Imperial College London

Port Operations Research and Technology Centre

Technical Audit of the MDST Transhipment Study

Date: September 2009

Status: Final

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The PORTeC team would like to express their gratitude to the MDS Transmodal Team, and particularly to Mike Garratt and Simon Marzetti, for their constant availability and their efforts in helping us to fully understand the model.

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1. INTRODUCTION

1.1 The Technical Audit of the Transhipment Study-Terms of Reference (TOR)

1.1.1 After a competitive tender process, the Department for Transport appointed the Port and Operations Research Technology Centre (PORTeC) at Imperial College to undertake a technical audit of the Transhipment Study[1] produced by MDS Transmodal (MDST).

1.1.2 The purpose of the technical audit was to "assess the suitability of the transhipment modelling approach and to recommend any development of the model to assist the future formation of ports and international networks policy".

1.1.3 This includes the review of the quality of input data, the suitability of inputs and modelling methodology, and the robustness of results. The identification of potential areas for further development of the model was also part of the audit.

1.1.4 In particular, the TOR mentioned as requirements:

The review of existing MDST documentation of the modelling processes.

The assessments of the relative strengths and weaknesses of the transhipment model.

The assessment of how the MDST updated report issued in 2007 addressed the concerns expressed following the original report and responded to its TOR.

The assessment of non-qualitative factors included in the modelling exercise.

1.1.5 The assessment does not include that of any model which has been used by MDST as input to the Transhipment Study (i.e. FORK, LINCOST, GBFM).

1.2 The policy environment of the Transhipment Study

1.2.1 The Transhipment Study was commissioned in 2005 at a time when deepsea ports in the UK were reaching capacity and major applications for expansion had been submitted (e.g. London Gateway and Bathside Bay).

1.2.2 Moreover, there was some interest, and even more so now, in what effect transhipment of deepsea container traffic via hub ports would have in relieving road congestion, hence the assessment of the sensitive lorry miles. The MDST study addressed the impact of 'direct calls' versus 'feedering' on sensitive lorry miles and rail utilisation.

1.2.3 In the meantime, London Gateway, Bathside Bay, Felixstowe South, Liverpool and Teesport have received conditional construction consent. In addition, Bristol has submitted an application for major expansion, which is currently under scrutiny. All these developments, should they proceed in accordance with current proposals, would produce a substantial increase in overall deepsea capacity and, perhaps, a temporary overcapacity in UK ports.

1.2.4 In assessing applications, the DfT has to undertake Environmental Impact Assessment studies. If the overall evaluation is negative, permission can still be granted if over-riding economic interest for the UK economy can be demonstrated. As a result, there is ongoing

[1] The audit exercise covers *"Container Port Transhipment Study"*, published in May 2006, and the updated version contained in the *"Update of UK Port Demand Forecasts to 2030 & Economic Value of Transhipment Study"*, published in July 2007.

interest in the Transhipment Study and in the extent to which it can inform the current policy debate.

1.3 The Terms of Reference of the Transhipment Study

1.3.1 As stated in the original Terms of Reference, the objectives of the MDST study were "to identify and quantify the main economic costs and benefits for UK ports and for the competitiveness of the UK economy of providing additional container port capacity to service the deepsea container transhipment market and, to identify means of reducing the costs and increasing the benefits of transhipment for the competitiveness of the UK economy". In the course of the study the 'deepsea container transhipment market' was reinterpreted as the 'deepsea container port handling market'.

1.3.2 In particular, MDST were required to assess:

The scale of direct call and transhipment movements at UK ports.

Factors determining trends in direct calls, amalgamation of routes, transhipment, and feedering (ship size, port capacity, etc).

Changes in time and money transport costs for UK trading industry.

Employment at UK ports and in UK industry.

Surface access to and logistics impacts of ports.

The impact of different UK port policy options.

Competition for transhipment traffic between ports in Belgium, France, Germany, the Netherlands and the UK.

The terms of reference did not include provision of a model; one was developed when subsequent questions from the DfT led to the realisation that one was needed.

1.4 The aim of the Transhipment Study

1.4.1 The scope of the Transhipment Study, therefore, was originally to assess the value of transhipment to the UK economy. It was initially meant to assess the value of third country transhipment, but it was soon evident to both the DfT and MDST that this kind of transhipment was not crucial to the case for port expansion and that no third country transhipment was possible without providing enough capacity for the UK market first.

1.4.2 Therefore, the scope of the work focused on assessing the value of more handling capacity in UK ports for direct calls versus feedering from transhipment ports. In particular it considered:

How and where containers will be transhipped.

Transport revenue within the GB economy.

Delivery costs per container to UK shippers and receivers.

The wider impact of any increase in delivery costs on the overall economy.

The environmental impact as reflected in Sensitive Lorry Miles.

1.5 Differences between the original report and the updated version

1.5.1 The first version of the Transhipment Study was issued in 2006 and was followed by a consultation phase.

1.5.2 Some of the most relevant issues that arose during the consultation with the industry were:

- Disagreement with the freight forecast (considered either over- or under-estimated).

- The fact that the version of the Great Britain Freight Model (GBFM) used by MDST made use of a 1991 base of inland origin/destination data within GB.

- Disagreement with the conclusions of the report that shipping lines would be reluctant to make calls at ports outside the Greater South East (GSE) other than existing traffic at Liverpool.

- The potential of Teesport and Bristol to attract transhipment of the transatlantic traffic to northern Europe and Baltic destinations, the potential of Teesport to attract direct calls of vessels going on to northern Europe and Baltic destinations, and the potential of Bristol to attract transatlantic traffic.

- Inconsistency of the scenarios analysed with the planning consents granted while the study was in progress.

1.5.3 In the light of the responses to the consultation phase, a revised version of the study was issued by MDST in July 2007, including the following modifications:

- An update of the inland origin/destination data to 2006 (instead of 1991) using a 'mean' of surveys produced by a UK port and a major shipping line.

- Analysis of further scenarios, based on the planning consents given in the meantime (a reduction from 9 to 4 scenarios, in agreement with the DfT).

1.6 The approach to the audit exercise

1.6.1 The work carried out by the Team has been focused on assessing:

- Model validity (consistency between what was stated in the MDST report and the actual model).

- Model input data (cross-checking against empirical data from other sources).

- Model robustness (analysis of model logic, comprehensiveness of factors taken into account, and opportunities for model improvements).

1.6.2 In order to audit the Transhipment Study, the Team requested further documentation from MDST. It emerged that the modelling methodology was not fully documented as it was not intended for use by others. However, as the documentation of the modelling methodology was not part of the original Transhipment Study terms of reference, it has been excluded from this audit.

1.6.3 The team started the audit work on the basis of the publicly available documentation (i.e. the two versions of the study) and an inception meeting with the MDST team. Further discussions with MDST occurred as the Team reviewed the correspondence between the methodology as described and the programming code in the model's spreadsheet.

1.6.4 Direct access to the spreadsheets that constitute the basis of the model informed the audit of model mechanism and robustness.

1.7 Structure of the report

The report is divided into four main sections, following this introductory section. In Section 2, the structure of the MDST methodology for the Transhipment Study is analysed. In Section 3 the methodology of the Transhipment Study is evaluated in order to assess the suitability of the inputs for the methodology and outputs, as well as the comprehensiveness, consistency and robustness of the methodology. Section 4 analyses the wider issues which might affect the results of the study. In the last section, potential areas for future development of the current model methodology are discussed and consideration is given to its usefulness for the assessment of future scenarios.

2. MDST METHODOLOGY AND MODEL STRUCTURE

2.1 Overview

2.1.1 The objective of the MDST Container Flow Model is to test the effects of providing additional deepsea port capacity at different GB port locations on the routeing of GB deepsea container traffic, within the context of multi-port container ship calls in NW Europe. An overview of the modelling process is shown in Figure 2.1.

2.1.2 The model has three main components:

Container traffic forecasts.

Container traffic assignment.

Economic impact assessment.

2.1.3 It uses 2004 data for the base year (although in some tables 2003 is used as base year) and models flows between four overseas trade lanes and multiple GB inland origin-destinations for 2005, 2010, 2015, 2020, 2025 and 2030. The results for 2005 have been checked by MDST against the distribution of containerised cargo through GB ports in that year derived from UK Customs data.

2.1.4 The model is run separately for each year, with the results collated in a multi-year worksheet. Model runs for the six years are done for each of the "capacity scenarios" which the model is designed to test. These are sets of assumptions about the amount, timing and geographical distribution of GB future deepsea port capacity.

2.1.5 The four overseas trade lanes are Asia, Mediterranean (including Middle East, India and Oceania), North America and Others (primarily South America and Sub-Saharan Africa). The container flows in these trade lanes are based on country of origin, unlike DfT statistics which are generally based on last port of loading (including transhipment ports). The Mediterranean trade lane largely excludes EU countries (Spain, France, Italy and Greece) which are regarded as short-sea trades.

2.1.6 Great Britain is subdivided into 133 inland origin-destination zones, based on counties and sub-divisions of counties.

2.1.7 Container flows in each trade lane are divided between five quasi shipping lines, each of which operates a given size of ship. The ships of each quasi line are treated as interchangeable, so if it makes economic sense for one ship to change its "string" (sequence of ports visited) then all ships of the same quasi line will make the same change.

2.1.7 GB deepsea container traffic is allowed to move through three groups of ports in the South East (Haven, Thames and Solent), and through four GB deepsea ports outside of the South East (Liverpool, Clyde, Teesport and Bristol). It is assumed that quasi lines visit at most one GB deepsea port, and that when they change their GB port of call they can shift to or from ports in the South East, or between ports outside the South East, but not between the three port groups in the South East.

2.1.8 Alternatively, cargo can move through two deepsea ports[2] in NW Europe (Rotterdam and Le Havre) which are linked to five GB feeder ports (Grangemouth, Teesport, Tilbury, Avonmouth, and Liverpool) via short-sea shipping services.

[2] Cargo can also be routed through a third hub port (Tangiers) but this facility has not been used.

2.1.9 In general, the model can be described as a cost minimisation exercise for the quasi shipping lines as their objective is to minimise their total door-to-door transport costs.

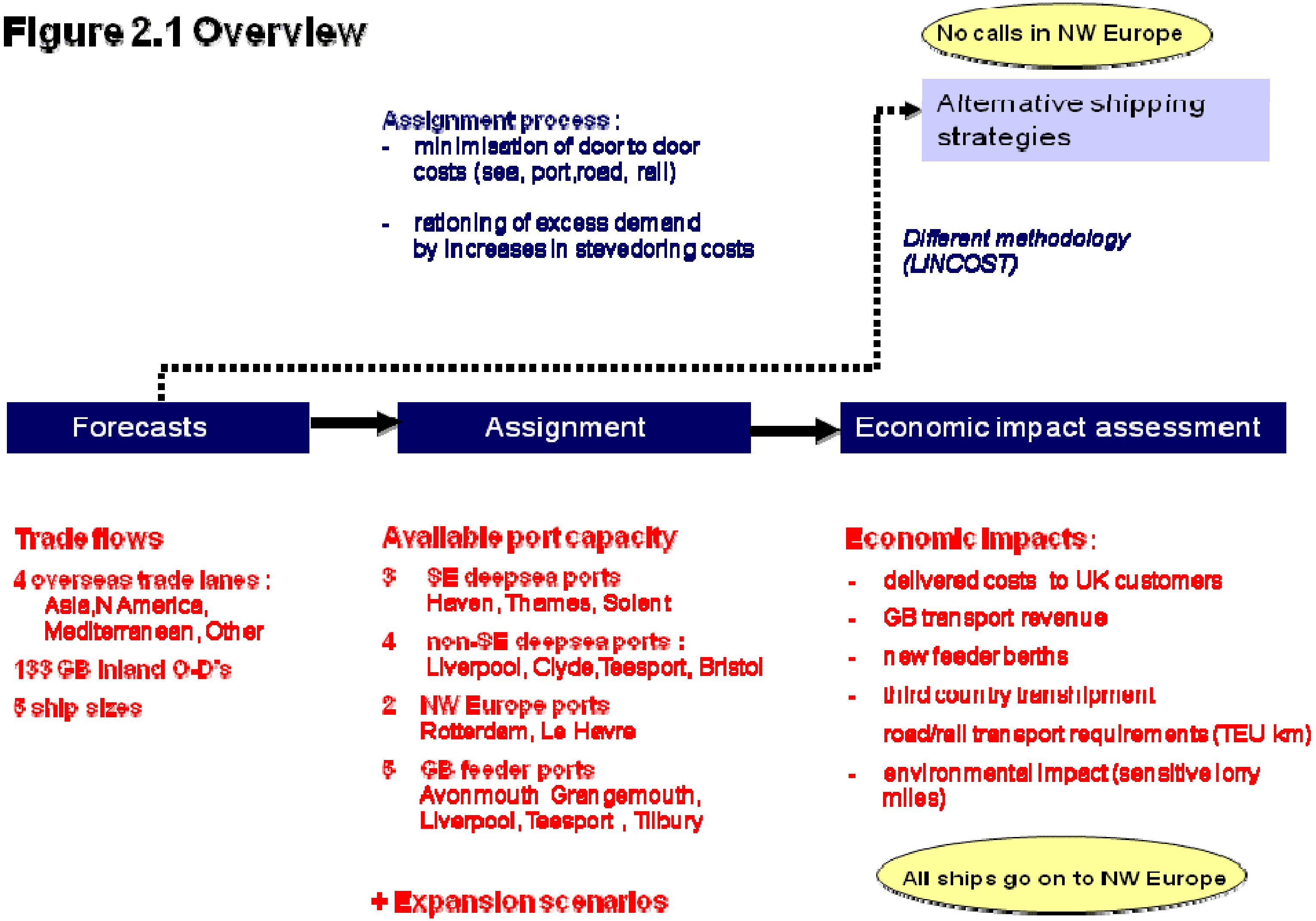
2.1.10 Equilibrium is reached when every quasi line is minimising its total costs within the framework of the GB deepsea port capacity constraints. These are modelled by assuming that whenever the desired throughput of a GB deepsea port exceeds its capacity, its stevedoring costs are increased in increments of 50p per container until enough containers find it cost-effective to divert to another route. In the first instance, this involves transhipment at a Continental port (Rotterdam or Le Havre) and feedering to one of five GB feeder ports (Avonmouth, Grangemouth, Liverpool, Teesport and Tilbury).

2.1.11 As stevedoring charges are increased there will come a point where a quasi line can reduce its cost still further by diverting to an alternative GB deepsea port or by not visiting a GB deepsea port at all and feedering all the containers from and to the Continent. The diversion of a quasi line to an alternative GB deepsea port (or to no GB visit at all) may well occur before all containers have shifted to a route involving Continental transhipment, so large step reductions in demand are possible. Such a step reduction in demand can result in excess capacity where none existed before stevedoring charges were increased. When this happens, the model assumes that the excess capacity is offered for “third country” transhipment (transhipment to ships to or from non-GB ports).

2.1.12 Once GB deepsea traffic for the scenario being modelled in any given year has been assigned to GB and NW Europe ports, and stevedoring charges have converged to market clearing values so that no ports are faced with demand in excess of capacity, the model outputs are presented to the “Output” spreadsheet for use in the economic impact assessment (estimated revenue, sensitive lorry miles, etc). This enables the economic impact of the scenario to be compared with a Do Nothing scenario, which assumes that no further GB deepsea port capacity is built.

2.1.13 The MDST Reports include a brief review of an alternative shipping strategy in which Asia-North America deepsea services are diverted to serve GB West Coast ports. This represents the case where the UK is served by a separate route from the remainder of North West Europe. It takes into account the net impact of such a change on unit costs to Continental Europe, even though these are of limited interest to the UK, because this will influence future shipping company decisions. The analysis uses an entirely different model (LINCOST), which has no relationship to the main container modelling process. For this reason it is not discussed any further here.

Figure 2.1 Overview



2.2 Traffic Forecasts

2.2.1 The disaggregation of the traffic forecasts which form the input to the traffic assignment process is illustrated in Figure 2.2. GB deepsea container traffic is broken down firstly by overseas trading partners (trade lanes), then by quasi shipping line, and finally by inland origin-destination zone. The result is a series of 2,660 trade flows (4 trade lanes x 5 shipping lines x 133 inland O-D zones).

Trade lanes

2.2.2 The GB traffic forecasts which form the starting point for the model have been prepared using another MDST model known as FORK. This is an econometric model for forecasting country-to-country trade flows by commodity at the two digit SITC level. It is based on historic Customs data for different countries, which is collected where possible on a tonnage basis. This is related to up to six macro-economic indicators for which short-term forecasts are available from various national and international authorities (GDP, price inflation, and exchange rates for each of the two countries). Longer term forecasts rely on historic trends.

2.2.3 The aggregate growth rates (% p.a.) which FORK produces for UK trade as a whole are applied to base year commodity flows through GB ports (tonnes), and then converted into container flows (TEUs) using representative stowage factors for each commodity. Total container flows, including empties, are forecast by doubling flows in the dominant direction, which is usually imports.

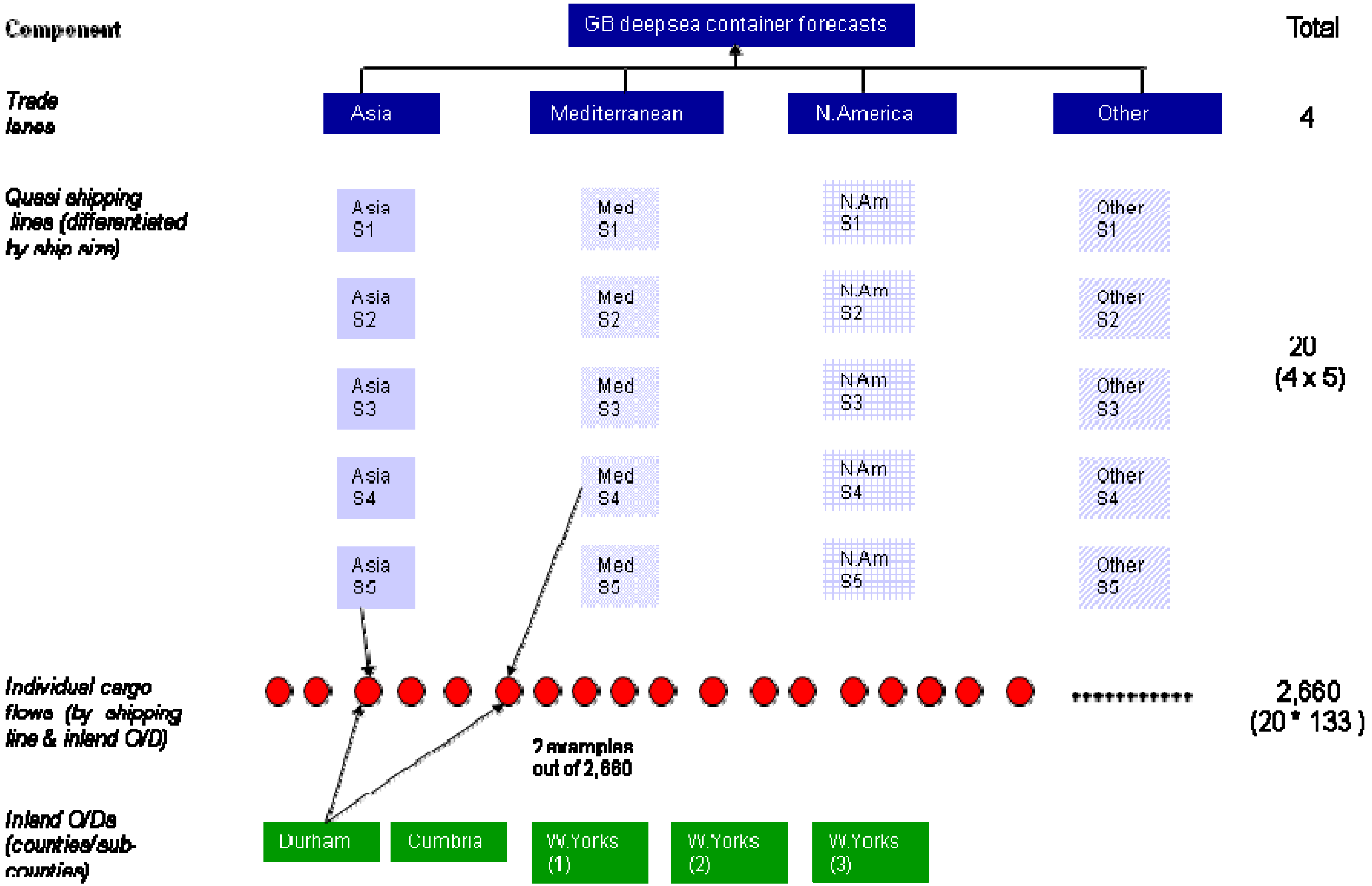
2.2.4 The forecasts of GB deepsea container trade used in the Updated MDST Report are shown in Table 2.1.

Table 2.1 GB Trade Lane Forecasts

Trade lane	m containers		Growth	% of total deepsea	
	2003	2030	% p.a	2003	2030
Asia	1.388	5.014	4.87	46.4%	54.7%
Mediterranean	0.670	1.914	3.97	22.4%	20.9%
North America	0.444	1.082	3.35	14.8%	11.8%
Others	0.491	1.149	3.20	16.4%	12.5%
Total	2.993	9.159	4.23	100.0%	100.0%

Source: MDST model spreadsheet

Figure 2.2 Traffic forecasts



Port groups

2.2.5 Whereas all non-SE ports are individually considered, ports in the South East have been aggregated into three groups:

Haven:	Felixstowe, Bathside Bay
Thames:	Tilbury, Thamesport, London Gateway
Solent:	Southampton

Quasi shipping lines

2.2.6 The container trade on each trade lane is split equally between five different quasi shipping lines, each of which is assumed to operate a different size of ship: large, semi-large, average, semi-small and small. The shipping lines on each trade lane operate completely independently of those on other trade lanes.

2.2.7 The relationship between ship sizes, expressed as a percentage of average ship size, remains constant, although the average ship size increases over time and also varies by trade lane. The proportion of each trade lane's traffic handled by each quasi shipping line remains constant over time.

Table 2.2 Ship Size Characteristics for All Trade Lanes

Shipping service	Ship size as % of average	Share of containers
S_1	150%	30%
S_2	125%	25%
S_3	100%	20%
S_4	75%	15%
S_5	50%	10%

Source: Communication from MDST

2.2.8 The average size of ship operating on each trade lane varies over time (Table 2.3), which means that the largest ships operating into GB ports by 2030 (150% * 12,911 TEU = 19,365 TEU) are very large indeed. The model does not address the issue of ship size constraints, but assumes that there will be facilities within each port or port group capable of handling the largest sizes of ship in operation in any given year.

Table 2.3 Average Ship Capacity by Trade Lane (TEU)

Trade lane	2004	2010	2015	2020	2025	2030
Asia	5,150	6,654	8,103	9,265	10,753	12,911
Mediterranean	4,050	5,138	5,872	6,702	7,745	8,923
North America	3,350	3,935	4,303	4,792	5,407	6,366
Others	3,000	3,651	4,072	4,519	5,244	5,710

Source: MDST model spreadsheet

2.2.9 The model assumes that the load factor – the number of TEUs carried by each ship for all destinations in its itinerary including NW Europe ports – is 90% of its capacity.

2.2.10 The proportion of each shipping line's trade which is destined for UK is shown in Table 2.4. It is assumed to fall over time because historically container traffic has been growing faster in Continental Europe than in the UK. This is true even after the exclusion of transhipment traffic, and reflects the appreciation of the Euro which has widened price differentials between locally-produced and foreign goods on the Continent much more than in the UK.

Table 2.4 Percentage of European Trade destined for UK[a]

Trade lane	2003	2005	2010	2015	2020	2025	2030
Asia	20.7%	18.1%	18.6%	18.1%	17.9%	17.7%	17.6%
Mediterranean	22.7%	21.4%	21.4%	21.1%	21.0%	20.8%	20.7%
North America	14.2%	12.8%	12.0%	10.9%	10.2%	9.7%	9.3%
Others	14.7%	12.1%	12.2%	11.6%	11.2%	11.0%	10.8%

Note: (a) UK is taken as a proxy for GB.
Source: MDST model spreadsheet

Inland origin-destinations

2.2.11 GB deepsea container trade is assigned to 133 inland zones. These are basically counties, with the larger counties split into several sub-units to avoid the "lumpiness" in the traffic assignment which would occur if the traffic from one large county switched routes. The counties which generate the largest amounts of traffic have been split so that no zone accounts for more than 1% of GB container trade. Most of the English zones account for between 0.5-1.0% of GB trade, although three of the Scottish zones each account for as little as 0.04% of GB trade.

2.2.12 The inland distribution of container traffic in the Updated MDST Report is derived from recent data provided independently by a major shipping line and a West Coast port, which MDST has compared with data from the DfT Continuing Survey of Road Goods Transport and Network Rail data on rail container movements from ports. The data has also been incorporated into the Great Britain Freight Model (GBFM). The Original MDST Report, in contrast, used the results of an origin-destination survey for GB container traffic carried out by DfT in 1991.

2.2.13 A summary of the inland origin-destination assumptions by planning region is given in Table 2.5.

Table 2.5 Inland Origin-Destination of Deepsea Container Trade by Region

Region	% of trade
North East	2.8%
Yorks&Humber	12.4%
East Midlands	16.5%
East of England	8.9%
South East	18.8%
South West	5.2%
West Midlands	13.1%
North West	15.0%
Wales	3.5%
Scotland	3.7%
Total	100.0%

Source: MDST model spreadsheet, Updated MDST Report

2.2.14 All trade lanes and quasi shipping lines have the same inland O-D pattern for their containers, and this remains so throughout the model run.

2.3 Door to Door Transport Costs

2.3.1 The transport cost data which form the basis for the assignment process fall into three groups, relating to land transport costs, sea transport costs, and stevedoring costs.

2.3.2 The inland transport costs (£ per container) vary with distance by zone-GB port pair. The shipping line costs are of two types:

- the fixed annual costs of calling at a GB deepsea port, which vary by port and shipping line (£'000 p.a.), and
- freight rates from Continental transhipment hubs to GB feeder ports (£ per TEU).

The stevedoring costs (£ per container) can vary by port, but are the same for each shipping line at each port.

2.3.3 The way in which each cost is calculated is described in the sections which follow. The costs are then combined as shown in Figure 2.3 to generate four major cost inputs to the traffic assignment process:

- port-zone land transport costs,
- the fixed annual costs to shipping lines of using different GB ports,
- transhipment costs from Continental hub ports to GB feeder ports, and
- stevedoring costs at GB deepsea ports.

The rationale for grouping costs in this way is discussed in Section 2.4, which describes the traffic assignment process.

Land transport costs.

2.3.4 The land transport costs from each county[3] to each potential GB port (including feeder ports) depend on whether the cost for container transport is lower by road or rail.

2.3.5 The formulae for calculating port-county road and rail costs (£ per container) are distance based:

$C_{rail} = 201 + (0.2624*d)$

$C_{road} = 80 + (0.7500*d)$ where d = distance from the county to the port in km.

2.3.6 The fixed cost for rail is higher than for road because it includes local collection & delivery costs to / from the rail depot (£89 per container) and the extra lift on – lift off costs at the inland rail depot (£62 per container).

2.3.7 The two formulae give a similar cost for a port-county distance of approximately 246km. Below this distance, where the average cost of road transport is less than rail, the road cost is used. Above it, the rail cost is adopted as the inland transport cost.

Sea transport costs

2.3.8 Deepsea shipping costs to GB ports include diversion costs from the main sea lanes through the English Channel, ship time in port, and port entry charges.

2.3.9 Diversion costs are based on the diversion distance from the main sea routes to NW Europe, not the full distance travelled by the ship from its last port of loading. Diversion distances are calculated on the basis of a triangular diversion pattern – a different route back to the sea lane from the GB port to the one taken to get to it – and are shown in Table 2.6.

[3] In the land transport cost model, the GB inland zones are referred to as "counties" although some of these are actually fractions of large counties. In this report, we have retained the use of county to refer to GB inland origin and destination zones.

Figure 2.3 Door to Door Transport Costs

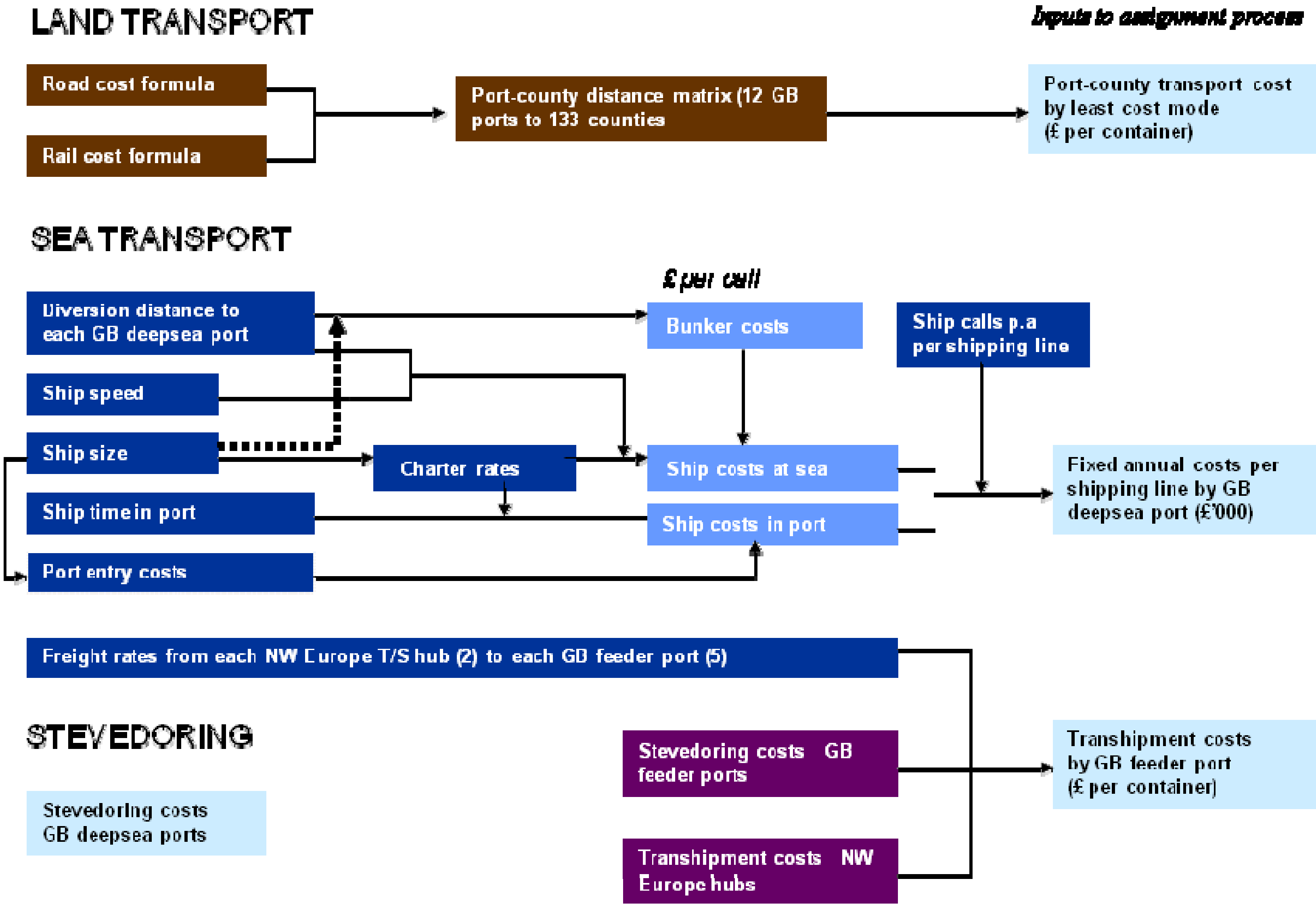


Table 2.6 Diversion Distances for Deepsea Ships (nm)

GB deepsea ports	Asia	Mediterranean	North America	Others
Felixstowe	38	38	98	38
London Gateway	80	80	140	80
Southampton	32	32	85	32
Bristol	374	374	326	374
Clyde	640	640	336	640
Liverpool	598	598	464	598
Teesport	299	299	133	299

Source: Fairplay Veson distance tables

2.3.10 The ship diversion distances are converted into costs for each size of ship by dividing the distance by the assumed speed to get the additional sailing time in hours, and multiplying this by the appropriate daily charter rate. Bunker costs are input to the model as a cost per mile, calculated outside of the model on the basis of ship size and speed, and the price per ton of bunkers. The figures used in the Updated MDST Report are shown in Table 2.7.

Table 2.7 Deepsea Ship Speeds, Charter Rates and Bunker Costs

Ship Size (TEU)	Speed (knots)	Charter (£ per day)	Bunker (£ per mile)
1,000	16.0	7,500	22
3,000	20.0	13,000	38
5,000	24.0	17,000	49
8,000	24.9	21,000	63
10,000	25.4	23,500	70
12,000	26.0	26,000	77
15,000	26.9	29,000	86

Note: (a) based on bunker costs of US300 per ton, roughly half price prevailing in August 2008
Source: MDST Original Transhipment Report

2.3.11 There are two other costs associated with calling at GB deepsea ports: ship time in port and port entry charges.

2.3.12 Ship time in port is assumed to be 10 hours. This covers berthing and unberthing time, plus a nominal allowance to cover the risks of delay that have been built into the sailing schedule. It does not cover cargo handling time, which has been excluded from the analysis because it will be the same irrespective of whether the ship loads and discharges its cargo in the UK or a port in NW Europe. It does include an allowance for the ship's time spent waiting for a berth, which is assumed to be low because of the reservation of berthing slots[4].

2.3.14 Ship time costs in port are calculated by multiplying the time of 10 hours (which can easily be altered) by an appropriate hourly ship charter rate, which varies by size of ship.

2.3.15 Port entry charges cover ship-related costs such as port dues, pilotage and towage, and mooring/unmooring fees. They are directly related to ship size, and have been set at £4 per TEU of ship capacity, a figure which can be varied but is always the same for all GB deepsea ports. It is treated as a fixed cost and it does not change during the runs of the model.

2.3.16 Feeder ship costs are treated in a totally different way to deepsea ship costs, in that they are based on freight rates rather than charter rates. The freight rates reflect a range of other

[4] The increase in stevedoring charges is also intended to discourage any increase in ship waiting times

factors as well as distance, and implicitly include bunker costs, port entry charges[5] and ship time in port. The feeder ship costs used in the Updated MDST Report are shown in Table 2.8.

Table 2.8 Feeder Ship Costs (£ per TEU)[a]

GB feeder port	Rotterdam			Le Havre		
	2005	2010	2015 on	2005	2010	2015 on
Avonmouth	105	109	112	83	86	89
Grangemouth	85	88	91	99	103	106
Liverpool	118	123	126	96	100	103
Teesport	70	73	75	84	87	90
Tilbury	59	61	63	61	63	65

Source: MDST model spreadsheet

Stevedoring costs

2.3.17 At the start of each model run different “base line” stevedoring charges can be set for each GB deepsea port, including those outside of the South East. In practice this facility has not been used, and the MDST Reports have been based on a standard stevedoring charge of £70 per container at all GB deepsea ports.

2.3.18 Once capacity constraints are encountered at a GB deepsea port, increases in stevedoring charges at that port are used as the mechanism for rationing demand. Charges are increased in 50p steps.

2.3.19 GB feeder port costs can also be set independently for each port, although the MDST Reports are based on a common charge of £50 per container for all feeder ports. MDST has stated this reflects market rates.

2.3.20 NW Europe hub port costs are restricted to the additional costs of handling transhipment traffic, on the grounds that the vessel would be going there anyway and would have to pay port entry charges in order to load and discharge its Continental cargo. Transhipment charges at NW European hub ports were originally set at £80 per container per two way move, which represents the basic stevedoring charge. In the Updated MDST Reports, an additional £40 per container was added for administration costs, bringing the total cost to £120 per container. This figure can be easily changed.

Conversion to a common basis

2.3.21 The land transport, shipping and port costs are calculated initially for a mixture of containers and TEU. The model converts them to a standard TEU basis by making assumptions about future changes in the proportion of 40ft containers. This increases the TEU/box ratio from 1.62 in 2003 to 1.75 by 2015, after which it remains constant.

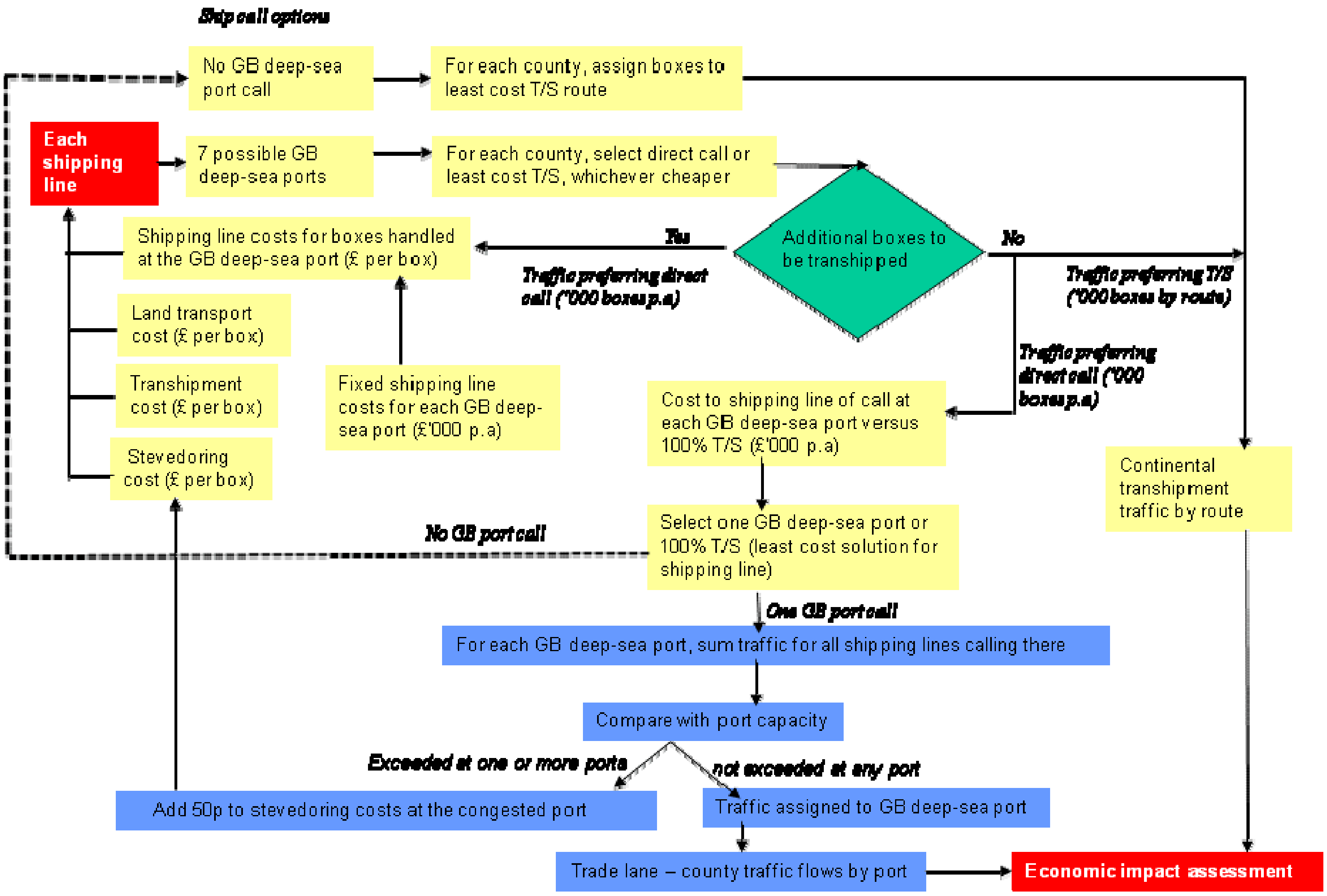
2.3.22 The land transport, shipping and port costs are also in a mixture of currencies. These have been converted to £ “off-model” at the exchange rates prevailing at the time the model was run.

[5] Stevedoring charges at the T/S hub are normally paid by the deepsea shipping line, and feeder port charges are considered separately.

2.4 Traffic Assignment Process

2.4.1 The traffic assignment process distributes container traffic between GB deepsea ports and Continental hub/GB feeder ports in a way which minimises door-to-door transport costs to the quasi shipping lines whilst not violating the capacity constraints at ports. Figure 2.3 and the description of the assignment process which follows have both been simplified to focus on what the model achieves, rather than the detailed mechanisms used to carry out the calculations.

Figure 2.4 Assignment Process



Assignment of county traffic by individual shipping lines

2.4.2 The model begins by distributing the forecast traffic for the year in question between the quasi shipping lines. Each shipping line is then faced with the choice of calling at one of seven GB deepsea ports (or port groups), or not making a GB call at all. In each case the ships also call at both Rotterdam and Le Havre.[6]

2.4.3 The model then examines for each of the seven GB deepsea ports in turn how the shipping line would distribute its traffic to the individual counties if that were its preferred GB port of call. For some counties it will be more cost-effective for the containers to be loaded and discharged at the GB deepsea port; for other counties – particularly those in Scotland and the north of England – it may be more cost effective for the containers to be transhipped via Rotterdam or Le Havre, as proxies for all main NW Europe continental ports, even when there is a GB port call, as the ship is going on to the Continent anyway and there may be a feeder port much closer to the county concerned.

2.4.4 The cost comparison which forms the basis for the decision on how to route each county's traffic is between:

GB deepsea port cost = Ship diversion cost + stevedoring cost + port-county land transport cost

Transhipment cost = Continental port transhipment cost + feeder ship cost + GB feeder port stevedoring cost + county-GB feeder port land transport cost

Both of these costs are calculated in terms of £ per TEU[7].

2.4.5 When calculating the direct call costs for each county, the quasi shipping line costs at the GB deepsea port under consideration (£ per container) are calculated by dividing its fixed annual costs at that port by the amount of traffic carried on its ships. At the beginning of the model run the traffic carried is determined by the input data (the quasi line's share of all GB containers in its trade lane), but as soon as it becomes more cost effective for the quasi line to tranship some of its GB containers at a Continental port the number of boxes loaded and discharged at the GB port falls, increasing the unit costs of using it. This makes the GB port more expensive for each county relative to the costs of transhipment, resulting in more transhipment traffic.

2.4.6 This feedback loop produces an iteration sequence in which successive increases in the unit costs of ship calls become progressively smaller until they converge to an equilibrium. At this point, the shipping line reaches a final decision on how much traffic to move through the GB deepsea port and how much to tranship via the Continent.

2.4.7 When calculating transhipment costs, each quasi line reviews 33 alternative distribution options, from which it selects the one with the lowest cost. There are 33 options because each of the five GB feeder ports can be served by feeder ships from one or both Continental hubs, resulting in 2^5 (= 32) options. In addition, there is the final option that none of the GB feeder ports are served from either Continental hub.

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[6] The detailed procedure followed by the model is to divide the traffic in each trade lane into three parts, pro rata to the capacities of the three SE port groups. Each part is then split between the five quasi shipping lines operating on that trade lane, and these "sub-parts" are then offered to the appropriate SE port group and all non-SE deepsea ports. As a result, the three SE port groups do not compete with each other.

[7] The charge is set by MDST at £70 per container, converted to TEU by division by a value (TEU/box ratio) that changes over time (maximises at 1.75)

Shipping line port choice

2.4.8 Having carried out the exercise described above for each of the seven possible GB deepsea ports, the quasi line now has to decide which one (or none) to use[8]. It does this by summing for each GB deepsea port of call and none the cost of delivering containers to each of the counties via the preferred route for that county.

2.4.9 This is illustrated graphically in Table 2.9, in which the shaded areas indicate the preferred routeing pattern for each county under each GB deepsea port option. In addition there is an eighth option which needs to be considered: no GB port call at all.

Table 2.9 Comparing Port Choices

County	GB deepsea port option														No GB port
	Haven		Thames		Solent		Liverpool		Clyde		Teesport		Bristol		
	GB	T/S	GB	T/S	GB	T/S	GB	T/S	GB	T/S	GB	T/S	GB	T/S	T/S
A															
B															
C															
D															
E															
etc															
costs	£x million		£ y million		£ z million		etc								

Notes: GB = direct call at the port indicated above
T/S = the lowest cost of the 33 available T/S options

2.4.10 After computing the costs of each port choice option, each quasi line selects the one with the lowest total annual costs, and assigns its traffic accordingly between the preferred GB deepsea port (if any) and Continental hub/GB feeder port routes. Because different quasi lines have different cost structures arising from differences in ship size, they may choose different ports.

Port capacity constraints

2.4.11 The model then sums for each GB deepsea port the total amount of traffic loaded and discharged by the shipping lines which have chosen to call there, and checks this against the total capacity of each port to ensure it is not exceeded.

2.4.12 If capacity is exceeded at any of the seven ports, that port raises its stevedoring charge by 50p per container for all containers handled there. The whole costing exercise is then re-run from the beginning with the higher stevedoring charge in place. This affects not only the distribution of each quasi line's traffic on a county-by-county basis, but also the quasi lines' port choice decisions: containers and/or quasi lines migrate between ports in response to the higher charge. As a quasi line may be able to reduce its cost by migrating to an alternative GB deepsea port (or none) before all the containers carried by that line have migrated to a Continental transhipment option, large step reductions in demand may result. There are restrictions in the model to the patterns of migration that are permitted: a quasi line cannot migrate between South East ports, so if it leaves a South East port it must go to a non-South East Port or not visit a GB deepsea port at all.

2.4.13 This second iterative process continues with congested ports increasing their stevedoring charges in increments of 50p until such time as all GB deepsea ports have throughputs which are less than or equal to their capacities. As the migration of a quasi line to an alternative port may result in a large step reduction in demand, there may be excess capacity when the model reaches a market clearing equilibrium even though the stevedoring charge has been increased to ration demand. The final traffic routeing for each trade lane-county pair is output

[8] The model does not allow a shipping line to make more than one GB deepsea port call

into a large spreadsheet which is used in the final part of the study to carry out the economic impact assessment of different port expansion scenarios.

2.4.14 Any unused GB deepsea port capacity is assumed to be available for third country transhipment (the transhipment of non-GB containers through a GB port).

2.5 Port Development Scenarios

2.5.1 The port development scenarios to be tested by the model are expressed in terms of different amounts of GB deepsea port capacity at different locations. These have been based on existing or planned quay lengths, and quay productivity assumptions expressed in TEUs p.a. per metre of quay. Both of these parameters can be easily varied.

Existing port capacity

2.5.2 The MDST Reports are based on productivities in the region of 1,110 TEU p.a. per metre of quay. This is 5-10% higher than in 2004, when ports in the South East were working just below capacity, and remains constant from 2010 onwards. Productivity is slightly lower at the smaller ports (Thamesport, Tilbury and Avonmouth) and at Liverpool (existing and new) where there is a lower ratio of back up space relative to quay length. Port capacity at existing deepsea terminals in 2010 is shown in Table 2.10.

Table 2.10 Capacity at Existing GB Deepsea Terminals in 2010

Deepsea Port	m TEU
Felixstowe	3.100
Thamesport	0.613
Tilbury	0.524
Southampton	1.657
Bristol	0.559
Liverpool	0.974
Total	**7.427**
Clyde	0.334

Note: (a) Clyde has the capability for handling deepsea ships, but is not competitive for deepsea traffic because of its distance from the English Channel sea lanes.
Source: MDST model spreadsheet

2.5.3 As noted earlier, NW Europe hub ports and GB feeder ports are assumed to have unlimited capacity, as they are expanded to meet demand.

Port development scenarios

2.5.4 The four port capacity scenarios used in the Updated MDST Report[9] were:
Scenario 1: No increase in deepsea port capacity (the Do Nothing situation)
Scenario 2: Expansion at Felixstowe South, Bathside Bay, London Gateway, Liverpool and Southampton
Scenario 3: Scenario 2 plus expansion at Bristol and Tees
Scenario 4: Scenario 3 less expansion at Southampton

A summary of the capacity provided by these scenarios is given in Table 2.11.

[9] The original MDST Report tested eight scenarios for the provision of additional port capacity, including one which looked at the possibility of ports in NW Europe experiencing capacity shortages, resulting in an increase in their transhipment charges and shipping line interest in direct calls to Northern and Western Britain.

Table 2.11 Capacity to be Provided Under Different Scenarios (m TEU p.a)

	2005	2010	2015	2020	2025	2030
Existing Ports	6.66	7.43	7.43	7.43	7.43	7.43
Felixstowe South	-	1.01	1.01	1.01	1.01	1.01
Bathside bay	-	-	1.55	1.55	1.55	1.55
London Gateway	-	-	2.55	2.55	2.55	2.55
Liverpool	-	-	0.44	0.44	0.44	0.44
Southampton	-	-	2.04	2.04	2.04	2.04
Total: Scenario 2	**6.66**	**8.44**	**15.03**	**15.03**	**15.03**	**15.03**
Bristol	-	-	-	1.33	1.33	1.33
Teesport	-	-	1.11	1.11	1.11	1.11
Total: Scenario 3	**6.66**	**8.44**	**16.14**	**14.47**	**14.47**	**14.47**
Total Scenario 4	**6.66**	**8.44**	**14.10**	**15.43**	**15.43**	**15.43**

Source: MDST *Updated Transhipment Report*

2.5.5 There is an implicit assumption in the model that enough new port capacity will be designed to accommodate the maximum size of ship calling in future, avoiding the need to divert ships to NW Europe ports because they are too large to be handled in GB.

2.6 Economic Impact Assessment

2.6.1 The economic impact assessment estimates the effects on the UK economy of different scenarios for increasing GB deepsea port capacity in comparison with a "Do Nothing" base case. It takes as its input the output of the traffic assignment process, which shows the container routeing pattern for each trade lane-county pair, together with the costs of each leg of the journey (deepsea shipping line costs, land transport costs, etc.).

2.6.2 The model estimates the net impact of each scenario in terms of:

- Feeder berth requirements.
- The delivered costs of containers to GB shippers/consignees.
- GB transport revenues, including port revenues from third country transhipment.
- Road & rail transport requirements.
- Environmental impact in terms of sensitive lorry miles.

The basic building blocks which are used to calculate the economic impacts are shown in Figure 2.5.

2.6.3 **Feeder berth requirements** are obtained by dividing the number of TEU moving through each feeder port at the end of each model run by a nominal figure for quay productivity of 770 TEU per metre (the same for all feeder ports), and an allowance is then added for the increase in quay space required to accommodate the growth in short-sea (non-feeder) traffic. The latter reaches 1,007m by the end of the evaluation period.

2.6.4 **Delivered cost of containers** to GB shippers/consignees is calculated by adding:

- Deepsea ship diversion costs to GB ports (sailing time and time in port).
- Transhipment costs in NW Europe.
- Feeder ship costs to GB ports.
- GB port charges for deepsea and feeder ports (stevedoring charges, plus port entry charges for deepsea ports).
- GB road and rail costs from GB deepsea and feeder ports to individual counties.

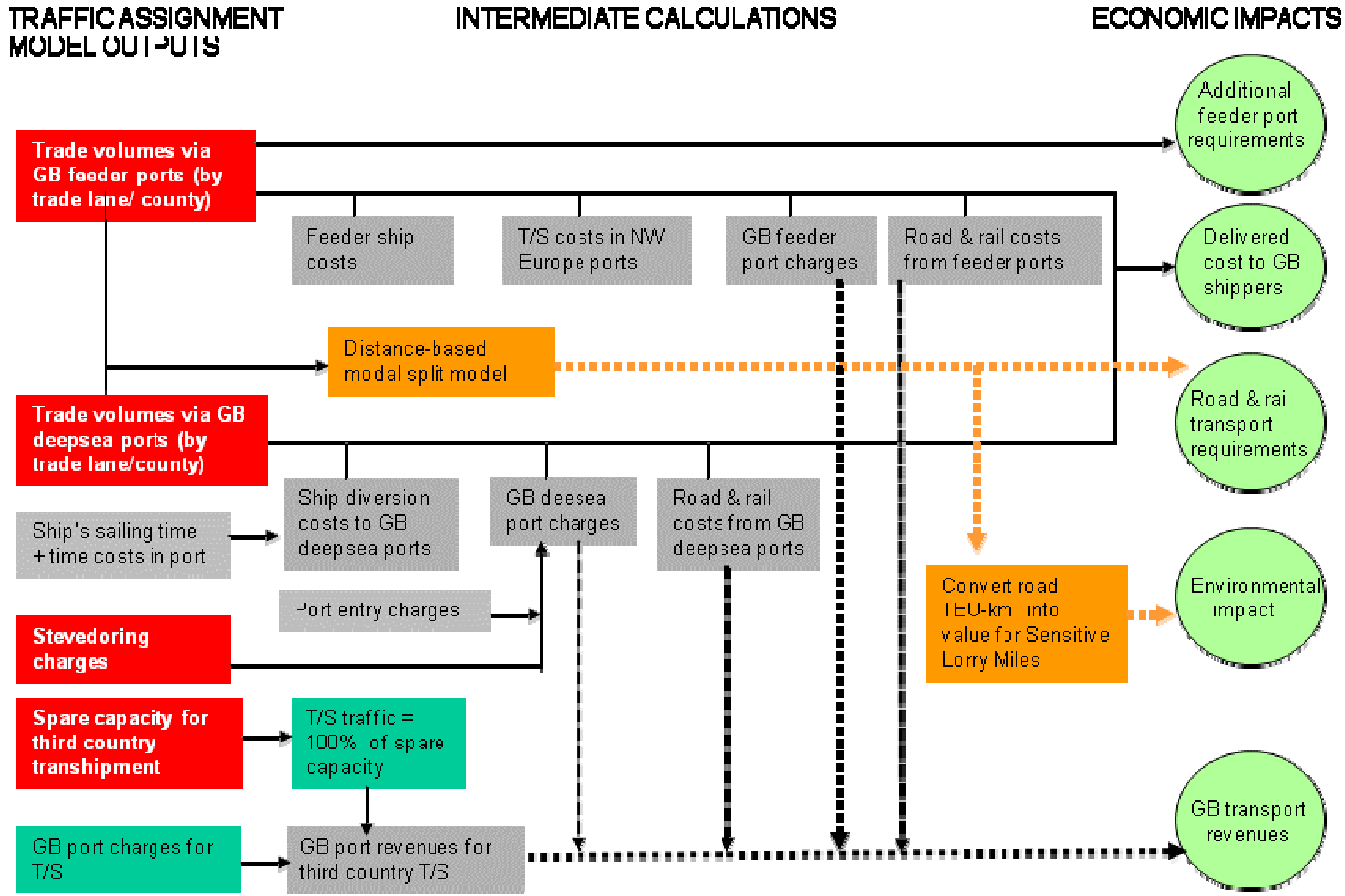
2.6.5 **GB transport revenues** are the revenues which accrue to UK-based transport service providers, and are calculated by adding:

- GB deepsea and feeder port charges for GB container traffic.

Road and rail costs from GB deepsea and feeder ports to the counties. The road and rail costs used in this calculation are the same as those used in the traffic assignment process (i.e. they represent the least cost mode of transport for each port-county pair).

Port revenues from the handling of third country transhipment traffic. The revenue calculations assume that all of the spare port capacity available for third country transhipment is actually used for this purpose.

Figure 2.5 Economic Impact Assessment



2.6.6 The model assumes that deepsea and feeder ships are all foreign-owned, and excludes their freight earnings from the calculation of GB revenues. It also assumes that all trucks are UK-owned, and includes 100% of road haulage costs in GB revenues.

2.6.7 **Road and rail transport requirements** are the total TEU-km moved by road and rail. The modal split for each port-county pair is calculated using a distance-based formula, not the cost-based formula used in the main traffic assignment process. It calculates rail's market share as follows:

$Share_{rail}$ = 0% for distances of up to 200km
$Share_{rail}$ = 100% for distances of over 540km
$Share_{rail}$ = (d-200)/340 for distances between 200-540km

where d = distance from port to county in km. The 50% mode split point occurs at 370km, which is not the same as the distance at which the costs of road and rail land transport are equal (246km).

2.6.8 For each mode of transport, the model calculates the total number of TEUs moving between each port-county pair, the proportion travelling by that mode of transport, and the distance. These are multiplied together and then summed across all port-county pairs to provide national totals.

2.6.9 **Environmental impact**. The road transport requirements (TEU-km) are expressed as a monetary value for environmental impact assessment purposes by converting them into truck-miles[10] and then multiplying them by a standard figure of 28.5p per truck-km.

2.6.10 This is lower than the weighted average value for Sensitive Lorry Miles calculated by DfT/SRA for the GB road network as a whole (53p per truck-mile or 33.12p per truck-km), as long distance container lorries travel relatively short distances in the conurbations, and also minimise their use of non-motorway roads. For comparison, the current values for Sensitive Lorry Miles are shown below.

		pence per lorry mile
Motorways:	high congestion	69p
	medium congestion	27p
	low congestion	4p
Trunk & principal roads:	conurbations	138p
	other	53p
Other roads:	conurbations	174p
	other	45p

2.6.11 The additional environmental costs associated with the construction of new deepsea port capacity are calculated by comparing the value of sensitive lorry miles in each port development scenario with those in the Do Nothing case. Continental transhipment allows containers to be delivered by sea to feeder ports located closer to the market, but the use of feeder ports results in a higher proportion of GB deepsea container traffic being distributed by road rather than rail.

[10] Based on the TEU/box ratio for the year in question and assuming one container per truck, even though in practice a small proportion of trucks carry two 20ft containers.

3. COMMENTS ON THE MDST MODEL

3.0.1 Our comments on the MDST model relate to the model structure, the input assumptions and to general "fitness for purpose" issues. These include the sensitivity of its results to variations in input assumptions.

3.0.2 In section 3.6, we attempt to draw together our comments on the overall sensitivity of the results to changes in model structure and input data and assess the applicability of the model in supporting maritime policy formulation.

3.0.3 The comments focus on the issues which are likely to have the greatest effect on the conclusions that can be drawn from the model's output. They follow the same sequence as Chapter 2, dealing in turn with the traffic forecasts, land and sea transport costs, the traffic assignment process, the scenarios which were tested, and the economic impact assessment.

3.0.4 We recognise that in some areas there are differences of opinion between ourselves and MDST. In some cases, this is because of differing data sources and in others because survey data is limited or unavailable. We have tried to make the reasons for any differences as clear as possible.

3.0.5 In other cases, our views on likely future developments differ from those of MDST. Again, these differences are arguable and we have tried to clarify the areas where our views are based on a different perspective.

3.0.6 In these areas, sensitivity tests could be beneficial to determine the degree to which the conclusions are dependent on exogenously forecast parameters such as terminal efficiency and quay face productivity.

3.1 Traffic Forecasts

3.1.1 The base year traffic data used in the model, which is from HM Customs, is difficult to cross-check against the principal independent source – DfT's *Maritime Statistics 2005* – because the two sets of data are compiled on a completely different basis. The Customs data is on a country of origin basis, whereas the DfT data uses the last port of loading, including intermediate transhipment ports, to classify containers by overseas origin-destination.

3.1.2 There is no explicit listing in the MDST model of the countries included in each trade lane, but it is known that MDST and DfT have used slightly different definitions for deepsea and short-sea trades. For example, the MDST definition includes non-EU countries bordering the Mediterranean, which are recorded as short-sea in the DfT statistics.

3.1.3 This makes it difficult to calibrate the forecasting model, although MDST have cross-checked the distribution of containers between GB ports which the model produces for 2005 against the distribution of containerised cargo by port shown in the Customs data, and found it to be reasonably satisfactory.

3.1.4 In respect of future traffic growth, the FORK model uses six macro-economic indicators to produce sophisticated short-term predictions of GB commodity flows (tonnes) at the two digit SITC level, but relies heavily on trend analysis for forecasting long-term changes in container flows. This is because GDP growth is a weak explanatory variable and may lead to certain types of structural change being overlooked. For example, trade in some commodities grows faster than others at different stages in the economic cycle. Furthermore the ratio of container traffic growth to GDP growth also varies significantly between countries, and in the same country over time, as the structure of the economy changes.

3.1.5 However the use of long run trend data can also give rise to misleading results when significant changes are taking place in the terms of trade that are not reflected in the past data. This is particularly true at the present point in time, with the slowdown in the world economy and the weakening of the £ relative to the Euro and US$. Sensitivity tests could be carried out to examine the possible effects of a slowdown in the world economy or a change in the terms of UK trade. The events of the past two months reinforce this proposal.

3.1.6 The treatment of empty containers in the MDST model is not transparent, and is difficult to check because empty container movements are not recorded in the Customs data, and are presented in a highly aggregated form in DfT's *Maritime Statistics 2005*, where deepsea and short-sea empties are grouped together. MDST have stated that empty containers in the dominant direction of flow have been included in their estimates of stowage factors for different commodities, but there is no easy way of verifying this. For GB container traffic as a whole, empty boxes accounted for around 7.5% of inward container movements in 2005[11].

3.1.7 Although better calibration of the base year traffic data, a more detailed explanation of the forecasting method, and greater separation of full and empty container movements are in theory desirable[12], the improved quality of the results would be unlikely to justify the additional time and effort required.

3.1.8 We note that the deepsea container growth rates forecast by MDST are broadly comparable with those put forward by other expert witnesses at the recent public enquiries into new container terminal projects. Further refinements to the traffic forecasts are therefore unlikely to be of immediate value, whilst a sensitivity test to examine the effects of a downturn in world trade would probably draw its traffic forecasts from an analysis of the current downturn and its effect on world trade rather than the FORK model.

Trade lanes

3.1.9 The use of the term "Mediterranean" for one of the four trade lanes in the model may be confusing to readers, as it omits the larger Mediterranean countries which are EU members. This is largely because HM Customs no longer collects trade data for these countries in a form which is useable in the model. It also includes some (but not all) of the regions outside of the Mediterranean whose ships pass through it, resulting in the following 2005 traffic breakdown:

	'000 TEU	*share*
Mediterranean*	528	43%
West Asia	549	45%
Oceania	155	12%
Total	1,232	100%

* mainly Turkey, Israel and North Africa

3.1.10 Traffic which is of purely Mediterranean origin has more alternatives available to it when GB deepsea ports become congested than deepsea traffic from more distant areas. It can be carried as short-sea cargo on ships which are able to use the smaller GB ports, including Ro-Ro terminals. It can move overland, entering Great Britain through the Channel ferry ports or the Channel Tunnel. As its ships have less need to go on to ports in NW Europe, some may terminate in Great Britain, discharging a full load of containers instead of the assumed 21%, whilst other ships might pair GB with Ireland or ports on the Atlantic coast of France. Even if the percentage of "pure" Mediterranean traffic taking up these options is small, it will produce some reduction in the amount of traffic wishing to use GB deepsea ports once these reach full capacity working.

3.1.11 The use of country of origin data to estimate traffic volumes in each trade lane appears to ignore the growth of large transhipment hubs in the Mediterranean at locations such as Algeciras, Tangier-Med and Gioia Tauro. Although classified as deepsea, some of the Asian traffic in particular is likely to reach GB on feeder ships which start their voyages in the Mediterranean. While larger than the feeder ships from North West European hubs, these will be smaller than the ships used on the main deepsea routes, and as a result may have a wider

[11] DfT Maritime Statistics 2005
[12] Routeing decisions for empty containers may be slightly different to those for full containers because the time pressures are less. However, very little is known about this. The main reason for separating out empties is therefore to provide a better check on total container flows in the base year for the model.

choice of GB ports available to them. This will also reduce pressure on GB deepsea ports once they reach full capacity.

Port groups

3.1.12 The aggregation of South East ports into three groups is based on geography alone, and does not take into account differences in their ownership. As a result, and in accordance with the DfT terms of reference, the model does not make any allowance for competition within port groups, for example between Tilbury (Forth Ports), London Gateway (DP World) and Thamesport (Hutchison Port Holdings) all of which are in the Thames group.

3.1.13 There is also a mechanism in the model which effectively prevents the South East port groups competing with each other. Although this does not appear to accord with the likely future competitive position, it is unlikely to have much effect on the results, as the proximity of the three South East port groups and the similarity of their assumed cost structures results in them reaching full capacity working at around the same time, albeit with some small differences in their “full capacity” stevedoring charges.

3.1.14 The calculation of route costings on the same basis and at the same time for deepsea ports inside and outside of the South East, means that the model does not appear to us to have any inbuilt bias in favour of South East ports, as some commentators have suggested. The fact that the majority of deepsea traffic ends up in South East ports is due primarily to their locational advantage.

3.1.15 The model assumes that all port groups and ports outside of the South East can handle all sizes of ship. In practice there is likely to be some differentiation between them, particularly as ship sizes increase over time.

3.1.16 In addition, as discussed in Chapter 4, a shipping line’s choice of port is likely to be influenced by several factors not included in the MDST model, such as transit time and inventory costs.

Shipping lines

3.1.17 The use of quasi shipping lines operating five different sizes of ship within each trade lane is an interesting way of exploring the effect of economies of scale on port choice. The ships of a given quasi shipping line are treated as inter-changeable.

3.1.18 However, combining the concepts of ship size and competitive shipping line behaviour into a single set of parameters makes it difficult to judge whether the rules used in the assignment process – which are supposed to reflect the competitive behaviour of shipping lines – are appropriate. For example, the model assumes that containers do not switch between ships of different size in response to changes in costs. This may well not be the case in future. It can be argued that there is a feedback loop to the shippers, in which the shipping lines are only able to capture traffic if they provide the services the shippers want. The feedback loop is likely to become stronger in future as overcapacity in container shipping moves the industry from a sellers’ market to a buyers’ market.

3.1.19 Shipping lines may be forced to adopt sub-optimal behaviour patterns because the model does not allow them to reduce the number of ship calls, at the same time increasing the proportion of GB cargo carried by ships that do call. This would be a relatively easy course of action for a shipping line with a large number of strings, and has already been observed at some congested ports.

3.1.20 For example, a shipping line or consortium with five strings in the Asia-Europe trade lane, only three of which call at GB ports, could reduce the number of GB calls from three to two per week, whilst increasing the proportion of their cargo destined for GB from 20% to 30%. However there could be cost implications if the change required an increase in transhipment activity outside of NW Europe – relaying cargo between strings – rather than being accomplished at the original loading ports[13].

3.1.21 Uncertainty about how shipping lines would respond to congestion and the need to allow for any other benefits associated with a service change makes this a difficult aspect of competitive behaviour to model, even though it would prevent some potential over-estimation of transhipment traffic.

3.1.22 The ship size distribution raises three other concerns:

It implies that the largest ships on each trade lane will be three times the size of the smallest, and that the number of ships will be the same in each size category. Actual ship sizes in the deepsea trade lanes appear to be more tightly distributed about the mean, perhaps because they reflect specific route operating cost structures. As a result, there may be less variation in shipping lines' propensity to divert to other ports than the model suggests.

The figures used in the Updated MDST Report suggest that by 2030 around 30% of GB-Asia trade will be handled in ships of 19,365 TEU. While this cannot be ruled out, it is difficult to envisage all GB deepsea ports being expanded to handle ships of this size by 2030.

The underestimation of transhipment caused by the above issue is offset by the fact that changes in ship size are not permitted during the model run to allow shipping lines to respond to significant changes in market conditions. This is likely to overestimate transhipment traffic[14] because containers could in real life continue to be delivered directly on a vessel of another size.

3.1.23 The port development scenarios used in the model suggest that it is unlikely that GB ports will be capable of handling so many very large ships. Indeed, industry discussions about how such large container ships might be deployed raise the possibility that by 2030 these ships would not call at the UK at all, but would instead rely on one or two Continental megaports from which containers would be transhipped to UK ports in large feeder vessels.

3.1.24 Ships of 19,000 TEU capacity are generally referred to as "Malaccamax". They are now actively under discussion, although there are varying views about their likely dimensions and power trains (single or twin screw). This size of ship is likely to require a draft of up to 20m fully laden, the maximum draft which can pass through the Straits of Malacca, where the minimum water depth is about 25m, at full cruising speed. The Suez Canal can currently take vessels with about 14,000 TEUs capacity and there is no reason in principle why it could not be dredged to cater for Malaccamax vessels.

3.1.25 Ship design strength factors are likely to limit overall length, so any reduction in draft would increase beam above the initial proposals of about 60m beam. This in turn would require longer crane jibs and higher strength quay walls to support the higher loads on the quayside crane legs.

3.1.26 As a result, the arrival of Malaccamax ships could lead to a fundamental rethink about the way in which Europe-Asia trade is handled, as these vessels will require purpose-built terminal facilities with very deep quay faces, long dredged channels to deep water and a new generation of cranes. As a result, there may be a move towards the use of hub ports with these specialised facilities and an increase in transshipment to feeder ports. This issue (which is likely to arise within the forecasting period of the study) goes well beyond the remit of the study or the forecasting ability of the model.

[13] According to MDST around 10% of GB deepsea traffic is already transhipped from a mainline ship not calling in the UK to another which is, usually for the shipping line's convenience or to enhance its service offering.

[14] A reduction in ship size would open up a wider range of GB ports, whilst an increase in ship size would allow the shipping line to handle more containers per GB call, reducing its unit costs.

Inland origin-destination data

3.1.27 The origin-destination data used in the Updated MDST Report is the best available, although the sources – a major container line and a non-SE port – suggest that there is probably some bias in the data, as pointed out by MDST. The shipping line is said to handle more long-distance and rail traffic than the norm for the industry, whilst the port data has a geographical bias, and contains more short-distance road traffic than is likely to be found at other ports.

3.1.28 Since publication of the Updated MDST Report the data have been cross-checked by MDST against the O-D distributions found in:

DfT's Continuing Survey of Road Goods Transport, which is based on diaries kept by a sample of hauliers.
Network Rail data on container movements from rail sidings to rail sidings.

We understand that analysis of this data broadly confirms the validity of the O-D split used in the model.

3.1.29 The model assumes that the distribution of containers between counties is the same for all quasi lines. In practice, some real shipping lines have regional strengths due to the location of key large customers, and these can lead to a call at a non-SE port which would otherwise attract only a small percentage of total GB trade.

3.1.30 Regional specialisation exists, but is still fairly weak. It underpins some of the current feeder services to Liverpool, but its ability to support a deepsea container terminal outside of the South East has not yet been put to the test. At the present point in time it would be difficult to incorporate into the model as data on the O-D distribution of containers by line remains commercially confidential.

3.1.31 Note that our study has not assessed the modelling of the alternative strategy set out in Para 4.14 of the MDST Final Report in which the Asia-North America services are diverted to west coast ports. This work was carried out using a different model, LINCOST, and lay outside our brief (See para 2.1.13 above).

3.1.32 Market specialisation by shipping lines – an inland origin-destination pattern dominated by areas close to the port rather than mirroring the national O-D distribution of traffic – might allow Teesport to attract one or more deepsea shipping lines. In this case, there are two potential markets – the Teesside conurbation, which is close to the port but limited in size, and the larger but more distant North of England hinterland. Whether or not a deepsea shipping line can be attracted to Teesport will generate useful insights into the factors affecting shipping line port choice.

3.2 Transport Costs

3.2.1 The transport cost assumptions are fundamental in determining the output of the model, and generally appear reasonable, although there are methodological issues relating to the way in which some of them are calculated.

3.2.2 Some of the transport costs cannot be regarded as entirely independent of each other because they are affected by similar market forces (for example fuel prices or the costs of capital). If the model were to be run again, sensitivity tests for a range of cost assumptions should be made to cover the present and likely future volatility of fuel prices.

3.2.3 Other things being equal, an increase in fuel prices is likely to have more effect on land transport costs than on sea transport costs, both proportionately and in absolute terms. However it is also necessary to consider the "second round" responses of the transport operators to higher fuel prices, for example the use of slow steaming by the shipping lines.

Slow steaming can of course have other drivers. On some routes it was initially introduced as a response to fuel price increases, but is now being retained even as prices fall as a response to over-capacity in falling markets.

Land transport costs

3.2.4 The formulae used to determine road and rail costs are derived from those used in the GB Freight Model and include a fixed cost per container and a variable cost per container-km (See Chapter 2 above). The model calculates the cost of transport for each port-county pair by each mode (road and rail) and then uses the lower of the two as the land cost for that inland transport leg.

3.2.5 The mode split between road and rail is separately calculated for each port-county pair from a second distance based formula. This mode share is used in the economic impact assessment to calculate road and rail requirements (TEU-km) and the value of Sensitive Lorry Miles. The cost and mode share formulae are inconsistent. Equality of cost occurs at about 250km, which could be expected to be the 50% mode share point if cost was the sole factor. But the mode split formula predicts the 50% mode share to occur at 370km, which is closer to the observed figure than would be suggested by the cost model.

3.2.6 From the perspective of port choice, the primary issue is the estimation of the mean inland transport cost at each distance, rather than the choice of mode. Comparison with work carried out for other studies in which leading hauliers and freight forwarders operating out of a South Eastern port were interviewed suggests that the average port-county costs used in the assignment model are reasonably close to quoted prices for distances up to about 250km, where road transport dominates and rail costs are to a large extent set by comparison with road costs. The MDST figures appear to underestimate the average costs for longer inland movements, possibly because the costs used are based on rail costs for distances beyond 250km, whereas a significant number of long distance containers are carried by road.

3.2.7 The reason may be that the MDST costs appear to have been developed from the analysis of contract prices for inland transport paid by a leading shipping line. These large contracts are focussed on round trips returning the shipping lines containers to the port of entry and are usually for a round trip loaded or unloaded. Rates for Merchant Haulage (which represents about 50% of haulage from some UK ports) are more complex and differ for full and empty containers. In addition, rates for 20ft and 40ft containers differ significantly by rail, but the differences are smaller by road. Comparison with the results of the earlier interview study suggests that the MDST model provides satisfactory inland transport cost figures for the main round trip container flows and hence the majority of inland container flows. It may be less suitable for the calculation of the costs of secondary flows with poor rail accessibility and of longer distance flows
.

3.2.8 The most likely reason for any difference between the modelled and observed mode shares appears to be that the mode choice is not solely cost driven, but includes service quality elements such as service frequency, journey time and the local road accessibility of the nearest inland rail terminal. The relative importance of these service factors (time, frequency, reliability and the accessibility of the inland terminal) is at present unclear due to the lack of up to date survey data for the origins and destinations of road containers to and from container ports.

Shipping costs

3.2.9 Charter rates are very cyclical. Although they can be changed fairly easily within the model, the determination of sensible long-term average costs is largely a matter of judgement. Several of the charter rates used in the Updated MDST Report, for example, are less than 50% of those used in the Original Report, reflecting in part the sharp fall in charter rates between the publication of the two reports. Even with the use of long-term average charter rates, however, there will be years in which the model’s results diverge significantly from the real-life situation.

3.2.10 A similar argument can be applied to fuel costs, although to some extent the effect of changes in bunker prices will be cancelled out by parallel changes in road and rail fuel costs. These were taken from the GBFM, which includes a spreadsheet for calculating road and rail costs which takes into account exogenous changes in fuel, labour and other input costs.

3.2.11 There is a close relationship between deepsea charter rates, fuel prices and feeder ship costs (i.e. increases in fuel costs affect feeder ship operating costs). If either of the first two is changed, for example during sensitivity tests, it is likely that the third will also change. At the moment the model does not make these changes automatically, although this is something which should be relatively easy to add.

3.2.12 Ship's time in port is currently set at 10 hours, with cargo handling time excluded from the model on the grounds that it is common to both direct calls and Continental transhipment. This is logical *providing* GB and Continental hub ports have comparable ship handling rates. These depend on the number of cranes supplied per ship, crane productivity and the average box exchange.

3.2.13 Regarding the number of cranes supplied per ship, there is evidence that the average number of moves per crane per year in UK ports over the last five years has been higher than in Continental European ports. This would suggest that port operators have been trying to control costs of crane and quayside labour provision as far as they can without adversely affecting customer service levels.

3.2.14 GB handling rates expressed in TEU per ship-hour are higher than US rates but appear to be relatively low by modern international standards, particularly when compared to Asian terminals. Until recently, Continental European rates were similar to UK rates, but there are now signs of improvement in ports such as Hamburg and Antwerp.

Stevedoring costs

3.2.15 The model allows basic stevedoring charges, before allowance for any uplifts caused by congestion, to differ between ports, but this facility has not been used because of the difficulty of predicting how stevedoring charges are likely to vary between ports in future. In the past charges have varied between ports and over time, as well as between customers.

3.2.16 The model's assumption that charges are higher in times of capacity shortage than when there is ample spare capacity has been well supported by anecdotal evidence over the past 20 years.

3.2.17 Stevedoring charges are determined by the balance between supply and demand rather than the costs of providing the service. However differences between ports in their construction costs determine the long-term average "floor" prices which ports have to charge in order to break even. These are likely to vary from one location to the next. If shipping lines are not prepared to pay the "floor" price, then new capacity may not be built as set out in the port development scenarios.

3.2.18 Differences in pricing strategy and port construction costs may therefore result in an actual distribution of traffic between ports which is significantly different from that predicted by the model. The two are particularly likely to diverge at times of surplus capacity.

3.2.19 The use of a constant "base line" stevedoring charge of £70 per container could over-estimate GB port revenues in the middle part of the evaluation period if the arrival of substantial amounts of additional capacity were to result in a price war. The port development scenarios shown in Table 2.11 produce a large margin of spare capacity around 2015, which may only slowly be absorbed by traffic growth. In practice, however, terminal operators are likely to drip-feed new capacity into the market, avoiding the oversupply situation which characterised the late 1980s.

3.2.20 Charges for transhipment traffic are particularly volatile, and it can be argued that the displacement of large volumes of deepsea traffic from GB to Continental ports in the Do Nothing scenario would have a significant impact on their transhipment charges if they were unable to expand fast enough to absorb it. This may have been partly taken into account by the increase in transhipment charges from £80 to £120 per two-way move between the Original and Updated MDST reports, but if so, it is possible that charges might fall later as more capacity became available[15]

3.3 Traffic Assignment Process

Door-to-door transport costs

3.3.1 The use of an assignment process based on door-to-door transport costs may produce a slight bias in favour of ports outside of the South East. When cargo is carried on merchant haulage terms it is usually in the shipping line's interest to move through a South East port because this minimises ship diversion costs.

3.3.2 However the shipper/consignee's responsibility for (and increased awareness of) land transport costs under merchant haulage terms could cause him to favour shipping lines using ports close to the cargo's inland origin-destination point. This assumes that ocean freight rates to northern and West Coast ports are similar to those to South East ports - or at least diverge by less than the land transport cost differential - and that shippers in northern and western Britain can generate enough traffic to persuade shipping lines to call at non-SE ports in the first place.

3.3.3 Unfortunately very little is known about the proportion of GB container trade moving under merchant haulage terms, or the relationship between door-to-door and port-to-port freight rates. MDST have informed us of one major line which carries 45% of its GB container traffic on merchant haulage terms (port-to-port). There have been other, more general reports in the press suggesting that the proportion of GB traffic carried on merchant haulage terms lies somewhere between 30-50%, but good survey data covering all the major container ports is lacking.

3.3.4 Another feature of the assignment process is the feedback loop which assumes that, as traffic is diverted to Continental hub ports, box exchanges per ship fall and the unit costs of direct calls rise. This is a neat assumption in modelling terms, as it provides a dynamic mechanism for driving the model towards equilibrium. It must be remembered, however, that the changes in unit costs are experienced in the first instance by the shipping line, which may or may not pass them on to shippers or their representatives. If it does, this might influence the choice of quasi line, something which is not allowed for in the model.

Vessel queuing

3.3.5 The model uses incremental increases in stevedoring charges to ration demand once one or more GB deepsea ports reach full capacity working. An alternative mechanism would be vessel queuing costs, as this is normally one of the main factors causing ships to divert to other ports.

3.3.6 However, queuing would be more difficult to model as berth occupancy and queuing time have a non-linear relationship. The waiting time is dependent on the number of berths in the port and the degree of peaking in the vessel arrival schedule, and rises more than proportionately with berth occupancy. The inclusion of vessel queuing costs would therefore require a fundamental restructuring of the model which may not be justified by its effect on model outcomes.

[15] Ports in NW Europe have traditionally had to recover a smaller proportion of their infrastructure costs than UK ports because of state aid.

3.3.7 MDST argue that raising stevedoring charges in response to congestion should keep vessel queuing times fairly constant. However, even then there are likely to be some differences in vessel queuing costs between the various port development scenarios, particularly in the period before the deepsea ports reach full capacity working.

3.3.8 Whilst increased stevedoring charges are to some extent a proxy for increased ship queuing costs, and may produce the same traffic assignment pattern, the choice between them does have an effect on the economic impact assessment. Increases in stevedoring charges feed through into increased GB revenues, whereas increases in queuing costs are assumed to be borne wholly by foreign shipowners. And whilst increases in stevedoring charges have a clear effect on the delivered cost of containers for GB importers and exporters, the effect of vessel queuing costs on these costs is more indirect, depending on how vessel queuing is allowed for in the sailing schedule, and whether the shipping line feels able to pass on its costs.

Port infrastructure

3.3.9 When comparing demand with capacity, the model assumes that the Continental hub ports and the GB feeder ports all have unlimited ability to increase capacity in line with demand. The Continental port congestion experienced in 2007, which occurred partly because of unexpectedly rapid growth in demand, could suggest otherwise. However, this assumption was relaxed in a sensitivity test forming part of the original study.

3.3.10 The model does not make any comparison between the costs of providing deepsea and feeder port capacity. Additional port capacity of one type or the other will be needed if all of the forecast GB traffic is to be accommodated. Whilst the MDST model highlights some of the differences in costs and benefits between building deepsea ports and building feeder ports, it was never intended to cover them all, for example differences in construction costs per metre of quay or TEU of capacity.

3.3.11 The original terms of reference did not require these factors to be included. As a result, the model cannot be used alone to decide what type of new port capacity is most beneficial to the UK – it must be supplemented by other types of information in order to arrive at a more broadly-based decision.

Spare capacity

3.3.12 The rationing of capacity in conditions of excess demand by increasing stevedoring charges in increments of 50p produces equilibria in which SE ports have throughputs significantly below their capacity. This occurs because of the incremental (rather than continuous) increases in stevedoring costs, their applicability to all containers at the congested port, and most importantly the “lumpiness” of traffic volumes caused by the diversion of quasi lines away from ports before their respective box exchange has dwindled to nothing.

Table 3.1 Model Results: Capacity and Throughput at SE Deepsea Ports ('000 TEU)

	2005	2010	2015	2020	2025	2030
Scenario 1 (Do Nothing)						
Capacity	5.259	5.893	5.893	5.893	5.893	5.893
Throughput	5.035	5.686	5.769	5.590	5.410	4.780[b]
Capacity utilisation (%)	96%	96%	98%	85%	92%	80%
SE feeder port throughput	-	0.059	0.423	0.899	1.679	2.980
Scenario 2						
Capacity	5.295	6.903	13.052	13.052	13.052	13.052
Throughput	5.035	6.407	8.083	9.429	11.210	12.601
Capacity utilisation (%)	95%	93%	62%	72%	86%	97%
SE feeder port throughput	-	0.030	0.020	0.023	0.109	0.489
Scenario 3						
Capacity	5.295	6.903	13.052	13.052	13.052	13.052
Throughput	5.035	6.407	8.073	9.429	10.203	12.593
Capacity utilisation (%)	95%	93%	62%	72%	78%	96%
SE feeder port throughput	-	0.030	0.020	0.023	0.109	0.106
Scenario 4						
Capacity	5.295	6.903	11.010	11.010	11.010	11.010
Throughput	5.035	6.407	7.91	9.237	10.132	10.011
Capacity utilisation (%)	95%	93%	72%	84%	92%	91%
SE feeder port throughput	-	0.030	0.024	0.027	0.920	0.499

Source: MDST Updated Report, Tables 4.18, 4.20, 4.22, 4.24 and 4.26

3.3.13 Table 3.1 shows how cargo is transhipped to SE feeder ports even when there is spare capacity available at the deepsea ports for direct calls. This is because the number of lines that can be accommodated in each capacity-constrained SE port falls as the number of containers carried by each line increases over time, whilst the amount of traffic "lost" when a line diverts to another port increases. This results in significant "lumpiness" of the predicted throughput relative to capacity.

3.3.14 We understand from discussions with MDST that some of the traffic shown in Table 3.1 (above) as moving through SE feeder ports could in practice utilise spare capacity at the SE deepsea ports when these are at equilibrium. If this were to be the case, there would be some reduction in GB feeder berth requirements. The use of spare deepsea port capacity for short-sea and feeder traffic – which is not provided for in either the model or the MDST Reports – would also have some effect on GB revenues because of the displacement of third country transhipment traffic, and could also produce a small change in the delivered cost of containers to GB customers, depending on whether the boxes paid deepsea or feeder port stevedoring charges.

Changes in demand

3.3.15 One possible response to port congestion which the model does not explore is the replacement of deepsea suppliers by overland or short-sea supply sources, or even the disappearance of some low value trade flows altogether. In road traffic modelling this is equivalent to replacing a fixed matrix O-D pattern with a variable matrix. However, the complexity of doing this within the context of container shipping is probably not justified by the degree of improvement in the results. Such an exercise would also encounter formidable problems in arriving at a set of reasonable working assumptions.

3.4 Port Development Scenarios

Port capacities

3.4.1 The quay productivities used to calculate port capacity are understood to have been obtained from UK port operators during the original study, reflect evidence considered at planning enquiries, and were set out in MDST's Terms of Reference for the Updated study. They are low by international standards for ports working at full capacity[16].

3.4.2 It is sometimes suggested in reports on European container port productivity that comparisons with ports in the Far East are irrelevant, since those ports operate in a completely different context with major economies of scale. This is true in the case of major export ports such as Yantian, which has achieved terminal productivities of 3000 TEUs per metre of quay face per year.

3.4.3 What is less frequently recognised is that some Far Eastern ports such as Hong Kong are mixed ports catering for both exports and sea transhipment and serving a wide range of vessel sizes using quays first constructed up to 35 years ago. These terminals are regularly achieving 1,500 to 2,000 TEUs per metre of quay face per year, which may be contrasted with the range of 812 to 1,221 TEUs per metre per year used in the Updated MDST Report.

3.4.4 Table 4.17 of the Updated MDST Report raises two important issues. The first is that the capacity figures appear to be broadly similar to the current operating productivities. In reality, the operating figure rises with increased throughput until capacity is reached and new berths are brought on stream. The average terminal productivity figure falls then increases until capacity is again reached. So capacity figures for existing terminals should always be greater than or equal to current operating productivities.

3.4.5 More importantly, the MDST study assumes that the quay productivity will not improve over time after 2010 due to new technology, acquisition of more back-up land, improved yard layout, better management of operations, etc. This is against a background where, in the face of restrictions on expansion, Southampton has already improved productivity and has aggressive targets for future productivity improvements, subject to additional investment in automated equipment similar to that used in Hamburg. We believe that there will be continual productivity improvements across the industry over the next 20 years due to present and future changes in technology for both new and refurbished terminals and that this should be reflected in the model.

3.4.6 MDST have pointed to current continental port productivities to support their future productivity forecasts. Continental port productivities need to be carefully disaggregated into individual terminals to separate out the older terminals (which often have short quays, limited draft and

[16] Quay productivities in Europe are generally lower than in the Far East but higher than in North America. However, the figures are usually based on the traffic actually handled (throughput) rather than the traffic which **could** be handled (capacity). Even when there are capacity rather than use indicators, these normally include the margin of spare capacity needed to ensure an efficient service, and it is not uncommon for them to be exceeded as traffic grows, particularly if planning constraints delay or limit expansion.

in some cases, tidal locks) from the latest terminals. Only the latest terminals are appropriate for capacity comparisons with future terminals in the UK, which will have similar facilities and levels of technology.

3.4.7 The second adjustment which must be made is to use the future capacities rather than the existing productivities, since we believe the latest terminals are almost certain to be operating below capacity at present.

3.4.8 Operators are reluctant to publish future capacity targets, but we have held confidential discussions with a leading continental operator operating two terminals serving both deepsea and feeder traffic who considers that 1500 TEUs per metre per year is a reasonable short-term target and that 1750 TEUs per metre per year is achievable in the medium term with appropriate investment in partial automation. Moreover, they suggest that it will prove difficult to finance the civil engineering costs of major expansion in the longer term unless these levels of productivity are achieved.

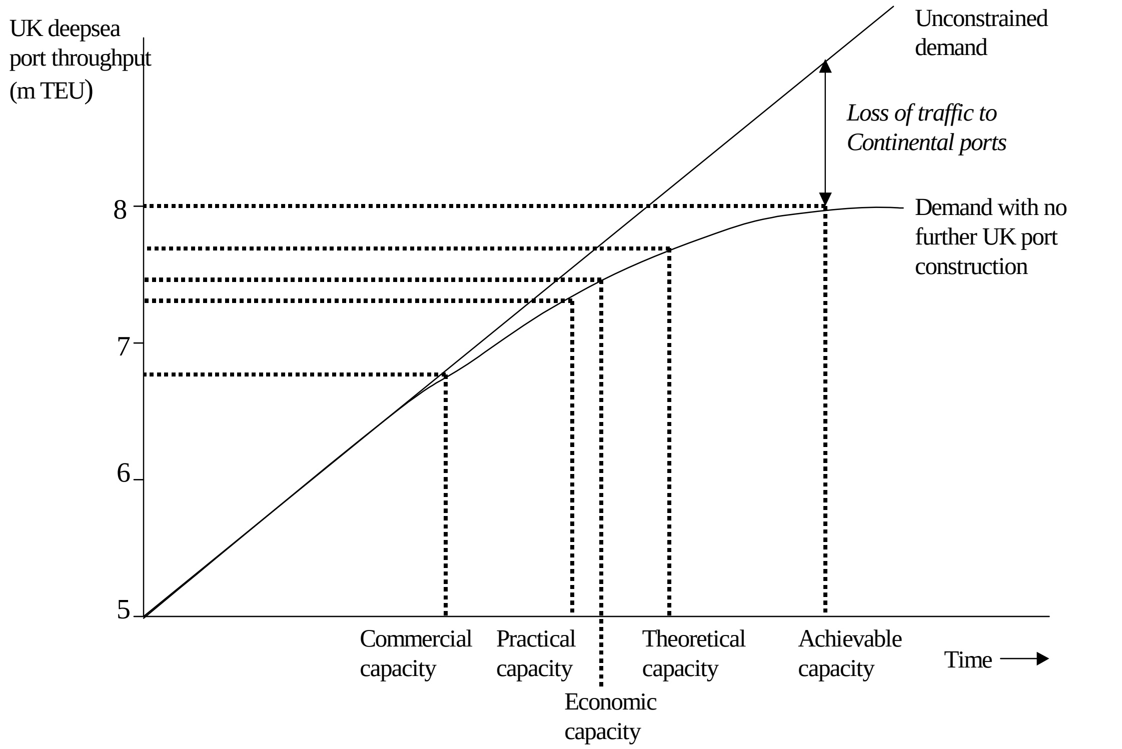
3.4.9 MDST have said that whilst ship handling rates, and hence both crane container handling speeds, and the numbers of cranes assigned to each vessel are of vital importance to shipping lines, the quay face productivity is not. In fact, service standards for shipping lines may be improved by lower levels of quay face productivity.

3.4.10 This is true, but from the perspective of the terminal operator, quay face productivity is vital to achieving a satisfactory rate of return on the terminal's physical assets. So the terminal operator's objective must be to increase quay face productivity without prejudicing customer service levels. This can be done by increasing crane operating speeds (which benefits both parties) or by providing more quay cranes per unit length of quay and per vessel, thereby reducing vessel turn round times, but at extra cost.

3.4.11 On older, short quays, little benefit is achieved by the terminal operator unless a combination of higher operating speeds and perhaps an extra crane can provide a quantum change by which an additional vessel slot can be achieved within the existing vessel arrival schedules. On newer and longer quay faces, it is more likely to prove both possible and cost effective to increase productivity, in part by investment in handling equipment. Hence our view (supported by leading terminal operators) that future quay face capacities on the new terminals in particular will be higher than the historic figures.

3.4.12 Port capacity can be defined in many different ways, as illustrated in Figure 3.1, and the figures proposed for any port at any point in time may vary over quite a wide range. Provided that there is space and planning permission for expansion, as there may be if the productivity improvement is under-estimated, the use of a relatively low capacity figure may be self-fulfilling.

Figure 3.1 The Relationship between Different Definitions of Port Capacity



Definitions

1. **Commercial capacity**: the maximum throughput which can be achieved at the quality of service which the operator would like to guarantee to customers
2. **Practical capacity**: the maximum throughput which can be achieved at a quality of service acceptable to most customers
3. **Economic capacity**: the throughput at which increases in operating costs, reduced quality of service or loss of customers makes the construction of new facilities economically viable
4. **Theoretical capacity**: the throughput which produces the maximum technically desirable utilisation rate for port facilities (quays, yard space, mechanical equipment)
5. **Maximum achievable capacity**: the throughput at which all additional deepsea business would necessarily have to relocate to ports outside of the UK

3.4.13 The rate of construction of additional facilities will be set by operators to match the increase in demand at handling rates which are sufficient to finance expansion. It is not clear to what extent the MDST model can reflect this dynamic scenario. In the MDST model, if a port has excess demand as a result of the selection of a relatively low capacity figure, then more 50p increments will have to be added to the basic stevedoring charge to force the surplus traffic to leave. The selection of arguably low port capacity figures therefore results in high stevedoring charges.

3.4.14 However, the use of relatively low capacity figures by MDST ensures that GB deepsea ports are able to provide a relatively high and secure quality of service. These are undoubted benefits but cannot be internalised within the model, making it difficult to arrive at an objective assessment of either the “economic” capacity of GB ports or – even better – a capacity figure which is consistent with the model’s assumptions about traffic diversion costs.

3.4.15 Unfortunately, the future quay productivity assumption– which in this case is essentially a matter of professional judgement – is also one of the parameters to which the model results are likely to be sensitive. The MDS model uses values largely based on current practice, and evidence considered at planning enquiries. We believe the sensitivity of the model to different assumptions should be considered further.

Port development scenarios

3.4.16 Since the Updated MDST Report there have been further changes in terms of the amount of additional deepsea capacity that is likely to be built in the UK, in new developments in particular, and in the proposed timings.

3.4.17 Table 3.2 summarises the capacity assumptions used in the updated MDST report and the current status of port development plans, ascertained from press reports.

Table 3.2 Port Development Plans

Port group / **Port**	**Quay length (m)**		**Capacity (m TEU)**		**TEU/metre**		**Completion date**	
	MDST[a]	**Current**	**MDST**	**Current**	**MDST**	**Current**	**MDST[b]**	**Current**
Haven								
Felixstowe existing	2,793	2,793	2.8	) 5.3	1,015	)1,300[c]	-	-
Felixstowe South	910	1,285	1.0	)	1,110	)	2010	2014[d]
Bathside Bay	1,400	1,400	1.55	1.7	1,110	1,215	2015	no date
Thames								
Tilbury existing	590	590	0.523	0.523	888	888	-	-
Thamesport existing	650	650	0.613	0.613	943	943	-	-
London Gateway	2,300	1,255[e]	2.55	1.7	1,110	1,355	2015	2012[e]
Solent								
MDS base	1,357		1.377		1,015		-	-
Actual 2007 inc berth 203		1,624		2.00		1,232		
MDST expansion scenario[f]	1,840		2.042		1,110		2015	Phased from 2010
Current overall plan[g]		2,187		3.75		1,715[h]		
West Coast								
Liverpool existing	1,097	1,097	0.974	0.85	888	775	-	-
Liverpool expansion	800	820	0.45	0.6	555	730	2015	2011
Bristol	1,200	1,200	1.35	1.5	1,110	1,250	2020	2014
Other								
Teesport	1,000	1,000	1.1	1.5	1,110	1,500	2015	2013

Notes: (a) Figures used in Updated MDST Report.
(b) MDST completion dates are intended 'by' the year X.
(c) The productivity of the new berths is understood to be between 1,700-1,900 TEU per metre.
(d) 730m to be completed by 2010.
(e) Phase 1 only. The final length remains unchanged.
(f) Illustrative quay length to deliver additional 2 million TEU capacity at 1,110 TEU/metre.
(g) Total container port quay length and capacity with redevelopment of quays within existing port footprint.
(h) Average productivity for the container terminal as a whole, with auto and mated stacking.

3.4.18 There have been five main announcements since the publication of the Updated MDST Report:

An increase in the scale of development taking place at Felixstowe South, both in terms of the additional 375 m of quay length being provided and general productivity improvements. The additional capacity which this provides has increased from 1.0m TEU to around 2.5m TEU.

On the other hand, the terminal operators at Felixstowe have advised that the Felixstowe South development will be constructed in phases over a longer period than was assumed at the time of the MDST Report, and the large amount of additional capacity which it provides may in turn lead to the Bathside Bay project being undertaken more slowly than was originally envisaged.

DP World began a global review of its expansion strategy in January 2009, in response to the downturn in container volumes. Prior to this review, the London Gateway project was due to be undertaken in two phases, which may also allow the amount of spare capacity in the market to be more carefully controlled.

The significant increase in productivity to achieve 1.6 million TEU throughput in 2007 at Southampton's existing container terminal shows what can be done when ports face genuine capacity constraints through a mixture of increased quay length and increased productivity.

An expansion plan to add 2 million TEU capacity has been put forward at Southampton, some of which has already been implemented with the incorporation of feeder berth 203. It is claimed that this can be carried out within the port's existing footprint and does not require either a Planning Enquiry or a Harbour Revision Order. Nevertheless, DP World's majority stake in Southampton Container Terminal (now renamed DP World Southampton) is likely to mean that its development and any investment in greater productivity is co-ordinated with the expansion of London Gateway.

3.4.19 This suggests that within the South East, increases in capacity will be carefully managed by the two dominant owners to ensure that they are in line with demand. Outside of the South East, however, the increase in competition could occur earlier than expected, and be on a slightly larger scale.

3.5 Economic Impact Assessment

3.5.1 Our main comment in relation to the economic assessment is that the MDST model is probably unnecessarily complicated for its original purpose – assessing the economic benefits of building additional deepsea port capacity to support third country transhipment and reduce the transhipment of GB cargoes at Continental ports.

3.5.2 At the same time it is not the type of modelling approach that economists have traditionally used for carrying out economic appraisals of port policy decisions or for the economic appraisal of any port investment decisions. Its complexity and its strong focus on traffic routeing patterns divert attention from other important issues which will affect the amount of future GB container traffic which is transhipped, for example:

The scope for increasing the capacity of GB ports within their existing footprints, and the costs of doing this.

The economics of building deepsea ports versus feeder ports.

The location and size of the sites available (and suitable) for new ports of either type.

Social and security of supply arguments in favour of dispersed port development.

3.5.3 Our more detailed comments relate to three specific items in this part of the model: the need for additional feeder berths, environmental impact, and GB transport revenues. The way in which the model calculates the delivered cost of containers of GB shippers and consignees appears reasonably straight forward, whilst the modal split assumptions used to calculate road and rail traffic requirements have already been discussed.

Additional feeder berth requirements

3.5.4 Because the model does not include capacity figures for existing GB feeder ports, it may assign traffic to one feeder port which is already full whilst another feeder port lies empty.

Environmental impact

3.5.5 The calculation of Sensitive Lorry Miles is based not on the actual routes taken by containers moving between each port-county pair, but by adopting a unit cost which has been estimated. This is probably good enough for assessing the nationwide environmental impact of alternative scenarios, but may be misleading if applied to flows through individual ports.

GB transport revenues

3.5.6 The GB transport revenues appear to be calculated on the basis that UK port revenues and UK land transport revenues accrue to the UK but all shipping line revenues accrue outside the UK.

3.5.7 These assumptions do not appear to be correct either to estimate the net benefits to the UK as part of a UK cost-benefit analysis (which we understand was not the intention) or to estimate the net revenues accruing within the UK under the alternative policies. The analysis appears to overlook some significant factors in both cases.

3.5.8 If we consider the first case, theory indicates that provided all of the inputs are purchased in competitive markets, the net benefit to the UK of a selected scenario does not depend on whether the input resources are purchased inside or outside the country of interest. This is not the case where markets are distorted or where factors have no alternative productive use (e.g. severe unemployment) in the absence of a project or policy decision.

3.5.9 In the competitive market case, the producer benefit is the economic profit, corresponding to the return to shareholders. This may or may not accrue to the UK community, depending on ownership.

3.5.10 If we are interested in UK revenue, a larger part of the revenue (in particular a substantial part of the operating costs) will accrue to the UK, irrespective of the country of ownership.

3.5.11 The analysis appears to assume that all UK deepsea ports are UK-owned, all UK land transport is UK owned and all shipping lines are owned outside the UK. In fact, most UK ports are foreign owned (Hutchison Port Holdings at Felixstowe, Bathside Bay and Thamesport; DP World at London Gateway, Tilbury and Southampton (51%)).

3.5.12 Inland UK rail freight operations also now have a substantial overseas ownership. At the time the MDST reports were written, Freightliner (the main rail container service) was UK owned, and EWS, its much smaller competitor, was only 30% owned by Canadian National. Since then both companies have passed into 100% foreign ownership. In 2007 all of the shares in EWS were acquired by Deutsche Bahn (Germany) and Tranfesa (Spain), whilst in June 2008 Freightliner was bought by Arcapita, a Bahraini company.

3.5.13 The situation in respect of road transport is more difficult to judge. Most of the inland distribution work for containers is carried out by British companies. There is a growing foreign road transport presence, particularly for through Ro-Ro road traffic from European and East European origins. However, inland container transport to and from ports appears to be dominated by UK operators.

3.5.14 After a long period of overseas takeovers, the analysis is probably substantially correct in locating the ownership of the shipping lines overseas.

3.5.15 Under a cost benefit analysis, about 8-12% of revenues might be considered to be profit and allocated to the country of ownership. But even here, the difficulty arises that some of the equity is publicly traded and there may be UK beneficial owners such as pension funds.

3.5.16 If we consider only UK revenues, some of the port revenues will revert to the UK – for example in wages and the supply of other inputs as part of operating costs. Container ports have a high capital content and approximately 30-40% of the revenue is required to finance the capital employed. The capital expenditure on civil engineering design, construction and major refurbishment will have a high UK content, but almost all handling equipment is imported, irrespective of ownership.

3.5.17 Since almost all the large port operators are subsidiaries of large financial empires, the detailed origins of capital are (with the exception of sovereign funds) rarely known even to the regional managers.

3.5.18 The updated MDST report (page 108) also concludes that the additional revenues generated by GB ports from container traffic in Scenario 2 will be enough to support £2.5bn of new investment. It is not clear how this conclusion was reached. It is possible that the operating costs associated with these revenues were not included in the analysis.

3.5.19 With regard to the GB rail revenue, rail freight pays only marginal track costs (about 20% of the rail cost) and does not pay rail capital costs. In addition, rail freight receives a subsidy which averages about 10% of rail cost and is based on the Sensitive Lorry Miles benefits. Fuel represents 20% to 30% of operating costs and is currently rising as a percentage. The UK is now set to become a net importer of crude oil and oil products and is also likely to shortly become a net importer of gas, so the question of the allocation of the energy component of revenue becomes important. This revenue component is probably close to being neutral at present.

3.5.20 As with the ports, the majority of non-fuel operating costs, in particular labour, arise in the UK. Currently, rail freight rolling stock and traction is predominantly British built, but this may change in future.

3.5.21 The revenue assessment also appears to ignore potential non-port related UK revenues arising from ship operations, even if this is limited and mainly in the form of payments for UK-supplied inputs.

3.5.22 GB port revenues from third country transhipment may be significantly over-estimated, as there is an implicit assumption that all spare capacity at GB deepsea ports will be taken up by third party transhipment traffic, irrespective of whether there is sufficient demand.

3.5.23 At times when most European ports are operating below capacity, the transhipment market is highly competitive, and GB ports do not have any natural advantage which would make them the automatic choice for this type of activity every time spare capacity becomes available. At present there is a shortage of transhipment capacity, but the next wave of Continental container port expansion may lead to a short- to medium-term surplus.

3.6 Applicability of the Model

3.6.1 We have undertaken a very preliminary assessment of the ability of the model to support two levels of analysis:

Its ability to support analysis of the central issue of the MDST study, namely to test the effects of providing additional deepsea port capacity at different GB port locations on the routeing of GB deepsea container traffic, within the context of multi-port container ship calls in NW Europe.

Its ability to support the analysis of wider policy questions on which the Department may seek advice.

3.6.2 Our comments relate to three aspects of the model:

The underlying structure
The input data
The robustness of the conclusions

Model Structure

3.6.3 The MDST model is a cost-based model which allocates traffic flows to the least-cost option based on a relatively simple cost equation. In so doing, the model does not account for inventory and transit time factors either directly (through a supply chain analysis) or indirectly through the inclusion of service factors in the mode and route choice sub-models.

3.6.4 Transit time and inventory could be taken into account by switching the model to generalised cost. Because they affect shippers' choice of shipping line, it is reasonable to argue that these will also affect the shipping lines' port choice. It would also be relatively easy to change the model to take these factors into account, as this could be done through changes to the input assumptions rather than the model structure.

3.6.5 A change of this nature would also improve the modelling of mode choice (road – rail) for the inland leg, where service factors such as frequency of rail freight services which affect inventory cost are dependent on traffic volumes. However, as noted earlier, there is an absence of good up to date survey information on the origins and destinations of road containers bound to and from container ports.

3.6.6 The model is based on repeated iterations involving two feedback loops. Lack of transparency makes it difficult to check the robustness of its output with respect to the behavioural assumptions made and the inputs chosen except through sensitivity tests.

3.6.7 We have tried to assess whether the structure of the model is likely to lead to any bias in favour of either SE or non-SE ports, and have concluded that such a bias – if it exists at all – is likely to be small. It is more likely to be caused by the input data than by the model's structure.

3.6.8 The structure of the model may result in some over-estimation of transhipment volumes. This is because it does not allow shipping lines or their customers to respond flexibly to port congestion, for example by changing ship sizes, consolidating GB cargo into fewer ship calls, or switching containers from quasi lines which have decided not to call at GB ports to those remaining there. But it is not clear whether this would result in any bias for or against SE ports.

3.6.9 However the over-estimation of transhipment traffic caused by the model's structure is probably small compared with that arising from its input assumptions, particularly those relating to GB port capacity.

3.6.10 The most important single comment to be made about the model's structure is that it is based on the assumption that all GB deepsea container ships go on to ports in NW Europe. Whilst this has been largely true in the past, the introduction of much larger ships, a possible short- to medium-term surplus of shipping capacity, shipping industry concentration, the expansion of Mediterranean transhipment hubs, logistics developments, and slow steaming could all weaken this traditional pattern, and lead to new ways of supplying the GB market. MDST's LINCOST model may provide a useful tool for addressing this, but has not been included in the scope of this audit.

3.6.11 In a fiercely competitive market all shipping lines will be looking for ways of gaining an edge over their rivals, within the framework of their own increasingly complex global networks. This is likely to lead to a greater diversity of approaches to container routeing than we have seen in the past.

Input Data

3.6.12 If the model was to be used again, the cost data would have to be reassessed to take account of the changes in fuel prices and the subsequent changes in vessel operating practices such as slow running where spare vessel capacity is available.

3.6.13 At the same time the average port-county travel cost for inland trips in excess of 300km should be reviewed to take account of the actual mode split for the long distance port-county pairs and the higher cost of road transport over these distances. Real progress in this area would need better survey data on road flows in particular.

3.6.14 Other inputs which would need review include:

- Trade forecasts
- Trade lanes
- Vessel sizes
- Vessel charter rates
- Port productivity
- Port development plans
- Port ownership

3.6.15 **Trade forecasts**. The trade forecasts would benefit from two changes; the inclusion of upper and lower bound sensitivity tests (the lower bound being perhaps the more important at present) and a review of the way in which empty containers are dealt with in the model. The forecasting of origins and destinations is less critical and improvements are unlikely to be available through the GBFM improvement programme before 2010 to 2011.

3.6.16 **Trade lanes**. The most important change in the trade lanes would be to split the Mediterranean trade lane into that part which is genuinely deepsea and that part could potentially be served by short-sea Lo-Lo, short-sea Ro-Ro or land transport combined with Ro-Ro ferry or Channel Tunnel services.

3.6.17 It is debateable whether countries bordering the Mediterranean should be regarded as “deepsea” at all. EU Member States in the Mediterranean, which generate the largest volumes of traffic, have already been excluded from the analysis, and it is illogical to treat other states which are a similar distance from GB any differently. Turkey, for example, is regarded as deepsea and Greece as short-sea, whilst similar inconsistencies apply to Morocco/Spain and Egypt/Cyprus.

3.6.18 It is also worth considering the amounts of East of Suez cargo that are likely to be transhipped in future at Mediterranean hub ports. If these are significant, it could be worth reassigning them between trade lanes on a “last port of loading” basis, which would also make the figures more consistent with DfT’s own statistics, or activating the Tangier-Med transhipment port option in the model, which has so far not been used.

3.6.19 Following on from our earlier comment about the weakening of traditional routeing patterns, it may also be worth consider in more detail the economics of the Atlantic trade, coupled with the development of Irish trade and the role of Liverpool.

3.6.20 **Ship sizes**. It would be helpful to review and independently estimate the range of vessel sizes in each trade lane. A more serious problem is the forecasting of the larger vessel numbers, particularly in the East Asia-Europe trade. The model forecasts a large growth in the number of vessels exceeding 15,000 TEUs then allocates them to ports which have no development plans to accommodate them. In some cases it is difficult to see how they could be accommodated, even if the resources were available.

3.6.21 It would seem to be more realistic to develop a specific set of options for these vessels, including an option where they only operate from a small number of Continental or Mediterranean megaports.

3.6.22 **Charter rates**. In view of the continuing volatility of container ship charter rates, dual runs with high and low rates would probably be preferable to a single run based on long-term average rates, unless it could be proven beyond reasonable doubt that the model outcome is insensitive to charter rates.

3.6.23 **Port productivity** is perhaps the area where our views differ most from those of MDST. We understand that the low quay productivities, measured in terms of TEUs per metre of quay face p.a. and the lack of any productivity improvement over the next 20 years are based on advice from port operators and were included in the Terms of Reference for the update study. They also take into account container stacking constraints arising from the limited areas of land available behind the quay face, although this is a problem that can be resolved using various mitigation measures.

3.6.24 The assumptions used in the model do not reflect the productivity benefits expected from the new, more modern terminals under construction, or the improvements which have been taking place in existing ports such as Southampton, where determined and focused efforts to improve the utilisation of existing assets have been made.

3.6.25 The figures may also be influenced to some extent by the ports' need to convince the public of the urgency of providing new facilities, or by their reluctance to place productivity improvement targets in the public arena. Indeed, figures lower than these were submitted to some planning enquiries and were not subjected to detailed challenge. We would suggest medium term productivity forecasts of around 40% higher than those used in the model, and longer term figures which are 50 to 60% above them, based both on current practice at those Asian container ports which do not enjoy exceptional economies of scale in individual terminal operations and on current trends and future targets in leading Continental ports such as Hamburg. This does of course have a major effect on capacity requirements and the likely rate of development of the terminals for which planning approval has been obtained.

3.6.26 In the short term, these issues can be most effectively explored through sensitivity testing, to determine the likely impact of lower rates of trade growth (in the immediate future at least) and of higher levels of productivity and hence terminal capacity in new or modernised terminals.

3.6.27 **Port development plans**. The plans used in the MDST model have been superseded and will need updating. They should also be reviewed with operators against the forecasts of changes in vessel sizes.

3.6.28 **Port ownership**. Two companies – DP World and Hutchison Port Holdings – now control a high proportion of GB deepsea port capacity. This will affect both the speed with which new capacity is released onto the market, and the way in which the competitive behaviour of different ports is co-ordinated. This could result in a greater harmonisation of pricing than is allowed for within the model, even within the framework of UK competition law.

Robustness of conclusions

3.6.29 Our opinion of the model as a whole is that it provides a reasonable overview *at national level* of the outcomes of the scenarios which were tested, but cannot be used to assess competition between individual ports in the South East or the viability of proposals for port development outside of this region.

3.6.30 If there were a need for a model to support the development of future ports policy, it may well be better to develop a new model which addressed the issues of current importance more directly and provided greater transparency in its operation. The alternative would be to continue using the existing model in the circumstances for which it is appropriate, taking great care over the interpretation of its results and supplementing it with additional data and analysis where needed.

4. WIDER ISSUES AND WAY FORWARD

4.0.1 Chapter 2 of this Report describes the MDST transhipment model methodology as understood by the Imperial College team. Chapter 3 discusses its applicability primarily in terms of the original objectives of the Transhipment Study. However, the outputs of the model have been seen by some industry observers as contributing to the debate on wider policy questions currently under consideration by the Department, for example the role of ports outside of the South East, including Teesport, Bristol and Liverpool.

4.0.2 This section looks at the potential use of the model to support wider analyses and discusses ways in which the modelling framework might need to be extended to analyse in detail policy issues relating to container port choice in the United Kingdom (for example, rail and road access requirements).

4.0.3 Although we have used the MDST model as a reference point for this discussion, our comments should not be construed as a criticism of the model. We have simply tried to show where the concepts underlying the existing model would need to be modified in order to develop a model with the forecasting ability which is required to support wider policy objectives.

4.0.4 In our attempt to unravel these wider issues, we revisit the main key assumptions of the MDST model. In particular, we focus on two main aspects – the selection and scope of model agents, and the way in which their objectives affect port choice decisions.

4.1 Modelled Agents

4.1.1 There are 3 agents, or groups of agents, in the MDST model, namely shippers, shipping lines, and GB deepsea ports. A typical international movement of a container box or cargo is estimated to involve 25 parties on average. The central question is who determines the selection of route and mode for each leg of the journey.

4.1.2 The roles of third and fourth party logistics providers (3PLs, 4PLs) and freight forwarders as decision-makers in UK and European freight transport are likely to grow and broaden at the expense of traditional service providers such as shipping lines. Factors that play in favour of 3PLs include the capacity of major 3PLs to provide integrated and global logistics (not just transport) solutions, the increasing trend to outsourcing and contract logistics, the continuing flurry of consolidation in the 3PL market (e.g. DHL's acquisition of Exel, UPS' acquisition of Overnite), and the introduction of EU regulations banning the traditional cartel behaviour of the shipping lines and forcing them to compete. 3PLs can now cover such aspects as multi-modal arrangements, port choice, and the selection of shipping services. A recent survey found that 64% of all logistics costs in the UK are directed to 3PLs. In 2006, DHL/Excel transported more than 2.8 Million TEU in ocean freight and controlled around 6% of global market share of freight services in revenue terms (see Table 4.1)

4.1.3 The key question is how the increased role of the 3PL will affect the decisions on the selection of shipping line, mode and route. Agent models of freight transport run into serious problems of complexity and data collection, so it is probably more realistic to regard the shift as being one to minimising the overall cost for the shipper, taking account of factors such as inventory and transit time costs.

Table 4.1 Top 10 Global 3PLs in 2006

Company	Contract logistics revenue (US$m)	Market share of global contract logistics (%)
DHL-Exel	14,287	6.0%
CEVA	4,391	1.8%
Wincanton	3,293	1.4%
K + N	3,196	1.3%
UPS SCS	2,401	1.0%
Fiege	2,199	0.9%
Ryder	2,028	0.8%
Thiel	1,901	0.8%
Schenker	1,683	0.7%
CS/ND	1.634	0.7%

Source: Data Monitor, 2006

4.1.4 Governments and public authorities also constitute a potentially important agent in port choice and transhipment decisions. Public agents can use a variety of policy instruments to either promote or hinder the development of port and transhipment services. Indirect subsidies through mechanisms such as the provision of access channels or the construction of port infrastructure which is later leased to private sector operators have been common in Continental Europe, although they are now being reduced as a result of pressures on public authority budgets, despite the EU parliament vote in 2006 against the adoption of the EC proposed directive on free market access to EU port services.

4.1.5 The land legs of each logistics movement can be distinguished from the sea side in modelling terms and considered in two steps: origin-destination modelling and assignment by mode and route. The lack of adequate information on origins and destinations of freight movements is currently a serious problem for UK internal long distance freight. There is a need for a major freight traffic survey programme for internal heavy goods freight and for local light goods vehicle distribution.

4.1.6 For port traffic, the data issue is less serious, since Customs data combined with information from 3PLs can provide a good cross check on freight movements to and from ports.

4.1.7 Current work on UK internal freight assignment by mode and route envisages using the EUNET approach, in which the movements of containers by road and rail are modelled using a "logistics network" linking the major UK distribution centres before assignment to the road and rail systems. Good estimates of road and rail costs between these centres can be developed, together with average distribution centre handling and local distribution costs.

4.1.8 Problems still remain, of which the most important in cost terms is probably backloading and the cost of carriage for empty containers, particularly when (as in the UK) there is a major imbalance in freight between the two directions. In addition, we need to consider the logistics costs and how to include them in the model in a simplified manner at an aggregate level.

4.2 Objectives of Agents

4.2.1 The port choice element is a more complex modelling problem. As outlined in the previous chapters, the methodology behind the MDST model consists of a game between two groups of agents (shipping lines and GB deepsea ports) based on a cost-minimising exercise for the shipping lines versus a revenue maximising exercise for ports. The interests of shippers are not directly considered by the model, although they coincide in many areas with those of the shipping lines.

Port Revenue

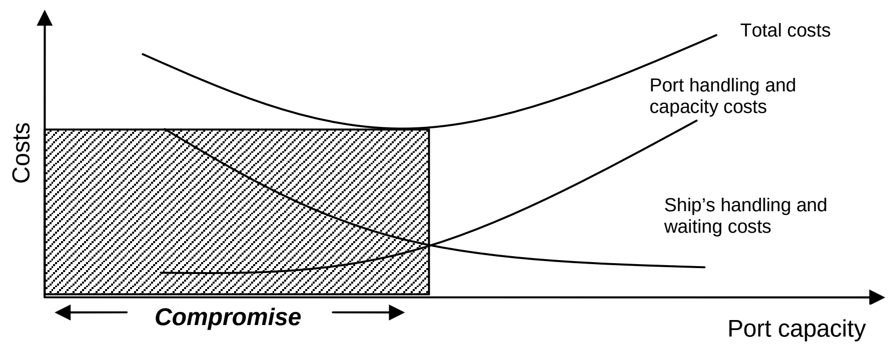
4.2.2 The rationale of the MDST mechanism for port revenue maximisation and ship diversion (the container stevedoring surcharge) may not be consistent with the economic and market behaviour of port and shipping agents.

4.2.3 Although the use of price increases to ration demand has been a common short-term response of ports to congestion, it has normally been followed by a medium-term response – investment in additional equipment or procedures to increase capacity within the existing port footprint – and a long-term response, namely investment in additional infrastructure close to the congested port (for example, improved road or rail access) or to development at a location elsewhere typically chosen "in the national interest". By supposing an inelastic berth productivity, the MDST model does not make enough allowance for the dynamics of port development beyond the short-term.

Ship Costs

4.2.4 The basic economic theory on the relationship between ship cost and port capacity is illustrated in Figure 4.1 below. Keeping other factors constant, the feasible solution is a compromise between the port costs to the ship (handling cost + waiting cost) and the operations and capacity of the port (including investment in additional capacity).

Figure 4.1 Interplay Between Port Capacity and Ships' Time in Port



4.2.5 The MDST model uses increases in stevedoring charges rather than queuing costs as a mechanism for rationing demand at congested ports. In reality, there will be queuing induced by port congestion, the result of which is that stevedoring charges and revenue might be over-estimated by the MDST model, everything else being equal.

4.2.6 Although fuel costs are included in the formula used to calculate ship time costs (at sea and in port), the actual bunkering operation itself is likely to take place at the end of the voyage in Rotterdam where there is a larger and more competitive bunker market; it is unlikely to have any effect on ship time costs in GB ports.

Cargo costs

4.2.7 It is reasonable to assume that cargo dwell time for collection/delivery purposes is the same at GB and Continental ports, however the model should include a reasonable allowance for the additional inventory costs associated with transhipment. With 23% empties (including empty export boxes), a typical contents value of US$ 35,000 per laden TEU, an average increase in transit time of 5 days, and a 7.5% p.a. interest rate, the additional inventory costs associated with transhipment would be around US$ 28 per TEU. This is large enough, in relation to the other costs in the model, to have a significant effect on the outcome.

4.2.8 It is difficult to predict whether it will increase or reduce transhipment volumes. High value cargoes with access to reasonably frequent services to Great Britain are likely to prefer direct calls, but similar cargo from countries with a weekly service or less may prefer transhipment because of the higher frequency of services to Continental ports. There is also the question of whether any of the so-called "Express Services" which call at relatively few ports en route would include British ports in their itineraries.

4.2.9 Inventory costs may well fall over time, as a result of the reduction in service intervals for feeder vessels as transhipment volumes increase, and the wider range of feeder services available on any particular day. The transfer of higher value cargoes to air freight, and the use of low value cargoes to fill empty outbound boxes, has also had an effect on inventory values.

Supply Chain Costs

4.2.10 The more comprehensive logistics costs described above may not in practice be decisive because shippers may have different logistics strategies. Indeed, the trade-off between transport cost and inventory cost (lead time) has implications that go beyond operational decisions to include aspects of strategic network configurations. For instance, while sea transport is almost solely based on the principle of cost minimisation, the advantages of using ports through a combination of sea and land transport can only be achieved with specific production and inventory policies along with adequate design of logistics facilities. From a logistics and supply chain perspective, decisions on freight flow models involving ports are closely linked to shippers' strategies toward logistics network configuration and supply chain processes.

4.2.11 A key feature of logistics network configuration is the degree of network centralization, which has both vertical and horizontal dimensions. A vertical dimension corresponds to the number of logistics tiers across the network, e.g. supply, production, distribution and sale, while the horizontal dimension describes the number of facilities within each tier, for instance the number or size of warehouses and retail stores in the distribution and sales tiers, respectively.

4.2.12 Other key features of logistics configuration are the degree of network segmentation and the nature of the supply chain planning process. Approaches used in network segmentation include continuous replenishment, postponement and mass-customisation while strategies for supply chain processes include make-to-order (MTO), make-to-stock (MTS) and assemble to order (ATO). Clearly, both locational and inventory policies will differ according to the strategy adopted, which in turn will impact the decisions on mode choice, traffic assignment and port choice.

4.2.13 An instance of the impact of network centralization on port and mode choice is the recent development of a £20m dedicated import logistics facility for ASDA at Teesport in 2006, following a strategic decision of the retailer to reconfigure its distribution network by reducing by half the number of its central warehouses[17]. According to ASDA, the new facility allows 70% of its non-food imports to go directly to the North by sea rather than by road from Felixstowe with an expected annual saving of more than 2 million road miles. The other major advantage of this facility is the creation of a demand for direct deepsea calls to Teesport, which is why the port has started developing the Northern Gateway Container Terminal (NGCT) – a £300 million new deepsea container terminal. Recently, PD Ports (the owner of Teesport) has reached an agreement with TESCO to build a similar logistics centre expected to be 4 times larger than ASDA's centre. The 1st phase of TESCO's facility at Teesport is expected to open next year.

4.2.14 PD Ports is pioneering the concept of "port-centric logistics" in the UK. This concept has been successfully developed and implemented elsewhere (see for instance the US ports of Galveston and Savannah) and consists of concentrating on shippers rather than ocean carriers, and providing value-added services (consolidation, break-bulk, postponement, customisation, etc.) that integrate their logistics and supply chain processes. Factors such as these can be incorporated into logistics chain models of individual companies to assess their distribution networks and to develop cost reduction strategies. However, they may be too complex to be included in an aggregate national port choice model.

[17] Joint ASDA and Teesport communication, 2005

4.2.15 The most promising way forward may be to include ports as potential distribution centres in the logistics network referred to earlier and to develop aggregate generalised cost models in which factors such as journey time and service frequency are used to model the supply chain costs indirectly.

Non-cost issues

4.2.16 Decisions on freight flows are not defined solely by cost and price considerations; other factors such as connectivity, frequency, reliability, and quality of service are also important drivers of port and mode choice. Other relevant factors include marketing, such as brand image, fidelity, discounts and straight re-buy, as well as customer service and contractual arrangements, whereby favourable treatment (berthing priority, price rebates, capacity/crane allocation, etc.) may be offered to specific users and/or services.

5. CONCLUSIONS

5.1 The auditing work

5.1.1 The audit of the two versions of the Transhipment Study has been conducted as follows:

Review of the reports

Preliminary description of the methodology

Clarifications from MDST

Review of the computer coding of the model

Assessment of the model

Analysis of potential model limitations

Comments on the modelling assumptions

Analysis of wider issues which could be included in future developments of the model

Factual checking of audit conclusions by MDST

5.1.2 Chapter 1 of this report presents an introduction to the auditing work and a background to understanding the environment in which the two Transhipment Studies were commissioned by the DfT from MDST.

5.1.3 Chapter 2 describes the modelling methodology used by MDST in the transhipment studies. The analysis of the reports was supported by inspection of the Visual Basic code used in the Excel spreadsheets that constitute the transhipment model. During the audit, the Team has been in constant contact with MDST to receive feedback on the Team's understanding of the model. The review of the modelling exercise, therefore, is based on the two MDST reports, the model spreadsheets, as well as the conversations and emails exchanged between the Team and MDST representatives.

5.1.4 Chapter 3 analyses the model in terms of fitness for the original purpose, challenging – where felt to be appropriate – the assumptions and methodology employed by MDST in the two reports.

5.1.5 Chapter 4 presents a brief indication of some of the other supply chain-related issues which might be included in any future modelling exercise. The auditing team understands that factors faced by MDST, such as modifications to the brief and therefore to the model, may have constrained the model development thus far. Therefore, this chapter presents issues which might be of interest for further development of the model, should there be interest in addressing wider policy issues.

5.2 Fitness for purpose

5.2.1 After a detailed review of all components of the model, the auditors came to the following main conclusions:

The cost-minimising approach chosen to drive the modelling exercise does not take into account various other factors which may affect cargo routeing decisions, of which the most important are transit time and inventory costs. This is because the model is driven by the interests of shipping lines rather than shippers. The inclusion of these costs will have a significant effect on the results of the economic impact assessment, and will also have some effect on cargo routeing patterns. In moving to generalised cost minimisation, greater consideration should be given to supply chains and the influence these have on port choice and inland transport. The inclusion of inventory costs in the model would be a start. This would require significant additional survey work.

The landside transport cost analysis could be significantly improved by considering the influence of regional distribution centres on port choice, and the implications of this for freight flows. The inclusion of modelled road and rail networks instead of average port-county distances would further improve the accuracy of the model, although it is recognised that this would be a very ambitious undertaking. This would permit a more detailed prediction of road/rail mode choice which could potentially take into account the effects of traffic volumes, cargo size, service frequency and route density. The use of regional distribution centres in particular is expected to significantly change the pattern of freight flows, mode choice, Sensitive Lorry Miles and ultimately port choice. We do, however, recognise the deficiencies in currently available data on the detailed destinations of road containers, in particular those departing from and arriving at container ports.

Consideration might be given to the movement and storage of empty containers, about which little is currently known. As they carry no inventory, and are more easily moved and stacked, they have a wider range of routeing options than full containers, and need to be moved less urgently.

Some of the parameter values chosen by MDST can be disputed. For example, the quay productivity values appear to be low, and have not been allowed to increase over time with the introduction of new technology and improved layouts at new terminals. Changes to these parameters may significantly affect freight flows, and therefore scenario conclusions. The MDST analysis also foresees the introduction of very large vessels and makes the assumption that all deepsea ports included in the model, both in the UK and the Continent, will be accessible to these vessels. It is our view that very large vessels will make only a limited number of calls in Europe and that some GB deepsea ports will not be able to accommodate them. In the shorter term, these issues are probably best addressed through additional sensitivity testing.

The modelling exercise is based on the premise that all deepsea vessels calling at GB ports will go on to ports in NW Europe, and that the transhipment of all GB containers which are not handled at GB ports will take place in Rotterdam or Le Havre. This is no longer the only plausible framework. The possibility of direct calls at West Coast ports by vessels going on to the United States has already been briefly explored by MDST using a different model (LINCOST), which we have not audited. Also there are now more options available for transhipment of GB cargo outside of NW Europe, principally in the Mediterranean, using feeder vessels which are significantly larger and travel over longer distances than those deployed in NW Europe.

The model, as it stands, gives a reasonable first estimate of the traffic distribution effects of the scenarios which were tested, but cannot (nor was it intended to) be used to model competition between ports in the South East, or assess with accuracy the viability of proposals for ports outside this region. We feel that parallel consideration of a range of other factors not included in the model would result in a more reliable process for port policy formation.

5.2.2 The following table summarises the points raised above, assesses their potential to influence model outcomes on the scale of high to low, and finally grades them with respect to our judgement of the difficulty in including them in the model. Clearly these judgements, while based on the evidence before us, are subjective and qualitative.

Table 5.1 Main Issues Affecting Model Outputs

Issue	Impact on results	Difficulty of modifying existing model
Use of only two agents (shipping lines and ports) with exclusion of shippers	L	D
Failure to consider inventory costs	L	E
Limited representation of regional distribution centres, plus inability of shipping lines to focus on regional markets/ large customers	H	D
Empty containers (behavioural differences)	L	D
Reclassification of Mediterranean traffic	L	E
Ship size distribution, and potential inability of some ports to handle all sizes of ship	M	E
Quay productivity	H	E
Vessel queuing	L	D
Operating patterns of deepsea ships (multi-porting in NW Europe, relay operations, slow steaming, string management)	H	D
Inland transport costs (introduction of networks, services frequencies, etc.)	L	D

Legend: H=high; M=medium; L = low;
D=difficult to include; E=easy to include

Issues shaded in Table 5.1 are we believe the easiest to tackle within the framework of the existing model.

5.3 Concluding remarks

5.3.1 The MDST model provides many useful insights into the way in which deepsea container traffic would redistribute itself in the event of a shortfall in deepsea container capacity in Great Britain. This is the main purpose of the model, which it satisfies well within the time and budget constraints governing its development. Like all models, however, it is a simplification of reality with scope for further development and should not be the sole basis for policy making.

5.3.2 Concerns about the model expressed by some representatives of the ports industry have arisen in part because they envisage it being used for purposes for which it has not been designed. For example the appraisal of new port investment projects or the forecasting of port-related traffic through specific sections of the road or rail network. The model could contribute to these types of decision, but its results would have to be interpreted very carefully, and it would almost certainly have to be supplemented by other types of investigation.

5.3.3 Some of the assumptions used in the model can be disputed, and others will inevitably change over time. There would be value, therefore, in DfT continuing to develop the model, as it throws up interesting areas for further research that have policy implications extending well beyond the original transhipment studies.