Establishment of a Container Transhipment Port in Scapa Flow, Orkney

1. INTRODUCTION

This document is a summary of a consultancy study undertaken by the TRI Maritime Transport Research Group at Napier University under the direction of Alf Baird, Head of the TRI Maritime Research Group. The study was jointly commissioned by Orkney Islands Council, Highlands and Islands Enterprise, and Halifax Port Authority in Nova Scotia.

The study was aimed at investigating the potential for the establishment of a container transhipment port in Scapa Flow, specifically in the context of a North Atlantic route between Orkney and Halifax, to cater for container traffic between North west Europe and the eastern seaboard of North America.

The opportunity has been created by the growth in capacity, size, and draught of container ships. Existing ports, for example on the continent of Europe, are having difficulty catering for these vessels without major dredging and other works, which apart from being very costly also raise environmental problems.

An alternative solution, of utilizing the larger vessels between Halifax and Scapa Flow, and transhipping containers at both ports for onward shipment via feeder routes to other existing ports in Europe, and by feeder or rail from Halifax to various North American destinations, has many attractions.

The heart of the study was the construction of a financial model to compare the costs of this alternative solution with existing arrangements. Whilst this summary touches on the overall conclusions drawn from the model, the model itself is commercially sensitive and is not being released in its entirety at this stage.

The study began by examining overall trends in the world shipping market, then detailed the concept of container transhipment and what it would mean for Orkney if such a port was established at Scapa Flow.

2. INDUSTRY TRENDS

2.1 Growth in container traffic

Average historic world container growth rates of 10-15% per annum are running at more than double GDP growth. Even more moderate expected future growth rates of at least 8-9% a year is regarded as highly bankable, with investors in container terminal projects not unexpectedly keen to lend against such trends.

World container traffic is expected to reach 222m TEU by 2000, 306m TEU by 2005 and 391m TEU by 2010. Over the 1995-2010 period, therefore, container volumes are expected to more than double.

2.2 Demand for new container terminal capacity

The top 100 ports combined accounted for an estimated 80% (i.e. 170m TEU) of world container traffic in 1999. Of these, the top 30 ports alone account for more than half (52%) of world container traffic.

To accommodate forecast increases in traffic, substantial new container terminal capacity will be required by 2005 and beyond. Additional capacity will need to be in the order of 100m TEU or, in other words, 100 additional container terminals each capable of handling 1m TEU a year.

Illustrating the growth in traffic, between 1995 and 2000, the number of container ports handling 1m TEU or above has more than doubled, from 30 to over 60. By 2005 it is possible that there will be more than 100 container ports each handling in excess of 1m TEU per annum. Some forecasters (e.g. PA Consulting) indicate a potential world port terminal capacity deficit of over 30m TEU in 2005.

2.3 Industry consolidation and increased ship size

In 1998, the 20 largest container shipping lines controlled 3.1 million TEU of total shipboard capacity, equivalent to 54% of world-wide capacity. The top 20 lines share of global container capacity has increased from 38% in 1984 and 41% as recently as 1996. Most of these lines together with others in the top 30 operate within nine major operating alliances (each alliance usually consisting of 3-4 lines) collectively accounting for almost two thirds of world container ship capacity. Further consolidation through mergers and acquisitions is expected as lines seek to secure greater economies of scale and scope in providing global service.

Part of the reason for increased carrier size relates to the increase in ship size – bigger carriers are needed to fill bigger ships. The average capacity of newbuild container ship for the top 20 lines is now 4,548 TEU, which is more than double the average size of ship currently in service. Capacity of the largest container vessels has almost tripled since 1980, from 3,000 TEU to 8,000 TEU. An increase in ship size is necessary to accommodate constant trade growth, as well as to reduce carrier unit costs in the face of fierce competition. Maximum ship size is expected to increase further to over 10,000 TEU and to perhaps as high as 15,000-18,000 TEU.

2.4 Implications of ship upsizing for ports

Many traditional liner ports are unable to accommodate the mega ships. Key barriers to a port handling such ships include the need to dredge far deeper channels, lack of terminal land area, and local traffic bottlenecks. Dredging in some ports involves capital expenditure running to several hundred million dollars. The current four-year programme of investment in channel deepening and infrastructure projects planned at US ports amounts to a total of $7 billion.

Mega ships are more easily handled at specially built offshore transhipment terminals than depth-constrained and congested cityports. New offshore mega-hubs being built in a number of locations around the world have the natural benefit of deep water and therefore avoid high capital and maintenance dredging expense. Furthermore, as almost all containers are transhipped at such facilities, the port itself neither contributes to, nor suffers from, landside bottlenecks.

Although many physically constrained cityports continue to seek to provide mega ship scale facilities, the cost of doing so is increasingly likely to fall on port users (i.e. the carriers). The US Government is proposing legislation to introduce a Harbor Services User Fee (HSUF) to be levied on ship operators. The implications of this are significant: for a 6,000 TEU ship, the HSUF would amount to an estimated $156,180 per voyage, equivalent to $26.03 per TEU. Taken over a year, a single weekly transatlantic service string would incur additional costs of $8.1m due to the HSUF.

In Europe, the European Commission is also considering cost recovery of state funded infrastructure through port charges. As competition increases between ports, it is clear that subsidies given for dredging are not consistent with a fair competition policy, or in ensuring that new investments are demand driven. This is especially evident in instances where more appropriate natural deep-water harbours exist (e.g. in Orkney). Consequently, such subsidies lead to market distortions and inefficient use of scarce resources.

Avoiding the need for huge investments incurred by large-scale civil engineering dredging programmes effectively removes the biggest single restriction against ship upsizing.

2.5 Container transhipment hub requirements

Approximately one quarter of all containerised cargo in ports relates to transhipment, and the general trend is towards a greater proportion of transhipped containers. Reflecting the pressure for more container transhipment, there are at least 16 new container transhipment hub terminals either recently completed or currently under construction.

"A hub port is a container port that provides terminal and marine services to handle and facilitate the transfer or transhipment of containers between feeder and mother vessels in the shortest possible time."

Aside from natural deep water, and adequate shelter for vessels, the key requirement of any offshore transhipment hub is its strategic position – a hub has to be in a geographically suitable location, preferably resulting in reduced steaming time for carriers. A favourable location for a transhipment hub therefore involves:

- Close proximity to trunk routes where deviation time is kept to a minimum, allowing for as short a trunk-haul transit time as possible, and;

- The capability to use fast feeder services to ensure door-door movements for various origins/destinations remain time and cost competitive with alternative direct service options.

The site itself must be sufficiently central to serve a large sub-region, and allow feeding costs to be minimized. Additional attributes attractive to users include 24 hours service, advanced IT capabilities, a broad range of support activities, and overall service customized to fully comply with customer requirements.

In addition, there must be significant cost savings for lines in their choice of a nominated hub. As offshore locations are also much cheaper to develop and to maintain than existing ports, lower running costs further benefit global carriers.

2.6 Benefits of offshore container hub terminal development

The primary benefits to be derived from diversion of mega ships to specially designed offshore hub terminals are as follows:

- Reduced pressure on existing constrained land areas at mature traditional mainports;

- Reduced costs from diversion of largest ships to cheaper offshore mega-hubs (e.g. cheaper land, less dredging/towage/multiple calls);

- Reduced pressure on traditional mainports to act as transhipment centres, with all the implications this entails for additional land take/access; and,

- An offshore transhipment terminal allows ever increasing demand (for freight transport) to be distributed across more ports in any given region. It also permits growth to be managed more efficiently and effectively.

2.7 Container terminal productivity

Most ports average a discharge rate of approximately 23 moves. Carriers are always looking for productivity improvements to provide faster port turnaround. To more effectively work even larger vessels this level of productivity must be improved upon.

An obvious way to increase productivity is to deploy more cranes per ship. However, at present there is a limit of 6 quay cranes per ship, and in some ports even less than this. Ideally, carriers are searching for a solution that will give a mega ship productivity level of between 300 and 600 container moves per hour. Inevitably this will require innovative solutions, encompassing more cranes/berth, faster cranes, and novel berth design.

There are various potential solutions to this problem, and practical examples have been considered in the study (e.g. Ceres new 9-crane Paragon Terminal in Amsterdam).

2.8 The North Atlantic container trade

The North Atlantic container market (i.e. containers carried by ship between North American ports in the range north of Cape Hatteras, and ports in Northern Europe) has been estimated by establishing the following:

- Traffic between US ports and North Europe (from PIERS data);

- Traffic between Canadian ports and North Europe (from port data);

- Empty container traffic (port estimates).

Total estimated container traffic for the North Atlantic in 1999 (i.e. excluding US Gulf and West Coast ports) is shown in Table X1. Overall the market amounts to an estimated 3.1m TEU, of which 60% is US port traffic, 31% Canadian ports (half of which is for US Mid West), and 9% are empty units. We believe these are conservative estimates as certain categories of cargo (e.g. military) are excluded.

Table X1. Total estimated North Atlantic container traffic, 1999

	TEU	% Share
US East Coast ports-North Europe	1,849,509	60%
Canadian ports-North Europe	952,129	31%
Empty Units	280,164	9%
Total	**3,081,802**	**100%**

This 3.1m TEU comprises the primary market for the proposed Orkney-Halifax container transhipment service. While such a service should also be able to tap into the other container volumes currently moving across the Atlantic to/from ports on the US West and Gulf Coasts, it would inevitably depend to a much greater extent on penetration of existing East Coast and Canadian port traffic. Any potential for Asian traffic using the Canadian landbridge has likewise not been considered at this stage.

With regard to traffic growth, between 1996-1999 the US-North Europe container market grew by 30% overall, from 1.4m TEU to 1.85m TEU. However, this masks different directional growth levels. Since 1996, the westbound container trade from Europe to US ports grew by 35%, but by only 5% in the opposite direction. The main cause of this is the booming US economy and a strong dollar.

The majority of traffic expected to be routed via an alternative Orkney-Halifax transhipment service would need to be diverted from services currently making direct calls through multiport schedules at ports in North America and in Northern Europe.

In Northern Europe, the principal ports handling container traffic for North America are Bremerhaven, Rotterdam, Antwerp, Felixstowe and Le Havre. (Rotterdam and Antwerp are considered as substitutes by a number of carriers - i.e. some carriers will not call both ports in the same service). It is therefore principally these ports that would need to be connected by fast feeder services to an Orkney transhipment terminal.

In North America, aside from Halifax, the main ports north of Cape Hatteras handling European traffic are New York/NJ, Norfolk, Baltimore, and Montreal. With an alternative routing via a transhipment terminal in Halifax, the three US ports would need to be served by fast feeder, with Montreal (and US Mid West) connected by double-stack rail services.

3. FINANCIAL MODEL

3.1 Aim of the Model

The aim of the model was to derive costs relating to a container transhipment service using Orkney and Halifax as hub ports (hereafter referred to as a MEGASHIP service), and then to compare these costs with the alternative direct service options (i.e. a MULTIPORTSHIP service). The main objectives are therefore:

- To estimate Total Shipping Costs per TEU for a MEGASHIP transhipment service, inclusive of FEEDERSHIP costs;

- To estimate Total Shipping Costs per TEU for a MULTIPORTSHIP direct service;

- To compare and evaluate Total Shipping Costs per TEU relating to a MEGASHIP + FEEDERSHIP transhipment service with a MULTIPORTSHIP service, and over a range of vessel sizes.

3.2 Container services modelled

Estimated Total Shipping Costs per TEU are therefore modelled for three specific types of container shipping service:

- **MEGASHIP** – vessels between 4,000-10,000 TEU capacity employed only on a trunk haul between Orkney and Halifax transhipment hubs;

- **FEEDERSHIP** – smaller capacity vessels employed to connect the Orkney and Halifax transhipment hubs with key ports at each end of the trade (i.e. in North America and in Northern Europe), and;

- **MULTIPORTSHIP** – vessels between 4,000-10,000 TEU capacity serving by direct call a range of ports in North America and Northern Europe in an End-to-End service.

3.3 Methodology

For each service type, the model employed requires development of the following submodels:

(1) Daily Fixed Cost per TEU

(2) Cost per TEU-Mile

(3) Cost in Port per TEU

(4) Total Shipping Cost per TEU

In estimating the total transhipment costs, the MEGASHIP and FEEDERSHIP cost-per-TEU, plus hub container lifting costs are summed, and thereafter compared with the alternative MULTIPORTSHIP cost-per-TEU.

Interim modelled costs were prepared for the Orkney-Halifax MEGASHIP service. These costs and related assumptions were then presented to major carriers and container terminal operators. The interim modelled costs were then refined to take account of industry views.

During presentations the industry suggested a need to also model other deepsea hub-hub MEGASHIP shuttle services in addition to Orkney-Halifax. Corresponding with suggestion made by the industry, the following MEGASHIP services were modelled and compared with alternative MULTIPORTSHIP services:

- Orkney-Halifax
- Orkney-Freeport (Bahamas)
- Orkney-Singapore

3.4 Modelled results

Total-Shipping-Cost-Per-TEU[1] were modelled and estimated for each of the three deepsea MEGASHIP services. Potential cost savings using Orkney as transhipment hub, based on optimal ship size for each route, were as follows:

- A reduction in Total-Shipping-Cost-Per-TEU of up to 23%;

- A reduction in one-off fleet capital costs of up to 7.5%

The model also permitted calculation of potential environmental benefits resulting from a change from MULTIPORTSHIP to MEGASHIP services. These benefits, again based on optimal ship size in respect of each route were as follows:

[1] TEU = Twenty-foot equivalent unit.

- A reduction in TEU-miles of up to 17%;
- A reduction in fuel consumption of up to 10%

Obviously cost savings and environmental benefits will vary by route, and by vessel size. However, the modelled estimates demonstrated that transhipment (i.e. MEGASHIP service) was superior in relation to each measure, and for all routes.

3.5 Explanation for MEGASHIP economic and environmental benefits

The principal reasons for this positive outcome in respect of transhipment via a hub port in Scapa relates to the identification in the study of diseconomies associated with current MULTIPORTSHIP services, both at sea and in port. These include, in particular:

- Extra intra-regional steaming time between ports for MULTIPORTSHIP services, the latter mostly involving substantial empty running (i.e. due to ships only part loading in each port), serves to increase ship cost at sea per TEU, whereas MEGASHIP and dedicated one-port FEEDERSHIP connections avoid such inefficiencies;

- Port charges levied on vessels are dependent on ship size (e.g. ship dues, pilotage, towage etc.) and occur in every port of call irrespective of the volume of cargo carried, giving a MULTIPORTSHIP additional cost in port penalties, and;

- The MEGASHIP, when fully discharged and loaded in the one transhipment terminal, enjoys a crane productivity and crane density advantage over the MULTIPORTSHIP service, thereby speeding up turnaround time.

In essence, while the MEGASHIP service incurs ‘extra’ costs associated with FEEDERSHIPS and transhipment handling, these costs are more than offset for a range of ship sizes by routing and port inefficiencies evident in a MULTIPORTSHIP schedule.

A key difference in this evaluation compared to previous studies is that, rather than consider only the marginal costs associated with transhipment (i.e. feeder plus extra lifts), it is far more relevant (if not vital) to estimate and compare the entire roundtrip voyage costs, including ship time and cost in port, also taking into account variations in terminal productivity.

The results of the detailed modelling exercise therefore indicates the potential for carriers to enjoy significant cost savings, and to generate major environmental benefits using transhipment via Orkney, compared with current direct call services. A comparison of transit times also shows that a MEGASHIP option would be competitive with MULTIPORTSHIP schedules for the majority of cargo origins and destinations in each trade route modelled.

4. TERMINAL FACILITIES AND EMPLOYMENT

4.1 Services and traffic flows

Based on modelled cost findings, and optimal vessel sizes, three separate levels of terminal utilisation and associated terminal development scenarios were considered:

- **Minimum (MIN) Scenario**
  - twice weekly North Atlantic MEGASHIP (4,000 TEU) service to Halifax hub

- **Medium (MED) Scenario**
  - twice weekly North Atlantic MEGASHIP (4,000 TEU) service to Halifax hub
  - twice weekly South Atlantic MEGASHIP (4,000 TEU) service to Freeport hub

- **Maximum (MAX) Scenario**
  - twice weekly North Atlantic MEGASHIP (4,000 TEU) service to Halifax hub
  - twice weekly South Atlantic MEGASHIP (4,000 TEU) service to Freeport hub
  - twice weekly Europe-Asia MEGASHIP (6,000 TEU) service to Singapore hub

The MIN scenario would generate an initial terminal throughput of 1.1m TEU per annum (from Year 2), while the MED scenario would be double this, 2.2m TEU per annum, and the MAX Scenario 3.9m TEU.

4.2 Terminal facilities

Under each scenario the terminal area, quay length, and number of cranes would also alter in line with variations in throughput (see Table X.2).

Quay length for a MIN scenario development would be 850m, with back-up area of 297,649m^2, and 8 cranes.

For the MED scenario quay length would be 1,701m, land area 595,298m^2, and 16 cranes.

The MAX scenario would require a quay length of 2,976m, land area of 1,041,696m^2, and 28 cranes.

Table X.2: Terminal facilities and cost

	MIN	MED	MAX
TEU Per Annum	*1,120,560*	*2,241,120*	*3,921,680*
Cranes	*8*	*16*	*28*
Straddles	*24*	*48*	*84*
Quay length	*850m*	*1,701m*	*2,976m*
Terminal area	*297,649m^2*	*595,298 m^2*	1,041,696 m^2
Total Cost	**$196.1m**	**$392.2m**	**$686.4m**

Terminal capital cost for the MIN scenario is estimated to be $196.1m, for the MED scenario $392.2m, and for the MAX scenario $686.4m. Two thirds of capital costs relate to infrastructure (i.e. quays, paving etc.) and one third superstructure (cranes etc.).

A further confidential financial model has been prepared in order to estimate terminal revenues, expense, and cash flows for developments corresponding with each of the three operating scenarios.

4.3 Employment impacts

During the early years of the terminal, employment in the facility would range from 273 jobs under a MIN scenario, to 547 (MED scenario), up to 956 (MAX scenario).

With a doubling of capacity expected after Year 10 of operations, albeit with a proportion of additional labour content (i.e. 50%) replaced through productivity gains, terminal employment is estimated at 410 under the MIN scenario, 820 under the MED scenario, and 1,435 under the MAX scenario (see Table X.3).

Table X.3: Direct terminal employment (Year 2 and Year 10)			
	MIN	**MED**	**MAX**
YEAR 2			
TEU throughput	1,120,560	2,241,120	3,921,680
Cranes	8	16	28
Total employees	**273**	**547**	**956**
Gross incomes	**$10.2m**	**$20.5m**	**$35.8m**
YEAR 10			
TEU throughput	2,241,120	4,482,240	7,843,360
Cranes	16	32	56
Total employees	**410**	**820**	**1,435**
Gross incomes	**$15.3m**	**$30.7m**	**$53.7m**

Based on a multiplier of 1:0.5, total direct, indirect and induced employment estimates range from 410 to 1,434 jobs after Year 2, to between 615 and 2,153 jobs after Year 10 (see Table X.4), depending on which terminal development scenario occurs.

Assuming that the majority of terminal employees are resident in Orkney, it would be expected that the majority of employment impacts resulting from terminal activity will also be in Orkney.

Table X.4: Direct, indirect and induced employment resulting from terminal operations (Years 2 and 10)			
	MIN	**MID**	**MAX**
YEAR 2			
Total jobs created	**410**	**821**	**1,434**
YEAR 10			
Total jobs created	**615**	**1,230**	**2,153**

Additional employment opportunities would/could result from:

- Terminal construction (initial phases and during future expansion);
- Designation of a Free Trade Zone (i.e. ‘Freeport’) in Orkney;
- Ship repair activities at Nigg.

As there are currently no deep-sea container terminal facilities active in Scotland, a transhipment terminal in Orkney would have no displacement effect at the Scottish level. Any adverse employment effects at other ports in the UK and on the Continent would be expected to be minimal as these ports would still be handling similar traffic volumes, albeit carried by FEEDERSHIPS.

5. ENVIRONMENTAL AND PLANNING ISSUES

5.1 Planning Application

As with all proposed development, a planning application must be submitted to the Local Planning Authority, in this case Orkney Island Council. The application must show a detailed plan of what is proposed, including elevations.

The Hub Port, or Container Transhipment Terminal proposal, falls within a particular class of proposed development which, under a European Directive and the associated Scottish Regulations, require the planning application to be accompanied by an Environmental Statement. This has to be a substantial document describing the direct, indirect and cumulative impacts upon the natural and human environments. The Environmental Statement will accompany the application and will be tested at the likely forthcoming Inquiry.

5.2 National and international significance of development

The Hub Port proposal is of such national significance that the application will almost certainly be ‘called in’ by the Scottish Executive for determination by the Minister rather than the Local Authority. This will change the Orkney Council’s role from having to decide the application to providing evidence as an input to the Minister’s decision.

The proposal will also have significance at the EU level. Currently the intention in Europe seems to be for big ships to be accommodated by artificially enlarging numerous traditional liner ports, one or more in each of the largest member states, and at considerable environmental and financial (including taxpayer) expense. Given availability of offshore hubs at deep-water locations, the net benefits of artificially developing new mega-terminal facilities in numerous urban and semi-urban locations (e.g. Bremerhaven, Rotterdam, Antwerp, Southampton etc.), each required to only partially work a MULTIPORTSHIP, appears both environmentally damaging and inefficient.

The offshore transhipment hub concept, already dominant in Asia, the Mediterranean and the Caribbean, but slower to develop in North America and Northern Europe due to inter-state port competition, resolves this dichotomy by allowing ships to grow to an economic size for trans-ocean crossings, using smaller feeder ships to penetrate shallow estuaries to reach city-ports. A similar move towards the offshore hub concept in Northern Europe would therefore reduce the need for expensive and environmentally damaging developments in shallow-water congested locations.

The Orkney proposal will certainly change the patterns of use in other ports and their expansion plans but by just how much is not yet known. However, the principle that some effects in Orkney will be offset by improvements elsewhere has to be established. The Environmental Statement therefore needs to assess the net change across European ports rather than focus exclusively upon Scapa Flow and its immediate surroundings.

6. Strategy implementation

In the final analysis, to attract investors, operators, and users, the competitive advantage of Orkney will need to be substantial and sustainable in the long term. Given the positive market and financial analysis, the results of this study indicate that such an outcome may be possible.

Assuming the clients wish to proceed with the project, the following dual approach is recommended:

- Further necessary studies (i.e. Civil Engineering, Environmental Statement) are carried out and a Planning Application submitted;

- A Steering Group is created to:

  - manage these studies, and;

  - select a preferred bidder through a competitive tender process to build and operate the terminal under concession.

This process will inevitably demand significant financial and managerial resources. The extent of resources required is difficult to predict and further work will be necessary to assess the budget implications.

It is worth noting that a similar competitive bidding process designed to attract major shipping investments to Scotland (i.e. Scotland-Continent ferry service) was recently successfully undertaken by Scottish Enterprise, Fife Council and partners. It is possible that lessons can be learned from the latter exercise in connection with the Orkney opportunity.

An indicative timescale for development is shown in Figure X.1. The entire planning, tendering, and construction process would be expected to take between 48-54 months in total, assuming that the Planning Inquiry is not excessively delayed.

Figure X.1: Indicative timescale for development				
Further studies				
	Planning Applic./Inquiry	Decision by Minister		
	Tender Process		Terminal Construction	
			Terminal opens	
0-6	**7-24**	**25-30**	**30**	**48-54**
MONTHS				

February 2001