D, 15(8), pp. 483-488.

Cho, C.-H., Kim, B.-I. and Hyun, J.-H. (2010). A comparative analysis of the ports of Incheon and Shanghai: The cognitive service quality of ports, customer satisfaction, and post-behaviour, Total Quality Management & Business Excellence, 21(9), pp. 919-930.

Dias, J.C.Q., Calado, J.M.F., and Mendonça, M.C. (2010). The role of European «ro-ro» port terminals in the automotive supply chain management, Journal of Transport Geography, 18(1), pp. 116-124.

Ding D. and Teo C.P. (2010). World container port throughput follows lognormal distribution, Maritime Policy and Management, 37(4), pp. 401-426.

Douma, A. and de Langen, P. (2010). Challenges for Using ICT to Improve Coordination in Hinterland Chains : An Overview, International Journal of Transport Economics, 37(3), pp. 287-305.

Ducruet, C., Koster, H.R.A. and Van der Beek, D.J. (2010). Commodity Variety and Seaport Performance, Regional Studies, 44(9), pp. 1221-1241.

Ducruet C., Lee S.-W. and Ng A.K.Y. (2010) Centrality and vulnerability in liner shipping networks: revisiting the Northeast Asian port hierarchy, Maritime Policy & Management, 37(1), pp. 17-36.

Ducruet C., Rozenblat C. and Zaidi F. (2010). Ports in multi-level maritime networks: evidence from the Atlantic (1996–2006), Journal of Transport Geography, 18(4), pp. 508-518.

Elsner, W. (2010). Regional service clusters and networks. Two approaches to empirical identification and development: the case of logistics in the German port city-states Hamburg and Bremen, International Review of Applied Economics, 24(1), pp. 1-33.
Ferrari, C. Percoco, M. and Tedeschi, A. (2010). Ports and Local Development: Evidence from Italy, International Journal of Transport Economics, 37(1).
Franc P. and Van der Horst H. (2010). Understanding hinterland service integration by shipping lines and terminal operators: a theoretical and empirical analysis, Journal of Transport Geography, 18(4), pp.557-566.
Frémont A. and Franc P. (2010). Hinterland transportation in Europe: Combined transport versus road transport, Journal of Transport Geography, 18(4), pp. 548-556.
Fu, Q., Liu, L. and Xu, Z. (2010). Port resources rationalization for better container barge services in Hong Kong, Maritime Policy and Management, 37(6), pp. 543-561.
Garcia-Alonso L. and Sanchez-Soriano J. (2010). Analysis of the Evolution of the Inland Traffic Distribution and Provincial hinterland share of the Spanish Port System, Transport Reviews, 30(3), pp. 275-297.
Haddad, E.A., Hewings, G.J.D., Perobelli F.S. and dos Santos R.A.C. (2010). Regional Effects of Port Infrastructure: A Spatial CGE Application to Brazil, International Regional Science Review, 33(3), pp. 239-263.
Hall, P.V. and Jacobs, W. (2010). Shifting Proximities: The Maritime Ports Sector in an Era of Global Supply Chains', Regional Studies, 44(9), pp. 1103-1115.
Handley-Schachler, M. and Navare, J. (2010). Port risk management and Public Private Partnerships: factors relating to risk allocation and risk sustainability, World Review of Intermodal Transportation Research, 3(1/2), pp. 150-166.
Haralambides, H., Hussain, M., Barros, P.C. and Peypoch, N. (2010). New Approach in Benchmarking Seaport Efficiency and Technological Change, International Journal of Transport Economics, 37(1), 77-96.
Haugstetter, H. and Cahoon, S. (2010). Strategic intent: Guiding port authorities to their new world? Research in Transportation Economics, 27(1), pp. 30-36.
Hung, S.W., Lu, W.M., and Wang, T.P. (2010). Benchmarking the operating efficiency of Asia container ports, European Journal of Operational Research, 203(3), pp. 706-713.
Jacobs, W., Ducruet, C. and De Langen, P.W. (2010). Integrating world cities into production networks: the case of port cities, Global Networks, 10(1), pp. 92-113. [authors' version available @ PortEconomics.eu]
Jafari, M., Taghavifard, M.T., Rouhani, S. and Moalagh, M. (2010). E-commerce development experiences in world's leading container ports and offering a model for Shahid Rajaee Port, Maritime Policy & Management, 37(1), pp. 53-72.
Jaffee, D. (2010). Labour and the geographic reorganisation of container shipping in the US, Growth and Change, 41(4), pp. 520-539.
Kamble, Sachin S., Raoot, Arun D. and Khanapuri, Vivek B. (2010). Improving port efficiency: a comparative study of selected ports in India, International Journal of Shipping & Transport Logistics, 2(4), pp. 444-470.
Konings, R., van der Horst, M., Hutson, N. and Kruse, J. (2010). Comparative Strategies for Developing Hinterland Transport by Container Barge: Analysis for Rotterdam and U.S. Ports, Transportation Research Record, 2166, pp. 82-89.
Lam, J.S.L. (2010). The integrated approach for port selection, ship scheduling and financial analysis ,Netnomics, 11(1), pp. 33-46.
Low, J.M.W. (2010). Capacity investment and efficiency cost estimations in major East Asian ports,Maritime Economics & Logistics, 12(4), pp. 370-391.
Marianos, N. and Lambrou, M. (2010). An Integrated Methodology for the Evaluation of Electronic Port Services, International Journal of Service Science, Management, Engineering & Technology, 1(3), pp. 63-83.
Marques, R. C. and Fonseca, A. (2010). Market structure, privatisation and regulation of Portuguese seaports, Maritime Policy & Management, 37(2), pp. 145-161.

McIntosh, R. Christopher and Skalberg, K. Randall (2010). A statistical approach to US harbor maintenance tax rates and replacement user fees, Maritime Economics and Logistics, 12(3), pp. 263-279.
Meersman, H., Pauwels, T., Van de Voorde, E. and Vanelslander, T. (2010). Applying SMC pricing in PPPs for the maritime sector, Research in Transport Economics, 30, pp. 87-101.
Morales-Fusco, P. Saurí, S. and Spuch, B. (2010). Quality indicators and capacity calculation for RoRo terminals, Transportation Planning and Technology, 33(8), pp. 695-717.
Ng, A.K.Y. and Pallis, A.A. (2010). Port governance reforms in diversified institutional frameworks: generic solutions, implementation asymmetries, Environment and Planning A, 42(9), pp. 2147-2167. [authors' version available @ PortEconomics.eu]
Ng, A.K.Y. and Song, S. (2010). The environmental impacts of pollutants generated by routine shipping operations on ports, Ocean & Coastal Management, 53(5-6) pp. 301-311.
Ng, A.K.Y and Tongzon, J.L. (2010). The Transportation Sector of India's Economy: Dry Ports as Catalysts for Regional Development, Euroasian Geography and Economics, 51(5), pp. 669-682.
Notteboom, T. (2010). From multi-porting to a hub port configuration: the South African container port system in transition, International Journal of Shipping & Transport Logistics, 2(2), pp. 224-245. [authors' version available @ PortEconomics.eu]
Notteboom, T. (2010). Concentration and the formation of multi-port gateway regions in the European container port system: an update, Journal of Transport Geography, 18(4), pp. 567-583.
O' Connor, K. (2010). Global city regions and the location of logistics activity, Journal of Transport Geography, 18(3), pp. 354-362.
Pallis, A.A. and De Langen, P.W. de (2010). Seaports and the Structural implications of the economic crisis. Research in Transportation Economics, 27(1), 10-18. [authors' version available @ PortEconomics.eu]
Pallis, A.A., Vitsounis, T.K. and De Langen, P.W. (2010). Port Economics, Policy and Management: Review of an Emerging Research Field, Transport Reviews, 30(1), pp. 115-161. [authors' version-available @ PortEconomics.eu]
Palma, P.J., Cunha, M.P. and Lopes, M.P. (2010). The best of two worlds: How privatization affects the identity of a public organization, Public Management Review, 12(5), pp. 725-746.
Pantouvakis, Angelos and Dimas, Athanassios (2010.) Does ISO 9000 series certification matter for the financial performance of ports? Some preliminary findings from Europe, Maritime Policy and Management, 37(5), pp. 505-522.
Paul J. A. & Maloni M. J. (2010). Modelling the effects of port disasters, Maritime Economics and Logistics, 12(2), pp. 127-146.
Pinto, M.M.O, Goldberg, D.J.K, Stupello, B. and Haley, C.W. (2010). Regulation and price setting of pilotage services in Brazil, Maritime Economics & Logistics, 12(4), pp. 430-442.
Ramos-Real F.J. & Tovar B. (2010). Productivity Change and Economies of Scale in Container Port Terminals, Journal of Transport Economics and Policy, 44(2), pp. 231-246.
Reynaerts J. (2010). Simulating mergers between stevedores, Maritime Economics and Logistics, 12(1), pp. 8-35.
Rocha C.H. and Britto P.A.P. (2010). UK Container Port Investment and Competition: Impediments to the Market, Maritime Policy & Management, 37(2), pp. 163-174.
Rodrigue J-P., Debrie J., Fremont A. and Gouvernal E. (2010). Functions and actors of inland ports: European and North American dynamics, Journal of Transport Geography, 18(4), pp. 519-529.

Rodrigue J-P. and Notteboom T. (2010). Comparative North American and European gateway logistics: the regionalism of freight distribution, Journal of Transport Geography, 18(4), pp. 497-507.
Rodrigue J-P. and Notteboom, T.E. (2010). Foreland-Based Regionalization: Integrating Intermediate Hubs with Port Hinterlands. Research in Transportation Economics, 27(1), pp. 19-29. [authors' version-available @ PortEconomics.eu]
Roso V. and Lumsden K. (2010). A review of dry ports, Maritime Economics and Logistics, 12(2), pp.196-213.
Saeed, N. and Larsen, O.I. (2010). An application of cooperative game among container terminals of one port, European Journal of Operational Research, 203(2), pp. 393-403.
Saeed, N. and Larsen, O.I. (2010). Container terminal concessions: A game theory application to the case of the ports of Pakistan, Maritime Economics and Logistics, 12(3), pp. 237-262.
Simões P. and Marques R. C. (2010). Influence of Congestion Efficiency on the European Seaports Performance: Does It Matter? Transport Reviews, 30(4), pp. 517-539.
Simões, P. and Marques, R.C. (2010), Seaport performance analysis using robust non-parametric efficiency estimators, Transportation Planning and Technology, 33(5), pp. 435-451.
Slack, B. (2010). Battening down the hatches: How should the maritime industries weather the financial tsunami?, Research in Transport Economics, 27, pp. 4-9.
Taneja P., Walker W. E., Ligteringen H., Van Schuylenburg M. and Van Der Plas R. (2010). Implications of an uncertain future for port planning, Maritime Policy & Management, 37(3), pp. 221-245.
Theys, C., Notteboom, T.E., Pallis, A.A. and Langen, P.W. de (2010). The economics behind the awarding of terminals in seaports: Towards a research agenda. Research in Transportation Economics, 27(1), pp. 37-50. [authors' version-available @ PortEconomics.eu]
Thill J.C. and Lim H. (2010). Intermodal containerized shipping in foreign trade and regional accessibility advantages, Journal of Transport Geography, 18(4), pp. 530-547.
Turnbull, P. (2010). From social conflict to social dialogue: Counter-mobilization on the European waterfront, European Journal of Industrial Relations, 16(4), pp. 333-349.
Tzannatos E. (2010). Cost assessment of ship emission reduction methods at berth: the case of the Port of Piraeus, Greece, Maritime Policy and Management, 37(4), pp. 427-445.
Vaggelas, G.K. and Pallis, A.A. (2010). Passenger ports: services provision and their benefits, Maritime Policy & Management, 37(1), pp. 73-89. [authors' version available @ PortEconomics.eu]
Van Reeven, P. (2010). The effect of competition on economic rents in seaports, Journal of Transport Economics and Policy, 44(1), pp. 79-92.
Verhoeven P. (2010). A review of port authority functions: towards a renaissance?, Maritime Policy & Management, 37(3), pp. 247-270.
Wang, J.J. and Cheng, M.C. (2010). From a hub port city to a global supply chain management center: a case study of Hong Kong, Journal of Transport Geography, 18(1), pp. 104-115.
Wiegmans, B.W. and Geerlings, H. (2010). Sustainable port innovations: barriers and enablers for successful implementation, World Review of Intermodal Transportation Research, 3(3), pp. 230-250.
Wortelboer-Van Donselaara P. and Kolkman J. (2010). Societal costs and benefits of cooperation between port authorities, Maritime Policy & Management, 37(3), pp. 271-284.
Wu, Y.-C. J. and Goh, M. (2010). Container port efficiency in emerging and more advanced markets, Transportation Research E, 46(6), pp. 1030-1042.

Wu, J., Yan, H. and Liu, J. (2010). DEA models for identifying sensitive performance measures in container port evaluation, Maritime Economics and Logistics, 12(3), pp. 215-236.

Yoshida, Y. (2010). New evidence for exchange rate pass-through: Disaggregated trade data from local ports, International Review of Economics and Finance, 19(1), pp. 3-12.

Zondag, B., Bucci, P, Gützkow, P. and de Jong, G. (2010). Port competition modelling including maritime, port, and hinterland characteristics, Maritime Policy & Management, 37(3), pp. 179-194.

Al-Eraqi A.S., Khader A.T. and Mustafa A. (2009). DEA Malmquist index measurement in Middle East and East African containers terminals, International Journal of Shipping & Transport Logistics, 1(3), pp. 249-259.

Almotairi, B. and Lumsden K. (2009). Port logistics platform integration in supply chain management,International Journal of Shipping & Transport Logistics, 1(2), pp. 194-210.

sustainability in seaports: a case study from Egypt, International Journal of Environmental Technology & Management, 10(3/4), pp. 427-441.

Cullinane, K. and Wang, Y. (2009). A capacity-based measure of container port accessibility, International Journal of Logistics Research & Applications, 12(2), pp.103-117.

De Langen, P.W. and Chouly, A. (2009). Strategies of terminal operating companies in changing environments, International Journal of Logistics Research & Applications, 12(6), pp.423-434.

Ferrari, C. and Basta, M. (2009). Port concession fees based on the price-cap regulation: A DEA approach, Maritime Economics & Logistics, 11(1), pp. 121-135

Garcia-Alonso, L. and Sanchez-Soriano, J. (2009). Port selection from a hinterland perspective, Maritime Economics & Logistics, 11(3), pp. 260-269.

Hall, P.V. (2009). Container ports, local benefits and transportation worker earnings, GeoJournal, 74(1), pp.67-83.

Imai, A.; Shintani, K. and Papadimitriou, S. (2009). Multi-port vs. Hub-and-Spoke port calls by containerships, Transportation Research Part E, 45(5), pp.740-757.

Jaja C. (2009). Port development in Nigeria: Trends and patters, Journal of Transportation Security, 2(4), pp. 107-119

Lagoudis, I.N. and Platis, A.N. (2009). Using birth-and-death theory for container terminal strategic investment decisions, International Journal of Decision Sciences, Risk & Management, 1 (1/2), pp. 81-103.

Laih, C.H. and Chen, K.Y. (2009). Economics on the oprimal port queuing prising to bulk ships, Applied Economics, 41(22), pp.2817-2825.

Ng, A.K.Y. and Gujar, G.C. (2009). The spatial characteristics of inland transport hubs: evidences from Southern India, Journal of Transport Geography, 17(5), pp. 346-356.

Ng, A.K.Y. and Gujar, G.C. (2009). Government policies, efficiency and competitiveness: The case of dry ports in India, Transport Policy, 16(5), pp. 232-239.

Norzaidi, M.D., Siong, C.C., Murali, R. and Salwani M.I. (2009). Towards a holistic model in investigating the effects of intranet usage on managerial performance: a study on Malaysian port industry, Maritime Policy & Management, 36 (3), pp. 269-289.

Panayides, P.M. and Song, D-W. (2009). Port integration in global supply chains: measures and implications for maritime logistics, International Journal of Logistics Research and Applications, 12(2), pp.133-145.

Panayides, P.M; Maxoulis, C.N.; Wang, T.F. & Ng, K.Y.A. (2009). A Critical Analysis of DEA Applications to Seaport Economic Efficiency Measurement, Transport Reviews, 29(2), pp.183-206.

Parola, F. and Sciomachen, A. (2009). Modal split evaluation of a maritime container terminal, Maritime Economics & Logistics, 11(1), pp. 77-97.

Pettit, S.J. and Beresford, A.K.C. (2009). Port development: from gateways to logistics hubs, Maritime Policy & Management, 36(3), pp. 253-267.

Raya, J.M. (2009). Spanish seaports specialisation: a choice analysis, International Journal of Shipping & Transport Logistics, 1(4), pp. 386-395.
Roso, V., Woxenius, J. and Lumsden, K. (2009). The dry port concept: connecting container seaports with the hinterland, Journal of Transport Geography, 17(5), pp. 338-345.
Saeed, N. (2009). An analysis of carriers' selection criteria when choosing container terminals in Pakistan, Maritime Economics & Logistics, 11(3), pp. 270-288.
Sharma, M.J. and Song J.Y. (2009). Performance based stratification and clustering for benchmarking of container terminal, Expert Systems with Applications, 36(3), pp. 5016-5022.
Song, D.-W. and Lee, P.T-W. (2009). Maritime logistics in the global supply chain, International Journal of Logistics Research and Applications, 12(2), pp.82-84.
Soppé, M., Parola, F. and Frémont, A. (2009). Emerging inter-industry partnerships between shipping lines and stevedores: from rivalry to cooperation? Journal of Transport Geography, 17(1), pp. 10-20.
Talas, R. and Menachof, D.A. (2009). The efficient trade-off between security and cost for seaports: a conceptual model, International Journal of Risk Assessment and Management, 13(1), pp. 46-59.
Theofanis S., and Boile, M. (2009). Empty marine container logistics: facts, issues and management strategies, GeoJournal, 74(1), 51-65.
Tongzon, J.L. (2009). Port choice and freight forwarders, Transportation Research Part E, 45(1), pp. 185-195.
Tongzon, J.L., Chang, Y-T. and Lee, S-Y. (2009). How supply chain oriented is the port sector, International Journal of Production Economics, 122(1), pp. 21-34.
Ugboma C., Ugboma, O. and Damachi, B. (2009). A comparative assessment of service quality perspectives and satisfaction in ports: evidence from Nigeria, International Journal of Shipping & Transport Logistics, 1(2), pp. 172-193.
Verhoeven, P. (2009). European ports policy: meeting contemporary governance challenges, Maritime Policy & Management, 36(1), pp. 79-101.
Chang,Y-T., Lee, S-Y. and Tongzon, J.L. (2008) Port selection factors by shipping lines: Different perspectives between trunk liners and feeder service providers, Marine Policy, 32(6), pp. 877-885.
Cochrane, R.A. (2008) The Effects of Market Differences on the Throughput of Large Container Terminals with Similar Levels of Efficiency, Maritime Economics and Logistics, 10(1), 35-52.
Cohen, J. and Monaco, K. (2008) Ports and Highways Infrastructure: An Analysis of Intra- and Interstate Spillovers, International Regional Science Review, 31(3), pp. 257-274.
De Borger, B., Proost, S. and Van Dender K. (2008) Private Port Pricing and Public Investment in Port and Hinterland Capacity, Transport Economics and Policy, 42(3), pp. 527-561.
De Martino, M. and Morvillo, A. (2008) Activities, resources and inter-organizational relationships: key factors in port competitiveness, Maritime Policy and Management, 35(6), pp. 571-589.
Defilippi, E. and Flor, L. (2008) Regulation in a context of limited competition: A port case, Transportation Research Part A, 42(5), pp. 762–773.
Blumel Boeve Becagno Chilk (2008) Ship, Port and Supply Chain Security Concepts Interlinking Maritime with Hinterland Transport Chains, WMU Journal of Maritime Affairs, 7(1), pp. 205-225.
De Langen, P.W. (2008) Analysing Training and Education in Ports, WMU Journal of Maritime Affairs, 7(1), pp. 5-46.
De Langen, P.W. and Nijdam, M.N. (2008) Charging systems for Waste Reception Facilities in Ports and the Level Playing Field: A Case from North-West Europe, Coastal Management, 36(1), pp. 109-124.
Dekker, S. and Verhaeghe, R.J. (2008) Development of a Strategy for Port Expansion: An Optimal Control Approach, Maritime Economics and Logistics, 10(3), 258-274.

Everett, S. (2008) Public sector deregulation: a paradigm in conflict, Maritime Policy and Management, 35(4), 341-351.
Farris, M.T. II (2008) Are You Prepared for a Devastating Port Strike? Transportation Journal, 47(1), Winter 2008.
Goodchild, A. and Mohan, K. (2008) The Clean Trucks Program: Evaluation of Policy Impacts on Marine Terminal Operations, Maritime Economics and Logistics, 10(4), pp. 393-408.
Laik, N., and Hadjiconstantinou, E. (2008) Container Assignment and Yard Crane Deployment in a Container Terminal: A Case Study, Maritime Economics and Logistics, 10(1), pp.90-107.
Lambrou, M.A., Pallis A.A., and Nikitakos N.V. (2008) Exploring the applicability of electronic markets to port governance, International Journal of Ocean Systems Management, 1(1), pp.14-30.
Liu, C-C. (2008) Evaluating the operational efficiency of major ports in the Asia-Pacific region using data envelopment analysis, Applied Economics, 40(13), pp. 1737-1743.
Magala, M. (2008) Modelling opportunity capture: a framework for port growth, Maritime Policy and Management, 35(3), pp. 285-311.
Magala, M. and Simmons, A. (2008) A New Approach to Port Choice Modelling, Maritime Economics and Logistics, 10(1), pp. 9-34.
Mangan, J., Lalwani, C. and Fynes B. (2008) Port-centric logistics, International Journal of Logistics Management, 19(1), pp. 29-41.
McCalla, R.J. (2008a) Container transhipment at Kingston, Jamaica, Journal of Transport Geography, 16(3b), pp. 182-190.
Notteboom, T.E. and Rodrigue J.P. (2008) Containerisation, Box Logistics and Global Supply Chains: The Integration of Ports and Liner Shipping Networks, Maritime Economics and Logistics, 10(1), pp. 152-174.
Paixão-Casaca, A.C. (2008) Motorway of the sea port requirements: the viewpoint of port authorities,International Journal of Logistics: Research and Applications, 11(4), pp. 279 – 294.
Rettab, B. and Azzam. A. (2008) Re-export Intensity and Trade Costs: Port Facilities and Services, Maritime Economics and Logistics, 10(3), pp. 229-242.
Roso, V. (2008) Factors influencing implementation of a dry port, International Journal of Physical Distribution and Logistics Management, 38(10), pp. 782-798.
Song, D-W. and Panayides P.M. (2008) Global supply chain and port/terminal: integration and competitiveness, Maritime Policy and Management, 35(1), pp. 73-87.
Van Der Horst, M.R. and De Langen, P.W. (2008) Coordination in Hinterland Transport Chains: A Major Challenge for the Seaport Community, Maritime Economics and Logistics, 10(1), pp. 108-129.
Vaneslander, T. (2008) Expansion in cargo handling: geographical and functional issues, Maritime Policy and Management, 35(2), pp. 193-214.
Vining, A.R. and Boardman, A.E. (2008) The potential role of public-private partnerships in the upgrade of port infrastructure: normative and positive considerations, Maritime Policy and Management, 35(6), pp. 551-569.
Weston, R. and Robinson, R. (2008) Value migration and profit pools in port-oriented freight systems: the implications for new patterns of efficiency, Maritime Policy and Management, 35(3), pp. 253-270.
Wiegmans, B.W., Van Der Hoest, A. and Notteboom, T.E. (2008) Port and terminal selection by deep-sea container operators, Maritime Policy and Management, 35(6), pp. 517-534.
Yip T.L. (2008) Port traffic risks - A study of accidents in Hong Kong waters, Transport, Transportation Research Part E, 44(5), pp. 921-931.
Bassan, S. (2007) Evaluating seaport operation and capacity analysis—preliminary methodology, Maritime Policy and Management, 34(1), pp. 3-19.

Bichou, K. and Bell, M.G H. (2007) Internationalisation and Consolidation of the Container Port Industry: Assessment of Channel Structure and Relationships, Maritime Economics and Logistics, 9(1), pp.35-51.

Cahoon, S. (2007) Marketing communications for seaports: a matter of survival and growth, Maritime Policy and Management, 34(2), pp. 151-168.

De Langen, P.W. and Pallis, A.A. (2007) Entry Barriers in Seaports, Maritime Policy and Management, 34(5), pp. 427-440.

Giulano, G. and O'Brien, T. (2007) Reducing port-related truck emissions: The terminal gate appointment system at the Ports of Los Angeles and Long Beach, Transportation Research Part D, 12(8), pp. 460-473.

Goodchild, A.V. and Daganzo, C.F. (2007) Crane double cycling in container ports: Planning methods and evaluation, Transportation Research Part B, 41(8), pp. 875-891.

Hall, P.V. (2007) Seaports, Urban Sustainability, and Paradigm Shift, Journal of Urban Technology, 14(2), pp. 87 -101.

Kim K.H. and Kim, K.Y. (2007) Optimal price schedules for storage of inbound containers, Transportation Research Part B, 41(8), pp. 892-905.

Lin, L.C. and Tseng, C.C. (2007) Operational performance evaluation of major container ports in the Asia-Pacific region, Maritime Policy and Management, 34(6), pp. 535-551.

Magala, M. (2007) Targeting market opportunity for port growth: a CART-based decision support system ,Maritime Policy and Management, 34(2), pp. 131-150.

Roh, H-S. Lalwani, C. and Naim, M.M. (2007) Modelling a port logistics process using the structured analysis and design technique, International Journal of Logistics: Research and Applications, 10(3), pp. 283-302.

Skalberg, R.K. (2007) The U.S. Harbour maintenance tax: a bad idea whose time has passed?, Transportation Journal, Summer 2007.

Talley, W.K. (2007) Financing port dredging costs: taxes versus user fees, Transportation Journal, Summer 2007.

Tan T.-Y. (2007) Port cities and hinterlands: A comparative study of Singapore and Calcutta, Political Geography, 26(7), pp. 851-865.

Tongzon, J.L. and Sawant, L. (2007) Port choice in a competitive environment: from the shipping lines' perspective, Applied Economics, 39(4), pp. 477–492.

Turnbull, P.J. and Wass, V.J. (2007) Defending Dock Workers—Globalization and Labour Relations in the World's Ports, Industrial Relations, 46(3), pp. 582-612.

Ugboma, C., Ogwude, I.C., Ugboma, O. and Nnadi, K. (2007) Service quality and satisfaction measurements in Nigerian ports: an exploration, Maritime Policy and Management, 34(4), pp. 331-346.

Vernimmen, B., Dullaert, W. and Engelen, S. (2007) Schedule, Unreliability in Liner Shipping: Origins and Consequences for the Hinterland Supply Chain, Maritime Economics and Logistics, 9(3), pp. 193-213.

Asteris, M. and Collins, A. (2006) The UK Project Appraisal Framework for Ports: A Critique, Journal of Transport Economics and Policy, 40(1), pp. 161-171.

Casaca, A.C.P. (2006) Insights into the port training of the new European Union member states, Maritime Policy and Management, 33(3), pp. 203-217.

De, P. (2006), Total Factor Productivity Growth: Indian Ports in the Era of Globalisation, Maritime Economics and Logistics, 8(4), pp. 366-386.

Dragovic, B., Park, N.K. and Radmilovic, Z. (2006) Ship-berth link performance evaluation: simulation and analytical approaches, Maritime Policy and Management, 33(2), pp. 281-299.

Ducruet, C. and Lee, S.W. (2006) Frontline soldiers of globalisation: Port–city evolution and regional competition, Geojournal,9, 67(2), pp. 107-122.

Ho, M.W. and Ho, K.H. (2006) Risk Management in Large Physical Infrastructure Investments: The Context of Seaport Infrastructure Development and Investment, Maritime Economics and Logistics, 8(2), pp. 140-168.

Jula, H., Chassiakos, A. and Ioannou, P. (2006) Port dynamic empty container reuse, Transportation Research E, 42(1), pp.43-60.
Llacer, F.J.M. (2006) Port privatization in Panama, Marine Policy, 30(5), pp. 483-495.
Pinto, C.A. and Talley, W.K. (2006) The Security Incident Cycle of Ports, Maritime Economics and Logistics, 8(3), pp. 267-286.
Ugboma, C., Ugboma, O. and Ocwude, I.C. (2006) An Analytic Hierarchy Process (AHP) Approach to Port Selection Decisions – Empirical Evidence from Nigerian Ports, Maritime Economics and Logistics, 8(3), pp. 251-266.
Banomyong, R. (2005) The impact of port and trade security initiatives on maritime supply-chain management, Maritime Policy and Management, 32(1), pp. 3-13.
Bichou, K. and Gray, R. (2005) A critical review of conventional terminology for classifying seaports, Transportation Research A, 39(1), pp. 75-92.
Casaca, A.C.P. (2005) Simulation and the Lean Port Environment, Maritime Economics and Logistics, 7(3), pp. 262-280.
Everett, S. (2005) Policy making and planning for the port sector: paradigms in conflict, Maritime Policy and Management, 32(4), pp. 347-362.
Ircha, M.C. and Balsom, M.G. (2005) Educational Technology – Enhancing Port Training, World Maritime University Journal of Maritime Affairs, 4(2), pp. 211-225.
McCalla, R.J., Slack, B. and Comtois, C. (2005) The Caribbean basin: adjusting to global trends in containerization, Maritime Policy and Management, 32(3), pp. 245-261.
Notteboom, T.E. and Rodrigue, J.-P. (2005) Port regionalization: towards a new phase in port development, Maritime Policy and Management, 32(3), pp. 297-313.
Olivo, A., Zuddas, P., Di Francesco, M. and Manca, A. (2005) An Operational Model for Empty Container Management, Maritime Economics and Logistics, 7(3), pp. 199-222.
Paul, J. (2005) India and the Global Container Ports, Maritime Economics and Logistics, 7(2), pp. 189-192.
Stough, R.R. (2005) Institutional barriers to port infrastructure and harbour development, International Association of Traffic and Safety Sciences, 29(2), pp. 30-40.
Tsai, M.C. and Su, C.H. (2005) Political risk assessment of five East Asian ports—the viewpoints of global carriers, Marine Policy, 29(4), pp. 291-298.
van Niekerk, H.C. (2005) Port Reform and Concessioning in Developing Countries, Maritime Economics and Logistics, 7(2), pp.141-155.
Veenstra, A.W., Mulder, H.M. and Sels, R.A. (2005) Analysing container flows in the Caribbean, Journal of Transport Geography, 13(4), pp. 295-305.
Wood, G. and Dibben, P. (2005) Ports and shipping in Mozambique: current concerns and policy options, Maritime Policy and Management, 32(2), pp. 139-157.