Proceedings of ICE
Civil Engineering 163 May 2010
Pages 29–33 Paper 09-00054

doi: 10.1680/cien.2010.163.5.29

Keywords
infrastructure planning; maritime engineering; transport management

Alfred Baird
BA (Hons), PhD, MCILT

is professor of maritime transport at TRI Edinburgh Napier University, UK

Redefining maritime transport infrastructure

Aided by investigation and analysis of European maritime policies and ongoing transport network developments, this paper redefines maritime transport infrastructure as the ships themselves rather than just the ports at each end. It argues that the seaway platform, namely the floating deck of a vessel, is comparable in a functional sense with road and rail infrastructure. This new interpretation could result in a more equitable approach to policy-making, public funding and user charging for maritime transport.

Transport infrastructure definitions tend to identify assets such as roads, railways, airports and ports (Pearce, 1992; Rutherford, 1995). When referring to maritime transport infrastructure, the emphasis is therefore primarily directed towards ports (Haralambides, 2002; Verhoeven, 2009). Extending any discussion of maritime transport further, aside from immediate port access channels, is usually done with reference to infrastructure inland, such as road and rail, and the relationship between ports/terminals and their land hinterland (Rodrigue and Notteboom, 2009).

Defining – or rather redefining – maritime transport infrastructure is an important outcome of this paper, and in particular setting out how this relates specifically to seaways as distinct from the ports at each end. Ships and ports are considered here also in the context of modal shift; that is, transferring freight from road to the sea, or the so-called 'motorways of the sea'. Reviewing this policy in Europe and ongoing developments in the context of creating comparable seaways to road and rail infrastructure allows for new insights about the reality of maritime transport infrastructure.

Whereas there is universal acknowledgement that roadways and railways are indeed transport infrastructure platforms, there appears to be rather more uncertainty about what constitutes a seaway platform. To argue that the maritime transport infrastructure platform is simply the port (i.e. the node) seems wholly inadequate when talking at the same time about roadway and railway infrastructure platforms along a given corridor, which may extend to several hundred kilometres or more.

This paper briefly considers the general policy approach to developing motorway-of-the-sea services in Europe and the influence this has had in helping reappraise society's understanding of maritime transport relative to land transport modes. This is followed with analysis of modal shift examples, emphasising some of the challenges faced, which tend to relate to market realities determined by ongoing policy approaches, the latter influenced by traditional thinking and definitions of transport infrastructure. Thereafter the discussion centres on developing, explaining and justifying the need to redefine society's understanding of maritime transport infrastructure.

'Motorways of the sea' policy

In Europe, governments at EU and member-state levels are now working to facilitate maritime services leading to a large-scale modal shift. According to the European Commission, the sea represents the only real solution to tackling road freight traffic growth in Europe, hence the inclusion of water transport projects in the Trans-European Transport Network (TEN-T) programme (CEC, 2004). While such motives are honourable, the appreciation of what exactly constitutes seaway infrastructure still requires careful consideration, more

Figure 1. European motorways of the sea

especially in view of economic consequences resulting from ongoing public financing of land transport infrastructure generally.

TEN-T maritime projects are intended to recreate the road and rail network on the water, by concentrating flows of freight in viable, regular sea routes (see Figure 1). The projects are expected to improve port facilities and infrastructure, electronic logistics management systems, safety and security, administrative and customs procedures, and access routes for year-round navigability. The policy and funding emphasis, therefore, is largely aimed at ports and transport access to ports.

The EU Van Miert high-level group, during its deliberations on extending Europe's TEN-T programme, nevertheless decided that motorways of the sea were 'floating infrastructure' (CEC, 2004). This corresponded with ideas put forward by the Groupement d'Intérêt Economique (GIE , 2007), albeit the latter went further by highlighting the need for public financing of the 'boat infrastructure' in the specific context of integrating waterborne transport into the trans-European networks. Clearly there is a recognition here that the 'boat' needs to be taken into account.

Such views were supported through the findings of the Sutranet project funded by the EU Interreg IIIB North Sea programme (Sutranet, 2007). Both GIE and Sutranet findings consider the role of the port as being that merely of a transport node and certainly not a seaway. In this regard, defining a sea port as maritime transport infrastructure seems totally insufficient.

EU funding is aimed at counteracting ongoing transport market distortions favouring land transport modes and member states are also expected to do more in this area. The various TEN-T maritime initiatives are intended to facilitate new developments through current limited financial intervention. Some success is also occurring with the EU Marco Polo programme, which aims to support motorway-of-the-sea service start-ups through limited grant awards based on forecast freight tonne-kilometres modal shift, albeit only over a limited period of 3–4 years. However, even if a project receives Marco Polo funding, the majority of investment in individual initiatives (i.e. 90% or more) is still expected to be provided by private transport operators. Thus, shipping operators are expected to risk their private investments in seaway capacity against state-funded roadway and railway infrastructure.

At the same time, public funding of roadway and railway infrastructure is set to continue at high levels for the foreseeable future, which will lead to ongoing challenges for maritime start-ups. Limited and short-term support for maritime transport modal shift initiatives is at odds with continuing large-scale public sector funding for roadway and railway infrastructure.

EU member states have been requested to co-finance maritime initiatives themselves as well and, under the new EU TEN-T policy, this is now allowable. In addition to international services between states, motorway-of-the-sea services could also comprise domestic and coastal routes within states. Where road transport does not pay its full cost of using road infrastructure, as in the UK, then the need for maritime support is found to be greater (TRI, 2002).

In Italy, the EcoBonus maritime incentive scheme is perhaps the most advanced modal-shift initiative so far within the EU. This provides for state support of €240 million over 3 years, with some 30 motorway-of-the-sea routes qualifying, and allowing for a 20–30% fare rebate to truckers to help equalise costs with road transport.

Another motorway-of-the-sea scheme in respect of routes between France and Spain has been implemented rather differently. In that instance, a tender process was developed for an Atlantic Spain–France service, based on an agreement between both countries and supervised by the European Commission. In this scheme, the ports have been selected by bidders themselves, not by the state. Subsidy is considered as start-up aid to support operations (over 3 or 5 years) with the criteria of evaluation for bids being

- 30% for traffic shifted from road (minimum 100 000 lorries)
- 30% for quality of proposition
- 35% for economic and financial performance
- 5% for other factors.

Clearly, the development of motorway-of-the-sea initiatives in Europe is still at an early stage. The European Commission and member states are also at a formative stage of really understanding what a motorway of the sea is, and how it fits into the wider transport policy context. Implementation of different maritime funding schemes by individual member states results in non-standardisation and could lead to confusion amongst service providers, many of which are transnational.

Conversely, those states not implementing any maritime scheme at all may be unlikely to gain modal-shift benefits from start-up of motorway-of-the-sea services. This suggests that there needs to be a better understanding of what is meant by the term 'maritime transport infrastructure', as well as a shift towards some standardisation on attractive and easy-to-use funding methods and incentives which take full account of subsidies applying to alternative land transport modes.

Modal shift and motorways of the sea

New maritime transport services have developed in a number of countries over recent years, with Italy being at the forefront of European motorway-of-the-sea developments over the last 15 years or so. Motorways of the sea in the modern sense arguably began when the Italian state-owned Finmare company introduced its innovative Viamare service in 1991. That service employed five three-deck roll-on roll-off (ro-ro) ships each capable of carrying over 120 road trailers plus 50 drivers, to provide a daily link between two dedicated out-of-town terminals at Voltri, Genoa and Termini Imerese near Palermo. While the Viamare *Autostrade del Mare* experiment was not without its difficulties (Baird, 1997), the initiative demonstrated for the first time in Europe what could be achieved in terms of road-to-sea modal shift on a large scale.

Since then, ship design and efficiency has continued to improve and today the right ships are available to do the job of modal shift more effectively. Existing ro-ro and ro-pax (ro-ro freight plus passenger capacity) vessels offer fast speed (22 knots (41 km/h) or more), coupled with high payload and high reliability (Figure 2). Although ships of 2000 lane metres internal vehicle deck capacity, equivalent to approximately 150 trailers loading capacity, have become something of a standard size for many motorway-of-the-sea services, far larger ships are now in service offering 4000 lane metres, and new ships of over 5000 lane metres will be delivered in 2010.

Such vast ship sizes means that seaway economies of scale are unmatched by other transport modes. Stena Line's two new 5500 lane metre (i.e. over 350 trailer capacity) ro-pax ferries delivered in 2010 have a 240 m length, 32 m beam and 6·4 m draught and can carry 1200 passengers in 540 cabins. These ships have a gross tonnage of 63 600 grt and cost €200 million each (ShipPax Information, 2009).

On roadways, a single road trailer per tractor is the norm, while on rail, even where road trailers can be carried (many railway systems are unable to carry trailers due to gauge constraints) the maximum number of units carried tends to be under 50.

To cater for the largest ro-ro/ro-pax vessels there is a need in ports for expansion in terminal land and storage areas, a shift to double-deck link spans and bridges to facilitate rapid handling, greater turning areas for longer and wider ships, and improved road access to accommodate larger traffic volumes at any one time.

In addition to economies of scale which help to lower unit operating costs, other strengths of the ro-ro/ro-pax motorway-of-the-sea option include the following (Sutranet, 2007).

- The ability of vessels to carry temperature-controlled units and unaccompanied or accompanied vehicles, with drivers using the ferry trip as a statutory rest break.
- Reduced wear and tear of trucks and trailers, less vehicle maintenance costs and lower insurance costs.
- Greater reliability due to deployment of large vessels which can better withstand the effects of adverse weather.
- Lower fuel costs and avoidance of road tolls and weekend bans on truck movement by road.

In this regard, the ro-ro/ro-pax motorway-of-the-sea functions in a complementary fashion to the long-distance trucking sector. In cost terms, while size and scale benefits give the motorway of the sea a basic unit cost-per-km advantage over road, other factors such as ongoing state subsidy for roadways and railways, plus ro-ro terminal handling charges (the latter not applicable in the case of road transport), plus local road haulage expense at either end of a route tend to limit the overall benefit of motorways of the sea in terms of total costs.

Previous research suggests that the sea leg of motorway-of-the-sea services may actually represent less than half the total door-to-door cost of a trailer movement (Baird, 2008). The other half of costs comprises terminal handling charges, plus local road haulage costs at the beginning and end of a trip. Nevertheless, a number of motorway-of-the-sea routes have been successfully developed over the last 10 years or so, each achieving success in freight modal shift from road to sea transport (Table 1).

The examples presented in Table 1 help illustrate the complex reality and challenges surrounding development of new motorway-of-the-sea services. For example, the 1990s

Figure 2. 'Standard' type 2300 lane m 24 knot (44 km/h) ro-pax ferry (source: Norfolk line)

Table 1: Selected motorway-of-the-sea routes and road trailer volumes (ShipPax Information, 2009)

Motorway-of-the-sea route	Operator	Route length: km	Date started	Road trailers carried (2008)
Barcelona–Genoa	GNV	648	1997	50 000
Civitavecchia–Barcelona	Grimaldi Lines	828	2004	48 821
Genoa–Palermo	GNV; Tirrenia; Strade Blu	791	1991	130 000
Naples–Catania	TTT Lines	413	2001	60 000
Salerno–Messina	Caronte & Tourist	352	2003	116 000
Naples–Palermo	SNAV	309	2002	60 000
Belfast–Birkenhead	Norfolk Line	224	1996	147 950
Rosyth–Zeebrugge	Norfolk Line	722	2002	40 000 (2006)
Kiel–Klaipeda	DFDS	722	1997	55 913
Ancona–Igoum–Patras	Superfast; Minoan; ANEK	1004	1995	199 909
Trieste–Istanbul	UN Ro-Ro	2102	1995	131 500

Balkans conflict coupled with poor road quality and access and problematic border crossings initially helped the UN Ro-Ro and Superfast Ferries services to develop. Illustrating motorway-of-the-sea complementarity with trucking, UN Ro-Ro was itself established and owned by Turkish road transport operators acting in collaboration (Torbianelli, 2000).

In Italy, road tolls and weekend bans on freight transport by road, as well as road congestion, have played a major part in helping to move freight from road to sea. Moreover, where a sea route offers a distance advantage over an alternative roadway (e.g. Genoa–Palermo, Genoa–Barcelona), this is also an important factor favouring the seaway.

In all of the examples the application of modern ship technology – and in particular the use of large, modern ro-ro and ro-pax ferries offering high payloads, attractive transit times, frequency and reliability – has had a large part to play in the success of motorway-of-the-sea services competing against parallel and often problematic roadways.

However, in instances where roads are still provided and maintained by the state more-or-less free to trucks (i.e. where there are no road tolls) the alternative private-sector seaway is not so readily a viable proposition. Indeed, although it can be demonstrated that ro-ro and ro-pax ferry solutions can work successfully in a number of different circumstances, policymakers need to exert care when developing or facilitating such initiatives. In the absence of a level playing field it remains difficult for the private sector alone to take the risk of starting up a motorway-of-the-sea service.

Redefining infrastructure

Researchers, policymakers and commercial actors generally consider 'maritime transport infrastructure' to be the port (e.g. Haralambides, 2002; Imprint-net, 2007). Thus the broadly understood position across the three main surface transport modes is that the principal surface transport infrastructures are

- road infrastructure
- rail infrastructure
- port (i.e. maritime) infrastructure.

On the European continent, at least, port infrastructure receives considerable public sector investment, and ports there are treated in a similar way from a public investment perspective as roads and railways (Baird, 2004). However, ports are also regarded as 'nodal points along a transport chain' (Unctad, 1992). This implies that ports themselves are not the transport chain; ports act as an interface, or in other words, as points of transfer between transport modes.

Indeed, the paramount asset a port must provide to facilitate its wide range of services is not water but land (Haralambides, 2002). Although it is correct to say that ports depend on sea transport, they are also highly dependent on land transport, for example road, rail, pipeline and, in some cases, inland waterways. The ship in this sense is only one of several different transport vehicles that serve a port.

If roadway and railway infrastructures both represent transport platforms extending hundreds or thousands of kilometres between nodes, it is evident that a port does not offer the same comparable facility (or anything close to it). A transport platform (or transport 'way') must consist of more than just terminals, which act merely as static interfaces between transport modes.

It has been suggested that EU ports will play an important role in the development of motorway-of-the-sea services (Psaraftis, 2005). Such a perspective further implies that such services are more than just ports. It also suggests that ports are not motorway-of-the-sea services.

If ports, being nodes, are not the 'transport platform' or 'way', then the seaway itself must represent the platform. And if the port is not seaway or motorway-of-the-sea infrastructure, then that raises another question – what is seaway infrastructure?

Whereas state entities generally procure, finance and maintain roadway and railway infrastructure, and in many countries ports as well, this is not the case with seaways. The port is evidently not the seaway, because it is a transport node, so in that sense port infrastructure is not in any way comparable to roadway and railway infrastructure, the latter offering a transport platform over long distances. This is the point at which any contention that maritime transport infrastructure consists only of the port becomes particularly weak and unconvincing (Figure 3). Inevitably, maritime transport infrastructure (i.e. the seaway) has to be a good deal more than the port.

The installation of any transport infrastructure platform provides for territorial continuity (GIE, 2007). This implies that once transport infrastructure is in place, it provides the capacity for unhindered movement of persons and goods across the Earth's surface. Once created, road and rail infrastructure offers this potential; but the sea on its own does not.

For the sea there is also therefore a need to create a basic transport platform; such a seaway platform has to be comparable in a functional sense to roadway and railway. Figure 4 illustrates the seaway platform, in this instance reflected in the ability of trucks to transfer from roadway to seaway via the nodal point or port. In the absence of a seaway platform – that is maritime transport infrastructure – sea transport cannot take place (Sutranet, 2007). In other words, sea transport cannot function without a platform, which comprises, in effect,

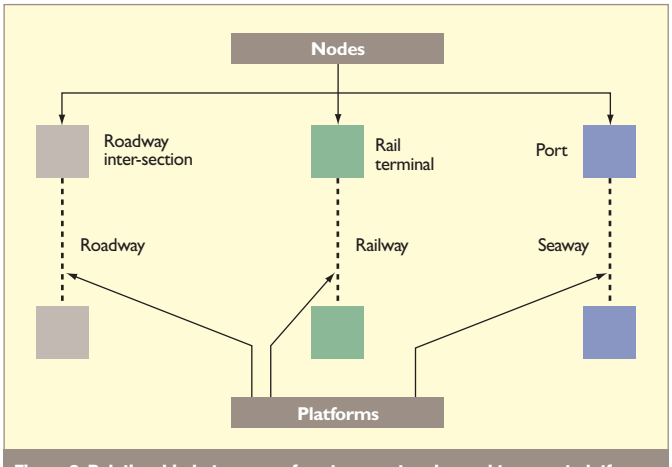

Figure 3. Relationship between surface transport nodes and transport platforms

Figure 4. The seaway transport platform – the main maritime transport infrastructure – is the deck of a ship

 ISSN 0965 089 X

maritime transport infrastructure, thereby enabling the provision of territorial continuity.

If transport infrastructure comprises any kind of works and structures that establish the platform of a means of transport (GIE, 2007), then in this regard it can be argued that the seaway platform must therefore be the deck of a ship. This is already in part recognised at EU level, reflecting the statement by the van Miert EC high-level group on TEN-T that a boat/ship is a 'floating structure' (CEC, 2004). However, the full policy implications of this – compared with state-funded roadway and railway infrastructure – have not yet been thought through. In other words, the boat has yet to be termed 'maritime transport infrastructure' or considered as such from a public policy and funding perspective. The floating structure – the ship – comprises both the infrastructure and the platform of waterborne transport.

The need to support motorway-of-the-sea services as an alternative to state-funded land transport infrastructure has raised calls in France (GIE, 2007) for the financing of the 'boat infrastructure' by public authorities, to the tune of up to 30% of the ship value. This estimate roughly equates to the cost of a ship's basic hull (or cargo platform), leaving the costs of propulsion machinery, accommodation and navigation, bridge systems and so on for the operator to provide. This approach would go some way to help equalise the effect of subsidies applied to road and rail infrastructure, thereby levelling the playing field between sea and land transport, although other mechanisms could equally assist such a process, such as road user charging.

Ports, and indeed navigation aids such as access channels and lights, may be considered as auxiliary to maritime transport infrastructure. However, maritime transport infrastructure or the seaway is composed fundamentally of the floating infrastructure of boats and ships. Ports are not the maritime transport infrastructure platform necessary to convey goods over long distances, and ports cannot function in any way comparable to parallel alternative road and rail platforms over long distances.

The ship, albeit mobile, must therefore be acknowledged as what it is – maritime transport infrastructure. The ship can also be termed the seaway transport platform. Irrespective of the terminology used, the ship, which is maritime transport infrastructure, must be regarded as entirely comparable to roadway and railway transport infrastructure in providing for territorial continuity. Transport policies need to reflect this.

Conclusion

Despite prevailing public policies and investments favouring land transport infrastructure, analysis of ongoing motorway-of-the-sea developments have helped signal the need for a new definition of maritime transport infrastructure. This new definition elevates the seaway in relation to the port, the latter being simply a node.

The theory explained and presented here states that the maritime transport infrastructure platform – the seaway – is the deck of a ship. The port is not a seaway platform; the port is a node. The seaway platform, and therefore maritime transport infrastructure directly comparable to roadway and railway infrastructure, is the ship. It is the ship that provides for territorial continuity, not the port.

Motorway-of-the-sea experience has shown that more efficient ro-ro and ro-pax ship technology in particular has helped facilitate effective motorway-of-the-sea solutions in an effort to overcome road transport problems and associated externalities resulting from increasing land transport usage. However, it is still the case that policy incentives and/or balancing mechanisms are needed to develop seaways further to alleviate continuing market distortions in favour of land transport modes and facilitate change.

Transport policies require appropriate adjustment to reflect more adequately the new definition of maritime transport infrastructure outlined here. Respecting this new definition of maritime transport infrastructure should enable policy-makers to develop and implement policies and initiatives that ensure maritime transport infrastructure receives appropriate consideration relative to other surface transport modes.

Acknowledgements

The author is indebted to Captain Jean Roptin, and to Dott. Gianni Migliorino, former vice president of Finmare, for their helpful advice and suggestions. The research also benefited from the support of the EC Interreg IIIB North Sea region programme projects Sutranet (2007) and Northern Maritime Corridor (2005). Comments and suggestions made by the reviewers were also helpful in improving the paper. Any errors are the responsibility of the author.

References

Baird AJ (1997) Coastal Ro-Ro freight ferry services: an alternative to trunk road haulage in the UK? *Transport Logistics* **1(2)**: 103–113.

Baird AJ (2004) Public goods and the public financing of major European seaports. *Maritime Policy and Management* **31(4)**: 375–391.

Baird AJ (2008) Re-defining seaway infrastructure: impacts for ports, modal shift and motorway-of-the-sea policy. In *Ports and Regional Economies* (Musso E and Ghiara H (eds)). McGraw-Hill, Milan, Italy, pp. 71–80.

CEC (Commission of the European Communities) (2004) *Motorways of the Sea, Implementation through Article 12a TEN-T*. Directorate G, CEC, Brussels, Belgium, Consultation document D(2004).

GIE (Groupement d'Intérêt Economique) (2007) *Transport and Territorial Continuity: Intergrating Waterborne Transport into the Trans-European Networks*. GIE, Les Pieux, France.

Haralambides HE (2002) Competition, excess capacity, and the pricing of port infrastructure. *International Journal of Maritime Economics* **4(4)**: 323-347, **doi**: doi:10.1057/palgrave.ijme.9100053.

Imprint-net (2007) http://www.imprint-net.org (accessed 10/02/2010).

Pearce DW (ed) (1992) *The MacMillan Dictionary of Modern Economics*, 4th revised edn. Palgrave Macmillan, Basingstoke.

Psaraftis HN (2005) EU Ports Policy: Where do we go from here? *Maritime Economics and Logistics* **7(1)**: 73–82, **doi**:10.1057/palgrave.mel.9100125.

Rodrigue JP and Notteboom T (2009) The terminalisation of supply chains: reassessing the role of terminals in port/hinterland logistical relationships. *Maritime Policy & Management* **36(2)**: 165–183.

Rutherford R (1995) *The Routledge Dictionary of Economics*, 2nd edn. Routledge, New York, NY, USA.

ShipPax Information (2009) *ShipPax Guide 09*. Ship Pax Information, Halmstad, Sweden, p. 210.

Sutranet (2007) *Sustainable Transport Networks for Research and Development – Sutranet*. University of Aalborg & Partners, Aalborg, Denmark, project funded by the EU Interreg IIIB North Sea Programme.

Torbianelli VA (2000) When the road controls the sea: a case study of Ro-Ro transport in the Mediterranean. *Maritime Policy & Management* **27(4)**: 375–389.

TRI (Transport Research Institute) (2002) *UK Marine Motorways Study*. TRI, Napier University, Edinburgh, for Engineering & Physical Sciences Research Council (EPSRC) and UK Department for Transport (DfT). See http://www.sml.hw.ac.uk/logistics/pdf/MarineMotorways.pdf (accessed 10/02/2010).

Unctad (United Nations Conference on Trade and Development) (1992) *Port Marketing and the Challenges of the Third Generation Port*. UNCTAD, New York, NY, USA, TD/B/C.4/AC.7/14.

Verhoeven P (2009) European ports policy: meeting contemporary governance challenges. *Maritime Policy & Management* **36(1)**: 79–101.

What do you think?

If you would like to comment on this paper, please email up to 200 words to the editor at journals@ice.org.uk.

If you would like to write a paper of 2000 to 3500 words about your own experience in this or any related area of civil engineering, the editor will be happy to provide any help or advice you need.