



Rail and multi-modal transport

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ARTICLE INFO

Article history:

Available online 4 December 2012

Keywords:

Rail transport policy
EU
Intermodal
Multimodal
Energy
Case Studies

ABSTRACT

This paper elaborates on the definitions of inter and multi-modal transport, as well as their differences in terms of performance. A survey of the barriers, both internal and external, to an efficient intermodal transport is included followed by an analysis of the advantages and disadvantages of combining rail transport with the other transport modes. Transshipment technologies for efficient freight service and some examples of freight rail corridors between sea and inland terminals are presented. The integration between air and rail transport is discussed and the potential synergies between air and high-speed rail services are emphasised. The paper concludes with a discussion on energy use for sustainable rail performance.

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1. Intermodal and multi-modal transport

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1.1. Definitions

The association of two or more modes of transport in a transport chain is a well-established and regular practice in the freight transport business (Lowe, 2005; pp 3). Yet, so far no overall consensus on a universal definition has been reached. The most common terms are *multi-modal transport*, *combined transport*, *intermodal transport* and *co-modality*. Over the years many definitions have been proposed. One of the first attempts was by the United Nations in 1980 with a definition on multi-modal transport (United Nations, 1980, pp 5): “International multi-modal is the carriage of goods by at least two different modes of transport on the basis of a multi-modal transport contract from a place in one country at which the goods are taken in charge by the multi-modal transport operator to a designated place for delivery in a different country”.

Some years later, in 1997, the European Commission (1997) proposed a definition for intermodal transport:

“Intermodality is a characteristic of a transport system that allows at least two different modes to be used in an integrated

manner in a door-to-door transport chain. In addition, intermodal transportation is a quality factor of the level of integration between different transport modes. In that respect more intermodality means more integration and complementarity between modes, which provides scope for a more efficient use of the transport system”

In 2001, three bodies including the European Conference of Transport Ministers, recently renamed International Transport Forum, the United Nations Economic Commission for Europe and the European Commission, agreed on the definition of the three terms: multi-modal, intermodal and combined transport (European Conference of Ministers of Transport, 2005; United Nations, 2001). The definitions being:

Multimodal Transport is the “*carriage of goods by two or more modes of transport*” (United Nations, 2001, pp 16);

Intermodal Transport is the “*movement of goods in one and the same loading unit or road vehicle, which uses successively two or more modes of transport without handling the goods themselves in changing modes*” (United Nations, 2001, pp 17);

Combined Transport is the “*intermodal transport where the major part of the European journey is by rail, inland waterways or sea and any initial and/or final legs carried out by road are as short as possible*” (United Nations, 2001, pp 18).

Recently the European Commission, in the mid-term review of the European Commission’s 2001 Transport White Paper (European Commission, 2001b, 2006), have proposed the term co-modality as

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being the “efficient use of different modes on their own and in combination” (European Commission, 2006, pp. 4).

In the body of literature, the emphasis has been placed on the concept of intermodality (Bontekoning, Macharis, & Trip, 2004; Janic & Reggiani, 2001; Lowe, 2005; Panayides, 2002; Zografos & Regan, 2004), although definitions for the other terms do exist (e.g. Lowe, 2005, pp 7 for multi-modal transport, or Lowe, 2005, pp 7 for combined transport). Table 1 presents some of the proposed definitions (Bontekoning et al., 2004).

1.2. Performance of an intermodal transport service

By definition, an intermodal freight transport service is an integrated chain of transport agents. There is a Freight Forwarder (FF) that organises and manages the various agents, aiming to get the most out of each party in favour of the overall performance of the transport service. The role of freight forwarding thus generates synergies that are added to the overall performance and reduces the waste that decreases the overall performance. Thus, it can be concluded that the overall performance is more than the sum of each individual transport service’s performance. Considering multi-modal transport, which by definition is made by a set of independent and non-integrated single-modal transport services; therefore, the overall performance is the simple summation of the various individual transport services’ performances.

Fig. 1 shows the performance of a multi-modal and an intermodal freight transport services. The vertical axis represents the performance (measure in any unit; note that the unit depends on the specific case, but it could be: time, reliability, flexibility or capacity). It is considered a transport service with three transport agents, TA1 (blue), TA2 (red) and TA3 (green), and one FF (orange). If transport agents are involved in a multi-modal transport service then, accordingly to the above assumption, the overall performance is the summation of each individual performance (left bar in Fig. 1).

If those transport agents are now involved in an intermodal freight transport service, then the overall performance will be higher due to the synergies created by and the reduction of waste obtained by the freight forwarder.

Assuming that first, each transport agent is being deployed at their maximum performance, second, that synergies are maximised and, third, that waste (inefficiencies) is reduced to zero (or to the minimum), then such assumptions would con-substantiate a situation where transport agents would be delivering the maximum possible overall performance. This performance is called the *theoretical performance* (right bar in Fig. 1), where the theoretical performance corresponds to the maximum performance attainable by an intermodal freight transport service.

However, diverse factors, further explanations are provided in later on, may create losses of synergies or waste between the transport agents and, in this way, may preclude the achievement of the *theoretical performance*. Hence the maximum performance attainable in the real world is always inferior to the *theoretical performance*. This performance shall be known as the *best possible in the real world performance* (second right bar in Fig. 1). This gap between the *theoretical performance* and the *best possible in the real world performance* (Gap 1 in Fig. 1) is called *Friction Gap* that corresponds to the level of friction. The Friction Gap cannot be eliminated by the freight forwarder because it is generated by properties that are intrinsic to the transport agents and, thus, outside the scope of the FF’s area of influence. In order to reduce the friction gap the transport agents should work together to eliminate the sources of friction, for example, investment in interoperable equipment, alignment of processes, and the like.

Calling upon the freight forwarders, it should be noted that they all are not equally skilled. Different freight forwarders follow different processes of production of intermodal freight transport services and as such, they are likely to obtain different performances from the same set of dual systems. The *actual performance*

Table 1
Intermodal transport definitions.

Author (date)	Proposed definition
Jones et al. (2000)	The shipment of cargo and the movement of people involving more than one mode of transport during a single, seamless journey
Southworth & Peterson (2000)	Movement in which two or more different transport modes are linked end-to-end in order to move freight and/or people from point to origin to point of destination
Min (1991)	The movement of products from origin to destination using a mixture of various transport modes such as air, ocean lines, barge, rail, and truck
Van Schijndel & Dinwoodie (2000)	The movement of cargo from shipper to consignee using two or more different modes under a single rate, with through billing and through liability (Hayuth, 1987)
D’Este (1995)	A technical, legal, commercial, and management framework for moving goods door-to-door using more than one mode of transport
TRB (1998)	Transport of goods in containers that can be moved on land by rail or truck and on water by ship or barge. In addition, intermodal freight usually is understood to include bulk commodity shipments that involve transfer and air freight (truck–air)
Ludvigsen (1999)	The movement of goods in the same load-carrying unit, which successively use several transport modes without handling of goods under transit
Tsamboulas & Kapros (2000)	The movement of goods in one and the same loading unit or vehicle, which uses successively several modes of transport without handling the goods themselves in changing modes (European Commission, 1997a)
Van Duin & Van Ham (1998)	The movement of goods in one and the same loading unit or vehicle, which uses successively several modes of transport without handling the goods themselves in changing modes (European Conference of Ministers of Transport, 1993)
Murphy & Daley (1998)	A container or other device which can be transferred from one vehicle or mode to another without the contents of said device being reloaded or disturbed (Jennings & Holcomb, 1996)
Newman & Yano (2000a,b)	The combination of modes, usually ship, truck or rail to transport freight
Taylor & Jackson (2000)	The co-ordinated transport of goods in containers or trailers by a combination of truck and rail, with or without an ocean-going link (Muller, 1995)
Slack (1996)	Unitised loads (containers, trailers) that are transferred from one mode to another
Spasovic & Morlok (1993)	The movement of highway trailers or containers by rail in line-haul between rail terminals and by tractor-trailers from the terminal to receivers (termed consignees) and from shippers to the terminal in the service area
Niérat (1997)	A service in which rail and truck services are combined to complete a door-to-door movement
Harper & Evers (1993)	One or more motor carriers provide the short-haul pick-up and delivery service (drayage) segment of the trip and one or more railroads provide the long-haul or line-haul segment
Evers (1994)	The movement of truck trailers/containers by both railroads and motor carriers during a single shipment
Nozick & Morlok (1997)	The movement of trucks and containers on railcars between terminals, with transport by truck at each end

Source: Bontekoning et al. (2004).

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