THE ANALYSIS OF THE TRANSSHIPMENT CAPACITY OF AN INTERMODAL TERMINAL

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Abstract. The paper deals with a presentation of the main requirements of the intermodal network and transshipment capacity mathematical calculation in an intermodal transportation terminal. It gateway terminal into an intermodal network is also presented in detail. The handling – transport –storage system, governed by the 20 – 80 regulation, is perfectly associated with the intermodal transportation idea.

Keywords: transhipment, intermodal terminal, handling, transportation

1. Introduction

Measurement of activities in passenger terminals is generally straightforward. The most common indicator is the number of passengers handled, sometimes differentiated according to arrivals and departures.

Measurement of freight traffic through terminals is more complicated than for passengers because the freight is so diverse and standard measures of weight and value are difficult to compare and combine.

In the globalization trend transport, and especially freight, services have become more critical in order for firms to compete.

Freight handling requires specific loading and unloading equipment. The result is that terminals are differentiated functionally both by the mode involved and the commodities transferred. There are a basic distinction between bulk, general cargo and containers.

Liquid or dry bulk refers to goods that are handled in large quantities that are unpackaged and are available in uniform dimensions.

General cargo refers to goods that are of many shapes, dimensions and weights and the handling is difficult to mechanize and usually requires a lot of labor.

Containers are standard units that have been designed for simplicity and functionality, so the container terminals are the foremost expression of a mechanized space since labor requirement are minimal. The intermodal container terminal heave specialized function required of the cranes.

New technologies, new markets and new organizational structures require change both from providers and consumers.

Intermodal logistics is recently defined in an international definition (ECE, 2001b):

- door-to-door transport;
- two or more transport modes (in essence road truck, rail, water/sea, air);
- seamless, integrated operation;
- use of intermodal containers, swap bodies, piggyback "RORO" (roll-on/roll-of) etc., and no handling of the goods themselves in changing modes.

The challenge is how to streamline policy strategies in intermodal transport correlate with the needs of businesses' supply chain management.

Intermodal transport must offer competitive services in terms of costs and quality at the "door-to door" level.

The quality criteria for intermodal transport refer to following points:

- short door-to-door lead-time;
- high frequency of transport services;
- high time reliability of transport services;
- easy access to a large number of destination terminals for each origin terminal;
- great flexibility of services;
- maximum volumes and weights of load units;
- minimizing freight damage vulnerability.

2. Requirement of intermodal network

Obviously a field of stress exists between the transport volumes needed to offer intermodal

services meeting the required quality conditions, on the one hand, and the costs of these services on the other [1,3].

The production chain could be transformed into flow goods, which starts with the supplier of the raw materials and ends with the consumer.

The flow of goods is focused on the client, with intermediate actors and consumers.

The flows of goods can be transformed into a transport network.

The basic idea is that collection, distribution and trunk network (figure 1) can be distinguished within transport chain [2].

The need for storage is the most laborious freight activity. Assembling the individual bundles of goods may be time-consuming.

This produces the need for terminals to be equipped with specialized infrastructures (grain silos, storage tanks, refrigerated warehouses) or simply space to stockpile, such as for containers.

Infrastructure considerations for any terminal are important as they must accommodate current traffic and anticipate future trends and also technological and logistical changes.

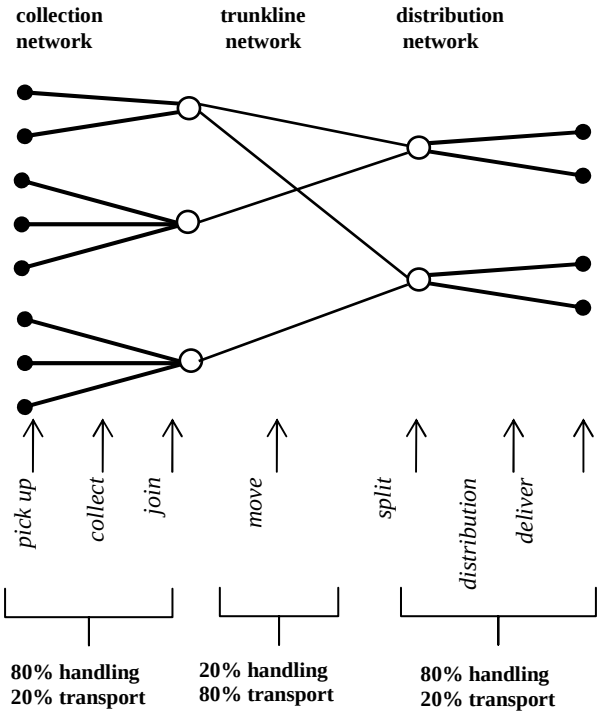

Figure 1. The flows of goods transformed into a transport network

A transport terminal is composed of a set of intermodal infrastructures taking advantage of a geographical location, conferring a higher level of accessibility to local, regional and global markets.

There is present in figure 2 a gateway terminal into intermodal network.

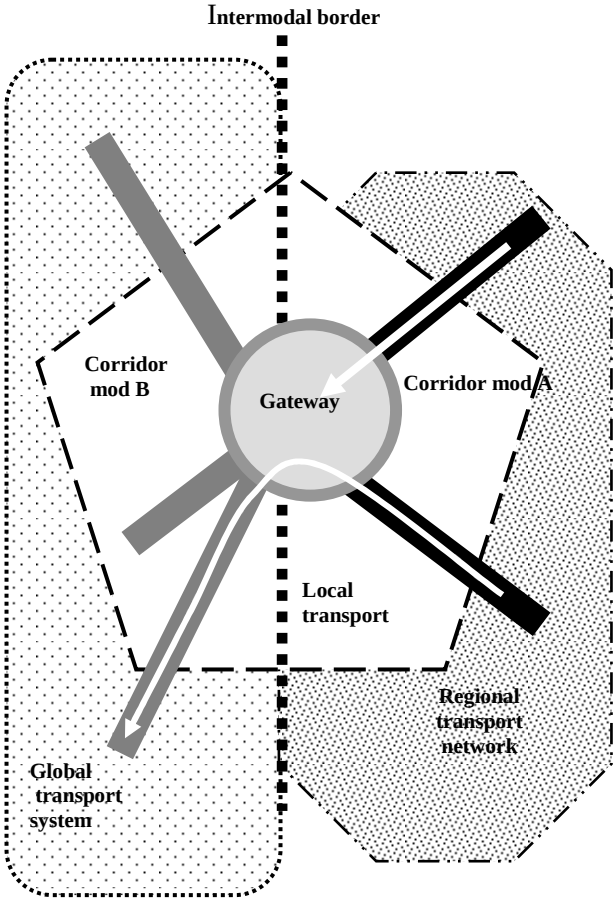

Figure 2 The gateway terminal

Depending on the mode being considered, terminals are bound to various degrees to the site.

For instance, maritime transportation terminals are particularly dependent on local conditions, especially for large port activities, which can be accommodated in a limited number of locations.

3. Transshipment capacity of an intermodal terminal

The practice of transferring loads between truck and rail transportation, has experienced a remarkable growth in recent years.

Transloading concerns the transshipment of loads from truck to rail and vice-versa.

It is done to exploit the respective advantages of trucking and rail, namely avoid long distance trucking.

A producer relying on long distance trucking to service a set of customers is facing many

difficulties.

The most significant one is the likeliness of empty travel for return trips in addition to the requirement of having a large fleet of trucks to insure a service frequency.

By relying on transloading (figure 3) the producer ship it's freight to a nearby rail terminal where truckloads are transshipped into trainloads.

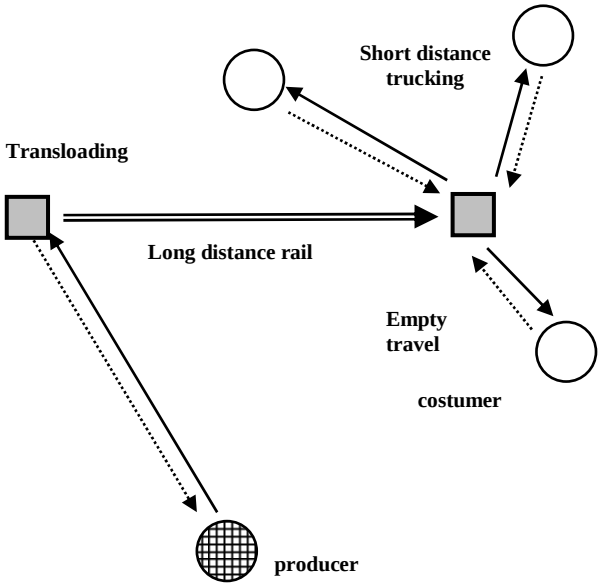

Figure 3. The loads transfer between truck and rail transportation mod

The larger loads are then shipped to a rail terminal in the proximity of a group of customers.

Shipments are then broken down to specific customers.

Doing so often requires a smaller fleet of trucks as shorter distances could permit the same truck to do several journeys per day.

The efficiency of the system mainly relies on the efficiency of rail terminals to accommodate its time requirements.

Near 1000 km is the minimal distance for transloading to be cost effective.

A vast array of value added activities has also emerged at transloading facilities depending of the type of commodities, such as storage, blending, packaging, consolidated invoicing, combined product shipments, bar-coding and labeling.

Usual the capacity limit of one terminal can't be compensated by spare capacity of another site due to operational reasons, customer patterns of behavior, railway access or intermodal operators supply policy.

The transshipment capacity of an intermodal terminal is the technical-operational capability of handling intermodal transport units in a certain period of time.

Intermodal railroad terminals, generally speaking, are facilities, which enable the transshipment of intermodal transport units or intermodal loading units between road and rail [6, 7].

The terms intermodal transport units (ITU) or intermodal loading units (LU) are used synonymously.

From the very beginnings all of combined railroad transport in Europe, a large variety of types of intermodal terminals as regards layout, handling systems, or process organization emerged.

The transshipment capacity of an intermodal terminal is determined by the infrastructure and superstructure, terminal process organization, type of intermodal services, type and share of intermodal transport units, customer behavior and opening times [1, 2, 5].

The capacity calculation formulae are widely acknowledged. They are as follows:

- Capacity depending on the length of the transshipment tracks:

$$C_{rail} = \frac{L_{track}}{L_{wagon}} \cdot K_{LF} \cdot K_{FF} \cdot 2 \cdot N_{TD} \qquad (1)$$

Where:

C_{rail} -capacity related to rail tracks [units/day]
L_{track} -length of transshipment tracks [m]
L_{wagon} -length of average waggon [m]
K_{LF} -load factor [LU/wagon]
K_{FF} -flow factor, the use of a track during the day
N_{TD} -number of traffic days per year

- Capacity depending on the available handling equipment:

$$C_{equipment} = C_G + C_M \cdot K_{UM} \qquad (2)$$

Where:

$C_{equipment}$ -capacity of the handling equipment
C_G -capacity of gantry crane
C_M -capacity of mobile crane
K_{UM} - utilization factor of mobile cranes for railroad transshipment

- Capacity depending on the available gantry cranes in [LU/year] is:

$$C_G = N_{gantry} \cdot \frac{P_{gantry}}{K_{MHgantry}} \cdot T_{open} \cdot N_{TD} \qquad (3)$$

Where:

N_{gantry} -number of gantry cranes
P_{gantry} -performance of gantry cranes [LU/hour]
$K_{MHgantry}$ -factor of management handlings
T_{open} -opening hours of the terminal per day
N_{TD} -number of transport days per year

- Capacity on available mobile equipment in [LU/year] is:

$$C_M = N_{mobile} \cdot \frac{P_{mobile}}{K_{MHmobile}} \cdot T_{open} \cdot N_{TD} \qquad (4)$$

Where:

N_{mobile} - number of mobile cranes,
P_{mobile} -performance of mobile cranes [LU/hour],
$K_{MHmobile}$ -factor for management handlings,
T_{open} -opening hours of the terminal per day,
N_{TD} -number of transport days per year.

Overall limiting terminal capacity depending on the smaller of the two values resulting from equation (1) and (2):

$$C_{TERMINAL} = C_{rail} \quad \text{for } C_{rail} \le C_{equipment} \qquad (5)$$

$$C_{TERMINAL} = C_{equipment} \quad \text{for } C_{rail} \ge C_{equipment} \qquad (6)$$

4. Concluding remarks

Transport terminals were not only differing from country to country but within each of the European countries as well.

The attributes of transport terminals are linked with their performances.

The location of a transport terminal is a factor to serve a large concentration of population and industrial activities, representing a terminal's market area.

New transport terminals tend to be located outside central areas to avoid high land costs and congestions.

Accessibility to other terminals is linked to the regional transport system.

The main function of a terminal is to handle and tranships freight or passengers.

The containers have revolutionized terminal operations. The rail industry has benefited from the container, which permits trains to be assembled in freight yards in a matter of hours instead of days.

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