

# MULTIMODAL AND INTERMODAL FREIGHT TRANSPORTATION: A REVIEW

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## ABSTRACT

**Purpose:** Generally, multimodal and intermodal have been widely used and being classified as the same definition. The purpose of this study is to have the comparative review between intermodal and multimodal terms whether these terms are carrying the same or totally different definitions to be used by researchers and industrial practitioners.

**Design/methodology/approach:** The methodology of this study was carried out by reviewing literature on multimodal and intermodal freight transportation in supply chain.

**Findings:** Multimodal involves international transportation for example ship by the use of container or cargo under a single contract. Meanwhile intermodal usually consists of intermodal terminals during the process. There is no right or wrong terms but depends to the researcher whether to use the term generally or specifically because both give the same definition of combination of two modes of freight transportations.

**Research limitations/implications:** This paper focuses to freight transportation only and do not discuss on passenger transportation.

**Originality/value:** This study will provide basic guideline for researchers for both definitions to steer clear of confusion for future reference.

**Keywords:** Multimodal, intermodal, freight transportation, supply chain

## Introduction

Economic globalisation requires firms to produce and deliver goods faster to customers around the world by managing supply chains and integrate logistics systems efficiently (Rondinelli and Berry, 2000). The operation of transportation will determine the efficiency of moving products. The progress in techniques and management principle improves the moving load, delivery speed, service quality, operation costs, the usage of facilities and energy saving. Transportation is one of the most essential components in business as through which raw material are procured by manufacturers and end products delivered to customers (Nazery, 2006) (John *et al.*, 2009). Therefore, transportation represents the biggest portion of company's logistics cost, taking up to 40% to 60% of such costs which included warehousing and inventory carrying charges (Murphy, 1998). The estimation for transportation expenditure could reach between 2% to 5% of the cost sale (Soriano, 2001). Many transportation systems are multimodal (Bektas and Crainic, 2007). A great logistics strategy cannot bring its ability into full play without the efficient transportation system (Tseng *et al.*, 2007). The present transportation system lacks coordination of different modes of transport, thus wasting the resources and decreasing the efficiency (Qingyun, 2007). Meanwhile in developing countries, transportation is the important ingredient of sustainable development. More integrated and more efficient transportation system should be remained and should create for better future planning in trends ahead (Crainic and Laporte, 1997).

### Freight Transportation

Freight transportation demand in Europe has been mounting by more than 30% during the last decade (Arnold *et al.*, 2004). Freight transportation is not only measured by the standard of its own share of a nation's gross national product (GNP), but also by the increasing influence that the transportation and distribution of goods have on the performance of virtually to all other economic sector (Crainic *et al.*, 1997). The freight transportation can be divided to four main transportation modes which are air, water, rail and road (Rondinelli *et al.*, 2000). Factors that influenced in choosing the mode of transportation are the capacity shortages, international growth, economies of scale and scope, security concerns and environmental and energy used concerns (Mary and Mario, 2008).

### Multimodal/ Intermodal Transportation

Intermodal transportation service and multimodal transportation infrastructure play a vital role in the logistics system for competing in global market in 21<sup>st</sup> century. As the demand for intermodal logistics services and multimodal transportation facilities grow, a seamless transportation becomes more central to integrated logistics. Multimodal transportation infrastructure adds value in logistics as integrated system (Rondinelli, *et al.*, 2000). Meanwhile other researchers agreed that multimodal container transportation is playing an increasingly important role in global supply chains and trade. (Vilko and Hallikas, 2011).

Intermodal transportation is characterised by the combination of rail and road, rail for long distances and large quantities, road for collecting and distributing over short or medium distances (Nierat, 1992) (Slack, 2001). Intermodal (or combined) transport can be a worthwhile alternative to unimodal transport especially for road transport. The main part of the journey is done by rail, inland waterway or sea, and any initial and/or final legs carried out by road as short as possible. The location of the terminals where a change of mode takes place matters in the evaluation of economic competitiveness but also in the success of multimodality (Arnold *et al.*, 2004). Figure 1 shows the example of intermodal networks. Figure 1 shows that intermodal transfer facility is modelled as point (a "hub") and geoprocessing script is run to generate "spoke" from that hub to the nearest transportation network elements for those modes that the hub serves (for example a railyard would connect the rail network with the highway network) (Swayne *et al.*, 2012).



Figure 1: Three transportation networks integrated through intermodal transfer facilities (Swayne *et al.*, 2010)

### Current Perspective of Intermodal and Multimodal Transportation

Contrary to multimodal networks, intermodal networks are connected through facilities which allow travellers and freight to transfer from one mode to another (Maria, 2000). While, other researchers used such common definition to position their contribution in the overall intermodal research field (Bontekoning *et al.*, 2004). Definition should cover typical organisational aspects such as synchronised schedules, task division between modes, and multi actor chain management. A common conceptual model should reflect the distinguishing characteristics of intermodal transport and serves as framework for the whole intermodal research field. The definition of intermodal freight transport is the movement of goods in one and the same loading unit or vehicle by successive modes of transport without handling of the good themselves when changing modes (European Minister of Transport, 1997) could not be used as common definition because it only covers the physical

characteristics of intermodal transport. Table 1 and Table 2 below show the definition of intermodal/multimodal from literature review.

<b>Authors</b>	<b>Definition</b>
Min (1991)	The movement of products from origin to destination using a mixture of various transportation modes such as air, ocean lines, barge, rail and truck
D'Este (1995)	A technical, legal, commercial, and management framework for moving goods door-to-door using more than one mode of transport
Jones <i>et. al.</i> , 2000	The shipment of cargo and the movement of people involved more than one mode of transportation during a seamless journey
Southworth and Peterson (2000)	Movement in which two or more different transportation modes are linked end-to-end in order to move freight and/or people from point to origin to point of destination
Maria (2000)	Integrated transportation system consisting of two or more modes connected through facilities which allow travellers and/or freight to transfer from one mode to another during a trip from an origin to a destination
Bontekoninet. <i>al.</i> , (2004)	Intermodal freight transport is the movement of goods in one and the same loading unit or vehicle by successive modes of transport without handling of the good themselves when changing modes (European Conference of Ministers of Transport, 1997)
Arnold <i>et. al.</i> , (2004)	Intermodal is defined by the European Conference of Ministers of Transport (ECMT) as the carriage of goods by at least two different modes of transport in the same loading unit (an Intermodal Transport Unit or ITU) without stuffing or stripping operations when changing modes
Bektas and Crainic, 2007	Transportation of people or freight from their origin to their destination by a sequence of at least two transportation modes. Transfers from one mode to the other are performed at intermodal terminals, which may be a sea port or an in-land terminal e.g., rail yards, river ports, airports, etc.
Crainic and Kim, 2007	The transportation of a person or a load from its origin to its destination by a sequence of at least two transportation modes, the transfer from one mode to the next being performed at an "intermodal terminal"
Vilko and Hallikas, 2011	Reiterate (Crainic <i>et. al.</i> , 2004

Table 1: Definition of Intermodal Transportation Extracted from Literature Review

<b>Authors</b>	<b>Definition</b>
ASEAN Framework Agreement on Multimodal Transport (1998)	The carriage of goods by at least two different modes of transport on the basis of a multimodal transport contract from a place in one country at which the goods are taken in charge by the multimodal transport operator to a place designated for delivery situated in a different country. The operations of pick-up and delivery of goods carried out in the performance of a unimodal transport contract, as defined in such contract, shall not be considered as international multimodal transport
Van Schijndel and Dinwoodie, 2000	Multimodal transport involves the movement of cargo from shipper to consignee using two or more different modes under a single rate (Hayuth, 1987)

Nazery (2006)	Multimodal transport presents a means to move goods across the supply chain in a synchronized manner and promote strategic partnership amongst players in the transportation industry who are dispersed and divided across various transport modes.
Vilko and Hallikas, 2011	Multimodal supply chains are international transport combinations of various modes of transport such as ship, rail, and road, primarily through the use of containers

Table 2: Definition of Multimodal Transportation Extracted From Literature Review

*Comparison between Multimodal and Intermodal Transportation*

From Table 1 and Table 2, intermodal and multimodal sharing the same definition of the movement at least by two modes of transports from an origin point to a destination point. From Table 1, intermodal transportation stressed on “intermodal terminal” or “intermodal facilities” that is not even an issue in multimodal transportation (Bektas *et. al.*, 2007) (Vilko, *et. al.*, 2011) (Maria, 2000). Intermodal transportation also stressed on a seamless journey (Jones *et. al.*, 2000) without stuffing or stripping operations when changing modes (Arnold *et. al.*, 2004) (Vilko *et. al.*, 2011). From Table 2 alone, multimodal used international definition and included other countries as the point of destination (Southworth *et. al.*, 2000). Multimodal transportation also included ship as one of mode of transportation through the use of cargo/ containers (Vilko *et. al.*, 2011) (Schijndel *et. al.*, *et. al.*, 2000). But in Table 1 the word shipment and cargo also being mentioned as intermodal transportation (Bektas *et. al.*, 2007) (Min, 1991) (Jones *et. al.*, 2000) but was not being stressed by other authors.

**Conclusion**

Commonly, intermodal freight transportation involve container by using numerous mode of transportation including rail, ship or truck. It also could reduce cargo handling, improves security, and reduce damage as freight transportation are using container and no handlings of freight when changing modes. The process for unloading and unloading containers in terminals are usually using gantry crane or reach stacker. Meanwhile, multimodal transport is the transportation of goods under a single contract with at least by two modes of transportation for example by rail, sea and road. The carrier is responsible for the entire carriage even though it is being performed by several modes of transportation. The carrier does not have to possess all means of transport and is often performed by sub-carriers (actual carriers).

The usage of multimodal term for example “multimodal transportation” or “multimodality” could have been used to show a combination of two modes of transportations generally. Meanwhile the term “intermodal” at all times has been used to illustrate the process specifically. It means that the authors used the term multimodal if they wanted to discuss on more of one mode of transport and they stated intermodal term when they explained the operations involved especially when it comes to the terminal facilities for loading and unloading goods. As in a nutshell, intermodal and multimodal freight transportation almost sharing the same definitions. These terms can be used as long as it has the meaning of the movement of goods by at least two modes of transports from origin to destination. Different authors defined intermodal and multimodal transportation slightly differently, and it seems that many attempts to attribute different names to what is basically the movement of goods by at least two modes of transport and this is why they used these two terms on the same papers for the same meaning.

To be more accurate, the definition of intermodal transportation can be used with the used of containers and intercontinental exchanges (Bektas *et. al.*, 2007) by the existence of intermodal terminals. On the other hand, multimodal transportation definitions must involve international transport for example ship by the use of containers or cargo under a single contract. There is no right or wrong terms but depends to the authors whether to use the term generally or specifically.

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